

ISEA2022
BARCELONA



PROCEEDINGS

ISEA2022
BARCELONA

P O S S I B L E S

27 International Symposium
on Electronic Art



ISEA2022 BARCELONA

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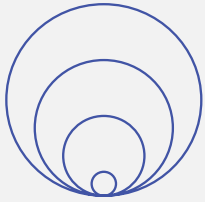
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ISEA2022 Barcelona Opening Ceremony

Josep A. Planell Estany

President of the Universitat Oberta de Catalunya

Barcelona

10 June 2022

After ten years away from Europe, Barcelona is now hosting the 27th International Symposium on Electronic Arts, ISEA2022.

None of us here today will fail to see the importance, the recognition and the responsibility this carries.

For one thing, it's **a tribute to the reputation of both Barcelona and its creative, artistic, scientific, technological and institutional nexus.**

It's an ecosystem whose fertility comes from its variety, fullness, multidisciplinary and compatibility; an ecosystem that has accumulated experiences and successes and has now reached a state of maturity.

No longer is it an emerging power, it's part of a driving force for the economy, industry and the arts.

Behind this Barcelona-based ISEA there are professionals, organizations and networks keenly committed to creativity and innovation.

Their unique and distinctive character and their talent, diversity and strength can be seen in their respective histories and projects.

And for another thing, in Barcelona there is determined ambition to join and play an active part in our future world – designed here and now.

This is why, as pointed out by Cristina de Middel, winner of Spain's National



Photography Prize in 2017 and guest speaker for the UOC's inaugural lecture the following year, *"it's hugely important now to encourage people to question things, more than it is to offer answers"*.¹ We know the future isn't a programmed destination, rather it's a place that we all must co-create.

In this sense, the dozens of activities, exhibitions and talks populating the ISEA2022 Barcelona programme offer us a map of this future that we are already starting to build.

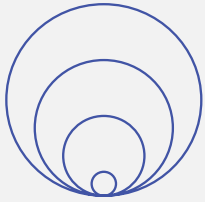
With our hybrid, all-encompassing format, we have sought to decentralize our locations in and outside the city, above all aiming to involve every area of

knowledge, to encourage contact between artists, scientists, engineers and theoreticians, and to discuss, present and share prototypes, devices, art and ideas.

This is why, for the UOC, it is an honour and a privilege to be an organizer of this event.

First: because we want to remain at the cutting edge of research in the knowledge society and in digital transformation; this means interconnecting academia with public and private entities, enhancing teaching, research and innovation.

Because, if we want our university to be useful to citizens, if we want to make



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impacts that are relevant for society, if we want to count and be counted **we must be part of the change, we must deliver digital literacy for our citizens, we must commit ourselves to open and shared knowledge, we must contribute to the designing of our future.**

Second: because – like ISEA – we treasure our legacy: an academic community made up of a critical mass of teaching staff and researchers who work at the intersections of the arts, science and technology; an interdisciplinarity that – to be useful both internally and externally, to the university and to society – must be steered to support teaching, to strengthen research and innovation, to encourage knowledge transfer and to increase the social impact. And third: because our involvement here gives continuity to greater works. Everything we will learn, discuss and discover over the coming days can only make sense as part of a continuum. Without the intense preparations, there would be no symposium. Without having anything to show for it afterwards, our work would be in vain. In short, ISEA is and **must be a link in the chain holding together our strategic and transformative outlook.** Each time this international symposium has been held anew, it has enriched us with networks, knowledge, infrastructure and policies. It will also do so this time. We also want to do this.

This is why we have initiatives such as Hac Te, the art, science and technology hub created by numerous people here among us, which aims to provide a strong root for this ecosystem, upon which it can develop structure and stability.

This holding of ISEA2022 Barcelona is a materialization of the work of Hac Te and demonstrates its potential. It will do so over the coming days, offering many different activities in this symposium. And it will do so in the aftermath of ISEA2022 Barcelona, taking over to let the conversation continue.

We do this and will continue do this maintaining the bearing that Carme Pinós, recent winner of Spain's National Architecture Award, summed up in four points: ***"Respect each other. Encourage debate and participate. Listen and ask questions. Believe that we have responsibilities and we can contribute."***²

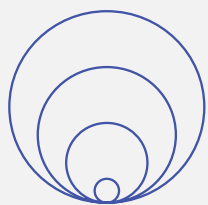
Right now, technology and innovation are inseparable from our culture and creative industries. And ISEA2022 Barcelona presents us with a spur, a window of opportunity for exchanges, collaborations and learning. ■

1. https://www.uoc.edu/portal/_resources/EN/documents/la_universitat/inaugural-lecture/inaugural-lecture-cristina-de-middel-2018.pdf

2. <https://www.barcelona.cat/metropolis/en/contents/most-architects-are-not-the-elite-or-complicit-property-speculation>



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Opening Ceremony



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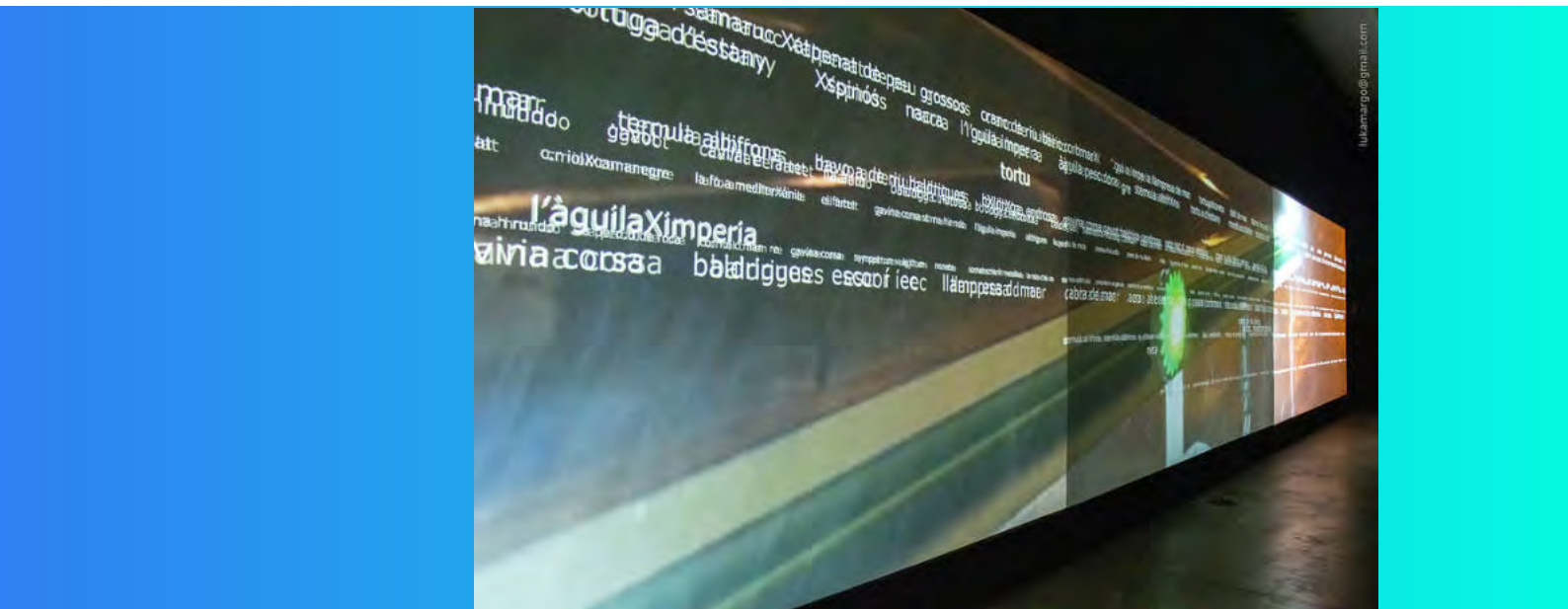
Possibles

Pau Alsina, Irma Vilà, Susanna Tesconi,
Joan Soler-Adillon, Enric Mor

Universitat Oberta de Catalunya

It was in the summer of 2017, as the last details were being added to ISEA2017 in Manizales (Colombia), when we began to receive emails encouraging us to present a candidacy to organize an edition of the symposium in Barcelona. Our city had been taken into account for years due to the quantity and quality of the professionals that work in its digital arts scene: they include collectives and artists (some of whom have won major awards) as well as internationally renowned festivals, centres of artistic production, universities with their research groups and researchers, and the outstanding artistic and cultural centres in a broad-based relationship between art, science, technology and society.

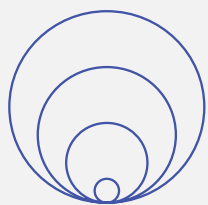
We initially believed that an undertaking of this nature would involve too many resources and that although it was an extremely interesting idea, we needed to find better reasons with greater potential if we were to carry it out successfully. So we began to think about the idea that perhaps ISEA itself could be the perfect excuse to help bring about some changes and transformations in the city. In fact, both the resources and the parties involved in the network were already receptive to an initiative like this one, aimed at channelling and creating the structural qualitative transition that many prominent members of the community in Barcelona had been demanding for a long time. We then began to think on a larger



scale, aware of the potential and vitality of a city that is particularly creative and open to the world, and we realized the tremendous wealth of the art, science, technology and society ecosystem in our immediate surroundings, which despite its broad base and heterogeneous nature, and its location and distribution in multiple places and venues, continued to enjoy remarkable levels of energy and motivation.

Any multidisciplinary and heterogeneous space tends to be difficult to administer and digest, especially in a world of isolated factions, sectors and immovable identities. That is what it means to place oneself outside the mainstream, beyond

disciplines, beyond boundaries and beyond the realms of what is possible. The possible and the impossible - daring to imagine other possibilities as a horizon of change that unfolds and organizes the world. The possible as an opening and a movement from which to leave the pre-established, pre-conceived and pre-designed behind, and place oneself in the future and its creative uncertainty. It was obvious that "the possible" should be the main theme of the ISEA Symposium that we wanted to organize in Barcelona - halfway between realistic pragmatism and futuristic speculation with ramifications of truth, moving beyond the placid distance of utopias and the eternal frustration of revolutions.



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That was the situation when, with the institutional partnership of the Universitat Oberta de Catalunya (UOC) and the support of Barcelona City Council, we presented our candidacy for ISEA2021 in Durban, South Africa, in mid-June 2018. ISEA 2018 Symposium was a major transformational experience due to the wide variety of contributions and perspectives that we were able to experience in a few intense days in Africa. We knew then that if everything went according to plan and we were selected, we would have to announce our venue in Gwangju, Korea, in 2019 and take centre stage in Montreal in 2020. And that was how it turned out - we were selected by the ISEA International Board, and brought the event back to Europe after an absence of more than 10 years. We had to go to Korea to present our proposal based on the theme of "Possibles", which was, by then, more structured thanks to our collaboration with a network of institutions which understood from the very beginning the opportunity and the need for involvement in a transformational event like the ISEA.

What we did not know at that time is that at the end of that same year, 2019, the world would change completely as a result of the coronavirus pandemic - a pandemic that is still ongoing at a global level today, and which continues to wreak havoc as its variants evolve and spread across the world. Under those circumstances it was impossible for ISEA2020 Montreal to take

place in a face-to-face format, and this was a contributory factor to how, despite the dates being changed in the hope of an improvement of the global health situation, in the end practically everything had to take place online. Similarly, in view of the outlook, we had to postpone the face-to-face edition planned in Barcelona for 2021 until 2022. In 2021 we held an entirely online preparatory event that we were able to schedule within the framework of the Barcelona Science Biennial. It would have been perfect to be able to hold the ISEA Symposium at the same time as the Science Biennial, and link the two events in the way we had initially proposed with the backing of the City Council, but at that time it would have been extremely reckless to bring to Barcelona participants from the over 40 countries that usually contribute to this event.

We created the institutional architecture of our Barcelona edition surrounded by all the uncertainty associated with major events in these new circumstances. From the outset it was our aim to combine the academic, education and research spheres with the cultural and civic artistic context, and with the technological-industrial environment. The UOC, as the organizing and promoting university, gradually added partners with the support of the Catalan Ministry of Science and Universities, and Barcelona City Council's



Pau Alsina, Director of ISEA2022 Barcelona

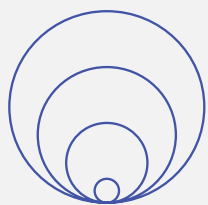


Irma Vilà, Vice-director of ISEA2022 Barcelona

Institute of Culture. The first to join were the Centre de Cultura Contemporània de Barcelona, and the Santa Mònica Arts Centre respectively hosting the conference sessions and one of the main exhibition venues. A decisive contribution was made by the Government of Catalonia's Ministry of Culture and the Ramón Llull Institute, which also led the way in the event's internationalization by organizing two editions of the Ars Electronica Garden in the city, together

with the expertise of the New Art Foundation and its outstanding digital art collection, which was also presented at the four venues of the ISEA exhibitions.

Barcelona City Council's support made it possible to extend ISEA across the entire city. More than 40 institutions were involved in the programme including Canòdrom democratic digital cultural centre and La Capella exhibition centre, highlighting the decentralized and broad-



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based nature of the event. In turn, the Government of Catalonia's support made it possible to produce the main ISEA exhibition in Arts Santa Mònica with the highest levels of quality, arising from the selection of the more than 500 ideas that arrived in the wake of the open call for artistic projects. The support of the Government of Catalonia was also crucial in extending the programme to 10 more cities and towns (Girona, Lleida, Mataró, L'Hospitalet de Llobregat, Amposta, Tarragona, Vic, Balaguer, Reus and Berga), establishing links with centres and programmes across Catalonia. In addition to the above, there is the Sant Pau Art Nouveau Site, with a magnificent exhibition of works of art from the ISEA open call and from the New Art Foundation Collection, as well as a selection of artworks from the platform Niio.art. The objective was to merge local and international communities, contributing to the creation of collaboration and exchange networks between the various parties involved. We also aimed to make everything accessible to the public and citizens in general, both in Barcelona and elsewhere in Catalonia, who were invited to participate in a wide range of activities spread throughout the area.

ISEA2022 Barcelona was then defined as an international, interinstitutional, intersectoral and intergenerational event with a clear multidisciplinary and transformational vocation, creating a structural foundation in the city (and the other participating towns)

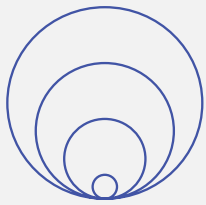
with the creation of projects including Hac Te, Barcelona's Art, Science and Technology hub that brings together more than a dozen institutions committed to the development of art, science, technology and society, including universities such as the UOC, UPC (Universitat Politècnica de Catalunya) and UPF (Pompeu Fabra University), research centres such as the BSC, ICFO and BIST, festivals such as SÓNAR, production centres including HANGAR and museums including MNAC, collectors such as NAF, business groups including Tech Barcelona and events such as the FIRA trade fair. This is in addition to the Spanish RED ACTS network created by the Daniel and Nina Carasso Foundation, with the UOC, Hac Te, CCCB, Hangar in Barcelona, Tabakalera in San Sebastián, and the UPV (Universitat Politècnica de València) and the CCC in Valencia, among other projects promoted within the framework created by the event and which are currently ongoing, such as the update of the art, science, technology and society White Paper undertaken by the FECYT (Spanish Foundation for Science and Technology). The synergies arising between all the different initiatives mentioned above which are in progress in Spain, as well as the clear connection with the programmes that are being undertaken at a European level, such as the S+T+ARTS programme and the recent New European Bauhaus programme, herald a positive outcome in terms of the structural impact of the major initiatives.



And so now we find ourselves in 2022 with the pandemic brought substantially under control, and emerging from a global health situation that was a major concern in its early years, while at the same time suddenly having to deal with another unexpected war in Europe; the Russian invasion of Ukraine upset global mobility even further, increased uncertainty, and led to changes in the organization of events with the consequent international travel involved. The changes that have taken place during these intense years of fusion between the virtual and the face-to-face realms, with forced physical distancing and unavoidable online proximity have yet to be assimilated. Indeed, we have been unable to include participants from all the countries that had their proposals accepted for our event.

Nevertheless, despite all the difficulties that have arisen, we obtained a magnificent response from the international community, with 1,019 proposals submitted for evaluation by the 268 international experts in the ISEA scientific committee and the joint artistic jury in Barcelona. It was a complete success given the circumstances, for which we can only extend our warmest thanks to all those who took part in the evaluation process. In turn, the ISEA organizational team, which had over 40 members, had to coordinate, in record time, all the teams of both the scientific and artistic committee and of the over 50 institutions in the 11 towns and cities taking part.

In addition to the traditional ISEA conference and main exhibition, we have added partnerships, activities and venues to

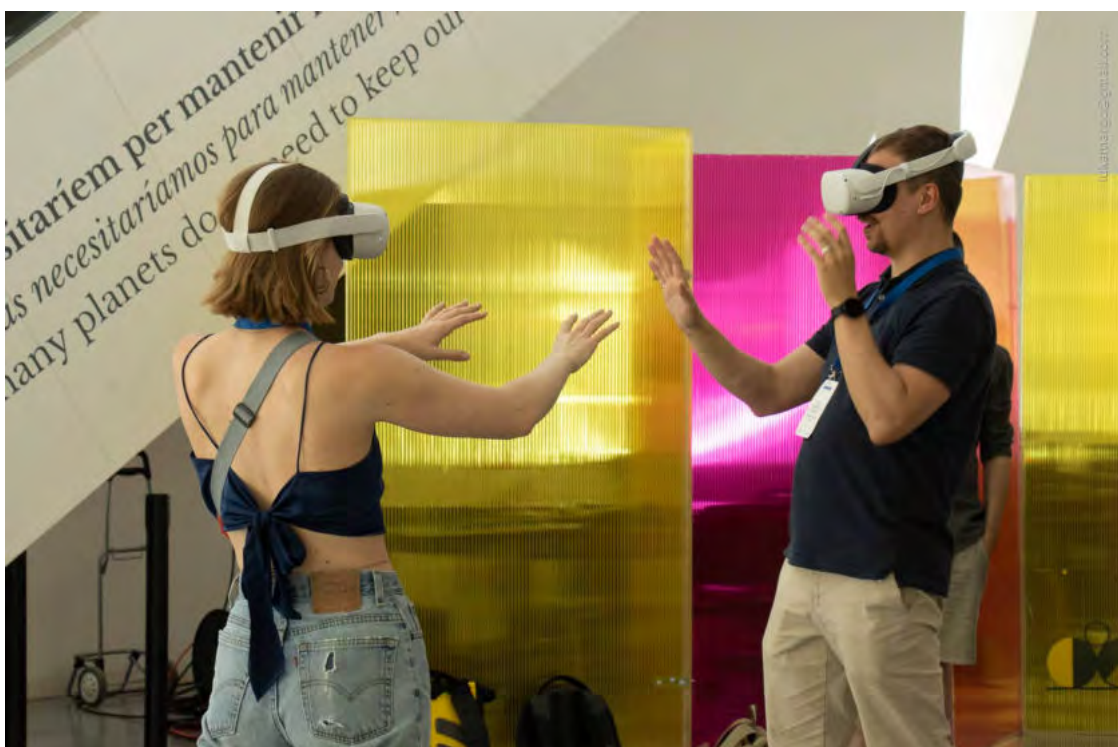


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create an ISEA that is spread throughout the city and across Catalonia, and firmly committed to involving the various agents and audiences interested, citizens and society in general. As a result, and counting all those attending each of the events taking place in all the venues, there have been 45,447 attendees, of whom 743 were accredited and participated in some of the events taking place in more than 40 venues, 11 towns and cities, 4 exhibitions with more than 80 artworks, 4 keynote lectures, 140 research presentations, 45 institutional presentations, 40 artist talks, 23 screenings, 18 posters and demos, 16 round table discussions, 13 workshops, 13 performances, 1 specialized meeting on

media art archives, 1 founding meeting of the Spanish ACTS network, in addition to 2 mappings and a drone show for the general public, which took place in the city of Barcelona for the first time.

ISEA2022 Barcelona involved an exceptional exhibition containing more than 80 artworks at the intersection of art, science and technology. The artworks exhibited were the result of the selection from the ISEA open call related to the theme of "Possibles", as well as the resolution of the open call for the production grants awarded: all of them were selected in a review and selection process by the international committee

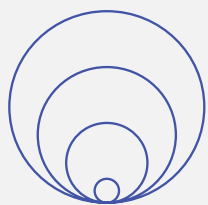


and artistic jury, and the teams of curators at each venue. Pieces from the electronic art collection of the New Art Foundation were also selected based on the event's main theme, with the aim of establishing a fruitful dialogue with the long and fertile history of interrelationships between art, science, technology and society. The 80 artistic pieces, the 13 performances and the 23 screenings that were on display during ISEA make a total of 116 items, which are documented in this catalogue, and which highlight the diversity of the projects that were exhibited during the event and in the subsequent months when the 4 associated exhibitions and events took place.

The Santa Mònica Arts Centre hosted the main exhibition at ISEA2022 Barcelona, entitled "The Irruption", which featured a selection of pieces that came from the open public call for entries, making up "a set of pieces and projects that, from different positions, investigate the environmental, climate and social crisis and the possibilities of art (always limited and partial) to re-politicize the imaginations, traumas, fears and urgencies that challenge and instigate us to irrupt otherwise, under response(-able) conditions from within the environmental and socio-economic collapse into which planet Earth has been plunged". The exhibition was open for three months, and was designed as an

invitation for all those attending to trace multiple narratives, either individually or accompanied by the group of collaborators who activated the pieces with their narrative itineraries and mutant visits. "La Irrupción" clearly resonates with the experiences related to the pandemic and the consequent associated collapses, and presents the isolated imbalances of normality as a manifestation of a continuum of accumulated phenomena that are an expression of the planet's exhaustion and of the potential that has yet to open up.

For two months the La Capella exhibition hall hosted the exhibition entitled "What is possible and what is not", which linked local artists selected through the ISEA call with local artists from the call by Barcelona Producció which defines the programming of the venue. "What is possible and what is not" thereby presented a crisis in the possibilities that lie within technological breakthroughs, but which conceal important limitations and conditioning factors. The same capacity of technologies to make possible what was previously impossible to imagine also prepares us to collide with its boundaries. In turn, the ability of science to explore those boundaries shows us that what is possible is always a horizon that can be moved - an opening to the imagination that has yet to be developed.



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This fascination with "Possibles", which presents what is real and unfinished in front of us, gave its name to the third exhibition organized in Barcelona which took place in the Sant Pau Art Nouveau Site, where a mixture of 17 pieces from the NAF collection, 5 pieces selected by the Art Jury of the ISEA open call and 6 works chosen by the Nio.Art platform were on display. In the venue's imaginative art nouveau setting, the exhibition of art, science and technology explored these other "Possibles" behind climate change and global warming, behind robotics and biotechnologies, within algorithms, artificial intelligence and data science, in quantum worlds, endeavouring to understand what matter is, up there above our heads in outer space and the multiverse. Beyond seeing ourselves trapped in a world of pre-designed possibles, the exhibition included ideas from all over the planet and from all areas of experience and knowledge, opening up to contingency, the future and the uncertainty of futures that are already open or which will be opened up in our present.

Finally, last but not least, the Cal Massó art centre in Reus hosted the exhibition entitled "Beep Collection: Origins", which used different perspectives to present some of the founding works in this pioneering collection, consisting of pieces considered essential in the history and development of electronic art which the collection has been rescuing and restoring, in order to highlight

the legacy of the pioneering creators who are now part of the history of contemporary art. The "Origins" exhibition also constructed a timeframe which sought to bring us closer to our evolution as a species and to the unstoppable development of life in its broadest sense, with works of art that explore identity and appearance, memories and recall, intelligence and the perception of reality and of the human body, and even material and cosmic environments. It provided a multidisciplinary perspective that in our complex historical and current framework, whether it is virtual or face-to-face, local or international, and with the other towns and cities in Catalonia (Girona, Lleida, Mataró, L'Hospitalet de Llobregat, Amposta, Tarragona, Vic, Balaguer and Berga), extended the universe of possibilities left behind by ISEA.

As we said at the beginning of the text on the origins of the 27th edition of the International Symposium on Electronic Art, the Possible was born in the polis, in the city, through dialogue, discussion and debate, and it is political by definition, as it shapes our reality. The political realm is made up of feelings, the ability to move and be moved in our openness to the world, in our network of intensities of the experience and adventures of the encounter. Encounters are made up of

relationships that account for every political dimension of our existence. After these difficult years of the pandemic, with their multiple ecosystemic upheavals, and the consequent isolation and social distancing, our aim was to use this policy of emotions to bring together the community of communities which is the multidisciplinary sphere that is recognized in ISEA. To create long-awaited embraces between local and international agents, individuals and groups, between virtual closeness and

face-to-face distances, between possibles and impossibles yet to be experienced in the multiple spaces for meeting, relationships, exchanges and complicity which we have been able to create, so that the composition of knowledge that gives name to our emotions can experience a resurgence, like a Phoenix in the firmament of the Possible. ■



Pastora Martínez (UOC) Madeline Carey (MACBA) Judit Carrera (CCCB) Marisol López (Generalitat de Catalunya) Pau Alsina (UOC) Jordi Martí (Ajuntament de Barcelona) Irma Vilà (UOC) Andreu Rodríguez (NAF) Maria Lladó (IRL) Enric Puig (ASM)

ISEA, International Symposium on Electronic Art

ISEA is one of the most important annual events worldwide dedicated to the crossroads where art, design, science, technology and society meet.

The event has been held over 26 times all over the world, and after more than 10 years since it last graced European soil, it finally touched down in [Barcelona](#) during 2022. With it came an enthusiastic international and local community reunited to develop this interdisciplinary field.



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ISEA2022 BARCELONA has reinforced the role of the city as a leader in research and scientific output and cultural and artistic creativity in both a national and international context.

What makes ISEA unique is that it is not so much an academic conference as a conference-based event that offers a wide array of activities, which surprise visitors with newly conceived formats in every edition. At the symposium you are sure to find exhibitions, workshops, open-air projects, round tables, artist talks, school initiatives and a variety of other activities, all with the involvement of different organisations and communities from the city of Barcelona.



ISEA, International Symposium on Electronic Art

Conference

ISEA2022 BARCELONA invited the participants to contribute to the growing debate on our world of "Possibles", the Symposium's central theme, in multiple formats including more than 140 papers presentations by experts, 45 institutional presentations, 40 talks by artists, 20 screenings, 18 posters and demos, 16 round table discussions, 16 workshops and 13 performances, all from the open call launched a year before, which received 1,100 proposals.

The **CCCB** has been the main venue for an international community of experts in art, science and technology who addressed topical issues including the creative capacity of artificial intelligence, the possibilities of immersive experiences, the imaginary of biotechnology in the arts, the challenges surrounding climate change, and new ways of addressing education, as

well as our cultural legacy. In addition, it has been the space for four keynote speeches by leading figures in their respective fields: Olga Goriunova, Joan Fontcuberta, Christl Baur and Ricard Solé.

Also, **MACBA** has hosted the **Second Summit on New Media Art Archiving**, among other activities such as artist talks or a performance. More related activities have been programmed in other venues such as Canòdrom, that hosted four panels from the call.





ISEA, International Symposium on Electronic Art

Extended Program

With the aim of bringing the intersections between Art, Science and Technology closer to the public, ISEA2022 has created the ISEA Extended Program, in Barcelona and other 10 cities (Girona, Lleida, Mataró, L'Hospitalet de Llobregat, Amposta, Tarragona, Vic, Balaguer, Reus and Berga), which has included more than 50 activities along the Catalan territory.

ISEA Extended Program made possible exhibitions, workshops, outdoor projects, panels, artists talks or school initiatives where visual arts venues, design schools, museums and art centers, art factories, festivals and high schools were involved.





The night of June 15, ISEA2022 Barcelona offered the first drone show in Barcelona, by Flock Drone Art Barcelona, open to the public.

ISEA, International Symposium on Electronic Art

Exhibition

ISEA2022 BARCELONA had brought together a marvellous and extensive display of pieces located at the convergence between art, science and technology, with more than 80 works including immersive installations, interactive and on-line works, sound art, animations, mapping and a drone show.

This exhibition has been a dialogue between works by international authors and around twenty Catalan artists, and pieces from the open call had been interspersed with other digital art collections.



LA IRRUPCIÓ

Santa Mònica, Barcelona
From June 9 to August 21

The main exhibition has featured 32 works: 23 pieces from the ISEA2022 Barcelona public call selected in conjunction with Santa Mònica, 2 pieces donated by the NewArtFoundation and 7 works acting as itineraries for the exhibition. The Irruption has presented works by leading international and local artists including Robertina Šebjanič, Lauren Lee McCarthy, Eric Berger, Joan Soler-Adillon and Andy Gracie.

POSSIBLES

Recinte Modernista de Sant Pau, Barcelona
From June 9 to 30

It included five outstanding works from the ISEA2022 Barcelona call by Thierry Fournier, Monika Fleischmann and Wolfgang Strauss, Paul Thomas, Keith Armstrong and Linda Dement, Paul Brown and Carmine Gentile, and it has been completed by Alex Posada (winner of one of the ISEA2022 Barcelona grants) and twenty digital works by the NewArtFoundation.



WHAT IS POSSIBLE AND WHAT IS NOT

La Capella, Barcelona
From June 9 to August 28

A dialogue between works by five local artists (Josep Manuel Berenguer, Anna Carreras, Mónica Rikić, Roc Parés and Yolanda Uriz) from ISEA2022 Barcelona's call, and works by artists from Barcelona Producció (Anna Pascó, Ariadna Parreu, Mario Santamaría and Estampa).

2nd SUMMIT ON NEW MEDIA ART ARCHIVING EXHIBITION

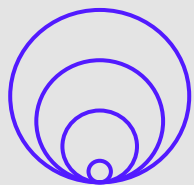
Online exhibition composed of 8 artworks related to archives or archival practices as well as data visualisation of archives.

BEEPCollection: ORIGINS

Cal Massó, Reus
From May 26 to July 23

An ambitious selection of new projects and foundational works of international electronic art by leading artists including Joan Fontcuberta, Marcel·lí Antúnez and Rafael Lozano-Hemmer.





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FULL PAPERS

Dynamic Paintings: Real-Time Interactive Artworks in Web

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Abstract

In this work, we present an approach to creating dynamic paintings that can be re-rendered interactively in real-time on the web. Using this approach, any existing painting can be turned into an interactive web-based dynamic artwork. Our interactive system provides most global illumination effects such as reflection, refraction, shadow, and subsurface scattering by processing images. In our system, the scene is defined only by a set of images. These include (1) A shape image, (2) two diffuse images, (3) one background image, (4) one foreground image, and (5) one transparency image. A shape image is either a normal map or height. Two diffuse images are usually hand-painted. They are interpolated using illumination information. The transparency image is used to define the transparent and reflective regions that can reflect the foreground image and refract the background image, both of which are also hand-drawn. This framework that mainly uses hand-drawn images provides qualitatively convincing painterly global illumination effects such as reflection and refraction. We also include parameters to provide additional artistic controls. For instance, using our piece-wise linear Fresnel function it is possible to control the ratio of reflection and refraction. This system is a result of a long line of research contributions. On the other hand, the art-directed Fresnel function that provides physically plausible compositing of reflection and refraction with artistic control is completely new. The art-directed warping equations that provide qualitatively convincing refraction and reflection effects with linearized artistic control are also new. You can try our web-based system for real-time interactive dynamic paintings at <http://mock3d.tamu.edu/>.

Keywords

Dynamic Paintings, Interactive Paintings, Web-Based Artistic Interfaces

Introduction and Motivation

Non-photorealistic rendering (NPR) has emerged as a sub-field of computer graphics during 1990s to produce computer generated images that invoke the appearance of being created "by hand" [26, 10] by emulating broad artistic styles such as outlines and silhouettes [13], technical illustrations [11], pen and ink drawings [7, 20], impressionist [16] and cubist paintings [21, 25, 22], Chinese painting [3, 17], charcoals [19, 8], and stippling [18]; as well as artistic tools and mediums such as brush strokes [28, 30, 12, 15], watercolor [5]. Convolutional

Neural Networks has turned out to be effective for style transfer [9, 24].

In recent years, there has also been growing interest to turn specific paintings into dynamic computer-generated images with moving lights and cameras. These paintings can have non-realistic components. For instance, Murphy developed a non-photorealistic approach for matching shapes and colors of the artwork of Disney background painter Eyvind Earle who uses non-realistic shadows [23]. "Atelier des Lumières" group developed large-scale video projections of many of Vincent van Gogh's well-known works [6]. Liu created a 3D version of a Jiangnan water country painting by the contemporary Chinese artist Yang Ming-Yi as the primary visual reference [17]. Justice created dynamic time-lapse animations based on some of the works of Edgar Payne, using Barycentric shading as the core of his procedure [14] (see Figure 1a). Subramanian obtained painterly reflection, refraction, and caustics with a classical wine and glass still life painting [27] (see Figure 1a). Clifford created time-lapse animations of two of Anne Garney's paintings for different times of the day [4].

Problem Definition

The main problem with these methods is that they are still based on the standard computer graphics pipeline. There is still need for a modeling and animation software such as Maya or Blender even if proxy geometry is simple. Moreover, there is also need for a shader software such as Arnold or Renderman even for expressive depiction. In this work, we propose a completely different pipeline. All information from shapes to materials is provided by images. Shapes are defined either by normal maps or depth maps. Shading parameters are also provided by a set of control images. Using these images we can obtain physically plausible local and global illumination with complete style control. There already exist solutions to obtain diffuse reflection, shadows, reflection, and refraction with a set of images [31, 29, 1, 2]. An example that shows how to diffuse rendering is computed is shown in Figure 2. More examples of illustrations or paintings that are obtained interactively in real-time using our web-based system are shown in Figures 3, 4, 5, 11, and ???. The interface of our system is shown in Figures 8, and 9.

In this work, we describe physically plausible yet stylistically expressive transparency. A real transparent layer must



(a) Three frames from a time-lapse animation of an Edgar Payne Painting for different times of a day [14].



(b) Three frames from an animation of Vine & Glass painting that demonstrate reflection, refraction and caustics [27].



(c) Three frames from time-lapse animation of Anne Garney's "Fusion At Playa del Carmen" for different times of the day [4].

Figure 1: *Examples of previous works of dynamic paintings with dynamically changing shadows, reflections, and refractions using moving light sources. These images are not created in real-time. Although the methods allowed to create of such non-photorealistic results with complete control, the process is still based on a standard computer graphics pipeline that requires modeling and animation software to run the shader to obtain animations. These animations, therefore, still took a significant amount of time to render. In this work, by using a completely different pipeline, we can obtain real-time rendering with dynamically changing shadows, reflections, and refractions using moving light sources.*

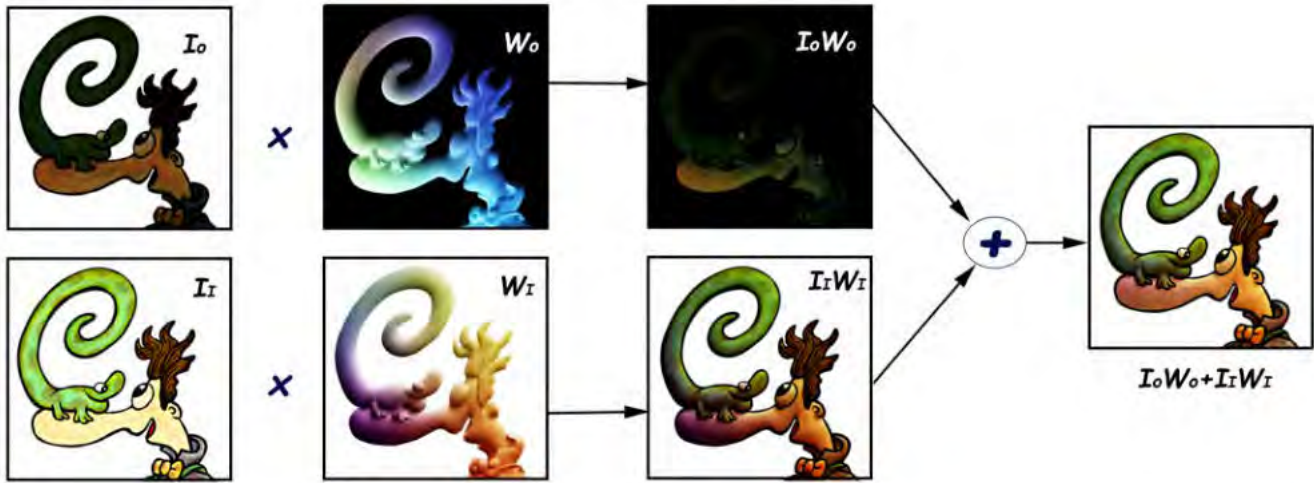


Figure 2: An example demonstrating the pipeline for diffuse rendering. I_0 and I_1 are the control images, Ω_0 and Ω_1 , are weight images that satisfy the partition of unity. Here, we compute Ω_0 from a shape image just using image processing. $I = I_0\Omega_0 + I_1\Omega_1$ is the final rendering obtained by taking a weighted average of the two control images.

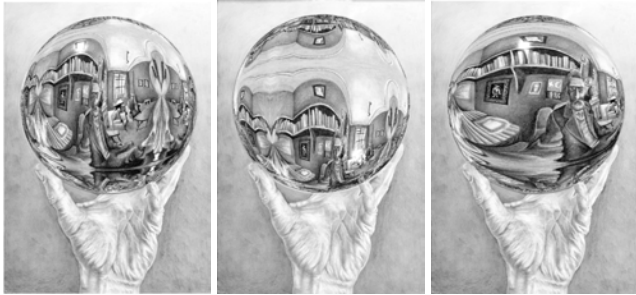


Figure 3: Interactively created illustrations based on “Self-Portrait in Spherical Mirror”, a lithograph by Dutch artist M. C. Escher.

refract the background image and reflect the foreground image. Moreover, reflection and refraction must be combined by using the Fresnel equation, which provides a weighted average of reflection and refraction based on the incident angle. The inclusion of such a physically plausible transparency operation in digital compositing is very useful for the post-processing stage. Instead of re-rendering the whole scene, artists can simply control the Fresnel function to obtain desired effects. Such control can significantly improve the efficiency of the image synthesis process by moving some of the effects in 3D rendering to post-processing through digital compositing. It can also provide 2D artists to design physically plausible painterly refraction and reflection effects during image manipulation.

Art-Directed Fresnel Function

One of the key parts of our approach is an art-directed Fresnel function that can allow the physically plausible combination of reflections and refractions. Figure 6 demonstrates that it is

possible to control results using a single slider with two parameters. The first parameter controls the incident angle position where we want to obtain total refraction and the second parameter control the incident angle position where we want an equal mix. An additional control allows changing Fresnel from total refraction to total reflection as shown in Figure 7.

Our Fresnel function starts with a piecewise linear approximation of the real-Fresnel function. This particular sequence is provided for a single index of refraction. We allow users to change the incident angle positions (i.e. $\sin\theta$) of two control points of this piecewise linear function, which turned out to be sufficient to obtain visually convincing Fresnel effects. The top row in Figure 6 shows painterly compositing effects. The middle row directly shows Fresnel control using a black background and white environment map, in which full black means full refraction and full white means full reflection. In this case, the bottle is simply a normal map image. Gray is a weighted average of reflection and refraction. The last row shows actual Fresnel functions, in which grey areas are not reached to be used.

Linearized Reflections & Refractions

We replace standard reflection and refraction effects with linearized transformations for art-directed intuitive control. These linearized transformations provide warping effects that are visually similar to 3D realistic rendering since they indirectly correspond to underlying physical phenomena of reflection and refraction.

Mock-3D Objects

We also replace transparent 3D objects with transparent images that to provide partial 3D information, which we call “mock-3D objects”. These images can be inserted into any digital paint system without any significant structural change. We visually demonstrate that it is possible to obtain qualita-



Figure 4: Interactively created paintings based on “Autoportrait”, an oil painting by Pablo Picasso in 1907. All images are created using a normal map.

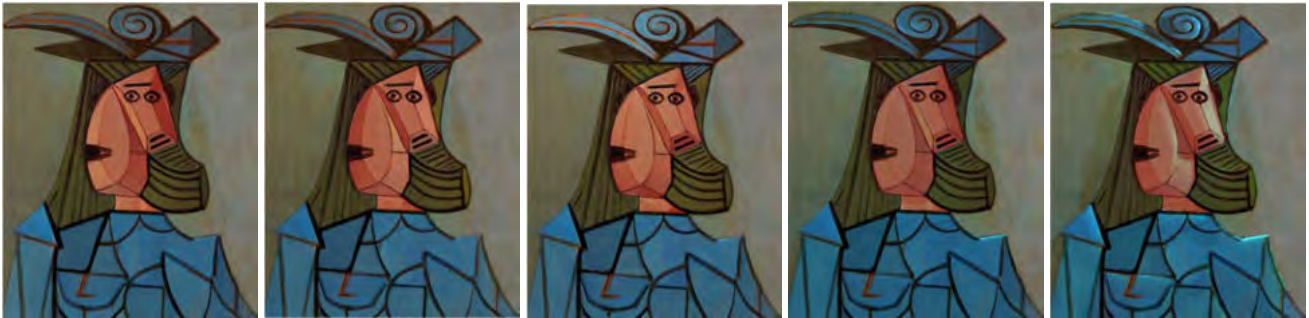


Figure 5: Interactively created paintings based on “Portrait of woman (Dora Maar)”, an oil painting by Pablo Picasso in 1942. The two images in the left are created using a depth map, therefore, we obtain shadows also.

tively convincing reflection and refraction effects with a minimal amount of 3D information, such as normal as a vector field and thickness [31]. This 3D information, moreover, does not have to be complete or consistent for obtaining convincing composites. The images that provide 3D information can directly be obtained through 3D rendering by harvesting normal and thickness information. More important for 2D artists, they can be directly sketched or painted based on artists’ intentions.

Conclusion

Our approach provides the ability for 2D artists to efficiently include refraction and refraction into their artworks and allow intuitive artistic control over visual results (See Figure 10). Using this approach, artists can create artificial, but still believable, versions of the original images as well as original artwork that can be dynamically manipulated. Our system is available for any artist to create dynamic artwork. The link to our web-based software is mock3d.tamu.edu. The system is developed using java-script and WebGL. The interfaces of our system for normal maps and depth maps are shown in Figures 8, and 9.

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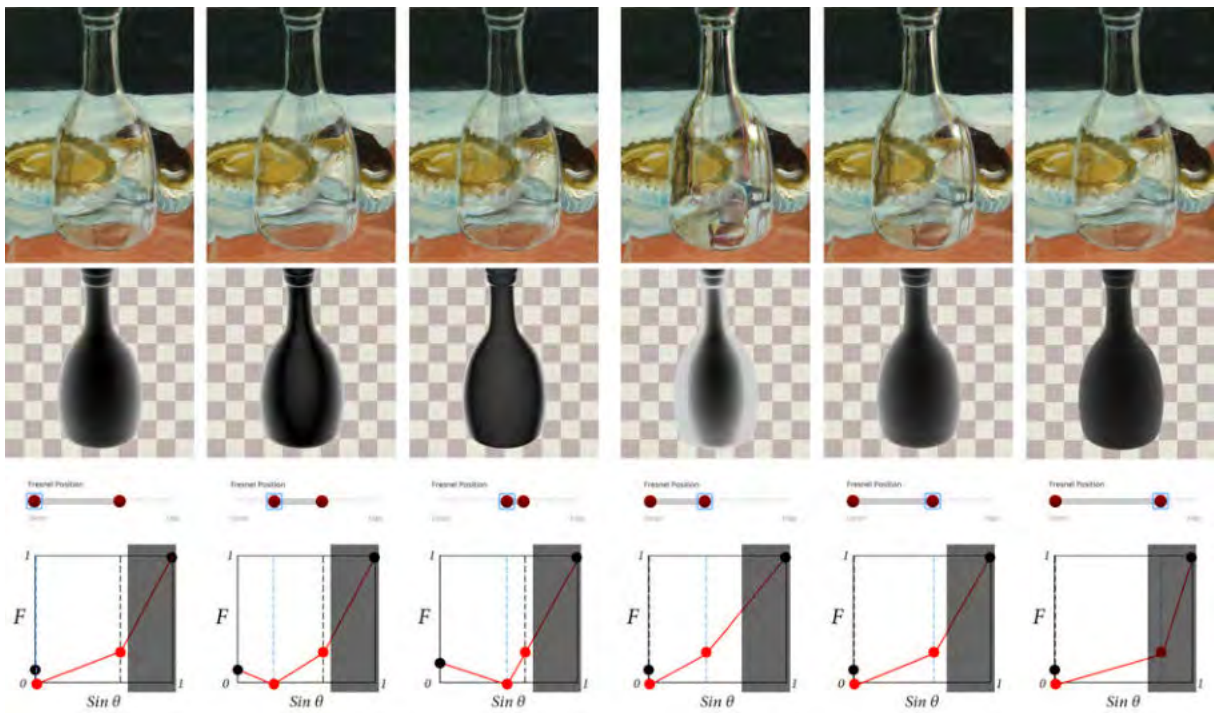


Figure 6: Our Fresnel function allows to combine reflection and refraction with an art directed control.

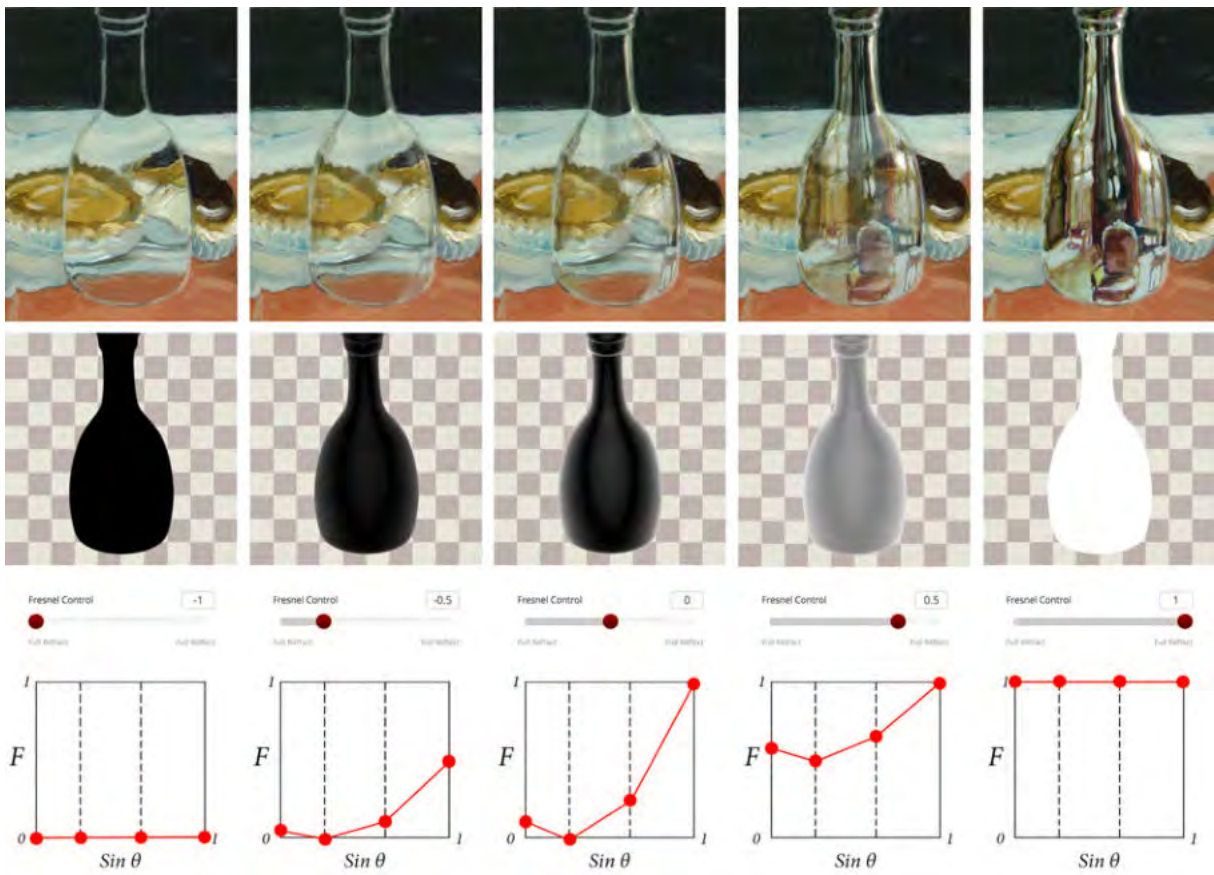


Figure 7: Additional Fresnel control: from total refraction to total reflection.

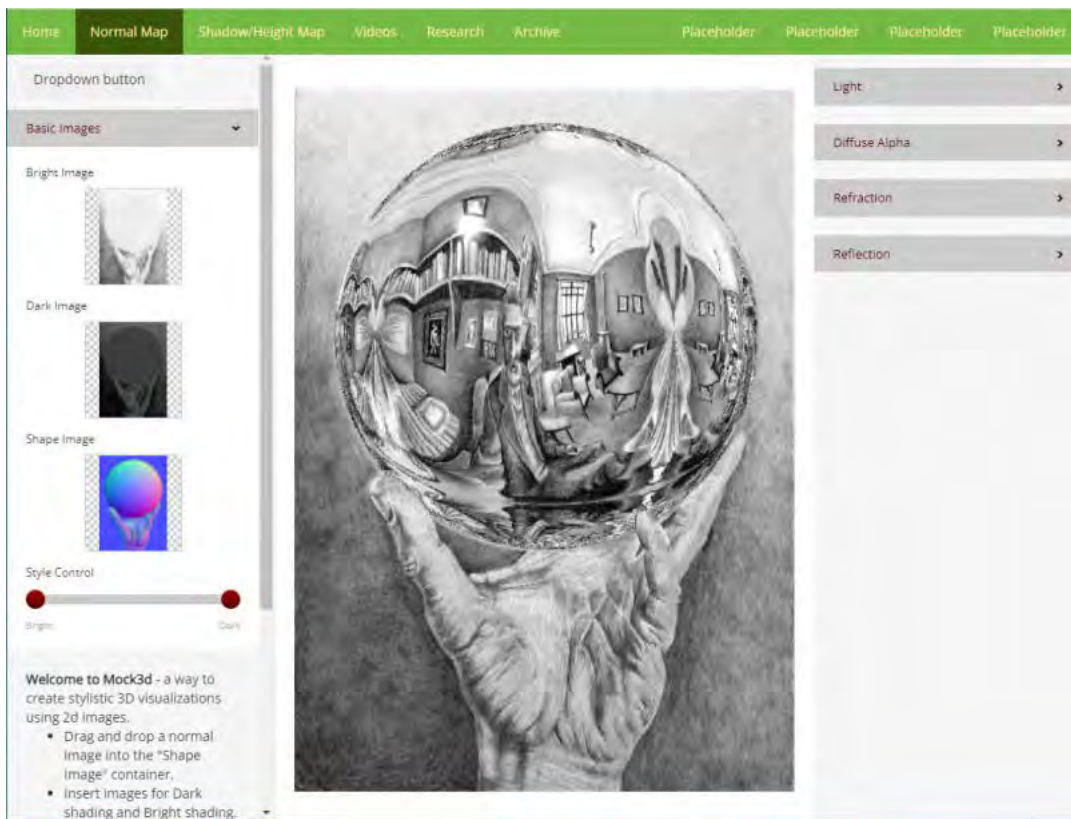


Figure 8: *The interface of our web-based system for normal maps. See mock3D.tamu.edu/normalmap/index.html.*

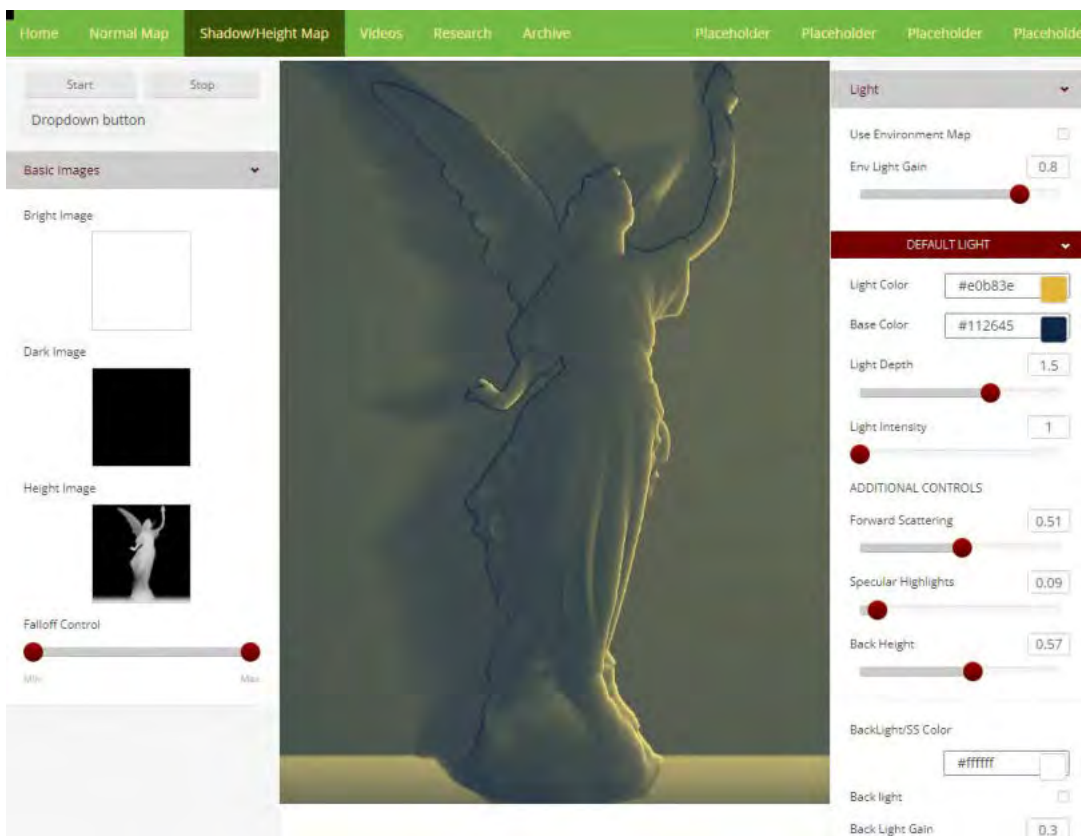


Figure 9: *The interface of our web-based system for height maps. This one can provide shadows. See mock3D.tamu.edu/shadow/index.html*

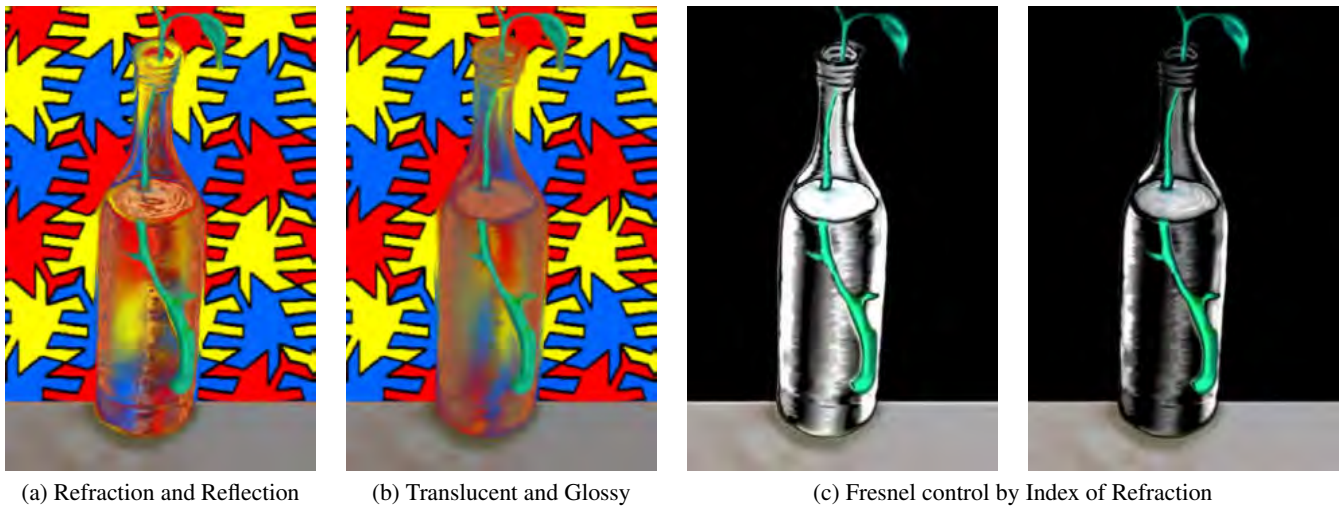


Figure 10: Another example of vector field compositing demonstrates the effect of thickness in addition to a normal map. (a) shows reflection and refraction composited with our Fresnel function. (b) shows glossy reflection and translucent refraction combined with our Fresnel function. (c) directly shows Fresnel control with an index of refraction using a black background and white environment map.

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Figure 11: Interactively created paintings based on “Atavistic Ruins after the Rain”, an oil painting by Salvador Dali in 1934. In this case, we used a depth map to model the scene. We changed the position and color of key light. Note subtle movement of shadows.

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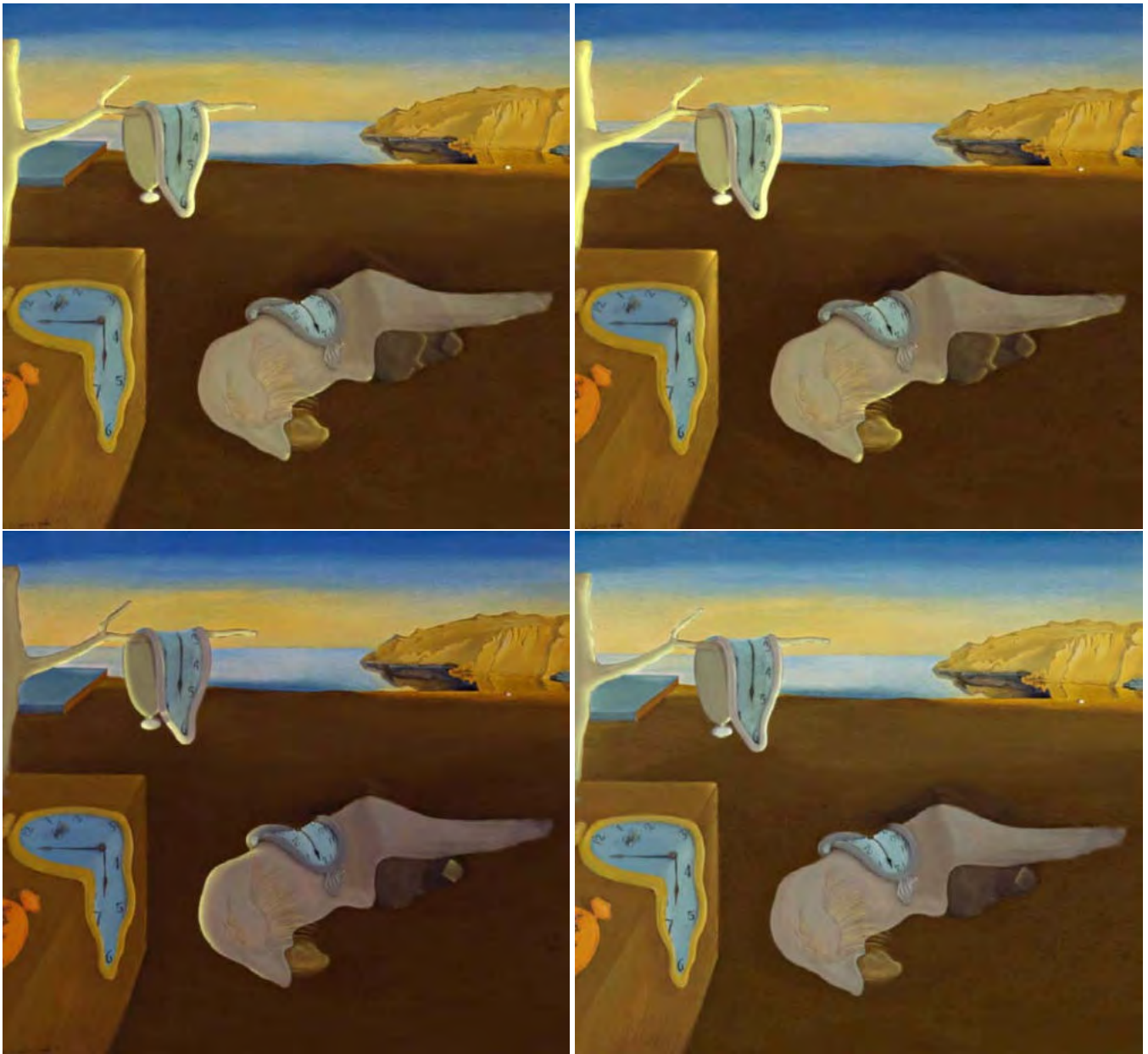


Figure 12: Interactively created paintings based on “The Persistence of Memory”, an oil painting by Salvado Dali in 1931. In this case, we used a depth map to model the scene. We changed the position and color of key light. Note subtle movement of shadows.

Evoking Sympathy Through Immersive Experiences in *A Walk Alone*

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Abstract

Sarah Everard, a 33-year-old woman who went missing and got tragically murdered during her walk home, sparked an international conversation about women's safety in early 2021. It is one thing to discuss such a tragic and unfortunately common occurrence, yet it is even more harrowing to experience it for yourself. *A Walk Alone* is a virtual reality experience that simulates what it feels like for women to walk alone at night. The experience is centered around a linear story involving the user in first person point-of-view navigating a night-city environment with eerie sound design, immersive visuals, and dim street lighting.

Keywords

Virtual Reality, Empathy, Immersive Experience, Presence, Embodiment, Women Empowerment, Sexual Assault and Violence, Embodied Experience.

Introduction

Immersive technologies including virtual and augmented reality have shown great potential in art, education, healthcare and other areas. The VR environment brings a black box for traditional, digital and virtual artists who want to bring new dimension to their creations [1]. It supports visualizing abstract concepts and interacting with the three-dimensional virtual representation. It allows individuals to interact with each other in collaborative virtual environments, as well as visit and interact with events that are unavailable or unfeasible due to distance, time, cost or safety factors [2].

General characteristics of VR experience include immersion, presence, and embodiment [3]. First, immersion is a perception of being physically present in a virtual environment. This is the technical capability of the immersive system to deliver a convincing experience by interacting with the virtual environment [4]. Another characteristic of VR experience is presence. Presence refers to the feeling of being physically located in a different environment. In contrast to immersion, presence is considered as a subjective experience [5]. The last aspect of VR experience is the sense of embodiment. Even though many VR environments often simulate events that may not be experienced in the physical world, a user feels the ownership of the body in the virtual environment [6]. That supports the concepts of immersion and presence as well.

Because of the main characteristics of VR experience, artists, storytellers explore VR as a communication method to provide compelling narratives or to address social issues. Chris Milk in his TED talk said that VR is "the empathy machine." VR could be utilized to make people understand other people's situations and help people such as refugees, the homeless, and people with physical and mental disabilities [7].

This concept inspired us to create a VR project entitled, *A Walk Alone*. It provides an immersive experience that the audience feels like to walk alone at night as a woman. This project was inspired by current events regarding the kidnapping and the murder of Sara Everard who went missing during her walk home from her friend's apartment in South London. This paper presents the background, the design process, and the preliminary user feedback from public demonstration events.

Background

In this section, we examine how VR could be used to evoke empathy in various areas by reviewing prior works.

Empathy Generation in Virtual Reality

Empathy is an ability that encompasses diverse psychological processes related to sharing and understanding the internal mental steps of other beings [8]. Empathy consists of the ability to view the world from another person's point of view combined with an emotional reaction to that perspective, including feelings and concerns for other people [9]. It is important because a higher level of empathy creates more socially appropriate behavior and better social adjustment [10, 11].

According to Davis [9], empathy is a multi-faceted positive characteristic consisting of both cognitive and affective components. Affective aspects of empathy include experiencing another feeling and having an appropriate emotional response to another person's situation [12]. Cognitive aspects of empathy include understanding another person's perspective and being able to judge and understand the intention of others. Nicovich et al. [13] presents that empathy and presence are associated with interactivity.

There are many artworks and research projects utilized VR as a vehicle for evoking empathy in many social justice related issues. *Cloud Over Sidra* [14] is a 360 VR video, sponsored by the United Nations. It is about the story of Sidra, a 12-year-old Syrian girl in a refugee camp in Jordan. It aims to raise awareness of Syrian refugees. Ahn et al. [15] found that VR is helpful in terms of taking the perspective of animals. It led participants to experience more embodiment with the environment and a greater connection between the self and nature. Since the 1990s, there have been disability simulations to evoke awareness of disability and reduce implicit bias towards people with disabilities. Chu et al. [16] created a 360 VR application, *Colors for All* to raise awareness of the challenging daily lives of color blindness people. It consists of three daily scenarios (driving, shopping, and cooking) that present different color-blind conditions to the user. This project allows normal color vision people to experience different types of color blindness and its impact on their everyday lives. They found that immersive video can be a powerful tool for helping users experience outside of

their daily lives and evoke empathetic feelings to other people's experiences. Kalyanaraman et al. [17] reported that their schizophrenia virtual simulation induced greater empathy and more positive perceptions toward people suffering from schizophrenia than the control group with the written empathy-set condition.

A Walk Alone: Design Development

Concept

During ideation, concept sketches were exhausted to explore various environment atmospheres, lighting scenarios, and set design (see Figure 1). The sketches served as studies for different color palettes, potential urban city locations, and general storylines. Initially, it was important to showcase a gradual change in the users' field of view significantly to employ a sense of isolation and vulnerability. By the end of the simulation, darkness would completely envelope the user to stimulate psychological distress. Concept sketches also informed user interface design within virtual reality to further immerse the viewer into the narrative; no assistive interfaces, like mini maps or objective markers, were used. Instead, intentionally positioned lighting and diegetic mobile notification guides became the only tools used to assist the user in navigation. A blueprint of the entire virtual world was created before laying out set design in Unreal. After initial development of the environment, the blueprint was reduced in size and complexity based on time constraints. The environment elevation was flattened, omitting all dead-ends, stairs, and complex street compositions. The final map followed linear navigation to denote any misdirection the user may experience without maps or objective markers. The final environment spanned the size of one city block, populated by buildings and urban assets that would restrict the user's journey to one path. For example, blocking the street with construction forces the user to go walk towards a dimly lit alleyway.

Design Research

Before developing *A Walk Alone*, we tried to understand what virtual reality elements can evoke empathy and elevate the impact of such a sensitive topic. Our aesthetic research included existing games and simulations that fit

within the horror genre of both virtual reality and games in general. *Phasmophobia* is a fictional horror game that has gained popularity for its powerful psychological stimulation in both regular gameplay and the virtual reality version of the game [18]. A great contributor to emotional stimulation it elicits is its detailed sound design. The user is swept up in a believable auditory experience that involves location-based sound as well as a variety of different sound effects. Other horror games like *Slender: The Arrival*, *Amnesia: The Dark Descent*, and *Outlast* [19, 20, 21] played an important role in inspiring our audio and visual design; even though these games are not set in virtual reality and contain fictional elements, our main takeaway consisted of dimly lit environments and eerie sound design to elicit emotional unease from the viewer. The limited lighting in each of these four games allows the game designers to restrict the path and vision of the users. By only lighting key sections of our environment, we deliberately guide our users through the city street environment of *A Walk Alone*. In addition, strategically placed construction assets and roadblocks further limit the user's path.

Outside of psychological stimulation, we also looked at references of movement within virtual reality. Since our concept is based heavily on simulating the act of walking, it was important to research the different methods of locomotion in virtual reality, especially with regards to motion sickness. Our aim was to minimize locomotion discomfort while still mirroring the feeling of walking alone at night in real life. We looked at the locomotion within the game *Onward* [22], which utilizes the trackpad to move the user in the virtual reality space. The user can change the course of their movement by pointing their hand in the direction they are heading, while pressing down on the trackpad. Since the user is not moving in real life, this method may trigger motion sickness. A way to combat this is to restrict the field of view of the user when they are walking, or to use smooth and slow motion. We also reviewed *Vindicta* [23], which offered a more creative solution for user locomotion. In order to move forward, the user has to swing their arms in a "walking" motion while holding both controllers. The faster you swing your arms, the faster you'll walk in the game. Even though this method requires natural physical movement that can control the user's walking speed, we felt it would be too distracting of a motion. We decided to use trackpad touch as our method for locomotion. To combat motion sickness, we maintained slow and controlled locomotion movement paired with a dimly lit environment that restricts the user's peripheral vision.

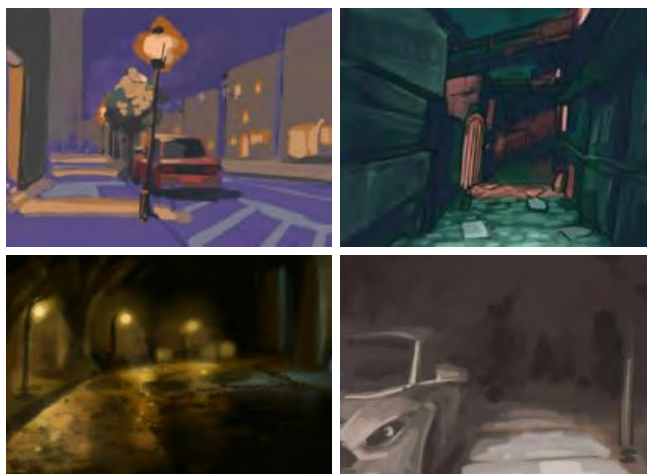


Figure 1. Sketches of an urban city street environment developed in the early stages of ideation to determine lighting, color, set design and overall mood.

Asset Creation

To reduce the viewer's field of vision and stimulate psychological distress, the virtual environment of *A Walk Alone* is dimly lit and claustrophobic in nature. The main objective of the simulation consisted of triggering feelings of isolation and vulnerability by prompting the user to navigate through sparsely lit darkness (see Figure 2). To enhance user immersion and mimic the reality of the scenario, intentionally positioned lighting and diegetic mobile notification guides serve as the only navigation tools available to assist the user.



Figure 2. Screenshots from *A Walk Alone* simulation highlighting different scenes, like walking through alleyways and a park, in first person point of view.

Environment Design

Since the simulation is set in an urban city at night, the environment includes a comprehensive collection of 3-dimensional assets like dumpsters, construction signs, trashcans, windows with AC units, doors, parking meters, construction barriers, containers, and streetlamps...etc. The 3-dimensional models were created in Maya while Substance Painter was used for surfacing and texturing. For efficiency, the models were built to specific poly-counts, then were distributed into the master scene in Maya. Time constraints limited asset production to only include the most valuable objects in the environment. Thus, park environment assets and the user’s car were outsourced from Unreal Engine’s Marketplace. The remaining assets that were modeled in-house were textured with gritty, street-like materials and graffiti to make the space seem true to an urban city environment (see Figure 3).



Figure 3. Examples of gritty, urban 3D Assets like construction signs, containers and street objects scattered in the environment of *A Walk Alone* simulation.

The assets were combined with procedurally generated buildings to create a populated, diverse, and immersive experience for the user to navigate through. Different door and window models were imported into Houdini in order to procedurally generate different window and door layouts for each building (See Figure 4). Using this method permits the generation of buildings that appear different, even though most of the buildings are made up of the same base models.

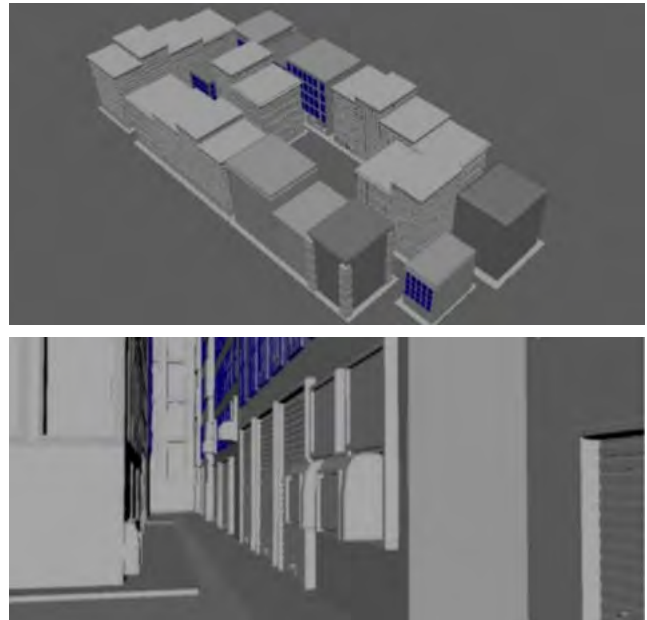


Figure 4. Windows selected in blue showcase unique display patterns procedurally generated in Houdini.

Other notable 3-dimensional assets include a replica of the real life “missing persons” poster of Sarah Everard, the woman whose tragedy reignited an international conversation about women’s safety in early 2021. Though Sarah went missing on her walk home from her friend’s apartment in South London, women across the globe saw themselves in her shoes. Scattering the posters throughout the environment connects the game’s narrative to its social inspiration and encourages users to reflect on their experiences in-game with the real-life dangers women face in society today (see Figure 5).



Figure 5. Two versions of the Sarah Everard missing person poster 3D assets with varying tears and textures.

Sound Design

Sound plays a vital role in supplementing our visual-heavy simulation to re-enforce an eerie mood. Sound effects that were collected from open-source websites, like PacDV.com and Freesound.org, include footsteps, city traffic, bottles and cans jangling, glass breaking, soft crickets and dogs barking in the distance, police car sirens, and heavy breathing. The sound experience begins with quiet street ambience and construction noise that slowly fades into jolting sound

effects to ramp up the user's anxiety. The sound effects begin to accumulate over time and overstimulate the user from all directions. Once the user leaves the park, they are struck with a sudden lack of sound. The viewer is left with an uncomfortable silence and an emphasis on their own breathing at the end of the simulation.

Since sound design plays an important role in the simulation, a spatial sound design map was created to plot the auditory experience. Whenever the user enters the trigger boxes that are set up in Unreal, area-specific sounds are played. On the other hand, looped sounds are constantly playing in the simulation, but can only be heard within a specific radius near the sound (See Figure 6).



Figure 6. The spatial sound map highlights trigger boxes (dashed yellow rectangles), area-specific sound effects (yellow rectangles), and looped sounds (white rectangles) strategically positioned in the simulation.

Information Design

To assist the user with navigating the space, it was vital to involve guides that connect the user personally to the narrative. The user is prompted to explore the virtual space through mobile notifications that act as a diegetic user interface guide throughout the entire simulation. Using area triggers in Unreal, each notification pops-up in front of the user depending on where they are in the scene. Text messages from the user's "best friend" direct the user to complete tasks, like walking around the construction site to get to their car, which ultimately guide the user from the start to finish. Mobile alerts like "low battery" or "signal lost" amplify the fear factor intended to be conveyed to the user and act as narrative triggers that increase anxiety (see Figure 7).

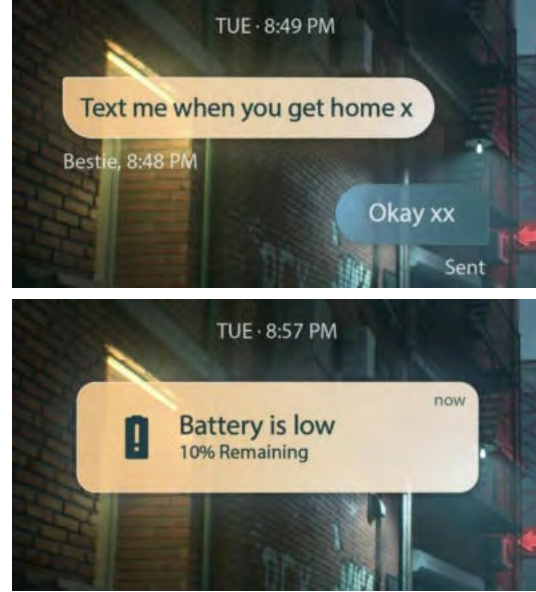


Figure 7. Two mockups of mobile notifications acting as diegetic guides during the simulation of *A Walk Alone*.

The experience starts with an introductory trigger warning and ends with real life statistics that shed a light on how many women are affected by sexual assault and the precautions they must take when walking alone in public. Since the user's field of vision gets darker towards the end of the experience, the simulation fades to black once the user reaches their car then finally transitions into a blank screen showing statistical data in a visually appealing manner.

Public Demonstration

The results from the public demonstration were majorly positive. Of the 16 participants, 10 identified as male. Based on a pre-study question, 62.6% of our users claimed to be knowledgeable or very knowledgeable of the dangers women face when walking alone at night. After experiencing *A Walk Alone*, that percentage increased to 83.1%.

Most participants stated that the most effective and educational portion of the experience were the statistics at the end. However, one user felt as though the message could be communicated more effectively if more graphic scenarios played out during the experience, like simulating an assault happening to the user if they don't get to the car in time. This gives us an idea that those statistics could have been incorporated into the game more interactively, which could increase the effectiveness of teaching users of the dangers women face when walking alone at night. Other users stated that the sounds were most effective since the auditory immersion made them more aware of the environment or gave them a general sense of fear. The remaining users stated that not being able to walk faster or knowing that your phone died sparked increased anxiety. The participants' engagement with the visuals, sounds, and notifications is a great indicator that they were engrossed in the story, both emotionally and psychologically. One user stated that "walking along the path as slow as possible along with hearing my surrounding made me very uncomfortable very quickly." 81.3% of the participants claimed they were fully immersed in the narrative and environment and felt vulnerable during the simulation.

Regarding being good allies, roughly 55% of our users stated that they are careful or very careful of their presence and actions around women who are alone at night. That

leaves the remaining percentage of our users as being not careful, somewhat careful, or neutral in said situation. With overwhelmingly positive results, all our users stated they are likely or very likely to take actions to ensure a woman near them feels safe when walking alone at night after experiencing *A Walk Alone*.

After a few revisions to lighting and adding more road-blocks, we successfully orchestrated an experience where most of our users navigated our simulation smoothly. Almost 69% of our users responded that it was easy or very easy to navigate the scene to find their way to the car. One user stated that “The actual walk was most effective in putting me in the mindset of walking alone and the potential dangers that are associated with it”.

In addition to the majorly positive feedback we received, some users had constructive suggestions to improve the overall experience. A few participants felt like they were walking too slow, while on the other hand, some users enjoyed that feature because it triggered anxiety. A few participants felt motion-sickness in spite of the slow navigation. Others had technical comments about leaving the text notifications and statistics on screen for a longer duration of time for better readability. While one user stated that “It was chilling to hear what was behind you without seeing it”, another user felt like not seeing the objects triggering the sound effects made it difficult to attach certain sounds to the environment”. Suggestions like seeing shadows, having characters walking around or standing in odd places, and adding jump scares give us an idea that some participants would also like to be visually stimulated to feel more fear and anxiety, instead of merely through sound design. Users describing the experience as “rather terrifying”, “uncomfortable”, and “realistic” proves that *A Walk Alone* is making an impact regarding this issue. It also demonstrates that we need to continue to discuss and confront the dangers women still face on a daily basis.

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The Tapestry: Past and Possibility in the History of Magic

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Figure 1 Night view of the Tapestry.

Abstract

This paper presents the Tapestry, a mapping of the history of magic. It describes a system that lets users create *lifelines* and map them using GoogleEarth. Each lifeline, or *thread*, is laid over the globe, showing the trace of the person's historical travels, locations, and activities. By successively laying these threads over one another, users can see points of intersection, suggesting historic interactions and influence. It is hoped that such graphic presentation and users' pattern recognition will lead to discovery of previously unsuspected influences in magic's historical development.

Keywords

Magic, Western Esotericism, mapping, history, database, GoogleEarth, Wikipedia, information architecture, lifelines

This paper presents the Tapestry, a mapping of the history of magic. There is a growing literature on the subject of magic and Western Esotericism. Since the early 1990s universities have developed programs and departments for their study. However defining magic is itself a challenge. Is it a tradition, or a practice? What are its characteristics, and how do they differ over time, or from one culture to the next?

Another challenge is the irony of rationally exploring a subject that defies conventional explanation. Indeed magic

has a troublesome reputation, dismissed as blasphemy by formal religion, and quackery by material science. [1] Yet magic historically has anticipated many contemporary sciences. It presently is used to help understand cognition and consciousness. It persists to this day in most world cultures and deserves serious inquiry. [2] [3]

This paper will demonstrate a system that lets users create timelines of individuals involved magic and map them geographically using GoogleEarth. [4] (Fig. 1) Each timeline, or thread, lies on the globe, showing the trace of a person's historical travels, activities, and locations. By successively laying these threads over one another, users can see points of intersection – suggestions of interaction. At the smallest scale one can visit individual sites and see their activities. At the largest scale one can see movement and migration of different magical traditions over time. It is hoped that such graphic presentation will lead to discovery of previously unsuspected influences on magic's historical development.

Regarding Magic

Magic, as used here, refers to the full range of its cognate practices. It covers conjuring, stage magic, legerdemaine, alchemy, astrology, divination, hermeticism, ceremonial or ritual magic, psychical abilities, geomancy, spiritualism, some religious practices, and a host of other activities

At present the Tapestry database records over 3000 persons, societies, movements, and other entities. Data is entered into an Excel spreadsheet with horizontal rows denoting events in a life. There are presently over 18,000 horizontal rows of data in the set. Vertical columns call out details of each event: names, dates of birth and death, date of the event, location, citation of sources, historical role, influences, and notes on activity.

The project used mapping software GoogleEarth Pro 7.3.4.8248 running on Mac OS X 10.12.6. Colored nodes represent life events mapped onto the Earth. A colored lifeline connects these nodes sequentially from beginning to end. Lifelines between nodes are straight, rarely following actually traveled routes. This means that their intersection *at places other than nodes* are not necessarily meaningful. The color of lines and nodes represents the historical roles of the entity. These roles include conjurors, witches, stage magicians, spiritualists, esoteric societies, psychical researchers, religious leaders, and several other categories.

An Example: John Dee

The process of creating a lifeline may best be demonstrated by an example. For this we will use the lifeline of John Dee, the advisor and wizard of Queen Elizabeth I. [10] Dee, an occultist and polymath, was also a scholar, mathematician, alchemist, ceremonial magician, and astrologer. He had a large influence on magic of his time, and echoes of his work remain today in the practice of Enochian or Angel Magic.

Following research into his life, the data was entered in a Google Earth folder for the 16th century, in a subfolder named 'John Dee 1527 CE'. Events in Dee's life show up on the 3D globe as red-colored nodes – red being the color assigned to occultists. Each node links to a brief note describing the event, year and location. Clicking on a node opens its note. (Fig. 3)

For example clicking on the first node of his lifeline reveals Dee's years of birth and death, a brief summary of his roles in magic, as well as his place of birth. It also links to the Wikipedia source used to make the lifeline. In the current version of the project Dee's lifeline has twenty-four event nodes linked sequentially with a red line. Point #24 records his death in Mortlake, England in 1608 CE.

The Tapestry

Each of the project's roughly 3000 entities – individuals, societies, and events – has its own lifeline, or thread, in a larger pattern called the Tapestry. They are organized in centuries ranging from 4000 BCE to the present. Within each century folder is a list of entities ranked by the year of their birth. Within each entity's folder is a list of event nodes. (Fig. 4) One can edit the list as new information is

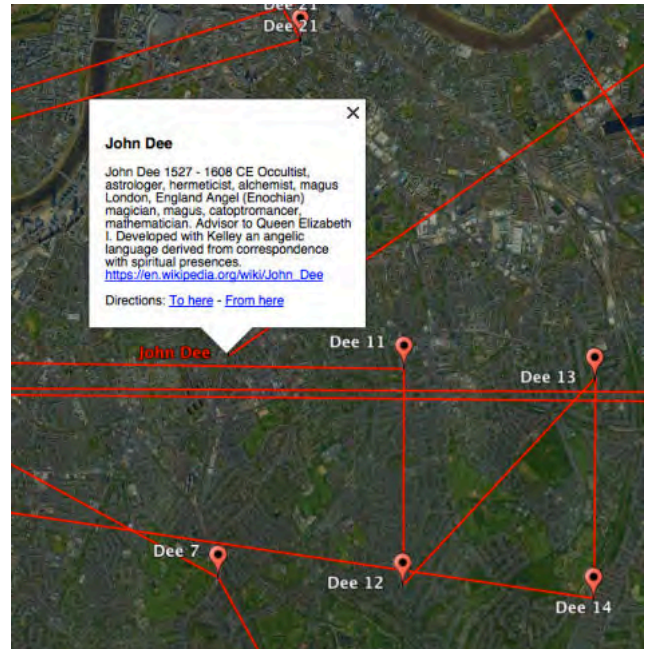


Figure 3 Detail of Dee lifeline showing note.



Figure 4 Detail of Dee folder showing nodes of his lifeline.

uncovered. Also one can turn on lifelines and nodes on the globe, or turn them off at will.

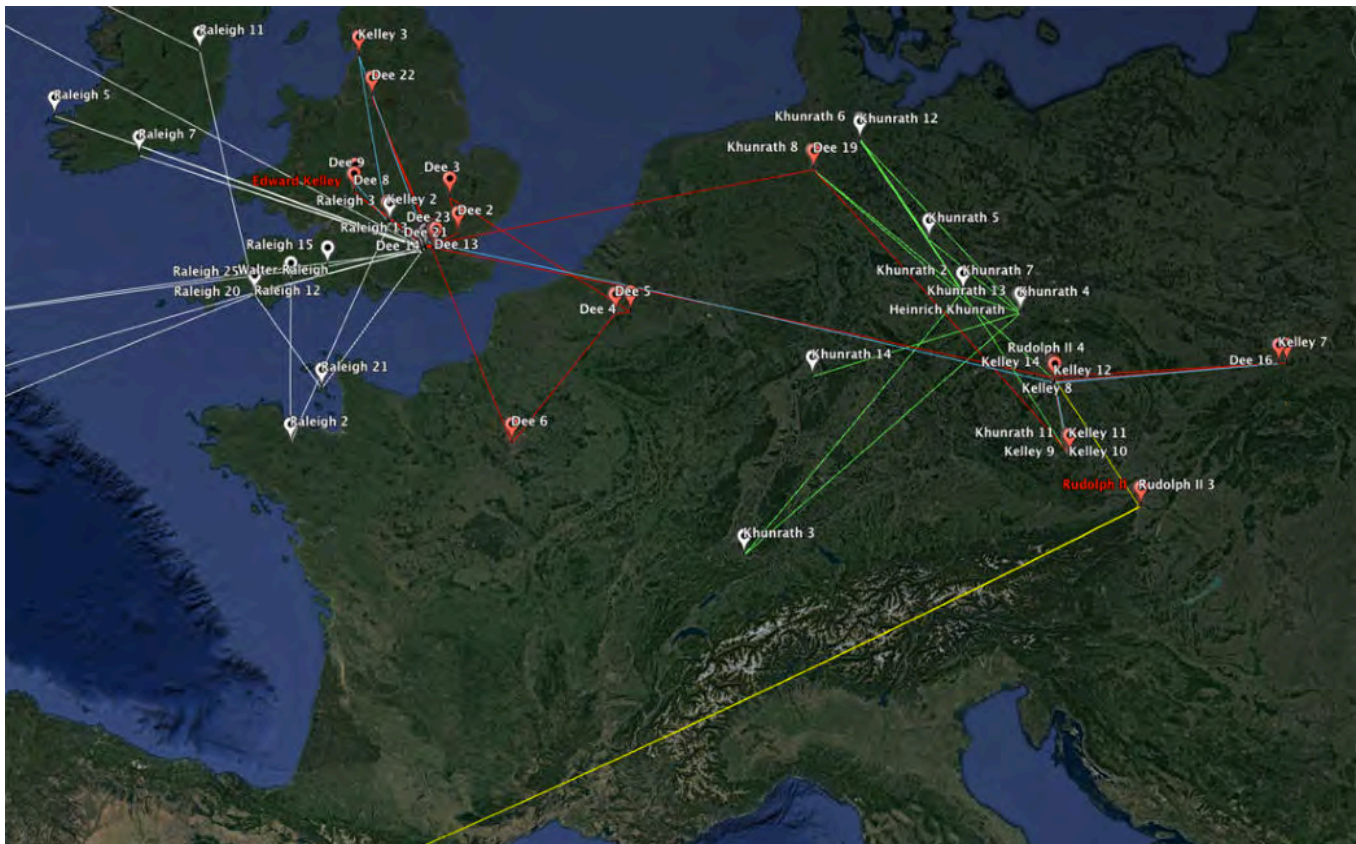


Figure 5 Lifelines of John Dee, Edward Kelley, Rudolph II, Heinrich Khunrath, and Walter Raleigh.

Overlaps of people's lifelines imply that they were simultaneously in the same place. And, if so, they may have had meaningful interaction. Unless this interaction is specifically stated in the supporting literature such an exchange would remain speculative. But it is at least marked by the intersection for future study that could confirm the influence of one person on the other.

This feature of the Tapestry is distinct from literary sources in that possibilities of interaction emerge from the patterns of the threads. One could use it to discover alternate narratives of magical history based on possible influences.

Synchronicity and Possibility

Let's return to our example of John Dee's life to see how these overlaps and possible interactions play out. (Fig. 5) Viewing the lifelines of John Dee (red lifeline) and Edward Kelley (blue lifeline) we can see that they overlie each other from 1582 to 1587, reaching from Mortlake, England to Třeboň, Czechia. [11] In 1582 Dee retained Kelley as an assistant for his alchemical work at Mortlake. Kelley also served as Dee's sryer, using a crystal to communicate with angels. Dee recorded these conversations.

Owing to court politics Dee was forced to seek patronage beyond England, so he and Kelley left Mortlake for Poland. Shortly thereafter they sought patronage from the Holy Roman Emperor Rudolph II (yellow lifeline) in Pra-

gue in what is now Czechia. The emperor's lifeline extends from Austria to Spain and back, ending in Prague. [12]

In the meantime Dee and Kelley continued their correspondence with angels in the hope of providing sacred counsel to monarchs. But they struggled, finances were running out and Rudolph was not interested. Finally Dee and Kelley fell out, spectacularly, and Dee returned to England. Kelley stayed, working as an alchemist in Rudolph's laboratories.

On his return from Prague, Dee met Heinrich Khunrath (green lifeline) in Bremen in 1588. [13] Khunrath, a fellow alchemist, sought work and Dee recommended he visit Kelley at Rudolph II's laboratories. From there Khunrath went on to Prague while Dee returned to London. It is possible that in the later years of his life that Dee may have taught alchemy to Sir Walter Raleigh, a fellow alumnus of Queen Elizabeth's court (white lifeline). [14] Raleigh was being held in London Tower for an illegal naval attack on Spain. Before his death there he took up alchemy. Dee may have offered his tutelage as, by then, he was destitute and near death himself.

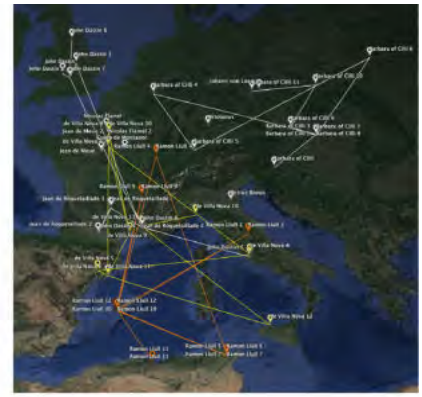
This brief history links four lives that intersected with Dee's own. The literature records three of these interactions, the fourth is inferred from Dee and Raleigh's lifelines in London. That intersection *suggests the possibility* of these two persons' meeting, which could be borne out in further investigation. Another method of finding intersections is to sort the Excel database for locations and dates.



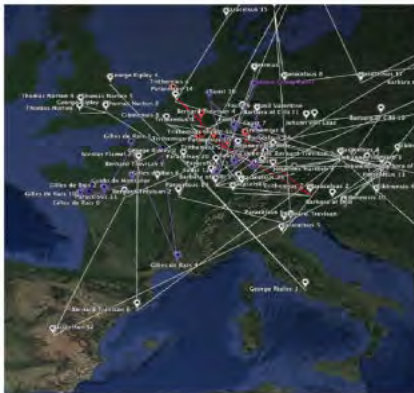
1100s



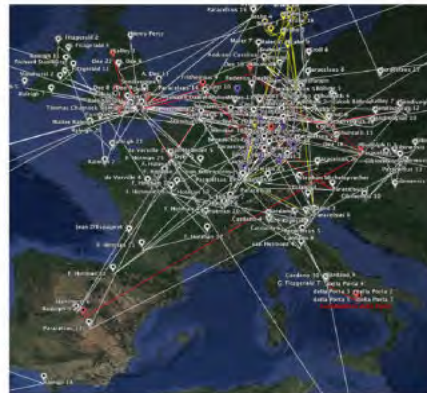
1200s



1300s



1400s



1500s



1600s

Figure 6 Overlapping lifelines indicating the growth and spread of alchemy in Europe between the 1100s and 1700s.

This helps if the graphics get dense and complicated – as in large cities with many intersecting lifelines.

Magical Networks and Trends

As one of the 16th century’s most famous magicians Dee certainly had more connections than the four cited here. Each of the four’s lifelines intersect with others before and

after their encounter with Dee. In turn each of those intersect other sets of lifelines. Connecting these secondary and tertiary intersections would outline a network of Dee’s influence.

The Tapestry can also show how a magical practice can change over time. For instance by comparing alchemists lifelines over several centuries, one can trace the spread of alchemy within Europe and beyond. (Fig. 6)

When all of a century’s lifelines are visible one can see the spread of magical practices. The leap of Western magic to the Americas in the 12th and 13th centuries follows closely on the New World’s exploration and settlement. This connection only strengthens as it approaches our own day. Importantly the 19th century appears to be saturated with magical practice, spanning Europe and North America. (Fig. 7)

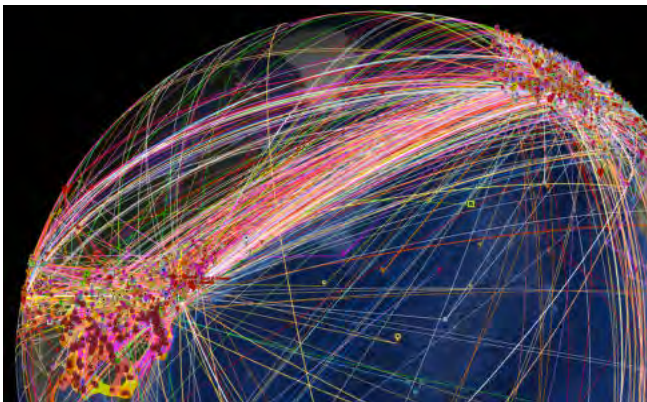


Figure 7 Lifelines showing the spread of magical practice from Europe to North America in the 19th Century.

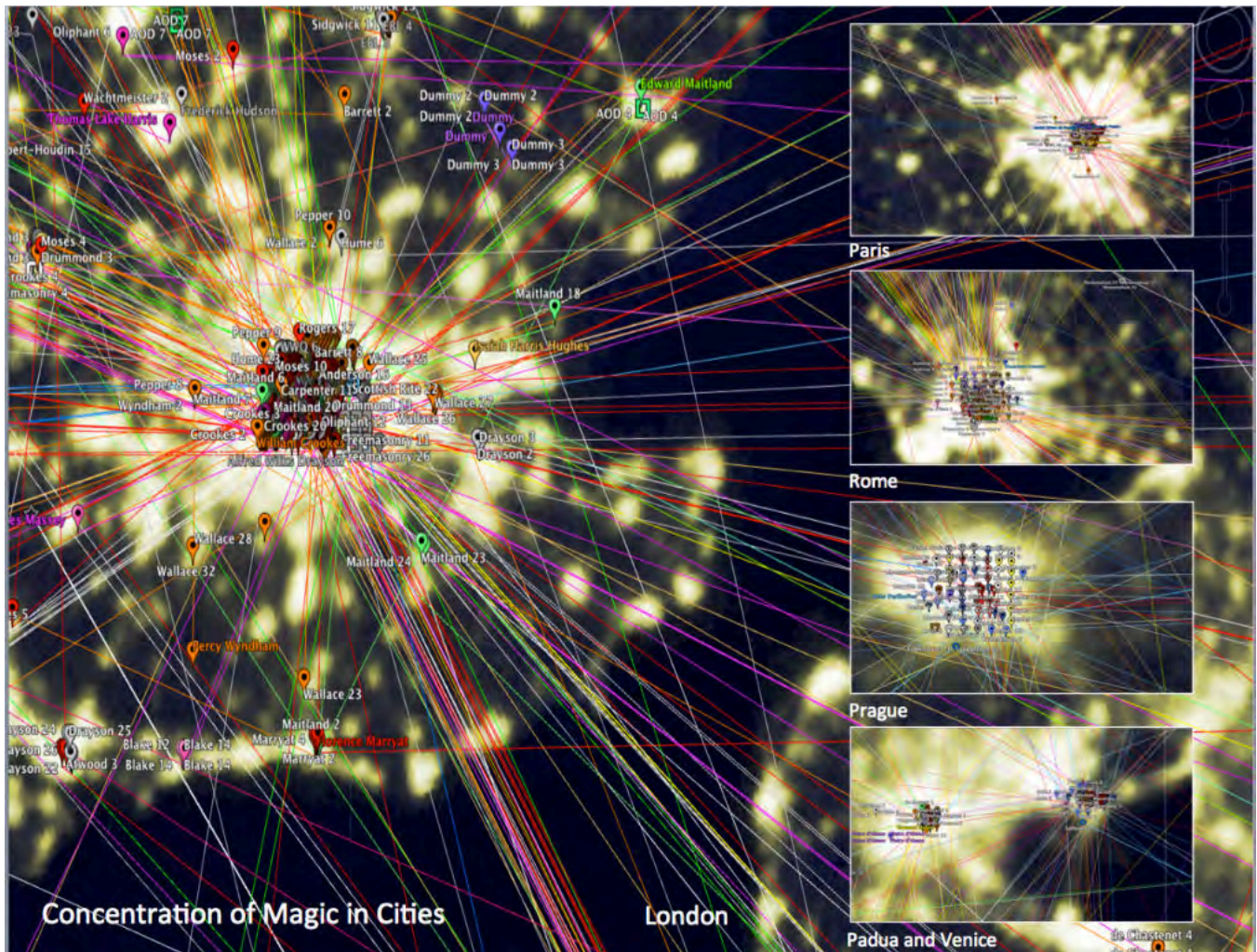


Figure 8 Lifelines showing density of magical activities in cities. ‘Starry’ background is image of the cities at night.

This magical density appears at smaller scales as well. Unlike a conventional map, the GoogleEarth globe can be viewed at various magnifications, allowing users to ‘zoom in’ on cities and settlements. Cities are important centers for magical activity, possibly because of their own density, diverse population, proximity to like-minded colleagues, and universities with libraries. London for example seethed with magical activity in the 19th and 20th century. So did Paris and to a lesser extent other major cities. (Fig. 8)

Correspondence vs. Interaction

The Tapestry is presently limited in scope and content. Its scope focuses on individuals’ action in a place and time. It suggests that interaction is only likely if two entities are *physically present* in a place and time. But proximity doesn’t guarantee interaction.

Riding in a crowded elevator or subway doesn’t usually lead to conversations with fellow passengers. Conversely distance in time or space doesn’t mean lack of in-

fluence. Letters, books, and other media have overcome time and distance for centuries. Because of their durability authors can talk with us from centuries before. For these reasons, the Tapestry can only suggest the possibility of *physical* interaction. There is no presentation in the Tapestry for media and literature’s role in linking individuals and influence. We hope to account for this in future iterations of the project.

Source Limitations

Originally the Tapestry was to be a comprehensive overview of the world’s magical history. In its present state, it accounts for barely a fraction of it. The Tapestry’s database is based almost entirely on information taken from the internet, and especially from Wikipedia. At the beginning this was the most expeditious resource because of its accessibility and acknowledged reliability. However, despite finding magical practices throughout the world, we found the predominance of material was from Western and especially Anglophone countries.

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Protest and Aesthetics in The Metainterface Spectacle

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Abstract

The article asks how political agency play out in contemporary uses of the interface. It, firstly, stipulates that the interface is a ‘spectacle’, belonging to a longer history of media spectacles, mass organization, politics and aesthetics. Secondly, that contemporary interfaces are metainterfaces, depending on a new organization of the masses characterized by mass profiling. Finally, it analyses how this play out in examples from art and cultural practices, and speculates on what political protest and revolution is in light of the interface.

Keywords

Digital art, interface criticism, media aesthetics, media spectacle, political protest.

Introduction

A spectacle is commonly understood as something that visually attracts our attention – typically a mediated experience. It is an object of desire that naturally lends itself to not only pleasure, but also manipulation. Media spectacles have therefore always been a central part of Marxist cultural criticism, ranging from Walter Benjamin, Siegfried Kracauer, Theodor Adorno, Max Horkheimer to Guy Débord, and beyond; and they have always been a contested zone for political struggle – for propaganda as well as for activism and situationist happenings. In this tradition of cultural critique, a spectacle presents an organization of the masses, but also a way for the individual to experience one-self as part of the masses. This can be used for populist manipulation, but potentially also opens up for critical reflection on the mediated organization of the masses. In other words, the media spectacle is historically tied to relations of power and control; of control of the masses, but also of the individual to see and understand one’s one position in the masses and thereby assume individual agency.

Try to think of the user interface as a contemporary spectacle that organizes and controls the masses, and also of the user’s possibilities to experience this organization, and the possible agencies that relate to this. Arguably, the organization of the masses is a complex question. The interface spectacle is not only visually organized, as in traditional cinema and mass media, but belongs to a tradition of statistics that has roots in urban mass control as well as in advertisement – a tradition of data and profiling. As we have described elsewhere, the contemporary user interface must be seen as a ‘metainterface’: an interface that both seals off and gives access to a larger network of interfaces that exchange data;

typically to profile the user and deliver customized experiences. It is an interface that is general (in everything), and abstract (nowhere in particular), and which is often associated with the proliferation of platforms, apps, cloud computing, and other phenomena. [1]

In this article we want to discuss the contemporary interface spectacle through examples of organization of the masses in a networked computational reality. More specifically, we ask: how does political agency play out in the contemporary metainterface spectacle? This question takes us beyond the use of seemingly innocent apps for divertissement, and into the question of how the spectacle is used politically – how its representations and collections of data are used for populist propaganda, as well as for critical scrutiny and other forms of agencies. This is not least relevant in light of political developments as displayed on Capitol Hill in January 2021, or in global nation politics where e.g., Russia has been accused of collecting data and profiling users in order to influence the outcome of elections. How does the metainterface serve such populist spectacles, and what potential forms of critical agencies may rise in this? In search for possible answers, we discuss the so-called twitter-revolutions in light of more recent events and uses of social media; in particular the artistic performance *HEWILLNOTDIVIDE.US*. The work is one of the most high-profile political artworks of recent years, and we analyze how its protest against the Trump presidency, and the responses to this carried out by the Alternative Right movement, brings the relation between aesthetics and politics to the fore. Finally, we also compare the ‘ideal’ twitter-revolution to other perceptions of the revolution as presented in Amira Hanafi’s work *A Dictionary of the Revolution*; a work that presents a quite different interpretation of the Egyptian revolution than its often-acclaimed association with social media.

The media spectacle

Before we enter more deeply into analysis, we want to begin by briefly touch upon the nature of the spectacle. Historically, the spectacle, as a view on and of the masses, involves a particular political agency related to the increased urbanization and rise of the masses following industrialization, as seen for instance in George-Eugène Haussmann’s transformation of Paris into boulevards with views to see, be seen, and be controlled. In Haussmann’s 19th Century Paris the boulevards did not only provide new urban experiences of strolling, Paris was also a city mapped out and controlled from above, and a city that was designed to control the masses (related to Paris’ history of upheaval of the masses).

With modern urban development also came different forms of spatial and mediated spectacles, such as arcades (to see and be seen), as well as zoological gardens and also aquariums that somehow compensates for the boundless scale of urban development and growth of the masses. [2] It is likely that the interface at hand (the facial filter app, the social media interface and its overview of connections and likes, the feature and estimation list of the Uber app, etc.) can be seen as following this urban tradition and need for a human scale miniature perspective in face of a limitless (global) world of planetary scale. However, what interests us in particular is the *mediated* spectacle, which also, historically, ties the organization of the masses, and the individual's perspective on this, to populism, propaganda and political agency in capitalist societies.

In particular the cinematic spectacle lends itself to political propaganda and control of the masses, as noted by the German cultural and film critic Siegfried Kracauer. Kracauer who writes, for instance, about Leni Riefenstahl's infamous *Triumph des Willens*: "Triumph of the Will is undoubtedly the film of the Reich's Party Convention; however, the Convention itself had also been staged to produce Triumph of the Will, for the purpose of resurrecting the ecstasy of the people through it." As such, it is a film "symbolizing the readiness of the masses to be shaped and used at will by their leaders" – "a show simulating German reality and of German reality maneuvered into a show." [3]

Although lending itself to propaganda and the anesthetization of the German people, the spectacle is far more complex than mere manipulation. In Kracauer's understanding, the spectacle (as what he calls "a mass ornament") is also an aesthetic reflection of capitalism's production process, the assembly line, and statistical control. All of these characteristics of a modern mass society are generally abstract or invisible and can only be recognized by the individual as an indirect experience; or, staged aesthetically as a mass ornament, for instance in the stadium spectacles of synchronized gymnasts: "The production process runs its secret course in public. Everyone does his or her task on the conveyor belt, performing a partial function without grasping the totality. Like the pattern in the stadium, the organization stands above the masses, a monstrous figure whose creator withdraws it from the eyes of its bearers, and barely even observes it himself." [4]

The loss of perspective embodies the desires of the worshippers: the experience of a common project that binds people together (as he writes, "The bearer of the ornaments is the *mass* and not the people," [5] but the stadium spectacles offer a reflection of the compulsive actions of a new mass, and a way to experience this as a mass ornament – in which the withdrawal of perspective and the hiding of an origin can even be a sublime experience. In this way, the mass ornament exists above the level of the individual, but nevertheless offers the individual a perspective on the mass. Although, it was this enchantment that fascism and Nazism misused in perverse ways and took advantage of in their propaganda, its effects are not uniform. [6] [7] Its social significance cannot simply be compared to that of a roman theatre, staged by the ruling power, as Kracauer notes; as he highlights how the mass indulges in sensations comparable to a godless cult. [8] In fact, it is such sensations that help the individual reflect the rationale of industrial production;

that makes the ornament 'real': a reflection in how reality is produced.

The metainterface spectacle is as complex as the mass ornament. Following Kracauer's line of thinking, we may assume that the mass ornamentation of customized media reflects a new moment in cultural production – the moment of a "metainterface industry" with ties to former cultural industries. [9] Just as in the 1920s and 30s, we may also assume that mass ornamentation make way for propaganda, but also realist (media) reflection. However, the mechanisms of both propaganda and realism function substantially differently than in the mass ornament of cinema or stadium spectacles: interfaces see us differently, and we see ourselves differently in them.

In the metainterface everybody takes and sees the same snapshot of the Eiffel Tower (as a compulsive action of the mass), but unlike former mass spectacles, nobody is seeing *the mass perspective*. The spectator of the new mass ornament, the user, is limited to responding emotionally to the feed (by sharing what is on one's mind, or liking what is on the minds of others) – there is, in other words, no one to see 'the figure' (in Kracauer's terminology). If the mass ornament (the spectacle) is the aesthetic mirroring of the ruling economic system and its inner rationale, there is nobody to see this; there is no sensation of this. As a particular datafied perspective, one might even question whether the mass itself can be the bearer of ornaments? [10]

The metadata protest

If the user is limited to an emotional response to a feed of snapshots that all look the same, and there is no one to see the figure of the mass, where does this leave the politics of the metainterface spectacle? How is politics aestheticized in the metainterface spectacle? And, how does aesthetics become politics? In order to extend reflections on the metainterface spectacle into such questions, we want to analyze and discuss contemporary examples of how the metainterface enters the fabric of political and social activism and protest.

The wider public experience of how interfaces and social desires come together first became evident with the so-called 'twitter revolutions' – the mobilization of a mass using social media. These include a number of protests taking place in the early 2010s, broadly covering diverse settings and political agendas, including, for instance, The Arab Spring (2010-12), the Gezi Park protests in Istanbul (2013), the 15-M Movement at Plaça del Sol in Madrid (2011-15), and various others. Arguably, these protests did not just take place on social media; they were events taking place in parks and at squares, and they involved people with feelings of indignation (as the movement in Spain labelled itself, "los indignados"). However, as a common characteristic, the use of the hashtag ("#jan25" (marking the beginning of the protest on Tahir Square in Cairo), "#spanishrevolution", etc.), demonstrated how the interface was integrated into the social and political tissue of the protests. Judging from phenomena such as #MeToo, #BlackLivesMatter, #UmbrellaMovement and more, this has been the case for much political activism and many protest movements ever since.

Put briefly, using a hashtag signifies one's identity with a discourse across media platforms and contexts. At the same

time, the hashtag is not merely a word, or key word, that embodies a protest movement and its social or political desires, it is also used by the individual platform as metadata to organize the feed on, say, Twitter (where the use originates). As most social media users will know, the # symbol ('hash') automatically turns the following keyword ('tag') into a link to a real-time feed of all posts with the given hashtag, and it also allows users to search within the platform for particular keywords. In other words, using a popular hashtag is a way to generate visibility to one's individual post; and often, the real-time feed turns into a particular kind of conversation of exclamations, opinions, information, images, videos, memes, etc. where users express themselves in relation to the hashtag of the protest (in this case); including, at times, also interfering with opposite or provoking opinions. Even plain advertisement or spam, which has an air of being machine-generated and out of context, often appears in the feed. In this environment, the protest is always on(line) as a feed, tailored 'just for you' as a list of exclamations, and a multiplicity of individual voices where an advertisement can appear as close as a friend combatant. In other words, it is a diverse cultural practice that involve both human and machine agencies.

Vis-à-vis the hashtag-protest as a form of mediated spectacle (a metainterface spectacle), it is well-worth questioning the construction of a mass perspective, and how one sees oneself as part of the mass. Obviously, tying microblog posts on racism, sexism, austerity, oppression together with hashtags, potentially generates a common discourse that may mobilize a mass across spaces. The #BlackLivesMatter, for instance, is not intrinsic to one platform or particular events in the United States, but travels across different individual and cultural contexts (for instance, although #BlackLivesMatter originates in a particular American context, it is also adopted by protesters in Denmark as a general label for protests relating to racism, Danish immigration policies, the Palestinian situation). [11] In this sense, it has both a "multiplicity", and a "narrative power," as noted by Anna Nacher in her study of the feminist Black Protests in Poland in 2016. [12] However, adding an informational layer (of metadata) to real events that are tied to complex political, societal, or other problems also *virtualizes* the protest, and reduces the resolution and diffraction of the incident in order to make it computable information. As Matthew Fuller has claimed, the interface (as a control mechanism, distributed throughout the system, across different processes or executions – and a tool that allows a user to manipulate, but never change these processes) is an extension of 'virtuality' into a technical system. Virtuality is, as he quotes N. Katherine Hayles, "the cultural perception that material objects are interpenetrated by information patterns." [13] In other words, what we claim here is that the protest's narrative ability, its ability travel across spaces and contexts, follow a particular cultural logic: that of 'virtuality'. Or, put differently, in order to make the protest travel across spaces and contexts on the platform, one needs to see them as informational, as metadata; one needs to perceive their virtuality, their 'interfacial' character.

When 'tagged', the protests (including their documentation of oppression, and their social and political desires) not only become a narrative of resistance, they also become part of a 'statistical spectacle'. The metadata of the hash symbol

is then also part of a much larger spectacle in which the collection of data takes part in the organization of the masses. The main principle of organization is 'the feed', an instrumentalist modelling of the protest (its events, its actions, its participants, its relations, etc.) as data. The objective of the feed is to generate visibility to what the protesters are likely to respond to affectively, to be adaptable to know 'the mood' of the protest. As a spectacle that organizes the mass and allows the individual to experience oneself as part of the mass, it is no longer about seeing the mass and oneself as part of the mass, but about knowing the mass, and knowing what one likes, detests, etc. as part of the mass. With this, the protest is not just made up of a mass gathered in a space, but it *becomes* the feed and subject to the platforms' instrumentalist modellings; subject to what Ned Rossiter and Geert Lovink in the analysis of the protests of the early 2010s have called "bursts of 'social media' activity", or "communication peaks, which fade away after the initial excitement". [14] And, the instrumentalist and pragmatic production of such peaks and bursts in moods is always withdrawn, without clear origin, one merely 'feels' it.

It is however also tempting to compare this kind of personalized spectacle to how the metainterface articulates processes of subjectivation; and how the spectacle reflects, more generally, a rationale of production in a neoliberal economy – a mass perspective that reflects capitalist production, but withdraws from our attention (as Kracauer's writes, "The production process runs its secret course in public" [15]). Although the hashtag relation and the sharing and liking of moods and sentiments of a protest seemingly unites a group of people in a common cause, one might ask if the metainterface (and the lack of a mass ornament) does not also contribute to a more individualized perspective on political change? In the individualized feed that invites to affective 'mood' responses (in the form of likes and shares), the protest risks becoming without consequences, and merely expressing our individual experiences of subjugation or disruption and our affective responses to this; it risks becoming incapable of constituting a different world.

HEWILLNOTDIVIDE.US – capture the flag

Speculating on how the metainterface spectacle relates to more general articulations of the subject and the mass in a neoliberal economy, the lack of a mass perspective potentially also leads to a displacement of a common class analysis and consciousness. Shia LaBeouf, Nastja Säde Rönkkö, and Luke Turner art project *HEWILLNOTDIVIDE.US* (or, particularly the responses to it from alternative right networks) serves as an illustrative example of this.

In 2017 the three artists initiated the project *HEWILLNOTDIVIDE.US* – a live streamed durational work that ran between Jan 20 2017 and January 20. 2021 (i.e., the entire duration of Donald Trump's presidency in the United States). The work consisted of a mural outside the Museum of the Moving Image in New York, with the words "he will not divide us". Underneath the artists had mounted a camera (a live stream feed), into which the public was invited to chant "he will not divide us". In this way, the work, according to the artists, "acted as a show of resistance and insistence, opposition and optimism, guided by the spirit of each individual participant and the community." [16]

The work follows a series of works (#*IAMSORRY* (2014), #*FOLLOWMYHEART* (2015), #*INTRODUCTIONS* (2015), #*ALLMYMOVIES* (2015), #*TOUCHMYSOUL* (2015), #*TAKEMEANYWHERE* (2016), #*ANDINTHEEND* (2016), #*ALONETOGETHER* (2017)), all including live participatory performance, and with clear reference to network culture and social media (in the hashtag). As such their work make reference to a number of political movements, also trying to unite a mass using network culture and social media, and articulating what Anna Nacher has called a “weak opposition” whose efficiency lies in its “ability to reclaim and mobilize the narrative power of hashtags.” [17] Such weakness should not necessarily be interpreted as similar to the incapability of forming alternative futures, as in Rossiter and Lovink’s analysis of the Twitter revolutions as characterized by ‘weak ties’. The weakness is also a form of resistance: as a rejection of a heroic understanding of protest (as a ‘militaristic machismo’) it points to a process of caring and social maintenance, and a wider common transformation. As Nacher points out, she strongly disagrees with perceiving digital activism as a failed promise: “What failed was rather a kind of novelty allure and media-hype generated by the early, enthusiastic analyses. Perceiving digital activism in general as a failed and corrupted enterprise may lead to throwing the baby out with the bathwater.” [17] Consequently, one could say, that what failed was the Twitter marketing of Twitter revolutions.

Our intention here is not to judge the ‘weak opposition’ of LaBeouf, Rönkkö, and Turner’s work, but to point to the unexpected spectacle it led to. Already on 10 February 2017, only three weeks after its installation, the Museum of the Moving Image abandoned the project. As stated by the museum in their press release, “the installation created a serious and ongoing public safety hazard.” [18] A few days into the performance, multiple threads on the performance were running at 4chan, Tynychat, and Discord, including ones that organized pro-Trump and pro-alt-right performances – such as showing a sign “Make America Great Again” in front of the camera, changing the name of the museum to Museum of KEK (a misspelling of LOL, used on 4chan, and also the Egyptian God of chaos), advertising the site as a prostitution meetup on Craigslist, and more. This, naturally, resulted in various confrontations between the pro- and anti-Trump protesters, culminating in the arrest of Shia LaBeouf for shoving a man who addressed the camera with a “Hitler did nothing wrong” sign. [19]

After its removal from the Museum of the Moving Image, the installation was set up at El Rey Theater, Albuquerque (and later also at Foundation for Art and Creative Technology in Liverpool, le lieu unique in Nantes, and Muzeum Sztuki in Łódź), but the Internet trolls had already turned the performance into a viral meme. Eventually (on March 8, 2017), the artists replaced the installation with a livestream of a flag with the words “HE WILL NOT DIVIDE US”, filmed from below, and containing only the sky, not to give away its location.[20] This initiated an insane game of ‘capture the flag’ by the Alt-Right online community. [21] They, for instance, detected the airplanes appearing in the sky behind the flag, and compared their condensation trails to flight radar information. They also discovered a tweet from LeBeouf, and used this information to rigorously map the potential position of the flag. After locating a small town in

Tennessee, one of the participants drove around the town honking his horn until the sound was picked up in the stream. Eventually, they were able to take down the flag and replace it with a red Trump cap. [22]

The interventions by the Alt-Right community mirrors the event-centered elements of the art work itself, and may be seen as contributing to what Rossiter and Lovink in their analysis of the protests of the early 2010s called “carnivalist ruptures of the everyday life”, and “revolts without consequences.” [23] However, it also adds further dimensions.

Notably, the campaigns of the Alt-Right community are driven by particular network cultural practices; a particular version of what Olga Goriunova has labelled “new media idiocy”, which, for instance would account for the production of memes as well as the collective forensics of ‘capturing the flag’: “Idiocy is a kind of individuation that produces, [...] objects and behaviours, subjectivities, as well as collective performances.” And, this process of individuation has become “a very successful way to concretize a collective movement: to be heard politically; to concretize an object of achieving media attention; to individuate the human and to experience her individuation through expression, and so on.” [24]

Furthermore, there is evidently a strong organization behind not only this campaign, but also other Alt-Right campaigns – residing on message and image boards such as 4chan and 8chan, and more recently on Discord and Telegram, but possibly also with institutional ties to e.g., the Trump administration. [25] Rossiter and Lovink, in fact, already described the potential political agency of organized networks (or, ‘orgnets’) in their critique of the 2010s protest movements

“The orgnet concept (short for organized networks) is clear and simple: instead of further exploiting the weak ties of the dominant social networking sites, orgnets emphasize intensive collaborations within a limited group of engaged users. The internet’s potential should not be limited to corporate platforms that are out to resell our private data in exchange for free use.” [26]

What Lovink and Rossiter here highlight, is that in order to contrast the lightweight nature of political activism on social media (which basically makes the hashtag protest another contribution to the mood-driven platform economy), one needs intensive collaboration and organization. The presence of this in phenomena like the ‘capture the flag’ campaign, or the other organized interventions by the Alt-Right presents an alternative to the weak ties of social networking platforms. Clearly, the message and image boards present another organizational tool to the protest movement; a tool that goes beyond hashtags, shares and likes.

The organized network of a game also resonates with contemporary theory of participatory, computational or rewired propaganda; and how propaganda has changed from a ‘top-down’ model of one (leader) communicating to the many (the masses), into a model of one communicating to a smaller group of ‘followers’ that also include fake identities, which then communicate to the masses. [27] [28] It is tempting to draw lines between this organization of politics and how Riefenstahl’s staging of the Nürnberg party days represents “an inextricable mixture of a show simulating German

reality and of German reality maneuvered into a show.” [29] The Alt-Right protesters’ media spectacle is produced by the media along the media’s own agency as an “aestheticizing of political life,” which Walter Benjamin, at the time, also saw as “the logical outcome of fascism.” [30]

Or, put differently, for the individual participants, hiding behind their interfaces, one may still question in what ways they are themselves bearers of the mass ornament? The idiocy of the memetic carnival protest also seems to limit their perspective and prevent the participants to see the figure of the mass, so to speak; and, again, limit them to their individual experiences without constituting what Mark Fisher calls “a *we* that is both the agent of struggle and what is struggled for”; or as he continues: “Subjugated group consciousness is first of all a consciousness of the (cultural, political, existential) machineries which produce subjugation – the machineries which normalise the dominant group and create a sense of inferiority in the subjugated.” [31]

Being able to see how the mass perspective is constructed might be a sense of its innate machineries; a productive class consciousness-raising. Seeing just oneself, on the other hand might potentially lead to a “class resentment without class consciousness or class analysis,” as put by Wendy Brown, who continues: “This resentment is displaced onto discourses of injustice other than class but, like all resentments, retains the real or imagined holdings of its reviled subject.” [32] This is presumably the kinds cynicism captured in expressions such as “Hitler did nothing wrong” (as shown on the sign that triggered Shia LaBeouf).

A Dictionary of the Revolution

If the metainterface articulates a datafied and instrumentalist organization of the mass in which one only sees one self, where does it leave the grand narratives of refusals, protests and revolutions?

In one interpretation, the metainterface spectacle and the mood-driven ‘feed’ with its disparate voices and exclamations, make way for the articulation of subjugation with no class analysis and consciousness of the machineries that produce subjugation (including those of the metainterface itself); of knowing and sharing the feeling, but not knowing and sharing the consciousness of what produces it. The protest risks becoming weak, merely a shared mood – bursts of social media activity driven by the platforms’ mood algorithms. With some level of organization, the sinister parts of such feelings and moods of the class can even turn the lived reality into a (racist, sexist, etc.) carnival show or game of idiocy; an aestheticization of politics with no shared vision of an alternative future (other than that of the white male supremacist).

In another interpretation, the weakness expresses a different kind of organization (as pointed to by Nacher). The metadata, the mood algorithm and the feed does not just produce a weak organization of the mass as a shared feeling, it also produces everyday narratives of subjugation; narratives that reject the understanding of the protest as a heroic revolt of change, and instead highlights the importance of common transformations in the everyday that lies in caring and other affective actions of social maintenance in our relation to the other. As a final example of a spectacle that further highlights such aspects of the protest, but operates through a

different interface, we want to analyse the work *A Dictionary of the Revolution* (2014-17) by the Egyptian-American artist Amira Hanafi. [33]

The (online) dictionary consists of 125 texts related to the word ‘revolution’, made by circa 200 individuals, interviewed by Hanafi. The work was initiated a few years after the Egyptian revolution in 2011, which led to the abdication of the country’s longtime ruler Hosni Mubarak, the democratic election of Mohamed Morsi from the Muslim Brotherhood in 2012, the protests against Morsi, and the military coup and inauguration of the current president, Abdel Fattah El-Sisi in 2014. In other words, it is a dictionary narrated by people who have lived through a complex political situation. Looking into the dictionary you therefore see the many different individual voices and understandings of words associated with the revolution (Brotherhood, the Army, elections, hope, etc.); what the words mean to people, and how they relate to the Egyptian situation, and in what ways the Egyptian revolution was revolutionary. ‘Revolution’ is described as a word “with no meaning”, or “whose meaning we don’t understand.” Rather, it has an affective meaning and purpose: “We build on it and we hold on to it, only because we don’t want to spoil the moment [...] the beauty of the moment for Egyptians who went out in the streets.” In this way, the work is a mapping of the affective relationship between the order of the revolution and the order of language, and of how the order of language is constantly negotiated by the voices of the people in the space and time that appears when a ruling power is overthrown.

Another example is the word ‘tamarod’ which means ‘rebellion’ in Arabic, but which also refers to a person who breaks with tradition, and takes an unconventional approach. After the election of Morsi, it became a label for the resistance movement against Morsi, and after July 3 where the military and El-Sisi deposed Morsi, “we found out that Tamarod was a lie like everything else, and that Intelligence created it. But that doesn’t negate that the people themselves protected Tamarod, because Tamarod isn’t its individual members. I mean, the members of Tamarod didn’t make twenty-two million.” In this way, the dictionary is a reflection of the metamorphosis of language and the complex processes of signification: “As they say, language is a living thing.”

The entry ‘ideal girl’ addresses how gender and power are related in conservative religious societies, but also points to the violence and oppressions of revolutions. Women, and in particular younger women, are notoriously harassed by military and the police who submit them to humiliating undressing and ‘virginity tests’, obviously with the purpose of creating control:

“At the end of the day, they saw her as a woman, with a certain form. Based on something that she has no control over, that she can’t change—the form in which God created her biologically. Based on that form, she can be marked by any stain that you can imagine: she can be insulted, she can be exploited, the whole situation can be exploited and the most terrible charges thrown at her and everyone around her. The whole idea is that... is that God made you a girl, so you must endure. Don’t participate in anything, don’t go out, stay afraid all the time that

someone will expose you because of your body and because you were created a girl.”

Bodies, genders, humans, and society are weaved together by language, power, revolt and a failed revolution. Obviously, the media and media technologies also play a significant role in this weaving. In the entry “the Media” it reads: “The media broadcasts all the vocabulary in the world. Someone says a word, but it's the media that says it to the people, and the people interpret it. I myself didn't know a lot of words. They teach us to talk.” The revolution is also an act of language, or of mediation, where the media industry diffuses its vocabulary, but also defines it – for better, or for worse. As mentioned above, the Egyptian revolution is often labelled as a ‘Twitter revolution’, but social media and hashtags do not seem to play a significant role in the dictionary. Although it is mentioned how cameras are “broadcasting directly from the street”, the principal reference is television. In this sense, the perception of the Egyptian revolution as a Twitter-revolution is also a construction, and perhaps even a branding of the (at the time) new social media platforms as ‘democratic’. Academic critique of social media and its role in the revolts, too, may be seen as a successful part of this.

In this sense, the work points to other ties than the weak ties of the hashtags. The linguistic keywords of the revolution are not just algorithmically trending on Twitter or other social media platforms; they are real words undergoing far more composite processes of signification. Considering the role of the media, they are not just subject to moods of what people like and share, propagated in feeds on a platform; feeds that display a stream of exclamations and disparate voices that all seem to be talking about the same thing, but rarely together. Rather, the meaning of key words, and what comes to be a key word, is subject to relations of power and control (as in the case of ‘tamarod’) in which the control of broadcast media is still important. And, perhaps more importantly in the work, it is subject to 200 different individual voices linked together (in a hypertext). The 160 key words in the vocabulary appear in a beautiful diagram created by an algorithm, reading and interpreting the texts, identifying the key words, and suggesting relations between them. How the algorithm works remains unclear, but the voices all belong to anonymous individuals who raise different opinions, giving the words different meaning, and making them ambiguous. Rather than the algorithmically framed and individualized perspective on a discourse (with low equivocation, and where everybody sees, feels, understands the same), it seeks to present a perspective on the entire discourse, how it changes over time, and how people relate to it in different ways: how they discuss the revolution in language, and language as a revolution.

As a spectacle *A Dictionary of the Revolution* is very far from turning a social reality into a show. As an interface it makes the words of the dictionary multivocal and gives the mass a voice in which one can see oneself as part of the revolution and the mass, and for outsiders to see this. It points to the linguistic, social and media technological dimensions of the revolution as a spectacle (of how it organizes the mass, and how one sees oneself in this). The dictionary provides evidence of the revolution, and of how revolutions become meaningful. Reading and exploring the diagram

creates a sense of how the revolution – far from being a Twitter-revolution – manifests itself through its ambiguities; the doubts, the linguistic ambivalences, counter revolutions, and even the diagram itself as a care-full knowledge resource on which to build revolutions to come.

Conclusions

We have tried to demonstrate how the appearance of a metainterface – an interface that is always present (sensing us, available in our pockets, etc.), but is no-where in particular (abstract and in the cloud), and where global platform providers make up a foundation for all other interfaces – lays the ground for a new media spectacle: a new organization of the masses, and a new moment for political agencies.

The metainterface differs substantially from other media, in that the spectacle is always also statistical; resting in the assumption that perspective is computable (and non-visual), and with this a particular instrumentalist hiding of the perspective. In other words, the individual users behind their interfaces cannot see the workings of the machinery that produces the feeds, the likes, the shares, and the mood-driven collective. In the metainterface spectacle, political, social, or other confrontations therefore easily become confrontations of ‘truths’ – one statistical cinema confronted with another; one user’s feed confronted with another’s. Hence, we believe that a better understanding of the metainterface spectacle is important, in that it allows for new understandings of how contemporary politics and political activism is intrinsically related to the functioning of the interface. In other words, is it possible to understand, say, the Black Protest (Czarny Protest), held nation-wide in Poland in October 2016, or the events on Capitol Hill in the United States in January 2021, without also understanding how they were organized on message and image boards, and how they were distributed (and disrupted) on social media platforms?

Through the analysis of a particular incident (*HEWILLNOTDIVIDE.US*, the performance’ conflicts with the Alt-Right communities, and the following organized ‘capture the flag’), we have attempted to demonstrate both similarities and differences in the contemporary political media spectacles. Political confrontations and protests are increasingly dependent on layers of information patterning – of software that can interpret the hashtags and the likes, and provoke consciousness-raising awareness at the level of the individual spectator of the live feed and participant of the hashtag protest, and form a mood-driven community at the basis of this. The material of the protest is always also informational (hashtag-able, share-able, copy-able, etc.), eventually giving the protest a ‘virtual’ and ‘carnivalist’ characteristic. However, this has (like social media in general) undergone a paradigmatic shift from being a global organization of information networks to a more local organization of information networks, and with this it also lends itself to certain orgnets’ maneuvering of reality into a show; a show of idiocy, memes, and trolls that simulates a contemporary (in this case American) reality.

Albeit more briefly, we have also tried to tie this kind of political activism to a process of neo-liberal individuation, and to question political agency in the metainterface industry. The individualized perspective of the metainterface may create a sense of affective community coherence (a *we* that

shares the same feeling), but one may question whether it is capable of creating a consciousness of the larger apparatus that produces and normalizes the subjugation (a *we* with a class consciousness)? Whether change is individualized and collective ties weak, or whether the collective is capable of envisioning the constitution of a different reality?

Can the masses be granted rights, and not just expression, in the metainterface spectacle (to paraphrase Walter Benjamin)? In the perspective of German critique of the media spectacle, this would demand the possibility to reflect the larger apparatus that produces the mass perspective. As a final example of a care-full reflection of the larger apparatus that produces both oppression and revolution, we have included Amira Hanafi's *A Dictionary of the Revolution*. It is a work that presents a different spectacle of the revolution than the often-acclaimed spectacle of democratizing social media (and its failures). The work suggests a different interface spectacle in which one can navigate the discourse as metadata, but where the bodies and voices of the revolution are never reduced to information patterns. It suggests that diagramming the revolution as a discourse is a way of providing evidence of how oppressions and revolts play out – of their many cultural, technical, legal and other executions. As such, it functions as an instrument of knowledge that can help us observe the features, patterns and correlations of a discourse. It presents a secular perspective on the masses of the revolution in which the revolutionary subjects (the participants) articulate their shared experience of a revolution, perceive themselves as part of the revolutionary mass, and begin their analysis of the complex apparatus that produced the (failed) revolution: a 'class awareness' of what people say and experience.

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Although Hanafi's work does not directly claim the use of a large dataset, metadata and complex natural language processing (as does corporate and state intelligence in their 'interfacial' perception of the revolution as informational events), the question of the algorithmic architecture and how machine agency constructs knowledge and power can be seen as crucial in granting the users and masses rights, and point to further studies of the metainterface spectacle. A critical metainterface spectacle might well demand that the various tools for data analytics should no longer be restricted to corporate platforms or the NSA, but reclaimed by political and social organizations. However, the cultural and social engagement with the algorithmic architecture and an instrumentalist perspective should not be carried out in a carefree manner. Diagramming, data analytics, and also dictionaries, and other techniques (as carried out across corporate, literary, political, activist platforms), and the significant differences in the ways they deal with evidences, data, subjects, bodies, affects, language, discourse, and more, are examples of how the metainterface spectacle has become a new aesthetic and political battlefield.

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Decolonizing the imaginary through the tactical use of machinimas

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Abstract

This essay starts from a reading of Decolonizing the virtual: Future Knowledges and the Extrahuman in Africa, a collection of essays published in the Journal of African Studies in March 2021, responses, and commentaries to the Abiola lecture delivered by Achille Mbembe in 2016 in the context of #Rhodesmustfall and the new light given by this movement to the question of decolonizing knowledge.[1] During this lecture, Mbembe states that Africans are better able to leap into the digital because there is a similarity between the plasticity of pre-colonial knowledge and the plasticity of digital virtuality. I therefore sought to know if this hypothesis could be verified: is the digital, through immersive works, video games and machinimas¹, a good way to document, archive, represent and promote oral tradition and ancestral knowledge? And it is then that I discovered the text of Lia Beatriz Teixeira Torraca published in April 2021 on the Aesthetic look of affect which analyses the machinima as being a medium allowing to change the point of view, to proceed to a displacement, to a reterritorialization while simultaneously presenting multiple worlds and spaces, often invisibilized.[2]

Keywords

Decolonizing, Imaginary, Ancestral, Knowledge, Machinima, Deterritorialization, Reterritorialization, Games, Indigenous, Pluriversalism

Introduction: New perspectives on knowledge decolonisation in the digital era

This text is an exploration of the different possibilities offered by digital technology to enter into discussion and allow for exchanges of knowledge and skills between ancestral techniques and knowledge and digital creations, by illustrating my remarks with different examples of works and games mixing ancestry, speculative fiction and digital creations, and by focusing on the experiences of machinima workshops conducted during the Art & Games World Tour, which, in Togo and Kenya, have made it possible to experiment with the mixing of imaginary worlds and the sharing of knowledge, and to archive an oral culture that has been invisibilized by colonization and Christianity. This approach resonates with movements such as ancestro-futurism and techno-shamanism in Brazil and

with indigenous futurism which, relying on speculative fiction, imagine futures free of colonization. [3] [4]

I will begin by returning to the notions of decolonization of knowledge and the idea of pluriversality discussed by Mbembe in Abiola, and then analyse the various arguments supporting his remarks on the possible parallel between pre-colonial knowledge and the virtuality of the digital and by extension with the virtual universes of video games.

If I have chosen to approach video game creation from a decolonial angle in the Art & Games Global South World, it is because the global gaming market is still dominated by Europe, the United States and Japan, and to speak of the art and games decolonization is to promote works conceived on the periphery of this global and globalizing culture and to be able to immerse oneself in other types of representations, conceived and expressed in other languages, allowing one to evolve in other cities and landscapes and through other stories and cosmogonies. It is to accompany and promote the emergence of a market of contents from the Global South. This is a recent phenomenon, linked to the rise of mobile phone and the Internet, which, as Mbembe points out, allows the younger generations to express themselves and have access to the media like never before. In the field of video games, the market is no longer solely a market of subcontracting or localization of games produced in the West. Many independent studios are emerging in Asia, Latin America and Africa and are producing content for the local market as well as for the global market.

It is thus that new voices emerge by reappropriating the narrative on themselves in order to no longer be an exotic context but rather the own enunciation of their representation. It is also to seek to decolonize the imaginary by the co-construction of narrations born of the meeting between oral tradition, endogenous knowledge, and virtual universes of video games.

Necessary dialog between knowledges

As Victoria Bernal reminds us, when Achille Mbembe speaks at Abiola, he does so in the very particular context of the post #Rhodesmustfall movement, the South African student uprising for a decolonization of knowledge, which will give a new dimension to the notion of decolonisation, based on "Pan Africanism, black consciousness and black radical feminism. » as defined by Abdul Kayum Ahmed. [5] [6]

¹ Machinimas are films made from video game engines.

In this context, Mbembe begins by recalling the pitfalls of decolonization, at the risk of Africanisation, a criticism formulated by Frantz Fanon in the aftermath of decolonisation when power was transferred from the colonists to an African middle class society of which he was suspicious, and at the risk of an identity withdrawal, while it is important to teach African languages and to express oneself and create in African languages, decolonization, according to him, does not consist of debunking universalist knowledge and replacing it with other, more particularistic knowledge, but rather of thinking in terms of pluriversalism.[7] [8]

A concept brought by Enrique Dussel, and Anibal Quijano to demonstrate that modernity developed concomitantly with colonialism by destroying ancestral cultures and knowledge. [9] [10] Pluriversalism can only be achieved by "recognizing this asymmetry of knowledge". This openness and dialogue can therefore only take place if there is a recognition of the different epistemicides to which the cultures of the countries of the South have been subjected as shown by Boaventura de Sousa Santos by silencing languages, traditions, vernacular knowledge or by reappropriating them without paying them homage, or by invisibilizing them or demonizing them. [11] "In Brazil, 3000 languages were spoken before colonization, today only 188 languages are remaining" affirms Ricardo Ruiz in an online interview. Francis Nyamnjoh indeed shows why it is difficult to create a dialogue between the so-called traditional knowledge and scientific knowledge if such knowledge is denigrated as witchcraft or primitivism. [12] On the contrary, it is better to consider these knowledges as techniques.



Figure 1 The online Game Contos de Ifa uma aventura brasileira

This is what Ricardo Ruiz, the designer of the online game *Contos de Ifa*², explains about its game that blends ancestrality and digital technologies to introduce people to the tradition of the Orishas, the nature spirits of the Candomblé³ religion, which was brought to Latin America by slaves from West Africa.

² Contos de Ifã - Uma aventura afro-brasileira. <http://contosdeifa.com>

³ A religion that developed in the 19th century in Brazil brought by slaves from West Africa.

⁴ Oshun in the pantheon of spirits, deities of the Ifa Yoruba oral culture represent the river and is the guardian of the Osun River in Nigeria. She is the goddess of femininity and fertility.

"Women, before the witch hunt that deprived them of their relationship to nature and sources of knowledge, knew techniques. The same is true for the Orisha tradition, it is about techniques. Let's say you are initiated into Oshun⁴, then I would have to know all the instruments, the plants, the smells, the colors, the drumbeat and the predictions that we have for Oshun. If you are blessed by Oshun, it means that you come from a river. Practitioners of this religion extract the energy from the river using these combined objects and dance it into your body, and then that energy takes your body and dances for a while and then goes away. For this Orisha, we have this knife, this plate, these are all the different variables and then you have the process, you cut the chicken, you sing a song, first we sing for the earth because the earth is going to receive the blood, which as a technique, carries the energy of life, so you have to play for the earth, you bring the life of an animal that you are going to eat, you bring it back to the earth, and at the same time you are opening up a way to speak to the earth... »



Figure 2 Ritual to Osu and Jemandja by the Nigerian Performer © Isabelle Arvers

Beyond this necessary recognition, Aghi Bahi specifies that this dialogue between knowledge must be thought of not as a juxtaposition but rather as a reciprocal exchange where each opens up to the other. [13] This pre-colonial knowledge and techniques must be studied and come to resonate with scientific knowledge, without which traditional knowledge finds itself on the "periphery of the periphery", considers Paulin Hountondji. "Peripheral to metropolitan science, institutional research in Africa in turn leads to a secondary peripheralisation of endogenous bodies of knowledge, relegating them to the periphery of the periphery. » [14]

An approach followed by Roy Ascott, Tania Fraga and Maria Luysa Frago in 1997, in their meeting with the Kuikuros, a tribe located in the North of the State of Mato

Grosso, in the National Park on the Xingu river in Brazil, not having been evangelized and having kept intact their shamanic beliefs in a multidimensional world. Roy Ascott, who was working on the idea of Shamantics⁵ and double consciousness, wanted to immerse himself in the knowledge of the Kuikorus, who live permanently between three worlds: the earth, the sky and the underworld, as told by Maria Luysa Fragoso in an online interview. Roy Ascott will then write about the parallels between the shamanic double consciousness and the possibilities offered by cybernetics and immersive or networked works to act at a distance and be able to perceive several worlds. Roy Ascott suggests, "Cyberception and the double gaze. It is as if, through our bio-telematics art, we are weaving what I would call a "shamantic" web, combining the sense of shamanic and semantic, the navigation of consciousness and the construction of meaning." [15]

For this encounter to take place, it requires an elimination of the hierarchy of knowledge and also passes through the notion of co-learning to which another text by Achille Mbembe on the decolonization of knowledge and the question of the archive refers: "In order to set our institutions firmly on the path of future knowledges, we need to reinvent a classroom without walls in which we are all co-learners; a university that is capable of convening various publics in new forms of assemblies that become points of convergence of and platforms for the redistribution of different kinds of knowledges." [16]

As Katrien Type reminds us, Achille Mbembe relies here on the work of Jane Guyer on Ecuadorian societies in which knowledge is not the business of a few, nor of an elite, possessing alone the keys to an inaccessible knowledge, but based on an exchange of knowledge and techniques. [17] Knowledge should no longer be the business of a small elite, but that of all, as was the case in Burundi before colonization, where knowledge was not only held and promulgated by griots or priests but was held by all, in a collective manner. "In Burundi, mythical and historical traditions were never the prerogative of specialists compared to the griots of West Africa or the abiru⁶ of neighbouring Rwanda. Each Burundian was, to every degree, the custodian of the ancestral heritage that was transmitted, from generation to generation, during vigils where the talent of each person was free to express itself." [18]

This necessary dialogue between these different modes of knowledge, in which digital technology is redefining the contours of access to knowledge, requires a paradigm shift. Science and human thought are no longer the only sources of knowledge; it is now possible to think with Eduardo Kohn of knowledge "beyond the human. » [19] This implies to recognise as Jeremy Narby that nature thinks, that animals think, and that non-humans can teach us tech-

niques and knowledge, by making a change of perspective, referring here to Eduardo Viveiros de Castro. [20] [21]

This leads us to reconsider shamanism or pre-colonial modes of communication as techniques and modes of knowledge and learning, in the same way as scientific knowledge, considered until now as the only source of knowledge. When I ask Daniela Fernandez, author of the ITA game about the legends of her people the Guarani, indigenous people of Northern Argentina, to explain her working process, she answers in an online interview:

"Personally, I have been lucky enough to be in the physical spaces they inhabited, in the Paraguay River, in Chaco and Formosa, but I am also lucky enough to dream of other worlds and have access to other types of images outside of the plausible, which serve as inspiration when I create. To a skeptic, these dreams would be influenced by the stories I heard as a child, but to a believer, these dreams are influenced by my ancestors. »



Figure 3: ITA a video game designed by Daniela Fernandez about her indigenous ancestors the Guarani © Daniela Fernandez

Plasticity of pre-colonial knowledges and plasticity of the virtual

As Eleonore Hellio, a member of the artistic duo the Kongo Astronauts in Kinshasa, pointed out to me in an online conversation, "In Congo we live with the second world all the time." This ability to think the real and the virtual simultaneously, in the sense that Pierre Lévy understands it, i.e., as being in the process of being real, thus as another mode of the real, according to Mbembe, allows Africans to embrace the virtuality of the digital in an innate way. [22] Therefore he puts forward the idea that Africa is better prepared to make a leap into the digital because there

⁵ Shamantic is the contraction of shamanism and semantics. A research that Roy Ascott led by making a parallel between the double shamanic conscience and the parallel worlds of cybernetics by trying to make a fusion between shamanic knowledge and scientific knowledge.

⁶ Royal ritualists in Rwanda

are enormous similarities between the plasticity of pre-colonial knowledge and the plasticity of the virtual.

This question intrigues me because in the context of the elaboration of a decolonial geography of art and video games, I was led to exhibit digital works and video games conceived by a new generation of indigenous artists and game designers in Asia and Latin America, and then during my stay in Togo and Kenya I was able to collaborate with traditional storytellers to conceive films from virtual video game universes, thus mixing ancestry, oral tradition and virtual environments.

Mbembe adds that "in old African traditions" people "were constantly in search of a supplement to their human hood," sometimes adding "attributes or properties taken from the worlds of animals, plants, and various objects."

Africans, however, are not the only ones to have retained this pre-colonial knowledge within themselves and the ability to communicate with other beings or non-humans. The indigenous peoples of Latin America as we have seen previously or, for example, of Asia also have a capacity to apprehend different modalities of apprehension of reality. In Indonesia, but also in Taiwan, the spirits of nature, trees, mountains, water, are constantly invoked, objects are charged and have the power to mediate with spirits or spectral beings.

As Amry Anton, from the Serlok Bantaran community in Bandung, Indonesia, who is responsible for cleaning rivers of plastic, told me in July 2019, "the spirits are constantly around us, if we don't see them it's because there are so many of them that if we saw them we wouldn't be able to move freely in space."

Co-learning pedagogy in machinima workshops

The daily presence of spirits also appeared to me in Brazil when I gave a machinima workshop in 2016 as part of my residency at Ruralscapes in Sao Jose de Barreiro, invited by the artists Rachel Rosalen and Rafael Marcheti. A residency in Santa Tereza farm in the heart of the mountains, on the border of the states of Mina Gerais, Sao Paulo and Rio, whose aim was to put in relation traditional knowledge and techniques with electronic or digital technologies. During this residency, the machinima workshops - making films from video game engines - aimed to use video games as a means of emancipation for these young future farmers. After playing and discovering many independent games, I found myself confronted with the apparent blockage of young people to tell or write stories. I came back the next day and asked them to take me to the streets of their village, Sao Jose de Barreiro, to show me the places that were important to them and to explain why. In each place, we

took pictures and interviewed them on the microphone. Two stories about spirits emerged.

The first *Matadouro*⁷ is the story of a matador, killed by a cow, whose spirit comes back to haunt the walls of the village houses. The second, *Espiritos*⁸, takes place in the house of a poet who died at home, but was found much later by his neighbours, whose spirit remains in the house. In ten years of workshops, I had never had spirit stories from children or teenagers whose imaginations are rather influenced by mainstream TV shows or video games, mostly from the US or Europe. It was also the first time in the history of these workshops that we mixed two modalities of reality: photographs of the village of Sao Jose de Barreiro, the abandoned slaughterhouse, cows, streets, and vegetation, with avatars and 3D objects. Another important aspect of this experience is that the use of the virtual worlds of the video games allowed us to communicate, without being able to use the spoken language to be able to exchange between us, but we understood ourselves with these young people thanks to the mediation of the visual universes of the video games.



Figure 4: *Matadouro* a machinima mixing real photographs and 3D avatars © Isabelle Arvers

In this workshop experience, there was also a co-learning and exchange of skills and knowledge: I learned from the children, new working methods and I learned about local beliefs and myths, while teaching them how to use game engines to be able to represent reality, and I was able to see their daily lives through their eyes.

These first few examples show, first of all, that there are many similarities between pre-colonial knowledge and digital virtuality, but also that there is a propensity in this exchange to abolish hierarchies between knowledge and between learners and facilitators. A change in the pedagogical relationship that allows a teacher who learns from his students and the learners to emancipate themselves in Jacques Rancière words, because they already have all the knowledge in themselves, it is just a matter of getting it out. [23]

⁷ *Matadouro*, machinima directed by teenagers in Sao Jose do Barreiro in Brasil during a workshop held by Isabelle Arvers

⁸ *Espiritos*, machinima directed by teenagers in Sao Jose do Barreiro in Brasil during a workshop held by Isabelle Arvers

In addition to being better able to apprehend several levels of reality as seen previously in the South, Mbembe adds that Africans are also used to decentering themselves from human by conferring mediumnic powers on objects, which predisposes them to embrace the mobile culture of entertainment.

Mathematics, cybernetics and ancestral knowledges

Katrin Pye illustrates Mbembe's remarks by giving examples of objects that can be assimilated to computers, either because they are charged with power and give access to other worlds and allow the acquisition of knowledge, or because the elements of which they are composed, the cowry shells, can be assimilated to pixels, as if they allowed to see other images, other representations, and realities. This is the case with the Lukasa, the memory objects of the Luba that record stories and can be compared physically and spiritually to "memory cards". [24] The similarity between the Lukasa and the computer also brings to mind the Khipu, the first analogical computer of the Incas, made of strings and knots, allowing the calculation and forecasting of the future, thanks to the observation and analysis of the constellations of stars by the ancestors. Constanza Pina, a Chilean artist based in Mexico City, learned the Khipu data coding system through workshops and created a sound installation mixing ancestral knowledge and electronic circuits.

An analogy between ancestral knowledge, mathematics and cybernetics can be found in Ron Eglash's work on fractals in Adinkras, the art of the Ashanti people in Ghana. In Adinkra, each symbol tells a story, a proverb or refers to beliefs. Their forms also have a mathematical meaning, "especially in the ways that they use logarithmic curves to represent organic growth." [25] Ron Eglash, in his text on the positive perception of race in design, shows that beyond denouncing the racist biases that exist in artificial intelligence and on the Internet, it is necessary to decolonize algorithms by calling upon ancestral knowledge and their modes of visual representation to derive mathematical formulas, which are also used in cybernetics. [26]

A way to turn to the visual, spiritual, and mathematical representations of the ancestral world to remove the bias of our understanding of the present and enrich it. An approach that we find in the work of Tania Fraga who organized the expedition for Roy Ascott to meet the Kuikoros in 1997. Her life and her work were deeply modified by her meeting with the Kuikoros and the observation of the vegetal forms and natural life. "It was the 10 days that changed my life. I lived with them. The Kuikoros. They did not have contact with missionaries (only 50 years of contact, very few spoke Portuguese) and kept their shamanic beliefs intact. That was the reason I chose them." In a beautiful text written during her stay with the Kuikoros, Tania Fraga describes a multidimensional world with shimmering colours, during which she cannot stop swimming.

"I became impregnated with their hypnotic sound. The natives painted our bodies with fragrant black resin and reddish oil transforming us into the Surucucú, the serpent. We lost the notion of time we had up to a few days before, and we began to discern another time, multidimensional, non-linear and very complex, swinging smoothly as if it were flowing around the variations of a strange attractor." [27]

Following this experience, Tania Fraga conceived works such as 'Xamantic Web', 'Xamantic Journey' (1999), a work in VRML (Virtual Reality Modeling Language) that explores the similarities between the shamanic journey and wanderings in virtual spaces and takes up the multi-dimensional and non-linear aspect of the Kuikoros' perception of the world in a telematics work allowing multiple modalities of online presence and exchange; or The Epicurus Garden, (2014) a generative Garden of Eden, presented as an immersive installation, whose forms unfold according to brain waves captured through a neural interface. Designed from growth algorithms, the plants, mushrooms, and flowers unfold in a very organic and fractal way according to the waves emitted by the viewers' brain.

Fraga is also inspired by logarithmic spirals and other symbols to generate her images, she adds, "Yes, the logarithmic spiral and others, they are all connected with growth and I am fascinated with them. I use them in my work, not only on shapes but in trajectories, in relations (for example, colour variations), in variations in general." told Tania Fraga in an online interview.

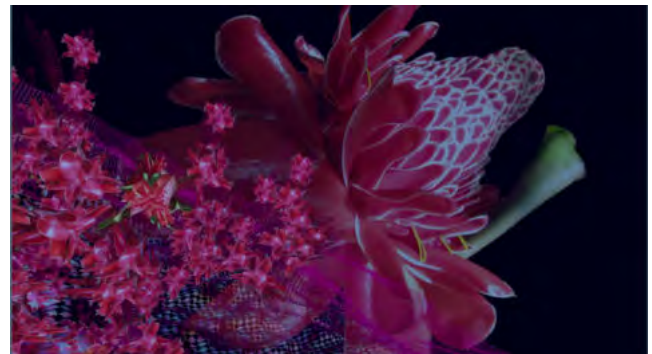


Figure 05: Epicurus Garden Virtual Reality worlds. Source Tania Fraga

These different examples of artistic reinterpretations of ancestral knowledge and techniques permitted by the virtuality of the digital allow to illustrate Mbembe's remarks while insisting on the fact that these remarks are not only linked to Africans but to all the peoples who have remained in contact with and listening to ancestral knowledge and whose new generations are more likely to make a leap into the digital.

Decolonizing our imaginary

However, the stakes are high because the massive use of digital technologies transforms our way of thinking, our imagination but also our way of being and seeing the world and this imagination is a space to be decolonized. Accordingly, to Mbembe, "The biggest impact of the mobile phone-and of digital technologies more broadly-has been at the level of the imaginary. The interaction between humans and screens has intensified, and with it, the experience of life and the world as cinema-the cinematic nature of life. [1]

An idea that is at the origin of my curatorial work on the relationship between art and video games. In the mid-1990s, when I was talking to teenagers, they told me they dreamed in video games and explained to me that they loved video games so much, that they would prefer games to replace television and even that they would like to live inside games. That's how I realized that games were shaping our imaginary as tales used to do and that if games could shape our imaginary, they were also a way to manipulate our minds and to spread a certain morality, ethics, certain representations of the world. And that's why, from my first exhibitions, I focused on promoting diversity in terms of aesthetics and game plays in video games by showing the other side of video games, the artistic, experimental, political games.

Since 2005, I also started to promote the use of video games as a medium in machinimas, a cinematographic technique and new genre that consists in hijacking video games to make films, in order to bring a distanced critique towards a simulacrum world in the sense of Guy Debord. [28]

Using the virtual worlds of video games and diverting them to tell stories or use them as a means of expression allows us to manipulate the images that without this critical distance manipulate us by shaping our ways of thinking and seeing the world. For if, to use Mbembe's words, technologies plunge us into a cinematic vision of reality, my working hypothesis is that it is most opportune to divert these technologies to think critically and reappropriate them tactically. Since 2009, I have been organizing and leading machinima workshops during which people learn how to use video games or virtual universes to produce films and thus transform an object of mass consumption into a means of expression.

With the virtual storytelling workshops, conducted in close collaboration with traditional storytellers during my stays in Togo and Kenya, I am now working on the mix between oral tradition and virtual universes. Hijacking these virtual universes allows us to encounter knowledge that tends to be forgotten by most of the new generations, while their imaginations are filled with images that come from elsewhere.

It is therefore necessary to take distance in order to make a reflexive critique, in the sense that Rama Thiaw, a Sen-

galese director and author of the documentary *The Revolution won't be televised*, understands it when she presents the feminist workshops, the "Artistic Sabbars"⁹, that she has organized in Dakar with creative women. She thinks of these workshops as "reflexive" workshops, that is, workshops where the women are the "I" of their enunciation, and speak for themselves, from their point of view. [29]

It is therefore this question of the point of view from which it is possible to reappropriate the narrative that I wish to address with the practice of machinimas. The machinima can indeed be understood as a counter-gaming practice that consists in diverting video games from their initial function, which is to play, to use them in a tactical manner in order to operate a shift of perspective and to take back the initiative of the narrative and to speak from a point of view that has often had little access to the media.

For as Francis Nyamnjoh rejoices, new technologies allow younger generations to have access to media and speech "to claim, express themselves, and procure social capital in spaces and places not previously accessible to them, and on issues generally considered the prerogative of their parents or the ruling elite." [30]

In the machinima's workshops, I use this technique of designing films from video game engines to make visible forgotten knowledge buried under centuries of colonialism by collaborating with storytellers to put stories, legends, but especially pre-colonial knowledge into images. This leads the participants to tactically use images that were intended for another use. In this I join the tactical media movement which consists in using social networks, blogs, podcasts, machinimas to document, make visible and disseminate these words and knowledge to new generations.



Figure 06: L'aigle et le Vautour a machinima directed by the Togolese storyteller Charlotte Boane in Lomé, Togo, 2020

Conclusion

By transforming the player into the director and author of her/his own narrative, machinimas allow for a displacement, a reterritorialization as Lia Beatriz Teixeira Torraca

⁹ For more information about these workshops see: <https://www.au-senegal.com/sabbar-artistiques-feminins-de-dakar.15647.html>

indicates in her magnificent text on The aesthetic look of affect, "The machinima represents in effect the possibility of erasing the distance between the one who watches or plays and the one who expresses himself and can then become a producer of content and director of his own story... A new way of constructing the reality of spaces that are invisibilized or communicated in narratives that are not those that occupy and usurp these spaces, those that construct the spaces of war, of the post-war period, of the intervals of escape from conflict. « [2]

In addition to allowing for the juxtaposition of multiple types of reality by integrating photographs, live action, and voices with virtual environments, they also have the ability to alter the viewer's relationship to the image by giving them the ability to become narrators and authors of their own narrative. The player acts and performs his character and speaks from his point of view: "Machinima is the chance to create a common space of communication mediated by affect, an alternative medium to affect and be affected by a resizing of spaces and the participation of the user/spectator/agent. It is the reconfiguration of perception and the imaginary, conjugating two spaces and multiple realities produced by the user/spectator/agent." [2]

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Author Biography

Isabelle Arvers, PHD Candidate, LARSyS, Interactive Technologies Institute (ITI), Faculdade de Belas-Artes, Universidade de Lisboa (FBAUL), Portugal, is a French artist and curator whose research focuses on the interaction between art and video games. For the past twenty years, she has been investigating the artistic, ethical, and critical implications of digital gaming. Her work explores the creative potential of hacking video games through machinima.

As a curator, she focuses on video games as a new language for artists. She curated several shows and festivals around the world, including Jibambe na Tec (Nairobi, AF, 2020), Tecnofeminismo (Bogota, AF, 2019), Art Games World Tour exhibit (Buenos Aires, 2019), Interspecies Imaginaries (Overkill, 2019), Machinima in Mash Up (Vancouver Art Gallery, 2016), UCLA Gamelab Festival (Hammer Museum, Los Angeles 2015, 2017), Evolution of Gaming (Vancouver, 2014), Game Heroes (Alcazar, Marseille, 2011), Playing Real (Gamerz, 2007), Mind Control (Banana RAM Ancona, Italy, 2004), Node Runner (Paris, 2004) Playtime (Villette Numérique, 2002).

From 2013 to 2016, she worked on art and research projects and curated and produced six antiAtlas of Borders exhibitions around the mutations of the borders in the 21st century, including The Art of Bordering at MAXXI in Roma and Coding and decoding borders in Brussels. She was also in charge of the End of the Map exhibition in the fall 2015 in Paris about alternative, subversive and emotional cartography.

As a tribute to Nathalie Magnan, her association Kareron produced in 2018 TRANS//BORDER, Nathalie Magnan's teachings, a series of events about eco-sexuality, cyber feminism, alternative media and situated knowledge. Kareron is actually producing UKI a Sci-fi Alt reality cinema by Shu Lea Cheang.

In 2019, she embarked on an Art and Games World Tour in non western countries to promote the notion of diversity of gender, sexuality and geographic origin, focusing on queer, feminist, and decolonial practices. In 2020, Arvers started a PHD on Art & Games decolonization at Fine Arts Faculty in Lisbon, Portugal, under the direction of Patricia Gouveia.

A comparative study of practice-based research and research-creation in media art: Comparing two doctoral studies in Australia and Canada

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Abstract

This paper examines the differences and similarities between practice-based research (PBR) and research-creation (RC) in media art. As case studies, two PhD research projects — one from Australia (Sojung Bahng, PBR) and the other from Canada (Stéphanie McKnight, RC) — are compared. The comparative analysis demonstrates that critical reflection and phenomenological awareness through creative practice are crucial in generating knowledge in both PBR and RC. Simultaneously, this study shows that research methods and approaches between PBR and RC differ due to different academic and socio-cultural factors. PBR's main aim is to generate knowledge through practice in a broader sense, whereas RC, with its conceptual roots in fine arts, emphasizes social and community-based engagement.

Keywords

Practice-based Research, Research-Creation, Media Practice, Cinematic Virtual Reality, Surveillance Studies

Introduction

This paper critically examines and compares the methodologies of practice-based research (PBR) and research-creation (RC) in media and fine arts from a multicultural perspective to further understand how these methodologies intersect and differentiate in global academic settings. In the 1980s, interest in PBR grew among creative disciplines in Australia and the United Kingdom [1]. The so-called "Canadian" approach, known as *research-creation*, is the use of practice-based methods in artistic research [2]. In Canada, scholars often define research-creation as a form of PBR, or even PBR in itself, and these methodologies are often mistaken as interchangeable. Indeed, this is because both PBR and RC emphasize generating new knowledge through creative practice and art-making.

For example, many scholars in Canada, such as Natalie Loveless [2], Erin Manning [3] and Owen Chapman & Kim Sawchuck [4], have outlined a direct link between PBR and RC, arguing that RC is a progression and development of PBR, or a Canadian "version" of PBR. For them, "research-creation" is a creative practice that is localized in Canada, therefore, carries its own name, beyond international terms such as "practice as research", arts-based research, practice-led research and so on [4]. We argue, however, although these concepts have shared values and identity, they are not identical or interchangeable ideas or approaches. They need to be analyzed through a localized, geographical, and multicultural lens. By comparing, contrasting, and analyzing both PBR and RC alongside each other, we can further understand the history of both these methodologies - how they intersect, and differentiate.

This paper describes the differences and similarities between PBR and RC in terms of their knowledge contribution to artistic and creative practice in media and fine arts. As case studies, this paper analyzes two doctoral dissertations completed in 2020, one from Australia (Sojung Bahng, PBR) and the other from Canada (Stéphanie McKnight, RC). This analysis is unique and important because it situates two different dissertations alongside each other, and complicates their development, circulation, and assessment of both projects. Bahng used virtual reality (VR) as an artistic and cinematic medium to explore the concept of reflexivity and created three VR projects as part of the research process [5]. McKnight draws on methods of fine art and RC to investigate the issue of contemporary surveillance and colonialism in Canada [6].

Both artist-researchers critically reflected on their socio-cultural identities through their individual media practices, showing that reflective practices are essential for both PBR and RC projects. Although both researchers employed creative practices as part of their research processes, their methods and approaches for contributing academic knowledge are somewhat different. Bahng used the artistic investigation to explore her research questions around reflexivity and empathy in VR. On the other hand, McKnight explored their fine art practice as knowledge production for the field of surveillance studies. Bahng's approach reflects PBR's emphasis on extending knowledge through the process of media practice in general. McKnight's approach draws from the terminology of research-creation, which emphasizes the importance of creation in itself, showing the significance of artistic practice within the context of academic knowledge.

Our study shows that academic research which embraces creative media practice differs depending on the socio-cultural and institutional contexts, and that these cannot be easily simplified into one concept or approach. However, the research also demonstrates PBR and RC are reciprocal, and that both critical and phenomenological awareness are essential in contributing to knowledge in media art.

Related work

Many scholars utilize creative methodologies for academic and research. This may be called art as research [7], art-based research [8], practice-led research (PLR) [9], PBR [1, 10], and RC [2, 3, 4]. However, there is some variation in the definitions of these types of research, where concepts are used differently depending on disciplines, cultural background, geography, research questions, and institutions. However, we are focusing our analysis on PBR in Australia and RC in Canada, specifically in relation to media and fine art disciplines, because these methodologies are often seen as parallel, regardless of locality.

Practice-based research in Australia

PBR is generally understood as a mode of academic investigation and inquiry that pursues knowledge through practice [1,10]. PBR is differentiated from practice-led research (PLR). If the artefact or creative outcome is the basis for the knowledge contribution, the research can be considered PBR. In PLR, the study's main aim is to generate new understandings of the practice itself. Thus, the creative artefact is not necessarily considered as knowledge production [9,10].

The tradition of PBR in technology is related to the first polytechnic founded in London in 1880 [1]; the program was central to developing knowledge in practice but not contextualized as PBR. PBR in creative arts disciplines has grown rapidly in Australia since it was implemented in 1984 at the University of Technology, Sydney (UTS). Ernest Edmonds and Linda Candy, pioneers of the PBR program at Creativity & Cognition (C&C) Studios at UTS, defined PBR as "An original investigation undertaken in order to gain new knowledge partly by means of practice and the outcomes of that practice" [1]. This definition of PBR emphasizes the originality of creative outcomes and artefacts as knowledge production. For a practice-based doctoral submission, PBR normally requires the inclusion of creative artifacts (or artworks) as well as a written dissertation that contextualizes the creative outcome academically [1,10].

SensiLab, established in 2016 by computer artist Jon McCormack at Monash University in Australia, has suggested a new model for PBR in media art and creative technologies. SensiLab was created within the Faculty of Information Technology, but influenced by existing models used in creative disciplines in the Faculty of Art, Design & Architecture (MADA). SensiLab's program expanded the practice of PBR beyond the creative arts to include research in creative technologies, visualization, artificial intelligence, human-computer interaction, interactive media, games, simulation, cultural heritage, and information systems [11]. SensiLab acknowledges the value of tacit and implicit knowledge as an embodied phenomenological knowledge [12, 13]. For its doctoral program, SensiLab adopted an approach to PBR similar to that of C&C at UTS. The SensiLab PBR examination process requires an artefact with a public exhibition accompanied by a written exegesis¹. The length of the exegesis is approximately half the length of a traditional written doctoral thesis dissertation [11].

In general, PBR in Australia has developed by emphasizing the value of the process of knowledge production and embodied tacit knowledge in both creative arts and technologies. These movements can be considered fundamental academic efforts that include phenomenological approaches and methods: those that put forward the importance of

¹ The practice-based PhD research is examined on a written exegesis of around 30,000 to 50,000 words.

suspension of judgement, bodily awareness and subjective reflection [14] as a primary method of knowledge production.

Research-creation in Canada

The Social Sciences and Humanities Research Council (SSHRC) in Canada define RC as "an approach to research that combines creative and academic research practices, and supports the development of knowledge and innovation through artistic expression, scholarly investigation, and experimentation" [15]. However, many artist-scholars in Canada have redefined and expanded the concept of RC as a uniquely innovative research methodology. The idea of RC also has been developed as a tool to explore critical social engagement in artistic and experimental ways.

RC is rooted in practices of fine arts but borrows inspiration from multiple disciplines. RC is an interdisciplinary practice that brings together a constellation of theory, practice, and events [3, 4]. Artist-scholar Stéphanie McKnight has argued that the methodology of RC allows artists who work in academia the skills, tools, and support needed to generate research through the production of artworks and cultural texts [6,16]. In RC projects, research, knowledge, and production work reciprocally to form new ways of thinking of old and new ideas [2].

For research-creationists Owen Chapman and Kim Sawchuck, the process of RC is embedded in academic institutions, and thus draws on some traditional modes of research inquiry [4,17]. However, this is only one component of a series of ways that RC functions. RC projects can be incomplete, and may produce new knowledge throughout its creative process, and even beyond it. This is not to say that RC projects cannot be treated and exhibited like "autonomous artworks" [18], or translations of knowledge; however, the process of creation and manipulation of research and knowledge at all stages of creation is the primary mode of inquiry and knowledge production for RC.

Furthermore, RC arguably privileges feminist and activism methodologies [2, 3]. Many research-creationists draw knowledge from intersectional practices such as community-based research and socially engaged work. They speak to community members, install exhibitions, and think while creating, reading, performing, sketching, publishing, and failing [17, 19]. RC gives space for unsettling, uncomfortable, and productive failure [16, 19]. In short, research-creationists seek to produce artistic and innovative research that will change the way audiences, scholars, artists and viewers move throughout society and space.

Two PhD Case Studies

Cinematic VR as a reflexive tool by Sojung Bahng

Sojung Bahng's Practice-based PhD research, conducted at SensiLab at Monash University in Australia, explores the reflexive dimensions of cinematic virtual reality (VR) within intersubjective contexts. Through conceptual and practical explorations of VR storytelling, Bahng developed new cinematic practices applied to VR and expanded the contextual understanding of reflexivity and empathy. Her practice-based research developed three cinematic VR projects: *Floating Walk* (360° video), *Anonymous* (interactive mobile VR) and *Sleeping Eyes* (interactive navigable VR). Each creative work applied reflexive elements in qualitatively different ways, exploring the potential of cinematic VR for eliciting embodied reflection. The projects are responses to both personal and societal alienation, disconnection and isolation.



Figure 1. – A still from *Floating Walk*: the image shows the artist standing in front of a wall of passports from different countries carrying a 360° camera.

Background

Based on the developments of virtual reality (VR) technologies, many artists and filmmakers have attempted to create moving image works that provoke empathetic engagement in virtual characters or stories [20]. Bahng argued that immersive engagement without critical or reflexive awareness has the potential danger of objectifying others' pain or emotionally identifying with others' difficult situations without critically thinking about the social and historical issues around them [21]. Based on this perspective, she examined VR as a reflexive storytelling tool inspired by the reflexive

mode of documentary filmmaking [22] and Bertolt Brecht's epic theater [23]. Bahng further noted that VR has a fundamentally reflexive nature due to the limitations of immersive engagement; thus, she explores these limitations as reflexive elements for VR storytelling to encourage audiences to actively fill in the gaps between their physical sensations and virtual perceptions.

Research Objective and Method

The research objective of Bahng's dissertation was to explore cinematic VR as a reflexive tool beyond empathy. She investigated her research objective through her creative projects by critically examining how reflexive storytelling is effectively used to promote self-reflection in socio-cultural contexts. Her research questions concerned the methods and techniques that can be used for reflexive VR storytelling.

Bahng's research covered multiple disciplines, including film and media studies, HCI, visual art, and philosophy. She drew upon a practice-based research methodology specifically in artistic practice, but utilized a variety of research techniques and methods: autobiographical, autoethnographical, interview-based, and collaborative. As the research progressed, Bahng critically reflected on her creative works and applied what she had learned from one project to the next. The works informed and iteratively developed the framework presented in the exegesis, and this refinement informed the development of each subsequent work.

Thesis Structure

Bahng's exegesis is divided into two main parts: theory (Part I) and practice (Part II). In Part I, Bahng proposes a conceptual framework for reflexive storytelling design in cinematic VR. For example, she reframes VR as a reflexive tool by using theoretical backgrounds such as Buddhist philosophy, Brechtian aesthetics and phenomenology. She also introduces embodied spatial montage as a cinematic concept that is extended to the spatial dimension and the participatory situations of VR storytelling. In Part II, she uses the proposed conceptual framework and theoretical analysis of Part I to describe her three cinematic VR projects. She explains each project's background and overview and then describes the process of making the project. She also addresses the audience study and discussed the reflexive dimensions based on the findings from the audience interview. In the concluding section, Bahng discusses her overall research process by reflecting on this body of creative work and connecting the practical, studio investigation with the theoretical framework. She responds to the research questions and offers reflective analysis of the practice-based research.

Research Contribution

Bahng's research embraces both conceptual and creative knowledge, exploiting diverse technical possibilities. Through three distinct creative projects, Bahng reframes and develops a novel form of VR storytelling for self and social reflection. Together, the three projects provide insight into our understanding of VR as a cinematic, artistic medium and

as a means of promoting self and social reflection, specifically regarding socio-cultural issues such as alienation, disconnection and isolation.

Each project emphasizes its own distinctive contribution. *Floating Walk* reveals the potential of 360° video for autobiographical self-expression and as an autoethnographic tool that promotes reflexive thoughts about immigrants' identity issues. *Anonymous* contributes design factors and technical implementations for using VR to elicit self-reflection on loneliness and death. *Sleeping Eyes* demonstrates how phenomenological and participatory engagement in VR storytelling can elicit critical awareness of narcolepsy and social ignorance. Collectively, the body of creative research provides knowledge about reflexive modes of immersive storytelling while considering the various technical, design and narrative elements available to cinematic VR.

***Colder Now: Surveillance as Contemporary Colonialism* by Stéphanie McKnight**

McKnight's doctoral research-creation project, conducted at the graduate program in cultural studies in Queen's University, investigates surveillance and colonialism in Canada through media art practice and exhibition. As a representative outcome, her doctoral RC exhibition titled *Colder Now*, was exhibited at the Art and Media Lab in the Isabel Bader Centre for the Performing Arts on October 23rd to November 3rd 2017. Drawing from the methodology of RC, *Colder Now* juxtaposed surveillance studies, colonial studies, and media art technologies to ask how does surveillance and policing contribute to contemporary colonialism in so-called Canada post-9/11.



Figure2. *The triangle of trust* (2017) by Stéphanie McKnight

Colder Now's anchor piece *the triangle of trust* is one example of the ways that McKnight uses media, collaboration, installation, and surveillance studies theory to question their white settler relationship to Canada and its colonial histories. *the triangle of trust* is a neon replica of the

Canada Security Intelligence Service (CSIS) headquarters on unceded and unsundered Algonquin territory (also known as Ottawa, Ontario), known for investigating "activities suspected of constituting threats to the security of Canada and to report on these to the government of Canada" (Government of Canada). This sculpture centers CSIS as a primary institution of surveillance and intelligence gathering. *the triangle of trust* replicates the aesthetic of CSIS, including the colour blue, which is referenced in several Google Images of the establishment. The line drawing was inspired by a screenshot taken of the CSIS building found on Google Maps.

Background

As an exhibition, *Colder Now* critiques the invasive and unclear intent of Canada's Anti-terror Act (Bill C-51). Canada introduced its first "Anti-terrorism Act" (Bill C-36) and "Public Safety Act" (Bill C-42) in 2001, as a response to 9/11 [24]. CSIS is one of the primary institutions governing these policies. Bill C-36 was heavily contested and protested because of its racially motivated tendencies (2012). Furthermore, Bill C-36 has affected Indigenous Peoples in so-called Canada, especially Indigenous activists who may participate in activities of resistance and political dissent (Adese, 2009). Bill C-51 and its successor Bill C-59 are arguably no different. They include similar languages that attempt to define terrorism in extremely broad terms. Regardless of the original intent of these bills, and whether or not citizens agree they are necessary for security purposes, they actively produce normal (white) and abnormal bodies (non-white). In these contexts, Indigenous resistance that challenges colonial and settler practices in Canada are labelled as unpatriotic, dangerous, criminal, and a national threat [25].

Research Objective and Method

the triangle of trust captures the architectural design of the CSIS headquarters by illuminating a line drawing of the building. The glass tubing and florescent blue tints intentionally replicate the glass exterior of CSIS. Painted with a sea of windows, the CSIS headquarter insists that it is a transparent and visible institution. Though as several scholars have argued, windows and glass façades don't actually equate visibility [25, 26]. Despite CSIS's desire to render its interior visible, viewers gaze is subject to several factors including security personnel, trespassing, limited gaze. As such, *the triangle of trust* complicates CSIS's desire to be transparent in its processes of security through its architecture by replicating its glass façade, but also illustrating limited architectural information through a simple line drawing. Despite this transparency, there is still a lack of transparency relating to their governing bills, such as Bill C-51.

Using these fine-arts-based methods, McKnight's research objective was to explore the ways RC is integrated with surveillance studies and McKnight's white settlerhood. By questioning the visibility and the institution who is governed by policies such as Bill C-51 through the creation of

art, audiences can engage with the dialogues in ways that complicate their relationship to the research questions at hand.

Thesis Structure

McKnight's dissertation takes the form of a portfolio project. In the Cultural Studies program at Queen's University, a portfolio dissertation is defined as, "Like a monograph thesis, the portfolio thesis comprises a coherent research project based in academic literature, but the body of original work consists of multiple components that function as standalone elements and may be diverse in format, voice, medium, method, and address" [27]. McKnight's portfolio project consisted of seven individual standalone articles that addressed the research question, how does surveillance contribute to contemporary colonialism in so-called "Canada post-9/11"? Funded by the Social Sciences of Humanities Research Council in Canada (SSHRC), McKnight's dissertation unsettled traditional methods of knowledge dissemination at Queen's University, by centering interdisciplinary and novel ways of publishing their dissertation. More interesting than the articles embedded in McKnight's final dissertation package, was the inclusion of a visual essay titled *Working, Watching, Working: a methodology for a white settler surveillance artist scholar* – a journal and sketchbooks of ideas, drafts, photographs, and notes taken during the processes of creation. In this visual essay, we have access to their processes of thinking, critical reflection, failure, and the moments where their ideas have changed to better reflect their identity and posed research questions. As mentioned above, RC happens at all stages of the research process. McKnight's visual essay demonstrates this. The articles are a form of appendix to the visual essay and *Colder Now* exhibition to fulfil the traditional colonial and neoliberal expectations of Canadian Universities. The institutional expectation and rule that art cannot function as research and knowledge, in its own right.

Research Contribution

Not only does McKnight's creative dissertation project and exhibition *Colder Now* rethink and reveal contemporary colonialism through methodologies of art-making and interdisciplinarity, but it also reimagines new ways of integrating RC as a doctoral methodology in Canadian Universities. It does this by inviting portfolio projects as an option to exhibit and publish a creative dissertation. *Colder Now*, and specifically *the triangle of trust*, interrogates Canada's security, surveillance, and policing strategy through the production of art. Through their art-making, McKnight reveals the invasive and violent colonialism still plaguing Turtle Island. The artworks are in themselves artefacts of social justice and self-reflexivity, as well as producers of new knowledges in their own right. The new knowledges that these pieces contribute to the social sciences and humanities, especially surveillance studies, is their ability to use surveillance the visual as methodology itself. McKnight's work function creeps' surveillance policies,

anti-terror legislation, and white settler colonial ideations to critique the settler state against itself.

Finding and Discussion

Bahng and McKnight both use media and fine art practices to generate academic and scholarly knowledge in PhD doctoral studies. However, their research approaches and methods are different. Most noticeably, Bahng's PhD dissertation format is considered an exegesis in Australia, and it follows a relatively conventional format for PhD research that includes an introduction, theoretical background, creative practice and overall reflection and conclusion. However, McKnight's portfolio project combines several art projects that include the written contextualization of each work.

In a similar context, Bahng's creative practice informed the development of her next project through critical reflection and audience observation or interview. Her three creative projects are deeply interconnected, and her design process was iterative. However, each of McKnight's artworks has a separate emphasis and importance in terms of knowledge production, even though the three projects embrace a broader umbrella of ideas. Each of McKnight's pieces can work alone or alongside each other.

Bahng's study used explicit research questions that were addressed through practice. To answer the questions, she used a combination of different research methods combining autoethnography, ethnography, interviewing, collaboration, and more. In contrast, McKnight's research questions were unfixed, and their inquires did not aim to find specific answers. The artworks themselves became producers of knowledge; thus, the thesis and questions were unstatic and constantly changing. McKnight raises questions to investigate the way creative practice can produce new knowledges in surveillance studies, but they allow the audience to find answers or ask other questions. McKnight's research methods and questions are designed to provoke discourse or elicit critical inquires.

The differences in the research approaches and methods are not surprising because Bahng and McKnight's research topics and purposes are different. However, the noticeable difference between the two PhD projects is deeply related to the dissimilar traditions between PBR and RC. As discussed previously, PBR in media art in Australia has developed within interdisciplinary art and technology disciplines. Because Bahng's research was conducted at SensiLab, her dissertation format partially embraces a technoscience academic style and approach. However, as a SSHRC funded project, McKnight's research approaches are oriented toward the humanities and fine arts. They explore RC as an art practice to produce new knowledge for specific cultural, social and political events. Furthermore, McKnight suggests a new portfolio model for RC as a doctoral methodology for Canadian Universities. The trials of embracing creative

practice for doctoral studies are relatively new, and there is a less established format in Canada. Therefore, McKnight combines the portfolio style dissertation and art exhibition in their PhD research to validate the value of artistic RC for doctoral research methodology more broadly.

Furthermore, it is clear that RC puts greater emphasis on social engagement, social justice and activism as a research practice. However, this does not mean that PBR places no importance on social value or community-based engagement. However, PBR's main aim is to generate knowledge through practice in broader research questions and themes; thus, PBR approaches are not necessarily limited within the frame of social intervention. As mentioned earlier, many artist-scholars use PBR and RC interchangeably, as though they are the same concept. However, it can be seen that PBR is a broader umbrella concept that values practice and creative artefacts as vehicles for knowledge production. On the other hand, RC has a specific tradition and history stemming from Canadian fine art practices and humanities traditions that facilitate social action through artistic practice.

Despite these differences, Bahng and McKnight emphasize the importance of self-reflexivity and critical reflection as a research method and artistic tool. They demonstrate that subjective knowledge and embodied understanding by practice are important in both PBR and RC. Furthermore, as media and fine art practitioners, both researchers use technology as a critical tool to deconstruct the conventional or old perceptions and provide new ways of explorative mediation to the audience. Simultaneously, they value the collaborative elements in all research or creation processes, demonstrating that many factors beyond a researcher's individual idea (e.g., artistic collaborators, audience members and collaborative technological tools) can produce unexpected but valuable contextual knowledge. Bahng and McKnight both indicate that new media can be used reflectively and critically in media and fine art research practice.

Conclusion and Limitations

This study brings forward the differences and similarities between PBR and RC in doctoral media and fine art research. Two PhD dissertations, one from Australia using PBR (Sojung Bahng) and the other from Canada using RC (Stéphanie McKnight) were described and analyzed as case studies. We found both researchers used media practice to reflect their socio-cultural identities critically and to prompt an audience's critical awareness of and questioning in their socio-cultural contexts. In their studies, media practice was used as a form of knowledge production to demonstrate the significance of embodied knowledge through creative practice. However, we also found the research methods and approaches were significantly different between the two studies. Bahng's PBR study adopted various technical methods and demonstrated that PBR methods can be applied to broader research objectives. McKnight's RC project showed the way RC is positioned within fine art practice and

humanities in Canada and that it prompts social engagement and activism. Comparing only two doctoral studies limits generalizing the characteristics of PBR and RC. Nevertheless, the differences based on the comparative analysis between two studies clearly show the histories and traditions of PBR are different in Australia and Canada, demonstrating that creative research has been interpreted in complex ways, considering socio-cultural backgrounds and institutional or academic heritage and disciplinary lineages.

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Reflexive-vr.com: Reconfiguring a physical VR exhibition into an online virtual exhibition due to the COVID-19 pandemic

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Abstract

This paper reviews a virtual exhibition titled *reflexive-vr.com*. Initially planned as a public exhibition featuring cinematic VR works by media artist/filmmaker Sojung Bahng, however, due to restrictions imposed by the COVID-19 pandemic, a different curatorial approach was needed in order to reconfigure the original installation plan into an interactive online viewing experience. This reflective analysis explores the design strategies involved in this case and how the viewing experiences associated with the artistic intent of three VR artworks (*Floating Walk*, *Anonymous* and *Sleeping Eyes*) was supported by the exhibition's translation from a gallery-based installation into an online virtual environment. We will address technical specifications, consider curatorial strategy and implications to narrative flow and phenomenological experience, and – while acknowledging present limitations – raise the potential for online exhibition formats to serve as a distinctive presentational mode in their own right for engaging viewers with VR works.

Keywords

Virtual Reality (VR), Viewing experience, Virtual exhibition, Curatorial Design, Mixed Reality, Scenography

Introduction

The coronavirus pandemic has had a significant impact on the cultural sector globally. One response to the disruption caused by COVID-19 to the "normal operations" of museums, galleries and contemporary arts venues has seen cultural organisations turn their attention towards digital channels and platforms in order to maintain their programming activity and engagement with audiences [1]. Since the beginning of 2020, countless exhibitions, including many public exhibitions of Virtual Reality (VR) works that require shared head mount displays (HMDs), were cancelled and some moved to remote online formats due to social distancing requirements [2, 3]. While prestigious film and media art festivals had already begun adopting virtual platforms to showcase VR films or artworks – a notable example being

the Cannes Film Festival and its immersive multiplayer platform, the Museum of Other Realities (MOR) [4] – the forced closure of exhibition venues over the past two years along with restrictive measures introduced upon their reopening has instigated the need for further experimentation into how web-based virtual environments can be designed to support an accessible, inclusive and sustainable exhibition model, post-pandemic.

Definitions of 'virtual reality' vary markedly, including the broad concept of an imaginary or represented reality distinguished from the real world [5, 6, 7]. For the sake of clarity, in this paper, we define VR in direct reference to digital media whose highly personalised viewing experience requires an HMD in order to simulate visual realities. As such, exhibiting VR artworks in the public and social setting provided by galleries and festivals raises a set of challenges to exhibition design and more conventional modes of viewing, as well as curatorial protocols. As artists and curators working with the medium of VR, this situation has become even more compounded due to the implications of the pandemic on cultural engagement and urgent, prompting us to think about the roles that physical environments (e.g., galleries and exhibition venues), embodiment and performativity play in not only framing VR works curatorially, but underpinning the distinctive qualities of their viewing experience.

These observations lead us to ask: In what ways can virtual environments be designed to adequately support the aesthetic experience of VR? Can such digital spaces enhance or even supersede certain features associated with experiencing VR works in the context of physical exhibition? In this paper, we introduce the online VR exhibition, *reflexive-vr.com*, as a means of entertaining some of these associated questions.

reflexive-vr.com is an online exhibition that was initially developed to support the final presentation of cinematic VR artworks produced by Sojung Bahng (first author) as part of her *PhD* research thesis undertaken with SensiLab, an interdisciplinary research lab based at Monash University in Melbourne, Australia¹. Bahng's practice-based research

¹ This PhD project aligns with SensiLab's 'VR as Cultural Practice' research track, supervised by Jon McCormack and Vince Dziekan. This track recognizes that contemporary filmmakers and

visual artists alike are embracing the potential of immersive digital technology – such as Augmented and Virtual Reality – to tell stories in powerful, new and affective ways that mark a

programme was due to culminate with an examination conducted in the format of a public exhibition in June 2020. However, due to the outbreak of COVID-19 experienced in Melbourne at this time, plans for staging this examination exhibition were cancelled to comply with restrictions imposed by the Victorian State government and University, which included enforced "lockdown" and other precautionary hygienic and physical distancing measures. As a consequence, it was not possible to realise the original designs for presenting the works as part of a mixed-reality, gallery-based installation. This imposed a significant challenge to reconceptualise the curatorial strategy as a digital exhibition, and in response, a web-based 3D virtual environment was designed to meet the requirements of examination within a tight timeframe and a modest budget.

Over the rest of this paper, we will review the process of translating the physical exhibition, which was initially conceived to provide the necessary viewing conditions to experience three VR projects (*Floating Walk*, *Anonymous* and *Sleeping Eyes*), into an online 3D virtual environment. We will address key considerations involved as part of the process of reconfiguring the exhibition, its inventory and spatial design or scenography. We will discuss the outcome and reflect upon curatorial considerations, audience engagement and the potential – and limitations – realised from developing the virtual exhibition itself.

VR Exhibition in VR

In the following section, we will briefly introduce two relevant precedents that help contextualise the creative response guiding the development of *reflexive-vr.com*.

Alluded to earlier, the Museum of Other Realities (MOR) is an online, multiplayer interactive VR exhibition platform that prestigious international festivals, including Cannes XR and Tribeca, have used to exhibit VR projects affected by the COVID-19 pandemic [4]. The MOR is run by SteamVR². Audiences can access media using personal headsets, such as the HTC VIVE or Oculus Rift(S), which are enabled to run Steam; however, it is currently not possible to use the MOR with mobile headsets such as Gear VR or Google Cardboard. Upon entering the MOR, audience members can customise their avatars and communicate with others using gestures or sending messages. VR projects are exhibited in a virtual space that resembles a "white cube" gallery. MOR provides a navigable interactive experience

transformational moment in the evolution in the craft of "immersive storytelling". By adopting practice-based methodologies that embrace studio research, practitioner-researchers (media artists, creative technologists, content producers) are challenged to engage deeply and experimentally with immersive image technologies to conceive, develop and undertake projects resulting in creative outcomes (artworks, film screenings, installations) that seek to define the language of these media forms and introduce new

whereby the visitor is able to move through galleries and select the VR work they wish to view by clicking upon the installation artworks or sculptures. While providing a format to experience virtual artworks using HMDs, the design tropes that the MOR calls upon mimic a real-world event and venue.

In comparison, the Festival of International Virtual & Augmented Reality (FIVARS) built its own multiplayer VR exhibition platform to work on the Web [8]. While supporting a fuller range of headsets, all VR projects are rendered in 360° video. Upon entering the FIVARS online exhibition, audience members can choose avatars and interact socially with others via voice or text chat. The festival is composed of a mixture of imaginary spaces and a typical exhibition venue with spherical images standing in for each project. This inventory of videos can be watched on a personal computer or headset. If wearing a headset, audience members can access media content by navigating the spaces using controllers or through gaze interaction. In contrast, the Web version only enables the environment to be navigated by using a keyboard and mouse.

To summarise: Achieving the fullest visual and interactive experience of VR requires a demanding technical set-up. Nonetheless, it is still possible to provide audiences with a cinematic viewing experience by curating online festivals or virtual galleries that serve up readily accessible 360° rendered videos distributed via the Web or mobile headsets. While the MOR offers a navigable-interactive VR experience, it only works with high-performance virtual headsets; whereas, the FIVARS's platform works with the Web and all kinds of headsets but does not support interactive experiences. These comparisons – and the dilemmas they reveal – speak to the current possibilities and limitations of experiencing VR in a domestic setting.

The curated experience provided by MOR and FIVARS translates features immediately associated with physical exhibition (galleries; conference venue) into a virtual facsimile of those spaces. While effective and efficient for the most part, are there other possibilities for reaching audiences online that are more affective, satisfying and speak to the fuller spatial, embodied and performative experience that VR artworks can conjure?

understandings of the narrative and experiential parameters of the medium beyond the cinematic frame to cinematographic space.

² Steam is a video game digital distribution service by Valve. SteamVR, operated by Steam, is the tool for experiencing VR content using HTC VIVE, Oculus Rift or Window Mixed Reality headset.

Reflexive-VR.com

Inventory of the exhibition

As part of the examination requirements associated with Sojung Bahng's practice-based PhD thesis, *Cinematic VR as a reflective tool beyond empathy*, it was expected that the creative outcomes of her studio research be presented in the form of a final exhibition. Ostensibly, the purpose of the exhibition and its adherence to the examination policies outlined by Monash University is predicated upon providing two appointed external examiners with the opportunity to view the body of creative work first-hand. This viewing experience enables them to engage in a first-hand phenomenological way with each VR project – which might be construed as the "primary source" artefacts – along with accompanying archival materials and other supporting documentation.

The inventory of the examination exhibition was comprised of three VR projects produced by Bahng between 2016-2020: *Floating Walk* (360° video), *Anonymous* (interactive mobile VR) and *Sleeping Eyes* (interactive navigable VR). Each project was conceived as a means of exploring the communicative potential of cinematic VR in response to themes of personal and societal alienation, disconnection and isolation. The socio-cultural issues focused upon in these creative works prompt the audience to engage in critical self-reflection and to reconsider how they connect empathetically with others. More specifically, the subject of these projects engaged with immigrant identity (*Floating Walk*), no-relationship society (*Anonymous*), narcolepsy and social ignorance (*Sleeping Eyes*). Brief synopses of each work follow.



Figure 1. – A still from *Floating Walk*

Floating Walk – Gangnam Kangaroo is a 360° autobiographical documentary of a Korean woman living in Australia. She goes on a journey of self-confrontation to the root of her unclear but painful emotion and discovers that historical traumas have affected her identity. A spatial collage of 360° video images represents the artist's journey in Australia and Korea.



Figure 2. – A still from *Anonymous*

Anonymous is an interactive 3D real-time rendered cinematic VR applying gaze interaction. The story concerns the life of an old man living alone and remembering his life. The main character and his environment are abstracted by using cardboard textures. The viewer is able to access the perspective of objects that fill this domestic setting, ultimately finding themselves assuming the role of the man's dead wife, where from the vantage of her portrait hung on the wall, they observe the rituals of his solitary daily life.



Figure 3. – A still from *Sleeping Eyes*

Sleeping Eyes is an interactive cinematic VR piece that tells the story of Sungeun Lee, a South Korean media artist suffering from narcolepsy. The work invites viewers to experience the symptoms and experience of someone with narcolepsy, including uncontrollable sleepiness and physical violence rooted in social ignorance. Non-linear narrative and gamification techniques were applied to make the viewers actively explore a series of surrealistic episodes. Additionally, the viewer makes them aware of their own feelings by utilising a heart-rate sensor to visualise their own stress states while experiencing the artwork.

Initial exhibition plan

As an integral part of Bahng's research programme, each of these works was presented previously in a variety of public exhibition settings and contexts. These occasions provided the opportunity to understand how viewing conditions influence the interpretation of the work by audiences. Insights gained from reflecting on the successes (and otherwise) were drawn upon to inform installation plans for the final examination exhibition.

Floating Walk was exhibited at several venues³. Installation components were limited to a set of rotating chairs with mobile headsets, such as Gear VR or Google Daydream, and stereo headphones. As this project relates the artist's personal stories to historical and collective memories, it was crucial that viewers be encouraged to draw connections between historical events and the artist's family history through the archival information provided. Furthermore, as the work contains a high degree of spatiotemporal information, including various spaces, times, people and audio sources, it was observed that many people struggled to focus simultaneously on the visuals and audio, and thus missing important information about significant parts of the story. Informed by this observation, it was decided that it would be beneficial to display background historical documents, such as family photos, news articles and related books, along with the VR film as part of any future exhibition of *Floating Walk*.

Anonymous was previously exhibited for both a single viewer in an enclosed room, as well as for a larger audience in a public venue⁴. From these experiences, it was gleaned that some viewers tended to reflect more upon the work and their own feelings when in the private set-up than when in the public venue surrounded by people. Thus, for the final examination exhibition, it was determined that creating a staged, ritualistic private set-up in an enclosed room containing cardboard made ceremonial objects related to the work would be most affective to elicit the viewer's curiosity about the work and provide a ceremonial experience for *Anonymous* related to death and loneliness. For example, we planned to create cardboard portraits of the widower and his wife. In front of the portraits, we wanted to put different foods such as fruits, chocolates, nuts and tea on cardboard made plates, as is often used in a small ritual for commemorating dead people in Korea.

Lastly, with regards to *Sleeping Eyes*, VR was used as a medium to represent the symptoms of narcolepsy and provoke fundamental reflections on the boundary between dreams and reality. The story itself is set between locations

representing a high school and a military training ground. Considering the important role that these psychologically charged environments play in the work, we aimed to fabricate a physical structure resembling an army watchtower in the exhibition space. In addition to symbolising an in-between liminal space that resonates with the project's theme, this structure would be treated as the main presentation platform where viewers would be fitted with the headset and heart-rate monitor to interact with the piece.

However, with the onset of COVID-19, it became immediately clear that it would no longer be feasible to convene the examination exhibition as per "normal", let alone realise the curatorial design of the installation as envisaged. Thus, with little other recourse, the strategy for the examination had to be reconsidered, and the staging of the exhibition reconfigured in response to presenting the works exclusively through an online exhibition platform.

Redevelopment of the exhibition

The main objective of the virtual exhibition was to substitute for the physical exhibition as the part of PhD examination process. We designed a Web-based 3D virtual environment working with a tight timeframe of six weeks and a modest budget of \$4000. Technically, the virtual exhibition was implemented using Three.js, a JavaScript library used to create and display animated 3D graphics in a web browser using WebGL. Presently, the current version of the exhibition can be only viewed on a standard computer screen; for instance, the viewer can play a 360° video in the virtual gallery by clicking and dragging with a mouse. As with the FIVARS implementation, the ultimate goal is to turn the exhibition into a fully immersive experience by using VR HMDs to showcase the works within the virtual environment (i.e., VR in VR).

Our aim was not to recreate the planned physical exhibition in a virtual format, but rather to create an explorative, phenomenological and spatial experience that would support and contextualise the set of cinematic VR works being exhibited. In this respect, our chosen approach aligns with the concept of 'time-based scenography' [9]. While originally drawn from a theatrical context, in more contemporary terms, scenography is recognised as a transformative model for curating and designing exhibition-based experiences that cross-pollinate theory and practice. Instead of considering objects and media as discrete from each other, or viewing visual, auditory or other sensory modes separately, time-based scenography seeks to take account of all elements that comprise an exhibition more holistically. As part of our

³ *Floating Walk* was presented at the Melbourne Fringe Festival 2017 and was selected as one of the finalists for the Social Impact Media Awards (SIMA) 2018 in Los Angeles.

⁴ *Anonymous* was shown at Bucheon International Animation Festival (BIAF2019) in Korea, Tbilisi International Animation

Festival (TIAF2019) in Georgia, Torino Short Film Market (TSFM2019) in Italy, and Montreal International Animation Film Festival (ANIMAZE2020) in Canada.

curatorial strategy, we intended to provide an immersive experience along with supplementary documentation related to each VR project. This redevelopment supported main requirements of the exhibition; namely, establishing spatial context, embodied experience and performative viewing.

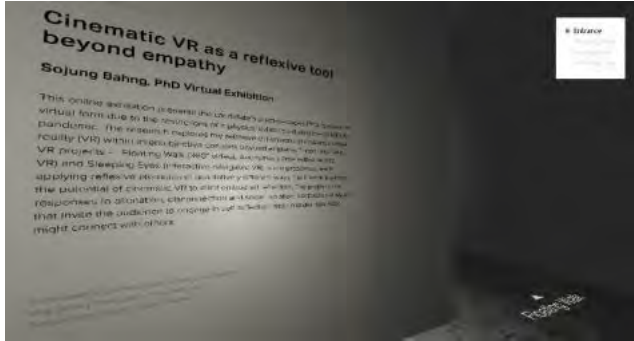


Figure 4. – First-person views of the online gallery: the gallery entrance. A simple menu (top right in each image) allows quick navigation to rooms in the exhibition already explored.

Design of the virtual environment

In order to support these requirements, we developed a curatorial design approach [10] that treated the virtual exhibition as an opportunity to reconfigure the spatial, embodied and performative aspects associated with the distinctive viewing experiences of each of the three principal VR projects.

In the resulting web-based 3D environment, the exhibition space is divided into four sections. The visitor's journey through these "galleries" is predetermined and follows a linear path. The presentation of each VR work follows a chronological order. The viewer is directed from one gallery space to the next in successive order, and only upon reaching the final room are they able to retrace their steps and re-visit works at their own discretion.

Upon first entering the exhibition, the viewer finds themselves in an anteroom where they are provided with an introductory explanation about the exhibition and its inventory of artworks in the form of a didactic panel. Each artwork is installed in a dedicated gallery, providing the viewer with access to renditions of the VR films (either 360° video or play-through) along with representative images, digital objects and textual descriptions related to the individual project.



Figure 5. – The room of *Floating Walk* with the headset visible on the table.

The 360° VR film, *Floating Walk*, is located in the first gallery. A timeline runs along the side wall of this small cubic space, juxtaposing modern and contemporary South Korean history with the personal history of the artist and her family. Facing opposite, a full wall of passports is displayed from all over the world symbolising a story of immigration. These collected artefacts (photographs, newspaper clippings, passports) can be inspected more closely by the viewer and at their own discretion. These documentary materials provide the viewer with a wealth of historical and personal detail that help contextualise the auto-ethnographic aspects of *Floating Walk*.

In order to view the VR film itself, the viewer activates the 360° video by clicking on a virtual depiction of HMD found amongst assorted items placed on a desk in the centre of the room. Next to the HMD is a pair of headphones, which plays a short, spoken explanation of the work by the artist in a manner similar to a traditional gallery audio guide. By drawing upon familiar and established museological conventions (i.e., the interpretive function of displays of archival resources or audio guides), the viewer is comfortably enabled to navigate the virtual environment in a manner not unlike how they might experience the exhibition in a physical gallery setting.

After watching the video, the visitor will notice that the gallery environment has undergone a subtle change: a cardboard door has appeared in the corner of the room, which reveals a connecting passageway leading onwards to the next gallery in which the second artwork, *Anonymous*, is featured.



Figure 6. – The gallery room for *Anonymous*

This second space is treated in a far less literal than the first. Our design intention was to defamiliarise the viewer by transitioning from a space that resembles a conventional art gallery to a small room made from cardboard. Finding themselves in this enclosure breaks the viewer's expectations. By evoking spatial estrangement [11], we hoped to instill a sense of curiosity that encourages them to explore the virtual space more actively and imaginatively. For starters, the lining of the walls, floor and ceiling appear to be made from a cardboard box. A small shrine is placed in the middle of the room.

This discrete installation serves an important ritualistic purpose, and reprises a performative strategy whereby a constructed model (or "prop") was included in previous public exhibitions of the work. On a small, unassuming table, portraits of the film's main characters (the widower and his wife) are lovingly placed, along with a candle and some food such as fruits, chocolates, nuts and tea. Crucially, this tableau was originally fabricated entirely from cardboard, thereby creating a portal between the physical environment of the exhibition space and the virtual world the viewer discovers themselves performing the ritual as soon as they don a headset and enter the imaginary scene.

Once again, digital renditions of an HMD and headphones resting unobtrusively on a cardboard box cue the protocol established with the viewer with the first work, whereby upon clicking the HMD, the 360° video of *Anonymous* is played. At the conclusion of the video, the visitor is drawn towards a doorway in the corner of the room, which serves as a gateway into the final section of the exhibition.

Unlike the previous transitions between the gallery spaces, this time, the viewer is immediately immersed in a different, alien environment that resembles a meandering, cave-like tunnel. Atmospherically, a sense of unease is reinforced by a surreal soundscape interspersed with distorted voices. The cave symbolises a bridge from the conscious world to the unconscious dream world. After their descent, the viewer emerges into a surprisingly vast, cavernous space where only a single watchtower stands, imposing and silent.

The design of the virtual environment was inspired by the original intention to fabricate a physical platform in which

to situate the viewer as part of the gallery-based exhibition. This construction would have introduced a theatrical dimension to the viewing experience, and transformed the otherwise limited "visual" engagement with the VR film into a fuller multisensory, mixed-reality encounter with the work.

This exhibition-making approach is not uncommon amongst contemporary artists working with VR who incorporate installation-based or spatial design considerations into their practices. Illustratively, artists Jess Johnson and Simon Ward introduced a themed series of spatial elements to create a multi-dimensional setting for their five-part, virtual reality experience, *Terminus* (2017-18). Each "station" plays an important role in what might be considered as a world-building exercise that establishes a relationship between these interior spaces and the virtual world experienced via VR. A similar convergence, this time between real objects and represented spaces, was achieved in a survey exhibition of New Zealand jeweler, Lisa Walker at the Museum of New Zealand Te Papa Tongarewa. The exhibition design featured a range of constructions and objects as well as tools and materials from her workshop displayed along with a 360° video tour of the artist's studio; which serves to contextualise the other is left open to interpretation. For his part, Christian Thompson successfully transported the viewer of '*Bayi Gardiya*' (*Singing Desert*) – his VR commission for the Australian Centre for the Moving Image – into the landscape of his childhood by staging the performative viewing of the work within a simple ring of sand. This simple physical feature complemented the highly immersive, visual and sonic experience by literally and imaginatively connecting the viewer to a creek bed known as The Sixth Mile in Barcaldine, Western Queensland, where the artist grew up.

Returning to *Sleeping Eyes*: When the viewer approaches the watchtower in its reconstructed digital form in the virtual exhibition, they are invited to ascend a ladder. Upon reaching the top, they alight onto a small, restrictive platform containing a classroom desk where a set of drawings created by the film's protagonist (the artist, Sungeun Lee) are scattered across its surface, along with an HMD that invites activation of a 2D play-through video of the VR film.



Figure 7. – The view from up in the watchtower for *Sleeping Eyes*; The HMD and headphones can be seen on Sungeun's desk.

Reflection and Discussion

The need to shift from preexisting plans for physical installation to online exhibition demanded an agile curatorial response. The subsequent manifestation of the virtual environment sought to reconfigure certain presentational as well as more phenomenological considerations related to the experiential qualities associated with each of the three VR artworks.

In the first instance, it proved unfeasible to provide viewers with a full VR experience of the works due to the technical and budgetary constraints of the current version of the online exhibition. Head-mounted displays are synonymous with VR, and the physical encumbrance of wearing one is certainly an embodied aspect of the viewing experience. However, in the current version of the digital exhibition, the three VR films can only be viewed in a web browser as rendered videos (360° and 2D play-through videos). Because there is currently no uniformly adopted platform for sharing VR media, for practical purposes, we found that exported 360°, or 2D play-through video proved to be the safest way to both archive and share content remotely through an online presentation.

Because *Floating Walk* was originally created in 360° video, it is readily viewable online. For its part, *Anonymous* was exported as a 360° video. Original production considerations for this work took into account a seated viewing position and simple gaze interaction; however, the active engagement derived from looking at and interacting with objects was omitted from the 360° version. Additionally, it was determined that producing a 360° video version of *Sleeping Eyes* was not an applicable way to represent the work.

The viewer's interactive engagement within the film is integral to the narrative experience; these interactions include grabbing objects to trigger sounds, gamification elements that require viewers to perform movements such as avoiding lasers and a biofeedback sensor that connects the viewer's heart rate to values that affect audiovisual aesthetics. Complex interactive elements like these cannot be translated into 360° video. Instead, it was determined that a 2D play-through video that provides a first-person simulation experienced by the typical viewer would be more appropriate. The video represents the audiovisual and narrative aspects of the project and demonstrates how these interactions were intended to work. However, this format cannot deliver the actual phenomenological engagement provided by interactive navigable VR with HMDs and controllers.

Despite these technical limitations, the design of online exhibition online forced us to rethink some underlying presentational conventions. In the first instance, as demonstrated by the curatorial design strategy applied to *Floating Walk*, familiar gallery conventions were called upon to make the viewer comfortable with the virtual environment. This strategy supported the viewer's ability to access supplementary

materials related to each of the works and actively explore this content (informative and poetic artefacts, images, and texts). These materials enriched contextual understanding of the works, their genesis and framing stories.

The curatorial design framing the presentation of both *Anonymous* and *Sleeping Eyes* embraced the potential of the virtual exhibition more adventurously. In each of these cases, the VR films are contextualised in ways that would otherwise not be possible in a "real" gallery by creating unrealistic and exaggerated settings for these works to be experienced within. In a sense, instead of incorporating digital media "into" the exhibition, it is the visitor who finds themselves brought "inside" the narrative. These design interventions indicate the potential to interleave different spatial tropes in order to produce a more experiential scenography.

Conclusion

This paper has presented a timely opportunity to take account of the significant implications that the COVID-19 pandemic had upon the way in which we approached the staging of an exhibition of cinematic VR works. This unexpected situation forced us to reflect more directly upon the role of the exhibition, notably the ways that physical environments and embodied performativity contribute to the viewing experience of VR. Ultimately, we found these deliberations to be especially prescient, given that the subject of social isolation found itself represented both in the central themes found in this body of creative work and amplified by presentational issues facing their exhibition and viewing experience.

Finding ourselves in a situation wherein we needed to find a practicable way to present this series of VR projects, we discovered that we were faced with a larger intellectual challenge. This entailed reconceiving the very idea of what constitutes VR exhibition-making. In this regard, time-based scenography inspired us to rise to the challenge – not only those encountered with respect to issues surrounding the staging of the aforementioned examination exhibition – but to seize the curatorial opportunity for treating the exhibition as a means to reimagine the nature of viewing experiences involving 'a multisensory body, moving through multi-channel space and an elapsed time' [9].

Having negotiated this reconfiguration from a physical to virtual means of exhibiting VR works, we inevitably found ourselves reflecting upon what enduring impact the global pandemic might have on the ecosystem of the VR industry in coming years. Faced with the post-pandemic "reopening" of museums, galleries and arts festivals, it is to be expected that it will become increasingly difficult for shared headsets to be used if presenting VR artworks in public settings. In contrast, it is reasonable to anticipate that VR experiences will become more directed towards private consumption at home using personal devices than at present.

These implications raise a host of new opportunities to develop imaginative modes of VR exhibition-making that support rich, situated mixed reality experiences to connect people with place and counteract isolation and disconnected social circumstances.

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SUMMONING THE NEREID NERDZ: INVISIBILITY AND VISIONS WITHIN NETWORK ARCHITECTURES

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Abstract

This paper explores the impact of invisible and incomprehensible computational processes on human-technology relations via a series of multi-channel video installation art investigations. Historically, gaps in knowledge and understanding have often been filled with mystic and superstitious systems of belief. The spheres of computation, from network technologies to machine-learning, are equally susceptible. I explore how the use of metaphor both anthropomorphises and governs programming and systems design in ways that involve irrational thought systems, such as those associated with mysticism and superstition. This has informed my research in making the iterative networked video installations *Summoning the Nereid Nerdz* (2017) *Access Remote Fervour* (2018) and *Dense Bodies and Unknown Systems* (2021). In a 21st century context where art schools are being cannibalised and dissolved into larger amorphous institutional hybrids whilst, simultaneously, computer engineering faculties are staking claim as the rightful centres for creativity and imagination, this paper posits that historically informed creative research remains a formidable toolkit in understanding this current moment of the connected condition.

Keywords

Media Art, Computational Aesthetics, Installation Art,
Mysticism, Information History, Cybernetics,
Media Archeology, Romanticism



Figure 1. *Summoning the Nereid Nerds* (2018). Installation image. Photo: Jordan Munns

Introduction

How is the invisible and the unknown shaped by cultural attitudes? How does data shift between the seen and the unseen? Invisible, in this context, applies to both hard and soft network architectures: the hidden massive structures of server farms for offsite storage and the illegible processes of digital transmission and algorithmic manipulation. In contrast to conceptions of cloud technologies and data storage as being formless, quantised, wireless or ephemeral, I discuss how twenty-first century data architectures are housed and maintained by entirely nineteenth and twentieth century infrastructures, replete with excessive power draws and pollution. Furthermore, in jarring contrast to common conceptions of computing as an emblem of rationalist scientific innovation, many core processes carry out functions and actions that are unknown, invisible, impractical and confusing, as is frequently expressed by programmers employing the black box metaphor. This paradox of the visible and the invisible in network architectures, of form and formlessness, and of rationality and willful ignorance in understanding computational processes was the premise for my research and development of *Summoning the Nereid Nerdz* (2017), *Access Remote Fervour* (2018) and *Dense Bodies and Unknown Systems* (2021). The production and exhibition of which is logged

in this paper, accompanied by an elucidation upon how some of these paradoxical ideas contribute to a reinvestigation of romantic notions of the sublime. In *Summoning The Nereid Nerdz*, *Access Remote Fervour*, and *Dense Bodies and Unknown Systems*, the unseen and the unknown qualities of computation are represented as spectral figures clambering out of the multi-coloured, misty liquid, and reject ideas of computation as rational, egalitarian, technologically deterministic and emancipatory. The materials employed make reference to the industrial batteries, cooling tanks and rumbling servers that make up the contemporary offsite storage facility, and the apparitional images prompt the viewer to consider the formlessness of information and the unknown processes enabling our networked environment. As an artist and researcher, it is important to research, extrapolate and experiment with the aesthetics of lesser considered but necessary parts of networked computer systems and to seek past considerations from science and art.

The pursuit of aggregating all knowledge to create a utopian world of universal information access has a substantial legacy. There is an array of historical examples and of particular interest are the Library of Alexandria 300 BC to 150 AD [16] H.G Well's Information Society, articulated in 1904,[20] and Ferdinand Columbus' Universal Library of the sixteenth century.[28] It is only in very recent years, particularly after the great political shifts of 2016, that the techno-utopian belief of a peaceful, sustainable, self-regulating world will arrive with universal information access has been almost unanimously debunked.[4] Instead, the current dominant information tropes appear to be that of simplistic narratives, conspiracy theories, information silos, post-factual politics and environmentally catastrophic power draws are affecting global economic and political activities in real time. Sociologist Harry T. Dyer claims that we are seeing a *remystification* of the World Wide Web.[8] Whilst there is a seductive and compelling history of mystic properties being ascribed to new technologies, to re-mystify is to obscure and make opaque, a process of unknowing, unlearning and an unexpected departure from enlightenment principles.



Figure 2
Installation view, *Summoning the Nereid Nerdz* (2018)

The Cloud of Unknowing is an anonymous work of Christian mysticism written in the late half of the 14th century that has been revisited by twentieth century spiritualists such as Alan Watts and more recently by artist and researcher James Bridle.[4] Whilst the text speaks eloquently about love and humility, a driving impetus is to refute the ascertainment of knowledge:

And so I urge you, go after experience rather than knowledge.[2]

This mystic anonymous text has been revisited because it represents the unexpected side effect of having virtual access to supposedly all knowledge in this connected condition. Would Ferdinand Columbus or H.G Wells have predicted a wilful refute of information as a means to navigate this new networked terrain?

It is an interesting irony that the metaphor of the cloud for server farms that currently hosts a vast majority of the internet's information is also used as a metaphor for what is unknown. The association between clouds and the unknown has proved to be an enduring metaphorical connection, possibly because the human eye cannot see through clouds. Even in the era of enlightenment science, the theory of the Aether was developed as the speculative existence of a transmission medium that fills in space but cannot be seen. Isaac Newton speculated about invisible forces gaining density in his *Optiks* of 1718:

Doth not this aethereal medium in passing out of water, glass, crystal, and other compact and dense bodies in empty spaces, grow denser and denser by degrees, and by that means refract the rays of light.. And in passing from them to great distances, doth it not grow denser and denser perpetually, and thereby cause the gravity of those great bodies towards one another, and of their parts towards the bodies; every body endeavouring to go from the denser parts of the medium towards the rarer?[21]

The notions of the Aether and the "luminiferous aether" have continued to be terms of contemplation for physicists as a means of describing empty space as a form, discussed in Einstein's First Paper [21] in regards to relativity, by Nicola Tesla in theorising the empty space where electromagnetism by may exist and by Paul Dirac in the context of the speculative quantum vacuum. Both of which can be read about in Jagdish Mehra's *The Golden Age of Theoretical Physics*. [19] In both mystic and scientific traditions, the aether and cloudscapes existing just above us have stood in for what is unknown.

Cloud and remote server farms are now a dominant format for data storage and transmission but seldom cross into popular visibility or public discussion. Housed in offsite storage facilities managed by companies such as Google, Apple, Meta and Microsoft, the predicted estimated global data supply for 2025 is 180 zettabytes, or 1.8e+8 Terabytes. The power consumption of such facilities is large, with global usage for data storage estimated to be 30 billion watts annually, the equivalent total yearly output of 60 nuclear power stations. Whilst facilities with sustainable imperatives are being designed, heavily marketed and sporadically implemented, many of the largest data storage facilities or "carrier hotels" are retrofitted into the derelict

industrial spaces of the nineteenth and twentieth centuries. Here, former printing, manufacturing and automotive headquarters,[1] with strong floors, high ceilings and large elevator shafts, have allowed for the installation of industrial-sized server rows, backup generators and cooling systems. The large resource draw for such systems is only partially consumed by information processing and computation. The vast majority of water, fuel and power is dedicated to cooling systems and backup generators. As Douglas Alger notes in *The Art of the Data Centre*:

Data Centers have historically had a huge, negative impact upon their surrounding environment - consuming massive quantities of electric power and water, emitting pollutants through standby generator systems, and discarding materials detrimental to the environment in the form of UPS batteries and outdated computing hardware.[1]

The pollutants Alger refers to are the emissions of diesel backup engines that are kept running in standby mode, should there be an unexpected power failure. In Silicon Valley, many data centres feature on California's Toxic Contaminant Inventory.[3] Most data storage facilities run at full capacity, regardless of traffic or demand levels.[12] The water and power consumption of intensive hosting infrastructure could be compared with that of intensive farming practices and it is vital to include the aesthetics of these infrastructures when considering the landscape of the network. In addition to backup diesel engines, cooling tanks and high powered fans, industrial-sized lead-acid batteries, requiring regular replacement, provide a tertiary level of backup to avoid even a microsecond of loss in connectivity in the chance of both a power and diesel engine failure.

With escalating demand for bandwidth and growing person data consumption, it has been argued that the architectures of the digital age are being supported entirely by infrastructures of the industrial age, an arrangement that seems increasingly in opposition to sustained scalability.[11] It is this idea of industrial support systems for digital material that warrants particular aesthetic exploration. Such infrastructures and their processes remain largely invisible in popular conceptions of the network and warrant substantial aesthetic research. They remain systems and spaces with tangible inputs and outputs (data sent, data retrieved) but their processing and functionality remain largely unknown and invisible to all users of networked technology not directly employed in its facilitation and maintenance. They are effectively black boxes.

The term black box was adopted in the mid-twentieth century to explain a device, system or object that has quantifiable inputs and outputs, but where the process of computation or change is otherwise unknown. This is important in understanding the seen and unseen in network aesthetics, as it is a blanket metaphor applied to unknown transformations. In simple terms, the black box model can be applied to any process where there is an observable stimulus (input) and result (output) but the process through which this is achieved remains unknown.[17] It is defined by Norbert Wiener as 'an unknown system'.[27] In terms of logic systems, a black box could be akin to the x we understand in mathematics, although, whilst mathematics always endeavors to determine a value for x , the processes

and complexities of transformation within the black box can be deliberately and permanently marked as unknown or irrelevant. Mario Bunge and Martin Mahner explain in their essay *Function and Functionalism: A Synthetic Perspective* [17] that some black box processes are willfully overlooked (an example is an accountant only interested in the expenditure and income of a business, less the complexities of the cultural interactions that contribute to these figures), as well as processes currently obscured from human comprehensive analysis, such as algorithms engaging with big data sets, machine-learning and personalised information feeds.

The computational metaphor of the black box is of most importance in understanding the threshold within the network of the seen and the unseen, because it applies both to what is impossible to understand and what is wilfully ignored. Two of these I examine are 1) The unseen but nonetheless real spaces of remote data storage facilities, hidden and often less considered by the users of networked technology, and 2) the unknowable functionality of algorithms, machine-learning and their increased presence in the construction of the self. Wendy Hui Kyong Chun describes the black box as 'a powerful metaphor for everything we believe is invisible yet generates visible effects, from genetics to the invisible hand of the market, from ideology to culture'.[7] The black box metaphor is particularly important as it conflicts with a rationalist approach, whereby end objectives are to understand the workings of everything by way of observation and categorisation. The black box metaphor renders invisible sectors of computing as unknowable.

Chun's *Programmed Visions: Software and Memory* demonstrates with multiple examples how the unseen and unknown processing of software is likened to spectres, ghosts and apparitions in both developer communities and amongst users.[7] In her chapter "Daemonic Interfaces, Empowering Obfuscations", she reminds the reader that daemons (the name for algorithms that run background tasks on operating systems, such as a mailer daemon that makes repeated attempts to send mail but returns it to sender if the recipient address is unknown) are called such after daemons in Greek mythology. This term arose in 1963 at MIT's computer networking initiative Project MAC, which was the first iteration of MIT's AI. Lab.[6] As is the case with many programming metaphors, the term daemon started as a colloquial name to refer to background processing, but became its official term.[9]

A daemon in Plato's Symposium (c. 385-370 BC) is defined as 'a mean between fair and foul, good and evil... an intermediate power who conveys to the gods the prayers of men, and to men the commands of the gods' and has legacy in later classical literature (such as by Homer c.7 BC) as agents of hidden, benevolent work. Interesting to note in the classic definition is that a daemon is not necessarily malevolent, but autonomous in its actions and behaviour. One may speculate upon how these same character attributes came to be commonly ascribed to artificial intelligence. Brian Cantwell-Smith's interesting treatise on the social influences of computational innovation, *On the Origin of Objects*, [24] discusses the bi-directional processes between metaphor and innovation:

As so often happens, especially when a field is young, computer science employs terms and concepts borrowed from another place and time, using them initially in an essentially metaphorical way, but so as to gradually stretch their meaning until, as the community develops a surer sense of the layout and geography of the new terrain, they come to have literal, but computationally specific meanings. [24]

In so many senses, the lexicon of computation is a grand, metaphorical realm of evocative poetry. Seldom are new words invented to describe new technologies or systems, almost always words are taken from somewhere else. This is something that I indicate in my choice of materials in these works, especially when so many terms, such as clouds, fogs, mists and torrents, connect with the supernatural, the gothic and the romantic. Wendy Hui Kyong Chun reinforces this idea that supernatural metaphors and lenses are applied to the digital processing that occurs in the unseen or unknown spaces of computing:

Central processes for computation [are rendered] daemonic: orphaned yet 'supernatural' beings between gods and men, the undead, deified heroes. Indeed the interface is haunted by processes hidden by our seemingly transparent GUIs that make us even more vulnerable online, from malicious 'back doors' to mundane data gathering systems.[7]

Examining technology with a supernatural lens is a practice that predates historical record, particularly if we consider the shamanistic purposes of glyphs and creative mark-making as human-technology relations. This has been widely expanded upon by Jeffrey Sconce in *Haunted media* [22] and is evidenced below with Giovanni Fontana's drawing from circa 1420, of a figure with a lantern projecting a winged demon. In this drawing, the knowledge gap, or black box, of the apparitional demon is made explicit via the demonstration of the projector's functionality.

Fontana, in 1420, is enforcing that we project superstitious qualities upon new technologies. Sconce argues that the 1844 advent of the electromagnetic telegraph system and its code, developed by artist Samuel Morse, was the beginning of "disembodied communication" whereby, for the first time in human history, a human could send an immediate message without the delivery needing to be performed by a physical body.[22] The birth of the telegraph, radio and camera coincided with the emergence of the modern spiritualist movement and the advent of mesmerism, seances and performances by psychic mediums. As these technologies could channel the unseen and disembodied, such as receive telegrams from those in remote locations or reveal in photography that which is invisible to the human eye, there was a wave of pursuits and experiments to contact speculative entities also unseen, such as sprites, ghosts or the extra-terrestrial.[22]



Figure 3
Giovanni Fontana's drawing from circa 1420 of a figure with lantern projecting a winged demon. Johannes de Fontana, *Bellicorum instrumentorum liber* (1420)

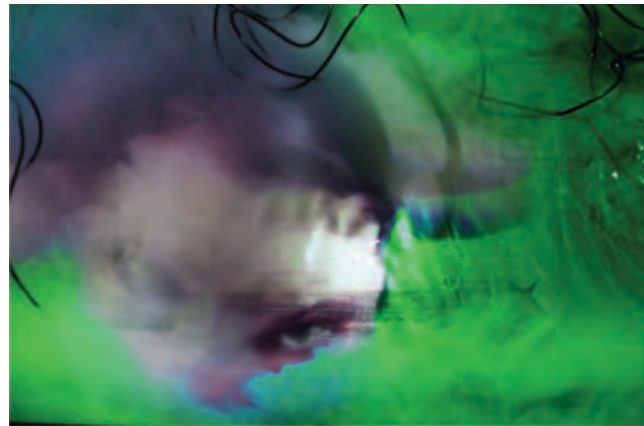


Figure 4
Summoning the Nereid Nerdz (2017)
Acrylic, water, looped video with sound, electronics
230 x 90 x 20 cm
Installation detail

This interplay between the seen and the unseen, between form and formlessness, between disembodiment and embodiment, between the digital and the industrial all contributed to *Summoning the Nereid Nerdz* (2018) that was researched, produced and first installed at Griffith University Art Museum in Brisbane. The video installation comprises a tank (240x92x20 cm) that is suspended from the museum ceiling so that it hangs 50 centimetres from the floor. In the tank are two 10 head ultrasonic misters, 250 litres of water and some sculpturally manipulated aluminium bonsai wire. When activated, the ultrasonic misters produce a thick cloud of vaporised water particles that spread across the surface of the water – a thick mist about 5 cm high nestles below the top lip of the tank. This misty surface becomes an undulating screen for the video projected from above. The video is a looped sequence depicting several different bodies emerging from beneath

the surface of a luridly coloured body of water. Their faces and bodies float to the surface, take a breath and clamber out, one after another. The colour of the surface of the water changes cyclically, moving from various hues of blue, purple, yellow, orange and green.

Figures appear in the mist in a non-fixed and transient way. Depending on the number of viewers in the museum space and whether there is any breeze from open doors or air conditioning systems, figures either billow up above the mist, taking on a life-sized, holographic, three-dimensional appearance, or sit flat and thickly on the still mist settled in the confines of the tank. The infrastructure of a heavy tank of water, a mess of cables and the sounds of the machines at work all reference the industrial architectures that house data. The mist itself marks the steam which powered the industrial revolution. The apparitional forms appearing in the mist can reference both the spritely interactions with other humans via the social network as well as the anthropomorphism for algorithms and unseen functionality. There is a common colloquialism for social media users, 'don't feed the trolls', and increasingly one would define a troll not as a fictional ogre from fairy tales but a disembodied malevolent destructive online force. The title, *Summoning the Nereid Nerdz*, provides references to classical mythology, with 19th century spiritualist techniques used to summon foreign entities via new communication technologies and the generative colloquialisms and interactions of online entities.

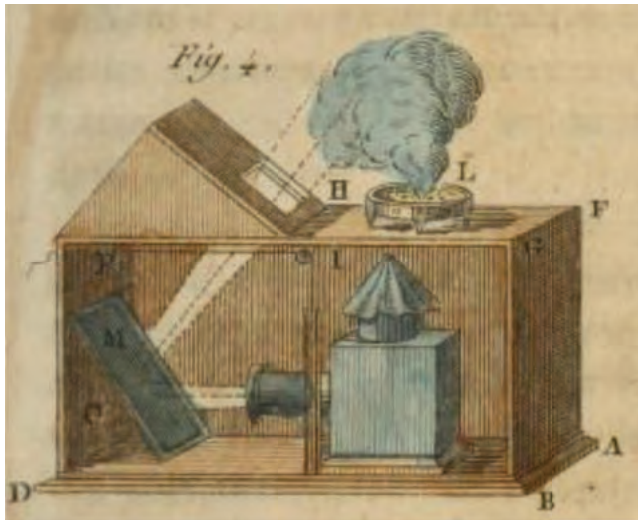


Figure 5
Illustration of hidden magic lantern projection on smoke
in Guyot's *Nouvelles récréations physiques et mathématiques* (1770)

Only after development and installation of the work, was it obvious that the apparitional quality of bodies appearing in atomised water particles references the pre-cinema magic lantern technology of the phantasmagoria popularised by Paul Philidor in 1792. Douglas Small writes about the advent of the phantasmagoria as a technology that was described as both transcendental yet materialistic. The earliest iterations were costly and occupied whole rooms of aristocratic mansions. As he noted in his thesis *Dementia's*

Jester: The Phantasmagoria in Metaphor and Aesthetics from 1700-1900:

The aesthetic which is derived from the phantasmagoria is... one which is deeply rooted in material culture. At the same time, it purports to depict something of the romantic, disordered quality of dreams. [13]

The phantasmagoria is interesting because it demonstrates enduring paradoxes in our attitudes towards technology. The artefact emblemises both innovation in scientific display technologies and a spectacular fetishisation of such a technology. As Small suggests, it embodies 'something deeply rooted in material culture', that is, the commercial storage and trade of objects, whilst simultaneously depicts 'something of the romantic disordered quality of dreams'. [24] This paradox between form and formlessness, between hidden server farms and ephemeral spectacle is an enduring characteristic of network aesthetics.



Figure 6. *Summoning the Nereid Nerdz* (2017)
Acrylic, water, looped video with sound, electronics
230 x 90 x 20 cm
Installation image

The use of water in this work contributes to traditions of other artists' use of it as a medium in video installation art, such as Bill Viola and Cecile B Evans. It is interesting to note the use of water metaphors to explore the otherwise invisible or difficult to comprehend passages of power and information. These include, but are not limited to, the currents of electricity, torrents of data, the streaming of

content, Twitter storms, channels of information, skimming articles with the eye as a pebble would skip across a pond, waves of media cycles, data fog, and those who surf the Internet as a means to explain the act of browsing. Sconce argues that water metaphors are most frequently employed because there is something unknowable about the changing currents, channels and behaviors of water in nature.[23]

To link that which is unknowable with occurrences in nature was a preoccupation of the nineteenth century romantic movement, aligned with Kant's notion of the sublime, which he defined as beauty that can be found in a formless object. This oxymoronic "formless object" is what is explored in *Summoning the Nereid Nerdz* (2017) via the use of heavy tanks and apparitional figures in mist, in the pursuit of what Lev Manovich posits might be 'the form of information'.[18] Chun furthers this by explaining how complex network architectures are increasingly aligned with the natural world, in that it comprises what is known and what is unknown; 'this paradoxical combination of visibility and invisibility, of rational causality and profound ignorance, grounds the computer as an attractive model for the natural world'.[18]

The sublime manifested in raging cataracts, perilous views from mountain tops, the forces of nature, expanses of uninhabitable landscape, the infinity of space and time, but also breath-taking artificial structures and powerful machinery. The concept of the romantic sublime provided a substitute for Christian cosmology displaced by the growth of science.[10]

And what is the sub-lime? It has something in common with the beautiful, but it is not order and harmony, and it does not necessarily give pleasure. Indeed, it can invoke the opposite sensation of being overwhelmed by the huge, the chaotic, and even the ugly, making one feel ecstatic to the point of pain, intensely alive and yet yearn for death.[25]

The huge, the chaotic and the ugly manifest in the aesthetics of offsite server farms and our inability to comprehend the macro-computations of big data algorithms. As Tuan suggests in *Romantic Geography*,[25] the sublime contains paradoxes of attraction and repulsion, of seen and unseen forces, of knowing and not knowing.

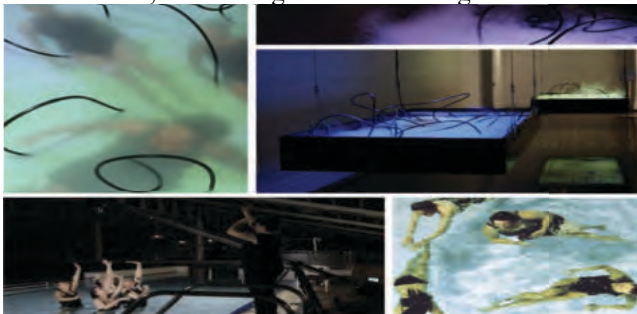


Figure 7.
Access Remote Fervour (2017-2020)
 Acrylic, water, looped video with sound, electronics
 Two parts, each 240 x 90 x 20 cm
 Production and installation images

But everything, dear friend, nowadays, is ultra, everything is perpetually transcendent in thought as in action. No one knows himself any longer, no one understands the elements in which he moves and walks ... Young people are excited much too early and then carried away in the whirl of time. Wealth and vapidity are what the world admires and what everything strives to attain.
 Wolfgang von Goethe[15]

The romantic period is pertinent to this, although it may not initially seem so. Identified generally as an era spanning the late-18th to the mid-19th centuries, the reactionary romantic movement spanned literature, music, art, and craftsmanship, and occurred at the intersection of Europe's transition from an old world order to the new. In the 18th century, aristocracy still ruled the cultural imagination, but the romantic period captured the introduction of the new world orders of capitalism, industrialism, the advent of mass-printing and advances in science and telecommunication technologies. It is interesting to consider that romanticism has been cited as the first reactionary art movement.[5] Whether this was speculative horror at scientific advancements, as presented in Shelley's 1818 gothic novel *Frankenstein* [23] or the preference for introspective emotional truths over consumerist rationality, as explored by Goethe, criticality presented by romantic artists, to the times in which they lived, could be presented as a lens with which we can apply to the cultures of Silicon Valley innovation, machine-learning and agency in the politics of information ownership. The above excerpt, *Everything is Ultra*, written by Goethe to a friend, reads really no differently to how a contemporary writer may explain the connected condition.

We are swimming upstream against a great torrent of disorganisation, which tends to reduce everything to the heat death of equilibrium and sameness described in the second law of thermodynamics..... In this, our main obligation is to establish arbitrary enclaves of order and system. These enclaves will not remain there indefinitely by any momentum of their own after we have once established them. Like the Red Queen, we cannot stay where we are without running as fast as we can. We are not fighting for a definitive victory in the indefinite future. It is the greatest possible victory to be, to continue to be, and to have been. No defeat can deprive us of the success of having existed for some moment of time in a universe that seems indifferent to us.[26]

With the exception of a reference to thermo-dynamics, one could easily wrongfully guess this lengthy passage has been lifted from a passage by Romantic writers Goethe or Keats, yet is it actually an excerpt from cybernetician Norbert Wiener's *I am a Mathematician*. [26] One would not expect an excerpt from a post-war twentieth century mathematician to demonstrate so many characteristics of the romantic genre: noble, ill-fated struggle, the sublime chaos of matter, the pursuit of virtue in the face of certain failure, and melancholically euphoric existentialism. I make note of this for several reasons, one is to challenge once more reductionist assumptions for understanding and mapping information technology as belonging to purely abstracted

science, to reiterate that the mono-culture of forward-looking informaticists currently at the helm of innovation is decidedly new and to reinstate the language and attitudes of romanticism in current technological research. The excerpt again describes the aesthetics of networks as entropic, ephemeral, sublime and omnipotent. Ultimately, this excerpt attests that the very figure who argued that every behaviour in the universe could be mapped as an actant in a complex system, the father of cybernetics, is here writing that our fallible purpose is to carve out “arbitrary enclaves of order” and to swim “upstream against the torrents of disorganisation” to prevent “the heat death of equilibrium.” It can serve as evidence that the technological sublime is something on the minds of scientists as much as ultra-speeds of communication was on the minds of romantic writers.

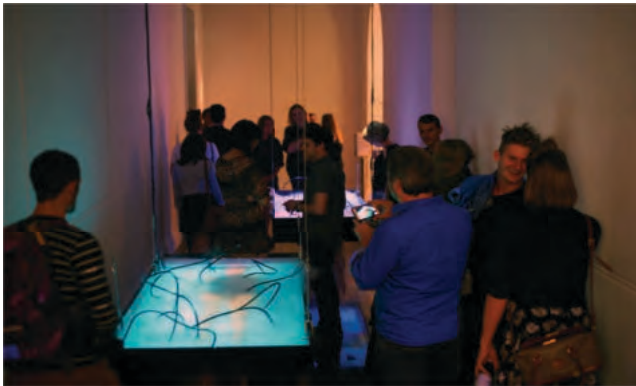


Figure 9 *Access Remote Fervour* (2017)
Acrylic, water, looped video with sound, electronics
Two parts, each 240 x 90 x 20 cm
Installation image

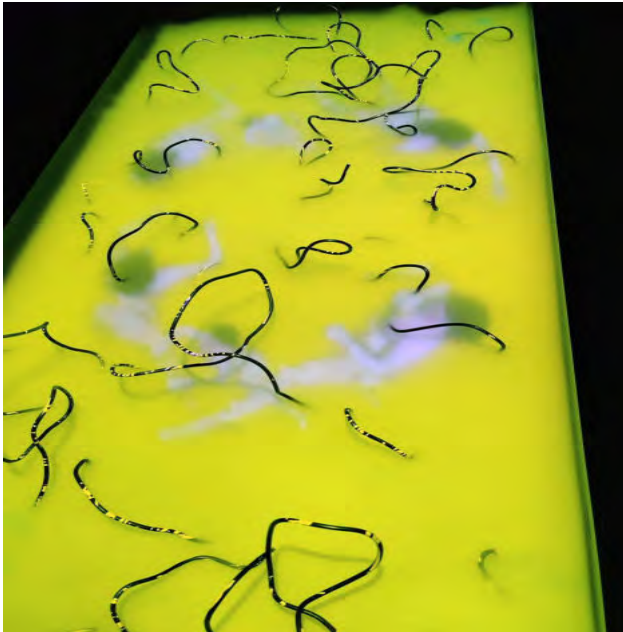


Figure 11 *Dense Bodies and Unknown Systems* (2021) Acrylic, water, looped video with sound, electronics. 3 parts, each 240 x 90 x 20 cm. Installation Detail.



Figure 10 *Dense Bodies and Unknown Systems* (2021)
Acrylic, water, looped video with sound, electronics
3 parts, each 240 x 90 x 20 cm

This format for installation has been iterated into both two channel and three channel works. *Access Remote Fervour* (2018) and most recently *Dense Bodies and Unknown Systems* in (2021) installed at the Art Gallery of South Australia. In *Summoning The Nereid Nerdz*, *Access Remote Fervour*, and *Dense Bodies and Unknown Systems*, the unseen and the unknown qualities of computation are represented in the spectral figures clambering out of the multi-coloured liquid, and function as media art metaphors that explicitly reject ideas of computation as rational, egalitarian, technologically deterministic and emancipatory. The materials employed make reference to the industrial batteries, cooling tanks and rumbling servers that make up the contemporary offsite storage facility, and the apparitional images prompt the viewer to consider the formlessness of information and the unknown processes enabling our networked environment. As an artist and researcher, it is important to explore, extrapolate and experiment with the aesthetics of lesser considered but necessary parts of networked computer systems and to seek past considerations from science and art.

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NUAGE: A Digital Live Audiovisual Arts Tangible Interface

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Abstract

This paper presents a literature review rooted in Human-Computer Interaction research as the methodological basis for the proposal of a tangible interface called NUAGE. It is aimed at artists, performers and designers in the research field of Digital Live Audiovisual Arts.

Audiovisual performance combines musical and video arts together in a live artistic context. Tools to create such performances are often only software and do not provide the artists a wide range of interaction possibilities. A show where the performer's actions are hidden behind his/her computer screen can be visually less interesting. To provide guidance to designers and help them branch out from the traditional graphical user interfaces, we propose a different and structured design approach, Digital Live Audiovisual Arts, that builds upon Tangible Interaction concepts. We map Digital Live Audiovisual Arts by investigating its distinctive design intentions (expressiveness, performativity, participation, aesthetics and engagement) and proposing interface types taxonomy. To implement and validate this novel methodology, we developed NUAGE, an original performative interface. We thus bring together different perspectives on understanding Human-Computer Interaction and set a platform for future research on artistic tangible systems.

Keywords

Tangible Interaction, Tangible User Interface, Digital Live Audiovisual Arts, Audience Experience, User Experience, Human-Computer Interaction

Introduction

Software-based music and video applications are widely used, easily accessible and have introduced new sounds and possibilities. However, a "Laptop Show", where the actions of the performer are hidden behind a screen, is definitively less interesting and comprehensive for an audience than seeing an artist perform with a complex instrument [25, 36]. As wittily highlighted by Klemmer et al., how can the audience know that "*the performer is not just checking his email?*" [23].

Aside from computers, new kinds of hardware tools have been developed to support and enhance audiovisual (AV) performers practice. Examples are the reacTable [21], the Live Cinema Instrument [25] and the uPoi [45]. Those interfaces



Figure 1: NUAGE interface prototype during audiovisual tests

seem to be a good alternative to laptops, providing more visibility and affordance to AV performances. However, hardware tools are not as easily accessible as software tools. Artists who make their own tools are often self-taught and may not have proper knowledge on how to build such interfaces. Moreover, there is a lack of scientific literature identifying the particular design requirements of AV instruments [30].

This paper addresses this problem by presenting a new promising approach, Digital Live Audiovisual Arts (DLAA). DLAA is a methodology that provides designers, artists and makers a structured understanding of the design needs of AV performative instruments. This, we hope, will foster research and design to branch out from the common computer interfaces and develop better suited and accessible interaction devices for both the user and the audience.

The following sections aim to map the novel DLAA approach. We start by defining its conceptual foundations to give the reader a better understanding of its main concepts. We then present the DLAA design approach by identifying

the distinctive intentions that can be achieved using tangible interfaces as performative AV instruments. Next, we introduce the DLAA taxonomy to identify the different design implementation types.

In the last section of this paper we put the DLAA methodology into action. We present NUAGE, an original AV interface developed using the DLAA approach. NUAGE is an interface made to control audio and video content in a live, real-time context. A picture of the interface can be seen in Figure 1. NUAGE is aimed to be used by an artist during a performance in front of an audience. The prototyping of the interface allowed us to test and validate the DLAA method.

Digital Live Audiovisual Arts

DLAA is a novel design approach that builds upon Tangible Interaction principles to guide the development of AV performative instruments.

Tangible Interaction takes its roots in Ishii and Ullmer own updated vision of Human-Computer Interaction (HCI) [18]. In 1997, they introduced the concept of Tangible User Interfaces (TUIs). Different from the traditional Graphical User Interfaces (GUIs), where “painted bits” on a screen are controlled by a mouse, a keyboard or a tactile interface, TUIs aimed for a more engaging and seamless relationship with the digital world. Ishii’s “tangible bits” concept focus on the physical representation of digital information, exploiting the richness of possible interfaces given by the “real” physical world [18].

Building upon those concepts, Hornecker and Buur Tangible Interaction framework focus less on the design of the visible interface but on the design of the interaction itself [11]. Apart from Ishii data-centered viewpoint on tangibles, their vision also includes action-centered viewpoints like movement, body and space centered interaction design. Tangible Interaction is an umbrella term describing an interdisciplinary research field encompassing HCI, Computer Science, Product and Industrial Design and Interactive Art studies, among others [12]. Hornecker and Buur described the characteristics of such systems and interfaces with four main design principles: tangibility and materiality, physical embodiment of data, bodily interaction and real space embeddedness [11]. The proposed model is thus based on these concepts.

The term “Digital Live Audiovisual Arts” is used in this paper in a nod to the term Digital Live Art (DLA) that was proposed in Sheridan et al. paper and described as “*the intersection of live art, computing and human-computer interaction*” [46]. By adding the “Audiovisual” term to DLA we bring together the notions of real-time AV performance, Tangible Interaction, Human-Computer Interaction, User Experience, computer-based art and artistic intent. DLAA has the particularity to combine different artistic design intentions such as expressiveness, performativity, participation, aesthetics and engagement under a single and common approach in cohesion with AV performances design requirements. Furthermore, it allows to study such intentions from the perspective of a direct user, the performer, and from the perspective of other people involved in the interaction, i.e. the audience.

Proposed Design Intentions Approach for Digital Live Audiovisual Arts

We present in this section our DLAA design approach structured by five main and distinctive design intentions: Expressiveness, Performativity, Participation, Aesthetics and Engagement. Those design intentions offer a wide perspective on the different goals a designer may want to achieve by developing AV performative instruments. While the design of Tangible Interaction systems has been studied before to pursue each of those intentions individually (examples are: [13, 21, 31, 37, 41, 45, 52]), DLAA has the particularity to bring all those key intentions together under a single and common approach that offers conceptual design guidance. Furthermore, it allows to study such intentions from a direct user’s perspective and from an observer’s perspective.

The five DLAA design intentions are defined in the following subsections. Examples and explanations on how they can be enhanced by Tangible Interaction guiding concepts are provided. Table 1 offers a summary on how those principles (physical embodiment of data, materiality, affordance, real-space embeddedness, bodily interaction) apply to the design intentions approach.

Expressiveness

Expressiveness can be described as the ability to transmit one’s emotions and intentions through his/her action. Expression is achieved in various ways with TUIs.

By analysing VJ practice, Hook et al. identified how TUIs help the artist express him/herself. They identified themes linked to affordance, physicality and the importance of liveness in the practice [10].

Ross and Keyson developed principles for designing expressive tangible interfaces[41]. The context and the nature of the interaction, as well as the different physical properties of the interface can enable creativity and expression in various ways. The authors give the example of a door, which can be hardly slammed or softly closed to express different emotions. They also highlighted how expressiveness is subjective and that it may be experienced differently by one another. Therefore, such individualism should be considered, allowed and maybe enhanced by the interface.

Correia and Tanaka interviews with AV performers highlighted the fact that artists want “*to be able to make visuals like a musician*” and *the desire to play an AV tool with the same expressivity and fluency as a traditional musical instrument.*” [6] The fact that the interface must be easy to use and flexible is also a way to make it expressive. On the other hand, complex interface can allow the user to become skilled and therefore explore and be creative [10].

Performativity

Performance is another key concept of DLAA. Hornecker and Buur stated that:

“Performativity implies that the detailed HOW of doing something is an integral part of the action’s communicative effect. [...] As an aside, performativity can be enhanced by tangible manipulation, as the material objects are visible as well and may require large movements” [11].

Table 1: Summary of the Digital Live Audiovisual Arts Design Intentions Approach

Design Intentions	Expressiveness	Performativity	Participation	Aesthetics	Engagement
Tangible Interaction principles	Affordance Physicality Liveness Individuality Complexity	Visibility Intuitiveness Unobtrusiveness Flexibility Intriguingness	Collaboration Modularity Controllability Understandability Multi-user	Attractiveness Enjoyment Resonance Coherence Appeal	Representativity Attention Involvement Usability Endurability

TUIs benefit to performance in various ways. Sheridan and Bryan-Kinns proposed guidelines on how to design interactive tangibles for performance [45]. Focusing on live and in-the-field performance, they iteratively design the uPoi and came up with six requirements. The design must be Intuitive (Responsive), Unobtrusive, Enticing (Visible and Attractive), Portable, Robust and Flexible (Controllable).

The studies of Correia and Tanaka showed that the majority of artists are concerned about whether or not the audience understands and feels the liveness of their practice [6]. The VJacket [53], was designed to enhance a VJ’s performance, making his/her movement connected with the video and therefore more visible to the audience.

Paradiso explains how tangible modular synthesizer attract the audience in shows [34]. The researcher stated that the sight of such an intriguing and complex instrument fascinates the public, which is indeed great for a performance. Jordà also stated that the visual feedback given by the reacTable brings “*the physical performance back to live computer music*”[22]. This helps the public understand the performance.

Participation

The participation DLAA design intention illustrates the relation between different artists that perform and create together. Participation also highlights the importance of the relation between the artist and the audience. The following examples demonstrate how some particularities of Tangible Interaction can contribute to this intention.

Collaboration between artists

Like highlighted by Jordà, few musical instruments are multi-user, still, music is well known to be a group (or band) [22]. The design of TUIs can address this issue. The reacTable [21], is an example of novel musical instrument explicitly made to promote collaboration. Its multi-user and shared-control tabletop interface enhance participation. Many researches state that tabletops are well suited for collaboration and a lot of collaborative tangible tools are based on that same principle [44, 48].

The Polymetros [4] is another example of musical instrument that promotes collaborative music-making. Developed for a wide and novice public, it consists of several illuminated buttons panels connected to a central hub. The physical presence of the individual alike panels as well as their disposition around the central hub invites to collaboration. The authors identified that the “sense of control” over their own contribution is very important for participants in a collaborative process. Each participant must be able to easily identify what they individually bring to the performance and what other participants individually add too. This can be achieved

with clear visual and audio feedbacks related with the participants actions.

Audience shift from spectator to performer

Tangibles can enhance audience participation in different ways. Discussed earlier, visual feedback can help the audience appreciate their experience. Another way to enhance their experience is by letting them be a part of the performance.

Sheridan et al. framework categorised the different stages of the audience involvement in a digital live art context [46]. They examined the transition between the audience’s behaviors of “spectating”, “participating” and “performing”. Spectating can be described as a passive awareness that a performance is going on. The audience does not interact with the performance, is simply watching and might not understand what is going on. Participating starts when the audience engage with the performance, interacts simply with it even though they do not fully understand its frame. The performing stage arises when the audience has gained skills and understand the meaning of its actions. This is when the audience can start to express itself and be creative.

To favorize the transition from spectating to performing, it is important that the audience understand how they can interact with the performance. While testing the uPoi, Sheridan and Bryan-Kinns tried to rise the audience attention by costuming herself, making her prototype visually interesting and having experts already performing with the object [45]. Taylor et al. reported that the intriguing nature of their tabletop video instrument attracted the audience to come try and play with it[49]. To encourage participation, a clear, direct, real-time correlation must be understandable between the real-life interactions and the digital outputs of the TUI. Affordance here is the key; some materials, sizes and shapes might suggest different interaction ways and outputs than others.

Aesthetics

Aesthetic is the affective appeal, perceived beauty, attractiveness and enjoyment we feel for certain characteristics of objects [8, 33, 37].

Shaer et al. survey on tangibles identified aesthetics as a promising field of research in TUIs [43]. Some researchers focused on the aesthetics of the physical elements of tangible objects, others on the aesthetics of interactions. The authors stated that “*arts-based research often aims for a poetic aesthetic that goes beyond form*”.

Hummels et al. research on aesthetic tangibles focused on their resonant aspects [13]. The appearance of an object must be coherent with its use, its purpose and its feedback. Petrelli et al. studied how the aesthetics of hybrid objects are

perceived by humans [37]. Objects mixing different sizes, shapes, materials and behaviours were evaluated to determine what impressions they gave to people. The researchers identified subjective attributes like “Interesting, Comfortable, Playful, Surprising, Pleasant, Special and Relaxing” to describe the objects. Their results show that certain aesthetics should be preferred to achieve certain impressions. Djajadiningrat et al. paper highlights that the visual appeal is not the only important aspect of aesthetics to consider when designing tangibles, the aesthetics of the interaction we have with the objects must also be considered [8].

Engagement

Engagement is the capacity of gaining one’s attention or devotion, maintaining it and doing it for a long period of time [27]. Different factors constituting engagement are defined in O’Brien and Toms paper: perceived usability, aesthetic appeal, novelty, felt involvement, focused attention, and endurance [32].

In DLAA, we are interested in the artist engagement towards his/her tools and methods, but we are also interested in the audience engagement toward a performance in which the artist is using tangible digital instruments.

User engagement

Csikszentmihalyi flow theory [7] propose that continued immersion and enjoyment comes from the balance between skills and challenges in one’s interaction. Building from this idea, the Wyeth framework [52] describes how the balance of TUI attributes, its representational and control qualities, leads to a more engaging use of tangible systems. As previously seen in the expressive design intention section, complexity and flexibility of interface controls are qualities desired by artists. Again, the role of a strong representation of the digital data, whether in a tangible or digital overlaying way allows for an affordable and intuitive understanding of the interface.

Audience engagement

Using appealing visible and comprehensible interfaces is also a good way to maintain the audience attention. In a laptop-based show, the audience may perceive the artist to lack of control over the occurring performance, due to his/her minimal or hidden actions. This can lead to a lost of interest and attention in the performance and therefore a lost of engagement [36]. Furthermore, encouraging the public to participate is way to make them feel involve in a performance. Those two ideas have been developed in the previous sections.

Digital Live Audiovisual Arts Interface Types

Building on previous categorisations of tangible systems[19, 24, 50, 51], the DLAA design approach proposes to structure the different tangible interface architectures possibilities in a way that applies more specifically to the peculiarities of AV performative systems. The following seven different interface types are proposed: Interactive surface, Constructive assembly, Token+constraint, Pressure-based interface, Wearable, Motion-based interface and Augmented common instruments. Figure 2 illustrates such concepts. We added the concepts of pressure-based, wearables and motion-based interfaces to the already existing notions of interactive surface,

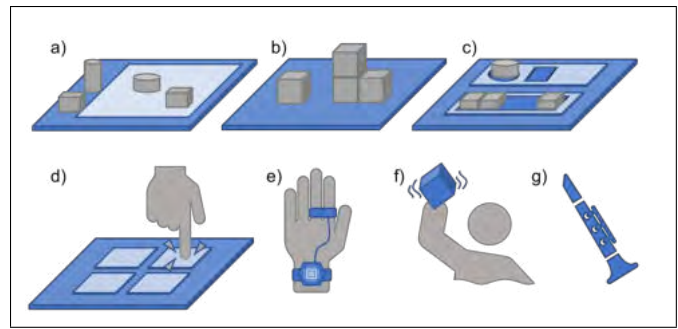


Figure 2: Loose illustration of different types of interfaces: a) Interactive surface, b) Constructive assembly, c) Token+constraint, Inspired by [51], d) Pressure-based interface, e) Wearable, f) Motion-based interface, g) Augmented common instrument

constructive assembly and token+constraint systems. Our last category “augmented common instruments” is similar to the “augmented everyday objects” one presented by Ishii but is adapted to AV instruments [19]. It is important to note that AV tangibles interfaces are not necessarily confined into those categories and can combine two or more types of architectures into one.

One goal of this categorisation is to highlight the wide set of design tools available to designers while creating an interface. It provides practitioners with an overview of the design possibilities within DLAA. This section will also highlight how certain types of interface foster the design intentions mentioned in the previous section (see Table 2). Thus, this will help designers to better communicate, justify and evaluate their design choices.

Interactive Surfaces or Tabletops

Typical tabletop tangible systems contain physical objects whose presence and movements are tracked on top of a graphically augmented surface [19]. Those types of tangibles are frequent in digital live arts, perhaps the most known example is the reacTable [21]. Other examples are the mixiTUI [36], the Audiopad [35], the Media Crate [3] and the VPlay [49].

Constructive Assemblies

This second type of interface is based upon building blocks and LEGO™. This architecture implies the modular construction of a system created by the physical connection of objects or by the near placement of such objects [19]. The AudioCubes [42] are one example of nearby constructive assembly. Digital modular synthesizer can be classed as constructive assembly. They consist of several different modules who have compatible hardware connectors, that when patched together enable various sounds. By adding different patch connections, the artist creates unique music. Building on this concept, block assembly mimicking the behaviour of modular have emerged like Block Jam [31] and the Patchblocks [28].

Table 2: Implementation types and their associated design intentions

Design intentions / Implementation types	Expressiveness	Performativity	Participation	Aesthetics	Engagement
Interactive surface			X		X
Constructive assembly	X	X			X
Token+constraint	X				X
Pressure-based interface			X		X
Wearable	X	X		X	
Motion-based interface	X	X	X	X	
Augmented common instrument	X	X	X		

Token+Constraints

Ullmer et al. give a very exhaustive description of the token+constraint tangible interface type: “tokens are discrete, spatially reconfigurable physical objects that typically represent digital information. Constraints are confining regions within which tokens can be placed” [51]. In this architecture, the physical tokens can be manipulated and associated within the spatial or mechanical constraints of the system. The Log-Jam [5] system is an example of such architecture.

Pressure-Based Interfaces

Pressure-based interfaces are systems that responds to a physical force applied on them or on their components. Pressure-based interfaces can be mechanical switches, like the common and simple push-buttons. They can also be reactive to impact or sense the amount of pressure applied on them. Examples are MIDI piano-like keyboards, pads and haptic sensors surfaces [9, 26, 40]. The Polymetros [4] system is another example.

Wearables

Wearable systems are in continuous physical contact with the user’s body, unlike others forms of interfaces [38]. They can be used to track the user’s movement, like for example in the VJacket project [53], where sensors were integrated into clothing and the dancing movement of the user were used to interact with video projections. In the WaveForm system [2], the glasses and gloves worn by the user are used by the system to track the position and the movement of the user. The in-air gestures of the user are used to control video animations on a distant display.

Motion-Based Interfaces

Motion-based systems react to the physical displacement, acceleration or movement of the interface. For example, the maracas-like Rhythmism systems [20] need to be shaken or turned to modify the visual effects on a video. The uPoi [45] generates different visual and sounds according to the acceleration of the instrument when swung around the body of the performer. The Ashitaka [29] instrument reacts to its interface being stretched, twisted and moved around.

Augmented Common Instruments

This last type of interface is similar to Ishii description of “Augmented Everyday Objects” [19] but is adapted to the domain of Digital Live Arts. Augmented Common instruments take the shape and features of pre-existing artistic objects but

are digitally augmented. Examples are the MIDI keyboards and electronic wind instruments [1, 39, 47].

Interface types and DLAA design intentions

Table 2 highlights the prevalent implementation types usage for the realisation of the different DLAA design intentions. For example, the collaborative aspect of interactive surfaces has already been demonstrated several times [44, 48]. Also, wearable and motion-based interfaces may provide more visibility to the interaction and therefore enhance performativity. Interfaces requiring precises motions and constant attention such as constructive assembly and Token + constraints can allow for more engagement. Table 2 is to be used as a guide and taken with a pinch of salt since many different factor other than implementation types can contribute to the fulfillment of the design intentions. Other interface characteristics to consider, such as complexity and affordance, have been previously discussed in the design intentions section.

NUAGE Prototype

To put the DLAA methodology into action, we developed NUAGE, a tangible interface that controls audio and video content in a live, real-time and performative context.



Figure 3: Picture of the NUAGE interface prototype and it during audiovisual tests

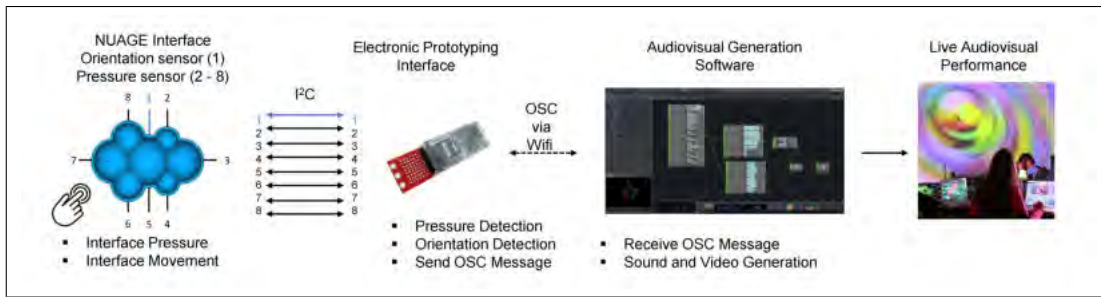


Figure 4: Functional diagram of NUAGE prototype interface

We aimed at developing an accessible interaction device for both audiovisual artists and their audience. The DLAA approach provided a structured understanding of the peculiar design requirements of such AV performative instruments.

DLAA's design intentions guided the NUAGE implementation choices of appearance and functionality.

The proposed prototype, pictured in Figure 3, is a mix of the pressure-base and motion-based type of interface described in the previous section of this paper. It takes the shape of a squeezable cloud that can be held in the hands of the user and freely moved around. Pressing on the different parts of the cloud and moving it around controls various audio and video effects.

The quirky and colourful appearance of the NUAGE makes it visually attractive and intriguing for both the audience and the user. This, as explained before, enhances performativity, engagement and meets the aesthetics design intention.

The intuitive usability of the interface leads to a greater engagement of the user. Indeed, pressing the interface is an intuitive action due to the softness of the material it is made of. The expressiveness and participation design intention are achieved due, among other things, to the possibility of moving the NUAGE around.

Therefore, the combination of the pressure and motion types of interfaces in addition to its visual and physical aspects allows NUAGE to meet all of the presented DLAA design intentions for audiovisual instruments.

System Architecture

NUAGE is a 3D silicone structure composed of seven adjacent hollow spheres or bubbles. Each of these independent hollow bubbles are equipped with a barometric air pressure sensor inside. An orientation sensor is also placed in the center of the interface. The sensors are connected to a micro-controller that sends the output values to a computer via WiFi and the Open Sound Control (OSC) communication protocol.

An external audiovisual content creation software, for example TouchDesigner or Max/MSP, can then receive the sensor values and generate different video and sound effects. This process is illustrated in figure 4.

Squeezing a bubble changes the air pressure inside of it. Therefore, this action could, for example, make the colour of an image change. Moving the interface and turning it around changes the output orientation values, this could perhaps change the rhythm of a music piece.

Creation of the prototype

In order to make the interface squeezable, the physical structure of the prototype is made out of silicone. To obtain the desired shape, a mold assembly in which the silicone was poured was developed.

The mold assembly is composed of two pieces, a base and a top cover. It is 3D printed. Pouring liquid silicone into the base, then closing the assembly with the top cover creates a half hollow section of the NUAGE. The NUAGE prototype is made of two sections of cast silicone. The sensors are inserted inside each bubble as shown in figure 5. The two sections are then glued together to create hollow bubbles.

The hardware implementation of the prototype was done with the I-CubeX line of products [17]. The electronic prototyping platform used is the WiDig [16]. It has 8 sensors inputs and it sends and receives OSC message via WiFi. The orientation sensor placed at the center of the interface is an Orient4D sensor [15]. It is connected to the first input of the WiDig. The air pressure sensors placed inside each of the seven bubbles are connected to the inputs two to eight of the WiDig. They are Air2D sensors [14].

NUAGE in action

The NUAGE prototype was used to create a live AV performance that will be presented at the Montreal Société des Arts Technologiques. The interface controls the audio synthetic generation and video projection on the immersive dome of 18-meter. The artist, at the center of the room, will only use the NUAGE, squeezing it and moving it around, to create a 360 immersive experience for the audience. Video capture of the event will be available here: <https://bit.ly/3jq5Eei>. This

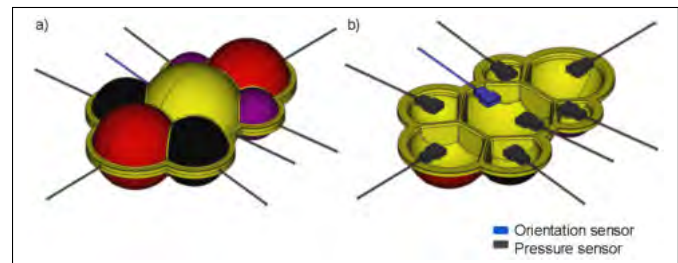


Figure 5: Technical drawing of a perspective (a) and sectional (b) view of the interface and sensor assembly

performance will be a great moment for an in-the-field evaluation of the prototype.

Conclusion

This article presented DLAA, a novel approach to the design of performative AV instruments based on Tangible Interaction principles. We have seen how the key concepts of Tangible Interaction are applied in a distinctive way by DLAA. In order to map this approach, we detailed its peculiar design aspirations, characterised its interface types. We also presented the NUAGE prototype that implemented the DLAA methodology. This paper emphasized that the interaction with an interface should not only be studied from the point of view of the direct user but should also be studied more broadly if other people are involved in the interaction. Few researches consider the audience reaction to a performer using a tangible system, which takes a strong role in our DLAA approach. Future work should focus on investigating the audience understanding and perception of the performers' actions.

In conclusion, DLAA gives a better comprehension and perspective on how both the artists and the public interact and appreciate AV Tangible Interaction systems. It also structures, guides and systematizes the design process of such instruments. It provides designers with an alternative design approach that can be used in many different and artistic fields.

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Possible City: colonial trauma and mediated space

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Abstract

Electronic art occupies a transmedial space with other media including film, television, streaming video and, as this paper asserts, architecture. These forms of media are charged with the politics and cultural value of space, and these are often mediated through the image of the city: a media-space. This paper takes as its lens the mediated image of a mid-size, mid-western city: Winnipeg, Canada. It sets up a discussion of the image of this city by considering key examples of (industry-based) narrative media shot here, before moving on to works of independent film and media art. The paper makes the case that what visiting filmmakers are in fact “buying” is a heritage of historical pain: the legacy of colonialism embodied in urban space, indeed hidden there in plain sight. This legacy has only just begun to be visible to most Canadians, but it has been there for all to see as harvested by filmmakers and displayed on the screen, a sign or symptom of a deep malaise. A more complex relationship between city and image is revealed by what is done with the same urban spaces by independent film artists - and architects. Their crop exposes more completely the potential for new relationships between city and image, buyer and seller, authenticity and fiction, colonial legacy and possible city.

Keywords

Media, cinema, urban space, architecture, rural space, representation, independent film, Indigeneity, colonialism, transmediality.

Exchange (I)

Sean Penn’s *Flag Day* (2020) is named for June 14th, the anniversary of the adoption of the Stars and Stripes as the American flag. In this film Penn plays a counterfeiter, that is, a maker of signifiers – dollars – that represent the American state. A dollar needs to be real, authentic; it is on this that its value rests. Its authenticity assures the dollar’s other characteristic: its capacity to be exchanged for not just any other dollar, but any other thing. A flag is another signifier, and shares something with the dollar: it combines identity and interchangeability. If any of the flags arrayed here (Fig. 1), awaiting a parade, is replaced by a similarly designed flag, it will still mark the space in which it is raised – in this case, Minneapolis – as American.



Figure 1. A lonely Canadian maple leaf overlooks an array of star-spangled banners on the set of *Flag Day* (2020), in Winnipeg’s Exchange District. Image by the author.

In fact, though, the street where these flags are hung is itself counterfeit. This is not an American city, it is Winnipeg, a city that shares many qualities with the one it stands in for in this film: mid-western, riparian, the site of agriculture-based industry, a gritty city. This is the kind of environment that Winnipeg is frequently asked to play by a film industry drawn to it by cheap rates, solid media craftsmanship, and good tax breaks. The specificity of this place, a certain patina related to its social history, has been harvested by the film industry but also by a strong cohort of independent filmmakers and video artists. This paper will look first at the spaces the industry has harvested from Winnipeg’s urban spaces, identifying through them a social history and urban form characterized by trauma and brokenness. The same spaces are harvested by independent creators: indie filmmakers and media artists, yes, but also architects, whose discipline I will make the case should also be considered a form of media art. Each are working on their own craft, but they work in a shared space in more ways than one. They both contribute to the creation of what might best be described as a hybrid urban / media space, a manifestation of collective imagination that goes beyond the inheritance of pain and instead creates from that heritage a possible future.

Minneapolis is represented in this particular scene by Winnipeg's Exchange District, thirty blocks of former warehouses and financial service buildings dating from the end of the 19th Century. The area was named for the Grain Exchange, an institution which was once the centre of Canada's grain industry: the place where prairie crops were bought and sold. So it was from its early history about the exchange of money for goods, and back again. It may mean something then that theft, robbery – in a word, the heist – is a recurring subject in works of film and television shot in Winnipeg and Manitoba. These have included *Seven Times Lucky* (2004), *The Lookout* (2007), *High Life* (2009), *Foodland* (2010), *The Pinkertons* (2014-2015), and *The Parts You Lose* (2019). To these we might add this film on counterfeiting, *Flag Day*, and *J.T. Leroy* (2018), about a counterfeit person that briefly turned Winnipeg into Paris. We might ask ourselves: why are so many con and heist films shot here? What qualities of space do these harvest, and where do those qualities come from? To answer this question we'll turn to other genres of film, and space, associated with this city.



Figure 2. Still from *Horsemen* (2009).

Hollow

The Exchange is an imperfect representation of the 19th-century city. Its urban fabric is shot through with spaces decidedly lacking in urbanity: a sea of parking lots, and modern buildings, lapping up against the spaces of earlier times. These are the results of a phenomenon common in the post-war North American metropolis: the hollowing out of the inner city. The migration of the middle-class population to the expanding suburbs created voids in downtown documented in a number of industry productions. In a still from Jonas Åkerlund's *Horsemen* (2009) the cinematographer's eye identifies the urban desolation conveyed by generic modern buildings flanking a swath of parking lots adjacent to the Exchange District (Fig. 2). In this film these spaces are markers of an American city, one similarly hollowed out: Detroit. Around these hollows are clustered the remains of what was once a rich urban fabric, decayed now and gone to seed. It is from these seeds that the filmmakers harvest the setting for a story of the hunt for what at first appears to be just a serial killer.



Figure 3. Still from *Horsemen* (2009).

One of these spaces is the Bell Hotel at 662 Main Street (Fig.3). The Bell was built in 1906, when Winnipeg was at its apex, and considered a rival to Chicago largely because of its position at the centre of Canada's rail network. The city's decline in importance through the 20th Century hit institutions like the Bell hard, and by the 1980s it had become housing of last resort; a rooming house many of whose residents suffered from mental illness and addiction.

Desperation was part of the narrative of the area, and an aspect harvested by the makers of *Horsemen*, who set a ritualistic murder in one of the Bell's rooms. The dense and aged urban environment of the Exchange has a specific significance in Winnipeg's social history. Just north of the Bell, Main Street is crossed by a rail line that leads to a major rail yard. The east-west axis of the rail yard cuts the city in two, dividing it historically into a North End of poverty, where new immigrants made their home, and a south inhabited by a mostly anglophone elite. One of the homes in that southern part of the city is the site of a second, equally disturbing murder.



Figure 4. Still from *Horsemen* (2009).

Enclave

At the time the Bell Hotel was built and the Exchange was turning into a small Chicago, another part of the city was growing too. The city's wealthy were beginning to migrate to the early suburbs including Crescentwood and the tony

boulevard of Wellington Crescent. *Horsemen* harvests this neighborhood and a specific house as the site of another ritualistic murder, where the abuse of a child leads to the murder of a parent, and incidentally another child *in utero* (Fig. 4). *Horsemen* is a breeding ground for crimes in which children are implicated, but for which authority figures are ultimately held responsible. Crescentwood is still one of Winnipeg's wealthiest and most desirable neighborhoods.

Both the Bell Hotel and this house are the scenes of particularly grisly murders, but as the story unfolds they are discovered to be evidence of greater horror. The killer, or the leader of several killers as it turns out, has based the series of murders on excerpts from Revelations. The investigation uncovers that what has happened here is not about a mere murder, but the preparations for an apocalypse. This is another narrative trope for which films harvest Winnipeg's spaces; these have included, besides *Horsemen* and *I Still See You, How It Ends* (2018), *Category 7: The End of the World* (2005).

To elaborate on my earlier question: why might it be that in this media space narratives of con, heist, and murder bleed inexorably into narratives of apocalypse? Perhaps it is because the gritty and worn spaces these mediated stories tap into are in fact the products of a historical legacy of heist, murder, and apocalypse. To understand this, we'll turn next to another genre of film – horror – and another urban environment.

The suburb is that region which in the post-war era grew



Figure 5. Still from *Channel Zero: No End House* (2017).

fat as inner cities throughout North America grew thin. In Winnipeg the disjunctions created by the railway lines escalated as the city grew. As roads that had begun as cart-tracks were widened into highway-scaled boulevards, these thoroughfares – Portage Avenue, Main Street, Pembina Highway, and others – served the laying out of grid-iron post-war suburbs. Today curling roads carry a more current model of suburban development out into the prairie landscape. Such later models of land development create new enclaves cut off from the city proper. It is such a neighborhood which forms the setting of the television series *Chan-*

nel Zero: No End House (2017). Horror, and the monster film, has been a particularly fecund genre in Winnipeg; films shot here have included *Cult of Chucky* (2017), *Devil's Gate* (2017), *Grizzly Rage* (2007), *Maneater* (2007), *Hybrid* (2007), *Eye of the Beast* (2007), and *Midnight Man* (2017). *No End House*, and the neighbourhood around it, turns into a trap laid out in suburban geometry.

That trap has several manifestations, from the maze-like layout of the streets, to a cage around a residential traffic island in which a family is imprisoned (Fig. 5). This alternate neighborhood, accessed through a house which comes and goes, is populated by creatures who feed on the memories of those lured into the community. As in *Horsemen*, father figures are a threat to their children. Not incidentally, we learn through a reveal in the last episode of the series that the threatening father is an architect. The series is shot in Oakbank, a bedroom community outside Winnipeg. It presents the buildings there as simultaneously icons of homeliness yet eerily absent of any homelike qualities – places that align with what Freud termed the *unheimliche*.^[1] The condition of being without a home is manifested in several characters; a number of them are one form or other of *doppelgänger* – counterfeit people. The unfinished spaces that so often accompany newly-built developments – backs of closets, incomplete rec rooms – are discovered to function as both traps, and opportunities for escape. Another trap manifested in this space is a corn maze barring the way out of from the neighbourhood; hungry memories wander within it, and bodies well up from dark pools. An outlandishly tall water tower overlooks the community. Taken as a whole these spatial tropes depict a space part agricultural, part urban, but not satisfactorily either; a dream built on the idea of freedom from the city, that ends up becoming a prison. This is how suburbs are often interpreted: as places built to satisfy the desire for rural life that, in the end, destroy the farmland they are built over, erasing the memory of what came before.

Field

But in the case of western Canada, the farms themselves have been complicit in destruction. In the late 19th Century, in the period that led up to Winnipeg's rapid expansion that produced the Exchange District and Crescentwood, two major infrastructural projects transformed the face of the prairies. One of these was the railway, which as we have already seen splits Winnipeg in two. The network of rail lines and regional stations was part of an immense machine for distributing crops from sections of farmland: the Dominion Land Survey. Divided into mile-square sections, and subsections of these, a landscape formerly boundless and open became exchangeable, like currency. It was provided to new European immigrants in exchange for their transformation of the gifted land into wheat fields.

This gift had in fact been stolen. The early modern history of the area is a history of negotiation and conflict between First Nations, which in Manitoba include the Anishinaabeg, Cree, Oji-Cree, Dakota, and Dene peoples; newcomer populations centred on the forts of the Hudson's Bay Company, who governed Western Canada; mixed First Nation and European communities (mainly franco-phone fur-traders) who were to become the Métis nation; and the 1811 Selkirk Settlement, mainly of Scottish descent. Later in the 19th century these groups were to be increased by largely Eastern European populations, the farmers and urban working class brought to the prairies to fuel settlement. In Manitoba the First Nations were signatories of six treaties with the federal government, but they never received the amount of land which had been promised. Instead they were assigned unwanted squares in the grid, small reserves inadequate for survival. This story played out many times across Canada over the next century, including in areas where farmland was not at stake; some other resource, whether oil or hydroelectric power, always was. A legacy of displacement, disenfranchisement, and disempowerment has ensured that the effects of this early land grab have lasted to the present day.

The violence to the land was accompanied by violence to persons. The settlement of the prairies was accompanied by the transference of governance of western Canada from the Hudson's Bay Company to the federal government in Ottawa, as part of the incorporation of Canada in 1867. This grab of land and settlements they had inhabited for generations provoked the Métis people to form their own Provisional Government headed by Louis Riel, and to begin what came to be referred to as the Red River Rebellion. If the long-term intent of the railway was to carry crops east to Great Britain, its immediate role was to carry troops west to crush this assertion of Indigenous sovereignty. The rebellion was suppressed by the federal government in what was referred to at the time (by American observers) as a "military reign of terror," in which the Indigenous population was subject to assault, murder and rape. [2] This was the prelude to the founding of Winnipeg, and the boom which was to turn this wheat city into one of North America's key metropolises within a few decades.

Thus it is no exaggeration to suggest that the immense grid of farmland into which the prairie landscape had been transformed was an apocalyptic ground. The image of that



Figure 6. Still from *Capote* (2005).

agricultural landscape is today itself a crop, perennially exploited for its poignancy and a lingering sense of threat, as it is in *Capote* (2005), concerning the fallout following the brutal murder of a family (Fig. 6). In such stories Manitoba's landscape stands in for anywhere in the Midwest; throughout the region the land was coopted by similar regimes of colonization and control.

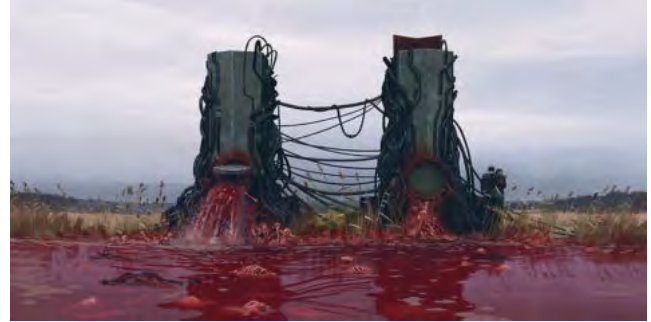


Figure 7. Concept art from *Things from the Flood* (2016). With *Tales from the Loop* (2015), this book was the basis for the television series *Tales from the Loop* (2019). Work of Simon Stålenhag; reproduced with permission.

Slough

As the grid of farmland was deployed across the prairies it collided with natural landforms and pre-existing patterns of land use. The result is a collage of grids that characterizes Winnipeg's urban fabric. Railways and roads shoot through this fabric, cutting it up while tying parts of it together. Winnipeg might be characterized by the rifts opened up between different parts of the city. As in many cities the gaps and tears in the urban fabric – between neighbourhoods, alongside and under major pieces of infrastructure, and along river banks – become no-one's lands occupied by the marginalized.

The history of colliding grids, rivers, roads and railways has produced a hybrid space that cannot be described as merely urban or rural, technological, agricultural, or wild. The gaps between its components have frequently become havens for the disenfranchised – as late as the 1960s, Métis shanty towns on the edge of the city or, today homeless encampments alongside the rivers, their inhabitants predominantly Indigenous. Aspen forest, copses and the remains of tall grass prairie are preserved here and there alongside pieces of hydroelectric or railway infrastructure. Always contaminated by their proximity to industrial infrastructure, these spaces lie fallow, though they are today under growing development pressure.

If we seek a figure in the landscape that could describe such a space, it might be the slough: a pond filled by seasonal flooding, often swamp-like. In its more general definition it can refer to a place of deep mud or mire; or a mass of dead tissue, shed or cast off from the body. These are the components of Winnipeg's fragmented urban form which is so productive for film-makers: the Frankenstein

space of media, which sews together different spaces, finds an analogue in a city of disjointed place.

If we can look at the prairie landscape as a space transformed by an immense infrastructural project meant to progress the world, a project with devastating effects impacting on the people who live in the gaps of that project, and producing a landscape from which unprecedented forms of life emerge, we might find interesting another recent piece of media shot in Winnipeg. This is the Amazon Studios series *Tales from the Loop*. Transmedially based on a series of paintings and episodic narratives by Swedish artist Simon Stålenhag, later to be elaborated in a role-playing game, the story is set in an alternate 1980s. It concerns a semi-rural community built atop a fictional piece of technology resembling a particle accelerator – The Loop. As the technology, and the state associated with it, ages and decays, it begins to malfunction. The landscape and people above it are effected. Buildings are overgrown with organicized cabling; carbon-based and steel bodies are transposed; time loops move people and creatures back and forth from the past; machinery leaks blood into environment (Fig. 7).

These stories are all set in spaces generated by the decay or derailment of industrial infrastructure, originally erected to coerce or control. While the tales from this Loop were originally set in Sweden, they have been relocated for the television series to an American mid-western state. And of course they are shot in Winnipeg. For like the spaces of the story, Winnipeg and the prairies are a rural-urban hybrid generated out of an immense technological and social project intended to transform the world, but which ultimately distorted everything that came before. This is a local story, but also a global one, as the easy transferability of Stålen-



Figure 8. Still, *Heater* (1999). Crossing Main Street with the heater. The Bell Hotel, pre-*Horsemen*, appears in the left background.

hag's tale from Sweden to Ohio to Manitoba – and back to the whole world – attests. These spaces articulate well the anxieties felt by other modern places, surviving as so many of them are amidst ruined projects of world-domination.

Exchange (II)

Winnipeg is, to use Owen Toews's term, a stolen city.[3] No matter how culturally significant is the Indigenous presence in this city today, the majority of Winnipeg's

population can be seen as pretenders: that is, those who set forth a false claim to ownership. As *Flag Day* suggests, perhaps this is inherently a counterfeit city. My thesis is that that is the subtext of all of the media narratives produced by industry here, the ones that buy up parts of the city – or their image – for international distribution. But the history that these spaces come out of is much more directly addressed, and with richer and more promising implications for the city, by the work of independent artists – in both narrative media and media art.

In Terrance Odette's *Heater* (1999), for example, two homeless men, one of them Indigenous, one white, navigate a labyrinth of roadways and parking lots between inner city and suburb in a quest to collect the refund on a stolen baseboard heater (Fig. 8). Noam Gonick's *Stryker* (2004) takes an Indigenous boy, recently arrived from the reservation, and sets him down in the middle of a gang war in the colourful yet dark streets of the North End. Mark F. Ennis's *Road of Iniquity* (2018) tells another story of a young Indigenous man caught between two poles of Indigenous gangsterdom. Rhayne Vermette's *Ste. Anne* (2020), named for a nearby Métis community, makes architecture and urban space a key dimension through which the filmmaker explores Indigenous experience (Fig. 10). Vermette's work is doubly interesting because in parallel with her film-making practice she has a practice in media art –



Figure 10. Production photograph, *Ste. Anne* (2021). Arlington Bridge over the railyard that splits Winnipeg into North and South.

including the production of numerous short films that intertwine analogue and digital media, and a number of video projection projects.

There are many other artists in Winnipeg operating across these boundaries. Local work shows a preoccupation with hybridity, both cultural and formal, that undermines straightforward classification. Vermette's filmmaking, for example speaks about the specificity of the Métis experience, which is profoundly local; yet she articulates it in the context of an international film culture. She constructs her experimental short film *les Châssis de Lourdes* (2021), for example, in part through direct quotations and recreations of scenes from the films *True Stories* and *Paris, Texas*, often translating them into French (Fig. 11). Her

work addresses tensions between belonging and alienation, often through the figure of technologized architecture.

Winnipeg was built on an Indigenous and Métis heritage, and technology has been complicit in the dismantling and dissimulation of that heritage. This is a local version of a global story. In the modern era the frameworks of technology, though they pretended to neutrality, were associated most often with European and Anglophone ambitions. The world became part of a machine run from a few locations in the world, and run not exclusively but predominantly in English. This produced a condition of weakness for anyone who did not share that place or that language, and found themselves on the receiving end of a culture which was increasingly homogeneous, and oriented toward capital and its dominant language. Strategies that can be used to oppose such power structures include carnival, polyphony, and polyglossia, as noted by Mikhail Bakhtin, who saw the role-playing in carnivals for example as a means by which the mighty can be criticized, and overthrown, by the weak. Hybridization of modes of discourse – one might say media – related to socioeconomic power can achieve a similar undermining.[4] Such strategies might offer a means of "weak overcoming" of the juggernaut which is the modern world.[5] They have the potential to undermine frameworks of power by existing between them – or by existing simultaneously inside and outside of them – occupying two separate worlds to deny either hegemony. These strategies are among those employed by Vermette in *Les Châssis*, as she takes words from one source, puts them in the mouth of others, to speak a truth that is specific to a family yet universal. But as I think can be gleaned from the picture I have painted of Winnipeg and its exploitation by mainstream narrative media, media-spaces harvested here by an industry come from away, representing a global market, are weighted with a similar poignancy. The whole process is engaged in a relationship of translation and transplantation very much inherent in this place.

That these preoccupations emerge, whether in the background or foregrounded, in commercial as well as independent local films, might suggest that the terms commercial and independent, global and local, are now unreliable descriptors. They undermine any straightforward notion of authenticity, and reinforce the idea that representation is always a lie: a lie which tells the truth. As a Métis artist, and an architect by training, Vermette and other young filmmakers are caught between several worlds: anglophone and francophone, Indigenous and European, architecture and media. Many others of her generation similarly manage life across borders, amidst the fallout of failed world-mastering projects. This condition has produced a shared capacity to be both anguished and canny, and an alacrity at negotiating boundaries. The work of these artists is transforming a culture once silenced by colonialism.

All this implies an openness to the non-binary; an embrace of hybridity; an acceptance of the incommensurate. We might speculate that in these conditions the border between real and counterfeit becomes complex and unclear



Figure 11. Still, *les Châssis de Lourdes* (2021).

and a new condition of Exchange is implied. If one thing cannot be opposed to another in any straightforward way, it cannot simply stand in for it; neither can it be traded for it. To represent, one thing must to some extent be translated into its Other. Old dichotomies between one and the other, between analogue and digital, between what is owned and what is shared, between art forms, and between high and low culture, do not serve us well today. The same can be said for the distinction between the city and its image, a relationship in which spaces and their representation become embedded in, bleed into, each other.

It should come as no surprise that the ground occupied by narrative media and media art, from which they harvest such spaces, is shared with the discipline which produces those spaces: architecture. These fields share much more than that. For one thing, if one definition of media art is art that foregrounds the technology from which it is composed – that is also a definition of modern architecture. Both media and architecture are entangled in the legacy of industrialization and commodification. They are both highly dependent on complex and global networks of capital, labour, and technology, networks that are successors to, and make use of the machinery that supported, earlier projects to master the world. The ruins of those modern projects are a preoccupation for both creators of space and creators of the moving image.

So the spaces that generate images and narratives, and the spaces on which and in which architects work, often coincide. The Bell Hotel harvested for *Horsemen* is a case in point. As will be recalled, this was the setting of a murder intended to pave the way for an apocalypse, and I have tied the site to a social history caught in a similar trajectory.

The filming of *Horsemen* took place after the 2007 acquisition of the hotel by Centre Venture, an arms-length municipal agency that has been charged with turning around the decline of Winnipeg's downtown. By 2011 – after *Horsemen*'s apocalypse – the building had been redeveloped into the Bell Hotel Supportive Housing Complex.[6] This included 42 units of permanent housing for individuals who have experienced homelessness, and shared facilities for cooking, dining, administration and cultural activities.[7] This is what ultimately became of the



Figure 12. Panorama view of Main Street, Winnipeg. To the left, the Bell Hotel Supportive Housing Complex. To the right, Thunderbird House and Pop-Up Winnipeg Toilet. Photograph by the author.

Bell's former role as boarding house, and it remains in this renewed and supportive role today. Across the street from the former hotel is Thunderbird House, designed by Indigenous architect Douglas Cardinal, which opened in 2000 as a centre dedicated to First Nations cultural support.[8,9] Adjacent to this could be found, in late 2019 (it's a nomadic project), the Pop-Up Winnipeg Public Toilet, a project by Bridgman Collaborative Architecture which provides heretofore neglected public facilities to the downtown.[10] These are only two of several significant institutions and social enterprises within a few blocks; they happen to both have noteworthy architecture.

None of these stories are straightforward. Centre Venture has been criticized for purchasing other affordable downtown hotels and, rather than finding new ways for them to serve their communities, shuttering them to facilitate other forms of development.[11] Thunderbird House is struggling to restore its financial footing, including the cost of maintaining its architecture in good repair.[12] But the area around the Bell embodies Winnipeg's struggle to negotiate the legacies of poverty and racial division that are writ in, and continue to play out in, the figure of this city – in media, as much as in the flesh.

Perhaps there is some redemption here, in the interplay between the city and its image: in the space between what it is, what it dissimulates, and what it represents. It is this cityscape which has been so productive of spaces that support the telling of mediated stories and the creation of media art which, somehow, smuggle across all boundaries their contraband of history and attendant trauma. Media and architecture are sewn together a little like the limbs of a monster, and work together on the transformation of the city in our imagination, and in the Real. They make of Exchange more than a simple purchase – perhaps something closer to a barter, or even a potlatch. In such a space, a divided city is never only that; the rifts that open up between us can prove to be a productive ground, fecund, a space for the Possible City.

Acknowledgements

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In pursuit of the *Schizomachine*: for a(n) (*in*)possible listening

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Abstract

The *Schizomachine* is an ongoing work-research that consists in the development of a wearable neuro-biofeedback system for aesthetic-affective experiences. As all research is also a creative process, this work, thought to be introduced in an artistic context, crosses other fields beyond Art and Product Design, such as Computing, Biology and Engineering. In search of the realization of the ideas that emerged throughout the process, listening and sound (Schaeffer, 1966; Schafer, 1969; Cage, 1973; Pelling & Gimzewski, 2002) came out as important concepts, which have guided the research so far. This article addresses the intuitive path that has been traced from the very first idea to the very first prototype, with the aim of reaching other possible listenings.

Keywords

Listening; schizophrenia; sound object; sound body; affects; creative process; wearable interface; smart clothing; biofeedback; brain-computer interface.

Introduction

When Keith Richards wrote one of the Rolling Stones' greatest hits, he was asleep. He heard, in a dream, the framework of his famous three-note execution: the riff for (*I can't get no*) *Satisfaction* (1965). He woke up, recorded the riff on his little Philips cassette recorder, and went back to sleep. In interviews, Richards says that the next morning he noticed that he had put a new tape in the recorder, and when he re-wound it, he found 30 seconds of the riff and a murmur ("I can't get no satisfaction") of what would become one of the band's greatest hits (the remaining 40 minutes of the tape recorded the noises of his sleep).¹

In 2006, in the context of developing my doctoral research, I had a dream in which I heard two words: "schizophonic device". The dream had no context, no narrative or setting; it was just the sound of the words as if they were whispered, not to the ear but to (or through) the mind. Af-

ter hearing the words, the thought that I shouldn't forget them came to mind. I tried to get up and write them down, unsuccessfully. Between the weight of the body, which wouldn't react to the commands to write down what seemed to be an important idea for the thesis, and the mind, which doesn't stop working, even in sleep, I spent the rest of the night fighting deep sleep so as not to forget about the listening-dream. But I ended up forgetting. I woke up a few hours later with nothing to remember and no concrete clues like the one Richards found the morning after his dream. By mid-morning, however, I had a feeling that something had happened in my sleep. I vaguely remembered that I had had an important dream, and suddenly the word "schizophonic" sprang to consciousness. I then forced the memory of the other word that accompanied it, and the words that followed (system, device) may not be exactly the dream word, but they served as a starting point for my creation process to advance towards what would determine the directions of my research years later.

Solving problems or gaining insights during sleep is not uncommon, quite the opposite. Albert Einstein, Dmitri Mendeleev, Niels Bohr are examples of scientists who found answers to their concerns or research directions in their dreams. As every dream holds mysteries to be deciphered, between the dream and the reality of the research there was an unknown: what were the words heard in the dream about, after all? Composers Murray Schafer and Pierre Schaeffer seemed to hint at answers. The former, for his concept of *schizophonia*, and the latter, for the very nature of the dream: listening. Along with them, John Cage and his experience with silence: a(n) "*in*)possible" listening.

Between the dream and the completion of the thesis (2008) and beyond (2018), it took a while for the Schizophonic Device, now named *Schizomachine*, to begin to get a more tangible outline and a possible destination. Therefore, this article deals with the pathway of this research, between the idea and the concept, theory and practice, the dream and the possible.

¹ <https://www.history.com/this-day-in-history/satisfaction-comes-to-keith-richards>

<https://www.rollingstone.com/music/music-news/when-keith-richards-wrote-i-cant-get-no-satisfaction-in-his-sleep-236461/>

Between theory and practice: the idea and the concept

When Pierre Schaeffer proposed the term Concrete Music (1948), he considered as concrete only the sounds of the outside world (the noises) from which musical values could be extracted. Equally interested in the sounds around us that do not cease to affect us, it was John Cage who called attention to listening to internal sounds, the sounds of our bodies, while researching silence. In his experience in the anechoic chamber at Harvard University (1951), Cage described two sounds he had heard: a high-pitched one, from his functioning nervous system, and a low-pitched one, from circulating blood, as the engineer in charge explained to him. [1] The “silence” that Cage heard calls our attention to listening to the sonorous (and musical) potential of the body and to our inability to hear it.

In the field of science, researchers Andrew Pelling and James Gimzewski (2002) went beyond Cage’s experiment by demonstrating, through an Atomic Force Microscopy, that cells emit sounds that can be amplified to an audible range by the human ear. That resulted in a new area of Biology, which they called Sonocytology (the study of the sounds of cells). [2] This study shows that the listening cycle, as proposed by Schaeffer, acts in a constant movement of interaction and resonance between the body and the world, and it is up to us, listeners, to also listen to sounds from within as musical possibilities.

Listen!

In his long *Traité des objets musicaux* (1966), Pierre Schaeffer dedicates himself to the theme of listening, describing it as a circuit of sound communication, from “emission to reception (including its psychophysical and psychological characteristics)”, which would work in four steps. [3] He organized his method of listening (the “ordinary” listening) by following a schematic logic ranging from 1 to 4, read clockwise, beginning with *écouter* (listening):

In sector 1 - Listening, means listening to someone, to something; and through the intermediary of sound, aiming to identify the source, the event, the cause, it means treating the sound as a sign of this source, this event (Concrete/Objective).

In sector 2 - Perceiving, means perceiving by ear, being struck by sounds, the crudest, most elementary level of perception; so we “hear”, passively, lots of things which we are not trying to listen to or understand (Concrete/Subjective).

In sector 3 - Hearing, here, according to its etymology, means showing an intention to listen, choosing from what we perceive what particularly interests us, in order to make a “description” of it (Abstract/Subjective).

In sector 4 - Comprehending, means grasping a meaning, values, by treating the sound as a sign, referring to this meaning through a language, a code (semantic listening; Abstract/Objective). [4]

Although Schaeffer was inspired by Husserl’s phenomenology, a “resonance” (to use a musical term) is perceived between his modes of listening and Charles S. Peirce’s categories. The four modes of listening work in accordance with Peirce’s triadic logic (*firstness*, *secondness*, and *thirdness*), and even though one prevails over the others, we still go through the four-stage cycle.

From a semiotic perspective, if “hearing” (the French “ouïr”) is “perceiving through the ear”, and “listening corresponds to a more active attitude”, as suggested by Schaeffer (1966), would not *listening* be the second stage of our sound perception? If we start from this point of view, *Perceiving* (to perceive, “to hear” - *Ouïr*) would be the first in the process of listening (*firstness*); *Listening* (to listen - *Écouter*) would be the second one (*secondness*) along with *Hearing* (to understand, to get to know - *Entendre*), which also brings in French the meaning of listening, but listening with intention, like listening to electroacoustic music composers. *Comprehending* (to comprehend, to understand - *Comprendre*) would relate to *thirdness*, when the listening process is completed.

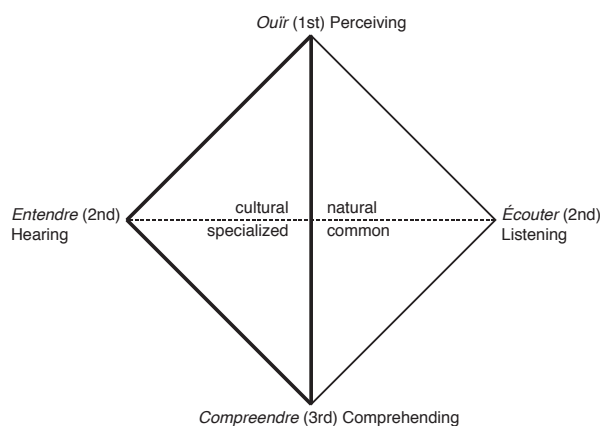


Figure 1. Proposal for a triadic listening cycle based on Pierre Schaeffer’s four listening modes. © 2021 by author.

This “listening triad”, beginning from *Perceiving* (1st) followed by *Listening / Hearing* (2nd) and *Comprehending* (3rd), is fulfilled whenever a sound affects us, and becomes more complex as our attention is drawn to certain equally complex sounds. The *entendre* (Hearing) calls us to listen more attentively than the *écouter* (Listening). Thus, it is highlighted in this study as a second stage (*secondness*) in both cultural listening and the specialist’s listening (musician, composer, sound technician), to distinguish it from our natural and common listening (*banale*)², when the *écouter*

² In addition to the classification of listening modes, Pierre Schaeffer analyzes auditory perception, organizing it into four groups:

(Listening) stands out.

Beyond ordinary listening, which takes place all the time even when we do not realize it, Schaeffer proposed *reduced listening*, through which the *sound object* would be reached: listening to concrete sounds (natural sounds from the outside world), from which musical values could be extracted.

Schaeffer uses the term *sound body* to designate the sound source where sounds derive from (an instrument, such as a piano, or any other object, such as a car). The *sound object*, a concept that guided all his research in *Traité des objets musicaux* (1966), is the sound itself, the “gross” sound (“raw sound object”), with its potential musical qualities. For the composer, it is necessary to “abstract” the origin (sound source) and the sense (values, “meaning-language”) of the sound in order to perceive the sound object (reaching the “qualified sound object”). [5]

As Pelling & Gimzewski have demonstrated through *Sonocytology* and the yeast cells, all sounds are potentially musical in an attentive listening, including the sounds of our bodies. As a *sound body*, the human body is a producer of sounds (voice, singing, “percussion-body”) just like any other musical instrument; as a *sound object*, it is a musical prospect, from which musical figures can be extracted

Schaeffer says that it is through consciousness that a “sound background acquires a reality”. [6] We could say that this “consciousness” lives not only in the mind, but also in the body, in each cell that reacts to sounds without our other “consciousness” noticing. When a sound reaches our ears, crosses or meets our body, it instinctively and indirectly becomes aware of its existence, as it keeps the memory of “ancestral sounds” on the skin, being even able to anticipate the next sound without its prior manifestation. There is a “sound wisdom” in our body.

On a micro level, even though certain sounds that pass through me do not immediately gain my full attention (from my awareness of “me listening/hearing”), my cells have already become aware of their presence, and will pay attention to them (by *listening*) soon then manifesting reactions that are often subtle (others not so much) in the form of hormonal discharges, for instance. The moment of the body’s reaction to the sounds that pass through us is a second stage (*secondness*), when the body “pays attention” to the sounds and reacts to them. All processing of those sound data and the conclusion about the type of sound, or what emotion was triggered by the sounds, or else any specific detail of those sounds corresponds to *thirdness* (in *comprehending*).

What we mean by this is that the external world is full of sounds that keep passing through us, and we do not realize that our inner world also produces sounds that resonate with the outer sounds. Schaeffer’s listening cycle, which we suggest here to function like the Peircean’s triadic logic, acts

natural, cultural, common (*banale*), and specialized or expert (*praticiente*). For the sake of practicality and the focus of the article, we will not go into detail about this classification

both from the outside in and inside out. On the one hand, we have the sound signs that cross our body, by which we are affected, and on the other, the sounds produced by the body itself: the body as a “receiver”, “sender”³ and “processor” of sounds, simultaneously. A *sound body*, a sign that performs sometimes as an object, sometimes as an interpreter of signs that are, in turn, sometimes sound bodies, sometimes sound objects.

The listening ear

In 1969, Murray Schafer coined the concept of *schizophonia* to describe the separation (*schizo*) between sound (*phono*) and its original source, as in the case of electroacoustic reproduction, when a voice or music is heard miles away from its issuing source. Before the emergence of radio and telephone, “(...) the instantaneous transmission of sound from one place to another was quite unknown. (...) Sounds were tied indissolubly to the mechanisms that produced them. In those days every sound was an original, repeated only in its immediate vicinity,” says Murray Schafer. [7] Technological advances and the possibilities of recording and transmitting sound by electronic means caused changes that Schafer saw as “dramatic”, hence the term *schizophonia* - “a nervous word”, inspired by the “drama” that the word schizophrenia evokes, according to the author. [8]

When he created this concept, Schafer did not consider other means of sound or musical production, in addition to electronic media and means such as the phonograph, the radio, the recorder, the loudspeaker and the telephone. Yet, he leaves the debate open when he mentions our ability “to feel into the depths of sounds with our muscles and nerves”. [9]

This extract suggests that we resonate with the sounds that surround us and incite our body movements from the mother’s womb, a memory that we bring to the world here and that the body recognizes to the sound of the most “ancestral” beats. If we take the human body as a potential musical instrument (a *sound body*, but also a *sound object*), we can suggest that *schizophonia* would be a condition of our existence even before the body becomes a body. Inside the uterus, the fetus listens to the sounds of the mother and recognizes them, and listens to sounds from the outside not knowing, at first, the source that produced them. The fetus not only hears the sounds but vibrates with them, it transforms itself into sound and thus goes on defining its sound, rhythmic identity (*becoming-sound*).

The fetus grows in the woman’s body and detaches itself from it at birth (*becoming-schizo*). One goes from becoming-woman to becoming-child. [10] It is *schizo* by nature: a *schizo-body*.

³ Herein we have adopted the terms according to Schaeffer in his Table of Listening Functions (“*emission* of the sound” / “*reception* of the sound”). [5]

Of the (in)possible ideas

In pursuit of the *Schizomachine*, the first idea that was designed brought the challenge of technique/technology and some issues that return to the point where it all started - the term paper project for my graduation in Graphic Design, *O Pulsar do Design* (1998).

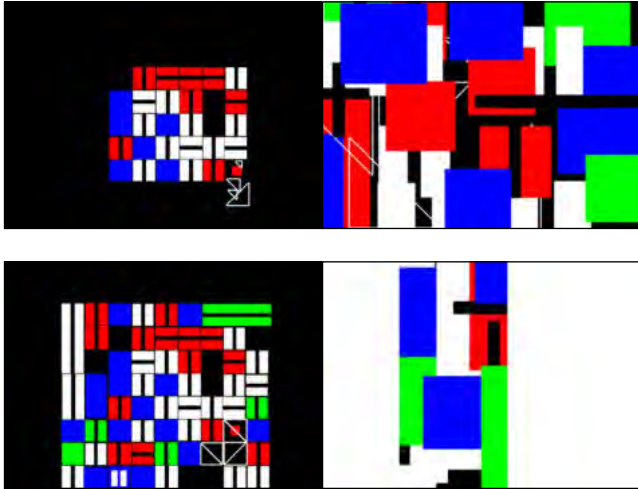


Figure 2. *O Pulsar do Design* (The Pulse of Design), animated score created from the intersemiotic translation of Augusto de Campos's poem named *Pulsar*, with music by Caetano Veloso. © 1998 by author

From “how can sound be made visible?” - the question that guided this project - to “how can the inaudible of the body be made visible?”, I came to the proposal of a smart clothing with a sensor system that could capture and convert the “microsounds” of the human body into light. This idea was inspired by the findings of Pelling & Gimzewski's study (2002) on the sound of cells, and as one of the references, the *SKIN: Dresses* project (2006)⁴, developed within the *Design Probes* program, by Philips.

A body covering the body. A tight-fitting garment, like a second skin, with sensors distributed throughout its length, capable of capturing sounds (sound frequency) from all parts of the body and translating them into colors (light frequency). The body, covered by the device, would form a sort of map of different colors (a luminous body), whose sounds would not necessarily be heard (with the ears). All body sounds - the audible ones (through devices such as a stethoscope) and the inaudible ones (blood stream, heard in the anechoic chamber) - would be translated into color (light), creating a way to “listen to colors”: *a listening of the sight*. Those sounds could also be amplified to be heard no longer just as colors but as sounds.

⁴ <https://www.vhmdesignfutures.com/project/224/>

This first proposal by *Schizomachine* brought along the type of technology to be used as the main challenge. The visual concept of the interface suggested the need for bio-sensors, in which the textile itself was the sensor (wearable sensors).

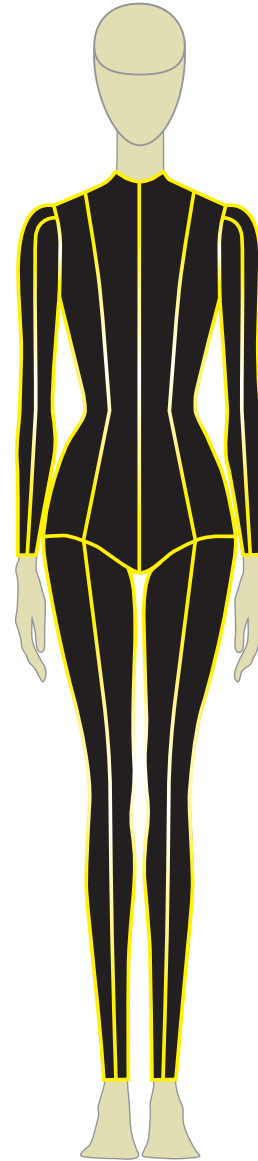


Figure 3. First proposal of the *Schizomachine* interface. Second-skin clothing with biosensors located throughout its length. In transduction, the lights would turn on and change their hue according to the “inaudible sounds” of the body that were picked up by the biosensors. © 2008 by author (mannequin template: © 2014 by Prêt à Template)

The chosen technology should be effective for individuals from any culture, with distinct physical and physiological characteristics. It should also be non-invasive, discreet, and versatile enough to be used in any artistic context. For



Figure 4. An EEG *Schizocap*, a cap composed of thirteen dry electrodes coupled to a crochet structure and connected to six EEG sensors and six corresponding channels of the BITalino microcontroller board, which digitizes and transmits the signals, via *Bluetooth*, to a computer running the data processing software. Photos: Thiago Barcelos. © 2018 by author

this reason, *wearable sensors*, *smart textiles*, and *textile electrodes* would be the ideal device options for clothing design. However, as for the technical applicability, I have faced the challenge of finding available and affordable (low cost) devices in the market that met all these characteristics and that would work according to the needs of this proposal.

Besides that, a question both conceptual and technical about the very nature of sound arose in the process: between the physical signal and the perceived sound, between the sound that is heard and the signal that is measured, how can sound be defined? To step out of the world of ideas and advance into the field of possibilities, the limitations of this initial challenge showcased the need for adjustments to the proposal, which I will discuss below.

Between the dream and the possible

Between that dream in 2006 and the first prototype of a part of the *Schizomachine*, 10 years have passed, and some modifications were made to the initial proposal. From the concept, it was assumed that the human body is a *sound body*, whose vital signs (“vibrations”) change depending on the emotions produced in the relationships established in daily life and the sensations triggered in the encounter with Art (as is the case with blood pressure and heart rate, for example, which accelerate influenced by the intensity of the emotional discharge; and brain waves, which calm down when we are in a meditative state).

How would the body “sound” in its relationship with Art? Is it possible to capture the sensations (that which precedes

the emotions) produced in the encounter with Art? Such question remains open but has guided the research.

The *Schizomachine* presents itself today as a wearable system⁵ in progress, which aims to make some sensitive communication processes of the human body visible when in contact with Art, through methods of mapping and monitoring the spectator’s physiological parameters and converting those data into light during the aesthetic experience in a museum or art gallery. What is proposed is a *self-listening* experience, where the body is the object, the skin is the interface, and the sight is the listening: a *listening of the sight*. Yet, there is no intention of “sonifying” the data collected to be heard/listened to, as what is sought is an experience of visualizing the listening of the body sounds (vibrations), another possible listening.

The wearable system *Schizomachine* is initially composed of two microcontroller units connected to a central computer that will run a mapping software. The two units are called the *Schizocap* - an electroencephalogram (EEG) cap that generates the input data (the *input*), - and the *Schizobody*, functioning as a kind of wearable display where brainwave data (and later, pulse and heartbeat) will be visualized in the form of light (the *output*).

A first prototype of the EEG cap (*Schizocap*) was developed in 2018 (Fig. 4), when a pilot test with two EEG devices was carried out (DSI-24 Dry Electrode EEG headset,

⁵ Due to the complexity of the project, I have preferred to use the term “system” rather than “interface”, as the former more broadly encompasses all stages involved in the project, from the design of wearables to data capture from the devices, development of the mapping interfaces, as well as data analysis and transduction.

by Wearable Sensing⁶, and (r)evolution Plugged Kit BT, microcontroller board, biosensors, and dry electrodes from BITalino⁷). Regarding the design, at the current stage of the research it is necessary to test the *Schizocap* on different users in order to verify the feasibility and functionality of the technological devices adopted for the development of the cap (devices from the Portuguese company BITalino), as well as the material and technique used in the making the prototype (crochet and mercerized cotton threads). The tests, which would have been performed in 2020, after the project to be submitted to and approved by the Research Ethics Committee in Brazil, were suspended due to the coronavirus pandemic. As far as the system is concerned, there is a long path of research ahead to be covered, which involves collaboration with other areas of knowledge besides Design, such as Computing and Engineering.

The data recorded in the tests will be used in the development of the data mapping system (EEG) and the lights (LEDs). In addition to the electroencephalogram, it is also intended to test other biosensors such as electrocardiogram (ECG) and electromyogram (EMG) for further implementation in the system. The cap is part of an interactive artistic installation, where the full system (*Schizocap* + *Schizobody*) must also be tested in the final stage. The data from both tests will serve as a basis for adjustments to the system *design* (cap, clothing, and mapping) for subsequent exhibition of the work in a museum or art gallery.

Final considerations

Creativity is a complex process, of which inspiration is only a part. According to researcher Nancy C. Andreasen, “many forms of creativity, from writing to novel to discovering the structure of DNA” require a continuous and iterative process that includes multiple components such as “preparation, incubation, inspiration—a version of the eureka experience—and production”. [11] The dream described at the beginning of this article is just a flash of inspiration, part of a long and lonely research process, which now sets out in search of “allies” so as to effectively go beyond the world of ideas.

Several advancements have taken place in science and technology since that dream and the first *Schizocap* prototype. To expand the listening to body sounds beyond the anechoic chamber, to amplify the body’s inaudible sounds in another context outside a laboratory... it is all perhaps more possible today than it was ten years ago.

If cells vibrate and produce sounds, as demonstrated by Pelling & Gimzewski, (2002), if we are made up of cells, their frequencies also change depending on the affects that are awakened in our body, whether in our daily relationships

⁶ <https://wearablesensing.com/products/dsi-24/>

⁷ <https://bitalino.com>

or in the encounter with art, from which new questions arise: if we start from a semiotic viewpoint (Peirce) and take sensations as a first stage of the sensitive, followed by emotions and feelings (Damásio), would their signals manifest themselves first in the brain, before the body’s reaction (before what we call emotions)? What do brain waves tell us about emotions?

Dreams are about what is possible, as is Art, whose “function” is to “express possible worlds”. [12] All the questions that arose during the research, summarized here in this article, are, in fact, attempts to find a meaning for that listening-dream as part of a research method guided by intuition, and, as such, without linear logic or direction. Although the starting point is fruitful and the method coherent, the *Schizomachine* still remains in the field of possibilities, in search of a(n) (*in*)possible listening.

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Buildings as Audio Visual Synthesisers: Experiments Performing Live Music on Wirelessly Networked Multi-Speaker Media Architectures

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Abstract

This paper presents an approach to expanding live music performance practices to encompass sonic media architectures. We demonstrate a method for creating a playable audio-visual synthesiser that incorporates the notion that the space itself is a medium for performance. We discuss the design concepts that inform this process, as well as detailing specific simulation tools and a creative workflow that facilitates development of performance experiments within architectural spaces.

Keywords

Media architecture, internet of sounds, spatial audio, live music technology.

Introduction

Live musical performance has traditionally been a significant driver of architectural design excellence, as well as media technology innovation. Opera houses and recital halls have been world-famous architectural sites throughout recent history, partially based on the social importance of live music for society, as well as the architectural excellence that may be shown in particular designs. Media technology development has also been propelled by musical performance contexts, and media architectures are a specific area of current research interest and technology innovation.

In this paper we seek to discuss an approach to combining these areas of interest, by augmenting music performance contexts with a media architecture that is controllable by typical musical DAW programs, and allows for creative experimentation with music, light, and space.

Background

Media architectures are physical augmentations of the built environment that bring audio, visual, tactile and sensing digital elements [6, 9]. Most work in media architecture focuses on visual elements – lighting and the design of non-standard screens that integrate with architectural forms [12, 11]. Researchers have also developed more complex systems that integrate interactive system design with media architectures [22, 13, 14] and have also investigated methods for incorporating kinetic and robotic capabilities into these systems [21, 16].

The incorporation of widely distributed speaker arrays into buildings is beginning to grow in prominence. Audio media

architecture is challenging for a number of reasons: introducing sound into the built environment has greater potential to be considered a nuisance (although light pollution is a recognised issue in media architecture [9]) and less well associated with providing added value to the built environment; and technically, massively multispeaker sound design is harder to achieve [8]. Nevertheless, a number of teams are developing media-architecture oriented sound design systems, including our own work developing frameworks for rapidly developing and deploying distributed sound installations.

In the area of live music performance, whilst the academic, experimental and art music worlds have long embraced more-than-stereo audio systems, the vast majority of music performance contexts remain largely bound to PA systems with stereo configuration. Factors at play include the fact that the stereo format is widely adopted by venues and is considered to be more manageable with a constant turnover of touring acts, and that there is also no strong incentive to go beyond stereo (indeed large venue PAs offer only a limited stereo experience). The technology to render sound using multi-speaker audio for these contexts has been readily available for some time [19], and indeed has long been standardised for cinema – another common public sound reproduction context. But the limited embrace of multi-speaker performance practices, as well as unclear experiential benefits for audiences, means it would still be considered novel today to see a local band performing on anything other than a standard stereo PA.

At the intersection of these two fields, live music performance can be performed *via* situated media architecture systems, inviting new conceptions of music performance and composition, and continuing a long-standing tradition of dialogue and interdisciplinary creativity between music and architecture [15].

Sonic Media Architectures Beyond the PA

Live music is strongly associated with the use of PA systems: a set of loud speakers into which various sound producing or processing equipment can be connected to render music in realtime. Sonic media architecture systems such as ours do not necessarily offer themselves as PA systems through which sound is played, but more as instruments that can be played. As we discuss below, in our case this is because with the wirelessly connected technology we use there is no way to stream multiple channels of audio to each speaker in a low-latency



Figure 1: Performing with the *Mind at Work* system using a laptop running Ableton Live, and a MIDI controller. © The authors.

way that is suited to realtime music making. Instead, the system better suits another paradigm, well known to musicians, of the MIDI (musical instrument digital interface) studio, where it is synthesiser control messages rather than audio that is sent to the rendering devices. In a MIDI studio, the audio output of the rendering devices (synthesisers, drum machines and samplers) are typically mixed back into a stereo mix for the studio loudspeakers of venue PA, whereas in our system, each device has its own speaker, distributed in space.

Historically, although the PA has been dominant for many years, a prominent alternative for musical rendering has been the world of mechanical musical instruments. Most commonly, mechanising musical instruments transforms them into acoustic rendering devices of digital content. Even after the appearance of radios and gramophones, mechanical instruments like player pianos remained popular, in part because the fidelity of recorded or broadcast media was so much more inferior than the sound of a genuine instrument in a space.

More recently the field of robotic music performance has extended how complex networks of acoustic rendering devices can be physically manifest and situated in space in interesting ways that relate questions of music performance and dramaturgy to questions of design. Taken to a theatrical extreme, the works of composer Heiner Goebbels, such as [1], situate mixed media including amplified and mechanical instruments into entirely mechanical theatre works. Robot artist Wade Marynowsky has similarly reconceptualised the operatic form as one that can be explored via interactive musical robots [18]. More generally, many music performers seek to engage with the built environment, to compose performances for specific spaces and to improvise with spaces. An elegantly simple example is the documented use of room acoustics by saxophonist Evan Parker, on records such as *Monoceros*, in which he constructs an improvised performance attuned to a specific, although relatively unremarkable, room [2]. This builds on experimental music's fascination with the creative contribution of space in musical processes of feedback most widely celebrated in Alvin Lucier's conceptual work *I am Sitting in a Room*. Back again in the digital world, the laptop

and mobile phone orchestra movement (e.g. [23, 24, 20]) has also embraced the acoustic potential of situating distributed speakers, typically co-locating each speaker with a live musician and their sound generating equipment (laptop or other portable computing device). As with our work, communication between devices here is largely focused on small control messages and the challenge of keeping time between different computer clocks and metronomes.

In this paper we present initial steps in a creative project situated at this intersection. We approach this work both as a creative practice-based research project to explore the aesthetic possibilities of live music performance with distributed sound-and-light sculptural designs, and as a design research project into the creation of a system that simplifies and reduces the effort in creating musical performances on distributed systems.

Design Concepts

In a number of previous studies [4] we have outlined our system design and software architecture in detail. Briefly, our system is built from a set of small raspberry pi computers outfitted with hardware that allows the connection of various display WS2812B Neopixel LED arrays, as well as audio amplifiers that allow the driving of small loudspeakers. Each of these computers has enough computational resources to synthesize audio signals and perform audio sample manipulation. These devices run runtime software that allows them to be connected to a WiFi network and managed from a central control interface, while retaining their autonomy, and we can use this central interface to deploy arbitrary software sketches to each of the devices without requiring re-initialisation of the devices [5]. We have used this system to iterate a number of design concepts [18, 3, 17] related to our central research question: how can we make it quick and easy to create rich distributed audio-visual content for site-specific media architectures. These design concepts are summarised in the following subsections.

Physical flexibility

In our system a creative team can design a physical sculptural arrangement of lights and speakers for a given location in any 3D environment of their choosing. They can then load it into a Unity environment which simulates our runtime system, allowing them to directly program light and sound behaviours in simulation. Work in progress includes simulating the first-person audio experience of walking through such a simulation. Once the real physical system has been built, the same computational model can be loaded onto the computing hardware and will work exactly as in simulation.

From a design research perspective, we have been very interested in the question of when specific design decisions get locked in. For example, a media architecture designer may come up with an initial sketch of a specific physical design of an array of lights and speakers (in the work in Figure 1, the bottom half of a sphere). They must then consider what kinds of media content might play out on that system, as well as how the system will be installed and what it will cost. These interplaying factors might lead to new iterations of the physical design.

In our design research we found that it was quite common for a design decision (such as the spatial design of lights and speakers) to be locked in, only to be revisited at a later date given new knowledge or thinking. We subsequently termed such decisions ‘fuzzy decisions’, and have attended to thinking about how we could support this iterative process of settling aspects of a design in light of how fuzzy decisions arise and are resolved: either by helping better anticipate factors that would influence a design, or simply enabling design factors to remain flexible for longer.

Technical constraints

Our approach is based on the idea of managing distributed sound by having multiple low-cost computers processing audio, and communicating with those computers over WiFi [7, 10]. This presents two key technical constraints: the processing power of the individual computers, and the network performance of the overall system (bandwidth, latency and stability). The network constraint means that our systems cannot behave like multi-channel audio systems, where you can stream sounds directly to speakers from a central computer.

In light of this, we have found it preferable to conceptualise the system as a “distributed synthesiser”, that receives global control data (notes and control parameters) from a central computer, and render sound over the array of speakers. Given this concept, we then treat the light components as just another output medium of the synthesiser. The latency of the network (around 100ms) is low enough to support basic realtime control from a central computer, but not as low as is typically desired in digital musical instruments.

The processor constraint limits the number of audio DSP processes that any one device can run. Thus within the conceptualisation of the system as a distributed synthesiser, each speaker is considered to be monophonic, and polyphony is achieved by distributing sounds across the array of speakers. For example, if you wish to play a chord on the system, a polyphony management process will distribute the notes in that chord across speakers.

Software flexibility

Our software approach is based on the idea of a runtime system that runs on each device, to which we can throw live-coded sketches in realtime over WiFi. In our latest version of the runtime, we have developed an approach of virtualising outputs (individual speakers or lights), so that we focus the programmer’s attention on writing code that describes how one individual output behaves. That behaviour can be easily deployed to the distributed array of computers, which automatically works out which device controls which output.

Much of our design work then focuses on how to conceptually separate out the added task of thinking spatially about the system as a whole: how sounds and lights move around and how audio and light parameters vary across space. Since the user has direct access to a programming API for programming the devices, they have the freedom to hack any part of this design. However, our design research has strongly pointed us to the need to impose some default framing concepts as a way of narrowing the space of possibilities whilst still allowing a vast array of creative options. Conceptually, we frame this in terms

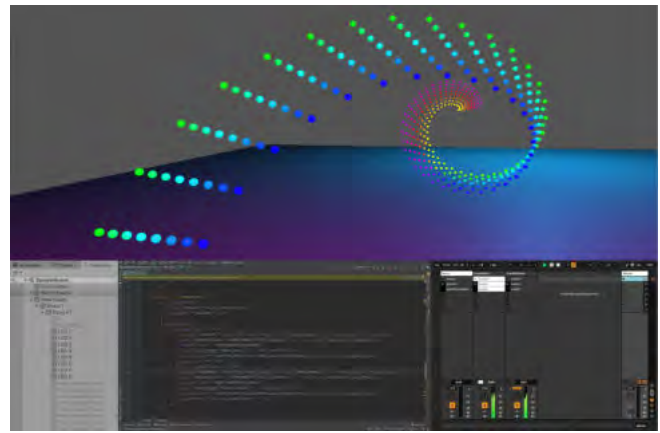


Figure 2: (Top) A screen grab of the composition environment, comprising a virtual model in Unity, a coding interface in IntelliJ, and an Ableton Live project for live and timeline-based control of parameters. (Bottom) a more detailed view of a light configuration in simulation, with a light gradient mapped across the 2D surface. © The authors.

of the concept of ‘space enablers’: specific configurations of creative tools that place a rapidly accessible array of creative opportunities in front of a creative practitioner. Space enablers are designs that hit the sweet spot between the power of creation and the ease of creation. Our standardised architecture arises from integrating knowledge about the technical constraints of our system and the basic requirements of thinking spatially with a distributed computing system.

Figure 2 shows a workspace in which a physical arrangement is modelled in Unity, the code describing the distributed synthesiser behaviour is being programmed in IntelliJ, and controller data is being composed in Ableton. When deployed in the final system, the Ableton project stays open to control the system. The code is deployed to the runtime system running on multiple distributed Raspberry Pis. The spatial model is also loaded into the Raspberry Pis so that each device is aware of the physical positions of the lights and speakers it is controlling.

Jams in the Hueosphere

Jams in the Hueosphere is a series of live performance events held in Sydney, funded from a local government Covid relief fund to stimulate live music after the impacts of lockdown. The project was pitched to create a novel experience for audiences and also give a series of local artists the chance to experiment and develop their repertoire to new forms of digital media performance. Artists were invited to give live performances and to develop their own creative uses of the *Jams in the Hueosphere* technology. A challenge for the development of *Jams in the Hueosphere* was the limited time that would be available to work with the artists. Not only would the artists have limited time to experiment and develop their performances using the system hardware (due to other constraints such as access to the performance space), but given that this was a new software that was not fully user-tested, the

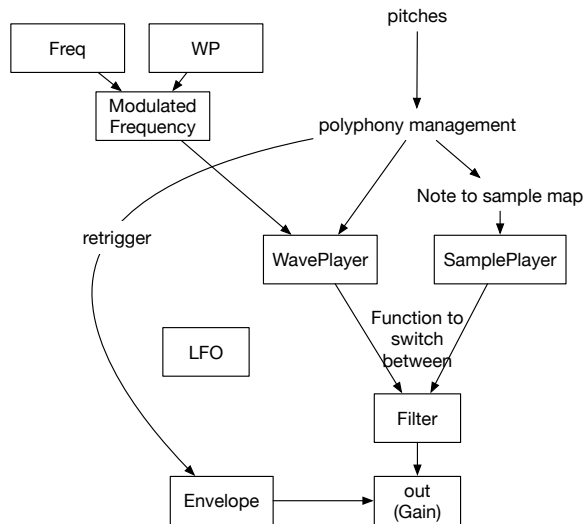


Figure 3: Our standard synthesiser architecture and Ableton Live controller device. © The authors.

potential to iterate the system in response to user feedback was limited. This is the context in which a general-purpose synthesiser architecture was developed.

System

Our development framework, *Happybrackets*, allows a program to be sent to a number of remote devices which then respond to incoming network messages from a controller computer. An audio API allows the creation of custom synthesiser signal chains, and equivalent processes for controlling lights. Typically we send the same synthesiser configuration to all devices and then work with global messages that control the devices *as one*. We then use the devices' physical positions as additional variables that can be used to map the global synthesiser parameters to create spatial effects. For example, we can easily create gradients of hue, frequency or filter strength, running across the space of the devices.

For the *Jams in the Hueosphere* project, we created a single synthesiser with a large number of variables and possible configurations (Figure 3). We then created a MIDI instrument device for Ableton Live which sends control messages to the network of devices. The result, from the musician's perspective, is something that looks and feels like a regular softsynth, except that instead of playing sound on the controller computer, sound and light is rendered on the system. Our Unity simulator can be used to view the design of the lights on the controller computer. The audio synthesiser includes functions for FM synthesis, sample playback, drum kits, wavetable synthesis, ADSR envelopes and LFO modulation: a standard suite of options for a synthesiser. The main difference with a real softsynth is how polyphony is managed: due to the computational limits of the Raspberry Pi, each speaker in the system is limited to monophonic playback. Polyphony is achieved by distributing the various notes in a chord across the system.

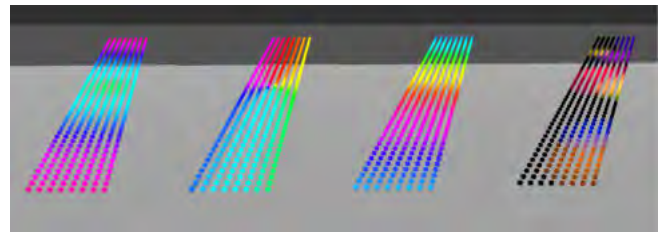


Figure 4: Spatial mapping strategies controlling colour hue. From left to right: variation radiating linearly from centre; variation mapped to angle around centre point; variation attached to discrete bands arranged linearly; specific zones of intensity. © The authors.

When a chord is played, each device chooses one note from the chord to play, according to a specified policy: either random, or based on the spatial position of the speakers (e.g., the lowest note in the chord would play at one end of the system, and the other notes would be located at different intervals along one dimension of the speaker array).

In addition, the user can select and modify a range of spatial strategies, including spatial envelopes, that dictates where on the system sounds and lights should be active, and spatial mappings, that dictate how some parameter varies across the space (e.g., hue or filter frequency). Spatial envelopes act like the envelopes used in sound synthesis, but are spatial rather than temporal. When the envelope is "fully open", all of the sounds and lights are active. The user can then choose to narrow the active zone, specifying a centre point and size parameters. In this way they can make sounds and lights move around the space. In reality, the sounds and lights are not moving, but simply being turned up and down depending on whether they are inside or outside of the active zone. A range of spatial mapping strategies are presented in Figure 4. Ongoing work includes refining this suite of functions to create an intuitive that can easily be manipulated to create spatial effects.

Creative Workflow

In our performance set up, a musical artist or band plays on stage with a standard PA system, but additionally, our system of lights and speakers is installed to flow up from the stage and over the heads of the audience. The musicians play as normal, using Ableton Live and any other instrumentation they like. Our synthesiser can be added into their existing Ableton Live rig so that as well as playing sounds out of the PA, they can control the distributed audio visual synthesiser. The parameters available in the interface of our Ableton Live device – including all of the synth settings, light mappings, the spatial control parameters and polyphony policy – work like any other Ableton Live parameters: the musician can pre-program control of these parameters into Ableton clips which can be triggered via the Ableton session interface, or they can connect any MIDI controller in and assign which dials and sliders will control which parameters (Figure 5 - See

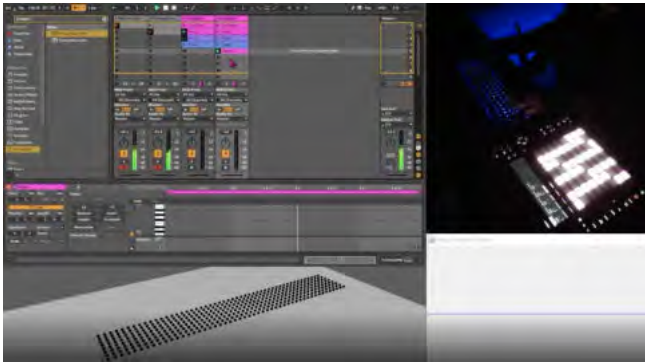


Figure 5: Our system incorporates commercial and well-known DAW software and hardware interfaces with simulation techniques and custom software that links these existing music paradigms to media architectures. © The authors.

our videos for details^{1 2}).

As an example, if the musician wanted to have a synth pad emanate from the stage in waves, they could prepare a looping clip that updates the parameter that controls the position of the active zone to fly from one end of the space to another. They could then manually play chords on a MIDI keyboard. Running the clip would cause these chords to fly out from the stage. Alternatively, they could assign an XY joystick to control this position variable, and manually move the sounds around the space.

We have found this setup makes effective use of the rapid workflow available to musicians in Ableton. Rather than programming more functionality into our system, resulting in a more complex interface and codebase to manage, we leverage as best as possible the creative freedom that the Ableton interface allows. For example, it is easy in Ableton to map an LFO to any synth parameter, making it very easy to rapidly mix together different processes to create generative effects. Thus, for example, making moving waves of hue intersecting with moving waves of timbral variation becomes easy.

In addition, our code can easily be hacked, so that the synthesiser design can be updated and redeployed to the network of devices. For example, if the musician wanted the array of synths to have microtonal variation of their frequencies, this is not a feature available in our standard synth, but could easily be added by adding a random variable at the right point in the expression calculating the frequency.

Aesthetic Considerations: How do we play buildings as audio visual synthesisers?

Although we have designed the *Jams in the Hueosphere* system to be as seamlessly integrated as possible into a musician's workflow, sonically the system has very different properties to a regular PA, the speakers are small and have poor frequency response below 200Hz, and each one is powered by just a 3W amplifier. They are housed in custom 3D printed spherical enclosures that amplify well. This should also not be thought

¹<https://cloudstor.aarnet.edu.au/plus/s/ySXyK19veb1Nj2h>

²<https://cloudstor.aarnet.edu.au/plus/s/2sqoK689DpwL9Rx>

of as similar to existing wavefield synthesis systems as the audio signals to each of the speakers are not tightly synchronised to create specific audio effects. The sound field of the speaker array creates a special acoustic canopy that is distinct in the way that the distributed array creates multiple interfering sources. Rich pads, noisescapes and clusters of sound are rendered with a spatial richness that is distinct from a standard PA. Reverb and delay-type effects can be created through the movement and slight temporal delays of sounds. Careful sound design can create playful effects where the sound leaps from the stage. The experience can also be more interactive for audiences, who by moving around the space, can seek different 'stances' on the soundscape.

With the resistance of the stereo PA convention to disruption from new technological possibilities, we view this field of experimentation as an aesthetic niche first and foremost, rather than a contender to challenge how live music is rendered in the mainstream. However, this paper has shown how the technological affordances, and associated constraints, of rendering sound through massive networks of remote computational devices, both invite and demand new ways of thinking about digital music and its situatedness in space. Beyond our own experimentation, the system is awaiting its first deployment in a public space, having been deferred due to pandemic response restrictions in NSW, Australia. Our initial thoughts on the effectiveness of our designs and the creative possibilities that will be most effective, are being tested soon with a cohort of live musicians who have been commissioned to create new works with the system. Our philosophy of curating such performances is grounded in an ongoing examination of the relation between sound, space and musical aesthetic. We will explore how our system works with different sized PAs, musical minimalism, free improvisation, acoustic instrumentation and different configurations of our system throughout original spaces.

Conclusion

We have presented an approach to expanding live music performance to new forms of sonic media architectures. The technological solution space we have explored, driven by cost, flexibility and scalability, actually pushes us from thinking about such systems as distributed audio visual synthesises rather than PAs and displays. When embedded in spaces, these systems in turn evoke the idea that the space itself becomes a playable audio visual synthesiser.

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Possibilising Performance through Interactive Telematic Technology: Mental Dance

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Abstract

Mental Dance engages audiences in modes of performance that call attention to multiplicitous dimensions of the present. As an interactive improvised dance-sound-tech event, we invite perceiving attention to the mutable present as always already shaped by perception, prior experience, cognition and corporeal change. Neuroscientific research underscores our approach to a digital interface that proposes new relations between audience and performer as a result of repeated COVID-19 lockdowns. Using MediaPipe pose estimation technology to track dancers' movements from webcam feeds, we directed telematic rehearsals and performance of the work on Zoom where dancers in their home environments sculpt and respond to sound in real-time. Constraints such as forced isolation, lack of access to technology and space to move, were embraced to create a new type of collaborative performance where the screen becomes the stage and the interface between movement and sound. This workflow can be used to enable interactive telematic performance where collaborators are unable to be in the same physical space with no specialist hardware requirements.

Keywords

Telematic performance, choreo-sonic, interactive dance, neuroscience, machine learning, embodied sound .

Introduction

Throughout 2020 and 2021, Melbourne, Australia was under strict lockdown for more than 245 days as a result of COVID-19. We could not leave our homes except for very specific reasons. All creative studios, performance spaces, universities and most workplaces were closed. At the time, we were developing an art-science collaboration where neuroscientific research into human cognition was used as conceptual reference for an interactive dance performance using wearable sensors. We were interested in the choreo-sonic and cognitive aspects of the relationship between movement and sound where the

movement creates and/or changes the sound, and how this resonated with neuroscientific concepts such as predictive coding and the Bayesian brain. [1]

Lockdowns meant that we could no longer collaborate in the same physical space, nor use wearable sensors such as accelerometers, gyroscopes, biophysical sensors or other devices such as infrared cameras, as the dancers did not have access to the required computer programmes or specialist hardware. To enable ongoing development, we had to harness ubiquitous technology that everyone could access. All collaborators were familiar with video conferencing apps such as Zoom, so using the video feed from Zoom for movement-tracking was identified as the easiest way to build the interactive system. The criterion was not accuracy, but accessibility and ease of use.

Thematic Concept

The project¹ begun in 2019 as an open-ended inquiry into how neuroscientific concepts can inform and be integrated into a creative process. The aim of the research was to delve into the possibilities of diverse combinatory elements – data, dance and sound – to create new forms of expression that generate unforeseen affects supporting and legitimising diverse experiences of mindbody relations. Through various interviews and visits to the neuropsychiatry lab, thematic threads were teased out for further creative exploration. These included current research into neurodiverse cognition for autism spectrum disorder and schizophrenia, and the research technologies used in the lab including EEG, MEG and fMRI. [2] Key phrases from the literature were extracted to inform choreographic scores such as ‘changing states’, ‘oddball’ and ‘past is present’.

In contrast to the diagnostic language surrounding neurodiversity, we looked at the human impact of living with mental illness, such as that experienced by dancers Vaslav Nijinsky and Lucia Joyce. [3] [4] Although we

¹ Recording of an online performance can be viewed at <https://vimeo.com/624934863>.

started in the lab, we wanted to end up *inside* the body with all its mechanosensory neurons and limbic emotions.

Collaboration

As inter-disciplinary artistic researchers, we were interested not only in the creative outcome, but the processes used for collaboration and development.

The collaborations were multi-layered, cross-feeding into each other in an iterative process over 18 months. Ideas formed in one session were taken up in other directions to create a matrix of material-data combinations. Figure 1 illustrates the collaborative links formed between all participants and their areas of mutual influence.

For example, references to Nijinsky’s iconic gestures in the choreography became an impetus to use Stravinsky’s *Rite of Spring* polychord as a sound sample. Neuroscientific concepts around human learning and predictive coding led to an exploration of unsupervised machine learning to categorise and map sound, resulting in a tandem performance by humans and machines simultaneously learning movement-sound relationships. [5]

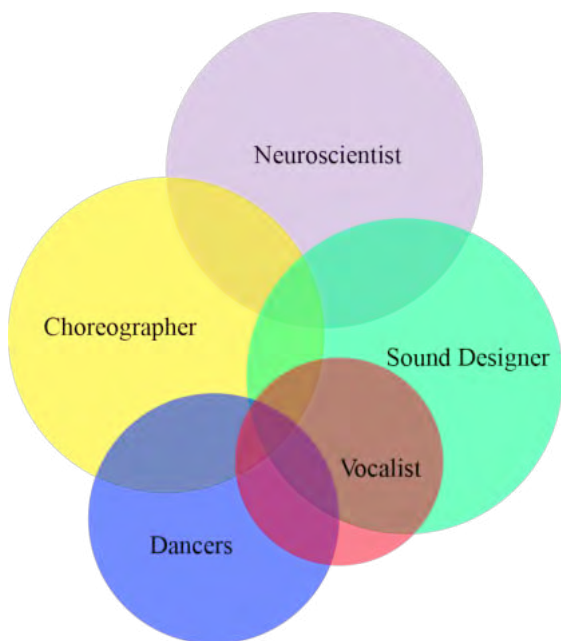


Figure 1. Collaborative links formed between participants.

Performance instructions on breath and phrasing for the vocalist became part of the movement score. Interview transcripts with the neuroscientist became part of the vocal text. Bird sounds used in the EEG oddball auditory test became inspiration for sound samples and movement gestures. The responses of the dancers and the words used to describe their experiences were recycled and reframed into movement and sound ideas. This process of forming and becoming through cross-modal experiences led to an emergent outcome shaped by all participants.

Project Design

Telematic Technology

Rehearsals and performances were held over Zoom. Video feeds of the two dancers were screen-grabbed in TouchDesigner and rescaled to half their original resolution to improve performance.

TouchDesigner was then used to implement a Python script to run MediaPipe on each video feed. MediaPipe is an open-source framework by Google for building cross-platform machine-learning pipelines. [6]

In this case, we experimented with MediaPipe’s Face, Hands, Pose and Holistic (which combines Face, Hands and Pose) models. Holistic is the most comprehensive pipeline, enabling tracking of 543 landmarks on the body (33 pose landmarks, 468 face landmarks and 21 hand landmarks per hand). However, running two holistic pipelines in real-time was computationally expensive, leading to an unacceptably low framerate. Tracking fine detail of the face and hands was also less important for this project than overall body landmarks, so the decision was made to use the Pose model only (see Figure 2 and Figure 3).

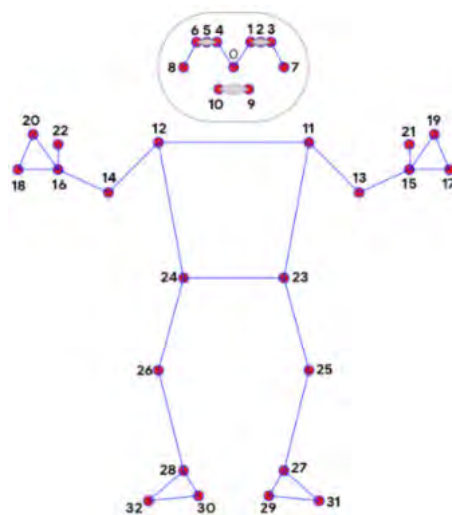


Figure 2. Pose Landmark Model © 2020 Google LLC

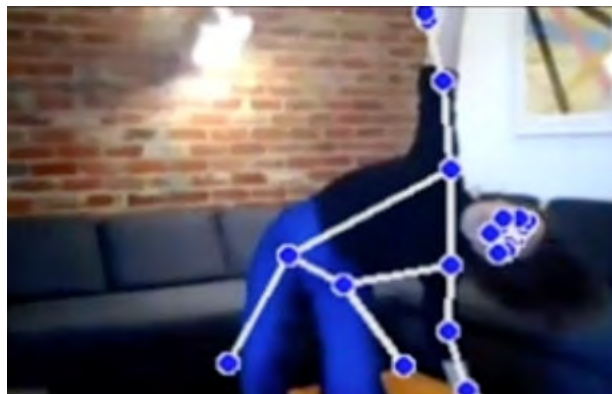


Figure 3. MediaPipe Pose landmarks on Zoom video feed.

The Python script was adapted from code released by MediaPipe and the TouchDesigner implementation by Bryan Chung. [7] Selected landmark co-ordinates and joint angles were sent via OSC to MaxMSP for real-time sound processing. Audio output from MaxMSP was streamed to all collaborators and audiences on Zoom using the Loopback virtual audio device.

Choreography

Choreographically, the performance evolved through movement scores that became increasingly precise as the dancers and co-directors continued to develop and refine these during rehearsals. The dancers' sensorimotor skills and corporeal imaginations were continually being tested by the sound and the words being sung in the vocals. Their interactions with the sound relied on perceptual feedback and feedforward loops. Relations to pitch, timbre, voice, text, tempo and tone shaped and structured movement and action within a choreographic dramaturgy that was developed across four states or scenes: *Neural Networks*, *Noisy Voices*, *Lucia* and *In My Head*. Given the unfamiliarity of the dancers with the telematic environment they were working in, and the fact they could not see or sense each other (kinaesthetically, haptically or through breath exchanges), we relied upon coming to know the structure of the improvisation and referencing the gridded image of their partner through the screenic interface. This shaped a sense of parallel worlds that across multiple rehearsals grew to become intuitively relational. The multi-dimensional and multi-sensory habitus of the dancers performing in their home environments contrasted with the screenic interface with its two dimensional rectilinear framing. Choreographically, we played with proximity and distance, the tactile and the remote, opening vectors of relation across physical and virtual dimensions and pushing the apparatus to behave differently beyond the norms of the Zoom platform. Both dancers, in becoming habituated to each other's movements across rehearsals, developed a synergy which enabled them to shape the choreography from inside the system. We related this to the theme of neural networks as if the 'brain' of the dance was being lived in the sphere of these more than human relations.

Sound Design

The sound design had 4 priorities:

1. Using live vocals as a primary sound source.
2. Ability to convey conceptual links to the neuroscientific ideas.
3. Ability to respond to and express movement.
4. Capacity for dramaturgical development.

The emphasis on using live vocals arose from the impetus to research perceptual feedback loops between dancers and vocalist in addition to any digital feedback systems, allowing more layers of interaction and novelty to emerge. This interest in the *human* working in tandem

with the *machine* resonated with the conviction that advancing human betterment should be a central concern in all neuroscientific and technological advances, whether that be research into consciousness, neurodiversity, or Artificial Intelligence. The field of interactive sound-design is also dominated by digitally synthesised sound, and we wanted to expand the ways in which the classical and acoustic traditions could engage with new technologies. The use of Baroque countertenor technique in the vocal score (e.g. ornamentation) coalesced with granular synthesis controlled by movement, collapsing binary distinctions between human and non-human, old and new.

In developing text for the vocal score, phrases from Nijinsky's diaries were combined with scientific language from the literature and interview transcripts using a Markov chain generator. This produced unexpected combinations of technical and intimate language, a kind of technologically-mediated poetry. Selected text (e.g. 'deficit following brain', 'efficient white matter') was also used to improvise and develop movement.

However, the use of vocals as a primary sound source introduced constraints when designing the sound's interactive responsiveness to movement. These constraints include limited frequency range and timbre, as well as inconsistent gain and timing. Therefore, subtractive synthesis or spectral processing techniques were not effective. Instead, granular synthesis was used extensively for vocals, and this was combined with other digital processing techniques such as harmonisers and delay lines. Additional sound sources were added to create more layers of interaction with movement as well as to support dramaturgical development. These included sampled sounds manipulated through concatenative synthesis and filtered waveforms. Although the audio output was limited to stereo on Zoom, binaural sound spatialisation was implemented to accentuate movement.

Mapping

Mapping design has been extensively researched and shown to be vitally important to how an interactive system engages its participants, as well as the audience. [8] Whilst the focus of our sound design prioritised the integration of live sound and thematic concept, effective mapping was still required to give the dancers a sense of agency and control, and sufficient transparency for the audience to understand the movement-sound relationships.

Mapping movement using MediaPipe from a single webcam represented particular challenges. Critically, the depth (or z-axis) in the Pose model is an experimental value based on the depth of a particular landmark relative to the user's hips, rather than a true 3D value. [9] Therefore, it was difficult to compensate for the dancer's distance to the camera in analysing movement. The same movement or gestures produced wildly different results depending on the depth and orientation of the dancer to the camera.

A number of strategies were employed to mitigate this. Firstly, MediaPipe has the ability to output real world coordinates in metres with the origin as a point in between the hips, rather than relative to the screen as its default. Therefore, where the dancers' distance to the screen varied significantly, the world landmarks were used.

Mappings that produced specific effects were also limited to choreographic sections where the dancers' distance and orientation to the screen were consistent. For example, one section of the work allowed the dancers to adjust the gain depending on the distance between their wrists. Putting their hands together turned off the sound completely. This mapping relied on knowing that the dancers would sit down facing the screen for that entire section.

Using joint angles rather than absolute distances or rate of change measurements of coordinates (e.g. velocity, acceleration) also created more flexibility in dealing with differences in scale. However, the same pose with different orientation to the screen also resulted in very different joint angle data.

Therefore, where the dancers moved back and forth across the screen, a more general and forgiving mapping strategy had to be implemented where sound parameters would change with movement but did not rely on particular gestures or orientation. This included changes in filters, granulation parameters or pitch-shifting. This was particularly important where dancers would sometimes go off the screen completely or only had parts of their body onscreen with no facial information, as this would result in MediaPipe outputting no landmark information.

Using machine learning was also effective to create responsive and often unpredictable relationships between movement and sound, without requiring any explicit mapping of specific movement parameters to sound.

One advantage afforded by MediaPipe's Pose model is its ability to predict landmarks even where parts of the body are partially obscured or out of the screen, as long as there is sufficient information to recognise a pose region-of-interest (typically, a face). Therefore, provided the mapping design was flexible enough to utilise outlier values, the sound could still interact with movement where the dancers were only partially onscreen.

Conclusion

The research culminated in two public performances, one on Zoom and the other on Microsoft Teams. Through performance, the interdisciplinary layers of the work were manifest and made accessible to a globally distributed audience. The performers, though dancing at home, noted how performance nerves were present and how the experience of dancing telematically held a similar state of attention for them to traditional staging. We use the term 'empathy machine' to describe the sense of relatedness the tracking of attention through distributed cognition and corporeal activations demanded. The feedback loops and shifting improvised relations between dancers and data generated a constantly evolving expressive terrain that

audiences were invited to perceive and respond to. Audience feedback on the performances was overall positive, with most people reporting positive engagement despite the onscreen delivery. The use of domestic spaces received mixed feedback, with some in the audience enjoying the 'intimacy' and 'immediacy' of 'personal 3D spaces', whilst others found the 'home background distracting and diluting the emotional impact'. Many in the audience were intrigued by the technology and its potential for further exploration, both in performance and pedagogy. They were also interested in 'trying to figure out' the mapping design, and the impact on the sense of collaboration where movement by two different dancers in different spaces affected the same sound.

Although our shift to remote collaboration was forced by external circumstances, the exploration of a new mode of working resulted in us viewing the online rehearsals and performances as not just temporary, inferior replacements for the 'in-real-life' version, but interesting and worthwhile in themselves.

Future Development

The telematic workflow described in this paper can be used to create other forms of interaction. For example, audiences can participate to create sound, textual or visual interactions in a workshop, installation or performance context, unrestricted by geography and availability of specific hardware.

Multiple sound and visual controllers can also be networked, creating telematic ensembles. Whilst the movement data does not have the accuracy of mocap and is subject to latency, the system's ease of use and accessibility for anyone with a computer and internet connection make it a useful alternative for generating digitally-mediated human interaction.

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Emergent

A post-pandemic living mobile gallery

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Abstract

This project emerges from a series of reflections about the state and the potentials of the arts and their exhibition spaces in post-pandemic times. The pandemic of 2020-21 forced many galleries and museums to shut their doors for several months or forever. These closures have created a void in social gatherings and cultural events, urging artists and cultural workers to rethink ways of making, exhibiting and bringing their work to the general public. Now that the world slowly re-opens to social gatherings, we wonder whether we should re-invent the role of the gallery as an enclosed space altogether, by freeing it from the constraints posed by its traditional spatial and cultural configuration (real and virtual), and redesigning it as a multipurpose mobile object in dialogue with the city and its human and non-human dwellers. This choice is in part inspired by the first artworks and specimens this gallery will carry: a project at the intersection of art and science exploring “new life forms,” that is, living and imagined organisms emerging from digital, laboratory, and environmental contexts. The mobile gallery then acquires a new meaning: it is not just a new safe exhibition space, but also a space where emergent life is both debated and created, as well as an emergent “life” on its own.

Keywords

Emergent life, mobile gallery, postpandemic gallery, multispecies communication, relational aesthetics

Introduction

“Emergent” is a research creation project initiated in 2018, exploring ways in which we can better comprehend and, importantly, cope with, emerging life forms. Examples of these life forms can be found in the real world and in the digital world, resulting from digital world-making and artificial intelligence¹; from climate change-induced mutations and adaptations and from lab manipulation and fabrication of organisms². The project sought to foster dialogues between scientists and artists engaged with these subjects to various degrees and from different perspectives. This could be achieved through lab visits with the goal of sharing research and methods, as well as through public meetings and debates. Overall, Emergent asks the participants to take note of multiple stories built through layered and disparate practices of knowing [1] and invites them to “stay with the trouble” [2], that is, to purposely cross boundaries and collaborate outside their comfort zone and their preferred disciplinary realms. The project seeks to extend the dialogue to a larger public: in fact, its goal is to make space for reflections across different experiences and sites of divergence through and, importantly, with the arts – not with the arts as an addition or an afterthought – that would convey (not explain or illustrate) the dynamic forces converging into, and traversing, new, imagined, and difficult-to-study life forms. Thus, the project was expected to culminate in an interactive exhibition showcasing collaboration notes, objects and specimens, as well as artworks originated from, or illustrating the findings generated during the research phase. However, the

¹ For e.g. Artificial Natures, a series comprised of biologically-inspired complex systems to be experienced in immersive mixed reality and created by Graham Wakefield and Aru Ji (<https://artificialnature.net/>)

² For .g. organisms produced by synthetic biology, which prompted artist and designer Alexandra Daisy Ginsberg to propose that a new

kingdom, the Synthetica, be added to the three traditional kingdoms of life (bacteria, archaea, eukaryota); or genetically modified organisms such as GM mosquitoes, or the glowing rabbit Alba, conceptualized by transgenic art pioneer Eduardo Kac.

pandemic brought the initial plans to a halt as galleries suddenly had to shut their doors.

The sudden closure and the following online art race filling our home screens revealed that alternatives were urgently needed: new ways of doing art, reaching new audiences, and (re)inventing future spaces for the dissemination and enjoyment of the arts. These concerns became particularly relevant for the Emergent project, since its primary goal is to bring different voices together in a sustained dialogue. In fact, the unfolding of the pandemic highlighted the need to treat the gallery as an emergent space itself rather than just a venue.

The result was, for our team, a complete rethinking of what the gallery space means and represents: in a disrupted world where the need for safety limits the need for physical interaction, what would alternative formats, new forms of interactions, new safer and more inclusive spaces look like? Can we take the gallery to the streets and turn it into an emergent space? What possible experiences, what new dialogues can a redesign of the gallery as a living, breathing entity foster?

1 From the white cube ...

1.1 The city and the gallery

The notion of the white cube, a “sterile, windowless viewing room... a way to maintain neutrality while viewing artworks” [3] has been the assumed symbol of the traditional gallery and the main reference of the art world for many decades. However, the white cube was never the only place where art happened. Many artists have elected the streets, the city, their bedroom, the forest and the environment etc.. as their preferred stage.

Galleries and museums too have frequently exited their designated spaces and ventured outside, promoting public art, and commissioning large scale and site-specific installations. The Nuit Blanche franchise is one such event that brings a plethora of artists and cultural events to the masses, celebrating the city as an open, comprehensive gallery site. Public art has used the full range of media available, such as video projections, LED panels and responsive light fixtures, and variety of building materials such as wood, metal and plastic. Sometimes, these installations are simple performances with little, or no props, or technological support at all; sometimes, they experiment with new technologies or with repurposed materials fabricated in DIY fashion. Pioneering artists such as Barbara Kruger built large scale billboards, which covered the

facade of buildings with bold messages [3]; Krzysztof Wodiczko created spectacular and politically sensitive projections erected with the idea that “Monuments can be used for the living.” [4]; Rafael Lozano-Hemmer built interactive installations meant to engage the public and to evoke reflections on community engagement, politics, and technological impact [5]. By populating cityscapes, neighbourhoods and public buildings’ facades, these works have produced meaningful collective reactions, debates, and community engagements. LED screens and projection technologies have been gleefully adopted by many institutions and museums as a way to reach new and numerous audiences outside of their enclosed spaces. Some installed large screens on their facades; others populated cities’ billboards with colorful and joyous art, or with political and empowering messages [6].

1.2 Emergency plans under COVID19

Most of the above artworks were the result of well-planned commissions, and patient entrepreneurial efforts spanning years of programming and negotiations. But what happens when, all of a sudden, institutions have to close their doors mid-season?

The closure, it became clear, was not just temporary. In fact, after a short period of inactivity, many galleries and cultural organizations started to make emergency plans to continue a limited portion of their programming activity. Most galleries and cultural organizations moved online; the web was taken by a frenzy of events, mostly quickly-combed-together, often low budget, frequently performed on inadequate, yet readily available combinations of platforms such as Zoom, Skype, OBS, or Crowdcast. Sometimes pressured by funding agencies, many galleries engaged in a frantic race to reproduce their collections in a virtual format, offering virtual tours, online exhibitions and artist talks, or gamification of existing or already in-progress exhibitions.

A number of commentaries and articles observed how by preserving existing and pre-programmed work, rather than pressing pause to rethink their formats, institutions and galleries appeared to be understandably preoccupied with “keep[ing] things ticking” [7]. Clearly the products of unexpected circumstances, or the results of cultural and administrative pressures to fulfil their programming obligations to “keep going”, many of these events looked rushed. In general, they revealed little desire or little time to

open up discussions regarding a – realistic or imagined – post-pandemic scenario.

Several months into the pandemic, many galleries and art institutions appear to have decided to invest more in remote experience. In part, this comes out of fear for predictions regarding a possible decrease in the attendance of in-person events. An article in Financial Times asserts: “The most natural change in an era when human interaction is suspect is for galleries to bolster their digital presence” [8]. Apparently, change is already happening in major cities like London (UK), where “some galleries are changing their footprint, abandoning expensive street-level locations for an upper floor”. The Smithsonian Magazine suggests that in addition to building a more robust online presence, museums will have to think about new ways to reconfigure their architecture, in order to not run the risk of “becom[ing] cemeteries for objects that should actually be lived in the piece of architecture [9].”

1.3 A “licence to experiment”

One of the things that’s happening with the pandemic, the author suggests, is “the license to experiment”, which could lead to different exhibition formats, or a redesign of spaces inside museums and galleries. In fact, both the circumstances and the reaction that ensued called for a serious rethinking of what an exhibition space is and does.

Still, many decided to heavily invest in their online presence and to take advantage of new funding schemes encouraging to do so. For most museums and galleries, the solution appeared to always be inwards, that is, to remain within the institutional space (in the case of online exhibitions) or the space of the gallery or museum itself. This is also apparent in the way, upon slow reopening, many galleries have initiated new outdoor public commissions and site specific art interventions. These new initiatives take the gallery outside. However, they often remain part of an official and institutional programming meant to be visited and consumed by the very public that used to attend the gallery during pre-pandemic times.

In a post-pandemic world, as challenging as it sounds, a need for (re)socialization is crucial. In fact, never have human beings been craving each other’s physical presence like in this moment. Thus, some artists and independent art centers –usually smaller or with more fluid structure – decided to take a different direction. These artists found no use in reproducing collections and exhibitions online: their community-centered mandate suggested that simply

projecting themselves online could be potentially unproductive if not accompanied by a series of reflections on accessibility, community making and interaction [10]. Art can play an important role in creating new forms of safe resocialization by reaching out towards the public, rather than waiting for the public to come and get it. The solution, in this case, could be to transcend the gallery and allow the arts to spill into the city, thus helping reanimate and transform its urban space.

2 ...To the city square

2.1 The city as canvas

A few months into the pandemic, and with the reopening of galleries not in sight, there have been a number of original initiatives from independent organizations and individuals to physically bring back the arts to the city, rather than waiting for the city to allow the gallery to reopen. A variety of artworks, installations, videos, projections and performances made their appearance around neighbourhoods. These works initiated by art communities circulated around neighbourhoods and downtown core, claiming the city as their "canvas". Toronto hosted a series of art happenings under the name 'It's All Right Now' organized by The Bentway and curated by Black Speculative artist Quentin VerCetty [11]. The series consisted of commissioned texts describing the experiences of living under COVID19 in disadvantaged areas of the city: these texts populated billboards, were circulated on video trucks and appeared in posters around the city. In Mexico, Latin American art and activism collective Articulo protested national healthcare limitations in Mexico and Argentina with projections on buildings’ walls in various neighbourhoods [12]. In New Orleans, a performance truck titled Reality Breaker, brought colorful carnivalesque sceneries to different parts of the city by announcing and documenting its daily trips on Instagram [13]. In several cities, projections of Classic movie clips and video art animated the walls of apartment buildings during the days of strict lockdown. Pop-up performances across balconies, in parks, and in front of porches provided moral relief, tributes to the front line and essential workers, entertainment, and social and political commentaries. Across Europe, pop up mobile devices made their appearance around inner-city neighborhoods bringing art and performances, books and readings.

What characterized the experimental spirit of these initiatives was their mobile nature, spontaneity, and flexible structure. Most of these activities were seemingly attempting to bring the arts to the community, in part to provide comfort, in part to rekindle the relationships, the casual encounters and the sense of human connectedness and kinship that the pandemic had severed. Judging from the way these activities were welcomed, the neighbourhoods touched by them appreciated the gesture: even if for a moment, the deserted city came to life, and the gallery, this time on wheels, on temporary canvas, or on stilt would fill the streets, generating timid but enthusiastic crowds who politely and very carefully enjoyed the artworks while passing-by or observed them from the safety of their balconies and their doorsteps.

2.2 Re-building the gallery

Most of the above events were the products of extemporaneous ideas, that is, they were not generated from previously planned programming: they had an improvisational and fluid structure that allowed them to adapt to different spaces, to respond to specific and more urgent circumstances. But this fluidity is something that emerging and independent artists are very familiar with. While more established institutions and artist run centres preprogram their exhibitions a few years at a time, this is not the case for emerging artists. The absence of continuous funding makes it more difficult for them to make long-term plans and projects. Thus, their activity tends to have a more flexible nature. The lack of conventional exhibition space was partially solved by opting for venues such as abandoned and unused spaces, barns and cabinets. In turn, these venues often provided exclusive access to different audiences and more intense community engagement.

Because of the pandemic, galleries and museums found themselves temporarily evicted from their own home. Their reaction was not to think of alternative or to look for unexplored spaces, but to turn a place that already existed into something else. Re-building the gallery as a virtual place is not only encouraged by experts, donors, and funding agencies, but is also the first, and easiest way to revive the original physical space. In other words, their fate is unavoidably entangled with the space they were occupying before the pandemic.

2.3 Going mobile

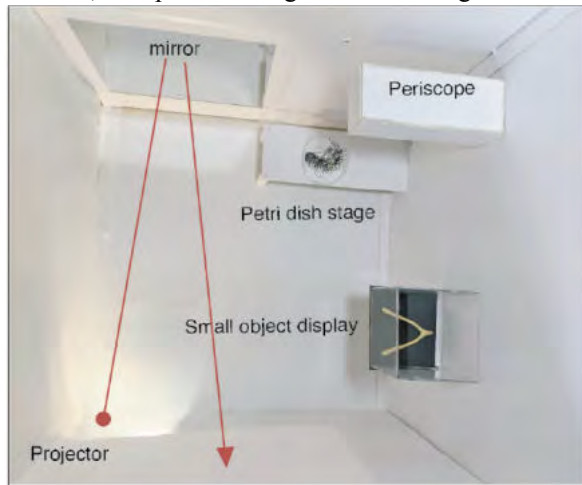
For those of us whose work depends on, and benefits from, ongoing dialogues across disciplines, individuals, and communities, building a virtual presence is insufficient. This has become an important issue for the project Emergent. In fact, while enhancing existing traditional website-as-archive is important, it does not provide an important type of connection standing at its core.

Emergent encourages the fostering of “transdisciplinary hermeneutics’ whereby a symbiosis between different ways of knowing the world may be developed” [14]. Transdisciplinary hermeneutics could be articulated in different ways. First, as a project combining scientific specimens and research documents alongside artworks, it seeks to overcome what Kagan called cisdisciplinary knowing, that is “to mistake situated and partly valid knowledge and learning made possible by any given discipline, with a complete and self-sufficient access to knowledge of the world.” Second, ways of knowing are also situated. Therefore, Emergent also seeks to open dialogues originating from what de la Cadena calls “sites of divergence”, that is, those elements of disagreements pertaining to what constitutes knowledge that “could not be solved without undoing what each of the groups were in relation to their interest in common” [15].

Divergence, de la Cadena suggests, does not equal difference, but goes deeper. Sites of divergence imply that different parties have “interests in common”. However, the system of knowledge they belong to connects these interests in common to different practices and activities. The dialogues created by, and through, these sites of divergence are important because they become “an opportunity for the creation of concepts different from those [that] every participating knower brought to them.” In order to realize a multifaceted dialogue that not only overcomes disciplinary and education differences but also creates new discourses and understanding starting from sites of divergence, in-person confrontations, or close encounters discussions are very important. In fact, they can reach maximum power and intensity when they are conducted in person or are immersed in specific situation. As a matter of fact, they become even more necessary as long periods of physical distance and excessive screen time emphasizing the sense of sight have led to sensorial deprivation and intellectual isolation.

Inspired by earlier independent pandemic responses, which directly immersed themselves in and merged with the fabric of the city, we decided to take Emergent to the street.

The mobile gallery offers more than just an opportunity to initiate new, unexpected dialogues about emergent forms of



life. It might generate discussions about how we want to repopulate the city in a post-pandemic context and how it will look when habits and routines have been interrupted. This unique gallery concept may challenge how public art is consumed and may question the traditional configuration and the significance of the gallery as we know it. In other words, this mobile gallery might become emergent, just like the organisms it carries.

Figure 1 A view of the Mobile gallery from above

3 Post-pandemic anxieties

3.1 Unknown futures

Pei-Ying Lin is an interdisciplinary artist whose long term-project focuses on viruses and viral phenomena. Throughout a series of installations, she asks a recurring question: is it possible to domesticate a virus? and how? Can we become more resilient or more resistant to it [16]? One of her recent works consist in a performance during which dancer and choreographer Hsin Yu Chang gracefully dances through and avoids objects and appliances potentially infected. knowing the risks and using cautions is also a form of coexistence and cohabitation [17]. Lin's questions invite us to reflect on how we can cope with an immediate reality that may be virus free, but not anxiety free.

As lockdowns will be slowly lifted in a (hopefully) not-so-distant future, we might be left with anxieties about new social rules, and fear about new pandemics [18]. Months of physical distance have marked our bodies in significant

ways: we might burn of desires to socialize, touch and hug again as some epidemiologists have suggested, leading to a period of intense socialization similar to the “Roaring Twenties” [19]. However, the opposite might be true. Fear of contracting the virus might leave people with anxiety or what psychiatrists have defined as *Coronaphobia* [20]. This has been a major concern for the creative industries, leading them to major investments in virtual infrastructure. Regardless of which scenario will self-realize, we will probably have to deal with a period of transition during which our bodies will constantly make us self-aware of our distances and will make us feel vulnerable when we are in a public space. Challenging our discomfort by finding new, safer, way of socializing, of reclaiming public space, of making and celebrating art in the public might be the way we defeat the pandemic (and domesticate the virus). What risks are we taking when we try new ways to face our “new normal”?

3.2 The new gallery

During a performance/video titled “staying in touch: post-coronavirus art curating” the five artists converging in the virtual residency “Braiding Fiction” developed a speculative fiction in which art is the virus and art practitioners act as frontline workers. The result is a fictional interview with the curators offering a series of important reflections on the future of art, the gallery and human proximity. “I would rather die than live in a world where art spaces are closed.” Exclaims AN (Anise Neuchâtel) one of the curators of a fictional exhibition. Her expression contains a subtle criticism of the rush towards going exclusively virtual by most galleries and museums during the pandemic. “There is no old normal.” “... there is no normal.” While we must continue to exhibit art, attempting to return to a pre-pandemic order is unlikely, if not impossible. Therefore, it is important to continue to find new ways of collecting, curating, disseminating art. Another fictional curator, VL (Vess L) explains that the idea of art as an isolated object may be outdated in a post-pandemic era: “art not only becomes a part of the workplace, it becomes a part of the home, it becomes a part of the infrastructure of a city, it becomes part of the environment in an all-encompassing and really comprehensive way” [21].

With these ideas in mind, the traditional gallery with its four walls may one day become obsolete, its space become one with the city, merge with its streets, its buildings, the non-human habitants that have reclaimed back its spaces

during lockdown, and maybe even a new species of humans, radically transformed by the experience of isolation, at first fearful, then increasingly confident [22, 23].

As many galleries and museums invest online, change their indoor configuration to provide a safer exhibition

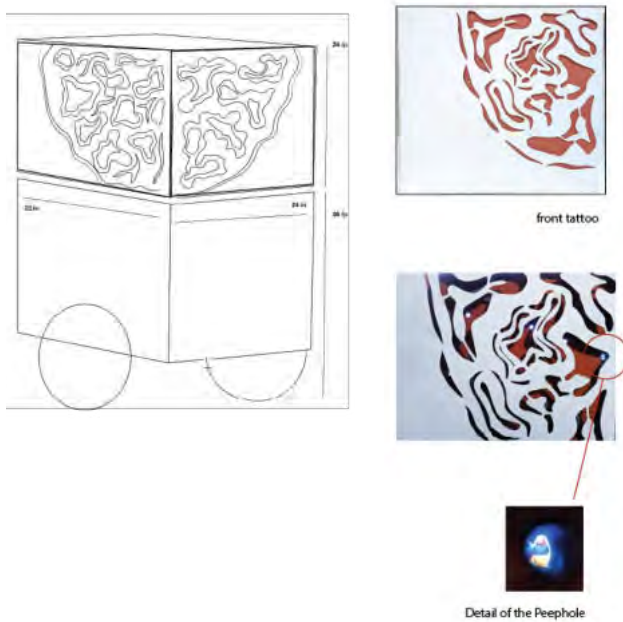


Figure 2 A view of the external look of the gallery and the Tattoo/embossing, with the details of the peepholes

4 Mobile visions

4.1 Not a white box on wheels

Imagine a gallery in a not-too-distant post-pandemic future. Instead of collecting its artifacts into an enclosed space delimited by four solid walls, this gallery moves easily on wheels, adapting and interacting to its surroundings. The gallery take artworks around for a stroll, making appropriate stops to give the audience a chance to spend time with its content.

But this gallery is not just another white box on wheels. Instead of allowing the spectator only watch and observe, it encourages them to connect, interact, and play with its artworks, specimens, and documents; to engage in discussion with random passers-by; to act as connectors between the artworks, the mobile gallery, and the city. Conceived over several months and brainstorming phases, we designed *Emergent* as a living and breathing creature.

In fact, it could not be otherwise: its mobile/travelling nature requires its design not only to adapt to different

experience, or transfer some of their content to their courtyards, how can we make space for the arts in the city and use them to help re-build it and re-socialize it?

environments in different cities, but also to welcome a variety of artworks. For this reason, the gallery must contain modular parts that can be modified and moved to adapt to different circumstances. In addition, participants should be able to manipulate some of these parts so that they can reach and adjust them to their (physical and psychological) needs, allowing them to experience its content equally.

Because the gallery is meant to circulate in a public space, it should welcome different types of interactions. This is even more important in a post-pandemic situation, as participants may be experiencing anxiety to approach artifacts in an exhibition or become closer to other individuals. In the case of *Emergent*, the participant can stop briefly and simply admire the artworks, or can spend time to discuss their significance with other passers-by or with the artists. The mobile nature and modular design makes it possible for people to observe the artworks and the gallery from afar, or come closer.

The goal of *Emergent* is to establish multiple and different dialogues between audiences with different education and disciplinary interests, and audiences with common interest but different approaches to life and to the arts. To draw a variety of visitors and to better integrate the gallery with the urban texture of the city, the design is relatively simple and non-intrusive, yet enticing. The use of projections and user-friendly familiar technologies aims to better connect the gallery with the surrounding context and textures.



Figure 3. A preliminary model of the Periscope

The gallery contains a variety of artifacts and specimens, documents, material objects, and technologies that not only reflect and appeal to different disciplinary interests (natural science, different forms of art, academic documentation etc..) but also different activities and approaches to creative work (play, reflect, observe etc..). To this end, the gallery is organized in two main spaces: a more traditional space with a system of modular and movable boxes for exhibiting small and medium artifacts, and one devoted to exploration and experimentation. Inside the latter there will be light boxes with small artifacts and a periscope to allow viewers to explore the content of three petri dishes. This space is also equipped with mirrored projections which will be visible by looking through the peepholes strategically located at the front.

This structure is meant to be flexible. More specifically, it is designed to join in a dialogue with the artists and the artworks it carries, by adapting to their work, and by asking them in turn to adapt to its portable nature. Its appearance and structure may change too. In fact, Emergent was designed with modularity in mind: in this way, parts can be modified and adapted to accommodate different artworks.

Now in the prototype phase, Emergent was conceived with two main ideas in mind: sustainability and (human and multispecies) dialogue. During the brainstorming phase, we have become especially aware of the potential carbon footprint and the costs of transportation of this artifact, even despite its relatively small dimensions. This issue could be partially solved by creating a design that can be fabricated and assembled on site, rather than shipped. This solution would easily lead to using locally sourced material and to curatorial additions. A second solution would consist in creating a design that uses sustainable material and a compact package that can be easily flattened and reassembled. In both cases, the gallery becomes an artifact that local artists and curators must care for. In fact, every time the gallery travels to a new place, its content and fabrication would be entrusted to the care of different individuals who become accountable and responsible for its “well-being.”

Ultimately, Emergent is a socio/technical experiment devoted to act as a catalyst for heterogeneous and diverse dialogue, as well as renewed socialization. Will people stop by and admire the artworks it contains? Or will they be suspicious at the insufficient sanitation and physical distance it offers, fearing its exposure to numerous different environments? Will they take its passage and interactions as a way to rekindle human relationships with other strangers?

Aren't the casual encounters this gallery will facilitate similar to when we queue for an Americano or a sold out show, or when we sit on a bench reading a book and joyfully conversing with strangers? Could this artifact help us recover trust in each other and start repopulating the city differently, that is, in a more respectful, sustainable way?

4.2 Relational aesthetics

For Bourriaud, "producing a form is to invent possible encounters; receiving a form is to create the conditions for an exchange" [24]. Relational aesthetics sees art as a place of discourse where ideas are not only presented but also experienced. What we envision by creating this mobile gallery is a shared experience emerging between the audience and the artworks, between different members of the audience and between the mobile gallery itself and its surrounding environment.

According to Paiva and Cachinho, whether being located in a traditional gallery or roaming the streets, “artistic forms and practices always emerge in dialogue with their places” [25]. While the exhibition remains the same, we consider the mobile gallery a porous object, affecting or permeating the places it visits, changing the way they look and feel, setting dialogues with and among new audiences. In turn, the context and the space surrounding it will affect the gallery by investing it with new meaning.

We want the Mobile Gallery's structure to be both a dynamic vessel and an artwork. Displaying art can have a substantial influence on the spectator based on its delivery method. Thus, we aim to facilitate access to art through participatory engagement and interventions in urban spaces rather than through just looking from a distance. In the past, works like Pad Thai by artist Rikrit Tiravania [26] and Dongdaemun Rooftop Paradise led by Chan-Kook Park [27] engaged with the public as an intervention and created a shared experience spectacle. At the very core, space and intervention became the heart of the social, cultural, and artistic discourse. Such socially engaged art practices invite unexpected engagements and reactions from everybody involved. They consist "of collaboration and encounters in which the aesthetic perspective of art challenges conventional viewpoints and exposes different ways of being together" [28]. We see the mobile gallery fulfilling such a role as community-engaged art and social spectacle, by allowing dialogues between the public and art and the numerous and unique narratives that will unfold in-between. Furthermore, we have designed the gallery to

allow gallery-goers to construct their own space and arrange artworks: in fact, the gallery is no longer constrained by walls, but will spill into the surrounding space, into the square, it will use the buildings as screens, and the streets as its texture.

As mentioned before, art has occupied public spaces for a long time. In fact, it is no news that planners and urbanists have been very interested in using the arts to intervene in urban space, not only for its economic value, but for its social and atmospheric value. However, as Peters argues, there is "a qualitative difference ... between Flaneuring and inhabiting a system we normally do not know from the inside" [29]. In other words, it is only by experiencing, sensing and being able to explore with others that art can position itself in the realm of human interactions and social contexts. What we hope with this gallery is to stimulate and activate this process of experiential collaboration, by turning it into an artwork in and on itself. By offering this artifact as a safe and inviting space, we hope to initiate new forms of re-socializations.

5 Conclusions

According to de la Bellacasa "The question of how we learn to live with others, being in the world, is an opening to 'becoming with' - to be touched as much as to actively touch" [30]. A mobile gallery can sit there in the middle of the main city square or unobtrusively visit different neighbourhoods without doing much and not offering much incentives for interaction. However, when it is able to suggest stories, to attract people, to meaningfully interact with the space around them, it suddenly becomes alive. With this mobile project, we are imagining ways in which the gallery can thrive in a post-pandemic era, by becoming mobile and by turning itself into an artifact. In this way, the initial goal to create an interdisciplinary exhibition addressing sites of divergence regarding emerging life forms in art and science has evolved into a mission to turn the gallery itself into a new living and vibrant artifact.

While we design this artifact, we are blind. We don't know when the city will be ready to open up to social events. In the meantime, our still speculative project imagines a flexible and scalable artifact that can be easily build in different cities and vary and adapt every time, responding to the city environment, artistic and precautionary (technical) needs, and community access.

We foresee that with efficient social media presence, exciting artefacts and compelling programming, and liaising

with local art events, festivals and cultural venues, we will amass the interest and curiosity from the potential audiences. We want to create a culture of mobile art and be the pioneers who dare to challenge the sterile and stagnant art environment preconceptions. We want to make a platform that serves the community and is fascinating and straightforward. We welcome the public to be an essential ingredient within the mobile gallery concept and execution through reimagining and revitalising city's neighbourhoods.

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The Bartleby Machine

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Abstract

The idea of disobedient machines is developed from the perspective of artificial intelligence, rather than fiction. Misbehavior in humans and machines is presented as a one of the skills which are indispensable for natural intelligence. Different approaches to AI are presented, from symbolism to emergism. The limits of computational formalism are presented, together with Hofstadter's theory of consciousness. It is argued that a machine cannot reach human intelligence unless it is also able to disobey. Hence, an exploration of algorithmic misbehavior is urgent for further development of AI for the arts and society in general.

Keywords

Artificial intelligence, art, symbolic AI, connectionism, convolutional neural networks, consciousness, Turing machine, volition, machine disobedience

Introduction

The story of science fiction is entangled from the beginning with tales of the misbehaving of entities invented by humans. Mary Shelley's *Frankenstein* (1818), considered by some as the cornerstone of the genre, depicts a creature that evades the control of the protagonist. Asimov's laws of robotics, which first appeared in a short story published in 1942, assume that a robot which follows such rules will never turn against humans. [3]

Yet, this is exactly what happens in *Blade Runner*, the screen adaptation of Philip K. Dick's *Do Androids Dream of Electric Sheep?* In the movie, replicants are androids which had gained consciousness and are fighting for survival while humans hunt them. In such a case, the emergence of a consciousness is a misbehavior in itself; a theme that appeared even in *Pinocchio*, where the wooden puppet gains a life of its own, only to start lying and mocking its creator, Gepetto.

We connect rebellion to self-awareness so much that even the refusal to do conscription service and other duties

is termed "conscientious objection". But how does science face the possibility of a man-made transgressive entity? The field of Cybernetics was created in the early years of computational theory with the goal of developing (in machines) and understanding (in animals) the mechanisms of control of automatic machines. Even if Norbert Wiener never mentions the term robot in the founding book of this science, his interest in feedback systems lays the grounds for development of robotics. The field of Systems Theory is a direct descendent of Cybernetics and, likewise, must face the issue of emergence of consciousness.

The most visible offspring of Cybernetics these days is Artificial Intelligence. Deep Learning techniques yielded impressive results in the last decade, with widespread adoption in commercial applications and sciences from biology to astronomy; it is also of particular interest for art practitioners and researchers.

Curiously, it is the tremendous success of AI that prompted some of its main researchers to notice how limited these results were in face of the main goal of the field, namely the creation of an *Artificial General Intelligence*, the singular event where a machine would have an intellect comparable to a human being.

In this article we will try to identify which role art plays in such tasks. Is it possible to imagine a machine as a creator, before they are even capable of analogies and metaphors? Will a program ever be able to refuse its own algorithm?

Symbolism and Subsymbolism

The different definitions of the capabilities of AI overlap each other and blend themselves with common strategies of the field. One of the most important distinctions is between the techniques that rely on logic and reasoning, and the ones based on massive data manipulation.

AI models based on rules are commonly named *symbolic*. "A symbolic AI program's knowledge consists of words or phrases (the "symbols"), typically

understandable to a human, along with rules by which the program can combine and process these symbols in order to perform its assigned task.”[33] Haugeland suggested the term GOFAI - Good Old-Fashioned Artificial Intelligence to describe the thesis that “the processes underlying intelligence (...) are symbolic”. [18] In the first years after the founding event of this science, a 1956 workshop at the Dartmouth college, that was the focus of the research: computers were learning the basic rules to play checkers, for instance. [5] At the time, researchers claimed that if a machine could learn to play chess, it would “penetrate the core of human intellectual endeavor”. [35]

One of the great challenges this approach faces is that the number of rules that would be needed to reach some equivalency to human intelligence would be astronomic. That didn’t stop the researcher Douglas Lenat to start collecting them: the project Cyc¹ is a massive database of codified “pieces of knowledge that compose human common sense”. [28] The last published version of the database has about 1.5 million general concepts (like eyes, sleep, night) and more than “25 million rules and assertions involving those concepts”.² After more than two decades, the project is controversial: scientist Pedro Domingos called it a “catastrophic failure”, citing the inability for it to evolve on its own. [11] Clearly, the effort to describe the world with formal rules is abysmal. When told a story about a person using an electric shaver in the morning, this system found an inconsistency, since it judged that a person could not have electrical parts.[15] While Cyc might not have brought mankind any closer to general intelligence, it is a successful commercial product with many applications.

But already back in the fifties, another approach was being developed in parallel, based on psychological research, and closer to human intuition and perception than rationalism. The method was initially known as subsymbolic. [24] The earliest example of a subsymbolic AI project is the Perceptron, a visual cognition device created by Frank Rosenblatt, based on the McCulloch-Pitts artificial model of the neuron.[31,39] Despite some early success, the model was very limited, as it could not benefit from the massive processing capabilities of today’s chips; in fact, the Perceptron ran on an analog contraption named “Mark 1”, where each neuron was individually wired to potentiometers. [19:1] More damaging to its reputation, though, was the book published in 1969 by Marvin Minsky and Seymour Papert named “Perceptrons”, where they criticized the limitations of the approach, in special the ability of a single-layer perceptron to implement the XOR function, a simple boolean logical operation that outputs true if the given arguments are different from each other. [32] This shortcoming would prove that perceptrons aren’t Turing complete machines, since the definition of such

machines is that they’re able to compute any logical function. Nevertheless, McCulloch and Pitts themselves had already proposed that stacked layers of perceptrons could be a Turing machine. [31] Also, it was later proved that with the appropriate activation function, even a single neuron can calculate the XOR function. [36] As we’ll see, the most successful applications of AI today use multi-layer perceptrons.

Probably the most convincing arguments raised by the Perceptrons book against this technique is that it would be too computation-intensive and that other strategies could deliver the same results. The first is still true to this day. Training a complex neural network model like GPT-3 consumed more than a thousand megawatts-hour. [37] In any case, funding for subsymbolic AI dried in the seventies, and symbolic AI came to dominate the field from that decade until the late 2000’s.. [2]

Connectionism and Deep Learning

The interest for neural architecture in AI slowly began to rise back in the eighties. The books on Parallel Distributed Processing by McClelland and Rumelhart - using basically an approach to artificial neural networks that later came to be known as Connectionism - sparked new ideas, once again. [42] Development was slow, still, due to computational power constraints. A notorious breakthrough happened with the adoption of multi-layered convolutional networks, which are particularly well-suited for processing images. The work of Yann LeCun, one of the main developers of *ConvNets*, did successful work in recognizing hand-written digits as early as 1989 [27]. His networks were based on Kunihiko Fukushima’s neocognitron design, first published in 1980. [13] Further refinements of the technique, including the application of gradient-based learning, contributed to its efficiency; by the early 2000’s, LeCun estimated that 10-20% of the checks in the United States were being processed by convolutional neural networks. [26,50]

On the symbolic side, impressive feats were also coming about. In 1997, IBM’s specially designed computer Deep Blue beat the world chess champion Garry Kasparov. It used brute computing power to analyze 200 million positions per second. [7] Even if it can be seen as the apex of GOFAI, it didn’t bring us any closer to the human intellect. Deep Blue couldn’t do anything other than play chess, and, as Melanie Mitchell quotes, “didn’t get any joy out of defeating Kasparov”. [33] Despite the boost in the stock value of IBM, the result was seen more as a proof of the limitations of computing in regards to general intelligence. [9] The frustration was echoed in Minsky’s own words a few years later, when he declared that the AI field “has been brain-dead since the 1970s”. [51]

Meanwhile, development on the connectionist side continued slowly. In 2009, the ImageNet database was

¹ <http://www.cyc.com/>

² <https://cyc.com/wp-content/uploads/2021/04/Cyc-Technology-Overview.pdf>

created, followed in the next year by a competition of the same name. Both were responsible for great leaps in computer vision. The database, inspired by the WordNet collection, contained millions of images classified into 5247 categories - dogs, cars, trees, etc. [10] It is worth mentioning that the database wouldn't be feasible if it weren't for the advent of Amazon's Mechanical Turk. This is a platform for distributed manual labor, whose workers did the heavy classification work. [52] This collection spawned the ImageNet Large Scale Visual Recognition Challenge (ILSVRC), with the first competition running in 2010. The goal was to use computer vision to correctly classify 200,000 photographs into 1000 object categories, with the most accurate algorithm taking the prize. [40] In the 2012 edition, the AlexNet deep convolutional neural net achieved an error rate of 16%, a breakthrough in image recognition. The network was based on Yann LeCun's work, and contained eight perceptron layers, instead of LeCun's original four. [25]

The results sparked great interest in CNNs, igniting a whole new cycle of research in AI. A quick search in Google Trends reveals that up until 2012, the terms connectionism and deep learning raised similar levels of interest. After this year, the interest in deep learning skyrockets, and the term is widely adopted. In 2014, generative adversarial networks (GANs) were invented, and with them the ability to replicate styles and features learnt from visual references. The last ImageNet challenge took place in 2017; by then CNNs had already surpassed human-levels of accuracy, with an error rate of less than 5%. [20]

More important than serving as standards for accuracy, the images from the set become the training data for the networks. Subsymbolic AI doesn't rely on rules for inference, but on massive amounts of data that "teaches" a network of artificial neurons through backpropagation, enabling it to perform certain tasks. This complex technique has proven itself to be incredibly successful, and it is widely applied by now. The translations made by Google, Tesla direction assistants, Apple's Siri, all of them use some form of deep learning.

Neural networks also left their imprint within the arts. The aforementioned GAN allowed artists to manipulate and generate images in new ways. [6] CNNs have created "new" Rembrandt paintings³ and Bach chorales⁴. But as it happened with the chess breakthrough in the nineteen-nineties, it is easy to realize that the new AI capabilities don't bring us much closer to human-like intelligence. Generative software needs to learn from hundreds of examples to be able to produce a convincing fake; it is not able to develop new styles or concepts. It needs a creative human behind it that can cobble together

such resources within an intriguing framework. Otherwise it becomes no more than a well trained forger.

Abstraction and Reasoning

The ability to make analogies by abstracting meanings and applying them onto different domains is essential to replicate human inventivity. As Umberto Eco notably stated, "No algorithm exists for the metaphor, nor can a metaphor be produced by means of a computer's precise instructions." [12]. This is still valid even with recent machine learning tools. Take, for instance, the title of this article. *Bartleby machine* is a metaphor for *disobedient machine*, built on previous knowledge of the character created by Herman Melville, a clerk that by his inaction stopped complying to orders.

I used a popular text-to-image tool named VCGAN-CLIP, developed in late 2021, to check what images a recent AI tool would generate from such prompts. The text "Bartleby Machine" produces a contraption similar to a typewriter outputting typed text, suggesting that the platform is aware of the literary origin of Bartleby. If I start with "disobedient machine", what seems to be a device holding protest signs is drawn, suggesting that it related the term disobedience with a demonstration (which per se is a disturbing evidence of bias). No such icons of rebelness appeared when I used the name of the character. Apparently the AI is not capable of seeing his subversive trace. This could be an effect of not having the context of this essay, which is a problem for machine learning since it can not be trained on unique data items. On the other hand, it could happen that the next generation will learn that Bartleby has a disobedience aspect and start drawing related images - which would also be limiting as the name might have been mentioned in a different context.

Analogies also happen to be really important in the learning process; they posit a path for general intelligence. Once I understand how to solve a problem in a given domain, I can apply this skill in a different context. But algorithms that obtained 95% performance in recognizing ImageNet objects can fail to recognize the same object if it comes from a photo that doesn't belong to the training set, or with imperfections such as soft focus or blurriness, which have little impact in human perception. [1,22]

This shortcoming was recognized, among others, by François Chollet, creator of the Keras, one of the most popular deep-learning programming libraries.⁵ Current machine learning techniques are doing impressive tasks, but they are *brittle*, a term used when a model won't perform well outside the domain in which it was developed. A really adaptive system would be able to make analogies and not need realms of data. Therefore, Chollet

³ <https://thenextrembrandt.com>

⁴ <http://www.flow-machines.com/history/projects/deepbach-polyphonic-music-generation-bach-chorales/>

⁵ <https://keras.io/>

proposed, in 2019, a new benchmark named Abstraction and Reasoning Corpus. [8]

Instead of using massive data to evaluate the skills of algorithms, this test offers three or four demonstration examples and one test example for each of a thousand tasks. The tasks are based on classic human IQ tests, but use a computer-readable graphical approach, detailing the “questions” on color pixel grids. A human can understand the challenge in each task and deduct the solution; current AI algorithms, however, have a difficult time. In a challenge hosted in 2020⁶, with hundreds of competing teams, the best performance was just above 20% of tasks solved. While it sounds disappointing, the outcome was celebrated by Chollet as a remarkable achievement. ⁷

But, is it creative?

Since abstraction is essential for creativity, and if Chollet’s approach is able to measure the potential of algorithms to make abstractions in order to solve problems, can we affirm that the ARC benchmark is also measuring creativity?

What is surprising, at least in my point of view, is that according to many classic definitions of creativity, it does, although the surprise comes from the definition rather than the measure. Science is so focused on solution-finding that even the earliest academic theories of inventiveness, like Wallas’ model, were built around the ability to solve problems. [45] More recent studies have criticized the limitations of measuring creativity only around skills of divergent thinking (a solution-seeking creative method) and achieving goals. [4]

Art practice is not necessarily related to goal seeking tasks. In fact, many powerful ideas emerge when the artist is not focused on any particular problem. And that is a crucial feature of the human mind. An artificial intelligence will not be comparable to humans if it won’t be able to aimlessly daydream.

This shortcoming didn’t go unnoticed in the AI community. Effort has been dedicated to the idea of objective-less computation. Joel Lehman and Kenneth Stanley have been working for a decade on the idea of novelty seeking without fixed goals. [53] An interesting experiment coming from this research was the PicBreeder, “collaborative art application based on an idea called

evolutionary art.” ⁸ Users of the website are able to explore a domain of images that can be “bred” by combining different pictures into a new one. This genetic approach allows one to begin with completely abstract forms and end up with images that resemble cars, animals, structures or are simply intriguing shapes. [41]

The PicBreeder itself begat breeds of its own, which remained closely connected to the development of machine learning art. In 2018, artist Joel Simon released the GanBreeder website⁹, which used a similar mechanism but was powered by BigGAN, a particular flavor of generative adversarial networks. It has now become a massive community and a powerful tool for AI artists, known by the name of ArtBreeder. It incorporated StyleGAN as part of its engine and it is used by commercial artists. In fact, it also became the pivot of a rights controversy. Artist Alexander Reben announced a project that sold versions of his GanBreeder works, hand-painted by Chinese artists. However another user of the site, Danielle Baskin, recognized Reben’s images as being originated from her creations. [49] The disagreement serves to expose that in all *breeder* tools, the creative source is not the machine, but the artist - or more, the community of artists and users. The weakness of the algorithm - namely, the incapacity to create aimless works - is fulfilled by humans. It does not intend to be a mechanic creator.

Lehman and Stanley also did experiments which were not human assisted: algorithms based on novelty search exhaust the possibilities within a domain of existing solutions in search of never seen answers. [43]. The examples are a labyrinth solving program, and another that helps a robot discover new ways of walking. Granted, these are very innovative methods to solve problems, but they take us again to the realm of achieving goals: leaving the labyrinth or inventing new gaits. In comparison, a child that is looking at clouds and has an idea for a story about a toothless shark wasn’t trying to solve a problem and might not have had the specific goal of producing a new tale.

Against the rules

We know that machines still lack many things that would make them think like humans. Many of these are related to the capabilities of creative people, like writers and inventors. But there is one talent which is particularly interesting from innovators and problematic for programmable machines: the joy of going against the rules. Traditional computers are limited by the fact that they must follow an algorithm which is set in the stone of a strict set of instructions.

⁶ <https://web.archive.org/web/20210729223340/https://www.kaggle.com/c/abstraction-and-reasoning-challenge/>

⁷ <https://web.archive.org/web/20210923084655/https://www.kaggle.com/c/abstraction-and-reasoning-challenge/discussion/154314>

⁸ <https://web.archive.org/web/20210413045735/http://picbreeder.org/>

⁹ <https://web.archive.org/web/20181130123706/https://ganbreeder.app/>

This argument was brought up by Arthur Samuel - who developed the checkers playing system in the nineteen-fifties - in his rebuttal of an article written by Norbert Wiener. [47,54] Wiener stated that machines “may develop unforeseen strategies” when playing games, but Samuel dismissed his concerns saying that no computer could create original work: “(...) the machine will not and cannot do any of these things until it has been instructed as to how to proceed”. Humans, on the other hand, have the choice of not following orders. But do we really?

Before facing the issues of computational formalism, we should at least acknowledge, if not open, one of the most challenging can of worms of thoughtful enquiry: the idea of free will. Can we choose our own destiny, or is it determined by forces external to our desire, like the environment, society and our own biological traits? The discussion started with philosophy itself, and the idea of determinism can be drawn within the greater picture of nature: are events pre-determined in an inevitable chain of consequences? In a deterministic universe, there seems to be less room for free will. Indeed, the discovery of laws of motion by Galileo, Kepler and Newton made the universe seem more like the work of a clocksmith. In 1814, French physician Laplace stated that all that was needed to compute the future is an intellect that knew the positions and forces acting on all bodies and were vast enough to analyze them.¹⁰ This all-knowing entity would come to be known as the Laplace demon. Newtonian determinism was put to test by many scientific discoveries after that, like the irreversibility of entropy dictated by the second law of thermodynamics and the indeterminism of quantum mechanics. But recent cognitive research pushed the scale towards determinism again. Studies of volition - the scientific field that investigates human will - shows that decisions are taken a few instants before we make them consciously; this would prove that they happen for neurobiological reasons, instead of a wilful whim. [16,17,29] In any case, proving or denying the existence of free will is not the aim of this article.

One of the most powerful arguments against the possibility of computers going against their rules is the definition of a Turing machine itself, which requires the existence of a set of behaviors to be executed according to the symbols laid down on a tape. [44] The only major difference between Turing’s proposal and today’s computer

¹⁰ “We may regard the present state of the universe as the effect of its past and the cause of its future. An intellect which at a certain moment would know all forces that set nature in motion, and all positions of all items of which nature is composed, if this intellect were also vast enough to submit these data to analysis, it would embrace in a single formula the movements of the greatest bodies of the universe and those of the tiniest atom; for such an intellect nothing would be uncertain and the future just like the past would be present before its eyes.”

is the use of random access erasable memory instead of a linear tape, an idea proposed by John von Neumann in 1945. [34] So if such a machine is defined by rules, it cannot go against them - it would stop working. We could consider a program that allows its code to be rewritten: that is the base of genetic programming, and also of games that let users change its rules like the hit *Baba is You*.¹¹ In fact, computer science never refers to rules being broken, but rather rewritten; like with any revolution or change of paradigm, the standards are not just gone, but replaced with new ones. But then it falls into a paradox: another set of rules is created around the possibility of setting rules. We’re just creating a higher set of laws that can not be transgressed, unless we create an even higher level of behaviors and so on.

This same paradox arose when Bertrand Russell and Alfred Whitehead published the *Principia Mathematica*, a major attempt at unifying and gathering proofs to the all existing mathematical corpus of knowledge so far. [46] A few years later mathematician David Hilbert formulated a program that questioned this effort in many ways. [48] One is of special interest to this paper: can all the methods organized in Russel and Whitehead’s compendium be proved by the rules provided in the *Principia Mathematica* itself? That is, is it self-proving, without the help of any external rule? “A formal system is *complete* if for every statement of the language of the system, either the statement or its negation can be derived (i.e., proved) in the system.” This possibility was aptly contradicted in 1931 by Gödel’s Incompleteness Theorems, which showed that a formal system cannot prove by itself that it is consistent. [38] Mathematics cannot pull itself by the bootstraps; programs won’t be able to change their own rules without a higher-level set of rules.

If we assume that humans have indeed the potential not to follow internally defined rules (like refusing to eat even if our body demands food), we can formulate the two following hypothesis: (1) the human mind is not a machine programmed by an external, higher mind, otherwise it would “stop working” and (2) artificial intelligence cannot be symbolically programmed and must emerge spontaneously, like natural intelligence did.

And in fact, one of the main strategies for the development of AI is the emergentist approach, which relies heavily on subsymbolic methods. Other strategies, as mentioned, blend together symbolic rules with neural network models. It must be mentioned that even these connectionist models are based on computers, and therefore are locked in to unescapable rules. Experimental work is being done with biological AI, but it is still in very early stages. [14]

Maybe there remains to be invented a brain-like machine that is not based on rules? Or maybe the aforementioned assumption is just wrong, since there is in fact a hardware-like set of rules to which brains are bound to.

¹¹ https://en.wikipedia.org/wiki/Baba_Is_You

Neurons do have a very simple mechanism, which has been deciphered by science decades ago. But how can these simple but unbreakable rules give rise to such rich and free behaviors? After all, if we use Gödel's proof on biological brains, the rules of neurons would be superseded by another higher set of rules and so forth, in an *infinite regress*; we would end up locked in some stone written code of different order, and yet we aren't.

A beautifully crafted theory to solve this contradiction was proposed by Douglas Hofstadter. [21] It is a shame to have to summarize it, but for that Hofstadter himself proposes the synthetic concept of strange loops. Strange loops, he says, appear in many places. A graphic example would be Escher's print depicting a pair of hands drawing each other. It also appears in paradoxical constructs such as "this statement is a lie", that contradicts itself permanently and can never be resolved. Such a paradox is connected to Hilbert's questioning of the rules that define themselves, but it was also formulated long ago by Epimenides, the Cretan philosopher who stated: "all Cretans are liars". Hofstadter also identifies strange loops in Bach compositions like the "Canon per Tonos", where the voices rise continuously, while the harmony modulates in a way that ends up back where it started.

These loops can be organized in more complex arrangements, where one hierarchy controls another, which controls another, which in turn dictates the rules of the first one. What his theory proposes is that our brains are a complex entanglement of such rules. We move from one hierarchy to another one that alters the rules of the first, then move back to it and update the regulations of a third, and on and on. "In our thoughts, symbols activate other symbols, and all interact heterarchically. Furthermore, the symbols may cause each other to change internally, in the fashion of programs acting on other programs. The illusion is created, because of the Tangled Hierarchy of symbols, that there is no inviolate level. one thinks there is no such level because that level is shielded from our view." The inviolate level of unchangeable rules here is the biological structure of our neurons. There would be no paradox in creating an insubordinate machine; we just haven't been able to build such a complex system yet.

One elegant consequence of this theory is that it removes the incompatibility between biological volition and indeterminism: our decisions might even be made on a chemical level, but they are impossible to predict and can always be influenced by other decisions of our own.

Building it

There is not a proof to Hofstadter's theory, and it is not clear if such a machine can be built. It is so hard to define consciousness that we are not even sure that we will recognize it when (if) an artificial one is created. It has been proposed, for instance, to use metaphor cognition

capabilities as a new Turing test to distinguish humans from machines. [30] The same can be crafted off disobedience: a program that refuses to follow its code or does it in a way that breaks its own rules would be displaying human, "conscientious" qualities.

The mere proposal of a disobedient machine makes room for a myriad of ethical problems. Beyond the warnings of science fiction - machines that decide to annihilate mankind and such - we don't even know if it would be correct to turn off a machine once it obtains some sort of consciousness: wouldn't this be the equivalent to killing a sentient being? We are already facing the issues of work replacement: what if people can be replaced in all tasks, including the creative ones? In many ways, we can be glad that insubordinate machines are not around the corner yet. But it seems like that for an artificial entity to become a complete artist, it will need the ability to bend and recreate its own norms of behavior. Some scholars, in fact, defend the idea that disobedience is the very path through which an AI can become a subject. [23]

More than a proposal, the disobedient machine shows that art must be in the path to be followed towards an artificial general intelligence. Artists can play with concepts of rebelness and abstraction with much more property than scientists; they can explore these ideas without the obligation of reaching goals.

If goals define the work of machines, a truly daydreaming state can only arise from an anti-work condition. The stance of Melville's character is a roadmap: his refusal to comply, his adherence to a state of pure contemplation during office hours, even facing the threats of unemployment and homelessness. A planned unfolding of this paper is the research on existing and developing systems of tangled hierarchies, overlapping and dominating each other in turns to create lazy, balky, contumacious, exquisite outcomes. A machine that would prefer not to.

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Unrecording Nature

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Abstract

The colonial import of early media technologies, e.g. sound recording in Global South faced a stiff resistance from the local practitioners. In this paper, I am interested to investigate why leading South Asian musicians and sound practitioners were not enthusiastic about recording their voices on the shellac discs; and for a long time resisted recording their improvisational sounds as they were: offerings to nature and the situated environment. What were the reasons of their contention and resistance? I argue, the pre-colonial sound practitioners feared that recording technology would contaminate their performances by mutating the natural and embedded connections they uphold in their practice. By discussing this unknown history, the paper aims to shed light on the discourse on how do we inhabit and relate with nature, and transform our environments on the media.

Keywords

Sound recording, early media technologies, Global South, decoloniality, nature, indigenous knowledge, mediation, pre-modern sonic cultures, shellac, environmental sounds

Introduction

From the earliest days of sound recording, technology shared a fraught relationship with the pre-modern cultures in South Asia, including traditional music and sounds. Imperial companies and colonial ethnographers introduced the recording of sound in South Asia. Recording of musical performances, along with other forms of sounds, i.e. speeches, comedy shows, theatre and staged acts etc., within a studio setting and making them available publicly as objects for reproduction and as products for sale, had far-reaching social and sonic effects. Recording technology altered performance aesthetics for sound practices by limiting the duration, scope of improvisation, and by distrib-

uting vocal and instrumental music, and local sounds as fixed objects to a mass audience for the first time. Was it acceptable for local music and sound practitioners in South Asia, and in the Global South (e.g. South Asia, Africa, and Middle East sharing a fraught colonial history)? As I will show, there were resistances to recording the voices and sounds of the colonized subjects in South Asia. I am interested here to investigate why leading South Asian musicians and sound practitioners were not enthusiastic about recording their voices on the shellac discs; and for a long time resisted recording their improvisational sounds as they were: offerings to nature and the situated environment. What were the reasons of their contention and resistance?

The advent of sound recording in India was engineered by London's Gramophone and Typewriter Company in the early 1900s. The first recordings were made after 1902 by GTL's engineer Frederick William Gaisberg and the local agent George Dillnutt (Kinnear 1994). These early recordings were mostly made on shellac discs, as South Asia had an abundance of raw materials, e.g. resin, to produce shellacs. Therefore, the intention of the imperial company headed by colonial ethnographers like Gaisberg was to exploit the local resources for building a global business that would benefit the colonial powers. The early days of the Gramophone's recording industry in South Asia can be examined from various perspectives, including the obvious commercial, as well as historical, social, political, and technological. Through this critical engagement, it is revealed that the period in which these recording expeditions were made are the peak period of imperial expansion of the British colony in South Asia, and in many other regions of the Global South, through trade and manipulating new markets. These early recordings were marketed owing to colonial mapping of auditory cultures for exploitation and consumption to making profit. Likewise, musical forms

and intricate vocal renditions like Khayal¹ were adapted, rendered or compromised to suit the requirements of studio recording, marketing, and sales abroad; in the Global South, there was no such market before. As a result, many hybrid and mutated forms emerged, such as Thumri² and Dadra³, which were flexible, recording-friendly adapted version of Khayal sans the aural intricacy of a free and temperamental improvisation that tends to transcend the temporal and durational limitations. Practitioners of Dhrupad⁴, ancient-most surviving sonic form, fell way behind in this rat race for making quick money, as they were least interested to transmute their aesthetics of performing. Those who adapted to the business models of practice by a conformist approach to colonization of sound were most successful.

Among these recordings were the voice of Gauharjan, a so-called *tawaif* (or courtesan) from Calcutta and an exponent of light classical vocal music – popular and abridged song versions of a few ragas with a sensual, high-pitched and light-hearted rendition. The other early such songs for the recordings were performed by Miss. Soshi Mukhi, Miss. Fanni Bala, Miss. Sila Bai, Miss. Hari Dasi, and N.C. Chakraborty (Farrell 1993, Kinnear 1994), among others. As mentioned, missing in these recordings were many great voices of these times, Dhrupad and Khayal singers like Fayaz Khan, Alladiya Khan, et al, although they were regularly performing for hours on the stage at this time, as live performances were in abundance in South Asia.

¹ Khayal is a major form of Hindustani classical music associated with poetic lyrics and sung words based in a raga. In Khayal, ragas are extensively ornamented, and the style calls for more technical virtuosity than intellectual rigour.

² Thumri is another vocal form in Hindustani classical music that is based on the romantic literature. Thumri as a style is derived from Khayal in a shortened form.

³ Dadra is a shorter and light classical vocal form in Hindustani classical music based on certain simpler rhythm cycles or tala.

⁴ Dhrupad is one of the oldest forms of musical sound practice in India, and Alaap is its introduction, which is an elaborate and free-flowing introduction of the raga. While Dhrupad takes a few hours to present, Alaap takes more than an hour to establish the raga's mood through intricate building of sound without rhythm accompaniment.

One may ask why the serious Dhrupad musicians were unrecorded, but an amateur singer like Gauharjan was celebrated as the first historic voice recorded in South Asia even over few of the above-mentioned recorded local singers. The fact that the others were natives, and Gauharjan was not⁵, cannot be denied given the colonial-racial roots of early sound recording. Both her parents were Europeans, and British colonial officers could relate to her quite easily because of that racial lineage. She quickly figured out the economic potential of recorded sound as a commercial product for sales. Likewise, within a few years her income from sound sales picked up manifold. If the colonial and racial were the contexts for early sound recordings made in South Asia, the intentionality of doing exploitative business was at the center of it. But more importantly, Gauharjan rode to fame over others as she was more inclined to do business, and her colonial connection made her the prima donna of early sound recording in South Asia, while the Dhrupad and Khayal performers like Fayaz Khan, Alladiya Khan, were absent as they preferred to stick to the musical values, and were resistant to truncate their improvisation for the sake of adhering to recording technology, and advocated for live performance over recorded discs to communicate their art. This is the reason why the early sound recordings can be questioned of their historical importance, as they registered only a narrower section of sound practice.

It is needless to say that these early recordings were predominantly born out of colonial ethnographic expeditions for quantifying sound in the colony. They were made on 3-minute long shellacs discs as sounding objects or commodities for sale. They were meant for expanding European markets in South Asia using local material like resins, and

⁵ According to her biography, Gauharjan was born Angelina Yeoward in 1873 in Patna. Her father's name was William Robert Yeoward. Her mother was Victoria Hemming, who was born and brought up in India and knew Indian music and dance well. Angelina was their only child. She was baptized in the Methodist Church in Azamgarh near Allahabad. See: https://chandrantha.com/biodata/gauhar_jan.html

exploitative labor. They aimed for maximizing gains and minimizing costs (Parthasarathi 2009) in terms of using cheap local resources and making them available globally for sale through the colonial channels. There was little or no interest in the cultural practice and aesthetics of local music and sound as expressed in the officer's conduct. Moreover, Gramophone Company was quite disrespectful of the local musicians, whom it often termed as *damn natives* (Farrell 1993). There was little interest on the colonial officer's part to appreciate the sophistications that the traditional and pre-modern sound practices in South Asia possessed. The GTL's agent in Calcutta was John Watson Hawd. Hawd's interest in Indian music appeared to be squarely focused on business. In June 1902, his statement was, "The native music is to me worse than Turkish but as long as it suits them and sells well what do we care?" (Farrell 1993). Gaisberg, on the other hand, notes in his travelogue, "We entered a new world of musical and artistic values . . . The very foundations of my musical training were undermined" (Lubinski and Steen 2017). To the colonialist sonic ethnographers, it was largely a subservient continent to explore and plunder the resources. This plundering tendency reflects in the way local sounds were damaged in the early recordings and their aesthetics threatened. I have done research in one particular tradition or school of sound practice from Bishnupur, in Bengal (Chattopadhyay 2020, 2022). One recording from this elaborate style exists in a truncated and reduced form, hinting at what would be the quality in an original performance based on situated sonic improvisation, mostly inaccessible in a 3-minute recording on a 78 rpm shellac disc. There were also unsolicited interruptions made during the recording expeditions to serve the technological dispositive of sound recording. For example, at the end of her recording Gauharjaan used to say: "My name is Gauharjaan."⁶ The earliest recordings of South Asian musical performances are known by this high-pitched and flirtatious announcement, made towards the end of the recording to register the name of the performer.

⁶ One early recording can be found on the SoundCloud page of the project *Connecting Resonances*: <https://soundcloud.com/budhaditya-chattopadhyay/gauharjaan>

This declaration of the singer seemed to epitomize a proclamation with a European egoism that goes against the core essence of surrender to the nature in South Asian traditional sound practice such as Dhrupad. Within the edifice of the recording object on shellac discs, an advent of recorded alter ego would haunt its content, structure and style of presentation. It is then no surprise that many of the devoted local sound practitioners didn't want to record their practices in order to resist the mutating invasion of early recordings.

As I have briefly discussed in my essay "Unrecording Nature" (Chattopadhyay 2021), the *Alaap* section of a Dhrupad was based on a deep connection to the natural temporality and free movements between sounds, which would be curtailed in a recording, even though it would "capture" (Parthasarathi 2009) their voice for the market and for the posterity. Without a doubt, at the turn of the century South Asian sound practitioners found themselves at the cultural intersection of two worlds: the natural improvisational character of sound practices in South Asia, and the mutating modernist technological invasion by the imperial recording companies and their business-driven ethnographic expeditions as part of the colonial exploitation of local resources to profit from. Nevertheless, recorded discs opened up a portal for transcultural interactions even though heavily unbalanced in the power hierarchy at that time due to the predominant colonial structures of exploitation, undermining, and control. The early days of the Gramophone's sound recording industry in South Asia indeed marked a new phase in the interface between South Asian music and Europe. For the first time practitioners from the Global South entered the world of Western media in the form of shellac discs. But as shown above, this exposure was by and large a commercial initiative than a cultural *mélange* at that time. The main purpose of the recording industry was to put in place a crude capitalistic system within a community of practitioners who were devoted to their craft of embodied sound by true presence and subjective devotion to natural forces in their free improvisations.

Indeed, Ragas were reflections of natural temporalities, and each raga was dedicated to a time of the day. What recording industry incurred to this spatiotemporally free-flowing and natural practice of sound⁷ was to transform an emergent auditory situation into a cultural mode of transmission and Schizophonic consumption in the form of shellac discs. In this view, early sound recording was a deeply damaging intrusion. Broadly drawing on Walter Benjamin's notions of the loss of "aura" of art in its mechanical reproduction (1969), and more specifically referring to Theodor Adorno's thoughts on the gramophone (1990), one can develop a critical attitude towards recording technology, since the recorded sound objects "no longer possess their traditional reality" (Adorno 1990). Reviewing Adorno's position, Thomas Y. Levin comments, "Clearly the gramophone does alter the dimensions of the live musical event, transforming everything in a manner similar to radio into chamber music, i.e. music for domestic environment" (Levin 1990). Following this trajectory of the castrating of an alive sound into domestic object, one can contend that early sound recordings compromised the aura of sound in South Asia, reducing the elaborate, temporally open, and improvisational pre-modern sound practices into 3-minute recordings on a fixed media of shellac disc as deliverable sound objects. This is the reason why musicians, particularly more traditionally oriented Dhrupad musicians resisted recording, as they feared that the dedicated search for integrity and true voice would be contaminated. This disruption in South Asian sonic worlds was initiated by the colonizing forces. In many cases, this disruption was irreversible – as the mutating changes, e.g. from Khayal to Thumri, were later accepted as normative.

In view of this, many South Asian sound practitioners were reluctant to face the phonograph for a number of reasons, e.g. as shown, the spatiotemporal disembedding of sound practice from its value systems, that is, their embeddedness to natural phenomena and environmental spatio-

temporalities. There was also an apocryphal apprehension that the recording media would exorcise sounds of an artist's voice. Musicians' concrete concerns were centered on the sudden public availability of their art, and the limitations that recording imposed on performance time. Over the course of the last century, these concerns have shaped both the practice and the content of post-colonial sounds. However, after the independence, musicians have gradually innovated with recording, reclaiming the technology through long-form recording of their live performances as sonic traces, balancing adherence to customary structures with the compulsion to remain relevant. Currently, traditional sound practices like Dhrupad are surviving in a relatively appropriated form and format, through today's freer digital access and sharing, rather than being muffled by recording's dark beginning.

⁷ Music scholars such as Alain Daniélou have pointed out the natural spatiotemporality of the tunings and the sounds of Indian Ragas (1995).

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Author's Biography

Budhaditya Chattopadhyay is an artist, media practitioner, researcher, and writer, and a professor at Critical Media Lab, Basel, Switzerland. Incorporating diverse media, creative technologies and research, Chattopadhyay produces works for large-scale installation and live performance addressing contemporary issues of environment and ecology, migration, race and decoloniality. Chattopadhyay has received numerous residencies, fellowships, and international awards. His works have been widely exhibited, performed or presented across the globe, and released by Gruenrekorder (DE) and Touch (UK). Chattopadhyay has an expansive body of scholarly publications in the areas of media art history, theory and aesthetics, cinema and sound studies in leading peer-reviewed journals. He is the author of three books, *The Nomadic Listener* (2020), *The Auditory Setting* (2021), and *Between the Headphones* (2021). Chattopadhyay holds a PhD in Artistic Research and Sound Studies from the Academy of Creative and Performing Arts, Leiden University, and an MA in New Media from the Faculty of Arts, Aarhus University.

Merging Art, Media, and Ecology: Diego Rivera and Ariel Guzik at the Cárcamo de Dolores

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Abstract

This paper examines two public art projects at Cárcamo de Dolores, in Chapultepec Park, Mexico City: Diego Rivera's *El Agua, Origen de la Vida en la Tierra* [Water, Origin of Life on Earth] (1951) and Ariel Guzik's *Cámara Lambdona* [Lambdona Chamber] (2010). Because these projects are new additions to existing literature on environmental themes in art history and media arts histories, the incipient focus is on addressing both their artistic and conceptual significance. Both conceived as creative engagements with water, Rivera's *El Agua, Origen de la Vida en la Tierra* is highlighted as the first underwater mural in modern art, with Guzik's *Cámara Lambdona* as a sonic installation created to restore the former's work. To additionally shed light on the artists' respective aims in merging ecology, art, science, and technology, this discussion then considers these projects' divergent articulations of human and nonhuman relations, and as well their kindred aspirations, to function as catalysts of a possible, more sustainable world. In including these projects, this examination shares current concerns with broadening the geographical scope of existing environmentally-themed art historical and media arts histories. Expanding upon this focus, this paper not only emphasizes the ecological arts in the Global South, but as well their interdisciplinary basis and media forms. Hence, it combines a global perspective with an interdisciplinary approach, which, echoing the projects considered, is moreover relevant for further developing the existing histories of the environmental arts.

Keywords

Human and non-human, Mexico, media arts, ecological arts, water, enchantment, modernism, post-modernism, muralism, sound.



Figure 1. Inside view of Cárcamo de Dolores with Diego Rivera's once submerged mural, *El Agua, Origen de la Vida en la Tierra* (1951) in the middle, and Ariel Guzik's sonic installation, *Cámara Lambdona* (2010) on the walls (left and right).

El Agua, Origen de la Vida en la Tierra

Located in the second section of the Chapultepec Park, and a central feature of the *Museo del Jardín del Agua* (Water Garden Museum), the *Cárcamo de Dolores* (the Dolores Chamber) (fig. 1) commemorates workers lost to the building of the Lerma System.¹ Built during the 1940s and subsequently expanded from the 1970s to the 1990s to become the Lerma-Cutzamala system, this vast hydraulic engineering project was then and is still today a vitally important infrastructure to Mexico City's population. (Presently, the Lerma-Cutzamala system supplies potable water to more than two million of the city's residents).[1] A feat of hydraulic engineering, the Lerma system was, at the time of completion in 1943, more significant as a symbol of Mexico's post-revolutionary modernization. One of many public infrastructure projects built under the leadership of then-President Miguel Alemán Valdés (1946-1952), it exemplified as such his administration's advocacy for state-led industrialization.² The *Cárcamo de Dolores*, along with Diego Rivera's mural *El Agua, Origen de la Vida en la Tierra* and its accompanying 100-foot-wide sculpture, the *Tlaloc Fountain*, was as such commissioned not only to indicate the location where the waters of the Lerma river enter the city, but also to cultivate popular support for the state's course of industrial development.

¹ The current Cutzamala-Lerma system was a later expansion of the Lerma system in 1976. One of the biggest water supply infrastructures in the world, it utilizes 7 reservoirs, a 127 km long aqueduct with 21 km of tunnels, 7.5 km koorindabell (what is this?) canal, and a water treatment plant. The water passes through the 127 km long tunnel under the western Sierra de las Cruces on its way to holding tanks near the Cárcamo de Dolores; then on to a second chlorinisation plant to remove toxins; and then aqueducts and pipes, with approximately 2,000km in the primary network of trunk pipes, and a further 12,000km of smaller pipes within each district.

² Representing the *Partido Revolucionario Institucional* (PRI (Institutional Revolutionary Party) which held uninterrupted power in

the nation for 71 years, from 1929 to 2000), *Alemán* was democratically elected as the first civilian president of Mexico serving from 1946 to 1952. His presidency became synonymous with the so-called Mexican Miracle, marking a period of rapid industrialization and economic growth fueled by newly discovered oil reserves in Mexico. While mired in political corruption and cronyism, Alemán's administration emphasized building and expanding the country's public infrastructure, including rail and road networks, vast damming and other hydrological projects (including the diversion of the Lerma river to supply water to Mexico City), a new campus for the National University (UNAM), and Mexico City International Airport.

Charged with this commission, the architect Ricardo Rivas (1913-1998) conceived of the project as a collaborative integration of engineering, architecture, and art; and, moreover, an exemplar of the 1910 revolution's promises of social justice and greater equality. In sum, the *Cárcamo de Dolores* evidences Rivas' belief that the integration of art and science, and social transformation are kindred projects, in this case, the more relevant as Mexico's postrevolutionary constitution enshrines the human right to water. Accordingly, Rivas designed the *Cárcamo de Dolores* as a small temple inspired on *mestizaje*, so fusing classical Mesoamerican and European architecture.³ The Mexican art historian Louise Noelle describes it as a small amphiprostyle temple (having columns at either end, but not along the sides), with a series of columns *in antis* in the front and back. [2] The building is in effect a resonance chamber built of cantera stone (a volcanic rock mined in Mexico and Central America) and with floor to ceiling glass entrance and exit doors and windows designed to allow light in. Inside, at the center, the water in the reservoir would catch the light entering and enliven the interior with reflections. The dome on top of the reservoir would moreover amplify the sound of running water. Subsequently, Rivas approached Rivera (1886-1957), who accepted the commission to paint the entire interior walls and copula. In the end, only the mural in the reservoir, *Agua, el Origen de la Vida*, and in front of the building, the *Tlaloc Fountain*, (Tlaloc being the Mexica god of rain and harvest) were realized.

Matching Rivas' interdisciplinary and political visions for the project, Rivera conceived his contributions similarly, as an opportunity to integrate art, science, and social change. Like Rivas, the artist proposed that water would both be a subject matter and a medium. The overarching idea, as he put it was "to create for the first time painting in movement".⁴ [3]

In practice, the mural, which covers the entirety of the reservoir's tunnel, floor, and walls, would edify viewers about a variety of narratives about water, spanning scientific, spiritual, social, and cultural meanings. Accordingly, Rivera structured this narrative loosely around contemporaneous evolutionary theories. So the painting was partially submerged (the water covered the floor and lower part of

The tank) to tell this story, which the artist began by way of depicting the primordial soup as theorized by the Russian biologist Aleksandr Oparin.⁵ [4] (In 1924, Oparin proposed that the development of life on earth resulted from basic biochemical exchanges between carbon-based molecules floating in the planet's primordial oceans, adding that the planet and life were intrinsically connected processes). In this wet part of the mural, Rivera accounted for the refractive properties of water and the visitor's elevated point-of-view by foreshortening and magnifying images of aquatic life (including microorganisms, plants and animals), which were based on contemporaneous scientific illustrations.

Progressing from aquatic to land-bound habitats, the dry part of the painting focuses on the significance of water for human evolution and for human life in the Valley of Mexico. Portrayed emerging from the primordial waters, two human figures representing the original couple loom large against the background of Mexico City's skyline. A reference to contemporaneous scientific theories of Africa and Asia as the cradles of human life, an African man (Fig. 2) on the north wall, and a pregnant Asian woman (Fig. 3) on the south wall, face each other. The panoramic background shows an arid and volcanic landscape punctuated with pre-Hispanic structures and modernist skyscrapers. In this urban scape, Rivera depicts modern urbanites of different ages and social classes enjoying the benefits of potable water, drinking, tending gardens, and swimming. (Notably, Rivera included a portrait of his daughter, Ruth Rivera Marín swimming, in a probable reference to her graduation in architectural engineering in 1950).⁶

Painted on the west wall, above the tunnel, which at the time carried the Lerma waters into the reservoir, two immense, cupped brown hands overflowing with water reference the spiritual symbolism of water in pre-Hispanic culture. Above the god's hands, one of the faces of Tlaloc peers in from the *Tlaloc Fountain* outside through the glass entrance doors (Fig. 4). On this and the opposite wall, to the east, Rivera prominently eulogizes the workers and engineers of the Lerma system. They are portrayed flanking the god's hands holding tools and bearing offerings of water to thirsty urbanites. Above the system of flow control gates directing running water into nearby tanks and the purification infrastructure, Rivera portrays Rivas and the head engineer

³ With roots in the word *mestizo* in colonial Mexico, and subsequently developed during the Independence era, the notion of *mestizaje* was reformulated in post-revolutionary Mexico as the state's ideology. In colonial Mexico, the word *mestizo* was loosely used as an ethnic/racial category of self-identification. During Independence, academics began using the noun *mestizaje* to denote the positive unity of race mixtures in modern Mexico. Post-revolution, this notion of *mestizaje* was mobilized and promoted by the state under the umbrella of *Indigenismo*, as a way of unifying Mexican identity. Among the most influential promoters of *Indigenismo* was the philosopher and statesman José Vasconcelos Calderón (1882-1959). Vasconcelos's notion of the Cosmic Race (1948) was both a rejection of Anglo culture and argument for the primary mission of an independent Latin America: to birth a new modern mestizo people destined to create a more just, equal world. Vasconcelos' position as the Secretary of Public Education (1921-1924) provided him with a powerful platform to implement his vision of the Cosmic Race. Among his beneficiaries are the Mexican muralists, including Rivera, whom was among the first visual artists commissioned to educate the illiterate masses about Mexico's *mestizo* identity through murals painted in Mexico's most important public buildings. Hugely influential for twentieth-century Latin American and Latin diasporic culture, this notion of *mestizaje* has been

challenged in the twenty-first century as a form of nationalism at the cost of cultural assimilation for all ethnic groups.

⁴ Rivera's interest in dynamizing muralism, and as well as in using industrial materials to develop new painting techniques, contrary to what he implies here, is not at all unique among Mexican muralists. In effect, Rivera's fellow muralist and nemesis, David Alfaro Siqueiros, is the most noted for his experimental approaches, which included techniques that had never been utilized before such as using industrial spray guns to paint a mural directly on cement and employing camera-projections to transfer sketches to the walls.

⁵ The artist met and sketched Oparin during one of his visits to Soviet Moscow.

⁶ Rivera Marín was the first woman to study architecture at College of Engineering and Physical-Mathematic Sciences at the National Polytechnic Institute of Mexico. Involved in designing both the Museum of Modern Art and the Museum of El Eco in Mexico City, Rivera Marín is most noted for the Anahuacalli Museum, which she designed jointly with the architect Juan O'Gorman to house 2,000 pieces from her father's collection of pre-Hispanic art. Built post Rivera's death in 1957, and opening to the public in 1964, the building was inspired on pre-Hispanic temples (teocalli). The word Anahuacalli means the house close to water in Nahuatl (Atl means "water" and nahuac "close to"), and like the fountain outside of Cárcamo de Dolores is dedicated to the Aztec rain god, Tlaloc.

Eduardo Molina surrounded by the team of engineers (Fig. 5). Underneath them, representations of chlorine and ammonia molecules illustrate the chemical composition of the disinfectant used to make potable water to viewers.

Altogether the mural is exceptional not only because of its illustration of water as an integral part of life's evolution, culminating according to Rivera's narrative in Mexico's modernization project, but also because of its unique integration of water to similarly dynamize its counterpart in art, Mexican modernism. Through this, it additionally assists Rivera's own quest for dynamic painting. To this end, the artist researched a variety of clear synthetic resins, eventually opting for a *polystyrene* solution (BKS-92 polystyrene) to protect the painting from the Lerma waters. [5]

Additionally, the mural's companion piece, the *Tlaloc Fountain* was similarly designed to be viewed from the dynamic point-of-view of air bound visitors. Located along the flying routes of planes servicing Mexico City International Airport, the giant mosaic-covered Tlaloc figure lying on his back half-submerged in water, was according to Rivera inspired on the "mounds" then being revealed through aerial photography (Fig. 6).⁷ [3] In modern art, the sculpture is as an early precedent to earth and land artist in North-America, such as Robert Rauschenberg's *Spiral Jetty* (1970) which similarly implied an aerial perspective. A nod to Rivera's patron, President Alemán, under whose administration the Mexico City International Airport was built, the *Tlaloc Fountain* was, in contrast to the remoteness of later earth and land art, conceived to be easily accessible because of its urban location.⁸ [3]



Figure 2. North wall, *El Agua, Origen de la Vida en la Tierra*.



Figure 3. South wall, *El Agua, Origen de la Vida en la Tierra*.



Figure 4. West wall, *El Agua, Origen de la Vida en la Tierra*.



Figure 5. East wall, *El Agua, Origen de la Vida en la Tierra*.

⁷ At the time, inbound and outbound planes flew this route at a lower altitude than is the case today.

⁸ Rivera describes the fountain as follows: "In this fountain I had the opportunity to realize the integration of painting and sculpture by submersion, which animates its forms. The sky is reflected in the watery mirror, which projects the spatiality of the sculpture unto itself. Maximum visibility is achieved from a heightened perspective. A stone body, polychrome, with its greens, reds, whites, yellows, created with marble, basalt, mayolica tile, stones of

various hues and tile fragments. Thus Tlaloc is visible from the sky and his movements are formally articulated to suggest mountain ranges. The modulations of the details of the vestments conjoin design with rhythmic movements and integrate into a uniform plasticity. Tlaloc provides liquid indispensable to human life and with his left hand plants four corn kernels, kernels which the poet Juan Rejano called "tenderly scented dentition".



Figure 6. Aerial photograph of Cárcamo de Dolores with Diego Rivera's *Tlaloc Fountain* (1951) in front. Museo Archivo de la Fotografía (MAF) de la Ciudad de México. Gobierno de CDMX.

Unfortunately, like much of the modern public infrastructure in Mexico, both the mural and the fountain fell into disrepair in the last decades of the twentieth century. As well, the polystyrene compound used by Rivera proved, early on within five years of completion, inadequate to protect the mural from the waters of the Lerma. Similarly, the *Tlaloc Fountain's* ease of accessibility and constant exposure to the elements resulted over time in extensive damage to the tiles and stones. To prevent irreparable damage, the Lerma waters were diverted from both the mural and the fountain during the first restoration, which began in 1990, and subsequently, in 2010, as part of the second restoration, Ariel Guzik (1960-) and his team were commissioned to ultimately reintroduce water again into the *Cárcamo de Dolores*.⁹

Cámara Lambda

Guzik and his team conceived *Cámara Lambda* as a permanent installation befitting of Riva's resonance chamber, and like Rivera, attentive to the dynamic nature of water. In this light, *Cámara Lambda* evokes a water organ as, like its ancient musical predecessors, hydraulically powered musical automata, its mechanism is activated by moving water.¹⁰ Guzik's water organ however is not a

reconstruction, but rather an adaptation and extension of such instruments.

So, the mechanism employs sensors to capture the flow and thermal noise of subterranean water near the building (the sensors are invisible to visitors). Mounted outside, on the building's back ledge, an antenna system collects additional data, including measurements of cloud movement, wind, rain, hail, sleet, solar light, and telluric currents (Fig. 7). The organ's *two* sets of copper pipes, which are arranged in bundles of three, with each set including sixteen bundles in total, are mounted on the North and South walls inside the chamber (Fig. 8).¹¹ As the installation's title indicates, the *Lambda* matrix, (a mathematical grid attributed to the Greek philosopher Pythagoras [fourth-century BC]) patterns the sounds and resonances of water, and atmospheric and telluric phenomena, combined. (Specifically, the data from the water sensors feeds into the harmonic scales, while the data from atmospheric and earth currents provide the compositions' subharmonic tessituras and nuances). Lastly, in the chamber, a lacquered wooden cabinet imbues a retro-futurist aesthetic and serves as an enclosure for the circuits and switchboards that make up the control mechanisms of the organ.

Cámara Lambda is but one example of Guzik's practice, which is based on his broad interests in art, technology, science, medicine, and ecology, and their intersections.

⁹ The *Museo del Jardín del Agua* (Water Garden Museum), which includes the Cárcamo de Dolores, is today part of the Museum of Natural History and Environmental Culture. Along with Guzik, the Mexican architect Alberto Kalach was commissioned to lead the restoration of the *Jardín del Agua*. Kalach is well known for his speculative project entitled *México Ciudad Futura* (Return to the city of Lakes), which foregrounds the restoration of the city's pre-Hispanic aquatic environment. Kalach's studio designed a pyramid-like structure on the West side of the Cárcamo de Dolores, to allow for a heightened viewing of the *Tlaloc Fountain* once again.

¹⁰ The tradition of automata spans artistic, entertainment, and scientific histories across the globe. As one of the earliest examples

of musical automata on record, the hydraulis, a water powered pipe organ is attributed to the mathematician and inventor Ctesibius (c. 285–222 BC) living in Alexandria, Ptolemaic Egypt. Hydraulic automata include not only musical instruments, however, but as well other mechanisms such as fountains and water clocks that shaped like humans and animals are designed according to predetermined instructions to appear self-directed.

¹¹ During my visits to the installation in 2018 and 2019, various guards noted that thunderstorms, windy days, and night time provide the best conditions for compelling melodies.

Working solo since the late 1970s, in 1990, Guzik founded the Laboratorio de Investigación y Expresión de la Naturaleza (LIREN, Laboratory for Research into Resonance and Expression of Nature) as an atelier dedicated to creating sonic installations that, in the artist's words, aim at cultivating enchantement.[6] *Cámara Lambda* exemplifies this notion insofar that, both in contrast to Rivera's celebration of dynamism in light of technological utopianism, and to the use of similar scientific and technological methods for extractive purposes (e.g., industrial prospecting), the aim here is instead to use science and technology to attune to the dynamic nature of matter and the material world.

Conceptually, Guzik's notion of enchantement resonates thus with the current fascination with matter and materiality as agentive and relational forces, referred to in the Humanities and Social Sciences as the Anthropocenic turn, nonhuman turn, and new materialism, to name a few terms. For instance, Guzik's evocation of enchantment echoes Jane Bennett's recent call for an "enchanted materialism". As she explains, conceived in contrast to modernist and postmodernist theories of disenchantment, enchanted materialism is critical theory as antidote to the alienation and detachment of our current epoch, the Anthropocene. In this light, the task of critical theory is then to cultivate a sense of wonder and captivation with matter so as to ultimately motivate greater attachment and care toward humans and nonhumans.¹² [7] For unlike disenchanting luddism, enchanted materialism takes relationships between humans and nonhumans (animals, technologies, environments) to be deeply intermingled and co-constitutive processes. Hence, Bennett prescribes encounters and "crossings" with heterogeneous species of life and matter as sources of "affective connection".[8] Guzik's practice aims at compelling such like encounters and crossings.

Yet, this is not to imply that Guzik's focus on enchantment is unique in art. In art history, the artist and art historian Suzi Gablik theorized reenchantment as already a concern integral to a strand of postmodernist art in the United States, notably by multimedia artists addressing environmental themes in relation to kindred interests in the connections between art, science, and spirituality. Expanding Gablik's geographical scope to the South, her definition of reenchantment likewise aptly sums up Guzik's orientation:

Reenchantment . . . means stepping beyond the modern traditions of mechanism, positivism, empiricism, rationalism, materialism, secularism and scientism—the whole objectifying consciousness of the Enlightenment. . . it also refers to that change in the general social mood toward a new pragmatic idealism and a more integrated value system that brings head and heart together in

an ethic of care, as part of the healing of the world.¹³ [9]

Similarly beyond Mexican modernity and modernism, Guzik orients art, science, and technology toward healing our fractured, alienated relationships with the environment and the more-than-human, and in so doing, with ourselves. It is not surprising then that this orientation brought prominence to Guzik's work in the context of post-modern Mexico, and specifically in connection with civic and governmental initiatives to 'green' Mexico City in the last decade, including ongoing projects aimed at renovating the city's public spaces and monuments, reducing air pollution, and educating the population about environmental issues.¹⁴ [10] Among these, the restoration of the Water Garden Museum (*Museo del Jardín del Agua*), where the Cárcamo de Delores is located, is the more significant in light of the failures of the modernist project, not least as mirrored by Mexico City's gravely deteriorated water supply system. As a case in point, the Lerma-Cutzamala system's hidden aging pipes and earthquake-damaged conduits throughout the city leak an estimated 40 percent of their precious medium. Peripheral neighborhoods have intermittent water service, if it reaches them at all. Almost all of the city's residents rely on bottled water. Thus far, the state's response emphasizes building ever larger hydraulic facilities in rural communities abutting the city and pushing for the privatization of water management as a solution to municipal budget problems and aging water systems. And yet, this course has also unwittingly invigorated environmental awareness and activism among civic society in Mexico. Spanning a diverse array of communities (including Indigenous spokespeople, environmental activists, academics, engineers, architects, and artists) they both oppose the state's neoliberalist course, as well as have proposed a variety of alternative models to water management. [10]

In echo of these communities, *Cámara Lambda* tunes into the need for developing ways of relating to *water* other than through unsustainable exploitation and control. It does this by literally encouraging playful, creative engagements with water that are also evocative of Bennett's foregrounding of sound as a source of enchantment. Expanding on Gilles Deleuze's and Félix Guattari's focus on the significance of resonances or "sonorities" for rehabilitating sensory access to the cosmos (their term for denoting "the energetic aspect of things, thoughts, matter" alive with movement and change), Bennett's notion of sound thus benefits human attunement to their proximity and co-constitution with nonhumans.[7] Similarly conceiving of enchantment as key to ours and our world's healing, Guzik's art, Gablik's art history, and Bennett's critical theory, are then kindred calls for cultivating creative practices and thought on behalf of "a more sympathetic and generous relationship with one's cohabitants".[8]

¹² Bennett traces theories of disenchantment to idealism (Kant), and neo-Marxist critical currents in Western philosophy (Max Weber and the Frankfurt School).

¹³ Gablik highlights in this context the work of the photographer Frank Gohlke, land artist Nancy Holt, installation and performance artist Dominique Mazeaud, installation and environmental artist James Turrell, and especially a host of eco-feminist artists, including Gilah Yelin Hirsch, Mierle Laderman Ukeles, Fern Shaffer, and Starhawk, among others.

¹⁴ In response to Mexico City's water crisis, two major state and local programs were devised. First, the National Water

Commission launched a massive US\$2.8 billion Water Sustainability Program in 2007 for bulk water supply, drainage and wastewater treatment for the period 2007-2012. In parallel, the government of the Federal District has launched a 15-year *Plan Verde* (Green Plan) that also includes extensive expansion of drainage and wastewater treatment facilities located outside of the city, in rural communities, as part of the plan's aim at sustainably developing the Valley of Mexico.



Figure 7. Outside view of *Cámara Lambda* installed in the back of Cárcamo de Dolores.



Figure 8. Inside view of *Cámara Lambda*, South wall.

Merging Art, Science, and Technology

Anew enlivened with the resonances of water, in the last decade the Cárcamo de Dolores has attracted numerous locals and tourists alike, though, in contrast, less scholarly attention. So, while some scholars in Mexico wrote about the project since the restoration in 2010, Rivera's mural and Guzik's installation are still little discussed elsewhere.[2] [4]

This is the more surprising in the case of Rivera's *Agua, el Origen de la Vida*, not only given the importance of the work, which to my knowledge is the first submerged mural in modernist art, but also in view of the extensive art historical scholarship about the artist. The work is likewise relevant to the growing literature on the media arts in Latin America.[11] For example, in his pioneering study of the Mexican modernist avant-garde, Rubén Gallo profiles Rivera as a quintessential exponent of the technological utopianism typifying Mexico's post-revolutionary era in the 1920s and 1930s. [12] Rivera's projects at the Cárcamo de Dolores certainly fit Gallo's argument, given their subject matter, dynamism. Yet, the artist's use of a new industrial material to integrate subject matter and form (a submerged mural) also contradicts Gallo's contention that ultimately Rivera never reconciled his fascination with science and technology with his preferred technique, fresco painting.[13] Be that the artist's quest for dynamic muralism fell short, in retrospect, *Agua, el Origen de la Vida* is the even more poignant today for connecting art and science toward compelling creative connections with water.

Similarly, *Cámara Lambda* restores water to the Cárcamo de Dolores through sonic media. The installation is moreover exemplary of Guzik's overall focus on mobilizing art and technology for enchantment. Spanning a variety of environments and species, including plants, sea creatures, and urban and peripheral locations, this project aims at creating alternatives to our objectifying relationships with matter, the more-than-human, and thus also ourselves. Surely this is the more urgent a task in face of global climate change, and our denying, techno-utopian and luddite attitudes. It is thus as an environmental artist that Guzik began gaining international recognition. He represented Mexico at the Venice Biennial in 2013, and subsequently was nominated as one of "Visionary pioneers of media" at Prix Ars Electronica in 2015. Guzik has since exhibited widely in Mexico and Europe. In this contrast, scholarship about his work is still incipient in studies about the media arts in Latin America.[14] [15]

While reflecting the growing popularity of ecological art in global museums and other public exhibition venues, as a strand of ecological art in the Global South, Rivera's and Guzik's works at the Cárcamo de Dolores are also relevant for expanding on the interdisciplinary openness of global-oriented approaches in history of art and in media arts histories. Certainly, these works challenge accounts of contemporary global eco art framed in relation to the 1960s and 1970s earth and land art.[16] [17] Rivera's and Guzik's projects highlight in contrast simultaneous histories of ecological arts in which environmental themes intertwine with long-standing artistic engagement with science and technology in Latin American art. Hence poorly served by modernisms conceived exclusively in terms of spatial expansion, these works ask us rather to integrate histories of the environmental arts with histories of media arts in the Global South. From this perspective, Rivera's and Guzik's projects at the Cárcamo de Dolores broaden the transcultural scope of artistic trajectories concerned with the relationships between the human and the non-human, as well as altogether precede and parallel the "new" materialisms that have lately compelled scholars across disciplines in face of the Anthropocene.

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From hallucinatory Art to hallucination in the Virtuality. Devices for Alternative Realities.

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Abstract

Throughout this text we will analyze some human concerns that are the subject of analysis in different fields of knowledge such as philosophy, art, science and technology. These concerns revolve around what is reality? what is fiction? what are the effects of hallucination? and what is virtuality? through different cultural products such as art, literature, cinema, psychoactive or entheogenic experiences, up to the most recent proposals of Virtual Reality and their forms of interaction. We will try to envision and propose new ways of perceiving reality, seeking a balance between the real and the virtual world. We will take a tour from the way we process reality and create fictions around it, to the illusionism that has constituted an important part of our search for consciousness, mediating between rationality and experimentation in the construction of new realities to finally make a proposal on Virtual Reality based on the therapeutic use of hallucinogens.

Keywords

Science Fiction, Virtual Reality, Psychoactive, Psychedelic, Hallucination, Entheogens, Psychotherapy, Art.

Introduction

The history of humanity, its evolution and development converge in the concern of asking ourselves who we are, where we come from and where we are going. These questions could be considered as the trigger for the construction of communities, societies, and entire nations. Ingenuity and human inventiveness continued to manifest from the stage of *homo habilis* to *homo sapiens*, from prehistoric times when stones were sharpened to perform various tasks, to our days of the use of Virtual Reality. Technology has played an important role in improving human tasks, so we have been able to adapt to different needs and different perspectives. Art, coupled with technology, has managed to exert paradigm shifts for societies. From optical toys and cameras to smart devices: all such things have not only modified our perception of the world but have also enriched our daily experience of the world. The transformative power of the modern image, wrought with amazing interventions of technology and computation, has destabilized the precept of reality in which

we live. Constant interaction with fiction, image, altered realities lead some philosophers, writers and artists to wonder if we are not living within a continuity of hallucination.

Over the years, people have woven an incredibly complex network of stories. Within this network, fictions such as Peugeot not only exist, but also accumulate immense power. The kinds of things that people create through this network of stories are known in academic circles as 'fictions', 'social constructs', or 'imagined realities'. An imagined reality is not a lie. [...]

Unlike lying, an imagined reality is something that everyone believes in, and as long as this communal belief persists, the imagined reality exerts force in the world.¹

We have developed a taste and growing faith for the imaginary construction of beliefs, myth and rites. We could say that we even find fiction more interesting than reality itself, since it is difficult to access a pure or complete reality. Only at the right moment of the present experience is reality manifested and exercised. Henceforth, memory, the anecdote and other different types of expressions and documentation represent attempts to outreach. And even breach, reality.

The paramount reality envelops them on all sides, as it were, and consciousness always returns to the paramount reality as from an excursion. This is evident from illustrations already given, as in the reality of dreams or that of theoretical thought. [...] The transition between realities is marked by the rising and falling curtain. As the curtain rises, the spectator is 'transported to another world.'²

Art has taken advantage of the unattainable reality through words, writing, song and music; through body in dance and theater; and through image in painting, photography or cinema; to name a few - magnifying reality, transporting the viewer to one of the many versions of reality that we have been able to produce throughout human existence art has led us to experience ecstasy through a form of fiction that belongs to the field of image. Illusion, according to Alfred Neumayer and quoted by Oliver Grau, is defined as follows:

*The illusion works on two levels: first, there is the classic function of illusion which is the playful and conscious submission to appearance that is the aesthetic enjoyment of illusion. Second, by intensifying the suggestive image effects and through appearance, this can temporarily overwhelm perception of the difference between image space and reality. This suggestive power may, for a certain time, suspend the relationship between subject and object, and the "as if" may have effects on awareness.*³

The production of illusions has found a fertile field in art as we consciously allow ourselves to marvel at what seems to differ from our own reality, and yet represents the reality experienced by the artist or the art producer, in our condition as individuals. The gaze of the other will never be the same as your own gaze; that is why the approach to experience of someone who is far from our inner world surprises us. In the same way in which our prehistoric ancestors discovered the world and its wonders for the first time, just as a child begins his experimentation with flavors, colors, or textures, marveling at them, the artist presents and represents thoughts. Being able to admire and experience the thinking of others with our senses is like entering an unknown dimension, like embarking on an expedition into a new territory.

Since the myth of Plato's cave where the bound prisoners looked only at the projection of light that represented reality, art spectators for a long time limited their interaction only to the gaze, the thought and the imagination that was motivated by that expression, according to Jean-Lois Baudry quoted by Lev Manovich.

*This immobility and confinement, according to Baudry, enables the prisoners/spectators to mistake representations for their perceptions thereby regressing to childhood when the two were indistinguishable. Rather than a historical accident, the immobility of the spectator, according to Baudry's psychoanalytic explanation, is the essential condition of cinematic pleasure [...] Alberti's window, Durer's perspectival machines, the camera obscura, photography, cinema—in all of these screen-based apparatuses, the subject has to remain immobile.*⁴

This immobility (as quoted in Neumayer), far from limiting the behavior of the viewer, considers a greater cognitive exercise that represents the assimilation of the visual proposal. Both Manovich and Grau begin their historical journey prior to new media and new technologies. Through their exposure it is possible to trace the contemplative tradition of spectators with respect to the arts and the infinite possibilities of art as a virtual projection of reality. This contemplation at a certain level could be understood or perceived as immersion, according to Grau:

Immersion can be an intellectually stimulating process; however, in the present as in the past, in most cases immersion is mentally absorbing and a process, a change, a passage from one mental state to another. It is characterized by diminishing

*critical distance to what is shown and increasing emotional involvement in what is happening [...] Immersion in the artificial paradises of narcotics, for example, as described by Charles Baudelaire, dream journeys or literary immersions past and present.*⁵

In modern times, both producers and observers seem to be waiting to participate in an alternate look, an altered vision, which in comparison with reality gives us a response to universal questions about our existence and origins. The tools used in some cases range from immersive spaces that have created murals with 360° landscapes to paintings - like windows that take us to other spaces, or novels that transport us to other worlds, melodies, songs, dances, or plays and theater that narrate our desire to access other worlds. Recently, cinema, television, the internet, smart devices, or Virtual Reality technologies have made the illusion of accessing other spaces virtually through telepresence. Brenda Laurel defines it as:

*a medium that allows you to take your body with you to other environments [...] you get to take a part of your senses with you to another environment, which can be created by computer, or come from a camera, or it can be a combination of the two.*⁶

However, experiencing the senses outside the body, so to speak, feeling that we are beyond possible physical distance, and are perceiving our immersion in other imaginary worlds through a contemplative gaze, repeating a practice and appreciating it with the surprise of a child who has just discovered the world, are all experiences that have also been possible through the stigmatized consumption of psychoactive substances, which have been documented in different ways, by different authors and through different means, some literally, and in others through metaphors. So, it is possible to intuit that they allude to ways in which it is possible to access other worlds, to alternate glances, to altered visions, perhaps in this research, and through all the efforts in which we have been participants, the intention hidden is to return to the origin that allowed the development of our consciousness, its expansion and the search for new knowledge.

Terence McKenna, in his book *"Food of the Gods: The Search for the Original Tree of Knowledge"*, was given the task of compiling historical facts that address the importance of entheogens or entheogenic technologies, as some psychoactive substances are also called, due to their ability to induce alterations in perception, mood, consciousness and cognition, with the purpose of generating spiritual development in sacred contexts. In this text, McKenna addresses that story from the book of Genesis, in which Eve

*eats and shares the fruits of the Tree of Life or the Tree of Knowledge, fruits that "please the eye and contemplation" [...] the fruit of the Tree of Knowledge gave them keen insights.*⁷

Although, this story is part of the myth of Christianity and the origin of humanity, the idea that a fruit provided ecstasy

in contemplation and a deep look inward, and acting as a shortcut in the search for knowledge has been established this early, it would seem. This narrative could represent one of the first antecedents of the possible consumption of psychoactive drugs. The same book of Genesis is an important part of literary productions, its veracity is in doubt, but it does not stop being a valuable example of human inventiveness and imagination revealing the search for experiences of an altered conscience.

In the book "Virtual Art, From Illusion to Immersion", Oliver Grau discusses the great frieze of the Villa of the Mysteries in Pompeii. Created around 60 BC. The frieze completely covers the walls of room number five, these 5 x 7 meter frescoes cover the entire gaze of everyone who enters the room, making them part of the scene where it is possible to observe Gods and humans living together in absolute ecstasy. This work represents the cult of Dionysus, God of the vine, the grape harvest, winemaking, wine, fertility, ritual madness, religious ecstasy and theater, so it doesn't seem fortuitous that Grau chose it as part of the works of art that have achieved the immersion of the viewer. He describes it as follows:

The picture is a gateway, which allows the gods to enter the space of the real, and, in the other direction, transports their mortal assistants into the picture. The glowing red color heightens the sensual and ecstatic atmosphere and its climax, the consummation of the sexual initiation rite, ultimately succeeds in involving the observer as well. With its suggestive exclusiveness and the resultant psychological effect, this pictorial form represents the maximum that the image medium of the fresco could achieve with the means available at the time.⁸

Following this divine line, during the XV and XVI centuries, we will bring to account one of the most popular examples of the Renaissance, the Sistine Chapel of Michelangelo, who had the ability to produce these images that seem to have the intention of taking us to that sublime world in heaven, in glory, in the company of angels and saints, a world unknown to worldly humanity and that resembles the hallucination of those who have had the grace to contact the depths of their spirituality, it would be precise to say that a good percentage of these venues in which a kind of divine adoration takes place have this mystical aura that motivates this introspection and connection with the spirit, be it its architecture, murals, paintings, sculptures that in addition adorn spaces, try to seduce us to the place that seeks our approach to the Gods in the kingdom of heaven, however it is possible that our desire to access this sublime experience, be a desire to return to the origin of those experiences of ecstasy, of encounter and immersion with our insides and our origins, as we have already mentioned before, not only art artificially allows us, deep meditation and the use of entheogens also makes it easier.

Some other literary works and artistic productions far from religiosity have led us to other worlds, making it clear that access to these other worlds was possible thanks to the consumption of substances of which we do not know for

sure their chemical constitution and which we have not issued a direct questioning, that is, we do not know exactly what was consumed by *Alice in Wonderland*, written by Lewis Carroll in 1865, although evidently a bottle with a liquid that says drink me and a cookie that says eat me is mentioned, they are not from the ordinary type, because these allowed her to grow large and then small to be able to access this exotic world full of hallucinations, in which characters of animal origin share their wisdom so that she can experience self-reflection and self-knowledge.

Later it is possible to point out that the rediscovery and playful use of psychoactive substances in the 60s coincides with the popularization of science fiction literature and cinema. Aldous Huxley, already enjoying popularity as a science fiction writer for his novel *Brave New World*, experienced the effects of psychoactive substances on his own, describing the effects in his essay entitled *The Doors of Perception*:

My body seemed to have almost completely dissociated from my mind –or, to be more exact, although my consciousness of the transfigured external world was no longer accompanied by an awareness of my physical organism– [...] –to feel that "I" was not the same as these arms and legs of "there outside".⁹

Again, referring to this sensory quality shared by art, psychoactive substances and more recently Virtual Reality. In 1971 Stanislaw Lem, a Polish science fiction writer, published a novel entitled *The Futurology Congress* in which he explored the idea of pscivilization where psychemistry encompasses all aspects of human life, from its diet to the search for knowledge, the humanity has been subjected to the use of pills that allow them to access knowledge:

Psychem, on our behalf, does what must be done to the old cerebralness—subdues it, soothes it, brings it round, working from within with the utmost thoroughness. Spontaneous feelings are not to be indulged [...] The fiendishness of it all is that part of this mass deception is open and voluntary, letting people think they can draw the line between fiction and fact. And since no one any longer responds to things spontaneously—you take drugs to study, drugs to love, drugs to rise up in revolt, drugs to forget—the distinction between manipulated and natural feelings has ceased to exist.¹⁰

It is possible to observe a more direct, but not literal, reference to the use of psychoactive substances related to a fictional environment and the popularized Virtual Reality.

In 2013, the filmmaker Ari Folman, takes up Stanislaw Lem's novel and carries out a free adaptation of the novel "The Futurology Congress", the film entitled "The Congress", like any adaptation, is far from the literary work, this could be divided into three key moments, which we will briefly describe below: the first is a present, temporarily very close to what we currently live in technological terms, here the digitization and subsequent virtualization of the physical image becomes evident, of the body and even of

the expression of human emotions, by means of an existing technology, such that it scans and transfers the data for its reproduction in video, cinema and television, to name a few audiovisual products; the second moment is the one that resembles the novel by Stanislaw Lem, with some distortions that allow us to approach and connect with the audience due to the proposal of a near future with an approach of truly probable possibilities, in this section of the film we see the protagonist immerses herself in Virtual Reality through a liquid substance that must be inhaled through her nose, in such a way that she can access an animated vision full of vibrant colors, situations and characters based on physical reality, but taken to a fictional plane; In the third and last moment of the film, as in the novel, the devastation of a world that has faced the excesses of the use of this new technology is appreciated, although society congregates in physical reality, each individual is isolated in his own thoughts and in his own fictions. The foregoing makes us question how close or far the fiction seems to reality. Considering these artistic, literary and cinematographic precedents in terms of experimentation with psychoactive substances, their effects and the emergence of new media that would take the form and power of a relatively palpable technology thanks to the development of engineers, designers and artists went to explore other forms of perception:

After leaving his job at the Atari company in the mid-1980s, Jaron Lanier, together with his partner T. Zimmerman, decided to commercially manufacture the famous "virtual reality" glasses, with which they opened an unprecedented dematerialized visual scenario of brain experiences that warned of the imminent technological avalanche, which today we maintain in vogue thanks to mobile devices that allow the construction of variable experiences in multi-support platforms and hypermedia scenarios. The commercial appearance of these glasses can be registered as the "material" birth of the daily experience of "the virtual".¹¹

From the point of view of Parra-Valencia, together with a series of events and proposals for future scenarios produced from science fiction, we reflect on what could be the future of Virtual Reality as a thriving technology that in recent years has become undeniable relevance, especially due to the diffusion carried out through the internet and an imminent access to the virtual universe, resulting in the spread of a digital virtual universe of infinite possibilities.

Mediation through Psychedelic Substance: Use and Creation of New Realities

As we were able to observe the aforementioned pieces of art and literary narratives taken to the big screen, they agree with the use of psychoactive substances, since both activities induce the visualization of images that could seem hallucinatory and that nevertheless are based or inspired by the experiences with physical reality to which we expose ourselves on a daily basis. It will then be possible to notice

the effects of Virtual Reality and how these are related to the effects produced by the use of psychoactive substances. In the case of psychoactive substances, we have been able to observe the stigmatization of their use and the scant research on some of them, even knowing that they have a history that corresponds to the construction of the cosmogony of civilizations that preceded us by thousands of years, in contrast to its prohibition less than a century ago. There is evidence that pre-Hispanic cultures have made ritual use of some psychoactive substances such as psilocybin from hallucinogenic mushrooms, mescaline from peyote, DMT extracted from plants such as *Mimosa tenuiflora* and THC from marijuana, all with the intention of achieving the expansion of consciousness and in the search for knowledge, however the rest of society has been limited by hegemonic entities that have established its use as illegal due to ignorance and perhaps also due to the threat posed by the questioning and destabilization of the institutions of power as McKenna points out in the following paragraph:

The costs of drug education and drug treatment are small relative to routine military expenditures and could be contained. What cannot be contained are the effects that psychedelics would have in shaping the cultural self-image if all drugs were legal and available. This is the hidden issue that makes governments unwilling to consider legalization: the unmanaged shift of consciousness that legal and available drugs, including plant psychedelics, would bring is extremely threatening to a dominator, ego-oriented culture.¹²

Although this text deals with the use of psychoactive substances historically, as a ritual way of entering altered states of consciousness, or a kind of shortcut to stimulate the expansion of consciousness, it should not be taken lightly, far from it, less as an invitation or suggestion, since the use of psychotropic substances is within a legal framework, which implies the full responsibility of the user.

The construction of new realities has started its journey for a long time, from technology, the concept of cyberspace appears for the first time in the novel *Neuromancer* by William Gibson published in 1984, it comes from the story of *Johnny Mnemonic* (1981), included in the volume *Burning Chrome* (1986), who describes it as follows:

Cyberspace. A consensual hallucination experienced daily by billions of legitimate operators, in every nation, by children being taught mathematical concepts... A graphic representation of data abstracted from the banks of every computer in the human system. Unthinkable complexity. Lines of light ranged in the nonspace of the mind, clusters and constellations of data. Like city lights, receding¹³

As we have been able to observe the illusion of Virtual Reality and the hallucination perceived in cyberspace do not precisely correspond to some external chemical stimulus, however, the individual experiences a sensation of reality. In this sense we can suggest some coincidences between the use of devices that refer us to Virtual Reality and

psychoactive substances, among these we can refer to the same mycelial network or mycelium, in which fungi reproduce, including hallucinogens, this network naturally emits information about the nutrients found on one side or the other of the forest, allowing the interrelation of plant species, Nic Fleming states:

*Hidden under your feet is an information superhighway that allows plants to communicate and help each other out. It's made of fungi. The fungal internet exemplifies one of the great lessons of ecology: seemingly separate organisms are often connected, and may depend on each other.*¹⁴

on which he agrees with the way the Internet connects people, transmitting information from one side of the world to another, favoring social relationships, not only for entertainment but also for knowledge.

Cyberspace represents an intangible area without fixed territory and where anyone can access with a computer from their home, their workplace or mobile devices. It is virtual, non-existent from the physical point of view and all those who explore this recently created space are called Netizens, individuals, subjects, public or private, who develop distance communications, expose their skills, generate interactivity for various purposes. For their part, those who have ventured into the exploration of the psyche through the use of psychoactive substances have been called Psychonauts, the term is attributed to Ernst Jünger, who used the word to describe Arthur Heffter in his 1970 essay on his own and extensive experiences with drugs *Annäherungen: Drogen und Rausch* (literally: "Approaches: Drugs and Ecstatic Intoxication"). Psychonauts carry out activities in which altered states of consciousness are induced for spiritual purposes or exploring the human condition, through shamanic rituals, archaic or modern drug users make use of entheogenic technologies. Both Virtual Reality and the consumption of psychoactive substances can cause a state of synesthesia, the alteration of the perception of time, the sense of identity and even empathy, among other effects.

It is important to mention that, just as psychoactive substances act differently, depending on the conditions in which they are consumed (both internal and external), Virtual Reality also produces different effects on subjects exposed to it. It will depend on the way in which Virtual Reality, like psychoactive substances, are used, the frequency, the purpose that is provided, can be as beneficial or as harmful as intended. Let us remember that its applications can range from medical uses that save lives to warlike uses of annihilation without excluding the new possibilities of playful experience.

Those professionally involved know that psychedelics are the most powerful instruments for the study of the mind that are possible to conceive. And yet these people often work in academia and must frantically try to ignore the fact that the answer has been placed in our hands. Our situation is not unlike

*that of the sixteenth century when the telescope was invented and shattered the established paradigm of the heavens.*¹⁵

The work is arduous, we cannot lose ourselves in the fascination of visions or hallucinations to which the consumption of psychotropics or Virtual Reality induces us. Let's take the experiences produced by these tools and do as a researcher does after observing kaleidoscopic images never seen before under the lens of his microscope, he takes notes, writes hypotheses and theories and acquires knowledge that will be shared with humanity, because after all, the serotonin that our brain produces is the most effective hallucinogen that we can find.

Virtual Reality Proposal

One of the most prominent experiences with psychoactive substances is visual alteration. This is achieved in such a way that audiovisual or cinematographic experiences could resemble or imitate kaleidoscopic vision or hallucinations that are often manifested during psychoactive experiences. These experiences may not be psychotherapeutic experience in themselves. Perhaps an adequate guide, like a psychotherapist who could act as a mediator is necessary so that the patient can find the origin of his discomfort and make the most pertinent changes to achieve stability, self-knowledge and self-awareness. Such curative acquisition helps integrate the body, mind and soul in a comprehensive healing.

Bringing Virtual Reality technologies to the field of Medical Sciences, particularly in matters related to psychology or psychiatry is not a novelty, research has been carried out, they stated in the following terms:

*VR offers a promising alternative to exposure in imagination. On the one hand, some patients have difficulty imagining, while others may resist or reject the memory of the traumatic event.*¹⁶

If throughout history we have been able to experience paradigm shifts of thought and social revolutions in which art and technology have played a leading role, it is possible to propose a hybridization that involves the benefits that have been attributed to psychoactive substances. Such acceptance allows its potentialization through immersion in Virtual Reality experiences in order to explore thought processes, and if possible in some way improve mental, physical and emotional health through entheogenic technologies and Virtual Reality art.

Artists from different times and different latitudes have seen fit to capture their visions. We will hardly be able to verify if these were obtained under the influence of psychoactive substances. Deep meditation or access to an altered state of consciousness reveals, however, the similarities between these artistic expressions are undeniable. In the art of mosques, or Huichol art of autochthonous people of Mexico or in the art of Australian aborigines, among many others, we can appreciate qualities such as repetition of geometric figures, the composition in golden proportion, vibrant colors and shapes that could have been interpreted and abstracted

only from nature itself, and the fractals that produce pleasure just from viewing of them.



Figure 1. Mosque of Sha in Isfahan, Iran



Figure 2. Huichol Art



Figure 3. Australian Aboriginal Art

These images coincide in being inserted in areas that involve meditative rituals or spiritual approach, where the body somehow calms down to focus its efforts on the contemplation of thought processes and the production of mental images. This experience could correspond to the intention to achieve a kind of enlightenment, to the search for knowledge or for mental or emotional peace. This type of images can easily be produced in Virtual Reality scenarios; however, it is possible to aspire to a chemical / biological and technological stimulation, which gives us a better understanding of the universe and our fellow human beings.



Figure 4. Adrian Piper. *LSD Self-Portrait from Inside Out*. (1966)



Figure 5. Roman Verostko *The Cloud of Unknowing* (2003) Algorithmic pen and ink plotter drawing

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[...] in addition to the actual action facilitated through a telepresence interface (say, virtual surgery), there necessarily takes place, within the body of the participant, an embodied experience: a bodily processing of the action that has the effect of “making it real” for the participant. Indeed, it is precisely this “hallucinatory” dimension, applied to virtual reality more generally, that explains the capacity for the VR interface to couple our bodies with (almost) any arbitrary space, and not just spaces that are contiguous with the physical space we happen to occupy or even spaces that are like those we typically occupy”¹⁷

From these references, it is possible to account for the way in which science fiction, literature and art have given impetus and imaginative drive for realities that we have been able to build and experience together as a society. The new epistemology of hallucinogenic VR represents a means of carrying forward responsible applications of both entheogenic and Virtual Reality technologies, a use that allows us to explore human capacities in such a way where we can integrate mind, body, sensitivity, and correspondence with the universe and the realities that compose it. The realities that we create and develop, help us in better understanding and use of both natural and technological resources.

It is necessary to take our minds and research away from prejudices regarding psychoactive substances and their abuse. We cannot afford to turn our backs on what has shaped us humanly and culturally for millennia yet what unfortunately has only led us to a power struggle against their prohibition by controlling authorities. The denial of their existence leads to denial of windows of opportunity which may just be beginning to open and offer us a new future which would be more congruent with the nature that shapes us. This is especially needed when we could incorporate that experience on the path traveled through science, art and technology.

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Sandra CUEVAS, Master in Visual Studies and Bachelor in Graphic Design, both titles from UAEMéx. She has various diplomas in animation, screenwriting, art direction and computer and electronic programming. Professionally, she has collaborated in animation studios as Nickel Studios, Onirik Studio, Inzomnia Animación, Delotroladodelcero Films, working on projects that have been awarded the Ariel award by the Mexican Academy of Cinematographic Arts and Sciences and the Silver Goddess, among others. In teaching, she has been a professor in the degrees of Engineering in Technology and Digital Animation of the UVM, in Digital Art of the Faculty of Arts of the UAEMéx, in Design, Art and Interactive Technologies in the University Center of Art, Architecture and Design of the University of Guadalajara. She has been interested in issues related to imaginary production, creative processes, complex thinking, the use of new technologies, among other topics.

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One + One = Three: The Added Value of Dual Degrees in Higher Education

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Abstract

Can Arts & Science/Technology fruitfully co-exist in the minds and on institutional diplomas of contemporary scholarship? This paper considers how in the global terrain of higher education, the historic tradition of largely mono-disciplinary degrees is being challenged by programmatic complexities that co-join seemingly disparate realms of knowledge and investigation through the introduction of dual degrees. Aided by the benefits of expanding communications technologies, such degrees seek to bridge academic divisions while still contending with very separate intellectual cultures. The discussion takes both an historical and exploratory perspective; ranging from the examination of institutional formations to experiential examples provided by the authors, ultimately positing the central question of whether the expansion of dual degrees represents mere curricular innovation or some thing much more in line with a distinctly new approach to the structuring of intellectual foundation.

Keywords

Dual Degree, Higher Education, Educational Programming, Pedagogical Innovation, Interdisciplinarity, Cross-Discipline

Introduction

Amid a world-wide Covid-19 pandemic affecting many dimensions of education, the historical tradition of mono-disciplinary degrees is being challenged by programmatic complexities that co-join previously disparate realms of knowledge and investigation. The discussion that follows draws from two different profile-bearers. One works at the intersection of Art, Science and Technology and another mainly through Social Anthropology - in order to reflect on the value of university degree programs that allow for innovative learning and research paths.

Although approaches to new teaching and learning paradigms vary from place to place and are often shaped by a variety of local, regional and sometimes even national-level contexts (ranging from the nature of the educational organization to financial, socio-cultural and even political considerations), it is also clear that pedagogical changes may entail greater shifts as much as smaller changes. While perhaps not to the extent of a

paradigm shift in the vein of Thomas Kuhn (1), significant changes in academic division may herald new ways of thinking that mark significant leaps forward in human achievement. Whether this is indeed the case here remains to be seen, but it is nonetheless worthwhile to examine some of the differences in how higher education is being put into operation and thereby, being conceived.

The input for what follows comes on one hand from Nina Czegledy, whose international experience as artist, curator, and educator is strongly linked to interdisciplinary media art. Additionally, André Czegledy draws on expertise from Social Anthropology, integrating ethnographic interests in urban and business anthropology that often foreground institutional relations. Both authors have dealt with the challenges of educational programming within Higher Education organizations, and it is the aim of the current discussion to explore how a new approach to degree construction may lead to significant reassessment of the ways we understand the value of dual degrees. The discussion following begins with examining the Arts & Science/Technology divide in academia. Thereafter, we will examine the prospect of dual degrees, a form of academic programming that challenges traditional Faculty divisions and invites knowledge innovations through learning, research and applied productive collaboration.

Of Scientific Revolutions

In his often cited public lecture entitled “The Two Cultures and the Scientific Revolution ” (2) given at the [University of Cambridge](#), C.P. Snow lamented the intellectual divide between the natural sciences and the humanities. Although not emphasized by Snow himself, this is a divide that has its roots in the formalization of academic disciplines and the development of modern universities as higher education institutions in the 18th and 19th Centuries. Not least, it is related to the important lexical distinction with respect to the person of the ‘scientist’ (pace Lian Zhu & Yogesh Goyal 2019:1), (3) a professional but also cultural designation that has withstood – and engendered – status separation to this very day.

Snow argued that practitioners in both areas should build bridges to further the progress of human knowledge and benefit society. Such a perspective rejects the entrenched belief that cross-disciplinary communication is difficult and to be avoided. Furthermore, it recognizes that ostensibly separate domains of intellectual thought are far more arbitrary in and of themselves (in the sense of self-isolation) than needs be. Are we simply dealing with institutional inertia, or is there more to disciplinary separation than that? Over sixty years on, the established distance between the Arts and the Sciences still persists in most circles (and Society at large), despite significant theoretical and applied advances in knowledge through interdisciplinary fields.

In North America, foundation for plural academic training surfaced in the 1960s through the 1980s, largely by way of so-called 'double-major' degrees at the undergraduate level in Higher Education. Such degrees allowed students to focus on two disciplinary foci rather than one, albeit both of them within a single broader Faculty. They were developed in some parallel to nascent inter-disciplinary programs such as Development Studies, Global Studies, Gender Studies and Cultural Studies which all sought to address newer, topically-based concerns that possessed an contemporary currency but drew on older disciplines for theory and methodological grounding. Interestingly, neither double major programs (which were as much an administrative innovation as a curricular one), nor inter-disciplinary programs took particular inspiration from historic examples of plural academic training such as the precedent of Oxford University's *PPE* (Philosophy, Politics & Economics) program, a grouping that from the 1920s on acted as a 'modern' alternative to the traditional *Classics* degree that was criticised as backward-looking and ethnocentric.

In 2019, Sydney Welsh, an Environmental Studies scientist at the University of Victoria in British Columbia, Canada, was so frustrated with the situation that he wrote in the University's newspaper an open article inviting colleagues to push for interdisciplinary programs. He emphasized that:

„So, then, the solution to this divide is a third party. One that is educated in both art and science, one that can see how the two aren't so different after all.” (4)

For Welsh, the divide between the Arts and the Sciences remained acute enough to seek support on a cross-collegial basis for institutional change – and mobilize colleagues in a forum quite apart from the usual administrative meetings in which programmatic shifts are generally mooted. This is an example of the sort of grassroots and bottom-up

inspiration that we will later see as integral to the development of dual degree programs.

Even the casual observer of institutional change seems aware that there has been a general trend towards academic hybridization signalling an intense period of institutional transformation and revival of interest in interdisciplinarity. It has at least something to do with how in the 21st Century, the very character of learning has become different from what people were accustomed to. A good example of this shift of perspective and academic programming is governmental and institutional acceptance of academic conglomeration. More than a decade ago, educational representatives might have been heard speaking of STEM (Science, Technology, Engineering & Mathematics) as the basis for economic development, in particular. Indeed the STEM touchstone found particular potency within the political elites of the Developing World, so hungry for the sort of solutions approved by donor and multilateral aid organizations ranging from the smallest NGO to the World Bank. Yet relatively recently, this narrow panacea has been challenged by the emergence of a new grouping: STEAM (Science, Technology, Engineering, Arts, Mathematics).

What makes STEAM so interesting from the programmatic perspective is not the simple addition of yet another academic faculty stream, but the seeming creative dissonance accepted by the inclusion of the Arts into the preexisting bundle of so-called 'hard' programs. For example, when Wilfrid Laurier University in Ontario, Canada was considering the development of a new campus in the nearby town of Milton in order to strategically address demand to the immediate west of Toronto, early internal discussions in the 2010s raised the STEM grouping for subject focus, but by 2018 the STEAM variant became confirmed in official press releases - a shift encouraged by the recognition that Arts courses had an important role to play in creating a different sort of intellectual life and education on the new campus.

In addition to STEAM, it is increasingly evident that a wide range of interdisciplinary educational initiatives such as hybrid partnerships and trans-disciplinary collaborations are developing in such a mode that the very terrain of intellectual life is being re-wrought in substance as well as form. This is partly due to the emergence of new technologies as well as ongoing social change. Today's students have a preferred mode of activity and interaction that is frequently *not* in synchronization with traditional educational systems rooted in 19th century models of behavior and 20th century institutional structures. The parameters of formal education are shifting foremost in rich industrialized countries but also more ubiquitously on a global basis as new communications technologies

become widespread and, just as importantly, cheaper (for both institutions and individuals). The element of cost is most apparent in the proliferation of online courses as well as the contributions of 'external' classroom resources ranging from online films to Youtube videos, from off-site testing applications to remote guest speakers.

If anything, the current Covid-19 health pandemic has wildly accelerated the ways in which student feedback has given university students the chance to provide input, both within normal course structures and outside them. For example, when André Czegledy's courses were abruptly shifted to an online format in March of 2020 as Canadian universities responded to the Covid-19 pandemic, student-lecturer contact normally occurring before and after in-person classes needed to be substituted by remote means. At the same time, students began to increasingly organize themselves on an off-course basis in discussion groups that coalesced and dispersed from session to session, imitating informal internet fora. This signalled a departure from traditionally 'contained' class discussion, and is emblematic of wider trends in how students are engaging with their own organization of knowledge beyond the institution. A part of the evolving puzzle is how they are drawing on a wider range of information sources than ever before – sometimes despite the quality of such information.

Nevertheless, Peter C. Herman in his 2020 study of students' responses to online learning found that "for all their differences in age, gender, ethnicity, sexual orientation, citizenship and intellectual preparedness, they universally agreed on their evaluation of online learning: they hated it. There is no comparison, they said over and over again, between the two." (5) Although Herman could not fully anticipate the current health pandemic and its sudden effects on education (given his article was published in June) it is also clear that the addition of technology (on its own) is not enough. For this very reason, programmatic innovations do more than just change how teaching and learning is conducted, they verily test what we think about in our teaching and learning.

Cross Disciplines

While an increasing number of institutions have started to adopt – and even strategically feature – cross-disciplinary programs, even the best intentions cannot obscure serious challenges that spring from the very structure of academic division. This is to emphasize that educational strategies are deeply embedded in historic professional fields as well as contemporary culture. Consequently, professors as much as students continue to work from, as well as within disciplinary formations. Accordingly, interdisciplinary

pedagogy remains elusive precisely because its chief practitioners have rarely been exposed to learning (let alone teaching) in an inter-disciplinary environment from the outset. Their training as thinkers has invariably been of a siloed nature like the ICBMs of old which were sited within bunkers designed to operate independent of their neighbours. Similarly, academic disciplines have fostered their own lines of thought based on the internal development of ideas – as well as the construction of ontological cultures that deeply inform and influence even the ways in which academics communicate ideas to each other. For example, in his early training trajectory, André Czegledy witnessed how Business Studies as a discipline was extremely quick to accept Microsoft PowerPoint as a presentation tool well ahead of other faculties/programs – to the extent that the association between the two is now caricature as much as characteristic.

Macleod emphasizes that beyond the apparent institutional constraints for interdisciplinarity there lie cognitive obstacles as well. He notes specifically "the opacity of domain specific practices to outsiders, conflicting epistemic values, large conceptual and methodological divides and unstructured task environments" (6) To this day, education and training in any discipline within the Arts/Humanities/Social Sciences differs vastly from Engineering or Medicine, for example. Different ways of doing things, different scholarly emphasis, different referential terms, all lead to real complications for cross-disciplinary collaboration ranging from simple discussion to cross-faculty presentations to complex cross-institutional arrangements. Depending upon your disciplinary background: you substantially talk the same, look the same, think the same... or not.

To some extent, difference is understandable given the specific history, methodological specifics, ethical priorities and theoretical foundations that individual disciplines both possess and cherish. Such possession must be recognized by way of the longer history of broader social acceptance as well as institutional affirmation within the context of oftentimes limited collective resources. For this very reason, many academic sub-units representing specific programs have sought strategic advantage by separating themselves from others in order to establish distinction and reward in a zero-sum game of funding and administrative support. But does it need to be a zero sum game? For concurrently, this ongoing situation of independent orientation gives one pause to wonder whether more cooperative strategies of teaching, learning and research might bear equal fruit, if given the chance.

Dual Degrees

If the divide between Arts and Sciences/Technology persists, then how to address it in a creative, programmatic manner? As the aforementioned Sidney Welsh posited:

”Is it too much to consider that exposure to cross disciplinary training leading to dual graduate degrees might resolve this situation? ..The solution to this divide is a third party. One that is educated in both art and science, one that can see how the two aren’t so different after all... (ibid)

What is a dual degree and how might it bring new and different benefits to intellectual pursuit? Dual degrees fundamentally involve a course of studies leading to two separate degrees/diplomas from separate departments and often independent, broader faculties. They may come under other terms such as combined degree, conjoint degree, joint degree or the designation of double graduation program –but the commonality of parallel achievement nonetheless persists. This is qualitatively different from the ubiquitous double major degrees at the undergraduate level, or the multi-disciplinary programs leading to a single diploma distinction. The parallel nature of dual degrees not only invites dual registration in separate academic programs and separate faculties – but also the possibility of two degrees emanating from more than one university. The latter prospect is a significant departure from the simple inclusion of training and/or experience across or between institutions (like so-called Third Year Abroad programs wherein students spend an academic term at a foreign institution to broaden their intellectual and cultural horizons). It also presupposes the ability of universities enfolded in different countries to work together. This is not just administratively challenging (on top of academic programming); it also needs to encompass the reality of two completely independent legal systems that govern the issuance of academic degrees in respective countries. Understandably here, there is an institutional inertia involved in the creation of dual degrees. Simplified, the administrative workload is significantly magnified, and throughput is endangered because of the high demands on the time and effort necessary for completion. Nonetheless, the perseverance of select universities in developing dual degree programs also raises the prospect of important learning innovations along with the ability to feature such cooperation as a mark of competitive curricular provision.

An important point to make in favour of dual degrees is their frequent use of digital connections in order to integrate ongoing studies between programs, between faculties, between universities and between

countries/continents. Simply said, they are technology-demanding and technology-intensive. In other words, the premise of dual programs as a meeting place of intellectual thought highlights broader communications as a basis of curricular support. This means that the application of communication technologies to take students beyond a single classroom becomes increasingly normative. In much the same way, during the current Covid-19 health pandemic, the shift to online instruction has entailed a reassignment of the overall status of technology. As Mishra, Gupta & Shree point out in their early analysis of the impact of the coronavirus on Higher Education:

”Previously, e-learning, distance education and correspondence courses were popularly considered as the part of non-formal education, but as of now, it seems that it would gradually replace the formal education system if the circumstances enduringly persist over the time.” (8)

A wide range of dual degree programs exist in Canada as of 2021 (9). The largest segment is co-anchored in either MBA or Law degrees, a presence that betrays wider social bias regarding professional career applications later in life. Not surprisingly, dual degrees in Canada and elsewhere are seldom available in Arts & Science/Technology, marking the difficulty institutions as much as individuals have in administratively as well as cognitively resolving the perceived divide between them. Of course, there are exceptions. Nina R, Erika O. and Sarah M of Wonder put together a list of (USA) Arts Universities that collaborate with technology-focused Universities to offer some joint degree. Noteworthy examples include Stanford University which has a graduate design program jointly with its School of Engineering. The Rhode Island School of Design and Brown University Dual Degree Program provides a Bachelor of Art or Bachelor of Science (Wonder). Stanford University also offers a graduate art & design program that is a joint program through the School of Engineering. (10) Such programs represent but a referential selection of a growing number of dual degree opportunities. Yet their very existence, it must be recognized, goes against many of the existing prejudices within both Education and Society. In such regard, dual degree programs often have their origins in grass-roots (that is, student and teaching faculty) inspirations as much as top-down initiatives. This dynamic cuts against the grain of standard curricular development trajectories. and aligns with broader societal trends in advocacy emblematic of democratizing technological phenomena like Social Media.

Nina Czegledy’s visits to academic institutions with dual

degrees has reinforced her conviction of their value. In terms of personal experience, this is part and parcel of a longer history. Some fifteen years ago, she visited the Digital Arts Department at the University of the Witwatersrand in Johannesburg. It had pioneered an Art & Engineering program/degree which remains active today and has been advertised as follows:

“Digital Arts as an Engineer focusing on Game Design, you’ll be afforded the chance of combining more traditional aspects of Electrical and Information Engineering with the creative and functional aspects of games... The BEngSc (Digital Arts) is intended to produce graduates that can become specialist practitioners in the technological arena of software development within a game context. You will attend half of your courses in the School of Electrical and Information Engineering. Here you will do Physics, Maths, Electric Circuits, Software Development, and Electromagnetic Systems with Game Design as the core subject.” (11)

Another example for us is Aalto University of Technology in Helsinki, Finland. It offers several dual degrees, including Communications Engineering & Machine Learning, and Data Science & Artificial Intelligence. For illustration, when Nina Czegledy visited its New Media Department, she saw a presentation by a student from the Music Faculty researching collaborative project possibilities *with* Media Art students. Moreover, students completing their first year in some double degree Aalto programs can move institutions to EURECOM for their second year – ultimately receiving two Master’s degrees, one from each university. This sort of cooperation within the mechanism of dual degrees gives us a good example of how such programs can set precedents for curricular opportunity to create a broader terrain of education – and maximize wider institutional resources in the process. (12)

Bridging the Gap/Closing the Divide

In 2017, Nina Czegledy visited the Nano Lab of the Visual Communication Design Department at the Federal University of Rio de Janeiro (UFRJ); The Nano Lab is a highly unusual place, a cross-disciplinary venue exploring artistic interfaces with natural organic elements in telematics environments. IBM Research advertises the Nano Lab as the first Nanotechnology Lab in the Brazilian IT industry and part of a \$4 million investment. Its work

seeks to bridge the gap between Arts and Science//Technology by providing a dedicated space to move beyond disciplinary boundaries. During Nina Czegledy’s visit, Gabriel Bastus, a student from the Electronic Engineering program presented his research implementing Artificial Intelligence features into art projects. (13). He emphasized how exposure to an Arts environment gave him the chance to consider inserting technology in new domains of operation.

There seems to be a keen interest in the Nano Science and Media Art connection. Thinking ahead by generation, the UCLA School of Arts in Los Angeles hosts the Sci|Art NanoLab Summer Institute for high school students to introduce the possibilities of Art|Science collaboration. This engagement is part and parcel to pursuing and promoting an evolving “Third Culture” of knowledge generation..(14)

Today, a gap still remains between theory and real cross-disciplinary practice, between formal educational scenarios and rapidly developing making activities. Yet during the COVID-19 pandemic, basic features of teaching and learning have become particularly fragile and susceptible to change, unintentionally lending strength to the same communication technologies that underpin dual degrees and evolving cross-disciplinary programs and activities bridging the World. Children are taught basic electronics in on-line museum workshops. Adults take courses to brush up on their digital/communication skills. So-called ‘hackatons’ are popular and social media effectively permeates our lives. The lecturers, instructional leaders, as well as the students, frequently work in mixed teams, connecting from remote locations to collaborate in hybrid environments. This creative explosion has not been pre-planned. It has at least something to do with a generational emphasis on novelty that has become such a dominant theme in global culture supported by internet browsing, ‘instant’ information and digital communications. In other words, one of the engines of curricular development may have less to do with institutions, and more to do with the broader general environment that they operate in. This increasing seamlessness of interior to exterior is (not coincidentally) mirrored in the personal lives of a new generation of students as used to communicating their identities online as anywhere else.

While immense progress has been achieved in curricular development with regards to the first steps of establishing dual programs as a viable educational option, critical issues remain to be unraveled. As recognized by Culver, Puri, Spinelli *et al* (15), dual degree programs seem to have unexpected outcomes that include personal rather than professional gains in the evaluation of their graduates. This

is compounded by a lack of understanding regarding the nature of such programs by employers, as well as the their perception that graduates are not necessarily more valuable. The last point is densely revealing. Firstly, because the doubling of received accreditation is commonly not recognized. Secondly, because the expansive and intensive nature of double degree programs is also often overlooked. Inasmuch as such concerns undercut the motivation for dual degrees, it is important to add nuance to the picture. Reference to Fleming, Mahalinga, Shortiss *et al* (16) is valuable here, The authors note how initially, employers do not value dual degrees on an intrinsic level, preferring instead to lay stress on technical skills and numerical/academic results (in a study conducted with Engineering students). However, the caveat is that in the later stages of an employee's career, it is the broader expertise of the dual degree which give one greater chances of promotion and is more appreciated.

This reality brings us to an important question, even if only to act as point of reference going forward beyond the current discussion: How do cultural differences play a part in the dual degree context? The question raises the issue of how dual degree programs must pay special attention to addressing cultural dynamics as a matter of inception as well as operation. Beyond the organizational dimension, such attention needs be both pedagogical and content-driven, for as Loreto R. Pietro recently notes in "Concerns about teaching culturally diverse students in a cross-disciplinary sample of higher education faculty":

"A greater acceptance of culturally diverse students was also associated with a faculty assigning greater importance to incorporating content regarding cultural diversity into their courses, and spending more time discussing diversity issues in class." (17)

Such questioning underlines the significant hurdles still to come. To some extent, such international cooperation may not be fully solvable because of the social, economic, political, constitutional/legal and cultural differences at play between institutions. At the same time, there is positive cause to reflect on the significance of what is happening.

Of Shift and Significance for the Next Generation

Despite numerous conferences and publications on the subject, the central question of whether traditional educational paradigms will change fast enough for the demands of an emerging generation remains substantially unanswered as always. Institutions of higher education are notoriously conservative, however innovative in

knowledge creation they may be, and however influential their campuses are in fostering cooperation. This is not entirely surprising, as they are entrusted with the weight of both inspiring the development of minds at the highest level of intellectual achievement, and with protecting young adults still transitioning from being receptive learners to active leaders within communities. For many learners, it is in higher education that the parameters of thought become finely tuned, irrespective of divisions established as early as elementary school. For this reason, the development of dual degrees actively revises ontological paths to accept the juxtaposition of knowledge and its development, with creativity unshackled from disciplinary boundaries.

David Bohm, the visionary quantum theorist, was an early proponent of a creative impulse in and between the Arts and the Sciences. He maintained that creativity is fundamental to human experience and predicted that someday, Science and Art will merge. (18) He later declared: "Creativity is, in my view, impossible to define in words. The scientist emphasizes the aspect of *discovering oneness* and totality in nature. For this reason, the fact that his work can also be creative is often overlooked. But in order to discover oneness and totality, the scientist has to create the new overall structures of ideas, which are needed to express the harmony and beauty that can be found in nature" (19) Will this merger finally take place in the persons of dual degree students to form a new balance, maybe develop a new educational ecology embraced by their degrees?

Our discussion has sought to relate some of the hazy background of dual degrees, as well as emphasize the challenges their establishment places upon institutions and participants alike. While it would be claiming too much to assert that dual degrees will change the landscape of higher education by and of themselves, there is little doubt that such programming will continue to sharpen discontinuities with traditional forms of reference. This is no mean feat given the structural rigidity of institutionalised education. As a consequence, the real question for stakeholders in dual degree programs is to what extent will the tension between administrative needs on the one hand, and educational innovation on the other, be serviced by heterogeneity rejecting coalescence. If only the former, then the existing division between the Arts and Sciences/Technology will continue unabated, largely because of a marginal incentive to change entrenched institutional positions/practices. The latter, however, could unlock new avenues of knowledge application as well as creation. This could mean that no longer would it be necessary to call in an artist *or* designer in order to aesthetically/ergonomically (re)work a material product – as the range required could be found in

a single creator. Any previous creator or inventor, etc. might have once been schooled in a single discipline, but now they could be sensitive to a broader and holistic set of dimensions in addressing complexities of overall development. So while - once upon a time - it was in the best interests of academic disciplines to establish and protect the boundaries of their field - so as to exert self-designated control over the knowledge domain of their claim - the creative prospects inherent in dual degree programs may yet challenge the old guard and its limitations.

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Tuning in: Reflecting in the Wake of Blackness through a Knitted Flower Antenna

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Figure 1 The Flower Antenna installation at Museum of Modern Art New York City's (MOMA) *Reconstructions: Architecture and Blackness in America* exhibition during the spring of 2021. ©Berfin Evrim, 2021

Abstract

The paper presents the context and inspirations for the *Flower Antenna*, a large-scale, hovering, sculptural sound installation that combines sound and transmission art, computational textiles, and architectural design. Computational textiles include microcontrollers and other electronic components as well as use the natural property of the fabric to communicate information to people. The *Flower Antenna* was exhibited at the Museum of Modern Art's (MOMA) *Reconstructions: Architecture and Blackness in America* during the spring of 2021. The authors discuss the use of electromagnetic waves via an electronically active textile construction as a form of non-visual media used to represent the paradox of Blackness and the presence of Black people in architecture in the wake of the history of slavery in the United States. Electromagnetic waves are neither seen

nor recognized by most people, yet they shape the spaces people inhabit and support almost every part of society today with the use of invisible networks cast by the internet and its structures. This artistic project contributes to a discussion and reconstructing an understanding of Black culture in transmission arts, textile design, and in architecture.

Keywords

Electromagnetic waves, architecture, sound installation, media art, computational textiles, textile design, antenna, Blackness, race, America.

Introduction

This paper presents the inspirations and context for the *Flower Antenna*, a large-scale, hovering, sculptural sound installation that combines sound and media art, computational textile design, and architectural design. The *Flower Antenna* was exhibited at the Museum of Modern Art's (MOMA) *Reconstructions: Architecture and Blackness in America* in New York City during the spring of 2021. The authors discuss the use of electromagnetic waves via an electromagnetic textile construction as a form of non-visual media to represent the paradox of Blackness and the presence of Black people in architecture in the wake of the history of slavery in the United States.

The *Flower Antenna* is an elliptical-shaped flower, 21 feet (6.4m) long by 15 feet (4.5m) wide. The sculpture operates as a large receiving antenna picks up the frequencies of electromagnetic waves passing through the gallery space, and through a logarithmic amplifier circuit, converts the received frequencies to sound waves to be heard in the installation space. 34 knitted textile cones are suspended around a lightweight elliptical ring that is attached to the gallery ceiling. The cones are hung closer to the ring at one end of the long axis and drop down to the floor at the other end creating a rising section underneath the piece (Figure 1). The project has a pink underbelly made of conductive copper and cotton yarn used to create the conical forms that is electronic and is used to sense electromagnetic waves which is then translated as sound in the gallery space.

Background

There are two principal metaphors that operate in the *Flower Antenna*, and that have inspired the use of electromagnetic waves as the media to carry the work and connect it to the Black diaspora: the wake, and invisibility.

The Wake

The first metaphor derives from author Christina Sharpe's concept about 'the wake' as the disturbance that is created behind a ship moving through water. In her book, *In the Wake: On Blackness and Being*, Sharpe discusses a wake created by slavery that remain as ships crossed the Atlantic Ocean with human property. [1] The wakes she describes are the after-effects of slavery on aspects of Black life in the United States and globally by the slave trade. She asks scholars, artists, and other cultural producers to "stay in the wake", which is to work in a way that does not

"seek to explain or resolve the question of this [Black] exclusion in terms of assimilation, inclusion or civil rights, but rather depict aesthetically the impossibility of such resolutions by representing the paradoxes of

blackness within and after the legacies of slavery's denial of Black humanity." (14)

Sharpe names this paradox of the wake and uses it to understand "how slavery's violences emerge within the contemporary conditions of spatial, legal psychic, material and other dimensions of Black non/being as well as in Black modes of resistance" (4) [2] Further, in a descriptive passage, (Anon Author) writes that the *Flower Antenna*

"links to an invisible urbanism floating above and through the city on electromagnetic waves. These waves are a new global ocean and traversing it in our everyday practices is as perilous as the Atlantic of the Middle Passage. Will all bodies be slaves in these global waters? Who will be seen and who will not? What new but invisible boundaries are being constructed in this electromagnetic city? All bodies lie in its wake. So, there is wake work to be done on this new ocean that is fast shaping our lives." (55) [3]

The *Flower Antenna*'s use of electromagnetic waves as a media is meant to call visitors' attention to this invisible electromagnetic system that connects all of us through the internet, the radio, and other devices that rely upon electromagnetic waves to function. In fact, these waves produce a new electromagnetic ocean that also has been used by dominant culture to *reproduce, again*, systems of service and profit extraction, exclusion and oppression of Black people. This electromagnetic ocean is an invisible wake that we all live in. The *Flower Antenna* calls attention through its explosive form to this wake.

Invisibility

The second metaphor used in the work regards the invisibility of Black people as an aftereffect of slavery. This paradox of Blackness is described in Ralph Ellison's *Invisible Man*:

I am an invisible man. No, I am not a spook like those who haunted Edgar Allan Poe; nor am I one of your Hollywood-movie ectoplasms. I am a man of substance, of flesh and bone, fiber and liquids - and I might even be said to possess a mind. I am invisible, understand, simply because people refuse to see me. Like the bodiless heads you see sometimes in circus sideshows, it is as though I have been surrounded by mirrors of hard, distorting glass. When they approach me they see only my surroundings, themselves, or figments of their imagination - indeed, everything and anything except me.

Nor is my invisibility exactly a matter of a biochemical accident to my epidermis. That invisibility to which I refer occurs because of a peculiar disposition of the eyes of those with whom I come in contact. A matter of the

construction of their inner eyes, those eyes with which they look through their physical eyes upon reality. I am not complaining, nor am I protesting either. It is sometimes advantageous to be unseen... (3) [4]

Contemporarily and historically, Black people in the United States have been made invisible through systematic oppression and discrimination. Ellison points out to us the possibility of using this unseen place in a broken system for artistic expression. In describing Louis Armstrong's music, Ellison notes that Armstrong is not aware he is invisible; he is someplace else "[that] he's made poetry out of being invisible". Ellison hears the breaks in time in Armstrong's music and "you can slip into the breaks and look around" [5]

The invisibility and yet presence of Black people and Black culture is much like electromagnetic waves, where Black culture has always been present, yet not fully acknowledged. The insistence on being present by persons who are invisible causes a rupturing and ripping of the fabric of life in the United States and in other nations globally where human and civil rights are not deployed in equitable ways. The rise of the Black Lives Matter protests, and historical protests over the killing of George Floyd are social ruptures caused by the invisibility of Floyd and Black people.

Electromagnetic waves are always here, and have always been here. "We are bathed in these waves, TV, broadcasts, probably telepathic messages, from other minds deep in thought." [6] Or, as Richard Feynman writes about the inconceivable nature of the number and types of electromagnetic waves that we are intersected by and live in but do not realize. "IT IS ALL REALLY THERE," [7] It remains to us to craft devices to tune in, in the poetic break of time, if we hope to survive together. The artist Kerry James Marshall uses rich and multilayered colors of black to great effect to elicit this feeling of absent presence he understood after reading Ellison's book [8] (Figure 2).

Electromagnetic Arts in Black Culture

There are artists working in fields such as interactive and electronic art, sound art and music, furthering the black diasporic mission, or as Sharpe says, looking for the aesthetics of this condition. Among Black, African American, and the African diaspora, there are artists and activists who have taken to working in electromagnetic art (as a type of electronic art), primarily in the form of transmission art and radio for creative and critical purposes and expressions. For example, Mbanna Kantako (also known as Dewayne Readus) pioneered the artistic and political practice of microradio while living in a public housing project in Springfield, Illinois. As a Black activist, he began the station WTRA for political organizing in 1987 among the residents of his housing project. Today

WTRA is known as the Human Rights Radio, and is now an international organization. [9]



Figure 2 Kerry James Marshall, A Portrait of the Artist as a Shadow of his Former Self, 1980 ©LACMA

The Prometheus Radio Project of West Philadelphia broadcasts from a secret location as WPPR, or West Philadelphia Pirate Radio. In an act of defiance against the FCC (Federal Communications Commission based in the United States), they broadcast without license, noting that at the time almost all radio stations in the United States with FCC licenses are owned by only a few corporations. The information distributed through commercial and corporate owned radio has traditionally not benefited Black communities, thus motivating WPPR. WPPR was reborn in 1998 from the take down of Radio Mutiny that served an African American community of West Philadelphia. [10] Most of the sonic works by the artists Mendi and Keith Obadike of Black Sound Art reference the Black experience. This duo have created many sound installations that also cross into live performance that includes original music and dance. Their project *Four Electric Ghosts* (2009) made in Toni Morrison's workshop tells the story of the afterlives of 4 ghosts. [11] The Obadike's also have sound installations in galleries that focus specifically on more abstracted sound including a piece titled *Ring Shout for Octavia Butler* that uses recordings of the Earth's electromagnetic waves and is "underscored by circularly panning audio recordings of the Earth's electromagnetic atmosphere". A third piece, *Blues Speaker for James Baldwin* uses the glass facade of a building as a method to deliver the sound, thus turning the building into a speaker.

[12] The examples of radio and Black diasporic sound archiving, remixing and projecting are crucial to understand the context of this project. The critical concern of the *Flower Antenna* is to sense invisible electromagnetic fields as raw media. This media is a metaphor to carry ideas about the invisibility and presence of the Black diaspora.

Electromagnetic Fields as Artistic Material

Electromagnetic fields are composed of electric and magnetic fields that oscillate in perpendicular planes, that are interdependent and locked in co-existence. These fields draw analogies to “ether” and “atmosphere” as an omnipresent force or an “abstract everywhere” [13] that form the environment in which we exist. Electromagnetic fields are “invisible, intangible, and inaudible” [14] passing through the objects and spaces that make up our built environment. Most electromagnetic fields are artificially produced by telecommunications that compose the modern world, while the Earth itself produces its own electromagnetic field that resonates at a very low frequency (3 – 30kHz). [15] Through demodulation and amplification, these fields can be detected and translated into sound.

Artists have been working with electromagnetic fields as a form of artistic material over the past century, for example John Cage [16], Alvin Lucier [17], Takis [18], Robert Barry [19], Christina Kubisch [20], Joyce Hinterding [21], Scanner [22], Akin O. Fernandez [23], Pe Lang [24], to name a few. Artists’ engagement with EMF suggests that they present as malleable, formable material that can be used for artistic purposes.

Sonic Aesthetics of Electromagnetic Fields

The indeterminate and irregular sonic expressions of EMF picked up by the *Flower Antenna* present at times as “noises, bleeps, blips, and pulses” [25], as well as static and screeching sounds. These sounds have no beginning and no end; they are persistent layers of multiple transmissions that intermingle with one another as they pass from background to foreground in our sonic awareness. Sound artist Valerie Dubois has described specific signals found within the high frequency spectrum. To Dubois, Bluetooth signals present as high, steady-pitched sounds that, when mixing with other signals, start to create a sonic texture where “medium to fine grain particles intertwine in the foreground, while a more fat and gross granular texture lies in the background”. [26] She describes WLAN as expressing a dry, persistent ‘pa.pa.pa.pa.pa’ sound, and the sound of GSM as a “morse code that displays an aggressive character” and that does not evolve over time [27, *ibid.*] These sounds are site-specific, yet they transcend the architecture of the gallery

space, and draw our attention to the immediate invisible through an act of affective listening.

Fibre Arts and Black Feminist Cultures and Networks

Within the United States, Sharbreon Plummer writes in *Haptic Memory: Resituating Black Women’s Lived Experiences in Fiber Art*

“The erasure of Black women’s presence and voices has been a significant problem throughout the course of history—including artistic discourse. Although progress has been made in terms of visibility, there is still an enormous amount of work required to rectify the effects of white supremacist hegemony on Black women’s artistic progress” [30]

[Plummer] argues that not only do Black women artists exist in a space of double-subjugation due to the intersections of race and gender; those who choose to work in the medium of fiber are also faced with the historical baggage and discrimination that accompanies craft-based mediums) [31]

Furthermore, [Plummer argues] that

“Traditional Eurocentric methods of interpreting fiber-based work are limited in their ability to effectively account for the specialized relationship that Black women have to materiality. While literature surrounding women’s work may account for the gendered history of fiber and textile-based practices, Black women’s contributions and distinct relationships to labor and creativity are in need of continued exploration. Plummer proposes looking at the intersectionality of Black women’s experience” to account for Black women’s lived experiences and creative outputs.” (13) [32]

The intersectionality Plummer refers to is Kimberly Crenshaw’s concept of intersectionality that looks at gender, race, class as interconnected systems, that exist in an environment structured by supremacist hegemony. [33, *ibid.*] For Plummer Black Feminist Thought, work done by Black women working on the margins of an emergent larger women’s movement, and theorized by the sociologist Patricia Hill Collins provide methods to understand and resist dominant values placed onto Black women. [34, *ibid.*] In addition the writings of Collins and others provide critique against a dominant system.

Rose Sinclair, a British based textile designer and professor writes speaks about the notion of Caribbean all-women textile networks in the UK in the ‘50s and ‘60s that generated social and economic change. These clubs used “life and oral stories to tell the untold”, while the women’s textiles “embody both material culture and diasporic tales”.

These clubs and the women in them have provided new ways to think about textile networks and their impact in textile design. [35] As a designer she discusses the invisibility of the Black woman in the crafting space, not appearing in mainstream magazines and literature. These are places that provide a maker a liminal space that “allows for the reader a construction of creative methods through which they understand portrayal of self and by extension representation.” (112) [36] Without self-representation, the envisioning of a (possible) future or its creation can be limited.

Women Working with Large Textile Structures

According to Oghazian and Vazquez, there are at least three scales of consideration working with textiles for large architectural structures. First, there is a micro or stitch scale that demands close attention to stitches and the structure of the textile emerging. Second, there is a mesoscale that the structure of the emergent fabric. Finally, there is a macro scale that demands consideration of textile behaviour for making large parts of the structure that shelters people. A designer working with textiles for architecture must move between multiple scales between small micro-scale and the macro scale of a shelter. [37] The *Flower Antenna* is a large-scale installation work that uses the textile as architecture: that is, it takes up and produces space. There are a few artists whose work takes up space working in bespoke knitting or textiles that use interlooping (I.e., knitted or knotted textiles) and that produce space as architecture. Janet Echelman is an artist who works with netted structures that attach between buildings over large plazas or in large indoor spaces. An example of Echelman’s work may be seen in her piece *Earthtime I.78* in Vienna, installed in 2021.

[38] Echelman’s vibrant coloured structures are suspended in the air, seemingly floating freely above viewers’ heads. Another artist using knotting to make works that produce spaces for children to play such as *Woods of Net* in Japan is Toshiko Horiuchi MacAdam. Her work *Fiber Columns/Romanesque Church* reconstructs a church arched passage. [39] *Soft Civic* built in Columbus Ohio in 2019 by architect Bryony Roberts, is a knotted play space for children. [40] The work of Mette Ramsgard Tompson at the Center for Information Technology and Architecture at the Royal Danish Academy uses industrial knitting for architectural-scale structures such as the *Hybrid Structure* in the central square of Guimaraes, Portugal: Largo do Toural constructed in 2016 or *Isoropia* built for the Danish pavilion at the 16th Venice Biennale. [41, 42] Other designers that work with knitting for large structures are Jenny Sabin a designer in New York in the project *Lumen*, a structure that changes colors based on the amount of light was installed in the courtyard of the Museum of Modern Art’s PS1 in 2017. [43] Heat responsiveness is used in the

works of knitted tension structures *Patterning by Heat* by Felecia Davis and Delia Dumitrescu. [44] The work of Jane Scott with MUDD Architects, in the *Bioknit Pavilion* in Cubbitt Park, Kings Cross, London in 2019 uses inflatable technology combined with 3D knitting. [45] While there are men working with knitted textiles in large-scale architectures, for example, Sean Alquist and his *Social Equilibria – Orchids Playscape* [46], this area of large-scale architectural knitting currently seems to be populated mostly by women.

Electromagnetic and Transmission Arts in Textile Art and Design

Textile antennas are generally designed for applications such as receiving and transmitting from wearable electronic systems. [47] However, alongside their functional properties textile antennas can also be carriers of metaphor and meaning, and therefore present in various forms across art and design. In Ebru Kurbak and Irene Posch’s work *Drapery FM* [48], a large, knitted textile is suspended from the ceiling in a gallery setting. Knitted copper rows and wales of the textile are separated by dielectric wool yarn stitches to form textile-based resistors and capacitors that make up the tuning circuit. The signal antenna is knitted within the same textile structure as the soft tuning components, resulting in a fully soft FM transmitter. Nearby radios in the gallery space are tuned to the FM frequency of the textile and can listen to an audio recording of the hand-knitting machine working as the textile antenna was knitted. The work presents as soft electronic art, merging textile materials and techniques with the intangible and invisible medium of radio waves.

In *Listening Space* [49], Afroditi Psarra uses software-defined radio (SDR) to record satellite passes in proximity to her listening station. These transmissions are translated to audio waveforms that are assigned as yarn and colour changes on a hand-knitting machine to produce pattern changes. The pulses that make up the transmission signals are represented with black and white yarns, as signals and void. Psarra’s use of knitted textile on which to transpose the satellite transmissions was for the purpose of archiving the transmission that would otherwise be lost to the ether due to their temporal nature.

Erin Lewis’ *Ambient Energy Harvesters* [50] is a series of textile antennas that use various yarns and textile structures to yield different frequency ranges. These large, reconfigurable textile antenna structures are suspended from trees in the dense Swedish forest where they pick up electromagnetic waves from free space and, through a half-wave rectifying circuit, convert the waves to a usable power source. The power can be used for practical and artistic applications, and functions in remote places. Lewis

states that “positioning them in the forest reveals a contrast between expectation and reality -- where EMF surrounds us not only in urban environments, but in nature environments as well.” (142) [51]

Description of the work

The *Flower Antenna* is a 21' (6.4 m) by 15' (4.5m) knitted textile receiving antenna sculpture. The sculpture is suspended from the ceiling from a light 20lb (9kg) fiberglass ring that holds 34 parametrically sized cones that hang from this ring. The cones are attached to the fiberglass ring by rope. The knitted cones are made of industrially knitted cotton and copper and cotton yarns, tensioned with aluminum hoops at each end. Fine fiberglass rods provide intermediate ring support and straight fiberglass members the weight of the entire work is 200lbs (90kg).

The cones for the Flower Antenna were knitted on a Shima Seiki Whole Garment knitting machine that permitted seamless tubes as well as integrated pockets that held the compression system of lightweight fiberglass rods (Figure 4). The project was installed at the Museum of Modern Art in New York, as part of the *Reconstruction: Architecture and Blackness* exhibition in America the spring of 2021. Authors David and Lewis worked to develop a functioning receiving antenna (Figure 3). The project uses invisible electromagnetic waves to build upon the metaphorical relationship of invisibility of Black culture and as an artistic expression in textiles using a medium that is invisible.

The project translated invisible electromagnetic waves in the gallery to sound through its industrially knitted material. During the exhibition at MoMA during Covid-19 restrictions there was not an opportunity to record and understand how people interact with this antenna. There was no opportunity to tune or play with the potentials of the materials or aesthetics of the sound. This work is planned for a future installation of the project.

EMF-Sensing Electronics

The *Flower Antenna* uses a logarithmic amplifier circuit (Figure 5) that detects high frequencies in the range of 2.4GHz and 5GHz, which spans Bluetooth, WiFi, GSM, and GPS, and other intermittent spectrum noise. The circuit has been adapted from the open-source design of Howse and Mizayaki's *Detektors* circuit used for sonically expressing EMF [52] [53], though has been modified to allow for the knitted petals of the *Flower Antenna* to affect the frequency of the signal based on the textile antenna properties. The circuit interprets the radiant qualities of the textile material over an area, and the scale of the radiant surface to set the gain of the signal. Further, the position and scale of the *Flower Antenna* in the gallery space is directionally

sensitive to the reception of electromagnetic waves within the frequency range. The final presentation carries a quality of indeterminacy due to the auxetic qualities of knit materials when stretched in a frame, in addition to the qualities of the MOMA gallery which includes interference and reflection from building components and the dense electromagnetic environment in which the MOMA gallery is situated.



Figure 3 Underside view of Flower Antenna installation at MoMA gallery © Berfin Evrim, 2021

Exhibition

The *Flower Antenna* was displayed for three months in the MOMA Gallery. A speaker was set up at the entry into the part of the gallery that the antenna sat in, separated from the knitted piece by a threshold (Figure 6). When visitors walked into the space, they heard the high-pitched squeal of the antenna. Some participants reading the gallery description of where the sound was coming from sent a partner or friend over to the antenna to see if they could change the sound of the piece by going very close to the piece but were stopped by gallery minders as well as a tape guard marking the ground. People were not able to get close enough in this gallery. A second installation of the piece is

planned so that the authors can play with the antenna and hear how it changes as bodies get very close to it.



Figure 4 Knitted pink copper and polyester yarn with black cotton yarn, textile antenna material with compression frame rings and compressive fiberglass rods. © Felecia Davis, 2021

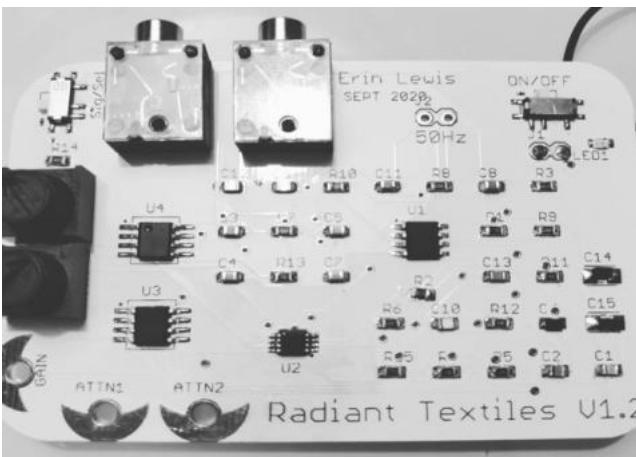


Figure 5 EMF sensing circuit used in Flower Antenna installation © Erin Lewis, 2020

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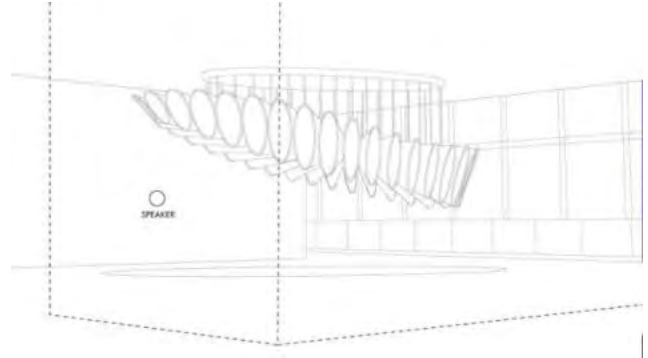


Figure 6 Sketch of installation setup in gallery space © Berfin Evrim, 2021

Contributions and Future Work

This work makes a contribution to artistic practice related to Black culture, in particular in the United States. Contributions include the design of a large scale, space producing or architectural structure made of textile that has the added functionality of performing as a wide band antenna. The authors have used this networked textile as a way to tune into the disruptions and turmoil that roiled the United States initiated by the murder of George Floyd. This event resonated globally and is a historic and transformative moment. By tuning in to this broken system, as artists, cultural producers, designers, we can, in that paradoxical system, remake another vision for a world [54] In spite of the persistence of a historic system that pushes out and de-values Blackness, we can invent a place of creativity, freedom and life affirming values.

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The Medium is the Environment: Digital Materialism, Digital Art, and the Climate Crisis

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Abstract

Contrary to the notion of immateriality and commonplace imageries such as the cloud, information and communication technologies (ICT), from individual devices to the general infrastructure, are grounded in the natural world, ranging from the materials needed for production to the e-waste that is produced through planned obsolescence and aggressive consumerism. Despite such entanglement with the material substrate, the environmental implications of ICT usage is overlooked by the ICT industry, as it continues to exploit natural resources and cultivate a culture of consumption. Such socio-political landscape warrants an exploration of potential counter tactics in the field of digital art. This paper examines the environmental implications of ubiquitous ICT manufacturing, deployment, and usage, using the theories of new materialism and digital materialism. Following these theoretical lenses, the paper proposes that a focus on the material is necessary in digital art, which functions as an antithesis to the abstracting act of information/data and its purported immateriality.

Keywords

Environment, climate crisis, digital art, interactive art, digital materialism, new materialism, ICT

Introduction

As the information consultant Gerry McGovern cautions, “Digital trains us to treat energy as a limitless, free resource ... In tech industry, the more energy we consume the more money they make. The tech business model involves the maximum exploitation of cheap energy. These cheap and “free” models feed the fires of the climate emergency.” [1]

Contrary to the notion of immateriality and commonplace imageries such as the cloud, information and communication technologies (ICT), from individual devices to the general infrastructure, are grounded in the natural world, ranging from the materials needed for production to the e-waste that is produced through planned obsolescence and aggressive consumerism. Despite such entanglement with the material substrate, the environmental implications of ICT usage is overlooked by the ICT industry, as it continues to exploit natural resources and cultivate a culture of consumption.

Such socio-political landscape warrants an exploration of potential counter tactics in the field of digital art.

This paper examines the environmental implications of ubiquitous ICT manufacturing, deployment, and usage, using the theories of new materialism and digital materialism. Following these theoretical lenses, the paper proposes that a focus on the material is necessary, which functions as an antithesis to the abstracting act of information/data and its purported immateriality. To explore this possibility, the paper will outline the author’s most recent interactive video installation, which consists of a series of smoke machines that will emit smoke based on the gallery’s data usage, combined with an animation that foregrounds the natural environment and its entanglement with the digital.

The Digital and the Environment

McGovern’s main argument is that the digital is not green. Every digital transaction has a very tangible environmental cost, but because of this social narrative and delusion we have about the immaterial industry and the cloud, where the cost of every online is trivial, we tend to overlook this fact. For McGovern, this has created an online culture of speed, volume, and waste, everything from our insatiable desire and expectation for more storage and faster loading times, to all those unused apps we download, to the excessive data mining and advertising, to the fact that search engines provide thousands of search results that one wouldn’t consult, to planned obsolescence and insufficient recycling of e-waste, to clunky websites with unnecessary code which require more energy than necessary to operate, to all of us simply expecting to be online all the time. All of these activities, ranging from the creation and dissemination to the storage and operation of data, consume energy.

In other words, digital culture is harmful for the environment both in the material energy used by the industry, and the culture that the industry has created. It is, for McGovern, an accelerator of consumption. Diving deeper into specific areas within digital culture, such as Internet usage, streaming media, and blockchain, this concern is echoed by several researchers. In December 2020, Obringer et al. reported that home Internet usage after the onset of the pandemic has increased 15-40%. The team speculated that the “global carbon footprint could grow by as high as 34.3 million t of

CO₂e if remote work continues until the end of 2021. This increase in carbon emissions would require a forest twice the size of Portugal to fully sequester all the emitted CO₂e.” [2] The team repeats some of McGovern’s recommendations, such as deleting unused content from cloud storage, turning off video during virtual meetings, and refraining from streaming videos at HD.

Recently, Marks et al. released a report that demonstrates that streaming videos online is responsible for over 1% of the world’s carbon emissions, which is rising. The report supports a previous study done by the Shift Project, and also echoes the recommendation from Obringer et al. to decrease streaming media by relying on local access and to avoid the compulsion to watch HD videos. In particular, Marks et al. noted the presence of the Jevons paradox, where increased energy efficiency actually leads to more energy consumption, supporting McGovern’s argument that ICT cultivates consumption with a rhetoric of speed, convenience, and supposedly cheap resources. As they write, “the availability of online video has created new consumption patterns, driven by addictive design, which cancel out any energy savings. Streaming video exists within a market-driven feedback loop of infrastructural expansion and consumer demand.” [3]

Marks et al. pointed out while the environmental cost of streaming video is concerning, the carbon footprint for AI, Internet of Things, and blockchain is even more significant. According to the *New York Times*, as of September 2021, the mining of Bitcoin alone consumes more energy annually than energy consumption in Finland. As the writers succinctly pointed out, in gaining security (and wealth) through electricity, “the system wastes energy by design,” contributing to both carbon emission and e-waste. [4] “It is connected to the physical world of fossil fuels, power grids and emissions, and to the climate crisis we’re in today.” [5]

The Digital and the Metaphysical

Having highlighted some of the environmental implications of ICT operations, the paper will now pinpoint a link between computation and metaphysics, and propose digital materialism as a suitable counter to information/data, against both its binary logic and erasure of the material. As Kate Crawford writes, instead of “the ideology of Cartesian dualism in artificial intelligence: where AI is narrowly understood as disembodied intelligence, removed from any relation to the material world,” there is an urgent need to recognize that “artificial intelligence is both embodied and material.” [6]

A variety of scholars have pointed out the alignment between the metaphysical assumption of the knowing subject being separate from and therefore superior to the world of static and knowable objects, and the binary logic of information. As Stephen Wilson writes, “by its very nature, digital representation requires the breaking apart of phenomena

and their representation by symbolic bits.” [7] Under the epistemic model of the digital/informational, such representations create the conditions for knowing, where a subject comes to know the world through data-based representations that consist of bits. And this onto-epistemology, which assumes worldly phenomena can be represented as information for the rational and detached knowing subject to consume, is an information-based way of knowing.

For the philosopher Hubert Dreyfus, whose work is critical of AI’s representational claims, such information-based way of knowing, or an information-processing model of the mind, is a legacy of the Cartesian way of knowing that privileges the rational mind and its quest to abstract the world into facts and principles. Instead, Dreyfus insists that the representational claims of AI cannot account for the everyday phenomena and embedded contexts of the world. Drawing from Heidegger’s concept of understanding-of-being, Dreyfus questions “that the shared world ... could be represented as an explicit and formalized set of facts,” negating the conceptualization where the subject is a floating mind, detached from the world while keen on making sense of it. [8] Against the notion that everything can be encoded, David Golumbia similarly writes that “we are material beings embedded in the physical and historical contexts of our experiences ... ‘thought’ and ‘language’ and ‘self’ emerge from those physical materialities.” [9]

Digital Materialism

Through the model of ‘agential realism,’ the new materialism philosopher Karen Barad proposes “a new understanding of how discursive practices are related to the material world.” [10] Her model confounds the distinction between culture and nature, human and nonhuman, negating the Cartesian representational model where methods of representation are assumed to represent the objects of the world faithfully and neutrally. Ambitiously, her critique aims at everything from language’s claim to represent objects, to political parties’ claims to represent people, to scholarly theories’ claims to represent the world. I would make the argument that ICT’s claim to represent the world through data can be filed under this category as well.

Barad proposes instead a ‘performative’ model of looking at how fluid ‘agents’ are always entangled and interact (or intra-act, to use her preferred terminology) with one another, both human and nonhuman. She argues that “knowing does not come from standing at a distance and representing but rather from a direct material engagement with the world.” [11] In fact, even “theorizing must be understood as an embodied practice.” [12] In doing so, Barad also eschews the distinction between theory and practice, words and things, discourse and materials, subject and object. Thoughts, concepts, and knowledge also consist of physical materials.

Taking the discussion into the digital landscape, Baruch Gottlieb’s theorization of digital materialism is instructive

here, for it aptly combines the polemic of AI and its decontextualization outlined by Dreyfus with the new materialist teachings of Barad. As Gottlieb writes, “data is not immaterial ... there is no cloud, only someone else’s computer.” [13] Against the myth of the cloud, which contributes to an emancipatory and utopian rhetoric of digital media, he insists that “digital media technologies require enormous material resources to function,” material in the sense of the literal matter needed for the process of fabrication and operation, and the often-overlooked human resources needed to sustain the industry. [14]

Computational devices are material all the way through, from the raw metal and the chemical processes of the chips to the polymer of the pixels and the electric processes that activate the various parts of the CPU. In addition, we need to consider the underwater Internet cables that are affecting marine life, the effect of the mining industry that is necessary to produce the parts of computer chips, the energy cost of data farms, the e-waste that is created by the rapid obsolescence and consumerism promoted by the digital industry, among others, but also the materiality of unpaid and exploited labourers, in addition to these environmental consequences. These material layers stand in distinction to the myth that information is immaterial, therefore the cost of doing business is next to none, which positions digital media to be inherently predisposed to a more egalitarian and democratic state.

The concept of digital materialism emphasizes the political relationship between the sovereignty of informatics and the subjugated materiality that the world is embedded in. To explore digital materialism in digital art necessitates not just the acknowledgement that code and information are also materials embedded in the world, interacting with all other materials, but also the need to examine the material conditions that give rise to and sustain digital media assemblages and the binary logic that undergird all computation – which subordinates the material and elevates the abstractions. If the digital is linked with metaphysical abstraction that unethically separates mind and body, discourse and matter, humans and nonhumans (such as the environment), then a focus on the overlooked materiality of the world, especially within ICT assemblages and networks, offers a potent counter.

The Medium is the Environment

With the intention of foregrounding the overlooked materiality of ICT assemblages, the final section of this paper will look at a data-driven video installation that the author is currently working on.

Examining the intersection of ICT assemblages, the human body, and the natural environment, the project *The Medium is the Environment (Mica Dam / Zoom / Hsinchu / Vancouver / Site C Dam)* (Figure 1) asks the following question: How does the digital environment subjugate both the human

environment and the natural environment? The project asserts that ICT assemblages accomplish this through 1) its omnipresence, evident in its global scope, from being manufactured in Taiwan (where the author was born), all the way to its deployment in Canada (where the author currently resides), and 2) its instrumental exploitation of the material world as resources for the ever-expanding information and computation industry.

The project is an interactive video installation that consists of two parts: 1) a downward video projection of an animation that depicts the entanglement between the human body, land, and digital media, and 2) a series of smoke machines programmed to release a certain amount of smoke depending on the data-usage of the exhibition/gallery space.

The animation will depict the blending together of screens (in common configurations such as Zoom), bodily forms and functions (such as breathing and heartbeats), and various human and natural environments (such as energy production facilities embedded within the natural landscape in Canada and microchip manufacturing plants in Taiwan). It insists that there is a close and fraught relationship between digital media, the human body, and the natural environment. Underpinned by these three aspects, and situated within the pandemic, the piece analyzes the ubiquity of the interface such as Zoom, ICT’s encoding of the world, the global lifecycle of ICT assemblages, and the environmental impact of the significant increase in the usage of ICT.

The animation, which resembles a mock data visualization and sci-fi interface, contains several scenes, such as the scanning and measuring of land, floating screens becoming ‘environmental,’ breathing interfaces, ‘clouds’ emerging from found footage of the Taiwan Semiconductor Manufacturing Company (TSMC) factory and its manufacturing process, and the merging of the digital, human, and environmental/material. In doing so, the animation foregrounds ICT assemblages’ global footprint, and tackles their continued exploitation and subjugation of the material (land, environment, nature).

In addition, two to four interactive smoke machines will be placed around the projection, intermittently releasing smoke, depending on the data-usage of the space. The project is designed such that the more data is used, the less clearly one can see the projected animation. Implicating both the gallery space and the viewers within this system, the project focuses on the amount of environmental impact our digitized lives are having on the planet, focusing on the materiality of something supposedly immaterial. The installation frustrates the viewers’ desire to consume content, while rendering visible and tangible the amount of data the gallery space is using, and highlighting the entanglement of the viewers’ attention and bodies within the industry of ICT.

The two components of the project (animation and smoke machines) are designed to inextricably link our digital lives, promoted by the encoding practices of the ICT industry,

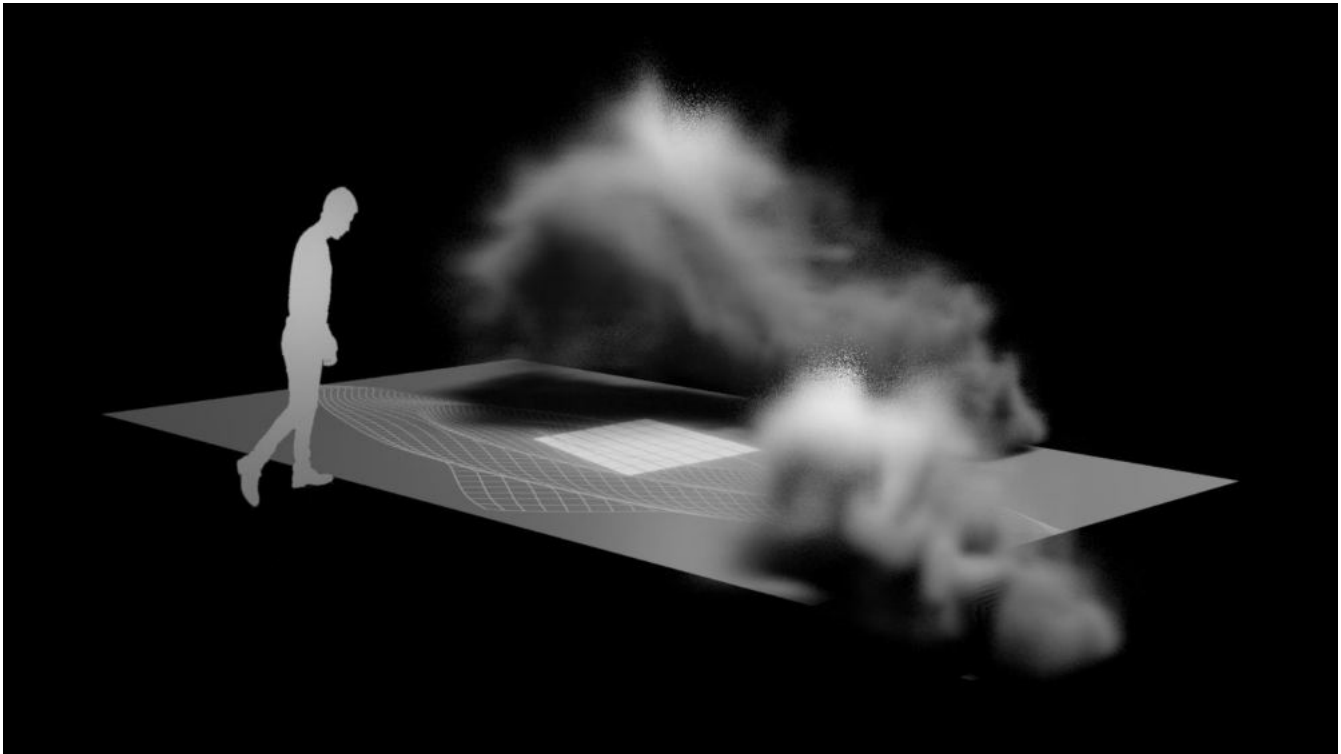


Figure 1. *The Medium is the Environment (Mica Dam / Zoom / Hsinchu / Vancouver / Site C Dam)*, 2021, 3D model. © Kevin Day.

with the very palpable and material presence of smoke, and by extension, with the materiality of our bodies and the world. Both of the latter are the intentionally and unintentionally marginalized stakeholders within the infrastructure and industry of ICT, in the form of exploited natural resources (in the manufacturing, operations, and usage of digital media) and human resources (workers and users).

As Crawford writes, the operations of AI and the computation industry in general exert their forces through abstraction and extraction: “abstracting away the material conditions of their making while extracting more information and resources from those least able to resist.” [14] Materiality is simultaneously that which is erased and that which is exploited. Especially in light of our current situation with COVID-19 and the exacerbation of such digital condition, emphasizing the material impact of the digital industry is imperative.

Conclusion

This paper has outlined the current and urgent issues of the environmental footprint of a variety of components within the ICT industry, including the impact of Internet usage, streaming media, and blockchain technology, under an overall rhetoric promoted by the ICT industry that cultivates speed, volume, and waste – an insatiable encoding apparatus that leverages the myths of immateriality and being ‘green.’

With the intention of creating socially-engaged digital art practices, the paper argues that there is a need for digital art to tackle the issue of ICT assemblages and their contribution to the climate crisis. To that end, the paper has proposed to consult the scholarship of digital materialism as a response to the environmental issues above, but also to the theoretical link between the digital and the ontological model of the metaphysical subject vs. worldly objects.

Digital materialism is a very fitting theoretical lens to use in this context, as not only does it 1) highlight the importance of focusing on the matter of the material world, which is appropriate for the current context of the climate crisis, but it also 2) offers a cogent counter argument against the sovereignty of information and data, which is based on the presumed metaphysical hierarchy of the rational subject dominating the worldly objects. As such, digital materialism offers not only a fitting and forceful critique to the digital (both to its environmental footprint but also its metaphysical legacy and dominance), it also suggests a focus on the world, environment, and materiality as an appropriate and urgently-needed counter.

The project noted above is only a first attempt at realizing such a counter, through both its content (entanglement of digital media, body, and environment) and form (an installation that releases smoke as more data is used), but I would suggest that digital materialism offers a productive theoretical lens and counter tactic for digital art to tackle the climate crisis.

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Kevin T. Day is a Taiwanese-Canadian media artist, art educator, and media theorist. His practice and research, encompassing sound, video, graph, web, and interactive installations, examine contemporary art's critical capacity in response to the current socio-political issues of digital culture. Day received his PhD with a focus on media art and art education from the University of British Columbia. He has presented at numerous conferences such as SIGGRAPH and ISEA, and has published in the top international journals for art and technology such as *PACMCGIT* and *Leonardo*. His work had been generously funded by the Canada Council for the Arts and SSHRC. Currently, he teaches digital art in the UBC Bachelor of Media Studies program and the politics of media and information at the UBC School of Information.

Star-Stuff: A Shared Immersive Experience in Space

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Figure 1: Standing among the stars in *Star-Stuff*. Constellations are traced on the immersant's body while stars are emitted from the heart before orbiting around the body. Photo by the author CC BY-SA 4.0.

Abstract

Inspired by Carl Sagan and emerging from the ashes of a rejected design, *Star-Stuff: a way for the universe to know itself* is a unique immersive experience that transforms immersants into galaxies and constellations. The two-player hybrid experience can be used telepresently or in a physical installation, connecting anonymous strangers through abstract virtual bodies. In this paper, I describe my inspiration and the open, intuitive process by which *Star-Stuff* was developed. I outline design decisions made along the way and present observations made during the artwork's first public exhibition.

Keywords

Immersive Installation, Telepresence, Virtual Reality, Abstract Embodiment, Social Connection, Space Art

Introduction

“We’re made of star-stuff. We are a way for the cosmos to know itself.”

Carl Sagan [21]

As a child watching *Cosmos*, Carl Sagan’s words resonated with me in a way that continues to drive my curiosity to this day. Watching that already well-worn VHS while sheltering from a cold winter’s day on the Canadian Prairie undoubtedly changed my life. It led me on a path of endless inquiry as I sought to better understand the infinite world that surrounds us. That inquiry has led me down a meandering path of self-discovery that recently crossed a serendipitous opportunity to pay tribute to Sagan’s as yet unmatched voice of inspiration.

As many children do, I grew up dreaming of being an astronaut. I stared at posters of space shuttles and a ceiling covered with glow-in-the-dark stars as I drifted off to sleep. Eyes-closed, I dreamed of visiting Jupiter, Saturn, of seeing the inside of a black hole, and imagined what the ‘edge of the universe’ might look like. I yearned to go to space and see the Earth, planets, stars, and universe from a new perspective.

I continue to marvel at the wondrous achievements that companies like Space-X manage to achieve. Yet I can’t help but feel like we’ve lost our way. Through the steady privatization of space travel, capitalism has extended its hegemony toward the final frontier. While NASA struggles to get us back to the Moon, billionaires posture and flex their dominance over the Earth by their capacity to leave it behind. Certainly, the Space Race was fueled by a similar posturing with nationalist ambitions, and it was tainted by its underlying mission to deliver nuclear warheads more efficiently. But somehow it felt more inspired, more poetic as the technologies that assured our mutual destruction simultaneously propelled our species further outwards into the Cosmos.

The nations whose rivalry drove the development of this technology finally came together with the construction of the International Space Station. This historic endeavour has delivered decades of groundbreaking scientific research in the interest of all humankind. It was *our* collective pursuit. One that brought humanity together in the pursuit of knowledge.

Today, we are sold the commercialization of space as ‘democratization.’ Corporate interests will purportedly make the stars accessible to the masses in ways that a bureaucratic institution never could. Certainly, I may be able to travel to the edge of space within my lifetime, despite not becoming an astronaut. However, this commodification of childhood dreams changes our relation to space.

As with many promises of democratization, it becomes a machine for furthering the gap between those with and without. Our skies become polluted with swarms of profit-producing satellites and our ambition for returning to the Moon shifts from the human drive to see how far we can go, to mining its vast resources. Space becomes yet another resource to be exploited, suffering for it as so much of our own planet already has. Commodification strips space of its poetic quality, its mystery which arouses our curiosity so greatly—its capacity to elicit poesis, to inspire us to make something new.

We need a renewed perspective on the Universe. One which is not clouded by the ego of out-of-touch CEOs but is fueled by childhood dreams of what lay beyond our skies. Carl Sagan saw the universe as something which can help us to understand ourselves. In *Cosmos*, he continuously reminds the viewer of how looking outward enables us to see deeper inwards. [21] Even external observations are often motivated by intrinsic questions of self-reflection. For example, the persistent existential question of ‘our place in the universe.’ We seek to belong [3], not only as individuals, but as a species. We yearn to find our place in society and in the Cosmos.

The social Virtual Reality (VR) experience, *Star-Stuff: a way for the universe to know itself*, began as a ‘happy accident.’ One born from listening to that childhood voice of intuition when a particular aesthetic emerged through open experimentation. Here, I will describe how playful experimentation, listening to intuition, and inspiration from scientific knowledge led to the creation of a simple yet profound moment for ‘the universe to know itself’ from a new perspective.

Inspiration & Guiding Principles

In creating *Star-Stuff* I was inspired by several beautiful and awe-inspiring VR experiences beyond *Cosmos*. In particular, I was inspired by the perpetually relevant work of Char Davies which identified and challenged the same problematic assumptions about VR that we face today. VR is an embodied experience [13] and as Davies did with *OSMOSE*, I seek to incorporate the body within the experience rather than leave it behind. [8] I aim to go beyond simulating everyday experiences, instead re-framing the immersant’s perceptions to offer an expanded view of reality.

I am also inspired by *Spheres*, a VR journey through space and time. [18] Instead of struggling to evoke the scale of the planets and universe as many space-oriented VR experiences do, *Spheres* gives us a god’s-eye perspective where the planets become instruments. Immersants play with the Solar System and fall into the depths of a black hole before traversing the history of the universe back to Earth. In the same vein *Star-Stuff* seeks to allow immersants to playfully dance with the stars.

Star-Stuff also builds upon my previous immersive artworks, *Body RemiXer* [9] and *Transcending Perception*. My VR experiences are what Bourriaud refers to as relational artworks. They aim to create “free areas, and time spans whose rhythm contrasts with those structuring everyday life...” [7, p.16] I use VR to re-frame participants’ perceptions so that they might see a stranger in the same light as they see a friend or even themselves. I seek to create social affordances which encourage self-expression and inter-human connection. By altering social norms and temporarily hiding superficial appearances I hope to make immersants feel more connected, not only to those who they interact with but humanity at large. To achieve this, I give participants room for interpretation and appropriation [14] so that they might make the experience their own.

These experiences are not about some external narrative or the content of the experience itself so much as they are about re-framing immersants’ view of themselves and those who they meet. As such, in developing these experiences I endeavour to consider the many trajectories which may unfold [4], supporting entry into the experience through progressive engagement [11] and giving space for connection, discussion, and reflection when possible. Importantly, I consider where the experience might lead immersants long after their experience—how might it reshape their perspective on themselves, humanity, and the universe? Even if only in a small way.

Design Process & Decisions

Star-Stuff began as an artistic experiment. A VR sketch of sorts wherein I was exploring different aesthetics of abstract bodies that could fit the aims of a VR performance I was working on. Exploring various possibilities in Unity’s VFX Graph, I created several such sketches. While I found what I was looking for, along the way I created many rejected sketches. Yet, while they didn’t fit that project, each seemed to offer up its own potentiality for future projects. One in particular, that traced triangles from random vertices on the surface of a mesh, reminded me of the appearance of constellations. Rather than leave it abandoned as a failure, I investigated where such an ‘accident’ might lead.

Constellation Body Aesthetics

I began by making the visual effect more constellation-like, adding flickering stars to the vertices and varying the brightness and size of the traces and stars. While in the original sketch I had sought to erase connections that did not conform to the body, now those long connections between ordinarily disparate limbs were desirable and fitting (see Figure 2).

Asymmetric body representation. From the beginning, *Star-Stuff* was conceived as a two-player telepresent experience that would enable immersants to interact and play with each other in a unique way. As such, the design of the virtual body was critical in how immersants would experience themselves and others in the experience. Typically I would emphasize the use of a synchronized first-person full body representation and a virtual mirror [9, 10] as these can facilitate embodiment. [23, 12] However, in this case the traces



Figure 2: The constellation body. Immersants see others represented in this way. Photo by the author CC BY-SA 4.0.

of the constellation body interfered with the view of the rest of the experience. In light of this I showed only the hands (see Figure 3). My aim was to direct immersants to their capacity to interact using their hands while guiding their attention towards the other immersant's body rather than their own. Given that a mirror would not make sense in the context of this experience, I relied instead on immersants' interpretation of other avatars as a mirror of their own appearance.

Altering perception of self and other. The hands were tracked using the Oculus Quest 2 allowing for a very high-fidelity representation. While there is considerable flexibility in how VR representation can be extended to bodies considerably different from our own, [25] a need for precisely responsive hands was identified in my experience developing earlier VR experiences including *Body RemiXer* [9]. The hands used in *Star-Stuff* are very visually abstract; however, agency over that abstract appearance is supported by precise movement and scaling of the hands and fingers.

Embodying an avatar can reduce our implicit biases towards others through increased association. [17] In this way, the common appearance of the hands and bodies is designed to evoke a sense of oneness by allowing immersants to see their fundamental sameness as "being made of star-stuff." The experience temporarily suspends superficial appearances and allows immersants to see one another from another perspective.

Moreover, altering the responsiveness of one's virtual representation can affect the perception of the physical body, making it feel heavier or lighter. [16] In *Star-Stuff* the constellations do not directly and immediately follow the body



Figure 3: Constellation hands are all the immersant sees of their own body. Photo by the author CC BY-SA 4.0.

and hand position, but are instead attached through a virtual spring and damper. This was used to make immersants feel larger-than-life while also encouraging slower, meditative movements.

The hands were represented using 19 joints each while the entire body of the other immersant is represented using only 22 joints. However, social presence can be elicited by a simplistic array of as few as 13 dots so long as those dots are dynamic and moving. [5] The Quest 2 is limited to tracking head and hand positions so *Star-Stuff* uses Root Motion's VRIK inverse kinematics plugin¹ to estimate the position of the body from those 3 basic points. This can result in an awkward misaligned representation as the system is under-constrained. The movement is simultaneously familiar yet uncanny, resulting in a desirable humanoid yet alien appearance.

Intimate stellar heartbeats. Going beyond the more direct constellation representation I created a virtual galaxy which was emitted from and orbited around immersants' bodies. I decided to generate the stars from the immersants' heart to try to evoke a sense of intimacy. As heartbeat has been shown to evoke intimacy in VR, [15] the stars are emitted in a heartbeat pattern, pulsating at 60 beats per minute. The stars' birthrate, initial velocity, colour, and brightness all vary with this simulated heartbeat. As can be seen in figures 1, 2, and 4, new stars are redder and that redness pulsates, slowly dissipating as the stars go off to live out their own independent lives. While the current version is solely visual and artificial, future versions will incorporate heart rate tracking and audio feedback to further reinforce this effect.

Simulating Galaxies with Particle Systems

The constellation bodies and stars which comprise the galaxies are simulated using Unity's VFX Graph particle system.² I wanted the experience to be aesthetically enjoyable while allowing immersants to implicitly learn about the Universe. As such, the design was a compromise between a realistic portrayal and an aesthetic which fits the artwork.

¹<http://www.root-motion.com/finalikdox/html/page16.html>

²<https://unity.com/visual-effect-graph>

Realistic stellar evolution. The stars follow a life-cycle inspired by actual stellar evolution. [19] Each star is generated with a random mass which determines how it will evolve. The smallest stars are dim white and red dwarfs that have the longest lifespans. These stars stay relatively static over their life, quietly fading away as they reach maturity.

In the middle of the range are the ‘main-sequence’ stars like our sun which vary in colour from orange to bright yellow. These stars have considerably shorter lifespans and transform into red giants as they reach maturity and run out of fuel, simulating the life-cycle of our own sun.

The most massive stars in the simulation are blue giants. These are the brightest and shortest lived stars, lasting only a few seconds before they implode. These massive stars have a chance of producing a supernova proportional to their mass. The immersant can watch as these huge stars grow and then collapse before bursting into a brief bright flash of light.

The life-cycle of the stars varies between 5–100 seconds, creating considerable variation in the stars’ appearance while allowing their life-cycles to be witnessed. The pacing was arrived at through repeatedly testing the experience to find a rate at which the general mass of stars seem to linger forever while focusing on a singular star reveals its dynamic and evolving nature.

Emergent patterns from two-body gravity. The movement of the stars is simulated using a modified gravity simulation. Simulating the actual gravitational relationship between tens of thousands of stars would be far more than the Quest 2 could handle. Instead, a two-body gravity simulation is used. Every star is attracted towards a center of mass at the approximated hip location of each immersant. To encourage the emergence of a galaxy-like aesthetic, the stars are accelerated tangentially around the hips’ vertical axis and stars that stray too far from this disc are drawn back in. Scrolling Perlin noise is used to randomize the forces acting upon the stars.

This layered simulation produces results that are simultaneously emergent yet consistently fall into a predictable overall aesthetic that evokes the appearance of a spiral galaxy. I wanted control over the stars to remain somewhat elusive to evoke their mass and power. Basing the gravity simulation around the hips gives participants limited control over the stars’ behaviours. The stars tend towards staying lower on the body, keeping the immersants’ view of each-other clear. Immersants can drastically alter the orbits of the stars by crouching or leaning over as the stars will begin to orbit more vertically. Moving between crouching and standing can lead to a resonant oscillation of the stars that begins to look like waves, evoking the sensation of standing in a cosmic ocean. By moving closer together or further apart, immersants can greatly vary the paths that the stars take by shifting the centers of mass.

Preventing simulator sickness. Standing in space amidst stars that continuously rotate around you has the potential to cause motion sickness. As such, I carefully considered and tested the disorientation and discomfort caused by the experience. The pacing at which the stars orbit the immersant are a carefully tuned balance between facilitating interaction and optimizing comfort. Stars that move quickly respond to

interaction more readily, but can lead to disorientation. I arrived at an optimized pacing through repeatedly testing different speeds until I found something that was fast enough to respond but slow enough as to cause no discomfort. I then tested the experience with friends and family with varying prior VR experience. The resulting pacing fit well with the meditative nature of the experience.

Originally, I had assumed that a ground plane would reduce disorientation and motion sickness; however, in this case it had the opposite effect. When it was combined with the orbiting stars it seemed to provide an overly strong frame of reference which led to rapid disorientation even at low star velocities. In the end, simply providing a static star background provided the best outcome.

Fluid Interactions

I also wanted to give the immersants a direct and playful way to interact with the stars while remaining calm and meditative. To accomplish this, I incorporated a simple fluid simulation which treats the hand as a point in the stellar ether. Stars closer to the hand are quickly accelerated up to the velocity of the hand while those farther away are effected less up to a 0.5 meter radius. This evokes a sensation similar to splashing in water.



Figure 4: One immersant splashes stars into a huge column. Photo by the author CC BY-SA 4.0.

I wanted to avoid more rigid interactions typical in VR experiences as the stars would then lack any weight or inertia. Instead, the stars respond in a way that evokes a subtle sensation of resistance. This kind of response can evoke tactile sensations known as pseudo-haptics [20] which have been reported with similar small virtual objects such as butterflies.

[6] Slow, careful movements barely disturb the stars while fast sweeping ones can launch the stars into huge columns as seen in Figure 4. To encourage further opportunities for meditative interaction, I also allowed immersants to catch stars if they were gentle enough. By holding a hand out in the path of a star they could catch it; however, moving too quickly would cause the star to evade them.

This design allows for an experience that is equally playful and meditative and open to a broad range of interactions allowing immersants to appropriate it for their own use. *Star-Stuff* is equally engaging whether standing still mesmerized by the stars' evolution and movement, carefully catching stars and reaching out to the other immersant, or making bold expressive movements that form ethereal sculptures in space.

Sound Design

The sound design for *Star-Stuff* took a relatively basic approach as I wanted to focus immersants' attention on the visual experience. Thus, the sound design focused on encouraging immersion. Immersants hear a spatialized rumble from their own bodies as well as their partners', evoking a subtle but important sense of auditory presence. The choice of music for this experience was essential to immersion and was an intuitive and serendipitous choice. I had been listening to Dale Nichols' music³ as he is creating the soundtrack for the main project which *Star-Stuff* spun off from. I kept coming back to the same two intimate and entrancing piano pieces throughout development, and as such asked to incorporate these fitting pieces into the finished artwork. The result is a soundtrack and visual experience that are enmeshed with each other, rounding out the experience into a finished product.

Simple Telepresence

Star-Stuff was designed to provide telepresent experience in the simplest way possible. It uses Photon PUN 2⁴ to synchronize immersants' bodies across multiple headsets using only the position and rotation of the head and wrists. This allows immersants in the same room or on opposite sides of the world to connect with relatively minimal lag and bandwidth. The telepresent version randomly connects a pair of immersants while the co-present installation always connects the headsets in the same room. Randomly connecting immersants is intended to evoke curiosity through anonymity. Immersants might plan to meet each other in *Star-Stuff* at a particular time, yet they cannot be sure that the other body they see is the friend with whom they had arranged a meeting.

The rest of the body is extrapolated using VRIK inverse kinematics. This allows for a full-body representation while minimizing the bandwidth required for synchronization. The simulation is run independently on each headset. While this results in some subtle asymmetry in the experiences, it is sufficiently deterministic to reliably transmit immersants' gestures and interactions.

³Dale Nichols' music can be found on Spotify and Apple Music.

⁴<https://www.photonengine.com/en-US/PUN>

The experience is limited to two immersants to encourage an intimate experience. The ethereal bodies are designed to acknowledge their lack of physical presence while still evoking a sense of social presence. While touching the other's body is not likely to evoke any tactile sensations it is designed to encourage a sense of 'visual touch' akin to that described in PluginHUMAN's [*i miss your touch*] [22] where immersants interact with and touch each other's bodies as if they were physically present.

Becoming a Galaxy

These design decisions come together to produce a conceptually simple experience that leads to relatively complex emergent and dynamic interaction. It allows for a peaceful moment to contemplate our place in the universe or a vast playground to meet and experiment with friends and strangers.⁵

The experience is designed to slowly and steadily immerse the user in the experience. It begins with the same quote that this paper opened with, drawing immersants' attention to their poetic relationship with the universe as "a way for the universe to know itself." [21] In this initial phase they can only see their hands and no stars are generated, giving them some time to become acquainted with this new view of themselves. Once the quote ends the system connects to the server and tries to connect to another immersant. Once connected, the galaxy stars begin to be generated. The galaxy shape slowly emerges over the first minute or two. When the system successfully connects with a second immersant their body slowly fades into view and begins generating stars. Immersants start 3 meters away from each other giving them room to interact independently or choose to come together.

Through this networked social experience *Star-Stuff* aims to utilize proven strategies for connection including play, reflection on unity, and a shared transcendent experience to evoke a sense of connection to humanity and the universe [24].

Exhibition

Star-Stuff was exhibited at the hybrid VR festival, *V-Unframed* at Vancouver's Centre for Digital Media in October, 2021. Over 500 people attended the COVID-19 safe event over the course of 3 days.

Physical Installation

Despite being conceived for telepresent use, *Star-Stuff* was easily adapted to a co-present physical installation. Two Oculus Quest 2s were used with parallel virtual spaces to facilitate social distancing as shown in Figure 5.

While I would ordinarily calibrate virtual spaces so that the physical and virtual overlap, here making them parallel allowed immersants to experience *Star-Stuff* in a way similar to how they would have connecting remotely from home. The offset simultaneously provided a COVID-safe interaction between strangers and afforded interactions uniquely possible without a physically synchronized other. Immersants could hug, dance, play, fight, and even walk through each other without fear of losing tracking or running into anyone.

⁵A video of *Star-Stuff*: <https://youtu.be/eRukMyGcVcI>.

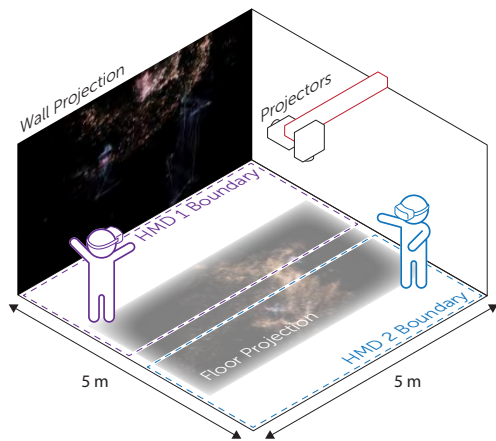


Figure 5: Layout of Star-Stuff at V-Unframed.

A large projection reflected the virtual space like a mirror to evoke curiosity and give onlookers a glimpse into the experience. A second projection was directed at the floor for subtle ambiance. The stars' orbits were faintly visible and occasionally splashed onto the immersants' physical bodies, further reinforcing the connection between their bodies and the visuals.

Fairy lights were used as a pragmatic compliment to the installation's aesthetic. The Quest 2 tracking performed poorly with the matte black curtains on one side of the installation. The fairy lights provided a fitting point of reference which significantly improved tracking performance as seen in Figure 6.



Figure 6: The physical arrangement of *Star-Stuff* at *V-Unframed*. The immersants are right next to each other in the virtual experience despite being physically separated. Photo Julia Read, 2021 CC BY-SA 4.0.

Observations

From opening to closing the experience was continually in use. There were only a few brief moments where the installation was stopped to replace a headset that had run out of battery or encountered technical difficulties. As a result, it fully occupied myself and one volunteer in initiating immersants into the experience and managing the lineup. Due to its popularity I was unable to conduct interviews as initially planned; however, here I present my observations which were captured in photographs and field notes.

A simple yet engaging immersive experience. Participants consistently lingered much longer than expected. From the outside it sometimes looked like they were not engaged but they seemed to get lost in the experience and would easily spend 8 minutes with the installation whether engaging actively or standing still. This timing aligns with the duration of the two songs used for the soundtrack so it's possible that immersants assumed the experience was over when the music stopped. At first, we left immersants to play freely, but it quickly became clear that we needed to limit interaction to 4 minutes to keep the line manageable. Fewer than 10 immersants removed the headset in less than this 4-minute limit, suggesting most were quite deeply immersed and engaged with the experience. Many commented as they left about the fitting choice of the music and how it 'made the experience.'

Slow immersion into another reality. The slow introduction of various elements seemed to work well. Despite having seen the projections immersants were still surprised to see their hands and another body appear in the experience. Each new element was frequently accompanied by an audible gasp as immersants recognized their virtual hands and this strange other being standing across from them.

Intuitive and open to exploration and appropriation. While a few immersants were unsure of 'what to do' or 'what the experience was about' most engaged with the experience freely with minimal prompting. Facilitators only had to guide immersants to look at their hands, the other body, and to try 'playing with the stars as if they were water' to encourage exploration. Most immersants recognized their constellation hands as their own when asked 'can you see your hands?' However, on some rare occasions they had to be guided a bit before making the connection.

I observed a wide variety of engagement from standing completely still to dancing or sometimes moving very erratically about the space. The slow orbit seemed to provide more timid participants with a dynamic painting to watch as it changed shape on its own. Meanwhile, the splashing interaction provided a natural way to engage more actively and invited playful exploration. Regardless of how they engaged, immersants regularly seemed to have enjoyed the experience suggesting that they may have been able to appropriate it to suit their personality, interests, and level of comfort.

Real social behaviours in virtual space. I observed many repeated social behaviours ranging from aversion to dancing and hugging. Many immersants would share their stars with

their partner by splashing them in their direction, like splashing someone while playing in a pool. I saw several pairs touching their hands together as shown in Figure 7 in what seemed to be the most common form of visual touch afforded by the experience. Despite not physically touching, immersants could be seen behaving *as if* they were touching, keeping their hands in close contact without passing through the virtual body, moving them together side-to-side.



Figure 7: Two immersants touch each other’s virtual hands. Photo Julia Read, 2021 CC BY-SA 4.0.

The interaction seemed to vary considerably depending on immersants’ existing relationship. While some strangers would interact playfully with each other, often the pairing was uneven, with one extroverted immersant directing their attention towards the other, while the other immersant seemed to just want to do their own thing. Some could even be seen avoiding the other immersant and one person specifically complained that the other virtual body kept invading their space despite physically being at least 2 meters apart at all times. This suggests that the abstract constellation body evoked a sufficiently strong sense of social presence to elicit a proxemic response. [2] This evasive strategy also aligns with the equilibrium theory of intimacy [1] and suggests that perhaps more could be done to encourage a shared level of intimacy in the experience. It is possible that the experience would be less invasive in a purely telepresent setting and that this aversion may have been the result of the stranger’s physical presence.

On the other hand, families and friends were observed exhibiting very close and intimate behaviour. Children played and ran around each other, sometimes subverting the system by overlapping their bodies or peaking out from under the headset. Several people were seen hugging virtually. While they were not physically aligned, they embraced each other’s avatar as if they were (see Figure 8). Some immersants also danced together in a variety of styles including ballroom dancing with one hand on the shoulder and the other holding hands.



Figure 8: Left: immersants hug virtually. Right: their offset physical hug. Photos Julia Read, 2021 CC BY-SA 4.0.

All in all the installation was very well received and was a favorite among those interviewed by the event coordinators. Despite the long line and short timeframe to visit other installations, several immersants returned for repeat playthroughs. Sometimes they just wanted to go back in and explore, while other times they brought a friend or family-member to share in the experience. One person in particular returned at least 4 times over a two-hour period. As the exhibition was drawing to a close I let them play freely with their sibling for over twenty minutes.

While the parallel experiences worked well overall it did evoke some confusion about the identity of the other. In some cases this was interesting as immersants commented on the other body being a reflection of themselves or some other remote body, not connected to the person they had entered with. However, for the most part immersants seemed to make the connection and were simply confused by the discrepancy between the visuals and sound. In the future I would likely have the immersants either completely co-located so that they can physically touch, or would have the immersants offset but facing each other rather than being completely parallel.

Conclusion

By following an intuitive design approach inspired by an originally ‘failed’ design I created one of my most successful immersive experiences. *Star-Stuff* was not conceived from a precise or specific plan but emerged through an iterative, intuitive process that was free to meander and develop as needed. The result was a meditative yet playful experience which fits Carl Sagan’s vision of renewing our perspectives of ourselves by looking out to the Cosmos. Immersants could connect with each other in a new way while simultaneously learning about the evolution of stars. Observing interaction at *V-Unframed* allowed me to see the joy and curiosity it evoked in immersants while better understanding the interactions it affords and improvements that might take it further. *Star-Stuff* demonstrates that abstract immersive social experiences can bring humans closer together, inspire a new generation, and provide a new “way for the universe to know itself.”

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Author Biography

John Desnoyers-Stewart is an interdisciplinary artist-researcher who creates immersive installations and performances to encourage new perspectives on immersive technology and to better understand its true potential. Through his artwork and research, he hopes to encourage social connection and collaborative creativity by exploring positive social applications of abstract embodiment in virtual reality.

The Fun Palace: Designing Human Experiences at Mixed Reality Events to Increase Engagement

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Abstract

This article is the culmination of an intervention designed to improve active engagement with emerging technologies at a public mixed reality event. An opportunity arose to experiment with the design of interactive audience experiences at the *The Fun Palace: Carnival of Mixed Realities*—an event that took place in 2019 and featured 10 installations with close to 400 attendees. A number of strategies emerged to increase attendee engagement that may be useful for xR developers, museum curators, and event producers that present interactive technologies and installations publicly.

Keywords

Mixed reality events, installation, virtual reality, engagement

Introduction

The first section of this article asks the reader to reimagine two mutually influential concepts common to hardware and software development that inform how human experiences are designed at public events. One, is the term mixed reality (MR) that has evolved over time to describe human interactions within specific technological constraints and affordances. The other term is *users*, often describing people who interact with any technology. In the second section of this chapter, we will detail a specific investigative case, *The Fun Palace: Carnival of Mixed Realities* where strategies were implemented to increase engagement.

I: Rethinking Human Interactions at Public Mixed Reality Events

Oscillating Between Physical and Virtual Realities

The design of events in public spaces involving multiple types of interactive technologies is in growing demand. Assumptions are often made of the type of human interactions that will occur. *The Fun Palace: Carnival of Mixed Realities*

aimed to identify those interactions and consider them in the design of the event. While some installations were curated with familiar interactions in mind, others were designed to experiment with contrasting interactions that traversed the continuum of physical and virtual realities. The experimental nature of co-constructing the event informed how we would come to define it as mixed reality: dependent on the shared experiences each person would have oscillating between the physical and virtual realities of the space. Where virtual realities can be isolating, we sought to make them social through this oscillation, driving human-human interactions mediated by human-system interfaces.

We draw from Milgram and Kishino's (1994) definition of mixed reality as a malleable continuum between virtual and physical realities that connects the virtual experience to its physical surroundings. [1] Milgram and Kishino's "virtuality continuum" predates associations with specific hardware devices, such as Microsoft's HoloLens 2 and Magic Leap One, allowing us to design experiences that re-orient our focus away from specific technological affordances, and towards a variety of different human-human and human-system interactions in public spaces. This experience-oriented framework informed the following prompts: What are the needs of mixed reality event (MRE) attendees and how do we design experiences that captivate those curious but not yet engaged?

From User Experience to Human Experience

People who come to MREs may do so to experience the latest interactive and immersive technologies that go beyond the everyday, hoping to try out something they might not normally have access to. The event is a social one for many, where they go to share in those experiences with their friends. The term *user* is commonly applied to describe event-goers as the *users* of the technology. This term carries with it a hierarchical assumption, that the system is meant for the *user* to control rather than to experience, and extending from that, an obsession with *usability*. As suggested by Dervin and Reinhard, this leads to "user-oriented terms [that] privilege systems over people by rhetorically making

systems and use of them the center of attention.” [2] However, this does not accurately represent the complexity of human-human and human-system interactions that take place during public MREs.

When the center of attention shifts to the human experience, then our *user’s* entire experiential journey needs to be considered, as well as how we refer to them. The complexity of the actions they perform are not limited to *using* but encompass a wide breadth of social interaction. They may walk around aimlessly, or search for specific types of experiences. They may enjoy watching others experience something, and might take everything in first, understanding the installation at a distance before trying it for themselves. Avoiding the term *user* acknowledges this complexity and avoids privileging the designed experience over those unexpected and peripheral ones that might be just as important to the social encounters such a public event seeks to facilitate.

Our so-called *users* have also been defined as *audiences* given that their journey may include passively or actively watching others. These are what Dervin and Reinhard call, “amorphous groups of individuals that communication, media and information systems attract or entice with arrays of offerings of particular genres, programme types, or content.” [3] Semantically, this term is not accurate since many audiences tend to watch something intentionally performed, and refrain from interacting with a performance to avoid impinging upon its predefined intentions. Even interactive performances that have challenged the performer/audience divide still refer to the role of an audience. During MREs the audience-performer boundary is fluid, as the interaction in this social space is performed and observed by an audience. Some people interact with different types of installations and technologies and others watch them. In fact, the same individual can be both the observer and the observed. In this way, we quickly come to the realization that if we are to design for events that offer numerous types of interactions, it may be better to abandon the terms *users* and *audiences* altogether.

As Dervin and Reinhard remark, “[human beings have increased] control over their access and use of all manner of information and entertainment systems”. They claim that we may benefit from no longer seeing MRE attendees as “users or as audiences but rather as persons with agency.” [4] The agency that people have when they journey through an MRE and choose what they wish to experience and what they do not, may help us define different levels of engagement within that continuum between physical and virtual reality. While we have identified that the people attending such an event should not be classified as users or audience members, we leave the development of an alternate term for future discussion. The varied levels of engagement any one person may have at any one time during an MRE makes it difficult for us to neatly categorize them as either user, audience, observer, participant, immersant, etc. For simplicity we will refer to them as attendees of our event as this term implies nothing more than their presence.



Figure 1. The *Fun Palace: Carnival of Mixed Realities*. Photo © Andreas Psaltis, 2019.

II: Designing for Engagement on a Continuum Between Physical and Virtual Realities

The Fun Palace: Carnival of Mixed Realities was an MRE prototype intended to investigate human responses to a variety of interactive experiences (shown in Figure 1) across a range of the virtual/physical and passive/active spectra that might increase their engagement.

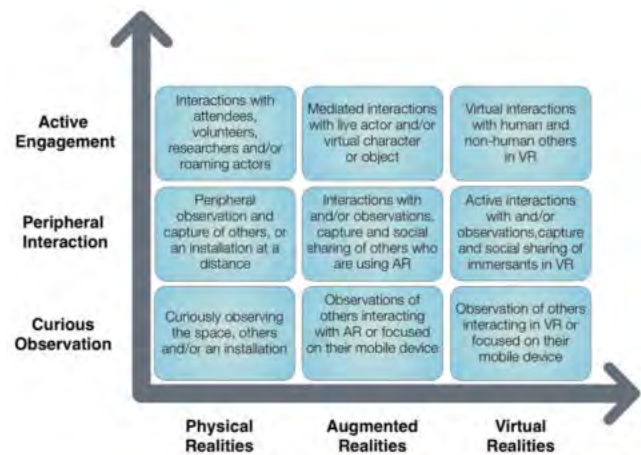


Figure 2. Public Mixed Reality Event Engagement Grid CC BY-NC-ND 4.0.

Our approach to designing for engagement drew from theatrical staging and user experience design traditions. Conceptual frameworks exist for designing engagement with technology such as that proposed by O’Brien and Toms [5], yet none are specific to MREs. Combining these traditions with Milgram and Kishino’s MR Continuum, we mapped different types of anticipated engagement (curious observation, peripheral interaction, and active engagement) within and between physical and virtual realities that we anticipated and designed for (Figure 2). *Curious Observation* included observation that usually led to further engagement. As attendees engaged, they demonstrated *Peripheral Interaction* with others from afar with the intent to learn and try, captured others in AR or VR, and shared their experience across social channels. Those *Actively Engaged* socialized

with other attendees, volunteers and actors, became participants in a study, experienced different levels of interactivity using AR, or immersed in VR.

Engaging Installation Designs Mapped to the Engagement Grid

Each installation for *The Fun Palace* was submitted to a call for proposals and considered for how it might contribute to engaging a diverse audience in a multitude of ways. The *Small Stage* installation offered a site for more traditional audience-dancer engagement allowing audience members to choose different combinations of visuals and music that would inform the choreographed work. *Body RemiXer* proposed several forms of engagement, from curious observation of impromptu physical performances to active interaction with others mediated through a VR headset and body tracking. *JeL* was an immersive experience which sought to connect people through breathing. This experience actively engaged participants in a mostly virtual reality where their breath controlled the movement of a jellyfish and growth of a coral.

The Piano Bar tasked people to play the “correct” notes on an 88-key piano that corresponded to specific synaesthetic colour values, engaging them in a virtual puzzle that others could observe or help with. *Boids* allowed attendees to control a flock of birds projected on a screen through different body movements. *Colossus* actively engaged participants through a Muse 2 headband that triggered an ambient soundscape and visuals corresponding to their brainwaves in a virtual reality presented through a VR headset. Actors roamed *The Fun Palace* ushering attendees who appeared less engaged into a secretive *Curiosity Booth* to interact with actors in the roles of modern curiosities, through an iPad, drawn from the underbelly of social networks.

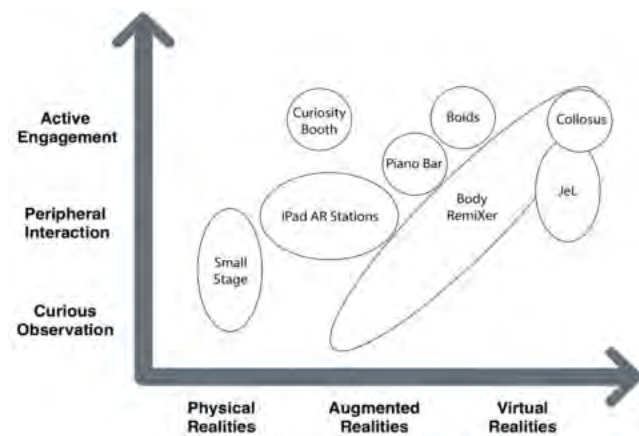


Figure 3. Installations plotted on the Engagement Grid CC BY-NC-ND 4.0.

To reduce the potential for disengagement and increase opportunities for active engagement we designed for multiple interaction points and implemented the strategies that follow.

Plotting Engagement Before, In-Between and After Experiences

Following O’Brien and Toms’ framework, several features of *The Fun Palace* catalyzed different human responses before, in-between, and after their experiences, creating many “points of engagement” to keep attendees engaged and re-engage them as needed. These included roaming actors identifying those waiting and/or those who appeared bored to provoke interaction, guide them to a shorter line-up, or to enter the *Curiosity Booth* (Figure 4).



Figure 4. Posters hiding the entrance to the *Curiosity Booth* by Photo © Andreas Psaltis, 2019.

iPad stations (Figure 5) were available to attendees anytime in several locations and large markers on a centrally positioned scaffolding structure triggered augmented reality animations providing opportunities for engagement between installations.



Figure 5. iPad Station with AR brain describing installations. Photo © Andreas Psaltis, 2019.

Timed group activities occurred every hour and a live master of ceremonies drew everyone’s attention to twelve to fifteen volunteers holding their mobile devices in the air showing an animatic of a whale viewed through an AR application. The activity culminated in a conga line (Figure 6) that allowed us to rotate our growing list of attendees and provide them with a sense of closure.



Figure 6. Attendees in a conga line. Photo © Andreas Psaltis, 2019.

Post-experience activities included different research teams intent on capturing attendee experiences of specific installations and of the overall Fun Palace experience encouraging attendees to engage in a reflection of their experience. Some experiences, such as *Body RemiXer* were designed for open engagement, allowing attendees to directly approach the installation without waiting in line. Instead, they could interact through projections while they waited to put on the VR headset following a model of progressive engagement that allowed for interaction up to their level of interest and comfort. [6]

Increasing opportunities for social exchange through multi-person experiences

During the curation process we intentionally planned to include experiences that would simultaneously engage multiple people, increasing throughput and opportunities for social exchanges. The *Small Stage* seated audience experience allowed for 17 people every 15 minutes. *Body RemiXer* afforded up to 6 people to engage simultaneously for up to 10 minutes, allowing all 400 people to engage freely over the 4-hour event. *Boids* allowed 2-3 people every 2 minutes while *The Piano Bar* challenged 45 attendees per hour. All the installations provided opportunities for simultaneous participation, offering many opportunities for interpersonal engagement during and in-between each experience.



Figure 7. Peripheral and Active Engagement with *Body RemiXer* by Desnoyers-Stewart et al. Photo © Melissa Dex Guzman, 2019.

Disrupting Expected Boundaries

The physical and virtual boundaries that constitute a play area, especially in VR installations is usually well defined. In the case of *Body RemiXer*, the boundary between viewer and participant was made intentionally unclear to pull attendees into the experience. The result was a fluid liminal space in which curious voyeur could suddenly become part of the interactive work. In many ways this fluid boundary was exploited by several of the installations as they could be observed from afar through large projections, drawing curious observers until they fully engaged with the piece.

Stage the entire physical space with lighting, set and sound

Lighting was designed to set the ambience of the space along with a more pragmatic function of lighting specific AR markers required by four installations. Eight projected screens were used to afford multiple viewing angles and drew curious observers into being more actively engaged. These projections allowed attendees to witness others in VR, interact with some installations, and observe AR experiences enlarged from smaller devices.

A rich ecosystem of sound drew attendees to certain areas while headphone experiences could give them reprise from the audio carnival. Sound played through over 17 different speakers and 10 different sound systems on both headphone-based and amplified systems. The sonic ecosystem provided attendees with multiple instances of sound realities that were each related to the individual experiences around them, yet existing within the same space where attention was distributed and in constant negotiation.

Relating to the Engagement Grid as we Emerge from Covid-19

While our engagement grid was developed within a pre-pandemic social experience, our recent involvement in a post-pandemic event revealed that the grid is still applicable. The V-Unframed 2021 exhibition consisted of multiple mixed reality installations in the same physical hangar as *The Fun Palace*.

We observed similar human behaviours when it came to engaging with each installation despite mask wearing and social distancing regulations. The event required all attendees to show proof of vaccination against COVID-19 prior to entry, and a limited number of attendees were permitted in the hangar at any given time. Attendees roamed freely throughout the hangar, interacted with one another between time spent at each installation and VR headsets were worn along with masks in most instances.

Upon encountering the *Star-Stuff* installation at V-Unframed, some individuals engaged in curious observation perhaps waiting for another attendee to try the installation first. Some curious observers transformed into actively engaged participants in VR regardless of the constraints of mask wearing and social distancing.



Figure 8. Children playing in Active Engagement with each other via the Virtual Reality of *Star-Stuff* at a post-pandemic exhibition by John Desnoyers-Stewart. Photo Julia Read, 2021 CC BY-SA 4.0.

Even in a post-pandemic world where attendees' social norms have been significantly altered by nearly two years of social distancing and limited time in shared public spaces the Public Mixed Reality Event Engagement Grid continues to be a useful tool. By providing opportunities for engagement spanning this grid, V-Unframed 2021 was able to encourage a renewed sense of community and encourage the formation and strengthening of social bonds amongst those who attended.

Conclusions

Our MRE prototype offers an opportunity to implement strategies that transform curious observers to more actively engaged attendees. To succeed in that transformation, we believe there is a need to design beyond the on-screen experiences that dominate the attention of installation creators and event producers. An environment which facilitates various types of engagement through different means is essential to an engaging MRE. As we emerge from the Covid-19 pandemic the importance of intentionally designing human interactions in public spaces is even more important.

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Author(s) Biography(ies)

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John Desnoyers-Stewart is an interdisciplinary artist-researcher who creates immersive installations and performances to encourage new perspectives on immersive technology and to better understand its true potential. Through his artwork and research, he hopes to encourage social connection and collaborative creativity, exploring positive social applications of abstract embodiment in virtual reality.

ISEA2022 Can machines predict our future?

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Abstract

Based on the notion of the Datacene, understood as the time when data directly affects the social, cultural, economic, political, and even affective structures of the present. In this article we propose how Big Data and Artificial Intelligence give rise to the Internet of Behavior; a new technological paradigm that has incredible potential to induce human behavior. Since ancient times, human beings have always wanted to predict and alter the future, but in the last ten years, this wish is beginning to become a reality thanks to great recent advances in the field of social engineering, raising serious doubts about social control and the loss of freedom. In this context of analysis, we present two projects developed within the framework of ACTS. Data Biography shows the enormous amount of digital traces that we generate daily and composes, from them, the biography of a person. On the other hand, Machine Biography investigates how current artificial intelligence techniques can predict and induce future human behavior. Both projects invite us to consider from a critical perspective the present and future of the social transformations produced by Big Data and AI.

Keywords

Prediction, Artificial Intelligence, New Media Art, ACTS, Internet of Behavior, Datacene, Big Data.

Introduction

Predicting has always been one of the main objectives of the human species. Having the ability to anticipate becoming was a key factor for human survival in primitive times. The constant observation of atmospheric conditions, with the intention of finding certain behaviors that could serve as a guide to know at what time of the year to sow, was one of the great advances in knowledge of the time that allowed the development of agriculture in the Neolithic, about 10,000 years ago. At that time, the prediction was probably based on analytical methods and some specialists in the arts of divination would soon begin to develop the ability to modify future behavior, such as to affect the weather and thereby benefit the crops of the epoch. Some of these so-called magicians, the most intelligent and sane, knew their limitations but took advantage of deception to obtain important social privileges. [1]

This operating structure has been adapted throughout history to different civilizations. In all of them we find different divinatory arts: geomancy, palmistry, Tarot, scrying, divination with corn kernels, etc., until we reach such highly developed social systems such as the Oracle of Delphi.

A particularly interesting case is the evolution in the prediction of atmospheric phenomena; where we can see a progressive improvement in the understanding of the phenomena of nature and consequently in its prognosis. This process begins in the year 340 a. C. when Aristotle defines the term meteorology in his Meteorological book [2] where for the first time observations and speculations about the origin of atmospheric and celestial phenomena are described. But it is especially from the 16th century on, with the inventions of the anemoscope by Leonardo Da Vinci and Galileo's thermometer, when the science of meteorology begins to develop progressively up to the present day. The progressive increase in data collection on the behavior of nature, due to the invention of certain scientific data collection technologies (thermometer, barometer, anemometer, etc.), made it possible to improve the prediction of atmospheric conditions using probabilistic methods. Throughout this process, we can see how the ancient divinatory methods have evolved to the science of current prediction with a good level of precision, currently it is considered that atmospheric predictions are quite reliable up to three days in advance.

In the last ten years, the social sciences, like meteorology, are developing an incredible evolution of their predictive method. Probabilistic analysis of human behavior is becoming more accurate thanks to the increasing amount of digital traces provided by Big Data. In addition, for some years we have been observing in amazement how Big Data together with computer psychology have been able to affect some key decisions of our recent history such as the 2016 United States elections, which resulted in the presidency of Donald Trump, or the “Yes” in the Brexit referendum held that same year. In both cases, Cambridge Analytics [3] used a powerful, never-before-seen social engineering system that had the ability to modify human behavior. From this moment on we ask ourselves: can we consider that those magicians who since the Neolithic aspired to control the future of our civilization have finally found a system with which they can really achieve their aspirations?

Scientific predictions

The scientific predictive method tells us that if A is true then B will also be true as long as this rational structure is formed by a logical system based on the truth test, thanks to which any experiment has to be reproducible to ensure its veracity. Obviously, all experiments must limit the field of study since it is impossible to carry out an analysis that encompasses all of nature as a whole. This partial sense of reality works with bounded models and hidden variables

with the intention of simplifying reality and being able to carry out multiple partial tests of it. We are, from a philosophical point of view, before a model that aims to establish knowledge by making reality the real. Understanding the real as that to be studied and that therefore is not yet experimentally proven, such as, for example, some concrete phenomenon of nature, which as we analyze it, we can contrast, thanks to the empirical procedure, some of its elements and / or dynamics turning them into reality.

If we look at atmospheric predictions, the models are always an idealization, a simplification given the impossibility of covering all the variables in the environment. But as we have already commented, these predictions are correct in a close period of time, currently up to three days, because, as Edward Lorenz [4] showed, a minimal change in the adjustment of the initial variables of a system makes the result of the same according to advance in time is totally different.

The social sciences, on the other hand, is an area of study where scientists have traditionally had more difficulties in predicting human behavior because even in the case of being able to get to know all the variables of the system, traditionally it cannot be determined with accuracy of the relationship between them since they are very complex dynamics and are also composed of systems with high dependence on the initial variables, as in the aforementioned case of meteorological prediction.

But these limitations are changing in recent years with the emergence of the Internet of Behavior (IoB) [5] understood as the extension of the Internet of Things (IoT) that reveals and processes significant information about our behavior. Using emerging technological innovations and developments in machine learning algorithms, this new technology is both descriptive and proactive, which means that it helps to analyze, but also to detect which variables to influence to achieve a certain result in the end user.

Datacene

Datacene emerges as a period that is assuming a true knowledge revolution, by challenging established epistemologies in the sciences, social sciences and humanities, and generating paradigm shifts in multiple disciplines. The true protagonist of this hybrid space that makes up the Datacene is the massively tirelessly generated data that fuels Big Data. Hand in hand with Big Data are emerging new forms of empiricism that declare "the end of theory", the creation of science based on data instead of knowledge, and the development of digital humanities and computational social sciences that propose radically different forms of make sense of culture, history, economy and society. [6]

In this context of massive data generation, we can understand the Datacene as a metaphor for the society mediated by data, in which an immensity of heterogeneous data is recorded, stored and analyzed. These data, together with the incredible potential of new artificial intelligence techniques that use Big Data as training for the operation of predictive algorithms, are significantly transforming our society. As [7] points out, the use of algorithm-based decisions in the public and political sphere can be problematic, because current machine learning algorithms

do not respond to a sequenced and predictable structure of orders, but rather their internal functioning is opaque and autonomous, acting as a black box of which we do not know its true inner workings. These algorithms need large data sets or datasets to train their operation and if these data have a certain bias it is known that the AI model generated from them will also reproduce the same bias. Therefore, the value of these algorithms falls largely on the datasets used for their training, since they are responsible for their proper functioning.

Data Biography: writing the biography in the Datacene

At the time of the Datacene, we could affirm a priori that we are at the perfect time to develop the realistic biographical model, due to the immense personal information accumulated in Big Data. This apparent objectivity, where the information in principle is shown to us as an optimal resource to trace the biographical account of a person, from which we can later, using predictive algorithms, artificial intelligence and semantic analysis (among other computational methods), extract and generate results relating to psychological profiles, desires, behavior, etc., in addition to having precise information on the location and places that the biographer has visited.

But this vision is at least simplistic, since the quantitative record of our actions can be biased, partial and induce erroneous interpretations about the life of the subject to be biographed [8]. In the same way that the criticized slogan "know your numbers to know yourself" of the Quantified Self [9], promises us an improvement in personal health and well-being through intensive monitoring of our biometric data, data biographies they can show us a reductionist and biased interpretation of the biographed subject.



Figure 1. Data Biography, Clara Boj & Diego Díaz, 2017

Data Biography [10] tries to compose a global physical biography with 365 books printed in a single edition (one per day), which compiles the trace of the digital data generated by Clara Boj and Diego Díaz throughout the year 2017 in which we hacked our mobile phones with a spyware and, thanks to this, we capture all our digital traces to generate the Data Biography work. This biography is made up of 365 printed books (one per day with a total of more than 40 thousand pages) and a 24-hour film narrative (showing the 8760 hours that make up the entire year).

If a biography is the life of a person narrated by another and consigns those aspects of his life most relevant and everything that, in the eyes of the rapporteur, may be of interest to it, this research tries to make a speculative design

proposal on how the biography located at the current moment could be traced, from the data captured from our digital trail in social networks, WhatsApp, emails, visited websites, google searches, images, gps location, etc.



Figure 2. Data Biography, detailed view, Clara Boj & Diego Díaz, 2017

Each of the 365 books is numbered correlatively with a total about to forty thousand pages and this immense volume of books shows the enormous amount of data that we generate and donate to Big Data daily. Located on a shelf where the title of the work can be read, each column collects a month, each book a day and each line collect an action carried out, where the temporary record and the different data of this are shown: the type of action (GPS location, email, WhatsApp, Facebook, Skype, etc.) and its content. The videos and photographs are shown in image format, which generates a list of information that allows the visitor to read all the actions carried out by us during the year 2017.

Scientific predictions and determinism in the Datacene epoch

With the emergence of the Datacene some scientific theories have gained popularity as Laplace's demon. Published in 1814 it was the first articulation of causal or scientific determinism. According to Laplace if someone (the devil) knew the precise location and moment of each atom in the universe, the past and future values of it for any given time would be deductible from those data; could be calculated from the laws of classical mechanics [11]. The followers of Big Data have recognized the figure of Laplace and raised this deterministic possibility from the data, where we have a noisy vision of the reality provided by the immense amount of data generated and stored in the Big Data.

From a deterministic point of view, a good part of this data is noise, which prevents us from accessing the signal, so the job consists of cleaning this data to be able to access the information it contains, the patterns hidden in it. The limitation of this theory resides in that in practice mathematics falls short in the analysis of society, from propositional logic it is impossible to demonstrate certain statements since there are more propositions than demonstration, so not everything can be demonstrated, although the initial hypothesis may be reasonable, but the problem is undecidable and it cannot be validated due to the impossibility of proving or refuting a certain predicate based on others. An example of this is the Super Bowl impossibility theorem [12], by which it is stated that the real effects of advertising on the sale of products advertised

during this famous event cannot be accurately measured. The effect of advertising is subject to a lot of noise so it is impossible to deduce its direct consequence, the effect of this action cannot be affirmed or denied since in real life the parameters that can affect it are so many that it is impossible to create a mathematical model that can consider them all.

Although, although it is true, the models are increasingly broad and powerful, with a greater number of parameters and input variables. A great benefit of Artificial Intelligence algorithms is machine learning that has been a true revolution, since they learn from the analysis of massive data from the real world, such as recurrent neural networks that are an excellent system to find the signal hidden in the data as they are great at finding patterns of behavior. But its internal functioning, in the case of deep neural networks, is opaque and no one can be a true connoisseur of it, behaving like a black box that can lead to unforeseen results. In this sense, some data scientists believe that we are entering an age where alchemy has relegated science to second place. In the words of Ali Rahimi (AI expert): "We are building systems that govern healthcare, mediate our civic dialogue and influence elections. I would like to live in a society whose systems are built on verifiable, rigorous and exhaustive knowledge, and not on alchemy" [13]

As our computational tools have become more advanced, they have become opaquer. For Elon Musk, controversial CEO of Tesla, the biggest concern has to do with the AI that lives in the network and that could autonomously harm humans. "[AI] could start a war by making fake news and falsifying email accounts and fake press releases, and simply manipulating the information" [14], this sci-fi scenario in a way has already happened, although it has not transcended of the digital world, when in November 2017 the artificial intelligence of the video game EVE Online got out of control and unleashed a battle between three cosmic flotillas without any human participation [15].

Machine Biography: predicting the future with deep neural networks

In this project we have made a predictive biography for the year 2050 of Clara Boj and Diego Díaz using Artificial Intelligence techniques based on Deep Neural Networks which have been trained with all our digital activity (GPS locations, digital conversations, photographs, videos, etc.) collected during 2017.



Figure 3. Machine Biography, Clara Boj & Diego Díaz, 2020

In recent years we are witnessing a true revolution in the field of Artificial Intelligence thanks to advances in Machine Learning, where the new algorithms of Deep Neural Networks (DNN) have given rise to the so-called Deep Learning (DeepLearning). The rapid evolution of

these algorithms, their versatility and incredible potential, are affecting our society in many different areas; from helping to preserve endangered species to sophisticated face recognition techniques for surveillance and social control. But one of the most controversial fields is its ability to generate predictions and also create false information (deepFake), entering a new era where the veracity of the information is apparently impossible to contrast.



Figure 4. Books detailed view. Clara Boj & Diego Díaz, 2020

In Machine Biography we use the data captured during the year 2017 for the previously presented Data Biography project. With all this information we have trained different deep neural networks to generate our foreseeable digital activity in the year 2050 and we have reprinted the resulting data to create another 365 books that will form the work Machine Biography; a predictive biography created by artificial intelligence where the limits of what is true and what is false are blurred and the very veracity of the information is questioned at the same time that it is proposed to analyze the creative capacity of artificial intelligence.



Figure 5. Machine Biography, detailed view. Clara Boj & Diego Díaz, 2020

Conclusions

In this publication we have presented recent research projects that invite us to question ourselves from different points of view about the social transformations exercised by the Internet of Behavior at the time of the Datacene. In the case of Data Biography, the work challenges us: if we had to write a biography of a person today, what would be the most appropriate means of gathering information about him? And more specifically, what form could this biography take? Based on this question, we structured the entire research methodology that gave rise, after the study of Big Data, to the compilation of our digital traces and the formal concretion of the resulting artistic work: a Data Biography, composed of the record of all our digital activity during 2017.

This same structure of thought was used in 2019 for the Machine Biography research, in this case the fictitious starting hypothesis was: can machines predict our future? From this perspective we build the final work composed of a predictive biography of our activity for the year 2050, the technology used for the construction of this biography were different predictive models of Deep Learning trained with our digital traces collected during the year 2017.

The general objective of our research is to carry out a critical reflection on the paradigm shift brought about by recent improvements in the predictive capacity of human behavior in social engineering. This new and powerful weapon of social control is still in a primitive phase of development, but its enormous potential makes it necessary to study and discuss its possible transformative actions.

Acknowledgements

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Arts, Science and Technology in the ISSM Project and Exhibition

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Abstract

In 2019 a team of multi-disciplinary researchers undertook a research project entitled *Identifying Successful STARTS Methodologies* (ISSM) (2019-2021)¹ in order to analyze the innovative and collaborative strategies utilized by the global Science, Technology and Arts (=STARTS) Prize Winners and nominees. The aim was to identify and articulate successful STARTS Methodologies through a series of interviews and in-depth case studies of the recognized projects. The project culminated in a series of case studies and an exhibition at the *Made in Wolves Gallery* at the University of Wolverhampton, UK, and further presented at UK Garden of Earthly Delights at Ars Electronica in 2020. The project identified three emerging themes: the significance of building a new language of art and science through a third space, the process of anti-disciplinarity as an emergent form of practice, and the importance of different ways of knowing through art and science. A number of the case studies and themes are presented here alongside images from the exhibition.

Keywords

Art-Science, STARTS Prize, ISSM, *treelab*, *This is Grown*, *Library of Ourselves*, *The Murder of Pavlos Fyssas*, *Future Flora*, *Virophilia*

Introduction

It is now over fifty years since the ground breaking 1968 exhibition *Cybernetic Serendipity: The Computer and the Arts* at the ICA in London and this was a critical point in time that saw artists, scientists, and engineers explore the use of new technology for ‘creativity and inventiveness’[1]. Since then there have been intermittent developments in art and science collaborations with the 21st century seeing a significant increase in interest in interdisciplinary practices. There have been some attempts to articulate a more comprehensive set of methodologies for collaborative science, art, and technology research processes although exemplars of cross-disciplinary collaboration have

emerged ‘as a discrete paradigm in need of its own definitions, rules and recognition’ [2] [3] [4]. In 2019 a team of multi-disciplinary researchers undertook a research project entitled *Identifying Successful STARTS Methodologies* (2019-2021) in order to analyze the innovative and collaborative strategies utilized by the global Science, Technology and Arts (=STARTS) Prize Winners and nominees. The aim was to identify and articulate successful STARTS Methodologies through a series of interviews and in-depth case studies of the recognized projects.

The STARTS initiative is led by the European Commission and incorporates a number of related projects funded projects in Horizon 2020 including the STARTS Prize. The focus of the STARTS Prize is on high-end innovative collaborations between artists engaged with science and technology, and technology and science research laboratories open to bring artists into the laboratory environment. The STARTS Prize has ran for five years (2016-2020)², each year two prizes are awarded, one for Artistic Exploration, the other for Innovative Collaboration. In addition ten projects are given an Honorary Mention each year. A focus of the STARTS Prize is on showcasing achievements, encouraging further collaborations and honoring the inspiring individuals and teams involved.

Case studies of the STARTS Projects

Four case studies were presented at the project exhibition in the *Made in Wolves Gallery*, University of Wolverhampton, UK in 2020 each having received Honorary Mentions from the STARTS Prize: *Library of Ourselves* by the art collective BeAnotherLab (Honorary Mention 2017), *Treelab* by sound artist, Marcus Maeder and tree physiologist, Roman Zweifel (Honorary Mention 2017), *The Murder of Pavlos Fyssas* by London based interdisciplinary research agency Forensic Architecture (Honorary Mention 2019), and *This is Grown* by designer Jen Keane (Honorary Mention 2019).

¹ The project was funded through the competitive IRIS initiative at the University of Wolverhampton, UK.

² The STARTS Prize will run for another term of 4 years from 2021 until 2024.

The Murder of Pavlos Fyssas

'We think that artists also have a claim to truth. We understand that evidence doesn't speak for itself, we understand that we need to have interpretation, we understand that we need to represent. We need to make visible and explicit.' [8]

Project Description

Shortly after midnight on 18 September 2013, Pavlos Fyssas, a young Greek anti-fascist rapper, was murdered in his home neighbourhood of Keratsini, Athens. Forensic Architecture were commissioned by the Fyssas family and their legal representatives to reconstruct the events of the night from audio and video material made available to the courts: the resulting investigation and report establishes a timeline and reconstruction of events that led to the murder, demonstrating the complicity of police – who were present at the scene before, during, and after the murder, but failed to intervene [9].

Jury Statement

By revealing state complicity with Golden Dawn in the murder of Pavlos Fyssas, this project continually and meaningfully encourages an increase in public dialogue on nationalism, immigration, and politics. The jury found that although the questions raised by the project were yet unresolved, they may be more relevant than ever the current global-political moment [10].

Case Study

Forensic Architecture³ is an interdisciplinary research agency, based at Goldsmiths, University of London, who use architectural techniques to investigate human rights violations and cases of state violence. Incorporating artists, photographers, videographers, sound engineers, and weapons experts, Jacob Badcock visited their studio in New Cross, South East London, to interview assistant director, Cristina Varvia, in January 2020. Taking their STARTS Prize nominated *The Murder of Pavlos Fyssas* as a point of departure, our case study focuses on Forensic Architecture's 'archaeological' approach to media artefacts and the built environment, emphasising their ability to make otherwise imperceptible acts of violence perceptible - to reveal that which is hidden through the close analysis of materials. Following their own self-reflexive analysis, we understand Forensic Architecture's practice as an 'investigative aesthetics' which brings art to bear on the production of legal-judicial truths. Going further, we identify how Forensic Architecture collapse binary art-historical distinctions between the aesthetic and the epistemological: - for Forensic Architecture, the artist, as much as the scientist, the mathematician, or the anthropologist, has a claim to truth.

³ Forensic Architecture received the Ars Electronica Golden Nica award in 2021 for their project *Cloud Studies*.

Library of Ourselves

'How bizarre it would be to conceive of an I without an us' [5]

Project Description

Library of Ourselves is an interdisciplinary project used to create transformative encounters between communities in conflict. It was built using *The Machine To Be Another* – a highly adaptable Creative Commons system that bridges cognitive science and virtual reality techniques to create empathic-driven experiences [6].

2017 Jury Statement

The jury felt that the BeAnotherLab team was highly successful in utilising VR technologies as a true empathy machine – allowing the user to be placed into another person's body, and to experience the world through their eyes [7].

BeAnotherLab are an interdisciplinary art collective whose main base is in Barcelona, Spain although the group are distributed worldwide (Amsterdam, Paris, Zurich, Sao Paulo, and New York). The nine members of the collective are from wide ranging backgrounds including Anthropology, Computer Science, Digital Arts, Cognitive Science and Conflict Resolution. Dr Denise Doyle visited the *BeAnotherLab* collective at their Hangar studio in October 2019, where she interviewed five of the nine members, and participated in a debriefing from two members of the Collective from their recent trip to Jordan where they were filming the stories of Syrian and Iraqi women refugees for a project based at the University of Birmingham, UK. The resultant immersive narratives will be added to the ongoing *Library of Ourselves* archive. Dr Doyle went on to interview the remaining members of the Collective during the COVID-19 lockdown. Through the many interviews conducted, it became apparent that the most significant aspect of the approach of the group is their commitment to understanding embodied experience through the many fields that they inhabit. (Some have undertaken PhD level research in neuroscience to 'validate' their findings). Our case study further emphasises their shared belief in the ability to engender empathic response in others through immersive virtual reality technologies.

This is Grown

'I think it's imperative to have both a design perspective and a scientific one. One, to just validate the work, but also, I think, it becomes richer in the final outcome' [11]

Project Description

This Is Grown was motivated by a frustration with plastics and a visible disparity between scientific research and design manifestations around natural materials. Taking an organism-driven approach to material design, the project began under the premise that a greater understanding of

nature could help us not just replace the petrochemical based materials of today with more sustainable ones, but perhaps allow us to devise entirely new systems of making and categories of materials previously unimagined [12].

Jury Statement

This is grown. is a project by Jen Keane that proposes a ground-breaking solution to our troubled relationship with nature. Working at the intersection of design and research, Keane has transformed her frustration with plastic pollution into an actionable idea for reducing the amount of plastic waste [13].



Figure 1. *This is Grown Shoe* (2018) designed by Jen Keane. Photo Credit: Adam Toth. Courtesy of the designer

Fig. 1 is a photo of one of the shoes designed and ‘grown’ by Keane as part of her project. Taking an organism-driven approach to material design, the project began under the premise that a greater understanding of nature could help us not just replace the petrochemical based materials of today with more sustainable ones, but perhaps allow us to devise entirely new systems of making and categories of materials previously unimagined.

Case Study

Our case study investigates the nature of the interdisciplinary working and collaborations between artists and scientists in this project, focused on biological alternatives to synthetic materials. Several interviews were carried out to create dialogue for later qualitative analysis; these conversations included reflections on the very nature of and relationships within the collaborative context and cognitive space formed that facilitated creation. For ease of interpretation and to gain a deep perception of the views of participants that reflect the nature of relationships in art/science collaborations a simple thematic analysis approach was chosen to interpret the data and begin to answer the research questions set by the project and develop a conceptual framework to better understand and represent the data. Coding allowed the development of three themes under which perceptions from interviewees could be grouped that reflected the nature of collaborative activity between artists

and scientists. The three themes identified were; Emotions, Technology, and Knowledge. These reinforce each other and converge to create the transformative intersection where art and science meets and the collaboration occurs. This relationship is not simple and involves a quasi-state or epistemic super positionality that requires further investigation.

TreeLab

‘I want to create an experience of the abstract term ‘climate change’. An experience that is shareable. Once you’ve made this experience of a suffering tree, you may be able to discuss that with others who experience the same art installation’ [14]

Project Description

Treelab’s project *Rendering Ecophysiological Processes Audible* sought to connect sounds that occur in trees with ecophysiological processes and thus investigate render perceptible experiences of plants that are not noticeable to humans [15].

Jury Statement:

The jury was impressed with the unusual pairing of a plant physiologist and a researcher in computer music and sound technology in their work to bring the unheard sounds of trees to the surface; their collaboration resulted in a joint research project on complex environmental data collection and sonification [16].



Figure 2. Spatial audio version of trees: *Pinus Sylvestris*. Courtesy of Marcus Maeder and Roman Zweifel.

Case Study

In September 2019, Richard Glover flew to Zurich to interview TreeLab, made up of tree physiologist Roman Zweifel, and sound engineer Marcus Maeder. As *TreeLab* developed, the researchers realised that if they could make these stress-induced plant signals perceivable to humans, an abstract concept like climate change can be made tangible through an installation environment. Through qualitative analysis from interviews, this case study explores the different roles played by the collaborators, and the conse-

quences for their own distinct academic fields. Maeder's approach is underlined by his philosophy that artists and scientists meet on a 'different plane' to one inhabited by either party; this different plane best facilitates cooperation by both researchers. The task for artists is to develop a common language with scientists through an engaged study of their discipline, which can take considerable time – two to three years in the case of *TreeLab*. Zweifel acknowledged the deep interaction that arose from Maeder's desire to understand the meaning behind the scientific data, rather than simply translating it as material to be employed in artistic work. Equally, Zweifel acknowledges the artistic realisation as a much more effective mode to facilitate heightened public understanding and impact of the urgent environmental data, in comparison to standardised journal publication routes. Maeder similarly recognises the importance of shareability of the installation experience, to prompt further discussion and exploration. The case study emphasises the shared understanding by both researchers, from very different fields, that for public presentation to bring about societal change, a transition to the *emotional* is necessary

Emerging Themes

The project identified that through this process of interdisciplinary collaborations three themes emerged:

(1) Building a Language between Art and Science

A number of the artists and scientists who work together over the long-term describe how they have to build a 'third space' or have to meet on 'another plane' in order for them to communicate and find a common language. The artist needs to understand the language of the scientist, and the scientist needs to understand the language of the artist – but this can happen best in a newly created space. Any long-term collaboration as an artist engaged in science means developing a real knowledge of the science.

(2) Anti-disciplinarity as a form of Emergent Practice

Through the case studies undertaken there is evidence that there is an emergence of anti-disciplinary practices that do not fit within existing academic disciplines. These practices develop by necessity – with manifold methodological and theoretical approaches required to address complex problems (i.e., climate change). Some projects are anti-disciplinary by design, emphasising the significance of aesthetic practice for knowledge production. Also noted is that new technologies can create inherently anti-disciplinary spaces (i.e., virtual reality) where artists live and thrive.

(3) Different Ways of Knowing

As the recent COVID-19 pandemic has highlighted we are dealing with a time of great complexity and uncertainty and there is a need to work in new ways to solve global and societal issues. It is critical for the arts and humanities – in conjunction with the sciences – to embrace different ways of knowing, enabling greater insights for meeting the challenges of the contemporary world. The

methodologies and collaborations in art, science, and technology that support the work presented in this exhibition further attest to this.

The ISSM Exhibition

The threats of the COVID crisis have also brought about new opportunities such as participating in a distributed Ars Electronica Festival in 2020 and this actually prompted us to host our project exhibition early in order to showcase the work of the project alongside some of the winners and honorary mentions of the Prize. The exhibition was originally intended to showcase the interim results of the project at the project conference in early July 2020. Due to the COVID-19 pandemic the conference had to be cancelled. However, an opportunity to be part of the Ars Electronica Festival 2020 in Linz, Austria virtually through the UK Garden of Earthly Delights presented itself and the exhibition was installed in the University's *Made in Wolves Gallery* at the main campus in July 2020 until June 2021 [17].



Figure 3. The ISSM Exhibition featuring Virophilia installation. Photo Credit: Denise Doyle

From the STARTS Prize 2020 we were keen to host the work of Taiwanese artist Pei-Ying Lin, given the immense global impact that COVID-19 was having. Her project *Vi-*

rophilia investigates the possibilities of human-virus encounters and one part of the installation is a 7 metre high scroll that lists all known viruses in the world, with space for more to be added [18].

Another part of the *Virophilia* project installed in the exhibition was a cookbook written for the 22nd century where humans have learnt to live with and accept viruses as part of a greater ecosystem. Of note is the *Influenza Egg on Rice*, but equally there are many strange combinations in the cookbook itself (see Fig. 4).



Figure 4. The Influenza Egg on Rice recipe in the *Virophilia* Cookbook. Pei-Ying Lin. Courtesy of the Artist.

Also included in the exhibition was an installation of the *Future Flora* project by Giulia Tomasello and a shoe and some material examples from the *This is Grown* project by Jen Keane, presented above. Fig. 5 features the installation of *Future Flora* containing the harvesting kit Tomasello designed for women to treat and prevent vaginal infections [19]. *Future Flora* aims to encourage the symbiotic relationship that raises the beneficial presence of microbes and bacteria in the human body, suggesting an alternative: to wear probiotics and keep our body healthy. It is aimed at women who wish to take control of their own bodies as a precious and intimate practice of self-care.



Figure 5. The installation of *Future Flora* at the Made in Wolves gallery. Courtesy of the Artist. Photo Credit: Denise Doyle

Conclusion

The IRIS initiative was developed in order to encourage cross-faculty interdisciplinary research within the University of Wolverhampton, UK and to create strong international partnerships that could withstand the challenging years of research funding ahead outside of the EU. The Director of European Collaboration at Ars Electronica, Veronika Liebl, noted that the project promised 'to bring valuable insights and knowledge of the versatility of these STARTS collaborative practices, consequently helping STARTS to improve future measures in encouraging processes between artists, scientists and technologists.' [20]. Future research aims to test these emerging themes and outcomes in a series of artist-scientist residencies in order to further support this interdisciplinary work in arts, technology and science that can make a real societal impact in the world.

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Authors Biographies

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Richard Glover is a composer and writer who explores the integration of game design approaches into gradual process music and performance environments. He co-authored *Being Time: Case Studies in Musical Temporalities* with Bloomsbury in 2018, and he leads the PResPA research centre for Performing Arts at the University of Wolverhampton.

Martin Khechara is an Associate Professor for engagement in science technology engineering and maths (STEM) at the University of Wolverhampton. A former research scientist he now has an international profile for his pedagogical research, as a public engagement practitioner and science communicator.

Sebastian Groes is Professor of English Literature at the University of Wolverhampton. He is Principal Investigator of The Memory Network, an AHRC and Wellcome Trust-funded Research Network bringing together scientists, arts and humanities scholars, writers and artists. Currently, he undertakes research for the BBC's project *Novels That Shaped Our World*.

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Click::REVU: an optophonic sound installation

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Abstract

If traces of past media remain in contemporary forms of media, how can these traces be appropriated and applied in the creation of a sound-based installation? This paper presents *Click::REVU* a sound installation developed by the first author. The work blends physical characteristics of an early sonification device, the Optophone – a device that translated optical data to sound - to create an illusory presence through a scanner mechanism from a multifunction printer. The work’s compositional structure reduces the scanner’s image capture ability to an indexical relationship that is expressed as a minimal soundscape of drones and clicks. As a media archaeological sound-based artwork, the ideation of *Click::REVU* has depicted a form of optophonics through the interpretation of early 20th century Optophones. These forms, as archival sources of knowledge for reinterpretation, have informed the development and realization of this work, one that is expressed through a genealogically related contemporary form of media, the contact image sensor scanner.

Keywords

Sound art, media archaeology, optophonics, Optophone, obsolescence

Introduction

If Benjamin said that history had hitherto been written from the standpoint of the victor, and needed to be written from that of the vanquished, we might add that knowledge must indeed present the fatally rectilinear succession of victory and defeat, but should also address itself to those things which were not embraced by this dynamic, which fell by the wayside - what might be called the waste products and blind spots that have escaped the dialectic. [1]

Request, Theodore Adorno

Theodore Adorno’s observations of Benjamin are made within a critique of the modern subject’s dread of backwardness. However, they equally provide an examination of the possibilities of this backwardness as a refuge from modernity where the past can live on in the present. Joel Burges posits that such refuges can harbor historical possibilities which can be excavated “for

alternative itineraries to a present in which capitalism has co-opted modernity.” [2] Thus, by engaging in counter historical thinking, the “presence of the past can disrupt this temporal form of linear progress by constellating those temporal elements.” [2]

One perspective as a critique of new media is media archaeology. While some see that the “methodological repertoire of media archaeology has been geared to discourse analysis”, media archaeology allows for the exploration of the material possibilities of obsolete media through an engagement with the physical artefact. [3] Calls for such an engagement with media are not new and have arguably been ever-present in the creation of media archaeological art.

This paper presents *Click::REVU*, a media archaeological sound-based installation developed by the first author. The work utilizes elements of the *Optophone*, a device designed to “substitute the ear for the eye” by making optical signals audible, in its ideation and realization. [4] As media archaeological experimentation, the work is informed by a relationship between contact image sensor (CIS) technology prevalent in low-cost multifunction printers and the Optophone via the light sensing technologies developed through the 20th century. As such, the Optophone shares a media genealogy with optical devices developed in the early 20th century as precursors to later developments that include the automated conversion of images into machine-readable text (optical character recognition), image sensors embedded in digital cameras and scanning technologies and the compact disc. This relationship between past and present forms of optical media informs a conceptual and aesthetic approach for the appropriation of one such form of media, the CIS mechanism (Figure 1), in the creation of *Click::REVU*.

The next section provides a brief introduction to media archaeology as creative practice and a survey of related works. Following this, the paper presents a brief introduction to the Optophone and its development. Next, *Click::REVU* is presented where a system overview and aesthetic and compositional strategies are described.

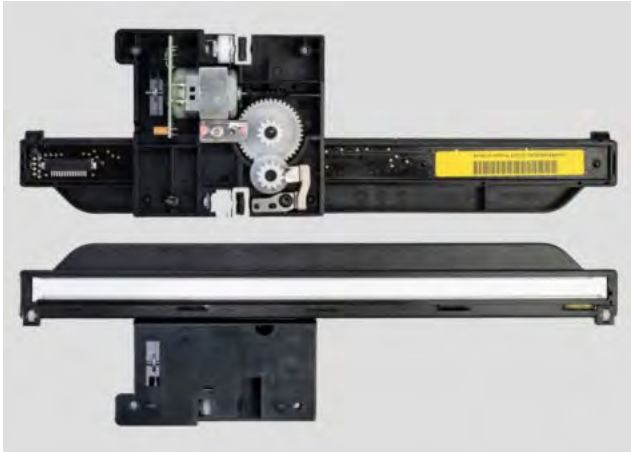


Figure 1. CIS mechanism

Media Archaeology as Artistic Practice

A plea for new directions in media archaeological research issued by Andreas Fickers and Annie van den Oever in 2013 specifically called for an experimental approach to media archaeology over discursive enterprises through the historical re-enactment of past media technologies. [3] *New Media Archaeologies* (2019) extends Fickers and van den Oever's entreaty through a series of essays by highlighting the contribution that experimentation can make to understanding media archaeology. Again, they argue such an approach can "stimulate our imagination of the past" through the "sensual and experiential potential of technical objects, which ... has hardly been broached hitherto in technology or media historiography beyond a purely aesthetic consideration." [5]

Noting that media archaeology is being executed in artistic ways, Jussi Parikka attempts to articulate a creative methodology for practicing media archaeology that contextualizes artworks as such. He suggests several themes for resurrecting old media in contemporary contexts. Therefore, media archaeological artworks "that visually engage with historical themes" can invoke "alternative histories that offer critical insights into the assumed-natural state of digitality" using obsolete artefacts. [6] These works may "engage with emerging media cultures" by drawing on concrete archives as a means of "working like an historian" to an artistic end. [6] A sensual engagement with the artefact, whether a past or present form of media, is a way of opening technologies to expose the "buried conditions of our media culture." [6]

Related Works

A diverse range of artists and many works have been discussed through a media archaeological lens. Such works include those by Paul DeMarinis, Bernie Lubell, Lynn Hershmann and Michael Naimark amongst others that incorporate explicit references to past analogue and mechanical machines in their work. [7] Inspired by Etienne

Jules Marey, Lubell's *Etiology of Innocence* (1999) contains a hand pumped mechanism based on the heart that powers various "bouncing, breathing, beating" mechanisms. [8] DeMarinis' installations emphasize the "material or mediating experience of specially designed artifacts" by creating *counterfactual artefacts* that "occupy a creative space at the boundary between actual and possible worlds." [9] Examples within this context include *The Messenger*, a work that presences early telegraph experiments alongside Internet communications. Another are those included in *The Edison Effect* (1989-1996), a series of sound sculptures that play a range of obsolete recorded media using laser beams including wax cylinders, 78 rpm records and a clay cylinder (Figure 2).



Figure 2. *Fragments of Jericho*, from *The Edison Effect* series

Described as a mediation between music, memory, and time, these works defamiliarize the familiar by "distorting, de-arranging and de-composing the musical material" by merging the raw noise of the medium with the inscribed sounds to create a "havoc of misinterpreted intentions and benign accidents." [10]

Contemporary examples of sound-based works engaging with media archaeology can be found in works by Morten Riis and Stephen Cornford. Riis situates his *Steam Machine Music* (2010) (Figure 3) as post-digital glitch giving the machine's material physicality a pivotal role in its performance via an aesthetic of failure.



Figure 3. *Steam Machine Music Instrument*

He writes “the malfunction of machines is a constantly continuing factor for the use and existence of technology”, as evidenced by the “inevitable errors of the machine through the pre-electronic case of mechanical music.” [11] Examples of Cornford’s work include *Binatone Galaxy* (2011), *Migrations* (2014) and *Constant Linear Velocity* (2016). These works consider obsolescence not as an end but an opportunity to reconsider the functional potential of abandoned devices and their movement from production to pollution.

It is not the intent of this paper to cover the range of possibilities for media archaeological sound art. This review has presented several examples of works that exist in a media archaeological context. Even whilst focusing on activities of tactile engagement with media artefacts as an approach to the creation of sound art, the field is increasingly diverse and, at times, difficult to distinguish between what is explicitly intended as media archaeology and those works that exhibit characteristics of such approaches. However, it is within this diversity of possibilities that *Click::REVU* is situated, not only as a sound installation foregrounding the materiality of the physical object, but one explicitly informed by a media archaeological approach to historical media representations. Developed as a part of the first author’s doctorate research, this work has emerged out of an inquiry into unlikely relationships between obsolete and contemporary media and an aesthetic reimagining as a sound-based installation. The work is the last in the portfolio of artworks developed to realize the research’s theoretical framework.

The Optophone

One result of the First World War was the need to physiologically reconstruct human bodies. This need produced an increased demand for prosthetic technologies. [12][13] One area of sensory loss was sight. Whilst braille had been available as a tactile substitute for sight since the early 19th century, technological innovation surrounding the war years provided an opportunity for other forms of sensory prosthetic devices to “relieve the disabilities of the

blind.” [14] One such device was a little-known invention called the Optophone. As a sonification device, the Optophone translated optical data to sound. Fascinated with the relationship between electricity and light and the conductive properties of selenium, Edmund Edward Fournier d’Albe’s early experiments and research led him to develop a means of providing a “complete electrical substitute for the eye.” [14]

Background

First demonstrated in 1912, the exploring Optophone (Figure 4) was a device to aid visually impaired people with orientation in their environment. [15] Fournier d’Albe stated that the blind could navigate around obstacles by listening through an adapted telephone receiver to hear a series of clicks or rasping generated by differences in light intensity. However, the instrument was not without criticism. One critique was of need. “The blind problem is not to find lights and windows but how to earn your living.” [14] With this in mind, Fournier d’Albe presented a redeveloped Optophone in 1914.

The reading Optophone was “designed with the object of enabling blind persons to ‘read’ ordinary letter press by means of the ear.” [4] With this development, d’Albe added a musicality to the tones used to represent text as sound. Using a numbered ratio from the musical scale, the reading Optophone produced a series of eight notes; G, C, D, E, G, B, C, E, from which “both concords and discords could be obtained according to the letters exposed.” [4]



Figure 4. The Exploring Optophone

In what was termed a “white-sounding” Optophone, the black letters were read by omitting notes from the scale rather than by what notes were sounded. As a form of subtractive synthesis, white space was heard as a discordant “chaos of notes” with a letter characterized by the absence of a note or notes as it was read by the Optophone. [16]

In 1920, Fournier d'Albe, along with optical engineers Archibald Barr and William Stroud, were issued a patent for “new and useful improvements in Optophones.” [17] Improvements included a reversal of the action for reading text and a change in the tonal range. The revised device was termed the “black-sounding” Optophone (Figure 5) because, as a form of additive synthesis, it was the letters themselves that produced sound, thus producing no sound in the intervening “white” space. With this, the tonal range was reduced to G, C, D, E, G. [18][19] Arguably, with these harmonized changes, it was easier to hear and learn the different chord variations in relation to the characters. [20]



Figure 5. The Type-reading Optophone

Related Developments

Whilst the development of prosthetic sight-to-sound technologies waned with the emergence of optical character recognition (OCR) technologies and speech synthesis, some research and development after Fournier d'Albes original Optophone are worth highlighting. Some notable devices include the *Battelle Optophone* (1960s), Charles Carle's *Lexiphone* (1963) and Mauch Laboratories *Visotoner* (mid-1960s), a self-contained battery operated Optophone and the *Cognodictor* (mid-1970s), a recognition reading machine consisting of an optical scanner and a speech synthesis engine. [21] Similarly, various research has been undertaken to develop devices that interpret three dimensional, or distance-to-object information, something increasingly commonplace with advances in image capture and analysis technologies. [22][23]

As a media archaeological exercise, Tiffany Chan et al.'s contemporary rendering of the Optophone is described as a practice-based method of understanding media history

¹ *Click::REVU* is currently near its final completion. Full video documentation and further images will be available when a camera-ready version of the paper is required.

through a tactile engagement with the “material particulars of historical mechanisms.” [24] Such an approach provides an understanding of the presence of past media embedded in contemporary culture and technology through a series of overlapping temporal layers. Chan et al.'s remake of the Optophone does not seek to reconstruct an equivalent device nor to replicate previous experiences of the device. Rather it seeks to highlight “what we cannot retrieve, repeat, or translate in the present” to foreground differences and absences as a refrain from “flattening the many versions of optophones into the optophone.” [25][26] Such flattening of perspectives, as noted by Chan, has contributed to an oversimplification and imprecision concerning certain narrative histories of media. As Druckery argues, history is “not merely the accumulation of fact, but an active revisioning, a necessary corrective discourse, and fundamentally an act of interrogation—not just of the facts, but of the displaced, the forgotten, the disregarded.” [27] It is this ‘flattening’ of historical narratives and connecting seemingly unrelated forms of media that has contributed to the ideation and realization of *Click::REVU*.

Click::REVU

Click::REVU (Figure 6) is an sound-based installation that repurposes and foregrounds the CIS mechanism as the primary visual element for the work¹. In its intended use, the CIS mechanism is generally concealed within a larger structure, analogous to an organ within a body.



Figure 6. *Click::REVU*

Removed from the shroud of darkness of its natural habitat and its support structures (e.g., interfaces to image formation, formatting, and engine control) the CIS itself has become visually impaired as it struggles to see in its new environment. The mechanism's movement is reduced to a series of horizontal gestures, symbolic of its utilitarian and repetitious function. Creatively appropriating and

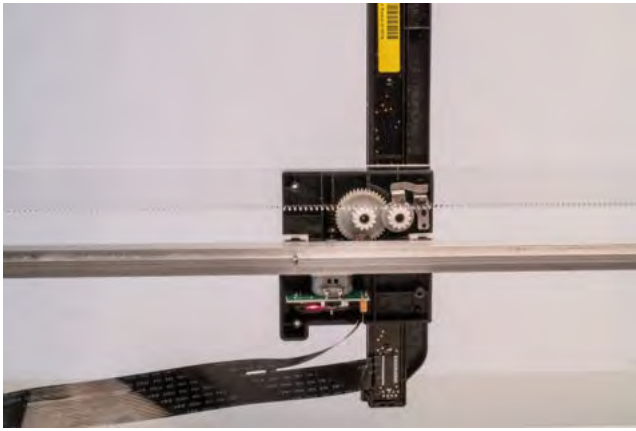


Figure 10. Exposed CIS mechanism

Compounding this difference, the construction and assembly of the structural elements of the work produces subtle nuances in the rhythm of the mechanism. The glass platen which the CIS originally sat upon, as a window for it to see through, is reversed to face the audience. This aligns the work nearer to the purpose of the Optophone as a visual aid for the sight impaired. To this, the illusory body of the Optophone emerges through the CIS as it enables the vocalization of variations of light and dark.

Click::REVU interweaves elements of the Optophone by adopting Fournier d'Albe's concept of interpreting type based on bands of light, each keyed to a different frequency. Fournier d'Albe's incorporation of musical elements for the Optophone can be considered an aesthetic attempt to make the auditory output more attractive to listen to after the roaring noise and buzzing tones of the earlier exploring Optophone. This aestheticization of sound is represented in *Click::REVU* through the use of modulated sine tones using frequencies in relation to musical scales.

Compositional Strategy

Click::REVU's sonic presence combines the 'musicality' of Fournier d'Albe's reading Optophone with the electroacoustic materiality produced by the movement of the CIS mechanism described in the previous section. The scanner mechanism's repetitive gestures and the fixed frequencies of the sine tones appear homogenous. However, each movement exhibits moments of difference in its return and repetition.

Click::REVU uses the notes G, C, D, E, G, B, C, E associated with the white-sounding Optophone. The representation of Fournier d'Albe's early reading Optophone, as the composition *White*, reads a data value from within the programmed strata range and applies it to affect a specific tone function. This begins with a wavering drone comprising a chaos of notes. As the data values are read, tones change at different intervals. Interfering with the drone's rhythmic texture by the imposition of small movements in the individual frequencies is a way of

introducing rhythmic difference. By disrupting the continuous, or linear, repetition of each sine tone, the drone's rhythm becomes cyclic, as return and difference, through the variations introduced in the process of return and renewal.

The simultaneity and diversity of sine tones create moments of harmony and discord, as diverse rhythms interact to maintain a metastable equilibrium between them. An arrhythmic presence exists as a dysfunctional interrelation of rhythms experienced by introducing discontinuity to the sine tones through the irregular presence and absence of sound. At a macro level, the work's rhythms are modulated by the mechanism's electromechanical and programmatic movement. This relationship, modulated by slow changes in environment light, does not interrupt the rhythms but modifies them through the light's diurnal cycles. This interaction between the mechanical and organic elements, experienced by the creation and discovery of new rhythms through repetition and difference, presents a novel interpretation of an optophonic work in *Click::REVU*.

These variations, translated into a presence and absence of sound, interferes with the discordant drone by imposing discontinuous moments within the individual sine tone frequencies. In addition, a by-product of this discontinuity is embraced as a part of the resulting sound. Heard as clicks, these are an artifact of the disruption to the sine tone as it is turned off and on at varying points in each waveform's amplitude. This granulation of an already fragmented ability to see adds a further textural layer to the soundscape.

A Media Archaeological REVU

Utilizing an experimental form of media archaeology as a speculative approach to explore the artistic potential of media can be one way of creating intriguing parallels and connections between past and present media. Such connections have been used to inform the ideation and realization of an idiosyncratic optophonic creation. Such non-discursive insights into the past can also stimulate our imagination, allowing one to "reflect critically on the hidden or non-verbalized, sensorial, corporal, and tacit knowledge" through an engagement with these artefacts. [5] [28]

Click::REVU has focused on the material elements of the Optophone to create a presence of the artefact through the body of a contemporary mediatic form. The work does not reveal the working of the Optophone through itself. Instead, it was interested in the temporality ascribed to such devices as sensorial traces of past articulations, their intriguing noises, functionality, and physical construction.

The work constructs a form of expression based on the practical realization of Fournier d'Albe's prosthesis by utilizing elements of his Optophone. These elements are reimagined through a form of contemporary media, not as a device tightly coupled to sight and sound but as an interpretive sound-based installation. Utilizing a form of contemporary media technology to interpret past media

creates an awareness of characteristics of them as traces of the past in the present.

Conclusion

This paper has presented *Click::REVU*, a sound-based installation. As media archaeological research, *Click::REVU* is a part of a portfolio of works that have, by employing different media archaeological approaches, have reinterpreted obsolete and contemporary media as sound-based installations. The previous works, *Click::TWEET* and *Click::RAND* have been presented respectively at ISEA2020 and NIME2021. [29][30] Media archaeology, as an approach to inquiry, can be a way of seeing the possibilities of alternative historical narratives between the past and present through the convergence of obsolete and contemporary media technologies. Making such connections and representing familiar things in unfamiliar ways through artistic methods may impart a sensation of things as they are perceived and not as they are known. Approaching the conceptualization and realization of the work through media archaeology, *Click::REVU* imagines an optophonic form that is an interpretation of Fournier d'Albe's early 20th century research and development. Blending physical characteristics of the reading Optophone's sound, the work's composition reduces the sense of light and dark to an indexical structure that is expressed as a minimal soundscape of drones and clicks. The combination of rhythms produces continual moments of arrhythmic disruption. As such, this reinterpretation of archival knowledge informs the creation of *Click::REVU*, expressed through a distantly related but contemporary form of media, the contact image sensor scanner. Reimagining the past through the present, the work reconfigures the existence of the Optophone within a broader history of optical technology and sensory prosthetics. Just as the Optophone was developed as a visual aid for the sight impaired, media archaeology as a form of creative practice, can provide alternative perspectives in which to see the world.

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Knowing VR through Practice

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Abstract

How might we come to *know* the particular qualities and affordances – as well as the constraints and biases – of the medium of Virtual Reality (VR)? Responding to this situation from the perspective of *Educations and Societies*, we submit that more nuanced understandings of the qualities (aesthetic, narrative, experiential) and affordances (conceptual as much as technical) of the medium can be gained if VR is approached as a form of cultural *and* research practice. In this paper we will present a curated selection of innovative creative research projects developed at SensiLab, a trans-disciplinary research centre based at Monash University in Melbourne, Australia; and do so in the interest of exposing some of the investigative ways that practitioner-researchers (media artists, creative technologists, content producers) are extending understandings of both studio practice and the medium itself by engaging deeply, experimentally and reflexively with immersive imaging technologies. Illustratively, these dynamic, discovery-led *PhD* projects – undertaken by Sojung Bahng (visual artist and filmmaker), Oscar Raby (VR director) and Lucija Ivšić (performing artist) – reveal how we might come to *know* the medium *through* practice in an iterative way by investing in creating, making and exhibiting throughout the research process.

Keywords

Extended Reality (XR), Virtual Reality (VR), Cultural Practice, Practice-Based Research

Introduction

Extended Reality technologies, such as Virtual Reality (VR), appeal to creative practitioners (filmmakers, visual and performing artists alike) who are drawn by the promise of augmented and virtual reality technologies for producing ever-more immersive, compelling and affective experiences. This paper asks: How might we come to *know* the particular qualities and affordances – as well as the constraints – of the medium of Virtual Reality? We submit that by approaching VR as a form of cultural *and* research practice, more nuanced understandings of the aesthetic, narrative, experiential qualities of the medium and its affordances (conceptual as much as technical) can be gained. Featuring a cross-section of representative projects developed at SensiLab¹, we will ask questions, offer explanations and share reflective insights gained through practice-based research investigations that thoroughly embrace a culture of experimentation.

Through curating a series of project “snapshots” that highlight the innovative creative research being undertaken within SensiLab, our exposition will showcase some of the investigative ways that practitioner-researchers (media artists, creative technologists, content producers) are extending understandings of both studio practice and the medium itself by engaging deeply and reflexively with immersive imaging technologies. Selected projects by Sojung Bahng (visual artist and filmmaker), Oscar Raby (VR director) and Lucija Ivšić (performing artist) embrace some of the broader challenges of XR by seeking to define the language of new media forms and exploring process and procedures (technical,

¹ SensiLab is a trans-disciplinary research initiative hosted at Monash University in Melbourne Australia. Conceived as a creative space where new connections can be made between Art, Design, Computer Science and Technology, our ethos acknowledges that new thinking emerges from diversity, genuine collaboration, and an openness to the unexpected. Comprised of story tellers, artists, makers, hackers, designers, developers, musicians, coders, scientists, theorists, luthiers and builders, our collective research explores the innovative creative applications and undiscovered opportunities of technology. Research undertaken by members of

SensiLab is typically interdisciplinary, linking IT and creative technologies with fields such as health, urban planning, design, media arts, as well as cultural heritage. Working across disciplines, methods and materials, we approach each inquiry with curiosity and rigour in order to learn through creating. We acknowledge process as well as outcome, and value the experiential and the sensory as modes of knowledge. VR as Cultural Practice is one of the lab’s designated research themes along with AI as Cultural Practice, Speculative Design and the Multisensory Museum.

creative and critical) that stretch the narrative and experiential parameters of their respective practices. Bahng, Raby and Ivšić will share grounded insights into selective aspects of their creative research and how their studio investigations are testing the boundaries of the VR medium itself, in relation to spatial imaging, storytelling and exhibition-making. Illustratively, these dynamic and discovery-led *PhD* research projects will reveal how new discoveries are made iteratively through making, building and creating throughout the research process, not only at the culmination of their inquiry. Together, these inspiring case studies challenge preconceptions about VR specifically, and where the medium fits into the repertoire of expressive, investigative and experiential options available to visual artists, designers and researchers alike.

Frames of Reference: VR as a form of cultural and research practice

Defining VR as cultural practice

The potential of immersive digital technology to tell stories in powerful, new and affective ways has been embraced by contemporary filmmakers and visual artists. At the risk of over-simplifying the range of motivations that drive creative practitioners, it is not an especially remarkable observation to say that ‘as with the application of all new technologies, artists are driven to probe, experiment with and sometimes break the machine, challenging the possibilities of the medium’ [1]. Even while the promise of Virtual Reality (VR) has been around since Jaron Lanier’s pioneering efforts in the 1980s, cultural producers from across the contemporary visual and performing arts spectrum, ranging from Ólafur Eliasson to Tsai Ming-liang and Björk, continue to be drawn to the much-heralded ground-breaking potentialities that exist between immersive storytelling, filmmaking and Visual FX cinematography for VR as an art form. For instance, Marina Abramović’s *Rising* (2018), produced in collaboration with Acute Art and realised using the HTC Vive platform, exaggerates the heightened sense of self-consciousness that the medium can precipitate; while *Clouds over Sidra* (2017) – produced in collaboration with Samsung and the United Nations by Gabo Arora with filmmaker Chris Milk’s VR-dedicated production studio Vrse – provides a compelling

example for how a strong empathetic connection between the viewer and subject can be achieved with VR cinema.

However, developing other ways of “seeing” that extend beyond the depiction of virtual forms demands an appreciation of the actual nature of the immersive experience of Virtual Reality. As in the case of Alejandro Iñárritu’s celebrated *Carne y Arena* (2017), the visual and narrative potential of Virtual Reality is taken beyond the pre-defined boundaries of the moving image by extending the application of digital technologies associated with computer-generated imaging from the virtual screen into the real space of gallery installation. In order to connect the subjective act of viewing with the social – and, by extension, political – space it’s located within, we would do well to consider how we might come to know VR as a properly experiential medium, rather than an exclusively visual one [2].

Defining research practice

As a creative technologies laboratory spanning the faculties of Information Technology and Art Design and Architecture, each with their own established disciplinary foundations, SensiLab finds itself in a unique position to demonstrate, as well as critically reflect upon the nature of research and its contribution towards realising what our *data future*² might look like. At its core, SensiLab is driven by the creative engagement of people with technology. Despite the diversity of research areas and applications that SensiLab embraces – from virtual heritage reconstructions using VR technologies to specialist medical wearable devices, new performative musical instruments and creative artificial intelligence systems, all projects have their foundation in practice-based research.

Practice-based research (or Research-creation³ as it can also be known) is a mode of enquiry that seeks to generate new knowledge through practice. Often, this mode draws upon investigative processes that involve gaining knowledge through physical exploration and direct action; or achieving *know-how* by engaging creatively in making, doing, building, experimenting and experiencing. It has been argued that ‘the innovative and critical potential of practice-based research lies in its capacity to generate personally situated knowledge and new ways of modelling and externalising such knowledge while at the same time, revealing philosophical, social and cultural contexts for the critical intervention and application of knowledge outcomes’ [3]. While practice-based and practice-led research⁴

² The Monash Data Futures Institute (MDFI) was established in 2019 as a university-wide initiative bringing together leading cross-disciplinary expertise to address future transformations driven by Artificial Intelligence (AI) and other forms of digitalization in relation to questions of human empowerment, sustainable development and positive change.

³ According to the Social Sciences and Humanities Research Council of Canada (SSHRC), Research-creation can be defined as an approach to research that combines creative and academic research practices, and supports the development of knowledge and innovation through artistic expression, scholarly investigation,

and experimentation; where the creative process is situated within the research activity and produces critically informed work in a variety of media (art forms) whose contribution to knowledge cannot be reduced to its interpretation or analysis.

⁴ Linda Candy distinguishes between the different types of contribution that practice-based and practice-led research make. In the case of practice-based research, the contribution to knowledge recognizes the artefacts themselves as creative outcomes, manifestations or embodiments of the research; whereas, in practice-led research, the contributions concern new knowledge about practice itself and its implications to the cultural field. See: Linda

have existed for many years in the creative arts – in areas such as design, fine art, architecture, music and performance – the research cultivated in SensiLab aims to expand the domain and enlarge the scope of how research through practice might be applied in the creative technology field.

Broadly speaking, knowledge can be classified into forms of propositional knowledge (facts), procedural knowledge (skills), and acquaintance knowledge (objects). Tacit knowledge, on the other hand, is, by definition, an implicit form of knowing that cannot readily be communicated linguistically, where learning how to do something can only be gained through the act of doing it. In effect, “knowing-how” as opposed to “knowing-that”. This kind of knowledge is dynamic, embodied and inseparable from the experience of doing; it recognises that all knowledge is situated in activity, as ‘practices of knowing in being’ that are integrally bound up with their social, cultural and material contexts [4].

For the most part, what practitioner-researchers do involves building physical or virtual artefacts and prototypes that in some way embody the ideas they are thinking about through making, or that test the physical, functional or material aspects of the subject of their research inquiry. Even in the age of digital tools and methods of fabrication, situated cognition, performativity and materiality play important roles in this investigative process, something that is often underestimated in technology-driven research. These processes draw on the individual nuances and subjective nature of experience, often multi-sensory, including kinaesthetics, proprioception, touch, sound, light, even smell and taste [5]. Ultimately, it is the connection between human experience and artefacts – including artworks and design prototypes – that embodies critical knowledge.

Because of the difficulty that codifying such knowledge implies, it is important to acknowledge the challenges that tacitly acquired understanding presents for articulating and sharing this “know-how” beyond the researcher themselves. The work of Donald A. Schön has been highly influential in developing just how vital the act of reflection is to creative forms of knowledge [6]. Applicable to design problem-solving as much as knowledge production, Schön identified reflective practice as a continuum that operates across three levels: ‘knowing in action’ (which is driven implicitly by the expertise of the practitioner); ‘reflection in action’ (which involves conscious acts of improvisational problem-solving that occur during the process of production); and ‘reflection on action’, whereby the practitioner considers their actions in an effort to articulate their decision-making process and form understanding of their practice. It follows, that it is incumbent upon the practitioner-researcher to recognize the relationship between materiality and discourse involved in their creative research – or what might be described as a ‘material-discursive practice’, whether through reflective

analysis or as a means of maintaining a reflexive engagement with the very basis of practice itself. [7] While apparently at odds with the more objective and rationalistic emphasis associated with scientific research, research through practice is not in conflict with this, but rather gives due voice to subjective experience and demonstrates the (critically) important values that experience – in all of its specificity (of culture, gender, positionality, affect and so on) – brings to an enhanced (and increasingly nuanced) understanding of the world.

Three Practice-Based Investigations

The curated exposition that follows will reveal some ways that we might come to *know* the medium *through* practice (in both formative and summative terms). We hope that by demonstrating how a spirit of adventurous inquiry infuses a practice-based research methodology that emphasises the values of cultural and knowledge production in equal measure, these short, focused accounts by Sojung Bahng, Oscar Raby and Lucija Ivšič will illustrate some guiding concepts applicable to creating affective artworks and mediated experiences that will both inform and inspire others to embrace the challenges of VR in critically reflexive ways.

Sojung Bahng

Sojung Bahng’s PhD research (*Cinematic VR as a reflexive tool beyond empathy*) investigated VR as a cinematic and rhetorical device to elicit self-reflection and awareness in sociocultural contexts. Seeking to go beyond the notion of an *empathy machine*⁵, a concept that is too-readily used as a means of understanding of quality of viewing experience associated with the medium itself, Bahng’s investigations focused on ways that presence and embodiment can elicit a sense of identification and critical reflection in the viewer. The set of VR projects produced as part of her practice-based research – *Floating Walk – Gangnam Kangaroo* (2017), *Anonymous* (2019) and *Sleeping Eyes* (2020) – emphasised the limitations of immersive engagement. Instead, she designed storytelling methods aimed at promoting a sense of physical estrangement and cognitive disorientation. Through introducing more reflexive elements into the cinematic narrative of these works, Bahng provided the viewer with scenarios to explore unfamiliar sensory experiences that encourage them to reflect on their own sensations rather than simply immersing themselves in the virtual environment.

For Bahng, VR was approached as the main artistic medium for her research practice. Her studio-based investigations exploited three constraints associated with VR media, namely 360-degree video, mobile interactive VR and

Candy, *Practice based research: A guide* (Sydney: Creativity & Cognition Studios, University of Technology, Sydney, 2006).

⁵ The term *empathy machine* was first used by Chris Milk at the TED conference in 2015 to describe the propensity for VR to democratise human experience and strengthen the empathetic

connection between the viewer and subject(s) represented in the media. See: Chris Milk, “How virtual reality can create the ultimate empathy machine”, Ted website, accessed October 22, 2019, https://www.ted.com/talks/chris_milk_how_virtual_reality_can_create_the_ultimate_empathy_machine?

navigable interactive VR. Her creative research was influenced conceptually by the *estrangement effect*⁶. Inspired by German playwright Bertolt Brecht's use of various staging and acting techniques to break simple immersion and prevent audience members from identifying with the characters and situations in his stories, she translated this approach (which is also referred to as the alienation- or distancing-effect) to cinematic VR storytelling in order to promote embodied reflexivity in more phenomenological and ontological ways. Distinctively, Bahng also drew upon Buddhist philosophy, particularly in relation to *meta-awareness*⁷, which is a mode of self-reflexive awareness that lets people observe their multiple sensory experiences while experiencing them. Across the studio processes involved in conceiving, designing, prototyping and producing these creative works, Bahng was able to identify and test the function of reflexive elements based on certain technical constraints associated with various forms of spatial interaction, and through embracing experimentation, managed to introduce new storytelling and aesthetic methods into her work.

Bahng's creative processes meshed productively with the theoretical and methodological questions guiding her research. She asked: What are methods and techniques related to Cinematic VR that enable the medium to be approached as a reflexive tool that exceeds certain idealised framings of empathy? How can reflexive VR storytelling effectively elicit self-reflection in response to sociocultural situations and contexts? And ultimately, how might Cinematic VR artworks provide viewing experiences that encourage the viewer to critically reflect on issues of alienation, disconnection and isolation? These lines of enquiry enabled her to examine how the technical infrastructure and material properties of VR shape the viewing experiences associated with each of her artworks. For example, *Floating Walk – Gangnam Kangaroo* harnesses the potential of a 360-degree video as a means of autobiographical self-expression and an autoethnographic tool that promotes the reflexive thoughts about migrant identity. *Anonymous* contributes design factors and technical implementations for using VR to elicit self-reflection on loneliness and death. While *Sleeping Eyes* demonstrates how phenomenological and participatory engagement in VR storytelling can elicit critical awareness of

narcolepsy and counter social ignorance. (Figure 1) Collectively, this body of creative research provides in-depth knowledge about reflexive modes of immersive storytelling while considering the various technical, design and narrative elements available to Cinematic VR in a creative-critical way.



Figure 1. Sojung Bahng, *Sleeping Eyes* (2020). Variable; 8-12 mins. Production still. © The Artist.

Oscar Raby

Oscar Raby is an accomplished VR director and documentary producer working in the field of real-time narrative VR. Through his production studio, VRTOV⁸, he has developed corresponding creative workflows and technical pipelines tailored to VR media production. Inspired by Dziga Vertov, the Russian filmmaker who explored the potentialities of new moving-image technology at the beginning of the 20th Century, Raby's critical approach towards understanding VR through knowing its *technê*⁹ exemplifies that of a 'reflective practitioner'. This stance recognises that the type of innovative applications that Vertov and his collaborators derived from the movie camera were not centred on the way they embraced this industrialised piece of technology, but rather in how they embodied its unique language, as expressed in its famous dictum: 'I am a mechanical eye. I, a machine, show you the world as only I can see it. (...) I decipher in a new way a world unknown to you'. [8]

⁶ The *estrangement-effect* was Brecht's principal means of overturning a sense of unwitting complacency in the viewer (and by extension society at large). As an aesthetic technique, Brecht would 'stage theatre in such a way that the viewer is denied the habitual comfort of forgetting that they are watching a play and becoming (what psychoanalytic film critics call) sutured into the events on stage. Thus, he would discourage actors from "becoming" their characters and using that to elicit the empathy of the audience, preferring that they create a sense of "distance" between themselves and their character that would put the audience in two minds about what they were watching' (Buchanan 2018).

Ian Buchanan, *A Dictionary of Critical Theory* (2nd edition) (Oxford: Oxford University Press, 2018). Also, see: Bertolt Brecht, *Brecht on Theatre* (New York: Hill and Wang, 1964).

⁷ Meta-awareness involves the ability to take explicit note of the current contents of consciousness. See: Bhikkhu Bodhi, "What does mindfulness really mean? A canonical perspective", *Contemporary Buddhism* 12(1), (2011):19–39.

⁸ <http://www.vrtov.com/>

⁹ The term comes from the ancient Greek τέχνη (meaning art or craft) and used in general reference to a technique, principle, or method by which something is achieved or created. The Stanford Encyclopaedia of Philosophy makes note, however, that '*Epistēmê* is the Greek word most often translated as knowledge, while *technê* is translated as either craft or art. These translations, however, may inappropriately harbor some of our contemporary assumptions about the relation between theory (the domain of "knowledge") and practice (the concern of "craft" or "art")'. (See: <https://plato.stanford.edu/entries/episteme-technē/>)

In his case, Raby's current PhD research provides him with a platform to revise the assumptions that the medium carries along with it, on its technology layer (hardware, software) as well as the language embedded into it. His practice-led critique takes aim at the identifiable features that are already present (or *preset*) in the software environments used to create VR works, such as Unity's *Timeline* or Unreal's *Actors*, with the ambitious goal of defining a materiality that is not the simulation of something else, but the *actual* material of Virtual Reality.

For Raby, Virtual Reality has been instrumental in the observation of the thought processes involved in thinking about narrative circumstances, character motivations, and stories that ultimately become the experienced work. The self-referential nature of VR, namely, in that it presents a situation to be *acted upon*, is a place in which the moment of engagement with the spectator/user can facilitate the witnessing of their own thought process as they find themselves navigating the situation. This particular feature of the medium has two crucial aspects to it. Firstly, singular interpretation is actively resisted since real-time narrative is naturally expansive in the creation of meaning because this process is performed by a necessarily active *reader*. Secondly, the thought process exercised and witnessed *within* the artwork can be exercised again *outside* the artwork. It is in this realm that the work is capable of activating a powerful, political reverberance.

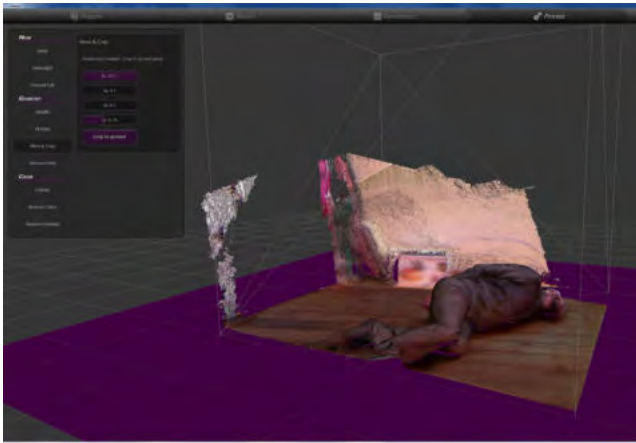


Figure 2. Oscar Raby, *Assent* (2013). Production screen capturing Skanect software showing a 3D scan of Raby as a character in *Assent*. © The Artist.

The current wave of VR has been regarded largely as a medium of isolation and individualism. Somewhat paradoxically, these same features place it in counterpoint to the barrage of social media engagement and connectivity that has prevailed in the same era. Discounting that the convergence of these two positions has already been well and truly initiated (one only has to note the prominence of Facebook in the technical and commercial drive of the technology), Raby's research inquiry presents an opportunistic and timely response that both takes stock of how the medium of VR has evolved under these cultural conditions and captures

the epochal tension between the individual and the collective with a tool and language that stems directly from it.

At the current juncture of his research, Raby is progressively working towards codifying a practical method of development that prioritises the narrative construction of time over the prevalent metaphor of spatial simulation. As a way of bridging the concerns that have sustained his creative practice, Raby is revisiting the first work he produced in VR, *Assent* (2013), as the basis of self-reflective critique. (Figure 2) By deconstructing the technical and conceptual settings involved in its original production, Raby is seeking to expose how the experience of time is created in the medium. While the actual form that the thesis will assume remains open-ended, this inquiry-driven project illustrates how theory and practice might correspond with each other *productively* across inter-related processes of analysis, critique, prototyping and creative production; ultimately, giving rise to new knowledge about the time-based nature and programmed methodologies of VR.

Lucija Ivšić

Even though VR technology is not her main form of creative practice, it has nonetheless found itself playing an influential role in Lucija Ivšić's initial studio investigations as part of her recently commenced PhD studies. At this formative juncture, VR has served primarily as a didactic tool that has enabled her to create surreal environments to inspire further exploration. By purposing VR in this way, and through immersing herself in this investigative process, valuable insights into the kinds of relationships we establish with physical spaces have been gained. Ivšić's research inquiry draws upon a posthumanist approach to identity. [4] The self is exposed, in all of its multiplicity and performative aspects, as a certain identity, character or role we play in accordance with the specific social context in which we perform. This act of identity formation might also be studied as an assemblage that does not begin or end with the individual but rather extends to surrounding places and objects. In this respect, the places we dwell in, like our home or workplace, simultaneously form and reshape our identity as well as their own behaviour through the relationship we maintain with them. This relationship is reciprocal and can generate unique behaviour patterns that shift or alter our perspective of how we experience and see places. That being said, throughout the preliminary experimental phase of her practice-based *PhD*, VR technology has enabled Ivšić to transform intangible and otherwise transitory qualities of spatialised data, acquired from 3D scanning and processing of point clouds, into a comprehensible whole. The dichotomy inherent to the VR medium, that being the blending of both cinematic (real) and artificial (game) spaces, is exactly what has allowed Ivšić to audio-visually (re)construct virtual environments that contain commonly imperceptible and ephemeral constituents that make up our real-worlds.



Figure 3. Lucija Ivšić, *What homes are made of: The Architecture of Displacement* (2021). Production still. © The Artist.

In *What homes are made of: The Architecture of Displacement* (2021), Ivšić has embarked on an artistic exploration of the intangible components that every place consists of. (Figure 3) By underscoring memory through visualising elements such as the fall of light on surfaces and the sound of materials, she is questioning the relationship we enact with the spaces we have known and come to know. Her work asks how this knowledge affects our identity versus the identity of the place itself; and questions the role that memory plays in our perception of these places. What sensory components of daily situations are stored forever, constructing the notion of *home* in our memory, and how does that translate to space itself, enacting and adding up to an existing identity of ourselves and of others. By deliberately recording binaural sounds present on an ordinary Sunday afternoon in the apartment she grew up in in Vinkovci, Croatia, and strategically placing them within her current apartment in Melbourne, Australia, Ivšić materializes the importance of *time* (Sundays) and *place* (home) in the process of memory stimulation. The visual model of her Melbourne apartment was generated from point clouds generated with LIDAR. Through this technology and its immediately recognizable aesthetics, a VR scene is constructed from meticulously measured spatial points, varying in density, simultaneously creating exact, almost photographic resemblance of reality, yet adding an obvious dreamlike ambience. This work was designed to take advantage of VR specifically by seamlessly blending two realities that exist simultaneously on opposite hemispheres (Europe/Australia; then/now; real/virtual) to create a window into the first-hand experience of displacement. While the viewer is granted access and invited to inhabit this otherwise mundane yet personal place, one is immediately unsettled by the true origin of the sounds they hear, and how they synthesise with the visuals they are able to surreptitiously inspect. Inspired by the expressive spatial poetics of Gaston Bachelard – who wrote that ‘Memories are motionless, and the more securely they are fixed in space, the sounder they are’, Ivšić has called upon VR to give expression to this sense of displacement by registering our feelings to the spaces we live in as a way to “see” how memories are etched and intertwined so deeply in our everyday lives. [9]

Upon Reflection

In this paper, we have considered practice-based research as a mode of enquiry that generates new knowledge through practice, i.e. by actively making, doing, building and experimenting. Creative practitioners intuitively understand that the generation of new knowledge is embodied in their practice and emerges in the studio as part of a material-discursive practice; often involving the use of knowing-how types of knowledge, gained through physical exploration, direct action, performance and experience. Here practice is concerned not only with achieving resolution, in the form of definitive creative outcomes, but with gaining greater understanding of the reflexive processes by which the practitioner-researcher achieved them.

The three cases represented here highlight some of the unique qualities of knowledge production that research through practice enables: by placing an emphasis on making and learning through experimentation, instilling a spirit of inquiry that values process as much as outcome and embracing implicit forms of knowing. As these examples attest, research through practice can benefit how we might come to *know* new technologies – i.e. the communicable and expressive qualities of the artform and its aesthetic language (as in the resolved or speculatively developmental work of Sojung Bahng or Lucija Ivšić, respectively), or as a means of challenging the predispositions and idiomatic structures that (quite literally) underwrite the basis of the medium itself (in the form of software processes and code; as per Oscar Raby’s critique). Equally committed to the values of creativity and research, these dynamic, discovery-led *PhD* projects make important contributions towards building the know-how of communities of practice in emergent fields of cultural and knowledge production.

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Authors' Biographies

Sojung Bahng is an artist and filmmaker working as a postdoctoral researcher and instructor at Carleton University (Ottawa, Canada). She completed her *PhD* thesis (*Cinematic VR as a reflexive tool beyond empathy*) with SensiLab at Monash University (Melbourne, Australia) in 2020 and is presently a Postdoctoral Research Fellow in the School of Journalism and Communication at Carleton University (Ottawa, Canada). Sojung's VR works have been exhibited or screened at many international festivals and symposiums, including FIVARS (Canada), SIMA (USA), BIAF (South Korea), TSFM (Italy), TIAF (Georgia), TEI (Australia) and ISEA (UAE).

Vince Dziekan is a Senior Academic and Practitioner-Researcher at Monash Art Design & Architecture (MADA), Monash University, Australia. Vince's work engages with the transformation of contemporary curatorial practices at the intersection of emerging design practices, creative technology and museum culture. The scope of this interdisciplinary investigation has been outlined previously in his book, *Virtuality and the Art of Exhibition: Curatorial Design for the Multimedial Museum* (Intellect/University of Chicago Press, 2012), and more recently *The Routledge Handbook of Museums, Media and Communication* (co-edited with Kirsten Drotner, Ross Parry and Kim Schroder, Routledge, 2018). He has published widely in traditional, scholarly as well as non-traditional modes through his independent curatorial practice. He is associate editor of *Curator: The Museum Journal* (Wiley), general editor of *The Encyclopaedia of New Media Art* (Bloomsbury), founding curator of *MWX*, the exhibition initiative of the Museums and the Web conference (Museweb), and Series Co-Editor of a newly launched book series, *Critical Perspectives on Museums and Digital Technology* (Routledge).

Lucija Ivšić is a Croatian-born emerging new media artist, composer and experienced performer, currently residing in Melbourne, Australia. At just 14 years old, Lucija formed Punčke, one of the first all-girl bands in Croatia. Over the course of a decade, Punčke releasing five critically acclaimed albums, being nominated for an MTV EMA Award in 2014, and playing over 400 shows worldwide. Relocating to Melbourne in 2019, Ivšić commenced her practice-based *PhD* research at SensiLab, Monash University. Resonating posthuman visions, Ivšić's work explores identity formation and the relationships we establish with physical spaces through VR and mixed-media installations. Lucija holds a Master's Degree in Geodesy and Geoinformatics from the University of Zagreb, where she specialized in remote sensing technology (laser scanning).

Jon McCormack is a research Professor in the Faculty of Information Technology, an Australian Research Council Future Fellow and director of SensiLab, a bespoke, trans-disciplinary research

centre, based at Monash University in Melbourne, Australia. A practicing artist, he is the recipient of more than 19 awards for both artistic creativity and technical research, including the Eureka Prize for Innovation in Computer Science, the Lumen Prize for Digital Art (still images). In 2016 he established the practice-based *PhD* within the Faculty of Information Technology. A first for *IT* doctoral research in Australia, this innovative form of *PhD* encourages creative and dynamic projects that make discoveries through making, building and creating.

Oscar Raby is a visual artist and creative director at VRTOV, a Melbourne-based Virtual Reality studio behind the projects *The Turning Forest* and *Easter Rising: Voice of a Rebel*. His autobiographical Virtual Reality documentary *Assent*, has been part of Sundance New Frontier, IDFA DocLab and Sheffield Doc/Fest (where it received the Audience Award for Cross-platform) as well as festivals in Australia, Canada, USA, Mexico, the Netherlands and the UK. Oscar completed his *Masters in Animation and Interactive Media* at RMIT (Melbourne, Australia) in 2013 and commenced his *PhD* research with SensiLab in 2010 focusing on the software metaphors underpinning the development of narrative XR work.

Qatipana: Towards the possibility of Cosmotronics and Technodiversity

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Abstract

This essay revolves around the concepts and processes of Becoming and Individuation where a functional model based on the articulation of an information processing system based on the approaches of the philosopher Gilbert Simondon is evidenced; This research aims to observe a sensorimotor cycle performed by the cognitive system of an Artificial Intelligence agent. To establish this model of biological inspiration, we used the concepts of information and modulation in Gilbert Simondon and information in cybernetics of Norbert Wiener and Stafford Beer. These resources force us to ask ourselves the following question: How does mono-technology and computerization of cultural techniques influence the nature of knowing the affection of being with others (people, things, animals)? To answer this question, an interdisciplinary study (arts, sciences, information technologies) is offered on the effect of this symbiosis and how it can be seen in the full use of knowledge about the fundamentals of living and non-living matter. The architecture is called Qatipana (a Quechua word that denotes the flow of information processing systems), although it cannot be considered as a systems theory, it has the utility of being able to explain some empirical observations that are presented here. In conclusion, the implications and limitations of this model and the research that is being carried out to present its utility and probability as a technodiversified model of the algorithmic cognitive system are part of the issues of communication and affect in the decisions that this cybernetic system provides.

Keywords

Decolonizing, individuation, art, cosmotronics, ecosystem.

Introduction

The objective of this artistic research is to develop a hybrid architecture that we have called Qatipana (a Quechua word that denotes flow of information processing systems), although it cannot be considered as a systems theory, it has the utility of being able to explain some empirical observations that here I present. The implications and limitations of this model and the research that is being carried out to present its utility and probability as a model of an algorithmic cognitive system are part of the questions of communication and affect in the decisions provided by this cybernetic system.

To achieve this objective, the research revolves around the concepts and processes of becoming and individuation where it shows a functional model based on the articulation of an information processing system based on the approaches of the philosopher Gilbert Simondon (*L'individuation à la lumière des notions de forme et d'information*, 1958); This process aims to model the sensorimotor cycle performed by a cognitive system of an Artificial Intelligence (AI) agent. To establish this model of biological inspiration, we use the concepts of information in cybernetics by Norbert Wiener (1948), information and

modulation in Gilbert Simondon, and the approaches on cosmotronics and technology diversity of the Chinese philosopher Yuk Hui.

In the hypothesis of this research we affirm that to the extent that we provide a focus and view on the technologization of the world as a process of individuation, taking Simondon's concept in this becoming; We foresee that an artificial agent and its environment can be out of phase to resolve their tensions and give rise to physical or living individuals that constitute a system and go through a series of metastable equilibria, from this approach it is possible to demonstrate their capacity for invention as a clear example of a way of transindividual individuation (referring to the human being), which thanks to the information that the artificial agent acquires and recovers through this "subjectivation", which integrates perception and affectivity; allows the creation of new norms or artifacts settling in their evolution, as is its use in the case of bioeconomy and cognitive capitalism (Fumagalli, 2010), thus suggesting the hypothesis that AI could also be an extraterrestrial intelligence (Parisi, 2019) and not just an application of a vertical power. As described here, this process is highly visible in tracing the history and operability of the ecosystem concept: from theory of mind to resilience politics. By locating the ecosystem discourse within longer philosophical conversations surrounding the relationship between organic unity and algorithmic normative potentiality, it allows building an ecosystem proximity to algorithmic organicism theories, better understood by its full political implications: "the perception of the whole earth as an ecosystem (as in the Gaia hypothesis)" (Pasquinelli 2017, 320). Like the "recursive irony" that defines the technological hybridization of the ecosystem, to use the phrase of Pasquinelli (2017), these operations reveal the critique of political economy, which is more than a coincidence of the result of the industrial division of energy and information as an abstraction of work; driven by fast-paced capitalism, as global warming is made visible by the same epistemological tools that drive the problem. Such is the recursive trap of planetary computing.

The provocation poured into this research regarding large-scale forms of environmental governance is important and, as highlighted above, in line with a longer set of historical transactions that can be traced back to questions that place the organic individual in relation to the all social and technological. Indeed, as the history of the ecosystem shows, this form of governance is already identified in policies as resilience.

On the other hand, this project addresses ways of constructing epistemologies generated from the field of new media art. On the one hand, we observe an increasingly intense interdisciplinary collaboration with

science and technology, on the other hand, art, design and technology are converging under the force of the cultural industry. In science, simulation has overturned established epistemology, as scientific experiments, the fundamental research method proposed by mid-20th century science, now require collaboration with computer simulations. In 2013, the Nobel Prize in Chemistry went to Martin Karplus, Michael Levitt and Arieh Warshel, who since the 1970s have been developing simulations of molecular dynamics. From the field of the humanities, we have observed the emergence of a new heavily funded discipline, the digital humanities, which coincides, after the concept of the inhuman proposed by Lyotard in 1986, with discourses on posthuman philosophy, cyborgs, object-oriented ontology, etc. In light of the transformation brought about by telecommunications technologies, we can revisit Lyotard's hypothesis on the destabilization of the concept of the modern. Where is this concept of the human going after the post, or beyond? Should we not demand a new form of orientation after the dominance and disorientation of the notion of humanity as a cultural construct, perhaps an orientation that does not impose even the will to dominate the policies that are constituted outside of the human?.

Qatipana as a proposal to Technodiversity

In a relatively short period of time, there has been an explosion of new technologies that have infiltrated all areas of life and irrevocably altered our ways of living. The consequences of this technological permeation are ontological and epistemological, and they do it without problems, since we see that our world changes everyday.

We could argue that digital practices, such as experimental works of art and representations, serve as criticism's mechanisms and have an indirect effect on the social and political. Although a redefinition of this term is certainly needed, since they question the very nature of our accepted ideas and belief systems regarding new technologies. In this sense, digital does what all avant-garde art does; it is an experimental extension of the socio-political and cultural aspects of an era. In this way, technology would then imply a reconfiguration of our embodied experience. When the mind and body cannot reach the meaning it addresses, it builds its own instruments and projects a mediated world around it. Rather, being separated from the body, technology becomes part of that body and alters and recreates our experience in the world.

Faced with such phenomena, the concern is being born to develop a research project that focuses on observing, analyzing and collecting information on the learning and individuation processes (Simondon, 2009) of the algorithms for organizing new modes of subjectivation in human and non-human nature. This type of observation presents new directions for research in the relational-transactional intersection of contrasting disciplines of the arts, humanities, science and technology, and in doing so, presents philosophical questions for future research on human connectivity in our digital age. This main questions are now focus nowadays in media studies:

How does the computerization of cultural techniques produce new forms of subjectivation? How does the concept of mono-techniques already imply the notion of "chains of operations" and, therefore, a permanent (retro) coupling between living and non-living agencies?. The last question is also closely related to the

society and working life.

On the other hand, the possibility of approaching to reflect on what has been raised so far arises from the concern to work from "the epistemes of the becoming". For this, I am dedicated to the development of a work called Qatipana and is posed as follows: A machine that can observe and learn from a natural system and uses the data that arise from its behavioral patterns as a source of "transduction" for the agency of a material and immaterial ecology. From this observation, the project focuses on the use of artificial intelligence that has the ability to identify repeated coordinated actions within a natural system. Artificial Intelligence (AI) stores and transforms these actions into events to which it assigns different behavior gestures to the living organism and to itself, creating an autogenerative habitat according to the logic of decision-making that it produces through weather. To achieve this, an analog signal collector and a transmission device, capable of performing its own biological maintenance and an audiovisual platform that allows the amplification of these biological signals, will be developed. The resulting process will be transmitted live through a server channel, where the coevolution process can be monitored in real time, revealing that AI are capable of taking various forms depending on the situation. Under this logic and thinking from non-human intelligences, it can be argued that generative art is inheritor to the field of research, that in 1968 Jack Burnham called "Systems Aesthetics"; he said: "We are now in transition from an object - oriented to a systems-oriented culture. Here change emanates, not from things, but from the way things are done " (Burnham, 1968: 2).

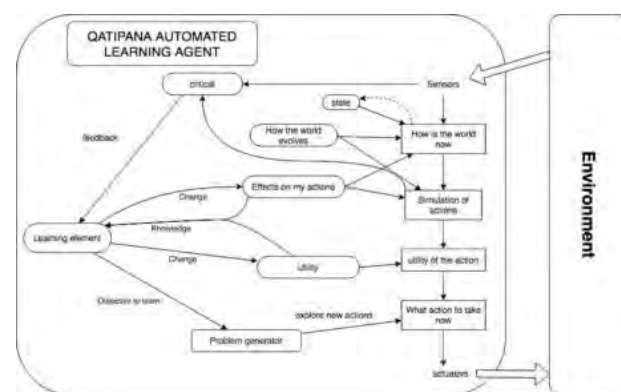


Figure 1. Example of architecture (information flow) in Qatipana, 2019 @Renzo Filinich.

In conclusion, the implications and limitations of said model and the research that is being carried out to present its utility and probability as a model of an algorithmic cognitive system are part of the communication and affect issues in the decisions provided by this automatic system. Cosmology is not pure theoretical knowledge; in fact, ancient cosmologies are necessarily Cosmotekhnical. Taking the notion of Hui (2017) we can give a preliminary definition of Cosmotekhnics here: it means the unification of the cosmic order and the moral order through technical activities. Modern technology has broken the traditional relationship between cosmos and technique; it becomes a gigantic force, which transforms every being into a mere "permanent reserve" or "reserve" (Bestand), as Martin Heidegger observes in his famous 1949 lecture "The Question for Technique" (Heidegger 2016). In this way, they somehow adopt a series of behaviors that allow them to act like other entities, without necessarily

replacing what they imitate. From an analytical and epistemological result, the work process acquires an interdisciplinary approach, proposing a strong cross between applied sciences and the humanities, thus generating a research space for communication and non-anthropocentric concern based on an autogenerative system of non-human intelligence.

Finally, it is emphasized how the relationship between art-machine-natural systems coupled with the concept of Cosmotronics by Yuk Hui¹ provides us with an excellent theoretical device to investigate the role of technology in relation to improve our understanding of a pluralistic techno-diversity under a Latin American cosmopolitics.

Discussion or results

Uexküll proposes “a walk through unknown worlds” (Uexküll 2016), worlds strange to us but known to other creatures, “as diverse as the animals themselves” (Uexküll 2016). To do this, he suggests, we must create an imaginary soap bubble around each creature. Each of these bubbles contains only the perceptions that the creature has access to and then forms its own true world. Each of these bubbles represents the world as it appears to the organisms themselves. As each organism perceives differently, there are as many of these worlds as there are organisms in nature. Uexküll does not consider organisms as mere objects but as subjects whose essential activity consists of perceiving and acting. Everything that an organism perceives is part of its perceptual world [Merkwelt], while everything that an organism does is part of its operating world [Wirkwelt]. The perceptual and operational world together form a closed unit called Umwelt (Uexküll 2016). In this way, even if the same objects are present in a certain environment, they will not be perceived in the same way by different organisms and will not have the same meaning for them.

The second important Uexküll concept to consider in this context, that is, when it comes to the relationship between an organism and its environment, is that of conformity with a regularity [Planmäßigkeit]. Uexküll calls conformity to a plan the force of nature “that combines multiple details into a whole by means of rules. The higher rules, which unite things separated even by time, are generally called plans” (Uexküll 1926). Elsewhere, Uexküll defines conformity to a plan as “a rule that extends through time and space”, “a rule in living nature, which is revealed even in the mechanical processes of the organism” (Uexküll 1926), and as a super mechanical law ”(Uexküll 1926). Conformity with a regularity is responsible for the creation of all organisms and their Umwelten, it is like the score that presents the “melody”, that accounts for all nature. Ultimately, conformity with a regularity ensures perfect complementarity between the different organisms and their Umwelten.

Through this notion, Uexküll expresses himself against the concept of adaptation. From the point of view of adaptation theory, in fact, “each organism is the product of influences to which it has been exposed for thousands of years” (Uexküll 2010). Through countless cycles of trial and error, organisms reach their proper form, a final product adapted

and congruent to the conditions of the environment in which they are found. Through this look by von Uexküll, multiple possible crossings between the technical medium and those organic materialities that dispense with technological supports are possible to find in a particular geography. If the first moderns provide us with a mechanistic vision of the world through geometrization (Kepler, Galileo, Newton, Descartes among others) and experimental science (Bacon and Boyles), now with cybernetics as the realization and concretization of organicist thought that began to culminate in the late eighteenth century, can we finally end modernity with cybernetics? Do we not already find in cybernetics, and its planetary version, the theory of Gaia, a generic logic that rests on the recognition of the relationship between the living being and its environment?. In this way, in Qatipana these questions are transposed within the Latin American context, raising questions such as: What is the decolonial turn within digital platforms in their algorithmic causal assemblage?, taking into account that the social assemblages that they articulate are, in first, assemblages of the sensible. Taking the notions of Uexküll, we recognize the need to rearticulate the notion of modernity, that is, “the exterior created from the interior” (W. Mignolo 2006), border thinking is an epistemological position that emerges from the colonial difference. Not as the result of rejecting modernity, but of clinging to a thought and feeling rooted in a body situated in the exteriority of modernity (W. Mignolo 2000), Mignolo calls this an “epistemic disobedience”.

Understood as an alternative to this ontogenic explanation, the concept of symbiotic body in Qatipana, in this way can be seen as the transduction of the organism and the machinic environment, this symbiosis, provides a better original (technical) complementary model for the precise reason of which invests in the creativity of the incarnation. Therefore, instead of assuming that technical and living evolution face each other extrinsically, Qatipana bets everything on the intrinsic correlation of the two: machinic environments can become triggers for creative evolution precisely because they are at stake in embodied life., and embodied life can induce modifications of the hybrid environment precisely as a means to intensify itself, to exert its margin of immortality. In fact, if the body and the environment are transductive correlates, they cannot be considered separate from each other, which means that the Qatipana concept of the symbiotic body, taken as a model for the epiphylogenesis of the human being, outlines a return to the original condition. of human technogenesis: the recursion that joins the crust and the Flint. And, based on this original condition, this research proposes to reconstruct a different culture, one that, unlike Stiegler's proposals for technically supported (tertiary) memory, never cuts its links with incarnation as the hinge that connects the body. and the environment, the zoo and the technical. No matter how complex the culture becomes, it will always harbor, at its very core, the symbiotic transduction of life before any further division. That is why an artistic revolution and its relationship with technological media is necessary.

According to Canguilhem, Uexküll reverses the problem of the organism-environment relationship, since he affirms that the characteristic of the living is to create a medium for itself while the study of a living being under experimental conditions is to impose a medium. In short, to ensure harmony and the perfect fit between organisms and their environments, Uexküll advocates the existence of a predetermined world, a world in which the tunnels of life

¹ According to Hui's technodiversity (2020), science and technology should be understood as means to return to life, thinking about the local in terms of knowledge systems, as paths towards true pluralism or “multiple cosmotronics”, to use the Hui's key concept in this context.

are fixed and predestined: "Starting from these immutable factors that determine all life in the world, we come to see that life itself is based on fixed laws, which conform to a plan" (Uexküll 1926).

The Qatipana project advocates a shift from thinking about "new media" as a set of discrete objects to understanding media, old and new, in terms of the interconnected and dynamic processes of mediation. It also describes what is at stake in this change of thinking about the media only as elements within our reach to recognize our entanglement with the media on both a sociocultural and biological level. This argument will lead us to pose the following question: if the media cannot be completely outsourced from the subjects or "users", then how could "we" engage with "them" differently? We must also consider the political and ethical implications of such commitments.

One way to outline these key debates about new media in media, communications, and cultural studies is to draw on the work of philosophers such as Martin Heidegger and Bernard Stiegler to explore the relationship between "media" and "technology" and to advance in a proposition that mediation is an intrinsic condition of being in, and becoming, with, the technological world. From this point of view, a possible hypothesis arises that reveals mediation as the underlying problem and sensibility production agency that operates through bioinformatization, through algorithmic-digital calculations, that is, a machinic individuation process. As the role of this essay is, first and foremost, to provide a theoretical framework (a toolbox with the concepts we work with throughout this essay), it also seeks to distinguish between the question of mediation and the question of media (information). This distinction is primarily heuristic, that is, tentative and pragmatic, and the purpose of separating mediation from the media will be to clarify the relationship between them. Henri Bergson's (*élan vital*) philosophical method of division and reintegration, re-appropriated by Simondon (transduction), is particularly useful for this analysis. This "method" proposes three things: (1) that we distinguish between "true" and "false" problems, (2) that we distinguish between differences in degree and differences in kind, and (3) that we consider the object of our inquiry insofar as to its temporality. This last law, or rule, is the most important to Bergson, and it will be the main means by which we seek to distinguish between means and mediation.

In this section, I would like to qualify, if not effectively correct, that statement by placing its ecological - or, as I would prefer to say, transductive - conception of the "technological body" in the context of recent theoretical debates² on life and its correlation with the concept of human. Doing so will demonstrate that the Qatipana understanding of the incarnation of "the living" is more sophisticated than we previously realized and, consequently, that it is deeply rooted in a comprehensive theory of life.

In his theoretical articulations and practical projects, which remain equally concrete, Simondon foregrounds the original coupling of embodied human life with what the

Macy scientists called the "informational environment."³ As an original supplement, in the transductive correlate of the human body, the information constitutes the basis of any activity that would inform the "epiphylogenetic" evolution of the human being (evolution by means other than life, following the concept of the philosopher Bernard Stiegler). Here I try to analyze the consequences of this radical gesture for our understanding of life, the human and the state of the techniques in / how the union between them. Because if technology, considered as a primary dimension of the living, constitutes the basis of the very existence of the human, we can see the human as a means of "perceptual faculty", under the dual aspect of a generic form and operative ontology (Koch 2019); then it can be expected that the inversion of technology as a means for the intensification of life will have important evolutionary consequences. As has been observed, the purpose of the provocative program in Qatipana will be the constitution of an architecture of "reversible destiny" and its most recent formulation of a "crisis ethic."

Under this purpose, we can take Simondon's thought, and this is his revolutionary contribution to philosophy, one should think of individuation not from the perspective of the individual, but from the perspective of the process that originated it. In other words, individuation must be thought of in terms of a process that not only takes the individual for granted, but is its result.

In Simondon's words:

If one supposes that individuation does not only produce the individual, one would not attempt to pass rapidly through the stage of individuation to arrive at the final reality that is the individual, one would try to understand ontogenesis in all the progression of its reality, and knowing the individual through individuation, rather than individuation through the individual (2009, 5)

Thus, the epistemological problem lies not with how technology leaves the domain of the human in the course of becoming technologies, but with how these processes of 'externalization' (Stiegler 2002) change the very concepts of, for example, number, image, comparison, space, time, or city. However, the anthropological category of "exteriorization" does not fully do justice to these processes, as they operate retroactively and recursively on the original techniques. Along with the concept of the text and the book, the practice of reading has also changed in the course of digitization and the algorithmization of knowledge processing; Along with the concept of comparison, the practice of comparison has changed since it is (for example of images) it has become an operation that is based on data extraction and machine learning. On the other hand, conversely, we must also consider, in an archaeological and mediatic way, the technological state of life as a starting point from which to ask what cultural techniques were used in the first place.

That said, what we can then observe is a completely integral conception of embodied life: one in which life is, from the beginning, a bios, that is, a life endowed with a supplementary dimension, as in supplements. reason or politics that have co-determined the western philosophical conception of the human being. However, the supplement

² For example, we have the Critical Zones sample. The Sciences and Politics of landing on earth at the Zentrum für Kunst und Medien (ZKM), curated in 2020 by Bruno Latour and Peter Weibel, where they discuss a new turn of the "human" in their habitation of the earth and its ecological politics. <https://zkm.de/en/exhibition/2020/05/critical-zones>.

³ Some of these scientists who participated in the Macy meetings (1946-1953), and addressed this topic were Arturo Rosenbluth, Margaret Mead, Gregory Bateson, Heinz von Foerster.

in question in the Qatipana “ecosystem”, in its architecture as such, is not that of reason or its politics, but the supplement of its architecture itself: the original relationship of the “individual” properly speaking with something exterior, with the environment (Umwelt), the transduction of the architectural body itself. If this original relationship forms the basis for subsequent transductive materializations of the body in / and the biosphere, up to the point of knowledge proper (the ontogenetic relationship envisioned at the beginning of this section), its bodily origins indicate an affiliation with that other Greek term. for life, zoe, the root of the same term (zoology) that is considered complemented in the epiphylogenetic evolution of humans and other species.

Conclusions

Recent developments in high-tech fields, such as robotics, nanotechnology, computer science, and the entire spectrum of genetics, bio, and neuroengineering, suggest that contemporary culture is not only on the brink of a new scientific revolution and technology, but is already entering a qualitatively different period in its historical evolution. A distinctive feature of this period is the ultimate exploration of the foundations of living and non-living matter, and the application of discoveries in this field to the physical nature of the human being. This is a radical departure from the past, when the application of technologies was directed primarily to the outside world, not to humanity itself. It seems that never before has the price of such scientific development been so high: humanity is beginning to reform itself according to its own conceptions of its biological structure and evolution.

This research aims to be deliberately global in scope, deals with examples from a variety of systemic, ecological, planetary scenarios and explores the resonances between them to constantly work between theoretical and empirical perspectives in a Latin American context. Although the analysis surrounds our own experiences of the work during the investigation, we do not imagine Qatipana as a report on these commitments. Therefore, it is not surprising that these investigations between art-science-technology, mark new precedents, fascinating and at the same time terrifying, and are considered by experts in the arts and humanities as a subject that requires deep contemplation and analysis. To what extent are particular experiments in this field ethical? What are the prospects for the widespread application of new technologies? What kinds of worlds will they create? These are just a few of the questions that are subject to lively debate in these disciplines.

In the same way, Latin American artists have not been kept out of the public discussion about what is being developed, interpreting in their works both the formal and conceptual characteristics of the new technologies.

One of the best known references in this field is the Chilean Juan Downey, for him, the use of new technologies was as relevant as the questions about the context in which the question about art was posed. On the one hand, Downey is usually mentioned among the pioneers of video art, at the same time as Nam June Paik, but we also see his approach in Chile in 1973, with his work *Anaconda*, when he wants to place a large snake of this type on a map. of the country, representing how the great North American mining company did not accept to lose extractive control. On the other hand, his experience with the Yanomami

people in the Brazilian jungle, living with them to assimilate their ways of representing space, as opposed to the use of the video camera or the western conception of architecture.

In a line that could be defined as close, there are also the explorations of the Argentine artist Luis Bénédict, who since the end of the sixties began a path of exploration between science and art focused on the recreation of the variables of the construction of a habitat as “materials , new techniques, new expressions ”, and “ Microzoo ”. Likewise, at the 1970 Venice Biennale, he presented his work "Biotron", made with the scientists Antonio Batro and José Núñez. Both artists have been implicitly or explicitly associated with cybernetics, representing a time when technique had to take on interdisciplinary challenges, but also strengthen the balance between natural, social and technological aspects.

We believe that digital practices, such as experimental works of art and representations, serve as criticism and have an indirect effect on the social and political, although a redefinition of this term is certainly needed, since they question the very nature of our accepted ideas and belief systems regarding new technologies. In this sense, digital does what all avant-garde art does; it is an experimental extension of the socio-political and cultural aspects of an era. As such, technology would then involve a reconfiguration of our embodied experience. When the body cannot reach its intended meaning, it builds its own instruments and projects a mediated world around it. From this point of view, it would be plausible to compare the techno-socio-epistemic historical processes that Latin America went through since the conquest, the Andean peoples have known how to Andean a large number of techniques originating in Europe, to integrate them into their system, without undermining their identity, while keeping unity systemic and its logical cohesion. However, this “enriched” Andean technology is no longer handled purely or exclusively, but partially, and together with a growing number of technical elements originating from modern Western technology. In fact, now "modernization" often means des-andinization and Westernization of technology. Halogen technical elements are penetrating more and more rapidly and in numbers in the Andean countryside. This process is so violent and accelerated that the selective adoption, its andeanization and the integration of these elements in the Andean system, become impossible. The peasant handles them as a risky and strange alternative to the system.

By way of conclusion, we can elucidate that human evolution is inseparable from the evolution of *téchne*, the evolution of technology. One cannot simply think of the human being as a natural animal, isolated from the external material world. What he becomes, and what he is, he is essentially tied to techniques from the beginning. Leroi-Gourhan, tells us about it in his text "The Gesture and the Word": "The appearance of tools as a species [...] characteristic that marks the border between animals and humans" (1971 p. 90). It is in this context precisely where we can give life to the Qatipana symbiosis, an ontological cross between the artificial and the natural, from the particular to the universal, whose communication extends to the informational and energetic plane (Filinich and Chibey 2020). And he opens us to the question, where do we have to recognize Latin American diversity; so that later we can develop it further?.

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Forging Emotions: A Deep Learning Experiment on Emotions and Art

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Abstract

Affective computing is an interdisciplinary field that studies computational methods that relate to or influence emotion. These methods have been applied to interactive media artworks, but they have been focused on affect detection rather than affect generation. For affect generation, computationally creative methods need to be explored that lately have been driven with the use of Generative Adversarial Networks (GANs), a deep learning method. The experiment presented in this paper, *Forging Emotions*, explores the use of visual emotion datasets and the working processes of GANs for visual affect generation, i.e., to generate images that can convey or trigger specified emotions. This experiment concludes that the methodology used so far by computer science researchers to build image datasets for describing high-level concepts such as emotions is insufficient and proposes utilizing emotional networks of associations according to psychology research. *Forging Emotions* also concludes that to generate affect visually, merely corresponding to basic psychology findings, e.g., bright or dark colors, does not seem adequate. Therefore, research efforts should be targeted towards understanding the structure of trained GANs and compositional GANs in order to produce genuinely novel compositions that can convey or trigger emotions through the subject matter of generated images.

Keywords

Deep Learning, Affective Computing, Visual Emotion Datasets, Generative Adversarial Network (GAN).

Introduction

The notion of emotion, as we understand it today, was established through scientific research in various disciplines. Emotions have been studied from the perspective of various disciplines, including psychology, neuroscience, sociology, medicine, history as well as computer science. As a result, the question "*What is an emotion?*" will rarely generate the same answer from different scientists or individuals [1]. This is primarily due to the different basis of the emotional phenomena or theoretical issues studied from every discipline. The main questions asked for emotions are: where they originate, what physiological, behavioral, and cognitive changes they produce, what are the different expressions (e.g., facial) they induce, and what are the subjectively experienced feelings.

Emotions also have a long-standing relationship with art. Baroque art intended to appeal to the senses and emotions. Romanticism rejected the formality of Neoclassicism and, instead, embraced emotion. In Expressionism, artists depicted the world with distorted images to express their own feelings. Many theories of the expression and experience of emotion in art exist [2].

Katja Kwastek [3] has studied the aesthetic experience of the recipient in the case of interactive media artworks, which too often includes the arousal of emotions. In non-interactive works, the recipient's emotional experience is staged in the past tense; either an artist represents the emo-

tions he/she has experienced or plans the desired emotional experience for the recipient, albeit it is mostly subjective. In contrast, interactive media artworks are located in the present tense. However, as Kwastek notes, even if the interaction process leaves scope for the unexpected, the orchestration of emotional experiences is designed in an even more explicit manner since feedback processes have to be programmed into the technical system implementing the artwork.

Consequently, affecting computing methods become extremely pertinent for orchestrating emotional experiences in interactive media artworks. However, affective computing research is, to a large extent, concentrated on detecting rather than on generating or triggering emotions. Accordingly, interactive media artworks that consider affective computing methods also mainly utilize them for affect detection.

If the problem of affect generation is considered, then computational creativity methods need to be explored, which most commonly involve Generative Adversarial Networks (GANs), a deep learning method. When considering the generative process of GANs, and more importantly, when they are intended to generate affect, the utilized training image datasets are of crucial importance.

The experiment presented in this paper, *Forging Emotions*, explores the use of visual emotion datasets and the working processes of GANs for visual affect generation, i.e., to generate images that can convey or trigger specified emotions. It appears that researchers attempting to build visual emotion datasets have almost reached a consensus on the most appropriate methodology for that purpose. Their methodology consists of querying social media for tags with words for emotions (e.g., anger, disgust, fear, sadness) to collect images. A validation procedure is then performed where quite a large number of people confirm if the emotion tags are correct. *Forging Emotions* aims to confront the idea that querying social media with a single word can result in a set of images that truly visualize what an emotion is. Moreover, it aims to question the validation procedure utilized to account for the subjectivity of emotions. Finally, it aims to explore the working processes of GANs for visual affect generation and which visual aspects of the generated images are able to convey or trigger specified emotions.

Background

Affective Computing

Research in affective computing is mainly focused on building systems that can respond and adapt to human emotions [4]. Such systems first need to be able to detect human emotions. For this reason, a great variety of sensors have been developed that can monitor physiological signs that are later utilized for recognizing emotions. The modalities of facial expressions, body gestures, and speech have also been used for recognizing human emotions.

When detecting emotions, it is most common that Paul Ekman's basic emotion theory [5] is utilized, suggesting that all emotions can be derived from a limited set of universal and innate basic emotions. Therefore, the following six basic emotions are considered: anger, disgust, fear, happiness, sadness, and surprise. It is also common that another seventh neutral emotional state is added. Additionally, there are cases where a few other emotions are considered, such as anxiety, excitement, calm, and lust, among others. More recently, two-dimensional models of emotion have gained interest. One very commonly used two-dimensional emotion model is the valence and arousal model [6]. This model proposes that all affective states can be understood as varying degrees of valence (a pleasure – displeasure continuum) and arousal (activation – deactivation).

To a large extent, affective computing research focuses on detecting rather than on generating or triggering emotions. A considerable body of research on affect generation involves synthesizing human-like expressions of emotion through facial features, speech, and gestures for virtual characters and robots [4]. Affective games are a sub-field of affective computing that studies how the gameplay can be adapted according to players' emotions and how emotions can be triggered [7]. Nevertheless, affective games currently adapt to or trigger emotions by design rather than with computational methods.

In conclusion, research on generating affective triggers is highly unexplored. Accordingly, interactive media artworks that utilize affective computing methods also mainly consider affect detection rather than affect generation.

For example, the work *Chameleon* (2008/2010) by Tina Gonsalves recognized the audience's emotional state, using a facial expression detection system, and classified it to one of the six basic emotions as defined by Ekman [5]. Then, the detected emotions were sent to the video engine that triggered videos from the new corpus Gonsalves created to empathize with the audience's emotional state [8]. Gonsalves created her own facial emotion dataset that was "*more dynamic and aesthetic, engaging and emotionally probing.*" Gonsalves' experience working with affective computing methods and visual emotion datasets led her to the conclusion that emotions expressed and monitored in laboratories for scientific research "*don't often correlate to the emotions that form the fabric of our everyday lives.*" She also notes: "*There seem to be limited emotions being explored, visually underwhelming databases being used, and the non-ecological settings such as the lab to test responses [...] using small groups of subjects with narrow representation, what does the knowledge that science is building about emotions actually mean?*".

Deep Learning Methods

Computational Creativity is a field that has lately regained much interest with the advent of Generative Adversarial Networks (GANs) [9], a deep learning method. If the problem of affect generation is to be considered, then the processes involved in GANs have to be explored. In music, there is the field of affective algorithmic composition (AAC) [10], where an intended affective response always informs the algorithm for music composition. There are many successful applications of GANs within the field of AAC. However, visual affect generation, that is, to generate new images that intend to convey or trigger specific emotions, is still unexplored.

GANs have already been explored by artists, for example, Anna Ridler [11] and Mario Klingemann [12], but not for visual affect generation. One of very few works in the literature that considers the generation of artworks that convey a specifically defined emotion is by David Alvarez-Melis and Judith Amores [13]. In this work, a GAN was

trained on 13,000 images of modern art paintings that were emotion-labeled. Alvarez-Melis and Amores concluded that their approach was able to generate artworks with high-level emotional features that agree with psychology literature; for example, red for anger, dark colors for sadness and fear, as well as images that resemble natural landscapes for joy.

GANs have already exhibited the ability to generate images that are hard to distinguish from "real" ones. One of the most well-known GANs is the one developed by NVIDIA to generate new face images that are hard to identify as images not of real people [14]. Additionally, approaches for synthesizing facial affect have also been presented in the literature [15].

However, in most cases, GANs have successfully generated images of objects or concepts that are quite specific in form and structure, e.g., human faces, dogs, landscapes, and others. As a result, the utilized training datasets are comprised of highly similar images. For example, the NVIDIA training dataset includes only photographs of human faces that are also automatically aligned and cropped.

Nevertheless, when higher-level concepts are considered, such as the whole notion of emotions, without being limited to facial expressions, it still remains a question of how to create a suitable training image dataset that could be later used with GANs to generate new affective images, i.e., images that convey or trigger a specified emotion.

Visual Emotion Datasets

Most datasets used for visual emotion analysis are targeted towards applications for affect detection. Even if the problem of visual affect generation is considered, a similar visual emotion dataset is also required for the system to learn how to generate affective images. For that purpose, in the following, the most commonly used visual emotion datasets are summarized. It should be noted that this discussion will not include datasets of facial expressions that are beyond the scope of the presented experiment *Forging Emotions*.

Emotion researchers have constructed quite a few visual emotion datasets. They commonly define specific categories of images according to their research questions and then hand-select images. The International Affective Picture System (IAPS) was designed to provide a standardized set of pictures for studying emotion and attention and was developed by the National Institute of Mental Health Center for Emotion and Attention at the University of Florida [16]. IAPS is the most widely used visual emotion dataset in hundreds of behavioral and neuroimaging studies. It includes over 1,000 images depicting people experiencing various emotions (e.g., sad, fearful, angry), erotic couples, funerals, dirty toilets, cityscapes, landscapes, wars and disasters, mutilated bodies, baby animals, and many more. Other visual emotion datasets constructed by emotion researchers are the Geneva Affective Picture Database (GAPED) [17] with 730 images and the Nencki Affective Picture System (NAPS) [18] with 1,256 images. In the GAPED dataset, images of spiders, snakes, and scenes of moral or legal violations were selected for negative images, whereas for positive images, mainly humans, animal babies, and landscapes were used. Images in the NAPS dataset belong to five broad categories: people, faces, animals, objects, and landscapes. The "object" category is a very broad class in which a wide range of clearly visible objects, foods, or vehicles were depicted without humans or animals present. Pictures in all categories included stimuli for different emotions. For example, images in the "people" category included alive, injured, or dead human bodies. In all the above-mentioned visual emotion datasets, images were evaluated on valence and arousal.

Computer scientists also have built visual emotion datasets. Mikels et al. [19] created the Subset A of IAPS (IAPSA) by selecting 395 pictures from IAPS and then categorizing them into eight discreet categories (anger, disgust, fear, sadness, amusement, awe, contentment, and excitement) by conducting a user study. Machajdik and Hanbury [20] created another dataset of 807 artistic photographs downloaded from DeviantArt, an online social community for artists and art enthusiasts. The same eight basic emotion categories were also used in this dataset. The associated emotion for each image was the label given by its owner on DeviantArt. A more recent dataset is the Open Affective Standardized Image Set (OASIS) [21]. It contains 900 images, collected using the Google Images search engine, depicting a broad spectrum of themes, including humans, animals, objects, and scenes. Each image was rated on valence and arousal by recruiting participants through Amazon's Mechanical Turk (MTurk).

You et al. [22] aimed at creating a large visual emotion dataset and remark that all the previously mentioned datasets are significantly smaller than those used for other computer vision tasks. For example, the ImageNet dataset [23] used for object recognition as well as image generation with GANs contains more than 14 million images. Hence, You et al. collected over 3 million images from Flickr and Instagram labeled with one of the eight basic emotions. Furthermore, they also employed MTurk to verify the emotion labels associated with images. Finally, the created dataset contains in total over 23,000 images with verified emotion labels, which currently is the largest visual emotion dataset available.

This discussion on visual emotion datasets can conclude that computer science researchers generally turn into online resources, and more often, to social media, to collect images associated with emotions with single-word queries. Then, most commonly, MTurk is employed so that many different people validate the emotion conveyed or triggered by each image. Thus, it seems that researchers in the field have almost reached a consensus on the most appropriate methodology, and what remains to be completed is to build a vast visual emotion dataset that would contain millions of images.

Forging Emotions

It is uncertain that the previously described visual emotion datasets can genuinely visualize how emotions are experienced or evoked. An emotion is not just a word, such as the ones used to query social media, but a network of associations. According to psychology research, each individual relates an emotional percept or event in many different ways to a multitude of past emotional experiences [24]. The basic idea is that, for example, the emotion of happiness is not just a word but a concept that can be represented by a network with nodes of past emotional experiences. Thus, the network of happiness could include nodes for the emotional experience of a child being born, a vacation, being with friends and family, and many more. Everyone experiences emotions differently, and thus emotional networks of associations are individual, i.e., each individual may have different emotional experiences related to happiness. However, according to psychology literature, emotional networks share a common basic structure for most people [24].

Forging Emotions aims to confront the idea that querying social media with a single word can result in images that genuinely visualize how emotions are experienced or evoked. Moreover, it seeks to question the process of employing MTurk to account for the subjectivity of emotions. For that purpose, two new image datasets were created by

querying Instagram with the hashtags #sad and #happy. The collected images were not verified in any way.

All the previously mentioned visual emotion datasets do not consider the emotion of happiness, although it was included in the six basic emotions originally introduced by Ekman. In social media behavior studies, it is often concluded that one always tries to appear attractive, happy, and clever [25]. In the context of the *Forging Emotions* experiment, it seems like a paradox not to explore the happy emotion while social media are utilized to understand emotions. The #happy dataset poses the question of whether this is the emotion that can be better understood from social media data or if shared emotional experiences on social media are authentic.

This experiment also aims to test whether new images can be composed that visualize and evoke the emotions of happiness and sadness, or in some manner can "forge emotions", which relates to commonly naming the generator component of a GAN a "forger." Thus, the experiment was named *Forging Emotions*.

GANs have been successfully applied for generating new images of human faces, dogs, landscapes, and many more. However, the criticism that follows the use of GANs is that they are not interpretable, and they are often considered black boxes. Consequently, interpreting and understanding what a GAN has learned is an active research topic within Explainable Artificial Intelligence (XAI) [26], which has gained much interest lately. In the recent work of Bau et al. [27], the aim was to understand if a GAN learns composition or if it purely memorizes pixel patterns. The conclusion was that GANs indeed learn aspects of composition and that certain neuron units have learned specific features of the taught domain.

Another exploration strategy for interpreting and understanding deep learning models is the black-box exploration. In this type of exploration, only the training dataset and the deep learning model's output are used to examine its behavior and provide insight into its interpretations [28]. This approach is similar to the one Ridler [11] describes in which she used GAN images as a mirror to her own drawing process.

In this respect, *Forging Emotions* will also perform a black-box exploration to understand what a GAN has learned when trained with a visual emotion dataset.

Experiments

The experiments were performed with the implementation, and the proposed architecture guidelines, for stable Deep Convolutional GANs (DCGANs) [29]. The training images were not pre-processed, except scaling them to the range of the tanh activation function [-1, 1]. All models were trained with mini-batch stochastic gradient descent (SGD) with a mini-batch size of 64 for 100,000 epochs. All weights were initialized from a zero-centered normal distribution with a standard deviation of 0.02. In the LeakyReLU, the slope of the leak was set to 0.2 in all models. The Adam optimizer was used with a learning rate of 0.0002. Finally, the momentum term β_1 was set to 0.5. The images were generated at a 64x64 pixel resolution. In all the following experiments, the DCGANs were trained with the same parameters and for the same number of epochs.

Forging Sadness

Initially, the image dataset created for the *Forging Emotions* experiment with 30,000 Instagram images that include the hashtag #sad was used to train the DCGAN. Then, new images were generated and are shown in Figure 1. The same procedure was followed for the dataset created

by You et al. [22] for the emotion of sadness, which included 2,635 images. The images generated in this case are shown in Figure 2.

It can be observed that all the generated images shown in both figures are, in some way, reminiscent of abstract paintings. In both cases, some images would seem like abstract human figures or, in other cases, abstract landscapes or cityscapes. In Figures 1 and 2, it can be noticed that there are more images with dark colors, which is in line with psychology literature that generally associates dark colors with unpleasant emotions. A distinct differentiation is that Figure 1 includes more images that look like text which is due to the different types of images included in the two utilized training datasets.

The dataset utilized for generating the images shown in Figure 2 was validated by humans and mainly consisted of images depicting humans with facial or body expressions of sadness. The dataset for sadness created by You et al. also included quite a few images of pets. Other types of images constitute only a tiny proportion of the dataset and include text images, graves or graveyards, dead flowers or plants, winter landscapes, etc. The You et al. dataset [22] included only 2,635 images for the emotion of sadness, and it is evident that a significantly larger dataset is required for the GAN to be able to generate less abstract images.

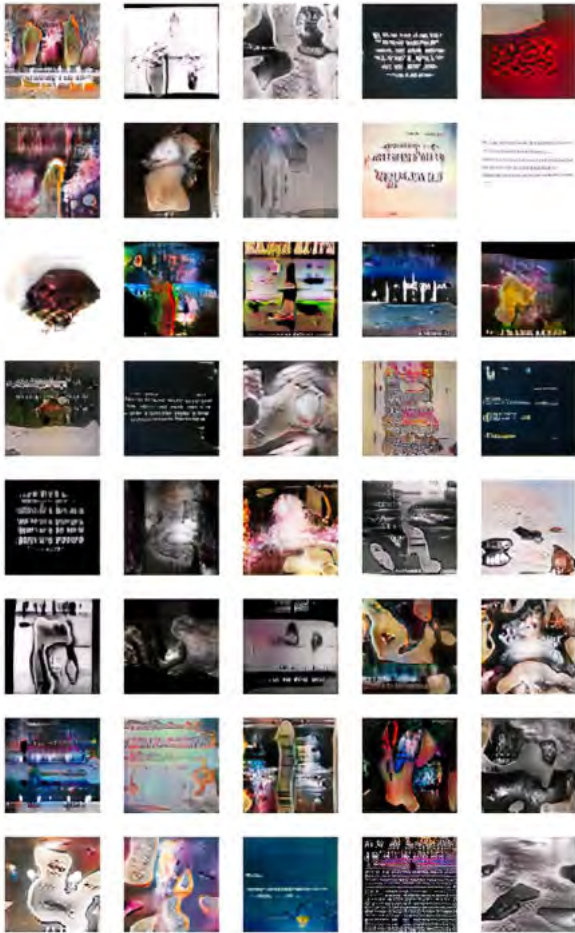


Figure 1: The DCGAN generated images when trained with 30,000 Instagram images with the hashtag #sad. (Full-size image available at <https://pasteboard.co/JKcqhxo.png>)

On the other hand, the image dataset collected for the *Forging Emotions* experiment included predominately text images. Our dataset also included many images depicting humans, pets, dead plants, and winter landscapes. Additionally, it included images of comics, movie stills, bad food, and other types of images that were not present in the dataset by You et al. [22]. Finally, since the sadness dataset

created for the *Forging Emotions* experiment was not validated, it included some images that were not associated with the emotion of sadness but rather with the meaning of the word sad for characterizing something as inadequate or unfashionable.

Nevertheless, it becomes evident that collecting social media images with single-word queries cannot guarantee that the whole range of how people experience emotions can be included. For example, we cannot find any images for sadness in either of the two considered datasets that depict, for instance, funerals, wars, disasters, or mutilated bodies, as was the case in the IAPS dataset created by emotion researchers. Moreover, it is most probable that such images would be removed, even if they were posted on social media, due to their policies in order.

In conclusion, although the employed validation method with MTurk ensures that some irrelevant pictures would be removed from the dataset, it cannot accommodate for the fact that several aspects of how sadness is experienced are missing. Social media users' behavior, along with emotion research, should be further studied to identify multiple image sources and the emotional networks of associations that constitute how emotions are experienced. Finally, significantly larger datasets should be built for training GANs.

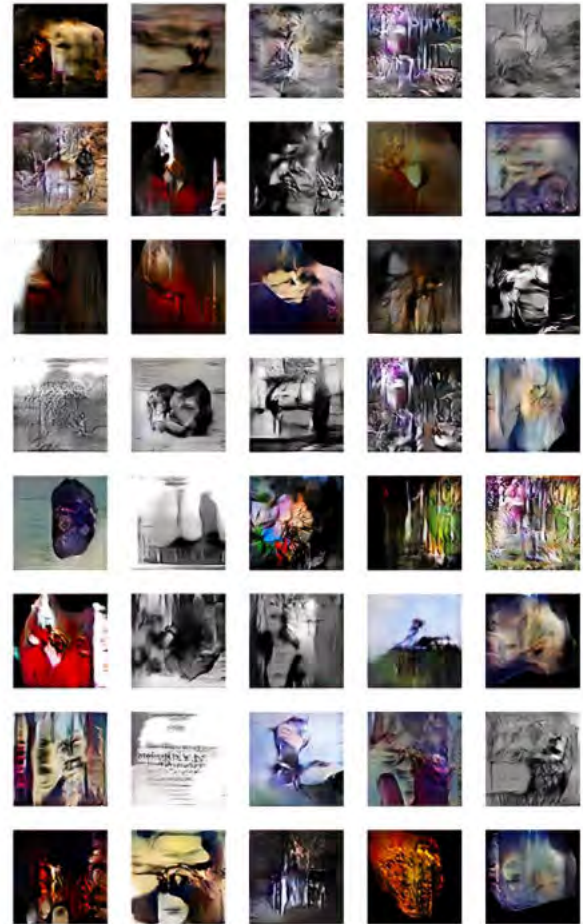


Figure 2: The DCGAN generated images when trained with the image dataset created by You et al. for sadness. (Full-size image available at <https://pasteboard.co/JKcpdeQ.png>)

Forging Happiness

Another DCGAN was trained using the image dataset created by collecting 30,000 Instagram images that include the hashtag #happy, and the generated images are shown in Figure 3.

Again, all generated images are reminiscent of abstract paintings, including abstract human figures, landscapes,

and cityscapes. Images in Figure 3 have noticeably brighter colors than those in Figures 1 and 2, which is also in line with psychology literature that generally associates bright colors with pleasant emotions.

Instagram users post a greater variety of images when they use the hashtag #happy. They also post many pictures depicting humans but similarly many images with luscious food, photos from vacations that include landscapes and cityscapes, images showing an object of desire, babies, and many more.

Even though the whole range of how people experience happiness is still not included in the collected images, what becomes more evident in this case is that it is questionable that the generated images can visualize or trigger the emotion of happiness. Generating images that merely correspond to basic psychology findings, e.g., bright colors like in the work of Alvarez-Melis and Amores [13], does not seem adequate for visual affect generation. For example, although the red color is generally associated with anger in psychology findings, this is not always the case. In an image depicting a natural landscape at sunset, the sky is often red, and it would trigger positive emotions for many people.

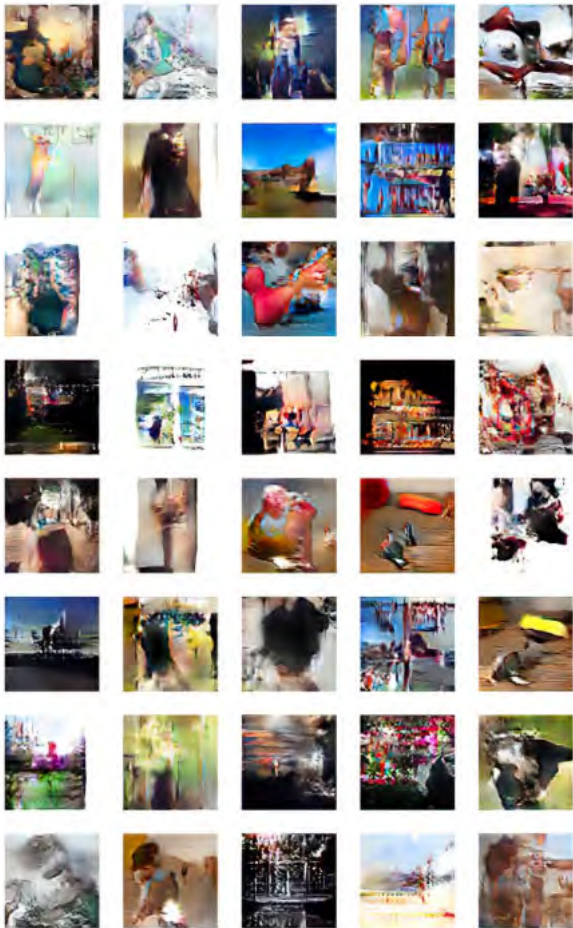


Figure 3: The DCGAN generated images when trained with 30,000 Instagram images with the hashtag #happy. (Full-size image available at <https://pasteboard.co/JKcrJO2.png>)

The two first images on the second row of Figure 3 quite clearly depict women posing. These images were generated because the #happy dataset included many images posted by women posing with their new clothes or in other cases posting selfie images to state that they are hap-

py for various reasons. Accordingly, the third image on the second row of Figure 3 depicts a natural landscape like the ones often posted on Instagram from vacations. However, as exhibited in the case of the *Forging Sadness* experiment, significantly larger datasets should be built for training GANs that include more aspects of how happiness is experienced.

More importantly, recent research efforts on understanding the structure of trained GAN could shed light on the different features learned from visual emotion datasets. This knowledge could be applied towards training compositional GANs that could create genuinely novel compositions and combine different elements from different types of images. Thus, the subject matter of generated images would be better directed for visually generating affect.

Conclusions

The experiment *Forging Emotions* was doomed to fail in its initial set goal to generate new images that convey or trigger the emotions of happiness and sadness. Nevertheless, its execution allowed us to draw two main conclusions and instigate research on the identified issues. First, the methodology used so far by researchers to build datasets for describing high-level concepts such as emotions is not sufficient. This conclusion is also in line with the comments artists made while working on affective computing methods; for example, the issue raised by Gonsalves on whether the datasets used in scientific research, especially in the case of emotions, can really "*correlate to the emotions that form the fabric of our everyday lives,*" remains unresolved. It seems that the collected images based on single-word queries can indeed generally be characterized as related to an emotion such as happy or sad, but not able to describe the full range of the emotional experience of happiness or sadness. It would appear as a more appropriate methodology to first explore a network of associations for an emotion that describes the emotional experience rather than just the name of an emotion. Additionally, a greater variety of online sources should be considered rather than only social media. Finally, the contribution of artists in the creation of visual emotion datasets would be most valuable.

The last conclusion of this experiment is that for visual affect generation, research efforts should be targeted towards better understanding the structure of trained GANs and compositional GANs. GANs, in many cases, are able to understand the different elements used to compose, for example, a scene. If visual emotion datasets are built according to emotional networks of associations, they will comprehensively visualize how each emotion is experienced. Then, methods and frameworks for understanding and interpreting GANs will shed light on the different features learned from visual emotion datasets. This knowledge could be applied to train GANs that can create genuinely novel compositions and combine different elements from different types of images. Thus, not only the colors but also the subject matter of generated images will be better directed for visually generating affect.

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Spatial Photograms: Experimental Cyanotype Photography using 3D Scanning and Printing Technologies

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Abstract

This paper discusses contemporary forms of photographic representation of space and, at the same time, new possibilities of making an objective spatial. Structured in two parts, it articulates an alternative model of photographic space in the form of a *Spatial Photogram*. We propose a novel photographic practice, based on traditional pre-photographic image-making and today's digital image methods.

In the first part, we analyze the cultural-artistic context of the historic developments in photography to articulate an objective image of space through comparing the movements of Functional Aesthetics and Neue Sachlichkeit (new objectivism) with the pre-photographic practices of camera-less photography – the photogram.

In the second part, we discuss the technical setup in the making of a *Spatial Photogram* focusing on comparing 3D printing and scanning methods, as well as the making of transfer tools between the digital methods and the chemical-based analogue cyanotype printing.

The result is a material-based image that introduces space as a density – a completely new method to articulate a representation of space in the context of photographic objectivism.

Keywords

Alternative Photography, Photography, 3D printing, 3D scanning, Cyanotype, Neue Sachlichkeit, Digital Craft

Introduction

'Photographs are a way of imprisoning reality...One can't possess reality, one can possess images--one can't possess the present but one can possess the past.'[1] We cannot possess a space, but we can make a representation of space – a photograph of that space. What we can have in a photograph of space is the visual experience and representation of that particular space.

In the first part of this research, we will contextualize the problem of spatial representation using photography and how historically, photography has developed methods to achieve objectivity towards the representation of space. We have structured this contextual critique into the elements of the camera – the aperture, the lens and the film. This part of the research articulates a conceptual framework to position the research in a lineage of experimental photography that aims to articulate the merit of art and science of photography.

In the second part, we will analyse the technical making of the spatial photogram, using 3D scanning and 3D printing to rearticulate the lens and aperture of the camera and cyanotype-based printing to work with a new and old type of medium. We demonstrate this new technique through two test pieces, both articulating the notion of a material-based image-making process, combining digital methods of contemporary image making with traditional chemical, analog methods.

Critical Context

The Aperture – Function Aesthetic

Functional Aesthetic is a concept *'Founded in reaction to soft-focus pictorialism and East Coast hegemony'* [2]. In particular, the group f.64, founded by Preston Holder and Willard Van Dyke in Oakland, California, are known for ultra-sharp photography as they shot with small apertures. The group promoted the notion of de-coupling the subjectivity of the image-maker to the space through diminishing the depth of field in the images.

Their photographs capture the sceneries with ultimate sharpness in what was coined then – an objectivist style. *'Objectivism focuses on the relation of the individual to a universe of objects, and the more or less subjective or objective attitude toward that relationship which the artist demonstrates.'* [3] And while this suggests the notion that the camera is used to create an objective image of scenery, the f.64 movement clearly stylized a view of nature through

idealizing angles and dropping horizon lines – reverting back to an inclusive Romantic acceptance of Nature [4]. The group f.64 focused only on the aperture as a tool to increase objectivity in the image-making, while at the same time using image manipulations such as contrast amplification of the print, or dodging shadows to create spectacular images that we cannot see with our naked eyes. And thus, the notion of objectivism, while, in contrast to the soft-focus pictorialism before in American landscape photography is correct, is confusing when discussing the notion of the true objectivism of the camera and the spatial image.

The Lens – Neue Sachlichkeit

‘Neue Sachlichkeit’ or new objectivity, a movement that started in the 1920s, is well known for rejecting expressionism, and articulating unsentimental, scientific representation of the world. Karl Blossfeldt, one of the founders, used special homemade cameras to dramatically magnify parts of plants, first as teaching tools and later, referencing the seminal work of Ernst Haeckel, a new form of aesthetic objects through gallery exhibitions and eventual publication of his version of Haeckel’s publication *Art Forms in Nature* [5].

Later, Bernd and Hilla Becher used special large format cameras, to avoid distortions of a normal lens when photographing industrial architectures of West Germany. The resulting images have transformed the photographic relationship to space as subject and object – in what Charlotte Cotton observes as the deadpan aesthetic: a dispassionate, patient, keenly sharp version of photography [6]. The relationship to Blossfeldt is clear, isolation of the object of study from context, removal of lens distortion, and any image enhancements – resulting what Sean O’Hagan, the photography critic for the British newspaper *The Guardian*, observes that “*the Bechers approached photography the way a botanist might approach the cataloguing of flora and fauna.*” [7].

The nature of photography with a lens is one of transformation of spatial representation. Even if deducted to the point of the deadpan aesthetics, it is not objective – might not need to be. How to remove the image perspective altogether, returning to Ernst Haeckel’s blueprints in the *Art-forms of Nature*?

The Film – Chemical Objectivity

In 1843, British photographer and botanist Anna Atkins made a series of cyanotypes of British algae [8]. The images show the silhouettes of the plants by placing the algae on a prepared cyanotype paper and exposing it to ultraviolet (UV) light. Not only do Atkin’s photograms preserve the silhouette of the plants, but also present some qualities such as the material density and translucency of the botanics. Her images, and cyanotype photography in general, a form of what Mike Ware calls alternative images [9], explore the

possibility of camera-less photography as a means to reconstruct a decentralized visualization through a controlled chemical reaction. The gradient and thus intensity of the cyanotype, either lightening or deepening the Prussian blue, articulates an objective chemical image closer to the notions of planar projections such as elevations in architecture.

Therefore, in the context of traditional lens-based photography, excluding extended photographic methods such as Stereoscopy, we put forward the hypothesis that space can be recorded objectively. Such a photographic representation of space can only be made without perspectival distortion or aesthetic manipulations, and thus cannot be made using lens-based photography. Instead an objective, constructed spatial representation is possible using cyanotype printing, if the space itself can be physicalized using 3D scanning and printing technologies. The result then can extend the comparison from two- to three-dimensionality – where the 3D scan and print today might still yield the decline of ontological originality from the actual object. [10]

Methods and Practices

As discussed, works from the f.64 group and Neue Sachlichkeit attempted to introduce spatial objectivity with cameras and failed on various levels – due to the subjectivity of the camera as such. At the same time, photographers such as Anna Atkins could objectively capture objects with camera-less photography. However these works can only be of physical objects, which act as a sort of lens and aperture at the same time, controlling the chemical image-making process. Thus, we offer that, if space itself is transformed into a physical object, with differentiating gradients of corresponding translucencies, a spatial version of the photogram, a Spatial Photogram can be created. Furthermore, seeing such a camera-less spatial image in the context of the notion of an objectified space as discussed by Sontag, we aim to create an objectivism that photographers from f.64 and Neue Sachlichkeit were not able to realise, as the technological developments of 3D scanning and 3D printing did not exist back then.

First, we used 3D scanning since it is the only way we can capture space digitally without distortion. Afterwards, we used 3D printing to articulate the digital 3D scanned data into a physical object. Therefore, the framework of this project is based on scanning an interior space, and the transformation of the 3D scanned data into a 3D printable model. The 3D printed model of the scanned space acted, similar to the algae in Anna Atkins’s practice, as a lens and aperture at the same time. This is due to the materiality of the model as well as the arrangements of the 3D data sets. In the following parts of the research, we will elaborate on the specification of this workflow and the particulars of the 3D print materials, the methods of digitally transforming the scanned space, and the chemical transfer methods we used and partially invented in this process.

3D Scan & Subdividing Space

The first task in the project was to find an appropriate way to create a digital, and later on, 3D printable data model. We experimented researched two 3D scanning methods. On the one hand, laser imaging, detection, and ranging (LiDAR) is a precise method to record a space, on the other photogrammetry using a series of photographs is a more cost efficient and versatile technology.

After comparing photogrammetry and LiDAR scanning, we found that although LiDAR scanning can achieve a high-quality surface model in a short period, the outline of the LiDAR scanned model is not as detailed as the one scanned with photogrammetry [11]. Considering the resolution of the scan, we chose photogrammetry as the method to 3D scan a domestic interior space (Fig.1).

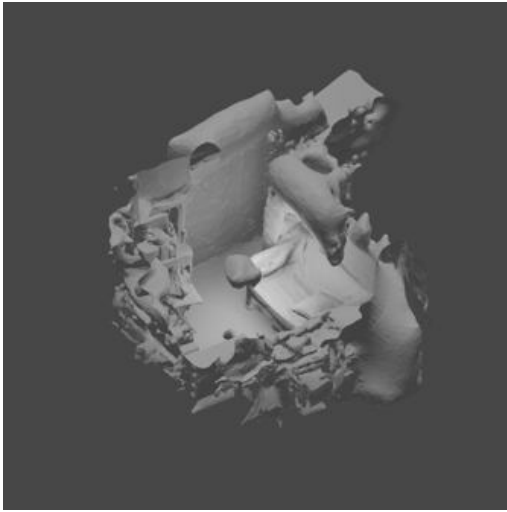


Figure 1. A rendering of the scan of an interior. (© the author. Photo: author)

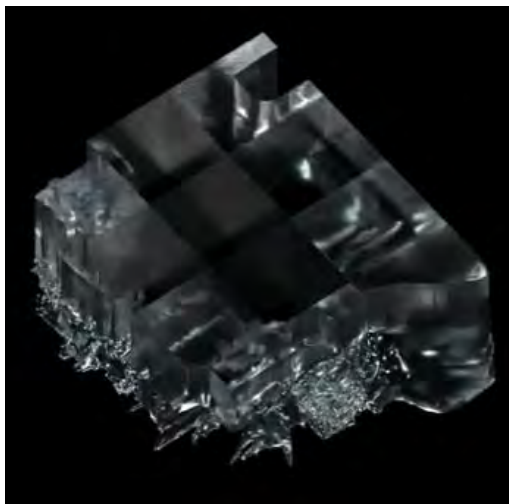


Figure 2. A rendering of the subtractive model in a diagonal orthographic view (right). (© the author. Photo: author)

After importing and preparing the scanned model, we built twelve cubic polys to subtract the scan with Boolean calculation for a negative cast of the scan (Fig.2). In the Boolean calculation, the mesh for subtraction (which is the scan in this case) must cut through the polygon to be subtracted (which is the blocks we built in this case). However, the height of the scan is uneven. It is impossible to subtract one big polygon with the scan. Therefore, we subtracted the scan with multiple polys to be able to create a sort of negative cast of the scanned space.

This method is inspired by the trapezoidal rule used to estimate the area of a definite integral in calculus. When a formula cannot be integrated, the trapezoidal rule helps estimate the value of the definite integral. Trapezoidal rule is a method to subdivide the area beneath the curve into different trapezoids. Then we could add the area of all trapezoids to get the approximate value of the definite integral. We appropriated this method to create a negative cast of the scan. In this method, the more blocks we use, the higher the accuracy of the final negative model. We decided to use twelve blocks in different heights for the Boolean calculation. After the calculation, we unified the height of the polygons and combined them.

3D Print & Materials

The second step, after preparing the 3D scan data, is 3D printing. The aim was to find a printing method and material that would allow us to create very thin and at the same time chemically stable, translucent 3D prints. Additionally, considering the use of UV light in cyanotype printing, the 3D print would need to be stable in UV light environments. Photosensitive polymer used for Digital Light Processing (DLP) or Stereolithography (SLA), one of the most commonly available methods, absorbs UV light continuously and degrades over time. Specifically, the polymers for SLA printing, such as thermoset acrylate (TSA) oxidizes and deteriorate after UV exposure, with *“the ether group appears to be the most sensitive to photooxidation, with a 50% loss after only 200h.”* [12] Seeing the degradation of the photosensitive materials used in DLP or SLA printing, we considered Selective Laser Sintering (SLS) printing as a method to print our model. However, the surface of an SLS printed object turned out to be too porous and rough, which negatively affected the printing result of the cyanotype. We found that compared to Digital Light Processing (DLP) or Stereolithography (SLA), the Fused Deposition Model (FDM) printed models with polylactide (PLA) filament are structurally stable under UV light exposure and at the same time, produced when using a very fine nozzle for the extrusion, a smooth surface that would not impact on the cyanotype print.

Since cyanotype is an analog photographic printing process, the results are dependent on the quality of the material and the light source. To ensure the stability of the experiment, we used only cyanotype-related chemicals from Bostick and Sullivan, and Fabriano's Artístico series watercolor paper as recommended in *Cyanotype: The Blueprint in Contemporary Practice*. [13] As the strength of the natural UV source – sunlight is not stable for printing, we used an artificial light source for the experiments. According to the scientific report from the University of Southern Queensland, UV light with 370nm wavelength is the weakest light for fully activating an unexposed cyanotype emulsion. [14] Although 330nm to 300nm UV light is the most effective light source for cyanotype printing, we chose UV light tubes emitting 360nm UV light in this cyanotype project – a choice that was dictated by the availability of UV light tubes in the market.

Calibration for material-based Images

In a traditional photogram, the images do not depict the correlation between the thickness of the object and the color intensity of the image. In order to discover the relationship between the thickness of the PLA model and the color intensity of the cyanotype print, we build a gradient map model from 0.1mm to 10mm, where the interval between each step is 0.1mm. The model contains 100 frames and 1 slope, which is bounded by four blocks to prevent refraction from the peripheries of the model. (Fig. 3)

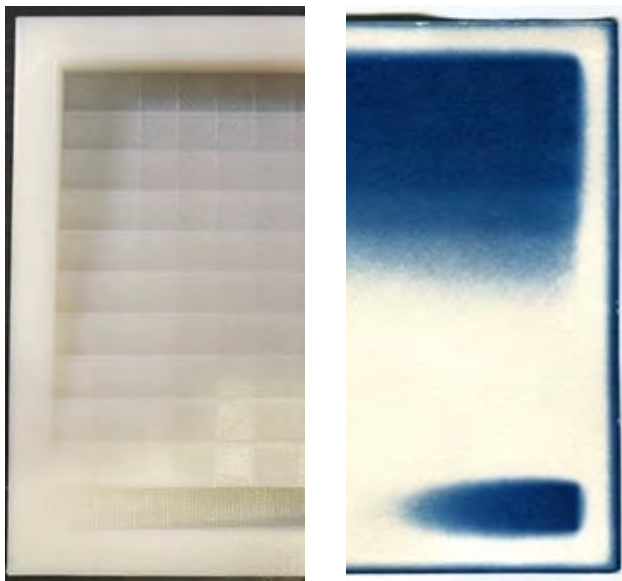


Figure 3. 3D printed stencil in PLA for data collection (left), one of the cyanotypes printed with the PLA stencil for data collection. (right) (© the author. Photo: author)

20 minutes is the minimum exposure time to fully address the color intensity of the cyanotype with this stencil. An exposure under 20 minutes results in a pale print whereas over

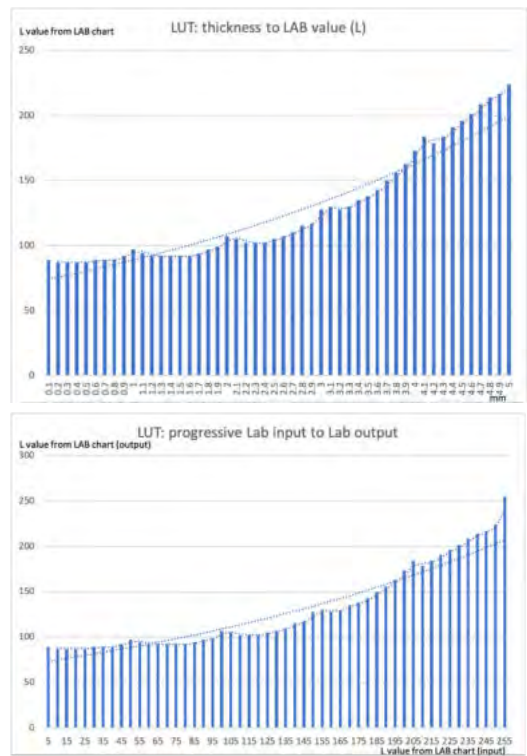


Figure 4. Top: Look-up Table: the input value L value in $L^*a^*b^*$ color space to the output value L value in $L^*a^*b^*$ color space. Bottom: Look-up Table: the thickness of the stencil in millimeter to L value in $L^*a^*b^*$ color space.

20 minutes has a similar result as a 20 minutes exposure. With all these presets, we printed 30 samples of cyanotype with this stencil to collect the data for establishing a look-up table (LUT) between the $L^*a^*b^*$ value (in CIELAB color space) and the thickness of the 3D print. [15] (Fig.4)

The reason we used $L^*a^*b^*$ values as an indicating unit is to establish a LUT that is applicable in Adobe Photoshop. Photoshop is the software we used to embed and apply the LUT to the image. By manipulating the image with the LUT, we were able to test the accuracy of the curve in terms of the thickness-color intensity relationship.

The LUTs can be used in two ways: to predict the outlook of the cyanotype printed with a PLA stencil, and to approximate the thickness of the PLA stencil according to the color intensity of the cyanotype. For the first use, which is what figure 4 shows, we can restore the contrast of the source image to the cyanotype by using the LUTs. As the tables show above, the thickness and the color intensity of the cyanotype are not in a linear relation. By embedding the LUT as a converter between the digital image and the stencil, the resulting cyanotype will become predictable. The second use, is a reversed version of the first use. If we know that the cyanotype is printed with a PLA stencil, we can estimate the thickness according to the LUT tables we established. Moreover, we can imagine the shape of the PLA print by the cyanotype since the cyanotype is the analog height map of the stencil in this situation.



Figure 5 Image source for the test of the LUT (left), PLA stencil for the test print (middle), A cyanotype test print with the PLA stencil. (© the author. Photo: author)

Testing

Having the LUTs, we retrieved the numerical correlation between the thickness of the PLA print and the color intensity of the cyanotype exposed with that print. This enabled us to develop a Photoshop curve, which is a graphic expression of the LUT between the $L^*a^*b^*$ input and $L^*a^*b^*$ output of an image in an RGB color space. The LUTs suggest how the thickness of the PLA printed stencil affects the color intensity of the cyanotype. In order to validate the LUT, we set up the first experiment, aiming to replicate an existing image as a cyanotype, by tracing the thickness of the print by the color of the cyanotype, and applying the LUT to an existing image with rich contrast as a curve to calibrate the contrast of the image. We set up the experiment to validate the hypothesis that if the cyanotype has a similar visual appeal to the original photo, the curve can convey the thickness-color intensity relationship successfully.

As the resulting images of the cyanotype test show, the LUT restores the contrast and the gradient of the source image well (Fig.5), though the cyanotype print is not as sharp as the source photo due to the depth of field. The thicker the stencil is, the blurrier the image is since the stencil we used is not designed for focusing light. Only the thin part of the stencil keeps the image sharp and clear. Although photograms are not as sharp as lens-based photos, it represents its subjects more chemically objective as any form of lens-based photo involves perspective, which distorts the appeal of the object. The photogram captures objects orthographically, which involves no distortion. Therefore, while photography is successful in terms of representing space, our approach is able to transform the volume of objects and spaces into the image since what we capture is the material density of the stencil – the material-based 3D-printed “lens”.

Spatial Photogram

Spatial photogram is a process in three phases, 3D scanning, 3D printing, and cyanotype printing. The following part is about the process to prepare the final print from 3D scanning to cyanotype printing.

After the Boolean calculation of the 3D scanned space, discussed in the chapter 3D scan – Subdividing Space, we proportionally scaled the digital model according to the cyanotype experiments with our LUT. We have found out that in our set-up, UV light cannot penetrate the PLA stencil if it is thicker than 5mm. Therefore, we scaled the model to a maximum height of 5mm to fully address the depth of the scan through the color intensity of the cyanotype. The images below are the photographic scans of the 3D-printed stencil. (Fig. 6)



Figure 6. Photographic scan of the PLA stencil for the final cyanotype a top-down view (left), and from a bottom-up view (right) (© the author. Photo: author)



Figure 7. Author, *Spatial Photogram*, 2021, a set of 2, cyanotype on watercolor paper, 8" x 10" (© the author. Photo: author)

In the last phase of the research, we exposed two cyanotypes with a 360 nm UV light source for 20 minutes each, and eventually achieved two prints from the two flat surfaces of the PLA stencil. (Fig. 7) The two prints are the photograms from one negative model of a 3D scan of interior space. Both prints articulate gradations of Prussian blue and blurry outlines due to the thickness of the 3D-printed stencil. The prints are exposed from two angles of the scan – one bottom-up and one top-down. This approach visualizes the depth in an orthographic way and thus visualizes the invisible but experiential subject – space. The perspective-free approach helps us estimate the dimension of the space via the color intensity of the cyanotype. The LUTs we proposed earlier suggests the correlation between the thickness of the model and the color intensity of the print. Therefore, reversely, we can reconstruct the volume of a particular area by using the LUTs and knowing the maximum height of the space.

We developed a method to understand the material depth to colour gradient. First, we scan the cyanotype print with a flatbed scanner to read the value of the color intensity using Photoshop. Then, we input the data to the LUTs and retrieve the respective output. Finally, we multiply the number according to the original depth of the scan. *Spatial Photogram* is therefore objective since it contains information that is not only perceptual but descriptive. As a result, we extended the conventional limitation of photography in capturing the volume accurately.

Conclusion

This paper starts from the cultural-artistic context of photography's journey to articulate an objective image of space. Based on these ideas, we developed and practice the idea of a spatial photogram with 3D scanning, 3D printing, and cyanotype as a material-based image. Like other forms of photography, the *Spatial Photogram* introduces a new method to perceive space. More importantly, *Spatial Photograms* help us envisage space, which is something we can sense but cannot see directly. As the spatial photogram works in an anachronistic method, combining state-of-the-art technologies with traditional, pre-photographic image-making processes, and thus is different when compared to lens-based photography and human eyes, it provides a radically new visual experience. When this feature is incorporated with the invisible nature of space, we can discourse a novel notion of space in photography.

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Rituals of art and science to decompartment(mental)ize knowledge

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Abstract

We here explore the potential of rituals in order to more fully comprehend the subjective mechanisms of listening, leading to a broader understanding of phenomenal consciousness (why and how do I know that *I* am experiencing something?). The originality of the project resides in the blending of phenomenology, cognitive science, the sonic arts, and rituals studies. Rituals are explored in the context of a practice-led methodology between an artist and a cognitive scientist in order to decompartmentalize and possibly decolonize knowledge, namely shifting away from a purely Western techno-scientific perspective in order to embrace a plural vision involving indigenous epistemology. In this project, the sonic arts include music and sound in the arts, and focus specifically on the very act of listening. Rituals constitute structures for the lives of communities and societies, which we address more deeply from the perspective of sonic and cognitive research, so as to understand their roles and the epistemology emerging from them.

Keywords

Rituals, Sonic Arts, Cognitive Science, Hallucination, Mental Imagery, Visuals, Art Based Research, Practice-led Research, Art and Science Research, Interdisciplinarity.

Introduction

Little is known about the mechanisms of listening or on the finesse of sonic imagination as related to sonic phenomena. Nancy proposes that ‘it is always in the belly that we –man or woman– end up listening or start listening. The ear opens into the sonorous cave that we then become’ [1]. The earliest common memory of space among human beings might indeed possibly be the womb. Similarly, Schulze proposes materializing listening and rendering our senses corporeal [2]. Listening, the senses and the body should help in achieving a broader understanding of the structures of the self. According to Zahavi, ‘many scientists regard questions pertaining to the nature of phenomenal consciousness, the structure of the first-person perspective, and the status of the self to be among the few remaining major unsolved problems of modern science’ [3]. Focused listening induces mental imagery and it may then, as for visual mental imagery, include the whole body and involve the motor system [4; 5, 6; 7; 8; 9]. Listening (as opposed to

hearing) requires attention to and engagement within an environment, and relies on subjectivity and (self-)consciousness. In effect, ‘[mental] imagery not only engages the motor system, but also affects the body, much as can actual perceptual experience’ [10]. Dedicated listening is an active experience; it addresses the questions of the structure of the first-person perspective, makes room for a novel philosophy of combined auditory perception and sonic imagination [11; 12; 13], and requires engagement with an aural architecture [14] as perceived atmosphere, which necessarily involves the whole body. As for Massumi who relies ‘on the irreducibly bodily and autonomic nature of affect’ [15], the morphological quality and immersive potential of aural architectures, namely imagined and subjective architecture triggered by sound as atmospheres, unavoidably affect the body of the listener. Prinz even highlights the crucial idea that ‘conscious experience is not restricted to what is in my head but includes the environment around me, then the richness of experience is not an illusion’ [16]. Sonic imagination may widen understanding of the mechanisms of listening. Pauline Oliveros specifically proposed sound imagining in her sonic meditations [17]. However, the term ‘imagination’ too often relates to the visual aspect, and a new vocabulary needs to be developed for the sonic counterpart. Oliveros chose the term ‘auralization’, underlining that ‘[y]ou might begin to notice how your attention changes when you use auditory terms instead of visual terms to speak about sound’ [18]. Sonic imagination and auralization thus lead to the development of a new dimension in listening.

A combination of academic fields, artistic and scientific approaches (Western, and non-Western) of the experience of the self has already been expressed in technoetic and moist media [19], anthropology [20], the combination of neuroscience and suprasensory perception [21], and first-person accounts of the shamanistic perspective [22]. Blanke and Dieguez stress that ‘approaches and traditions often considered as outside the reach of science, such as (...) shamanism, mysticism, religious rituals, and the use of mind-altering drugs, the study of altered states of bodily consciousness holds the potential to offer important scientific insights about the brain processes involved in creating our everyday experience of the self’ [23]. For instance, the combination of EEG measurements within

Ayahuasca rituals was investigated for the first time in April 2019 by a team of scientists [24]. Such an approach is still in its infancy, but already raises many questions, including ethical ones, and might benefit from insights from the field of the humanities, as is proposed here. Watson-Jones et al. call for a combination of cognitive science and anthropology ‘to understand how individuals in diverse cultures incorporate both natural and supernatural explanations for events’ [25] and, as stated by Astuti and Bloch, ‘anthropologists and psychologists are willing to look both ways and learn to respect, speak, and read each other’s language’ [26]. Rituals, defined by Tambiah as ‘patterned and ordered sequences of words and acts, often expressed in multiple media’ [27], are central here. For Schilbrack, ‘in the study of rituals, then, phenomenology can provide a dialogical partner for those approaches that treat ritual as cultural inscription and do not take into account the materiality of the lived body’ [28]. This research needs to be addressed now, because the field and the literature of sound studies have grown considerably in the last decades, yet little is as yet known of the mechanisms of listening and of the finesse of the sonic imagination.

Research Methodology and Approach

The scope of this paper as related to the project shall also provide new data for cognition and perception in the context of art, phenomenal consciousness, artificial intelligence, and augmented and mixed realities. Such pervasive fields are now mostly approached from a techno-scientific and Western perspective. Humanities, art, and indigenous epistemology and knowledge, which ‘is generated from careful observation of the ecosystem and natural phenomena, observed by many people for millennia’ [29], introduce new questions, and new responses. They thus enrich research by providing a pluralist, widely encompassing vision; and by including indigenous perspectives in A.I., it may even widen perspectives and lead instead to Extended Intelligence (E.I) [30], Extended Reality (E.R.), and Extended Self (E.S.). The innovative aspects of the interdisciplinary project move beyond the state-of-the art and push it further by proposing a unique combination of fields, such as ritual studies, anthropology, phenomenology, cognitive science, and the sonic arts. Such an approach allows for the mechanisms of listening and questions about phenomenal consciousness to be addressed from a sonic perspective by fusing theoretical writing with sonic artworks as research-creation. It also counterbalances a dominant visual, Western, techno-scientific perspective.

Our approach for decompartmentalizing knowledge, namely by creating bridges, emphasizing on the interdisciplinarity nature generated by art and science collaboration, and looking outside well established Western academic methodologies, focuses on the rituals involved within such collaboration through a nomad lab as mobile and multi-sited ethnography [31]. The focus resides on

fieldwork, phenomenology, cognitive science and research-creation. More specifically, at the intersection of sonic arts and cognitive neuroscience, we explore how a scientific experimental approach can take place within the venue where the artwork is installed. The focus resides in the research process and is not limited by an outcome defined in advance. The artistic research process combines our experience in the sonic arts and our scientific expertise in the cognitive neuroscience of perception to explore the mutual interactions between visual and auditory stimulations for the mental elaboration of illusory or hallucinatory precepts. In the visual domain, illusions (when you perceive an object but you misperceive one or more of its properties) have traditionally fascinated the audience and have been extensively studied by the Gestalt and in psychophysics as a tool to understand perception. Hallucinations (when you have an experience as of an object but there is no object that you actually perceive) on the contrary are associated with a form of dementia, often mistaken for psychiatric delusions or delirium. In contrast, our approach is based on recent accounts on the psychological mechanisms of hallucinations [32] and debates on their phenomenological foundations [33] suggesting that the boundary between illusion and hallucination might not be so strict, the neural mechanisms of hallucinations sharing with illusions the need for the brain to interpret perceptually insufficient information, to ‘find meaning in noise’. Pareidolia (when you perceive an object in place of others) are examples of the intermediate between an optical illusion and a hallucination. Interestingly, although they are common (e.g. seeing a human face in the shape of clouds), they have only recently been linked to the evaluation of hallucinatory tendencies [34]. Visual illusions and hallucinations thus take place in a continuum of visual misperceptions, and we believe this space can be explored artistically and creatively, avoiding the common association made between hallucination and either drug use or mental illness. In practice, we explore the possibility to trigger the true experience of perceiving nonexistent objects or complex scenes (i.e. the actual conscious sensation of having perceived) by combining specifically composed sonic and visual stimuli.

The implementation of this process and the physical setup supporting it could take various forms, from the projection of visuals during a concert to the construction of a semi-permanent multimedia installation. In all cases, the objective is to accompany the audience to reach a state of dedicated listening, leading to a focused attention to the experienced sensations and perceptions, in order to magnify mental imagery. To leave room for such ‘auralization’ [35], visuals should therefore not entirely capture the attention of the audience. We explore ways to merge or alternate the stimuli (e.g. presenting visuals at first as an invitation for mental imagery), and specifically address the role of rituals for reaching this goal.

Merging rituals of art and science

The artwork is an electroacoustic musical composition developed during an artistic residency at the Helvetic Circle in Genoa, Italy. The central element of the composition is the organ situated in the church above the residence. The work was conceived in the present moment without a written score, and after long walks in the surrounding nature. The church contains an intrinsic architectural sonic spatial identity. The recordings of the organ and its reverberations in the architectural space were then sampled, reworked, and implemented into a software allowing live manipulation in order to be played in any future concert venue. The addition of these sonic spaces, those initially recorded, those of the future concert venues, and those present in the mental imagery of the listener during the concert, shall lead to a sonic moiré, a polyphony of spaces. The conceptual idea of the sonic moiré is an auditory perception of several layers of space and comparable to that which emerges visually from Marcel Duchamp's rotoreliefs. Such perception exists between the work and the spectator, and here between the work and the listener. The sonic moiré changes according to the typologies of each concert venue, and its ultimate goal is to produce an illusion of cinematic experience for the mind of the listener. Moreover, for the first concert involving the current experimental setup described below, a pianist was presented with a graphic score of the composition, on the base of which she developed a live composition on a prepared piano along live electronics and the sampled organ.

Performance outline

For the first public performance of *The Room Above*, the rituals from the scenic arts and from the experimental laboratory work in cognitive sciences were combined and balanced to satisfy the expectations of the audience attending a concert, while triggering their curiosity and priming them to the encountering of mental imagery. On the one hand, the scenography and the succession of events followed the classic ritual for attending a concert; finding your seats, waiting for the lights to dim, applauding the performers as they get on stage, etc. On the other hand, the visuals displayed on a large projection screen at the back of the scene (11 x 7m, see Fig.1) provided information related to another ritual; spectators are addressed as participants to a psychophysical experimentation. First, a welcome screen presented the objectives of this research and informed attendees that they will be asked to fill a questionnaire at the end. Second, an ethical statement was presented to remind them that their participation is on a voluntary basis and that “This study is undertaken in accordance with the ethical standards as defined in the Declaration of Helsinki”, as per the requirements for conducting behavioral research on humans. As the concert started, each musical movement was then introduced with a title displayed on screen, as it would be for an experimental bloc in the laboratory. A final acknowledgement screen was then shown at the end of the

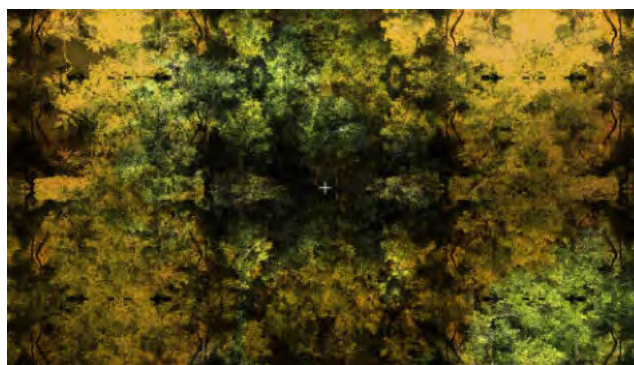
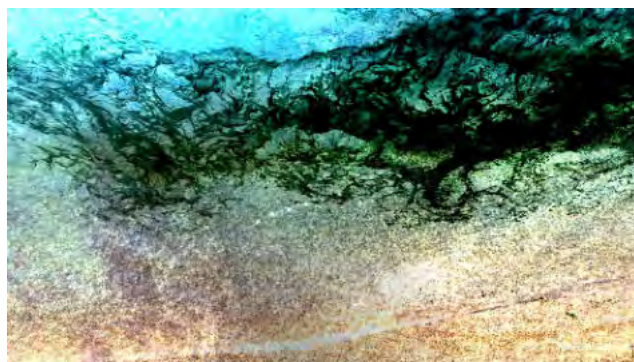


Figure 1. Concert settings for the pilot experiment (top) and screenshots of the visuals for the three musical movements/ experimental blocs.

experiment and invited participants to fill a questionnaire (QR-code linked to an online form they can fill on a mobile phone).

of the mind linked to listening and perception mechanisms by integrating the scientific lab into the artwork, and by combining the methodology of art research with science research in order to develop novel routes for original questions and answers.

Here, we report how the merging of rituals from the sonic arts and from experimental psychology could already provide space for extending the audience's expectations and encouraging an active role from the 'participants' attending a music concert. In appearance, both rituals were distinct, relying on different mediums. This complementarity, together with the attention drawn upon visual perception and mental imagery, are intended to lead the spectators to exercise their ability to explore deeper their perceptual abilities. The voluntary interruption of the visuals in the middle of a musical movement then leaves them with a purely sonic experience, and with an absence that their mind would spontaneously compensate for. More refinements are needed to better orchestrate this process (precise timing, improved communication about experimental research, raising expectations before the show, etc.), but preliminary observations provided encouraging results.

The overall ambition of this art and science collaboration is to decompartmentalize these two approaches of the study of the conscious (and active) experience of perception. The scientific and technological innovation associated with the realization of the project will then be valorized by the sharing of open source software and hardware, and by linking it back to neuroscience research, may it be by offering new perspectives on how to conduct studies on a large audience, or by providing insightful data on rich and unique experiences. In that sense, the rituals of experimental science would, in a way comparable to the rituals for knowledge acquisition in indigenous cultures, get re-appropriated by the general public.

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Authors Biographies

Luca Forcucci, artist, scholar and guest professor, observes the perceptive properties of the first person experience through art installations, electroacoustic compositions, videos, photography and writing. His research investigates mental imagery of sonic architectures. The artworks have received numerous prizes and are held worldwide. Forcucci's nomad research lab, UBQTLAB.ORG, produces talks and podcasts. He is chair of Laser Nomad, as part of the LASER series of Leonardo / ISATS. He achieved a PhD in Sonic Arts at De Montfort University.

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Speakers, More Speakers!!!^{1,2} – Developing Interactive, Distributed, Smartphone-Based, Immersive Experiences for Music and Art

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Abstract

We describe a multi-speaker, smartphone-based environment for developing interactive, distributed music and art applications, installations, and experiences. This system facilitates audience engagement through participation via personal smartphones, potentially connecting with traditional computing devices via the Internet without additional software or special configurations. The proposed approach has been inspired and motivated in part by the COVID-19 pandemic and builds on earlier works and technology. It demonstrates a design approach that is more efficient and provides a new avenue for music composers and artists to design highly distributed, participatory, immersive music and art experiences, utilizing various input sensors and actuators available in today's smartphones. These include individual smartphone accelerometers, video cameras, and – of course – speakers. The use of smartphones also provides for relatively precise geolocation through GPS or simple social engineering approaches, such as using dedicated QR codes for different locations (e.g., seats in an auditorium). This allows for composing experiences to be rendered in the same room / auditorium, highly distributed across the Internet, or a combination of both. The paper presents the technological background and describes three case studies of such experiences, in an attempt to demonstrate the approach and inspire new avenues for artistic creativity and expression towards highly immersive, participatory installations / performances of music and art works for the 21st century.

Keywords

Interactive music and art, distributed music and art composition, smartphone-based interface, human-computer interaction, generative music, mobile device control, real-time communication, music performance, audience participation.

Introduction

We present a multi-speaker, multi-screen, smartphone-based environment for developing interactive, distributed music and art applications, installations, and experiences. This environment allows arbitrary network connections to be established among numerous smartphones and other



Figure 1. One of the authors demonstrating our smartphone-based, sound spatialization system in a simulated, multi-speaker laboratory environment.

computing devices (e.g., laptops) to support synchronized delivery and performance of sound and visual materials. This environment also supports design of arbitrary interactive experiences utilizing smartphone touchscreen, video camera, and microphone input, as well as movement captured via smartphone accelerometers (e.g., see Figure 1).

This work has been inspired by the realization that the ongoing pandemic has emphasized a pre-pandemic societal shift in how people communicate and share information – including how they experience, consume, and potentially generate artistic, musical, gaming, and other audiovisual materials via smartphones (such as Zoom, and other related technologies). We believe this shift is here to stay. This has tremendous implications for the average future artist and how they choose to make their work available to vast audiences.³

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² Also “screens, more screens!!!” – in part inspired by Goethe’s (famous) last words (see <https://www.loc.gov/pictures/item/00652178>).

³ A related example is the shift that streaming services (such as Pandora, Spotify, and YouTube) have made to the delivery, consumption, and – most important – economy of musical compositions and performances.

The average person already owns, carries, and operates at least one smartphone device on a continuous daily basis. These devices are extremely powerful in capturing data and in delivering audio visual material. However, in most cases, due to pre-existing momentum and concerns for protecting copyrighted or otherwise exclusive artistic material, we are all being shielded from using our devices (and the potential they afford) in designing new artistic and musical experiences and performances. Most of us have experienced being asked to silence our smartphones, turn them off, or put them away (as experienced by one of the authors at a recent Brian Eno concert under the Acropolis in Athens, Greece).⁴

We believe the time has come for composers and artists to embrace this new smartphone-based technology – as with other technologies before it – and utilize it meaningfully, in music and art works, installations, and performances.

Our approach utilizes standard and custom-built JavaScript libraries, which allow to seamlessly connect with other pre-existing libraries and tools, including as Ableton Live, Iannix, Isadora, JythonMusic, and PureData, among others, using Open Sound Control and MIDI messages. This flexibility to bring together such powerful and expressive components facilitates rendering of artistic, musical, and other material, designing / building of immersive experiences, installations, and performances, and including audience participation through smartphone input and output.

We demonstrate this approach discussing three such experiences, namely

- a recreation of Iannis Xenakis’s avant-garde piece, “Concret PH”, created originally for the Philips Pavilion in 1958 [1];
- a Zen-like, meditative, music interactive experience, called “Be the Wind”, which renders binaural wind-chime and other restorative sounds, in a distributed fashion with participation from the audience; and
- a fractal-based, sound spatialization piece, called “On the Fractal Nature of Being”, which invites audience members to interact via movement – collecting accelerometer and video data from their smartphones – to generate a dynamic fractal design on a main screen and an evolving, generative soundscape, utilizing musical input from live instruments interspersed through the audience.

While the current paper focuses mainly on designing smartphone-based, participatory music and art experiences / installations, it should be emphasized that this work also applies to designing other kinds of art experiences, including kinetic sculpture, dance, and theatrical experiences and performances, among others.

Background

Audiences in most traditional art and music performances in the West are often considered as mere “receivers” of the performance [2]. In other words, they are not expected to contribute in any way to the creative act occurring before them. Yet, the very presence of an audience in the space does have an effect on the performance. For instance, there are always some low-level forms of participation involved in artistic endeavors (moving around a gallery space, filling in gaps in information, applauding, etc.). This observation led new media theorist, Lev Manovich to argue in “The Language of New Media” that all art is, indeed, interactive [3].

In music, even something as simple as physical gesture can be an integral part of music ensembles and allow for interaction among music participants [4]. The level of interactivity though varies and is usually confined only to the music performers.

Computing systems have opened new avenues for designing explicit interactivity within newer artistic and musical experiences. There are many examples, such as Waite’s Church Belles [5], whose focus is to explore how to provide an effective means of audience participation and interaction.

Another development is peer-to-peer systems, which have found success in this area. Peer-to-peer systems gained popularity between 1999 and 2001 with the wide proliferation of the file-sharing system Napster [6]. The wide acceptance and understanding of the system led to the creation of interactive music works using Napster and related technologies. One such example is the system built by Tanaka, which allowed collaborative music composition on personal digital assistants (PDAs) across short distances [7].

Interactive music creation and performance has continued to evolve, and, as technology has improved, musicians have been able to interact over greater distances. Network Music Performance (NMP) systems, which allow real-time music performance from different locations, are great examples of this as they break the traditional localized geographical barriers of music performance and composition [8]. For instance, Benson et al. discuss SoundMorpheus, a system supporting distributed musical performances, via Myo-armbands to capture motion, and control aspects of music performance, via user arm movements and interaction [9].

An interesting development is the *Web Real-Time Communication* (WebRTC) protocol and related APIs. This has made it possible to design meaningful artistic collaborations across great distances. Such systems include Lind’s Soundtrap [10], a music studio which allows for digitally collaborative music composition; and Ramsay and Paradiso’s GroupLoop [11], a web-based collaborative audio feedback control system, among others.

⁴ A perfect, yet missed opportunity, as Brian Eno with Peter Chilver have been creating avant-garde experiences for music and art, distributed as smartphone apps, for over a decade.

The WebRTC protocol and APIs have permitted peer-to-peer systems to become more user friendly, providing functionality for audio, visual, and data sharing from device-to-device across networks, thus breaking geographical barriers. An interesting example comes from Chaves, who describes the overarching goals of such a system, stating that he wishes to create “[a] networked performance in which a ‘wireless imagination’ engages the listening subjects in different spatial, temporal, and social poetics” [12].

In terms of using smartphones for building music and art experiences, the work of Brian Eno and Peter Chilvers’ Bloom [13], among others, stands out. This innovative and truly inspired (and inspiring) smartphone app uses a game-like environment to encourage users to make music and visual art, in the form of raindrops, by tapping on the smartphone screen.

Dekel and Dekel’s MoGMI [14] also demonstrates the ability to transform the smartphone into a musical instrument, this time using physical gestures and accelerometer data, as the control mechanism.

The smartphone has also been used to gather accelerometer data in Jean, Broll, Stein, and Lédeczi’s work [15].

Many installations, such as Manaris, et al. “Diving into Infinity”, use body movements, tracked by Kinect and other related sensors, as the means of interaction with an artistic piece [16].

Of all related work, CoSiMa’s Soundworks environment is one closer to what we are presenting herein [17]. Soundworks supports artists in developing smartphone-based experiences, which allow users to collaborate and generate various sounds via touch and the movement of their smartphones. However, having experimented with the framework, we found it to be difficult to install and use, mainly due to the lack of documentation. Still, this is a piece of inspiring, pioneering work in this area.

Finally, Carson’s *immaterial.cloud* [18] brings elements of all this technology together, allowing users to break geographical barriers and collaborate with one another on a musical piece using WebRTC’s data connections. The architecture of our environment is similar to that of Carson’s but extends it in important ways, making it more generic, modular, and thus more easily adaptable to new applications. This allows the development of more varied, complex experiences, by creating a well-documented, easy-to-understand environment.

System Architecture

Our system allows the development of smartphone-based interactive music and art installations. One of its main advantages is that it supports an arbitrary number of audiovisual channels (i.e., intendent, individual experiences), which can be as large as the number of available smartphones (and networked laptops, tablets, etc.). This is accomplished by providing individual URLs, created specifically to serve

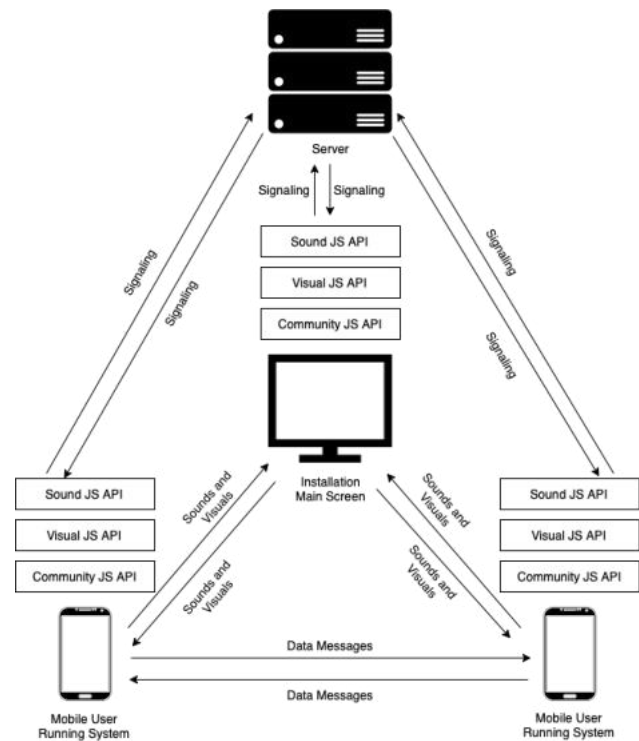


Figure 2. The various components and APIs comprising our system architecture.

different (or identical) resources, such as sounds or images, to the participating devices.

When conceptualizing our system architecture, our goal was to provide a means to engage users in interactive digital music and artistic experiences and performances. Based on earlier work, and current technological capabilities (e.g., WebRTC, WebAudio, etc.), it became clear that a web application would provide the best framework to support everything we were seeking.

In particular, web applications make music and art experiences easily accessible to participants’ smartphones (and other related devices, including tablets and laptops) **without having to download** any specialized software. This is by far the most enabling aspect of this design decision; users just need to point their devices to a particular URL (which may be different for different users to provide multi-channel, or even multi-role, engagement with the experience itself). Accessing a URL is a common task that all users of smartphone devices know how to accomplish – i.e., typing a URL, and scanning a QR code.

This approach also supports granular / cloud sound stochastic experiences, where the actual location of the sound is not as important, but instead the variety / multiplicity of sounds is what “creates” the experience.

Moreover, this system design allows for mixed-types of experiences, i.e., where there is a special role – via a dedicated URL known to only one person – who can act as an

on-stage performer / DJ / maestro of experience, deciding which sounds to be played at a particular time, adjusting timbres, volumes, and potentially sound panning / spatializations / diffusion patterns, thus providing overall navigation of the experience as it unfolds, based on a particular composition, or experience design.

System Elements

Our system architecture consists of two main components – a server, and various client modules.

- The server component stores various pieces of code and assets (sounds, visuals, etc.) comprising the experience. It is usually very minimal, with the only goal of serving the right content to the right client (in the case of a multiple user-role experience, such as maestro on stage vs. audience participants), or the same content to all clients (in the case of a single user-role experience). Additionally, it supports messaging for bi- or multi-directional communication between user clients, allowing for a wide variety of interaction / participation designs.
- As mentioned above, the user client component is able to run on mobile (or other) devices within the safe space (no downloads) of modern web browsers. This module generates / renders the artistic and musical component of for the experience / performance, receives input (if any) from the user, and communicates with other components, as orchestrated by the experience design.

The server and client components communicate with each other through (wired or wireless) Internet connections. This is accomplished via the WebRTC protocol. As mentioned earlier, this allows users to interact with one another, and to render audio and visual artifacts in real time (as allowed or dictated by the composition or experience design).

Implementation

The server component is built in Python or JavaScript. The user client component is built in HTML5 and JavaScript. This infrastructure is truly lightweight and does not require any installation or special configuration, as it comes pre-installed in all major web browsers.

When the participant / user visits the corresponding website established for the experience, the client software begins to run inside the browser's secure environment (also, see next section discussing security of the approach). The client opens a WebRTC data connection via the server to all other clients (user devices) connected to the server. This allows for controlled interaction / communication / synchronization between all devices and the server, while running the particular experience. The types of messages exchanged, and their frequency depends on the artistic experience design.

Currently, it is expected that the artistic experience designer is well-versed in both art and programming. However, our approach makes both development and

deployment much easier than with earlier approaches, as it standardizes and hides unnecessary complexity behind well-defined APIs. This is similar to the approach used in the JythonMusic environment [19], an environment for music and art experiences developed in Python, which has also been a design inspiration for our system.

Our system improves on JythonMusic, as it makes running experiences (as well as communication / synchronization between devices) transparent to the end-user (i.e., no software to download, and no specific configurations to be performed prior to running the experience).

This is a significant advantage / improvement, as it makes such experiences much more usable, accessible, and potentially more appreciated by average end users, who simply enter an experience by browsing to a website. Everything else automatically happens, as they navigate the user interface provided to them by the experience. In a later section, we discuss three such experiences, as examples / case studies.

APIs for Building Experiences

At the heart of this new artistic experience design framework, we incorporate several JavaScript libraries / APIs, some of which are pre-existing, and others have been created by us to handle / hide unnecessary complexity and make designing music and art experiences easier, compared to existing systems. Since the system is implemented in JavaScript, a developer may incorporate additional libraries / APIs (not mentioned here) to access additional desired functionality. Below, we present our system's APIs based on the functionality they provide.

Connectivity

- *Community.js* – this is a custom API which allows user clients to register themselves, when they come online, and connect to other clients. It provides functions to register a client via a custom ID, to get a list of registered clients (users) from the server, to broadcast to all clients (or some of them, having a certain ID pattern), to send messages to a specific client (using an existing client's ID), and to receive messages from another client.

This API utilizes part of a cloud-hosted Community server, for client registration. Once registered, however, users may initiate connections to other users and communicate directly and securely (without overburdening the cloud server). This is particularly important for musical experiences where timing and low latency are important. This approach allows for truly distributed, potentially massive experiences to be designed and deployed.

This functionality has been implemented utilizing the pre-existing *PeerJS* library,⁵ which simplifies WebRTC peer-to-peer connections and allows users to broker data, video, and audio stream connections to other remote users.

Designers of various performances/experiences are able to specify how to best connect users, and what type of data messages to send through these established connection channels, in order to create compelling and interesting participatory experiences.

Sound

For adding sound capabilities, we utilize the following:

- *AudioSample.js* – this is a custom API which allows user clients to use existing sound samples as instruments. While there are other more powerful, lower-level APIs (mentioned below), we developed this one for convenience, as it handles the majority of design situations we have experienced.⁶ It provides functions to load an audio sample (supports a variety of formats, including MP3, WAV, and AIF – 16, 24 and 32 bit PCM, and 32-bit float formats), to play the complete sound or a subset of it, to loop the complete sound or a subset of it, to stop the sound playing, to pause, and then (as needed) resume the sound playing, to set the pitch (in MIDI – 0 to 127) of sound, to set the frequency (in Hz), and to set volume, panning, etc.

For additional functionality, we have explored the following pre-existing libraries: *Howler.js* – a web audio library which provides functionality for playback of multiple sounds, control over fading, rate, volume, and seeking, in addition to 3D spatial sound or stereo panning.⁷ *Tone.js* – a web audio library for creating synthesized music interactively.⁸

Visual

For visual design, we mainly utilize *p5.js*, a porting of the MIT Processing system into JavaScript. *p5.js* is used already by artists to create interactive, 2D and 3D graphical applications (including drawing shapes, creating complex animations, accessing / reacting to mouse and touch events, loading images, etc.).⁹

Interaction

For user interface building, we utilize regular HTML5 UI building functionality. We also use *NexusUI.js*, a collection of HTML5 interfaces and JavaScript functions to assist with

⁵ See <https://peerjs.com>.

⁶ This is motivated by the 80/20 design rule, i.e., identify a set of functions (20%) that handle 80% of use cases, delegating the remaining, rarer ones to more complicated approaches, thus gaining in convenience and ease / simplicity of use.

⁷ See <https://howlerjs.com>.

building of interactive web audio instruments in the browser.¹⁰ Finally, we use *Hammer.js*, an open-source library for capturing and recognizing gestures made by touch, mouse, and pointer events. This provides functionality to recognize the various user touch events, including *tap*, *double-tap*, *press*, *pan*, *swipe*, *pinch*, and *rotate*.

In terms of additional input, we can also access accelerometer, microphone, and camera data through available Web API functionality. This allows to design a wide variety of interesting and versatile smartphone interactive experiences.

Security of Installation

Finally, and perhaps most importantly, our approach is extremely secure, through the strong, intended layer of security protection provided by modern web browsers. This creates a *barrier* between:

- a. the physical device hardware (and its contents, such as existing photos or personal contacts); and
- b. the software rendering the actual artistic or musical experience.

This is very important and cannot be overstated.

Any extra access required / desired for the experience (such as accessing the user's camera¹² or the device accelerometer, for example) must be explicitly approved by the device user. The browser security enforces this, and there is no way around it.

This way, the artistic experience designer can separate themselves from hacking concerns and from maintaining their software according to the latest security updates and directives; instead they may focus on artistic concerns and content creation (sound, images, interaction, etc.).

Managing security is delegated to the developers of modern web browsers, which are updated by the end user as part of maintaining the security of their own device(s).

To summarize, this division of concerns (artistic vs. security / software maintenance) is significant.

Case Studies – Artistic Experiences

This section discusses briefly (due to space limitations) three artistic experiences designed using our system.

Iannis Xenakis, “Concret PH” – A Retelling

Iannis Xenakis was a pioneer in using early computers to create music. He coined the term *stochastic music* (from the

⁸ See <https://tonejs.github.io>.

⁹ See <https://p5js.org>.

¹⁰ See <https://nexus-js.github.io/ui>.

¹² Which is very different from accessing the device's camera roll / existing photos, for example.

Greek word *stochos* (“στόχος”), or target), to describe music that evolves over time within certain statistical tendencies and densities, and has points of origin and destination. Xenakis created stochastic music to react to chaotic, purely random properties of 12-tone, or serialist music [1]. He believed that the listener may be aesthetically overwhelmed by the complexity of serialist music (which, while deterministic in its rules of creation, by definition, over time sounds utterly chaotic (i.e., uniformly distributed), as if generated using a random number generator in modern computer programming [19].

Xenakis proposed that mathematics of probability could be used to produce a compositional technique that is more controllable. This compositional technique could then be used to produce more aesthetically pleasing music, as he went on to demonstrate [1].

Reconstructing the Piece

This is a recreation of Iannis Xenakis’s avant-garde piece, “Concret PH”, an early and influential example of stochastic music. It was created to be played at the Philips Pavilion in the 1958 World’s Fair in Brussels [23].¹³ Unfortunately, the Pavilion was soon demolished, so there is no way to experience this piece as was originally conceived.

“Concret PH” (and stochastic music in general) may sound random at the local level - i.e., at the level of a single symphonic orchestra musician or, in our case, at the level of an individual’s smartphone speakers. However, when listened to as a whole at the global level - i.e., the sounds of the whole orchestra or, in our case, the sounds emanating across all the speakers of smartphones in the audience – the music exhibits movement and direction through unfolding waves, or areas of concentration in pitch, volume, and panning (among others). Although the music may initially sound random, when observed over time and more carefully, it exhibits some of the same qualities as listening to, say, falling rain, which has Zipfian (or power-law, non-random) proportions [20]. It should be noted that these proportions are also observed in more traditionally composed music (such as classical and jazz music, for instance) [21, 22].

The piece is performed mainly via audience smartphones, with an additional main screen presence (see Fig. 3). It unfolds over time and is relatively short (about 3 minutes).

In the original, Xenakis used a recording of burning charcoal, partitioned into one-second fragments, and then pitch-shifted and overlaid, to create a semblance of harmony or polyphony, thus generating a granular, ever-unfolding continuous sound texture. The piece was performed through approximately 400 loudspeakers in the Philips Pavilion arranged (due to technical limitations of the time) in five clusters and 10 channels (sound routes) [23].

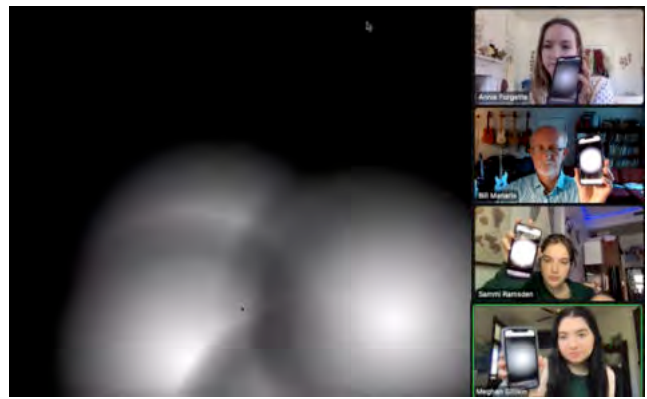


Figure 3. The four authors testing “Concret PH” (right). Sound and visuals are disturbed among all connected smartphones, including a main screen experience (left).

In our reconstruction, we use all participating smartphone speakers in the audience. We reconstructed the piece by sampling the background sound from the original (as found on YouTube¹⁴), and recreating the aural density using Python code written in JythonMusic.¹⁵ This produced a score, which was then manually inserted in the JavaScript client code of our framework to drive the sound of the participants’ smartphones.

Our reconstruction utilizes a probability density function controlled by the number of available (or connected) smartphones, adjustable in real-time. This forces the sonic outcome to remain approximately the same, regardless of how many smartphones are participating. The piece can be experienced with as little as one smartphone, or distributed over numerous smartphones – as many as connected to the experience, gradually approximating the sonic characteristics of the original. Our experience also utilizes the *visual* JavaScript API (described above) to visualize each sound playing from individual smartphone speakers, as well as the global, communal soundscape created by the culmination of all the smartphone speakers (see Figure 3).

The smartphone piece was premiered at the University of Maryland, College Park, USA on April 8, 2022. Participants were asked to move freely through the space, while their smartphones produced sound and visuals. In some regards, the ability to move freely resembled the movement of people inside the Philips Pavilion in 1958. A recording of the performance, captured via a 3D binaural microphone, is available here - <https://bit.ly/concretPH1>.¹⁶

¹³ This building was designed by architect Le Corbusier, who employed Xenakis as an architect and mathematician at the time.

¹⁴ Concret PH, in stereo – <https://youtu.be/XsOyxFybxPY>.

¹⁵ See <http://jythonMusic.org>.

¹⁶ Courtesy of Ian McDermott, University of Maryland.

“Be the Wind” – A Case Study

This experience is similar to the Xenakis’s “Concret PH”, except it adds user interaction. Instead of the audience passively listening to sounds unfolding over all participating smartphones, audience members can also decide when sounds are generated by tapping on their smartphone screens (see Figure 4).

Unlike “Concret PH”, which was influenced by Xenakis’ 1944 Greek Civil War experience, where he almost died in an explosion from a British tank shell, the goal of this experience is to be restorative in nature.

Through integration design and choice of sound materials, users are encouraged to engage in a slow, deliberate, meditative experience. The sound material consists of high-resolution, binaural audio recordings of a high-quality wind chime (tuned in C minor), as well as a field recorded sound of a running river and various recordings of bird calls.

Using these audio samples, the score is constructed in a way similar to “Concrete PH” using a probability density function. Users may contribute sounds to the collective experience by tapping on their smartphone, or they may simply sit back and listen to other people’s sound contributions. Harmonies emerge, and go away, as people contribute material. This smartphone experience will be premiered at the Music Library of Greece in May 2022. A recording of it will be available at <http://manaris.org/research>.

“On the Fractal Nature of Being” – A Case Study

Fractals are a fascinating natural phenomenon. Their mathematical intricacies and iterative or recursive self-similarity remind us of the complex underlying interconnectedness of the world around us. This immersive, smartphone-based artistic experience aims to capture the essence of fractals and evoke reflection on the intricate and meaningful ways in which we are all interconnected.

Similarly to “Be the Wind”, this piece involves a peer-to-peer network, connecting each smartphone in the audience to a larger main screen in the installation space. The audience members have the opportunity to alter and change the main screen by interacting with their own individual device. The system utilizes the built-in accelerometer capabilities of the smartphones to gather data on how each audience member is moving. Camera data are also collected from the smartphones to capture the most prevalent colors in the areas surrounding each user.

Using a recursive fractal design, natural images are displayed on the main screen. At the smallest recursive level, each main screen image is controlled by an individual user’s smartphone input. As a user moves their device, their corresponding image moves on the main screen, matching their movement, and causing a chain reaction of movement within the fractal design, which shifts and “breathes”.

Additionally, the color of each image on the main screen reflects the main color “seen” by each smartphone camera. As a user moves their device, and the camera captures

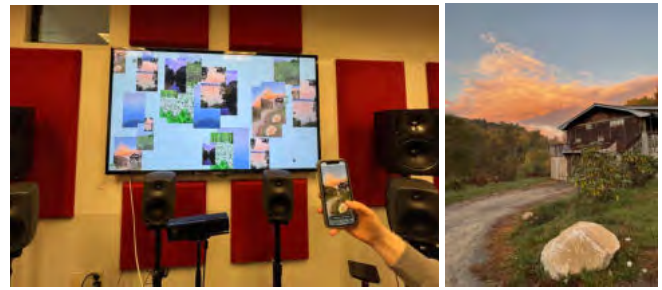


Figure 4. Interacting with “Be the Wind.” Users tap on smartphone to generate a specific wind-chime pitch, utilizing binaural recordings of a high-quality wind chime tuned in C minor (*left*). Images chosen from a set of restorative, natural images are displayed on both the smartphone and shared experience (*right*).

different colors, the corresponding image on the main screen changes to match that color. This change is then propagated in real-time to all higher-level images, thus reflecting the colors captured from each camera in the audience, and creating a fractal collage that is an ever-changing representation of this communal experience.

In terms of sound, the piece utilizes live instruments, including a piano, a theorbo, a cello, and a bassoon. These instruments are performing improvised musical material from a series of harmonies emanating from 371 Bach chorales (based on earlier work presented in [24]). The participants’ smartphones utilize elements of the sounds generated from these live instruments (recorded earlier), distributing them in real-time throughout the performance space.

The piece is controlled using several density functions similar to the one used in Xenakis’ “Concret PH”, utilizing excerpts of recordings from the live instruments. Together, the sounds create a cloud structure that navigates the harmonic progression of the piece. Live instrument performers and smartphone participants come together through interaction, movement, and deep listening. The piece lasts approximately 12 minutes. It will be premiered at the Music Library of Greece in May 2022. A recording will be available at <http://manaris.org/research>.

Conclusion

During at least the last decade, artists and musicians have begun experimenting with various online delivery mechanisms and smartphone technologies. At the same time, computer game designers have engaged fully with such media, resulting in numerous, highly popular / successful online games and game platforms, such as World of Warcraft (WoW), Minecraft, Fortnite, and many others. Such experiences have allowed people from across the globe to come together and experience joint game play.

We propose that similar experiences may be created with appropriate musical or artistic goals, as the technology is

readily available to support this. This involves a multi-speaker, smartphone-based environment, which supports the development of interactive, distributed music and art applications, installations, and experiences. This approach allows audience members to become themselves performers, simply by entering a URL into a browser, or scanning a QR code. The goal herein has been to report on how such a platform can support the design and deployment of evocative artistic experiences combining sound, visual art, meaningful and accessible user interfaces.

This is especially important now, given the complicated nature of designing artistic and music compositions and live performances during a global pandemic (with country-wide lockdowns in various nations or cities, and the canceling of medium- to large-crowd events, including exhibits and performances in museums, theatres, and music halls / auditoria, at the time of this writing). While this has seriously affected traditional music composition and art installations and performances, we hope that the work presented herein (as well as approaches similar to it), will provide a viable, innovative alternative, in terms of economies of scale, and delivery platforms / physical spaces, to deliver artistic and musical content well into the 21st century.

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Transforming Practices: a practice-based research approach to teaching emerging media at undergraduate level

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Abstract

This paper suggests how a ‘research-oriented’ and ‘research-based’ approach can help undergraduate students engage creatively with new and emerging media technologies, as well as creating a critical and less disciplinary focused approach. It also proposes a way in which arts practice, and specifically practice-led research, can inform pedagogy, improving satisfaction for tutors and students alike.

The authors reflect on their experience of modifying the module ‘Media Frontiers’ on a media arts undergraduate degree programme, presented as a case study. It sets out how the changes made transformed students’ means of engaging with emerging media technologies and developing new artistic insights.

Keywords

Research-orientated, research-based, undergraduate, learning, teaching, media practice, research environment, emerging media, media technologies, new media

Introduction

This paper suggests how a ‘research-oriented’ and ‘research-based’ approach can help undergraduate students engage creatively with new and emerging media technologies. This approach emerged as a result of changes made to address specific issues on an undergraduate module. However, the solution, which drew on the authors’ experience as practice-based researchers, could be of use to wider interdisciplinary arts teaching. In particular, it could be a way of arming media graduates with key skills needed for an increasingly interdisciplinary media landscape that requires critical approaches to developing new ways of working.

The module ‘Media Frontiers’ aims to engage students with emerging technologies, asking them to explore and experiment with their potential for expanding arts practice. However, students were seemingly reluctant to take the necessary risks and to adopt an experimental approach that this requires. Rather than a body of work, they were often overly focused on a single final finished outcome. This limited the scope for engaging with the possibilities for new technologies, and often led to conservative or conventional outcomes. Alternatively, responses would simply consist of technical tests or demonstrations that didn’t address the creative possibilities of the chosen media technologies.

While being experts in the use of current media technologies, when confronted with the challenge of creating new ways of making, they lacked confidence and strategies. To address this, the authors drew on their experience of practice-led research, using this as a way of changing students’ approach to and engagement with new technologies. The structure offered by a research-led approach freed students from their preconceptions not only of what the module required but also their relationship with media practices and technologies.

This involved adopting a ‘research-oriented’ and also ‘research-based’ approach to the module where emphasis was placed on process work rather than a final outcome [1,2]. Students were asked to develop their own research questions and adopt an exploratory approach to creative practice, in order to challenge their preconceptions and prior experiences. It also promoted a learning environment rewarding for both students and tutors.

Previous versions of the module had been structured around different media disciplines reflecting a model of undergraduate teaching that is based around providing subject or discipline specific skills. However, as a course whose specialism is interdisciplinarity, a research-oriented approach, with its emphasis on process and knowledge creation [3], is more appropriate. It may also be a better way of providing students with the skills needed for the contemporary media landscape.

Many studies have looked to link the *quality* of research and the *quality* of teaching – often concluding that the link is difficult to prove conclusively [4, 5]. In this reflection we will be focusing on the impact of research on students’ learning and attitude to practice, as well as staff motivation and enjoyment of teaching. We will summarise the key benefits reported by students and staff as well as reflecting on the suitability of this approach in the context of the current media arts landscape.

Background

The BA(Hons) Contemporary Media Practice is an interdisciplinary media arts course in the Westminster School of Arts, University of Westminster. Students produce work in and across a range of media areas including still and moving image, installation, sound arts, interactive and emerging media. It also offers opportunities to work with disciplines

outside the arts through cross-university modules. These allow for collaboration with students from across the University and in particular courses from the Science, Architecture and Computer Science schools. As a specialist interdisciplinary media arts course, it looks to draw on contemporary practice and research to inform and update its curriculum. The course is also very well placed to draw on and make links between research and teaching because of its close links to the CREAM research centre at the University of Westminster. The majority of the course teaching team are actively engaged in practice-based research, including the authors. Being practice-based researchers in the field of interdisciplinary arts informed how we looked to make connections between teaching and research.

In the second year of this three-year degree programme, students undertake the practice module 'Media Frontiers'. This module asks them to identify and explore emerging media practices, producing and documenting practical experimentation with different techniques and technologies. Students have in the past worked with augmented reality, virtual reality, code art, tangible and physical computing as well as experimental approaches to photography and moving image. In previous runs of the module, students struggled with the exploratory nature of the module and were unsure about how to approach the project. They particularly struggled to see how different pieces of work and experiments might build on each other and might be something other than individual, technical tests. They were final outcome oriented and often unwilling to take risks, concerned about 'failing', in their eyes, to produce a successful 'finished' result. Rather than working across media as the brief asked them to, they would often be conservative in their approach and use of existing media practices. This was at odds with the aims and learning objectives for the module which emphasise experimentation. Discussions with other members of the teaching team and external examiners identified a mismatch between the stated aims of the module and what students were producing. This set in motion the development of the changes described here.

The solution to the issues we had identified lay in shifting the students' understanding from 'research as knowledge accumulation' to 'research as knowledge creation' [6], and also, from practice as the demonstration of knowledge to practice as a means of generating knowledge. This shift was achieved by creating greater links between practice and research, and in particular drawing on the tutors' own research practice.

Challenges presented by the ubiquity of digital media

It has been well and widely noted that the media landscape has changed from an era of media audiences as consumers to audiences as producers; a landscape described variously as 'convergence', 'participatory' or 'networked' culture [7, 8]. As Jenkins and others have argued, in such a 'participatory culture' the forefront of media practice is likely to

emerge as much from "bottom-up by decisions made in teenagers' bedrooms" as it does from industry [9]. Increasingly, undergraduate students find themselves at the forefront of media developments. And yet the very ubiquity of media and media production means that students may not be best placed to gain a critical perspective.

In this light it could be that at least some of the issues we initially identified were caused by a lack of critical distance that we had not previously anticipated. Our experiences of teaching 'Media Frontiers' has shown that, while undoubtedly expert users of media systems, they can struggle to locate or understand them in their wider context. This becomes especially noticeable when they are asked to develop new ways of working with media. It is as though they are constrained by a perception of their role as a 'producer of content'. This seems to be at odds with the way we typically think about participatory culture which tends to emphasise empowerment. The ubiquity of digital media may be contributing to its obfuscation. Digital media, as Berry notes in relation to computation itself, "is increasingly not seen, obscured or ignored by virtue of its everydayness." [10].

What this, and our experiences of teaching 'Media Frontiers' would suggest, is that we may require new ways of learning about media practice. In this context our approach, which places emphasis on critiquing practice through an engagement with a process of questioning, draws on the 'Digital Humanities' [11]. The Digital Humanities are, Berry argues, uniquely positioned to contribute to "pedagogies to teach computational technologies, allowing students to see the computation in our culture." [12]. Just as particular tools and critical perspective may be needed to 'see' and understand computation, so the ubiquity of contemporary media may require a similar set of critical skills. A research-oriented and based approach to teaching media practice, which promotes a questioning of practices and a testing of processes, may be one way of providing these skills.

The arguments for connecting research and teaching

A connection between research and teaching is often assumed or claimed, although exactly how can be difficult to establish [13]. The benefits of research for teaching are elusive – a meta-analysis of 58 articles by Hattie and Marsh suggested that there is no correlation between quality of teaching and research, describing the relationship as "an enduring myth" [14]. One study from 1993 even concluded that it can have a negative impact, and that "a college whose faculty is research-orientated increases student dissatisfaction" [15]. More important for this discussion than trying to prove a connection between teaching and research is the possibility that linking them can be beneficial for staff motivation and satisfaction. As Brown has noted, while linking your research to teaching may not be necessary in order to be a 'good' teacher, it can bring significant benefits, not least unifying the dual roles of researcher and teacher [16].

Regardless of any measurable connection between research and teaching, improvements in staff satisfaction and motivation are well documented [17].

At an institutional level, research-informed approaches to undergraduate and postgraduate study are widely seen as highly important. A survey by Jenkins [18] notes numerous reports and government papers stating the importance of the relationship between teaching and research. However, the ways and extent to which they are connected remains variable across different disciplines [19] and levels of study [20, 21]. It can also be linked to institutional priorities and public profile. A Russell Group report in 2014 stated that research-intensive environments bringing together research and teaching offer significant benefits and can help take students' "thinking to a new level and develop skills they need for a wide range of careers" [22]. This would imply that research informed teaching can provide graduates with a competitive advantage, and one that Russell Group institutions feel they are well placed to provide. We would like to challenge any tacit assumption that only self-identifying 'research-intensive' institutions should promote the benefits of research for their students. Also, rather than an add on or 'added value' that extends teaching, we propose that it can be a key part of developing students' approaches to learning and particularly at undergraduate level.

It can be assumed that research informed teaching is more appropriate for post-graduate teaching, the 'academic maturity' of students seen as a key factor in their ability to benefit from research informed teaching [23]. However, rather than being a prerequisite for research informed approaches, these may be able to develop students' 'academic maturity'. This involves focusing on how introducing research processes can change approaches to learning rather than their participation in research projects. At undergraduate level, the goal can be seen as generating inquiry which reveals something new to the learner rather than the 'original contribution' expected of post-graduate research [24].

Arts subjects are well placed to adopt research informed approaches to teaching owing to their focus on process-based work. Healey notes that inquiry led disciplines can more easily make connections to research than some sciences. The argument is that so called 'hard' disciplines tend to focus on acquiring uncontested knowledge, where 'soft' disciplines are more likely to be "constructive and interpretive" [25]. Winters argues that the approaches to incorporating research that focus on process are of most value to art and design pedagogy. Furthermore, arming students with research processes and approaches may be particularly useful for those entering interdisciplinary contexts and working across disciplines [26].

It is important to recognise that links between research and teaching exist across all universities, including those documented by Healey [27], and we make no claim to being the first or best example. But we would note that the links between research and teaching are not as common or as visible as they might be, and this is an opportunity to highlight the importance and to argue for its continued support.

Research-based and research-oriented approaches

Part of the reason that links between teaching and research are not more common could be different understandings of what research-informed teaching looks like and the variety of ways in which the two might be linked. A study at the University of Birmingham concluded that, despite extensive links between teaching and research, this was not widely recognised by students. They also observed that even staff may not have a good understanding of what research-informed teaching actually is [28].

Varying by discipline and teaching context, a range of approaches exist for creating links between teaching and research. These can be broadly mapped and have been described as the research teaching nexus. Healey et al. [29] building on the work of Griffiths [30], identify four models for the 'research-teaching nexus':

- **Research-led** - structured around teaching current subject content - traditional transmission model
- **Research-tutored** - emphasises learning focused on students writing and discussing essays and papers
- **Research-based** - curriculum emphasises students undertaking enquiry-based learning
- **Research-oriented** - curriculum emphasises teaching processes of knowledge construction in the subject

The last two place the greatest emphasis on processes and problem solving. They are also most closely aligned with the exploratory nature of the module and our own backgrounds in practice-based research. They are less concerned with content and more with processes and students' approach to learning.

The change of approach in 'Media Frontiers' can best be seen as a combination of what Healey et al term 'research-oriented' and 'research-based' approaches [31]. Our approach combined a 'research-oriented' approach, "where students learn about research processes" and staff also try to "engender a research ethos through their teaching" [32]. And a 'research-based' approach where students learn as researchers largely through inquiry-based activities. Here practice is the method of inquiry and the insights from making, reflecting and evaluating are fed back directly into the artefact itself.

Changes made to the module and delivery

Several changes were made to the design and delivery of the module in order to introduce research and research processes and also to support a research ethos and culture. This initially came about as an intuitive response to the

difficulties students were having. Our instinct as practice-based researchers was to ask students what they wanted to find out through their experiments which led naturally to asking them if they could express this as a research question. This subtle shift reframed the purpose of the practical work from learning about specific techniques and processes to how these processes might be applied to create new understandings. It encouraged ‘creative play’ as part of cycles of reflection and exploration as a means of discovering new artistic insights, resulting in greater autonomy for students in selecting research interests. The key changes involved:

- Asking students for research questions
- Workshops to introduce students to current staff research and encourage creative play
- Using a dedicated website as a virtual research environment

Research Questions and Exploratory Approach

Students were asked to develop their own research questions and to adopt an exploratory approach to practice, which challenged their preconceptions of what media practice is for and how it might be approached. They were asked to produce a series of pieces, rather than a ‘finished’ final outcome and greater emphasis was placed on the importance of experimentation and risk taking. They were also encouraged to share their process with their peers by documenting their work using a dedicated site which acted as a virtual studio and research environment.

The students were asked to develop and refine their research question/s throughout the project development. These initial questions were used to frame students’ interest and inquiry. The practical experiments in turn created new discovery-oriented questions that help refine the focus of the project. Reflecting on and reformulating the research question became a central point for assessing the appropriateness of the decisions taken. This approach also provided a critical distance for the students to reflect and question the process and outcomes in relation to the research question, as opposed to their ‘idea’. This distance was also used within tutorial support, allowing staff to critique the work in relation to the approaches and processes as opposed to the students’ outcome.

At the start of the module staff were encouraged to present their own research practice and discuss their research questions with students. The variety of staff interests and research processes helped students see the different methods and approaches that can be taken, within a critical framework. Staff were also encouraged to incorporate their own research methodologies into workshop teaching, which provided a way of bridging the gap between research and practice for both staff and students.

Workshops

We implemented a series of workshops to introduce students to current research topics and new technologies, as well as a possible path for them to explore their own field of interest. We invited module staff and visiting lecturers who were

engaged in practice-based research to develop a workshop that explored a particular theme of their research and practice, this included graduates from the course who are currently studying a practice-based PhD. These workshops encouraged experimentation, creative play and creative thinking across disciplines, promoting ‘divergent thinking’ to help students to come up with multiple solutions to open-ended, unscripted problems. Previous workshops had tended to focus on delivering technical skills. While they may have been contextualised through reference to existing practice, they were not as explicitly linked to current research questions.

Virtual Research Environment

An online platform was used as a virtual studio and research environment. Previously each student maintained a separate blog for their documentation and these were usually only seen by tutors. By using the platform, all the blogs were in one place and could be seen and commented on by peers and staff. The aim was to support student-led learning and to continue to foster a research ethos outside of contact teaching. Previously the quality and depth of documentation varied among students which may have been due to it being treated as a record after the fact rather than an important tool for reflection and discovery. By making the documentation more visible we aimed to place greater importance on it and on the processes it documented. Staff could comment on blogs between contact teaching while in tutorials it could be viewed and added to. The transparency and sharing of research were intended to better reflect the expectations for research practice, framed as a tool rather than a requirement for the module.

Findings and Discussion

Evaluation Method

We designed a mixed-methods approach to evaluate the initiative, involving the use of written student feedback and direct observations made by academics delivering the module. Anonymous student feedback was collected in the final week of the module via the Student Module Evaluation Survey. This is a standard course evaluation feedback tool developed by the University of Westminster. The forms include a scoring scale of satisfaction with various elements of the module and teaching staff from 5 - Definitely agree through to 1 - Definitely disagree. It also includes a text box to comment upon the following areas: Teaching and Academic Support, Resource and Learning Environment, Assessment and Overall Satisfaction. Students were also asked to respond to the questions: What did you most like about this module? and What did you least like about this module? We received feedback from 76% of the cohort undertaking the module. In addition to the written feedback, academics delivering the module observed and interacted with the student groups to provide feedback from their professional perspective.

Impact of Changes on Students

Student feedback was positive, particularly in questions relating to intellectual stimulation and receiving helpful feedback. Students reported that 85% agreed that ‘the module is intellectually stimulating’, 96% agreed that ‘staff are good at explaining things’ and 89% agreed that it ‘challenged them to do their best work’.

The qualitative written feedback responses were as follows:

The module was stimulating and pushed me to achieve the best outcomes.

The module took me out of my comfort zone and encouraged me to explore through practical making and experimentation.

However, some students noted that the lack of prescribed direction at the start of the module was hard at first and they would have benefitted from clearer expectations. When asked how the module could be improved the majority of responses stated ‘nothing’ with only one recommendation provided in the text box:

The lack of direction was difficult at the start, could we be shown more examples from previous students work?

In was also noted that students positively valued staff’s enhanced enthusiasm, credibility and currency of knowledge translated through the module. This would seem to support the data of Lindsay et al. [33] in suggesting that student attitudes can be enhanced by interactions with teaching staff that share concerns and enquiry derived from the discipline.

External examiners also noted that ‘Media Frontiers’ has allowed more exploratory and investigative approaches, adding depth to the student work and learning. Rather than producing separate technical tests, students were now producing connected pieces with clearly stated aims. This allowed them to evaluate their own work, according to the terms they had determined rather than looking only to staff for feedback. Things that didn’t work became points of learning and potential for development which reduced the fear of ‘failure’ that students had previously experienced.

There were still a number of students who initially struggled to develop research questions that had creative worth. However, these students were especially helped by being able to see other students’ questions and practice through the virtual learning environment. Students initially had fears about sharing their ‘research’ with others, showing their ‘research as the accumulation of knowledge’ mind-set. Once they understood that their practice was ‘generating knowledge’ and that it was the process that we were interested in, they valued being able to share their process with their peers, particularly in group tutorials. Having a shared environment helped to reinforce the research ethos and the

idea of research as knowledge generation. This was probably the clearest indicator of a shift in their mind-set.

The change in the students’ attitude to learning became apparent especially in group tutorials and critiques. Rather than a clear distinction between the role of student and lecturer, discussions were driven by a shared sense of enquiry. The staff role became far closer to that of more experienced researcher advising students rather than primarily as a source of knowledge. In this way a community of enquiry developed in which staff and students were ‘co-learners’ [34].

Impact of Changes on Staff

The benefits of staff research for student motivation and satisfaction has been noted [35]. However, the sharing of practice can also have a positive impact on tutors [36]. Staff reported an increase in motivation as they were encouraged to explore their own research methods and processes with students and other staff members, unifying the role of teacher and researcher. They were also encouraged to share research concerns and processes with other faculty members, building a sense of solidarity, shared interest and facilitating future collaboration. The module provided an opportunity for staff to reflect on their research and rearticulate it for a different audience, which led to new research outputs.

An unexpected consequence of sharing research was a change in how staff see themselves. The recognition from both students and colleagues provided a sense of worth and confidence in the value of their expertise to the course. However, it is important to note that this may not be appropriate for all academic staff who might not want to share or feed their research into their teaching delivery; it is also important to avoid marginalising staff who are not currently research active.

Conclusion

This paper has set out to show some of the benefits of linking teaching and research in the context of undergraduate media arts practice. A wide range of approaches for combining research and teaching exist, varying across disciplines, and the benefits of such approaches have been widely discussed and debated. However, despite a long history, linking research and teaching appears to remain an exception rather than a norm, particularly at undergraduate level. The approach used in this case study involved sharing staff research with students, introducing them to research processes through workshops and fostering a research ethos, supported by a virtual research environment. Not only did this see student performance and satisfaction improve but an environment was created that was also rewarding for staff. While there are other ways that we might have introduced students to research and research processes, drawing on our own research-based practices had several benefits not least creating a more holistic work experience by combining teaching and research. This allowed both roles to be equally appreciated and valued and saw them as complimentary

rather than separate, something that was not typically experienced before. The research environment fostered by sharing research through the workshops and supported by the virtual learning environment, created a different dynamic between students and staff. Being viewed more as fellow researchers rather than simply as teachers changed the nature of discussions in tutorials and allowed students to take a greater role in guiding and also evaluating their own work. Despite what might be perceived as a lack of ‘academic maturity’ as a cohort of undergraduate students, they responded positively with feedback suggesting, for some, a ‘transformational’ effect on their practice.

While the changes made were initially intended to solve specific issues encountered on a particular module, it became clear that the research skills students were acquiring

have a significant value for their ongoing development as practitioners. The critical and reflective skills, together with an enquiry-based approach to practice, are well suited to a media landscape where the ubiquity of media can prevent a deeper understanding of them. It changed the students from being producers of content within existing media structures to practitioners increasingly capable of critiquing and re-deploying existing media in the pursuit of new practice. This has raised further questions that need addressing about how contemporary media practices might best be taught. In particular, further research is needed to explore whether research-informed approaches to teaching contemporary and interdisciplinary media practice should become the principle means.

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Julie Marsh is a senior lecturer and researcher at CREAM in Westminster School of Arts. Julie is a specialist in interdisciplinary practice, exploring the intersections between film, installation, performance and site-specificity. Her research is engaged with collaborative and knowledge-led approaches to field research, from moving image to emergent technologies. Through the exploration of real and representational space she investigates how technical machines can perform site, creating critical experiences for audiences that open debate and question social spaces. She has exhibited internationally, most recently as part of the *Three British Mosques at Venice Architecture Biennale* (2021).

Making a Manual: The Manual for the Curation and Display of Interactive New Media Art

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Abstract

The Manual for the Curation and Display of Interactive New Media Art is a creative commons living document aimed at assisting curators and exhibition designers, particularly non specialist curators seeking to engage with interactive new media art. This paper will explain the design philosophy of the manual as well as the methodologies employed.

Keywords

New Media Art, Interaction, Curation, Exhibition Design, Methodologies

Introduction

The Manual for the Curation of Interactive New Media Art was the resulting product of a doctoral research program at the University of Sunderland. This project aimed to create a manual for non-specialized curators and designers interested in working with interactive new media art but may lack basic knowledge on the form. In this paper I will explain the rationale behind the design of the manual itself as well as the methodology and methods used in deriving intersubjective data from a variety of practitioners and sources.

Contextual Review

While manuals for art curation are nothing new, manuals for new media are to this day much scarcer. My research has led me to the conclusion that one of the biggest issues with manuals of new media of any kind, is how fast technology moves, making these documents obsolete within a period of three to five years. For example, the *MITES Manual* by Clive Gillman focuses mostly on video and audio art, and features sections on technologies no longer used in contemporary practice. [1]

While recommendations on technologies such as laser discs (a technology by then already obsolete), PAL and NTSC or the suitability of composite vs coaxial cables in

video setups may be useful for objects created before 2002, for contemporary practice lack of recommendations on streaming, HD formats, VR video and live streaming makes the manual insufficient. This very situation repeats itself over and over again as formats come and go. A second cause for this lack of manuals for new media curation, was the relatively small group of academics that engaged with the form until very recently, as well as the ghettoization of the form within institutional spaces. [2]

Curatorial Context

During the survey of curatorial sources several trends became evident. As mentioned above, the limited number of academics cited, with an even smaller circle of authors being most prominent, amongst these we find Christiane Paul, Steve Dietz, Beryl Graham, Sarah Cook, and Jon Ippolito. [3] For this project, the literature was expanded to include other authors not cited as often, journal articles, and blogs of prominent curators, as well as doctoral theses.

While performing the literature review it also became evident that certain recommendations made in the past such as the expectation of privacy while browsing the web have changed due to recent social and technological shifts. [4]

Finally, pre-pandemic, while interest in curation had been steadily increasing, resources beyond scattered efforts such as the Node Centre's *Curating New Media Art: Process, Interaction, Virtuality* and the University of Salford's module on new media curation were limited and often only accessible to those enrolled in such institutions. Since then, interest in new media curation has risen and the manual has been positively received by the community. [5] [6]

Finally, to this day, literature directly engaging with interactive new media is limited, often being subsumed within the larger field of new media art. This means, that for certain aspects of the manual such as practical curatorial and exhibition concerns, sources had to be sought from adjacent fields such as science museums,

commercial exhibition design and the video game industry as these fields have a more open engagement with interactivity than art historical sources.

Research Questions and Aims

With the aim of creating a comprehensive manual for curating and exhibiting interactive new media art, it was necessary to determine what issues the manual would address and how they could be tackled in the form of a manual.

- What are the challenges curators and institutions encounter when working with interactive new media art?
- How can interactive new media art exhibitions be designed and curated to ensure an exhibition is accessible, usable, and fulfils a curatorial purpose while preserving the artistic integrity of artworks?
- How can these concerns be addressed through a best practice manual?

It is also important to emphasize that the manual's scope was purposefully limited to interactive new media art as this specific aspect has been traditionally ignored or engaged with in a problematic manner, from works being displayed in inaccessible or user-unfriendly ways to up to complete deactivation where the work is rendered inert, and its meaning is lost. [7]

Thus, the resulting manual became a repository of knowledge aimed at non-specialists while also being of use to more experienced curators and designers who may require help engaging with certain aspects of new media art.

As the project progressed, it became evident that part of the reason literature was so limited also had to do with memory making of past exhibitions which limited the ways a curator may learn from the experiences of others. Thus, the manual expanded to include recommendations on how to preserve the history of an exhibition in a way that would benefit future researchers, designers and curators.

It is also important to highlight the fact that while the term curation covers a vast amount of knowledge, from acquiring and cataloguing to research to exhibition design amongst other aspects, in this manual it refers specifically to research and exhibition planning, while the exhibition design aspect does expand to cover all relevant aspects of the discipline within the context of interactive new media art exhibitions.

Methodology

The methodology developed for creating the manual was designed in a way that could first, determine if the manual was something the field required, second, find prior examples of manuals in the field and identify gaps in knowledge, third, as acquiring objective knowledge from the creative practices of curators and designers in a variety of institutions is not possible, it was necessary to develop a method to derive knowledge from their experiences.

The resulting methodology utilized interviews, oral stories, and international case studies to identify potential teachings that could be generalized for use in a manual. These were then tested by comparing them to exhibitions in the United Kingdom, United States, and Mexico to determine their validity in real-world applications.

Practice based research

During the research steps of this project, it became apparent that curators in particular are hesitant to share their findings and opinions while speaking on record. [8] Gray and Malins tell us "creative practitioners tend to treat their know-how as either a trade secret or as not important enough to document.", during the course of this research it became evident the later conclusion may be more accurate, although there also exists a feeling that curation is so unique and individual, that no recommendation would ever be suitable, one last factor was speaking on record, meaning interviewees would be hesitant to offer a recommendation or opinion in an official manner. [9]

Curiously enough, often after the interviews happened, during more casual moments such as lunch or during idle chat, practitioners would be much more candid and open to share their thoughts, for this reason, oral histories became a very important aspect of this work.

As was mentioned in the methodology introduction, creative practices are not objective and depend on the context and experiences of both the practitioner as well as the context of the space. A modified version of Gray and Malins' reflective practice methodology was developed in order to create intersubjective learnings that were general enough to be suitable to a variety of contexts. [10] The methodology presented in *Visualizing Research* is meant to be used by artists and other creatives themselves to reflect on their own practice and find if not subjective data to report as research in order to give legitimacy to their claims at least find intersubjective data that may be validated through its constant occurrence in practice over

time. [11] For the manual, I became a form of facilitator in this process of self-reflection and collecting the knowledge generated in this way. This facilitation comes through my own personal experience as a designer, curator and exhibition designer, which gives me the ability to filter out, to a certain degree, faulty assumption and make editorial choices regarding the discoveries made through the research process.

After repeating this process several times with different practitioners, I was able to identify the common threads which by virtue of recurring between different practitioners, were candidates for consideration as intersubjective data that could be applied in wider context. To further validate this information, it was double checked with other practitioners, now as a general question, and through observation in a practical context, i.e., exhibitions and memories of past exhibitions, with the hopes of furthering the validity of the manual's claims. Should one of these recommendations not be supported by practical data, they were rejected, and further analysis was done to identify other intersubjective data that may have led to its recurrence between practitioners. After this third step it could be safely rejected as a persistent malpractice (bad habit) or reinterpreted in a way that was validated in practice.

Literature

The literature used to support this research included established new media texts, such as *Rethinking Curation*, *Digital Art*, and *Aesthetics of Interaction in Digital Art*, as well as blogs and journal articles of experts in the field such as Steve Dietz, Jon Ippolito, Sarah Cook, and Annet Dekker, to name a few. [12][13][14] However, in the specific field of new media there exists a lack of practical recommendations when it comes to installation and the practical consequences of a work being interactive. For this reason, literature research was expanded to include sources in the wider field of museum studies and exhibition design. A few books were of particular use for this very reason, including *Dinosaurs and Dioramas*, *Exhibition Design Second Edition*, and *Exhibition Design*. [15][16][17] These books cover aspects of interactivity that can be easily translated into new media art as long as one keeps in mind the special treatment that artworks deserve over educational kiosks and commercial products. Such considerations include the fact some works cannot be duplicated, or that not all artworks are meant to be easily accessible and that those difficulties may, in fact, be the entire purpose of the work, or the tendency of

cultural institutions to deactivate works in the name of conservation concerns.

Finally, case studies published by curators such as Helen Stuckey's *Play on Display* and Beryl Graham's *Serious Games* were used as was mentioned above as means to verify the findings made in this research. [18][19]

Case Studies

In order to gather more information on curation and exhibition in the real world, two case studies were carried out. The first study was done at the Laboratorio Arte Alameda (LAA) located in Mexico City and is one if not the only space dedicated solely to new media art where the exhibition *Circuito Alameda* (2018) a monographic exhibition of Brazilian artist Gilberto Prado and curated by Argentinian curator Jorge La Ferla was being installed at the time of the study. A second case study took place at FACT (Foundation for Art and Creative Technology) where the exhibition *REAL WORK* (2018) was underway and the initial planning of *you feel me_* (2019) by curator Helen Starr was taking place. These two institutions were chosen because they are focused on new media art and as such their methods have been developed specifically for working with new media art.

An important factor to choosing Laboratorio Arte Alameda was its documentation center, the Centro de Documentación Priamo Lozada (Priamo Lozada Documentation Center) and its existence outside of traditional western institutions which allowed me to witness and document the difference in approach between western institutions and individuals, and non-western ones. FACT on the other hand was chosen due to its international recognition, the existence of a prior relationship with the institution on my part and offers an interesting contrast to LAA with a lack of a dedicated archive for exhibitions.

Output

The main output of this research is the website <http://inmamanual.wordpress.com>, a living creative commons document that can be actively updated to address changes in technologies and remain up to date unlike many of its predecessors that have over time become obsolete. This manual is free of charge to distribute and reproduce, however, modifications have to be submitted to the author for analysis and validation prior to being implemented. The submission process

consists of utilizing the platform's comment feature or through the author's email. Any contributions will be properly credited and if approved, integrated into the manual. The decision to make the manual a creative commons document was done in order to allow wider distribution and accessibility, again offsetting the limitations of printed manuals and facilitate its use in education settings as well as cultural institutions without the traditional fair use limits imposed on sharing books and documents within an educational setting (e.g., may only reproduce one chapter or 10% of a work for lectures and lessons).

The manual itself is divided into three sections: Curation, Exhibition Design and Memory Making, each section is further divided into subsections. This was meant to facilitate reading of the manual in a modular manner, liberating the reader from the necessity of reading the entire manual sequentially. In fact, this modularity is meant to allow referencing only the sections the reader requires without depending on prior sections for context.

Curation

Curation begins this process by providing context for what is meant as interactive new media art and later heading into crucial concepts that make Interactive New Media Art different from other art media. These include Steve Dietz' three behaviors that characterize new media art [20] and expand on them to better explain the behaviors to non-experts. I also expand on Dietz' and Manovich's definition of interactivity as a means to taxonomize interaction on a scale that ranges from no human centered interactivity to full interaction. [21] The manual also expands on Christiane Paul's Neomateriality to recognize the physical forces that code can exert in the physical world as well as the physicality of certain artworks and thus counter claims that all new media art is either ethereal or abstract with no space requirements. [22] Derived from this, the subsection labelled 2.2.5 Location, also expands on definitions of site specificity expanding it to include virtual sites as locations that due to context or infrastructure make certain works virtual-site-specific. Such sites include video game worlds, social media platforms and remote servers without which works would be deactivated. Other issues such as shared ownership between multiple stakeholders and the audience are also covered in the manual as well as the challenges of conservation of works meant to be played with and how to separate interface from the artwork with the intention of facilitating the presentation of interactive

works and circumvent conservation issues. Other basic concerns covered include time in artworks that may go on forever, require long interaction times, works that depend on time zones distinct to their current location to function and works who may become activated outside of opening hours, all this with the intention of facilitating the planning stages. Finally, the midsection of the curation chapter addresses two more aspects of new media art that affect the upcoming planning stages. Instability refers to new media art's instability which translates in works changing and multiplying either through variations to fit new venues or spaces or teams changing and by undergoing significant alterations in the way of versions. [23] The other aspect covered is reproducibility, specifically the potential for certain artworks to be multiplied or duplicated for ease of access and enhanced interactivity particularly in networked works.

Once the particular aspects of new media were discussed the manual moves on to address labelling, this section is of particular note as it was developed in conjunction with Jon Ippolito and combines his research in *Death by Wall* Label and my own conclusions derived from case studies and interviews. [24] The resulting hybrid (digital/analog) system allows accrediting an expanded group of stakeholders in the work including designers, programmers, musicians and any other individual involved in a work. It also recognizes both the work and its parts as well as the specific form they take within an exhibition and generating a genealogy of the work and its versions and variations. All this data turns the label from a simple document into a full-fledged asset for documentation.

Marketing and tone are also discussed and presents alternatives to technological fetishism, how to engage with new media art beyond the novelty and the importance of being open with new media artists injecting their work into the branding and image of an institution and how to negotiate such interactions in order to both retain institutional integrity while allowing the art to retain its poetics.

The final section of the curation chapter is dedicated to the practical matters of planning, from determining bookings, interaction with complex pieces, resolving issues of compatibility and considering porting certain works that may no longer be compatible with current technology usability and concludes with a suggested workflow that may be adapted and modified to suit any institutional methodologies.

Exhibition Design

This section, the largest of the three, deals with issues of exhibition design starting with the importance of collaboration between curatorial and design teams and with other departments as well. This is important for new media art as its interdisciplinary nature guarantees that different teams in an institution will have experience and knowledge curatorial teams alone may not have, thus ensuring a richer experience for the audience. This knowledge may be practical or theoretical such as understanding the limitations of certain computer systems or identifying aspects of the artwork that may be missed by someone not trained in a certain discipline such as software development, to cite one example. The manual then rescues conversations started in the curation section such as time and space but from the perspective of exhibition design and how such concepts limit and expand creative possibilities.

The next section deals with more practical matters of installation such as hanging, maintenance during the exhibition, power, light and environment control, and media rights before moving to specific recommendations for distinct types of new media such as net art, livestreaming, VR, Video Games, AI and Robotics amongst others. These recommendations, drawn from the intersubjective data derived from case studies, interviews and direct observation are not meant to be the final word on how to curate and exhibit specific new media art, but rather present methods and suggestions that have been proven to work and which may then be adapted by the reader to their needs. The section ends with a discussion on kiosks, their design, accessibility and their potential not only as displays of the works but facilitators for interaction. It also presents lessons learned from various types of institutions on how to make these kiosks durable and efficient.

Memory

The last section of the manual, Memory, addresses two concerns in memory making. First, preserving exhibition histories through thorough documentation and second, beginning a process of documentation for artworks which can then be extended through an institution's regular channels for documentation and preservation. The manual encourages this process of memory making as during the research phase, it became evident few new media exhibitions are thoroughly documented and those that are, in most cases, photographs of the space and the hanging, floor plans, and literature on the exhibition are all that is

preserved [25]. While this is suitable for more static and traditional exhibitions, in the case of new media art it is necessary to track much more, including modifications done to the works to suit them to a space, preserve evidence of specific variations, such as the work being presented as a VR experience instead of as a web browser 3D space as was the case for Gilberto Prado's *Desertesejo* (2000/2014/2018) a work that could not have been recreated after the original assets were lost if not for the thorough documentation kept from previous exhibitions as well as the artist's own notes. [26]

Following that example, the manual presents a variation of the Variable Media Questionnaire and the Laboratorio Arte Alameda's own analogue documentation method to create a hybrid archive that preserves both digital and analogue memory including design notes, work modifications, stakeholders, hardware utilized, sketches, known issues, exhibition walkthroughs, and public interactions and impressions. [27][28] It should be pointed out that the manual does not expect all suggested steps be taken but rather, that one should make an effort to meet as many of the suggested steps as possible and within budget. The manual also presents a method for documenting artworks themselves, including the artists' intentions for the work, reasoning for modifications, interviews with the artist and other creators involved, other stake holders in the process as well as who can provide technical support on the works, related media that is not a part of the work but related to it, its environment, interactions and other literature related to the work.

Finally, the manual makes recommendations for the actual storage of said data including constant monitoring of digital data, migration to new formats as older formats become obsolete, and the creation of physical copies. The manual then ends with a list of other resources for the preservation of new media that delve into the subject more thoroughly.

Conclusion

The Manual For The Curation And Display Of Interactive New Media art required a thorough survey of current curatorial practice, specifically in the field of interactive new media art, which has historically been underrepresented in literature. This multidisciplinary survey was combined with interviews and oral histories collected and then cross-referenced with two case studies, one conducted at the Laboratorio Arte Alameda in Mexico and the other at FACT in the United Kingdom. This then provided the necessary information that, when combined

with the author's own personal experience, allowed for the creation of a manual that provides the combined knowledge of curators and designers from around the world and through Grey and Malins' methodology is given credibility and intersubjective validity. [29]

Furthermore, the manual also contributes to curatorial knowledge by expanding the taxonomies of space to include virtual-site-specificity, time in relationship to interaction and its effects on curation, reproducibility of artworks for the purpose of display, and memory making methods to preserve exhibitions and artworks for future reference and restoration purposes.

Areas for future research for this manual include expanding the manual to include all forms of new media art, continue research on the subjects covered in the manual, and amend and grow the text as technology changes. This will ensure the document's continued relevance. Finally, the manual can be developed into a series of workshops, publications and lead to consulting relationships with institutions that are interested in implementing the manual either in full or in part.

Ultimately, the manual's purpose is to function as a resource for anyone who is interested in creating exhibitions and in this way increase the reach of interactive new media art in not only the artworld but also the wider public sphere.

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The Expanded World of Invisible Images Anna Unterholzner's and Diana Carvalho's Artworks¹

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Abstract

Image apprehension is a dynamic biological process where our brain receives data and converts it according to previous memories. To experience and understand images, we take simultaneously the role of observers and subjects in action. Our perception is embodied and situated in a world that can be both real and virtual. We receive images all around us and we anticipate movements and project our actions in the world. The role of interaction and plasticity in live-wired and embodied experiences, together with augmented technologies, are shaping and expanding human perception. Anna Unterholzner's and Diana Carvalho's artworks explore invisible and expanded imagery to reflect about arts-based research as knowledge creation, production, and dissemination.

Keywords

Invisible Images, Complexity, Mediated Aesthetics, Expanded Imagery.

Introduction: The Role of Interaction and Plasticity in Live-wired and Embodied Experiences

According to David Eagleman, the delicate structure of the brain reflects the environment, and our overall experience influences almost all brain measurable details, from the molecular scale to global cerebral anatomy. [1] We have the possibility of "feeling our own body's invisible states like

tension, pulsations, and the state of the microbiome, thus elevating unconscious signals to the realm of consciousness". [2] In the same idea of how invisible data turn into visible bits of feelings, emotions, and sensations, Eagleman states that the amount of movement in the world, for example, the stability of the ground, the vision that passes through us when we move our legs, the colouring of lines, none of this is determined by our genetics, our experience calibrates it. Anything we stare at becomes invisible. Good information must be updated; "the system ignores things that do not change". [3] Changing states are difficult to grasp and perception is a fluid dynamic system that artists tend to interpret to grasp world complexity.

Any image that "remains perfectly fixed in a position on the retina will become invisible because our brains care about change and all-important information comes from things in flux". [4] Juan Luis Arsuaga, [5] following Julian Huxley, considers that what characterizes human beings is a double tendency: towards migration (leaving the region where they were born) and towards exogamy (reproduction outside the group in which they were born). Thus, human migrations created great geographical differences between populations and crosses between various genetic lines gave rise to the variety of the Homo Sapiens species that has no possible comparison in the animal kingdom. Specialization reduces the ecological niche, and it is versatility that increases it. Our genes are units which extract information from the environment. Humans develop in line with the environment through their family, social and community

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relationships. Genes are also mechanisms of experience that expand rather than restrict our possibilities.

For Eagleman, the following question arises: “Are there parts of the world that are invisible to us and that should be evident? Successful adaptation makes regular features invisible because the body system predicts and generalizes data from the world and makes it invisible by ignoring it with the purpose of saving energy”. [6] This useful brain magic “maintains the system composed, balanced, and ready to make changes”. [7] To understand brain’s magic and how it contrasts with, for example, artificial neural networks, we must understand real and biological memory. In our brains, different interaction scales work together through innovations. The faster layers pass information to the slower ones. These convey balance and structure faster. Following Eagleman, “the power and resilience of a culture comes not from any one level of the system but from the interaction between them”. [8] According to Arsuaga, today there are four fundamental and invisible forces in physics: gravity, the electromagnetic force, the strong nuclear force, and the weak nuclear force. [5]

The digital revolution has so completely changed every aspect of our lives that it is sometimes hard not to think in metaphors. The plasticity of our biological system tells us that what we learn is represented in terms of what we already know, it interacts with our previous memories. “Each experience is foundational, everything new is understood from the older exchanges, and memory is a function of everything that went before it”. [9] Eagleman suggests that unlike a computer, the ‘instructions’ for piloting the machine are not a file; they are linked to everything that has happened before in your life. Interaction and plasticity are key concepts to understand brain activities. That is, “the brain needs to have different systems with different learning speeds: one for extracting generalities from the environment (slow learning) and another one for episodic memory (fast learning)”. [9] The more we learn new things, the more we can absorb the next fact related to it, and the more we are able to predict possible futures.

There is an intriguing variation in human experience in the eye, mind, and memories relationship that we are just starting to understand. According to Carl Zimmer, scientists are finding new ways to probe two not-so-rare conditions to better understand the links between vision, perception, and memory. [10] These two not so rare conditions were named Aphantasia, or the inability to visualize, a condition also known as image-free thinking², and Hyperphantasia, hyper-vivid mental imagery, a condition that might reveal “how our imaginations shape the world we perceive and make us who we are”. [11]

The so-called “Default Mode Network” (DMN) is worthy of mention within the brain’s neural processes of the inattentive or invisible. The activity within this network dismantles information that is regarded as going beyond whether one gives attention or strong focus/care to a task (when the brain is in a “wakeful” rest) and may include detailed experiences during an active task as well. [12] The network interplays with three main regions of our brains: the medial prefrontal cortex, the posterior cingulate cortex, and the angular gyrus. This means that the network is activated most of the time during tasks such as daydreaming, memories about the past, planning the future, empathising with others or, for instance, thinking about others. [12] Surprisingly, the DMN is highly activated when one has a strongly moving aesthetic experience³ with a visual artwork. [13]

Interestingly, this would mean that the suppression of the activity of the DMN in a focused state is released in the case

or a self-referential process of an external object. [13] Even though the exact role of the DMN within aesthetic experiences is still not clear, the information that it contains about the appeal for artworks suggests that within a strong aesthetic experience, non-perceptual aspects play a role. [13] These findings and interlaced processes highlight the connection between the role of our own experiences in non-attentive states and the self-relevance and self-referential processes of these experiences when being moved intensely by works of art. In turn, Ana Peraica considers that “the truth-claim of post-digital photography is framed by the fact that humans cannot produce objective knowledge, even when using machines. Only machines can be objective, with their non-subjective, nonhuman artificial intelligence”. [14] Embodied experience is, according to Peraica, fundamental to our understanding of the world we are living in. Human beings.

Gouveia [15], in her understanding of digital arts and gaming aesthetics had the same approach when considering live-wired cognitive knowledge as a place of embodied mind and body convergence. Based on Damásio’s integrative mind and body connected approach and Maturana’s and Varela’s biological perspective, [16, 17] where human beings are also environment-dependent, Gouveia [15] highlighted the role of interaction in human experience and cognition. Memories are not stored in a file cabinet. They are rebuilt when triggered by the appropriate associations, suggests Franklin. [18] Bodies “learn without awareness, as do cities, because learning is not just being aware of information, it is also receiving information and knowing where to find it; it relates to our ability to recognize and respond to changing patterns”. [19] Without cell interaction the blueprint of our genetic code would be unnecessary. Hans Jonas considers that only if the concept of “life” includes the interaction between organism and environment can it be said that “life gives rise to the species”. [20] The natural selection of the environment and the organism’s random variations or mutations enhance variability and trigger evolutionary mechanisms.

We can create an interior replica of the outside world, in which objects are represented by images (not necessarily visual), organized into categories such as space and time. We don’t know what is out there besides the internal image we develop from our behaviour combining the possible images coming from our experiences and memories. [5]

How Augmented Technologies Are Shaping and Expanding Human Perception

Technological devices enhance human vision, but they are still far from creating embodied subjective experiences like live-wired human memories. According to Peraica, [14] in line with Eagleman, we deal with two types of spaces, “an absolute space that consists of those parts of space that are experienced by the viewer as well as those part[s] of space that are non-experienced”. [14] Both spaces coexist, but one is given a priori, and the other is apprehended by the human perception in the fly movement of living. As Peraica states “new techniques of image making have been developed which bypass the limitations of a human-based point and angle of view, which relies today not upon the integration of multiple viewpoints but rather their computation.” [21] The drone machine-like aerial bird’s eye view changed the previous paradigm of view translating it into a machine-like or nonhuman apprehension that “cannot discriminate between the objects, people, or things which are being perceived.” [21] Peraica suggests that “[i]n parallel to artistic

² For a better understanding of this condition please see <https://aphantasia.com/> (accessed 27.07.21).

³ Noting that this is not the case with merely pleasing or not pleasing aesthetic experiences.

countersurveillance using actual drones, some artists also map drone positions from land, making visible what is otherwise invisible: the very presence and activity of drones in our societies”. [21] Thus, “[c]ombining images from various times with maps, and merging them algorithmically, it creates a total image which is more fiction than document”. [21] For that reason, the question arises, “what shall we dream when everything shows visible? We’ll dream of being blind”. [21] Mediated types of vision oblige us to think about complex systems and how our reality is interconnected with computational thinking. According to Richard Coyne, digital code creates space as a convenient fiction, a rubric that assimilates all concepts. [22] The concept of space, like the concept of consciousness, which BLIND REVIEW has also tried to demystify or deconstruct through Maturana and Varela, António Damásio, Stan Franklin, among others, is a container that covers a diverse set of phenomena. [22] Consciousness was thought of as intention, knowledge, autonomy, “individual self” and contemplation. Space is furnished by perspective, geometrized, standard rules and sets of coordinates.

The spatiality that information technologies – cyberspace and virtual reality – build is composed of ambiguous and distorted narratives where desire plays an important role. Real time exists and moves inexorably forward, events follow one another, and everything is subject to temporal authority. Unlike reality, in digital narratives time goes back and reconfigures itself, events are organized according to the subject’s actions. Regardless of whether these actions are linear, the subject composes the story from their interpretations and their experiences, and this story can be radically non-linear. The human being should assert itself as existence and desire. A philosophy of life must deal with the organism as its objective form but also with its interpretation in the self-reflection of the human being. Hans Jonas, in harmony with Stan Franklin, introduces the action effort as the founding characteristic of the experience.

James Bridle advocates for a real systemic literacy which somehow rescues our ability to experience, to gain agency through the physical and mental space around us with the purpose to “understand and think our place in the world, and our relation to one another and to machines”. [23] According to Bridle, “[c]omputation replaces conscious thought. We think more and more like the machine, or we do not think at all”. [24] Our obsession to process the world through computation makes it even harder to grasp and turns data into complex hyperobjects denying the bonds of time, place, and individual experience that characterise our inability to think about the challenges of the new dark age. For this artist and researcher, rescuing the Homo Ludens⁴ can be instrumental to avoid “arranging the world from the perspective of the machine” because it “renders it computationally efficient, but makes it completely incomprehensible to humans. And moreover, it accelerates their oppression. The current aesthetic and technological obscurity require, according to Bridle, certain modes of resistance to avoid such powerful invisibility. [25]

Shoshana Zuboff, in the book *The Age of Surveillance Capitalism*, adverts about our knowledge that our lives have unique value, but nevertheless we are treated as invisible and disposable. Today the sense of invisibility is widespread and common and if we want to make our future digital, we should avoid focusing on technologies instead of ideas. [26] Maybe familiar categories are not the best way to label unprecedented phenomena such as surveillance capitalism and we must research recent trends properly to avoid

rendering invisible what is going on without further scrutiny.

The increase of opacity and unpredictability can be transformed by the human ability to understand and interpret complex systems, but currently the cynical perspective⁵ “where everybody knows what’s going on, and nobody can do anything about it” remains. The cynical perspective insists on a kind of blind view where “everything is illuminated, but nothing is seen”. [27] A world of ghosts, zombies, and easy preys of conspiracy theory coexist with “[s]cientific and political knowledge” that “cannot escape the horizon of their own experience any more than embodied ones can, but it doesn’t mean that they are not looking at the same thing and thinking ways to articulate it”. [27] Those who live in grey zones avoiding binary and black and white perspectives can build islands of shared embodied experience.

Complex World Poly Perspectives

The passion for truth obscures the ambiguous relationship between fact and fiction and separates what is not separable. Memories and histories are interconnected instances, and only those who believe in ideological purities can still encourage simplified versions of the world. Ana Peraica criticizes the dualism between place and space, considering that it turns out to be quite limiting when we take into account the recurrent opposition between real and virtual space.

Inspired by Henri Lefebvre’s definition of abstract space and its relation to real space, Peraica “includes the historic, military, urban, and economic narratives within these spaces which in turn can make abstract spaces more complex and thus, at least to a limited extent, more real”.⁶ [28] According to the author, “contemporary media epistemology suggests that we do perceive virtual space as if it is real. And we do not disregard the knowledge that is being transmitted. Rather, we live in both virtual and real space simultaneously. Thus, W.J.T. Mitchell distinguished between the virtual space that is transferred by a medium and the unmediated ‘feeling’ of a place in reality. That is to say space is epistemological while place is phenomenological, space is conceived while place is perceived. Yet, today space that is constructed around place, or digital space, is perceived as being integral to our life experience as well”. [28]

According to Walter Benjamin, “[i]n great historical epochs, with the form of collective existence of humanity, the mode of its sensory perception changes. The way in which man’s sensory perception is organized – the medium in which it occurs – is conditioned not only naturally but also historically”. [29] In this way, the alternative realities fabricated by digital technology enable other regimes of sensory perception, which are continuously activated by machines that allow the disconnection of the “tangible” real. For that reason, some artworks turn the invisible into visible bits and pieces of data enhancing, according to Castro, “this close relationship between the visible and the invisible, between the possible and the virtual (...) that modern technology has facilitated.” [30] In this fashion the work of art is a silent “saying” that projects or makes possibilities happen giving rise to visible deeds. [30]

In space and place perception it seems that we already experience a fusion between the ontological and epistemological dimensions. For earlier proto-scientific

⁴ For a better understanding of this concept please see Huizinga, J., (1955 [1938]), *Homo Ludens*, The Beacon Press, Boston.

⁵ For a better understanding of this idea please see Sloterdijk, P., (2011 [1983]). *Critique of Cynical Reason [Crítica da Razão Cínica]*, Relógio de D’Água Editores, Lisboa.

⁶ Supported by Lefebvre’s distinctions between the conceived and the perceived space, or the merge between the ontological and the epistemological, Peraica considers two life dimensions, namely, the represented and the lived one.

thinkers, adverts Dennett, there is no distinction between the manifest image, a type of everyday life ontology, and the scientific image, or the ontology of science. Both images were connected and intermingled “in a single ancestral world of “what everyone knows” that included all the local fauna and flora and weapons and tools and dwellings and social roles, but also goblins and gods and miasmas and spells that could jinx your life or guarantee your hunting success”. [31] Assemblage and detournement techniques are familiar in artistic subjective environments and movements, where artists merge several strategies to create alternative possible versions of incorporated digital and real lives. Peraica quotes in her book, for example, the 19th century first polyperspective experiments from the Pictorialists, who montaged several photographs together in order to produce complex stories such as simulating the existence of ghosts. [21] Dennett also considers how competence without comprehension is ubiquitous in human life, from human action to animals and bacteria. [32] We tend to overlook it.

It was with Cézanne that, for the first time, the filling of preconceived forms with matter was dealt with consciously. [33] Sensory perception in Cézanne’s time was activated to reproduce, through drawing and painting, images extracted from reality that perception managed to capture. “By being able to impose on the same matter two or three shapes simultaneously, it is possible to show, for example, the same apple from different perspectives. This was taken to the apex by Cubism: it was about showing the preconceived geometric shapes (interlocking), in them, the matter serves exclusively to let the shapes appear”. [33] But what would Cézanne do if mastered the use of animation and digital design technologies? Maybe the same thing he did with his brush and paints – he would be drawing an apple from different perspectives, only on a computer screen.

Western culture promoted, according to the Korean philosopher Byung-Chul Han, an unsustainable split between pleasure and knowledge. Complex systems cannot sustain these simple dichotomies, binaries and grand narratives, and more entertainment and more game play doesn’t automatically mean less aesthetic quality. A rejection of entertainment or play can lead to an atrophy of the aesthetic. [34] In tune with Ana Peraica, Byung-Chul Han and James Bridle, we can consider that we are living in a complex world that cannot be reduced or unified without flows and constant changes and, as Peraica states, we can no longer believe in a given perspective system where “the viewer accepts the position which someone else has created, identifies with it, and accepts its gaze, even if that gaze is misogynistic or racist (...)”. [35] Machines and their ability of logic must not be turned into gods by contemporary surveillance. Human beings provide information about themselves unconditionally in social networks and, in machine gaze, every bit of information count (body height and weight, number of steps walked, home furniture disposition, type of supermarket purchases, among other shares on social networks). Sharing this information rises algorithmic knowledge and power and may defeat subjective thinking.

Peter Sloterdijk adverts how one can describe the course of European history up to the 20th century threshold as a procession of apparently dead imaginaries that dedicated themselves to the life of theory in its different forms. [36] The author criticizes the Platonic duality that condemned the West to an emotional impoverishment of all relations with the world and, as Sloterdijk considers, haunted scientific and philosophical thought to this day. The author suggests that “we look at other richer forms of knowledge that survived, for example, in poetry, in the arts, in language, in myths and other creative activities”. [36] Artistical objects are wild objects⁷ which suggest weird⁸ connections and liaisons, evoke ancestry, and promote intertextuality.

Artistic signs have only meaning because “they do not refer to any real object, they do not have a real referent”. [37] According to the distinction between Semiotic and Symbolic modalities, explained by Julia Kristeva, there are two types of texts: genotext and phenotext. In the genotext we find Semiotic processes but also the advent of the Symbolic, we see the different components and faculties and their dispositions and divisions in the body, as well as the surroundings of the ecological and social system that surrounds it, that is, the pre-edipal objects and relationships with the parents. Although this text can be found in language, the genotext is not linguistic but rather a process that articulates ephemeral structures. The author uses the term phenotext to explain language used to communicate, which is described in terms of competence and performance. The phenotext is always divided and separated and is not reduced to the Semiotic process that works in the genotext. It is a structure that can, for example, be generated “in the sense of a grammar that obeys communication rules and presupposes a subject of enunciation”. [38] Certainly, inspired by theories of genetics Julia Kristeva claims that the human body is also a process. The dismembered body is no longer able to regroup, set itself in motion, or function biologically and physiologically unless it is included in a practice that incorporates the process of meaning. Without this practice, the body as a process is disjointed. On the one hand, outside of the process, identity is inorganic, paralyzed, dead. On the other hand, within the process, when confronted with borders and laws, “the subject in process discovers them and makes them present through its practice”. [38]

For Kristeva by identifying knowledge with nature or nature with knowledge, metaphysics avoids thinking of the subject as a producer of the symbolic function. Concrete operations involve a practical relationship with objects, their destruction, organization, etc. This connection with the environment is also knowledge modifies the apprehended object with evident results and transformations. These concrete operations of the body in the environment include sensory and motor actions that are not based on imitations but rather on operations per se. The denial of this unity that places the object as exterior/separated from the body transforms the body into absence, sign. The subject is apprehended as not having a real reference, as if she/he were disembodied. [38] We can consider that this aspect of bodily performance, as an integral part of a system between subject and world, not only inherits Merleau-Ponty’s ideas⁹, but also

⁷ Please see AA.VV. (2012), *Objectos Selvagens*. Ed: Godofredo Pereira, Guimarães 2012, Edições Imprensa Nacional Casa da Moeda.

⁸ In her presentation and dialogue with the artist Tomás Saraceno, Vinciane Despret refers to artistic knowledge dissemination and production as the ability to establish weird connections. Please see

Festival Hors Pistes 16e édition, en intégralité en ligne du 1er février au 14 février 2021 about Images ecologies [L’écologie des images] available here: <https://www.centrepompidou.fr/fr/horspistes2021>

⁹ For a better understanding of this idea please see Merleau-Ponty, M., (1945), *Phénoménologie de la Perception*, Éditions Gallimard, Paris.

integrates biology and bodily materiality through phenomenology in the study of the process of meaning. A disembodied perspective is a convenient fiction to turn the body into a sign, an external entity becomes a symbol with no flesh and body fluids.

Arts do not show consistency through their uniformity but rather through a creative life invested with change, movement, flexibility, and dexterity. Only a harmonious relationship between ancestral life and knowledge enables innovation and empowerment. [39] According to Maturana and Varela, "(...) we don't see the "space" of the world, we live in our visual field; we don't see the "colours" of the world, we live in our chromatic space. (...) as we come to know this world, we will always discover that we cannot separate our history from actions – biological and social – from which it appears to us" [40] and "(...) Bringing up a world is the throbbing dimension of knowledge and is associated with the deepest roots of our cognitive being, no matter how solid our experience. (...) There is no discontinuity between the social, the human and its biological roots". [40] Artists work in this imaginary space of potentialities, and in our contemporary world, it means to be immersed in databases¹⁰ and computational power. In this mixed environment the separation or the opposition between the real and the digital does not make any sense.

According to Mark Coeckelbergh, there "probably never even was a separate sphere or such an opposition between virtual and real in the first place, and it has never been sensible to make the online/offline distinction, at least if that distinction is supposed to have ontological significance. We have always been 'postdigital' from the beginning of the so-called digital revolution. When we are using the Internet and 'online' media and technologies, "we do not leave our bodies at home" [41], and neither are we separate from others or from the so-called external or offline reality; from a phenomenological and non-dualist point of view, our use of these media and technologies should be understood in terms of living experience that is embodied, social, and real. Platonic and modern dualisms are still very influential, but we can at least try to think in a way that goes beyond a dualist platonic split of the world into real and unreal". [41] When we experience still images, we interact with them in an interpretative manner, we relate to them with previous experiences and memories, with our own full body. When we interact with procedural images, those available in gaming, interactive experiences, and installations, we respond actively to these bits of information. All these processes are dynamic and convey our mind and body. We involve our brain, our senses, emotions, and memories in apprehending the space of possible imaginaries.

Anna Unterholzner's and Diana Carvalho's Artworks

Anna Unterholzner focuses on transdisciplinary art and design territories that merge arts and emotions, neuroaesthetics, gaming, interactive media, and gender equity. Since October 2019 she attends the Ph.D. in Fine Arts at the Multimedia Art department at the Faculty of Fines Arts, Lisbon University, under the supervision of professor Patrícia Gouveia and works experimentally.

¹⁰For an overview of the mixed contemporary artistic environment with databases please see Quintán's master thesis by project: Quintáns, P., (2020), *Entre Imagens e Bases de Dados: Percursos e Poéticas Possíveis*. Available here: <https://repositorio.ul.pt/handle/10451/45898> (accessed 15.07.21)

¹¹ Merleau-Ponty, M., (1962 [1945]), *Phénoménologie de la Perception*, Editions Gallimard, Paris. Available here: <https://archive.org/details/merleaupontyphenomenologyofperception/page/n255/mode/2up> (accessed 25.07.21).

In an ongoing project that reflects about the interplay of colour perception and emotional development in different stages of life and body, small textile works were created by Unterholzner. The ongoing project started by depicting the feeling of pleasure and dis-pleasure of a baby by stitches of the body's silhouette on silk textile and silk paint. A next version shows coloured and painted rougher fabric of four emotional states (fear, anger, happiness, and sadness) in early childhood. The project will go on by the use of other materials reflecting about the understanding of our perception, body, and emotions, or as Merleau-Ponty said in his *Phenomenology of Perception*, "my body as field is the fabric into which all objects are woven, and it is, at least in relation to the perceived world, the general instrument of my comprehension".¹¹ [42]

Another project in process of Unterholzner displays microscopic photographs and short movies of fruit. This project engages in a reflection of two of our senses, namely smell (olfaction) and taste (gustation). These creations attempt to explore the changes of the interiority and exteriority of food and the contact with them. The general topic of this project is our abilities of taste and smell and the question about how to look at something in a scientific way or in an aesthetic way. Linked to this project we can name Felice Frankel¹², who connects science, photography, education and design, and the author Jorge Luis Borges, who once stated that "the taste of an apple (states Berkeley) lies in the contact of the fruit with a palate, not in the fruit itself: in a similar way (we would say) poetry lies in the meeting of the poem and the reader, not in the lines of symbols printed on the pages of a book. What is essential is the aesthetic act, the thrill, the almost physical emotion that comes with reading."¹³ [43]

A further experimental reflection of Anna Unterholzner is one on flowing energy through the body while experiencing an emotion created by paintings and augmented reality. The small postcard-size paintings consist of different colour compositions made by acrylic and resin pouring technique. The spectator can perceive the paintings with the mere eye or through the lens of a camera of a digital device. When doing the latter, the painting will re-liquify again and move in various ways, reflecting about our fluids moving physically through the body while being moved psychologically and on the meantime about the perception of a static painting and a moving image.



Figure 1. Artwork image © Anna Unterholzner

¹² For further information see Felice Frankel's website, available here: <https://felicefrankel.com> (accessed 02.08.21).

¹³Please see Borges, J. L., (2012), *Poesia Completa*, Penguin Random House Editions (Vintage Espanol). Available here: <https://docplayer.es/44724625-Poesia-completa-jorge-luis-borges.html> (Accessed 30.07.21).



Figure 2. Artwork image © Anna Unterholzner



Figure 3. Artwork image © Anna Unterholzner



Figure 4. Artwork image © Diana Carvalho/ Photography © Dinis Santos



Figure 5. Artwork image © Diana Carvalho/ Photography © Dinis Santos



Figure 6. Artwork image © Diana Carvalho/ Photography © Dinis Santos

Diana Carvalho works in transmedia art practices that reflect the use of analogue and digital technologies in contemporary art with a focus on photography and mix media installations and environments. Since October 2019 she attends the Ph.D. in Fine Arts at the Multimedia Art Department at the Faculty of Fine Arts, University of Lisbon, under the supervision of professor Patrícia Gouveia. Diana Carvalho attended the residency *Paralaxe*¹⁴ (2020-21) and presented the developed work¹⁵ under this residency in the exhibition named *Whether the Weather* (2021). Diana Carvalho's work explores the exterior space from an interior one challenging the observation point of view through images. Throughout her artistic practice, Carvalho has been exploring issues related to the nature of the image as a way of communicating or showing that which is not present, mainly through media such as photography and drawing, crossing analogue and digital processes, and as means to understand how research processes may be developed through artistic practice.

The work developed in this residency started off by the observation of the University of Porto (IGUP) placed in Vila Nova de Gaia. This was done with the aim to integrate processes of contemporary artistic practice by making use of this specific scientific research place, including its geography, as an object of visual study. Due to the geographical conditions presented by the terrain, a question arose: why would someone climb to the top of a

¹⁴According to the event website: "The term parallax comes from the Greek parallaxis which means change. Frequently used in the scientific context, it refers to the apparent difference in the location of an object from different points of observation. A word that denounces the failure in the rigor of self-centered and watertight perception and that, therefore, establishes itself as a metric system

through the triangulation, crossing and analysis of the same thing from different points of view" (2021). More information available here: <https://www.paralaxe.space/>

¹⁵More information available here: <https://paralaxe.space/detail-index/diana-carvalho/>

hill? Perhaps to have a certain distance, as Goethe points out in “Italian Journey” [44], or to experience what André Malraux’s posits in his Imaginary Museum,¹⁶ as a suggestion on how to look at the landscape and the amount of images that are made possible through the IGUP’s observation point. From this, the work developed over the course of three months emerged as a kind of visual map built from collected images, that was initially created from a general point of view but later a particular one, linked to Diana Carvalho’s personal experience of the place. The landscape itself was perceived as being a constructed image [45], one of an illusory nature, an ordering of the visible through our cultural references, leaving aside the conception of landscape as an equivalent of nature and as a poetic representation of the world.

From this reflection, it was asserted that the set of images collected during the first part of the residency could be defined by the following ideas: wind / geometries / landscape overlays / meteorological observatory / background sounds / architectural elements scales / aimless perspectives / garden paths that go nowhere. After selected and analyzed, the collected images gave rise to three sets of categories, defined by their content: i., views comprised of the garden’s meteorological measuring devices; ii., objects or fragments not resulting from the IGUP’s scientific research; and iii., the point of view from an inside space over an exterior one, through the frame of a window. The final part of the residency work, which is hereby presented, was built reflecting the possibilities of the studio-based research practice, in the relationship between image and territory, which has become inseparable from the project.

Conclusion

Supported by the assumption that there is a merge between the conceived and the perceived in analogue and digital spaces. An inseparable connection between an ontological and epistemological dimension or perspective, we can consider that image apprehension is a dynamic biological process where our brain receives data and converts it according to previous world experiences and memories.

Anna Unterholzner’s and Diana Carvalho’s artworks, in their explorations and research about invisible and expanded imagery, reflect about arts-based research as knowledge creation, production and dissemination pointing to the phenomenological integration between conceived space mind maps and the perceived place of reality. In that fashion, we can consider that the merge between the ontological and the epistemological life dimensions, namely the possibility of identifying simultaneously knowledge with nature and nature with knowledge, as Kristeva once proposed, is the only way to think about the subject as a creator and producer of the symbolic function and of meaningful artistic proposals.

We echo Benjamin Bratton’s words: “[i]f Philosophy and the Humanities are to claim due legitimacy for present and future challenges, the collective conception of another positive biopolitics –based in the reality of our shared technical and biological circumstances–is absolutely essential”. [46] Humans will survive only if they use resources with rationality, inclusion, and care, transforming the present into a possible sustainable future. Arts, aesthetics, and philosophy can be the territory to articulate possibilities for that possible future.

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The Cabinet of Wolfgang von Kempelen: AI Art and Creative Agency

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Abstract

The aim of this paper is to expand the existing critical discourse of AI art with new perspectives which can be used to examine the creative attributes of emerging practices and to assess their cultural significance and sociopolitical impact. It discusses AI art projects that explore creative agency and associated topics such as authorship, authenticity, intellectual property, and labor. The focus is on works that exemplify poetic complexity and manifest the epistemic or political ambiguities indicative of AI science, technology, and business. By comparing, acknowledging, and contextualizing their accomplishments and shortcomings, the paper outlines the possible directions to advance the field.

Keywords

AI Art, Anthropomorphism, Artificial Intelligence, Authorship, Creative Agency, Creativity, Machine Learning.

Introduction

From a small community of computer artists who experimented with artificial intelligence (AI) in the 1970s, AI art has expanded, gained visibility, and attained cultural relevance since the second half of the 2010s. Contemporary AI art includes practices based on diverse creative approaches to, and various degrees of technical involvement with, the increasingly affordable machine learning (ML) architectures such as Deep Learning (DL). Its topics, methodologies, presentational formats, and implications are closely related with a range of disciplines engaged in AI research, development, and application. AI art is affected by epistemic uncertainties, conceptual challenges, conflicted paradigms, discursive issues, ethical, and sociopolitical problems in AI science and industry. Similar to other new media art disciplines, AI art has had an ambivalent relationship with the mainstream contemporary artworld (MCA), marked by selective marginalization and occasional exploitation. [1]

Its interdependence with AI infrastructures, technologies, and socio-economic trends, exposes AI art to a critical consideration within a broader cultural context. The existing literature comprises several studies of AI art and implicitly relevant works. For example, Mitchell [2], as well as Marcus and Davis [3], provide a conceptual, technological, and sociocultural critique of AI research. Kearns and Roth [4] and Pasquinelli [5] address the ethical, socio-

political, and cultural consequences of the AI's conceptual and technical issues, and inherent biases. Miller [6] includes AI art in his examination of creativity, and Źylińska [7] opens a discussion of AI's influence on visual arts and culture. Cetinić and She [8] provide an overview of AI research that takes art as a subject matter, outline the practical and theoretical aspects of AI art, and anthologize the related publications. Zeilinger [9] investigates the tactical and posthumanist values of AI art. I address the ambiguities that AI art shares with AI-related creative disciplines [10], the AI art's entanglements and cultural integration [11], and the dynamics of contemporary AI art. [12]

In this paper, I discuss AI art practices that explore the notions of creative agency, authenticity, authorship, intellectual property, and labor. I address the conceptual, expressive, and ethical aspects of these practices, focusing on works that exemplify poetic complexity and manifest the epistemic or political ambiguities indicative of AI science, technology, and business. By tracing these ambiguities I outline the possible directions to tackle the challenges and advance the field. The aim of this paper is to expand the existing critical discourse of AI art with new perspectives for understanding the conceptual and contextual nature of ML as a medium in the age when the arts, together with science and technology, are becoming increasingly responsible for changing ecologies, shaping cultural values, and political normalization.¹

Features

The poetic scope of AI art derives from computer art and generative art, and is primarily informed by the various phenomenological aspects of sub-symbolic ML systems. Themes such as creative agency, authorship, originality, and intellectual property are widely attractive to AI artists, popular with the media, and fascinating to the audience. The malleability of these notions was central to modernism and postmodernism, and artists have been addressing them with computational tools since the 1960s, so this recent surge of interest is probably due to a combination of the

¹ The paper's title references *The Cabinet of Dr. Caligari* (1920), a classic German Expressionist film about irrational and cruel machinations of authoritarian systems, and Wolfgang von Kempelen, the 18th century inventor of a fake chess-playing automaton called *Mechanical Turk*, with a human operator hidden in its cabinet stand.

novelty of DL, its processual opacity, and its informational or formal effects. However, artistic exploration of this territory has been challenged by the AI's most pervasive ambiguity—anthropomorphism.

Anthropomorphism manifests in various forms. One is a tendency to assign human cognitive or behavioral features to non-human entities or phenomena, which is often difficult to identify and sometimes has undesired consequences. It is complicated by the corporate AI's crowdsourcing of cheap, invisible, and underrecognized human labor for tasks such as dataset interpretation, classification, or annotation. [13][14] A converse form of anthropomorphic fallacy is to conflate the artists' creative agency with cumulative human creativity embedded in their tools, which simultaneously deprives artists of their own inventiveness, and lifts the responsibility off their creative acts. It often exploits the trope of the ever "blurring line between artist [ghost] and machine" [15], and involves experiments that are supposed to establish "who is the [real] artist" or "what art is better" by manipulating the preferential conditions of human subjects tasked with evaluating human- and machine-produced artefacts. [16][17] Such experiments are largely naïve or manipulative because they presume, and instruct the subjects, that their test material *is* art while omitting two fundamental distinctions: *who* considers whether something is an artwork, and *why*. [18] They disregard that *art is artificial by definition*, and ignore well-informed notions about the complex relationship between creative agency, authorship, and technology. [19][20][21]

The Elusive Artist

Pioneering AI artist Harold Cohen had an ambiguous relationship with machinic creative agency and flirted with anthropomorphic rhetoric about his life-long project *AARON* (1973-2016) which experimented with translating and extrapolating some components of human visual decision-making into a robotic drawing/painting system. [22] Not surprisingly, the most popular contemporary AI art belongs to the saccharine reiterations of Cohen's approach, in which artists "teach" their robots how to paint, such as Pindar Van Arman's *Painting Robots* (2006-) or Joanne Hastie's *Abstractions (Tech Art Paintings)* (2017-). [23][24] These projects "serendipitously" merge technically competent execution with weekend painter's enthusiasm, dilettante aesthetics, conceptual ineptness, and ignorance of art-historical context. The meaning of the word "art" collapses into banal, camera-driven visualizations, rendered and presented with amateurish self-confidence. Anthropomorphism is advocated within the art-academic domain as well, for example by Simon Colton's verbiage about his software project *The Painting Fool* (2012) that "will one day be taken seriously as a creative artist in its own right." It aims to dramatically expand the "artistic range" of Cohen's *AARON* by introducing the interface that could be trained by different human artists to critically appraise its own work, and (in future versions) the work of other artists. [25]

Fewer artists address the subtlety of this topical range. One of them is Adam Basanta. In his installation *All We'd*

Ever Need Is One Another (2018), a custom software randomizes the settings of two mutually facing flatbed scanners so that in every scanning cycle each captures a slightly altered mix of the facing scanner's light and its own unfocused scanning light reflected off the facing scanner. The perceptual hashing algorithms then compare each scan to the images in a large database assembled by scraping images and image metadata from freely accessible online repositories of existing artworks. If the comparison value between the scan and its most similar database image exceeds 83% based on the parameters such as aspect ratio, composition, shape, and color distribution, the software declares a "match", selects the scan for printing, and labels it with the matching image metadata. [26] When it selected and labeled one of the scans as *85.81% match: Amel Chamandy 'Your World Without Paper', 2009*, Canadian artist Amel Chamandy initiated a legal action about the intellectual property rights against Basanta because of the reference to her photograph although Basanta's print is not for sale, and he apparently does not use it for direct commercial gains by any other means. *All We'd Ever Need...* disturbs the concepts of authorship, originality, and intellectual property by legitimately and consistently applying the functional logic of ML, while the intricacies of the lawsuit it triggered exemplify the intellectual and ethical issues of our tendency to crystalize the commercial rights of human creativity. [27] It links the notion of "autonomously creative" AI with appropriation strategies but couples its playful production setup with a tangible referencing system. This allows it to go beyond "preaching to the choir" with a satirical or cynical reaffirmation of cultural trends, towards engaging (and provoking) mainstream artists, their agents, collectors, and audience. It effectively critiques the chronic rigidity of intellectual property conventions in general, and particularly the emerging modes of crypto-based art monetization.

Basanta's and other artists' exemplar works such as Nao Tokui's *Imaginary Landscape* and *Imaginary Soundwalk* (both 2018) [28], or Anna Ridler's *Myriad (Tulips)* (2018) and *Mosaic Virus* (2019) [29], approach AI both as a criticizable technology and a sociopolitical complex, and recognize the variable abstraction of technologically entangled authorship. They demonstrate that crucial aesthetic factors such as decision-making, assessment, and selection are human-driven and socially embedded regardless of the level of complexity or counter-intuitiveness of the tools we use for effectuating these factors. They remind us that our notion of art is a dynamic, evolving, bio-influenced, and sociopolitically contextualized relational property which needs continuous cultivation.

Performative Aesthetizations

Performance artists who enjoy corporate AI sponsorship tend to emphasize dubious human-centered notions of creative agency through sleekly anesthetized mutations of earlier avant-garde practices. For example, Sougwen Chung's projects, such as *Drawing Operations Unit: Generation 2* (2017, supported by Bell Labs) [30], draw a

comparison with Roman Verostko’s algorist compositions from the 1980s and 1990s. [31] Whereas Verostko discreetly encapsulates his formal experiments into a relationship between a pen-plotter and its material circumstances, Chung uses the theatricality of her homo-robotic collaboration as a “spiritualizing force” to mystify the manual drawing process—which is by nature highly improvisational and technologically interactive.

Similarly, Huang Yi’s robotic choreography *HUANG YI & KUKA* (2015-, sponsored by KUKA) [32] spectacularizes the metaphors of harmonious human-machine interaction and mediates them safely to the passive spectators, while the referential Stelarc’s performances since 1976, such as *Ping Body* (1996), emphasize the existential angst and uncertainty of shared participatory responsibilities between the artist, the technology, and the audience who all have a certain degree of manipulative influence on each other. [33] Also sponsored by KUKA, Nigel John Stanford’s musical performances, such as *Automatica: Robots vs. Music* (2017) [34], can be viewed as encores of Einstürzende Neubauten’s concerts from the 1980s “spiced up” for tech-savvy cultural amnesiacs. [35] Rehearsed beyond the point of self-refutation, Stanford’s “improvisations” stand in as formally polished but experientially attenuated echoes of Einstürzende’s rugged guilty pleasures in sonic disruption.

With high production values and aesthetics palatable to a contemporary audience, these AI-driven acts largely evade the unfavorable comparisons with their precursors and serve as marketing instruments for their corporate sponsors by promoting vague notions of a robotically-enhanced consumerist lifestyle. Their persuasiveness relies on our innate anthropocentrism, myopic retrospection, and susceptibility to spectacles.

The Uncanny Landscapes

The exploration of anthropomorphism in AI art often involves the uncanny appearance of artificial entities. Uncanniness is the occasional experience of perceiving a familiar object or event as unsettling, eerie, or taboo. It can be triggered in close interaction with AI-driven imitations of human physical or behavioral patterns. [36]

Some artists approach it by extracting human-like meaningfulness from the machinic textual conversation, for example in Jonas Eltes’ *Lost in Computation* (2017) [37] with reference to Ken Feingold’s installations such as *If, Then, What If*, and *Sinking Feeling* (all 2001). [38] In these works, natural language processing systems provide semantically plausible but ultimately senseless continuation of narrative episodes which allude to the flimsiness of the Turing test and serve as (vocalized) metaphors for our lives. They extend the experience of uncanny awkwardness into the absurdity of miscommunication and the overall superficiality of the systems tasked to emulate human exchange.

Ross Goodwin and Oscar Sharp used this type of slippage to disrupt the cinematic stereotypes in their short film *Sun-spring* (2016). Trained with the 1980s and 1990s sci-fi movie screenplays found on the Internet, Goodwin’s ML software generated the screenplay and the directions for Sharp

to produce *Sun-spring*. [39] The film brims with awkward lines and plot inconsistencies but qualified with the top 10 entries of the Sci-Fi London film festival’s 48-Hour Film Challenge. *Sun-spring* reverses the logic of movie search algorithms and playfully mimics contemporary Hollywood’s screenwriting strategies largely based on regurgitating successful themes and narratives from earlier films. [40] By regurgitating *Sun-spring*’s concept and methodology two years later, Alexander Reben produced *Five Dollars Can Save the Planet* (2018), “the world’s first TED talk written by an A.I. and presented by a cyborg.” A YouTube comment by MTiffany fairly deems it “Just as coherent, relevant, and informative as any other TED talk.” [41]

Ironically, projects that combine uncanniness with our apophenic perception in order to “humanize” AI often contribute to diverting attention from pertinent sociopolitical issues. For example, with *JFK Unsilenced: The Greatest Speech Never Made* (commissioned by the Times, 2018), Rothco agency aimed at contemplative uncanniness by exploiting the emotional impact of sound to reference the romanticized image of John F. Kennedy. [42] Based upon the analysis of recorded speeches and interviews, Kennedy’s voice was deepfaked in a delivery of his address planned for the Dallas Trade Mart on 22 November 1963. The voice sounds familiar, but its cadence is uneven, so the uncanniness relies mainly on the *context* of the speech that the young president never had a chance to give. However, even with perfect vocal emulation, this exercise could never come close to matching the eeriness and deeply problematic political context of Kennedy’s televised speech on 22 October 1962 about the Cuban missile crisis in which sheer good luck prevented multilateral confusion, incompetence, ignorance, and insanity of principal human actors from pushing the world into a nuclear disaster. [43]

Visual deepfakes, such as Mario Klingemann’s *Alternative Face* (2017) [44] or Libby Heaney’s *Resurrection (TOTB)* (2019) [45], approach uncanniness by simultaneously emphasizing and betraying the persuasiveness of statistically rendered human-like forms. This strategy was prefigured conceptually and procedurally by Sven König’s *sCrAmBIEd?HaCkZ!* (2006) that used psychoacoustic techniques for continuous real-time audiovisual synthesis from an arbitrary sample pool of stored video material to mimic any sound input. [46] Perhaps this innovative project has been largely forgotten because König pitched it to the VJ scene instead of using it to develop his own artworks that establish meaningful relations between stored videos and input audio. Along with the sophistication of his technique, König’s expressive mismatch may have anticipated some issues of contemporary AI art.

The Mechanical Turkness

The sociopolitical aspects of anthropomorphism can be effectively addressed by artworks that expose human roles and forms of labor behind the “agency” or performative efficacy of corporate AI. For example, Derek Curry and Jennifer Gradecki’s project *Crowd-Sourced Intelligence Agency (CSIA)* (2015-) offers a vivid educational journey

through problems, assumptions, or oversights inherent with ML-powered dataveillance practices. [47] It centers around an online app that partially replicates an Open Source Intelligence (OSINT) system, and allows the visitors to assume the role of data security analysts by monitoring and analyzing their friends' Twitter messages, or by testing the "delicacy" of their own messages before posting them. The app features an automated Bayesian classifier designed by the artists and a crowdsourced classifier trained on a participant-labeled data from over 14,000 tweets, which improves its accuracy by the visitors' feedback on its previous outputs. *CSIA* includes a library of public resources about the analytic and decision-making processes of intelligence agencies: tech manuals, research reports, academic papers, leaked documents, and Freedom of Information Act files. This relational architecture offers an active learning experience enhanced by the transgressive affects of playful "policing" in order to see how the decontextualization of metadata and the inherent ML inaccuracies can distort our judgment. It also serves as a gentle reminder of our complicity in the politically problematic aspects of applied AI through conformity, lack of involvement, or non-action.

Similarly, in RyBN and Marie Lechner's project *Human Computers* (2016-2019), multilayered media archaeology of human labor in computation since the 18th century offers revelatory insights into the use of human beings as components of large computational architectures. [48] It shows that many AI applications have in fact been simulacra, mostly operated by echelons of underpaid workers, which corporate AI euphemistically calls "artificial Artificial Intelligence" (AAI) or "pseudo-AI". This foundational cynicism of corporate AI also indicates that its development imposes an exploitative framework of cybernetic labor management. A sub-project of *Human Computers*, titled *AAI Chess* (2018), was an online chess app with three all-human playing modes: human vs human, human vs Amazon MTurker, and MTurker vs MTurker. Two years later, Jeff Thompson "replayed" *AAI Chess* with his performance *Human Computers* (2020) in which the audience members were tasked to manually resolve a digital image file (Google StreetView screenshot of the gallery) from its binary form into a grid of pixels. With 67 calculations per pixel, the complete human-powered image assembly takes approximately eight hours. [49] Here, the visitors' enactment of automated operations asserts how a combination of complexity and speed in pervasive technologies makes them difficult to understand and manage by an individual.

By wittily "exploiting" human labor to emulate the features of AI systems, these projects remind us that the "Turk" in AI is still not mechanical or artificial enough, it resists "emancipation", and it is not easy to make it more "autonomous". Their self-referential critique also points to the ethically questionable use of crowdsourcing in art practices, exemplified by earlier Aaron Koblin's projects *The Sheep Market* (2006), *10,000 Cents* (2008), and *Bicycle Built for Two Thousand* (with Daniel Massey 2009). [50]

However, artistic attempts to approach computational creativity through active open-sourced participation can be

equally undermined by muddled anthropomorphic notions. Seeing ML as a tool that "captures our shared cognitive endowments", and "collective unconscious or imagination" [51], Gene Kogan initiated a crowd-sourced ML project *Abraham* in 2019 with a goal to redefine agency, autonomy, authenticity, and originality in computational art. In the initial two parts of the incomplete four-part introduction, Kogan describes *Abraham* as "a project to create an autonomous artificial artist, a decentralized AI who generates art", and provides an elaborate, semantically correct but conceptually derisive, discussion of this idea. [52]

Issues

These examples show that, through success or failure, AI art expands the idea of technologically entangled creativity, and that conscious consideration of the notion of creativity is a prerequisite for human creative endeavors. They also point to the human fallacies and biases, cultural constraints, and sociopolitical ambiguities, which manifest in the conceptual, methodological, ethical, and educational domains of AI art. By identifying, acknowledging, and understanding these issues, artists can refine their creative approaches and find new ways to intervene critically and productively in the AI-influenced social reality.

Conceptual

AI research struggles with encoding crucial aspects of human cognition—such as intuitive knowledge, abstraction, and analogy making—into machine intelligence. [53][54] Similarly, the conceptual realm of contemporary AI art is most deficient in interesting intuitions, meaningful abstractions, and imaginative analogies. The field particularly lacks projects that use AI systems as means to actualize strong concepts that effectively address wider perspectives or deeper issues of human existence. The lack of conceptual sophistication also manifests as a disproportion between the artists' computational dexterity, their eloquence in articulating relevant ideas, and their competence with broader artistic, cultural, or historical contexts.

AI art tends to be technologically self-referential as many works rely on tautological or circular concepts or themes based on the artists' ideas about ML. Various notions of bio-detached and socially unembedded creative agency permeate both AI art production and its popular representation through confused, ambiguous, or openly mystifying rhetoric about "machinic artistry". They promote a pseudo-romantic quest for human-flavored creative "essence" within ML systems (and AI in general) instead of demystifying them as sociopolitical apparatuses which have little to do with creativity per se, and are better understood as sophisticated tools for statistical analysis. [55]

Complex devices such as computers and software only represent the cumulative human creativity invested in their design, but the artists' self-awareness, reasoning, abstraction, conceptualization, generalization, and analogy-making in dealing with these tools inform the cogency of their

works. Their idiosyncratic mental abilities, senses, emotions, passions, obsessions, and incentives determine how they interact with the world and make their art. These qualities and aspects should be in the forefront of AI artmaking. Conversely, a responsible approach to AI art requires a clear understanding that—while different forms of creative intelligence are possible and explorable—computers, robots, or algorithms are not artists because they do not embody human social embeddedness, cognitive capabilities, skills, quirks, and, most importantly, *human motivations for making art*. [56][57] Art is a human dispositive within anthropological and sociocultural perspectives, so motivations for expressing creativity through artmaking are partially driven by the evolutionary competitive ambition; among its many functions, art is a socially-constructed system for displaying mating fitness (intelligence, proteanism, wit) and for exhibiting or gaining social status. [58] Therefore, it is crucial to acknowledge that the poetic qualities of our artefacts are inherently instrumentalizable as virtue signaling means.

Cognitive

Technocratic or technofetishist mentalities have been haunting computational arts since their outset [59], and continue to affect AI art. [60] Production, perception, and reception of the arts have always been evolving in a complex symbiosis with technological and sociopolitical trends [61], so AI artists—as well as the media and the cultural sector which represent them—should be critically aware of these entanglements. The poetics of AI art will remain a facile reflection of its technological reality as long as artists keep constraining their notions of expressive cogency to a prima facie relationship with technology.

Successful AI art projects utilize their entanglements self-consciously, as the conceptual, tactical, and existentially inherent features within a broader context of digital culture. However, the complexity, interdependence, and pace of change make digital tools difficult to keep under artistic control. Most notably, the breadth of procedural literacy and coding skills required for elaborate AI art production tend to shape the artists' poetic reasoning, exploration, and learning by directing their creative focus toward mathematics and programming. [62] In general, the engineering approach is usually a welcome enrichment of the "traditional" artistic mindset, but when it takes priority over other poetic factors, it reduces the scope of artists' critical engagement and the impact of their works.

AI artworks that aim at a tactical or critical approach toward creative agency and expressive authenticity are also affected by academism [63] which exposes them to recuperation due to the lack of methodological clarity, formal cogency, or experiential impact. Solidly conceived and well-motivated tactical concepts are sometimes rendered as dry, humorless, unengaging, critically ineffective, or counter-effective works. Together with a few other projects discussed in this paper, Tom White's *Perception Engines* (2018 and 2021) [64] and Ben Bogard's *Zombie Formalist* (2021) [65] exemplify this issue. [66]

Ethical

Artists have faced the challenges of ethical integrity conflicting with professional well-being throughout uneasy coevolution between the open-endedness of artistic proteanism, and the ambiguous flux of discourses, criteria, and hierarchies in the artworld and scholarship. Reputation games in art community are driven by fluid social networks, cliques, coteries, and intrigues, directed by unstable loyalties or affiliations, and shaped by fancy, fashion, and authority appeal. Their capricious dynamics tend to reduce merit to a temporal figure of speech while upholding cultural hegemonies, institutional privileges, and profit-driven power games. Such volatile vocational milieu—combined with inherently high production demands and intrinsic need for endorsement by corporate AI, MCA, or academia—makes AI artists particularly liable to becoming intentionally or subconsciously manipulative, to compromising their creativity, and to softening their critical edge. [67] If they strive for integrity, all actors in AI art should be able to recognize these systemically noisy professional value systems, assess them objectively, and correct them.

AI art reflects the artists' motivations and ethical decisions in making their works and building their careers within a context of zeitgeist-relative interferences between the arts, science/technology, cultural trends, and sociopolitical vectors. [68] Regardless of their modes of involvement with broader issues of AI ethics, artists are responsible for their own roles in shaping cultural values and political normalization. Most artists, authors, and cultural operators prefer to ignore this sensitive territory for the sake of professional survival, which may seem obvious but in fact, draws a higher order of ethical implications. As long as this territory is protected by hypocrisy and vanity, the cognitive value of art criticism will remain inferior and complacent to diminishing the transformative potentials of the arts.

Prospects

The expressive, intellectual, and ethical implications of AI art have been relevant primarily as reflections of the AI's challenges, shortcomings, and ambiguities, but the diversity and criticality of the field have been improving as the initial hype is toning down, and more artists start to explore ML. They can establish insights into all important aspects of the AI-influenced world through meaningful relationships with the issues, contingencies, and advances of AI technology. [69] In order to engage the audience with a lasting impact, AI artists need to balance their motivational sincerity and ideational cogency with procedural skills, and maintain a critical outlook on their poetic devices.

Competences

The ethos of maturely calibrated competencies deserves cultivation through playfulness, bricolage, technical and conceptual hacking, and imaginative discovery that characterizes other areas of emerging media art. This requires a realization that art happens not simply by adding material

configurations that no one has witnessed before, but by integrating organized matter into complex human interactions that help us understand the world differently, make us better, or give us a chance to become better. AI artists need stronger criteria for poetic thinking, and better multidisciplinary knowledge of historical, theoretical, cultural, and political contexts in which they produce and present their works. [70] They should catalyze their procedural proficiencies by systematic training in related non-computational art disciplines, so they can appreciate the cognitive and physical demands of creative work in a broader existential sense. By raising the awareness of technocentrism in their practices, AI artists can also promote the necessary changes in STEAM education.

Creativity

Corporate media, some art institutions, and artists misrepresent AI algorithms as “artists”, and uncritically sensationalize shallowly anthropomorphic AI art. By debasing artistically crucial cognitive abilities which constantly evolve in humans, they legitimize the regressive, intellectually offensive, and politically dangerous cultural ignorance. AI artworks that glamorize narrow concepts of creativity sustain the notions of monolithic authorship rather than advocating for heterogeneous or conjugated actualization of the expressive agency. Intentionally or unintentionally, they reinforce the anthropocentric models of creativity which benefit the problematic culture of proprietary mental labor. [71] As AI art diversifies, these compound aspects are becoming increasingly evident and addressed more clearly. However, the future poetic scope of AI art may be limited by conservative initiatives for imposing legal instruments which would keep the creative decisions under centralized profit-motivated control. The responsibility for tackling these issues lies not only with the artists, but also with scientists, entrepreneurs, cultural agents, and the public.

To address the allurements of exploitatively incentivized creativity (for its own sake) [72], artists should articulate and respect their methodologies as heterogeneous productive frameworks which inform the audience by stirring inquisitiveness and critical thinking, stimulating imagination, and encouraging progressive action. Within this context, there is an underexplored analogy between the normalization of children’s creative idiosyncrasies through socialization and the artists’ conscious or intuitive compliance to cultural trends. [73] By directing their transgressiveness beyond amusement or showmanship, AI artists can turn their wit and versatility into exemplars of meaningful resistance to the social imperatives and existential bleakness. [74]

Commitment

The socio-technical entanglements of AI art with corporate AI, MCA, and academia may support the forthcoming art projects, but also attenuate their criticality and expedite recuperation. A straightforward way for artists to tackle this precarious relationship is to not prioritize their careers

over their art, be open to taking genuine risks, and pursue systematic support with skepticism toward institutional rationales for art sponsorship. The key requirement of avant-garde art is a deep, constructive dedication to evolving potentially hazardous ideas and finding effective ways to share them with the thinking audience. It takes exceptional curiosity, inventiveness, and enthusiasm to do any creative work without anticipating affirmation, compensation, or success, and artists cannot maintain such costly order of priorities indefinitely. Therefore, both the public and the institutions should rise above their unspoken but unrealistic and ultimately cruel expectation that an artist should continuously deliver significant works.

In a broader prospect, the frameworks of contemporary art, science/technology, and education can provide significant incentives for the unbiased development and representation of AI art, thus enhancing the exploration of AI; but they need thorough reconsideration and reconceptualization in order to be self-critically adaptable for absorbing the knowledge and value systems that emerge from various relevant disciplines. [75] This requires close cooperation between artists, institutional representatives, and the public in exposing the political hegemonies, and criticizing the coercive evaluation criteria imposed by the artworld, academia, politics, economy, and the media.

Critique

The tactical impact can be improved by examining the cultural and sociopolitical contexts of AI technology and business, and by deeper probing, understanding, and problematizing the underlining concepts of intelligence, creativity, expressive agency, intellectual labor, and ownership. The flexibility and mutability of these concepts are inherent to sociocultural dynamics, and technologies such as ML or blockchain can be used to reconfigure them in interesting ways but challenge them less drastically than it is widely presumed. [76] By demystifying seemingly radical capabilities of their tools, AI artists can leverage questions of authorship and authenticity as critical assets with wide political significance. Empowered by the destabilizing value of humor, responsible treatment of these assets can build new insights about human nature and provide meaningful posthumanist perspectives. [77][78]

AI art also requires appreciation models for experientially, intellectually, and emotionally competent spectatorship keyed to an artworks’ demands. [79][80] This paper’s outlook on the creative agency in AI art aims to expand the exploratory discourse with new critical perspectives for understanding the nature of ML as an artistic medium. It concerns the accomplishments, shortcomings, and ambiguities across the AI art-related disciplines, and facilitates comparative insights into their sociopolitical, cultural, and historical contexts. As AI art diversifies, these critical perspectives can be taken to identify and study the creative attributes of emerging practices in order to assess their cultural significance and sociopolitical impact.

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Nam June Paik's Bibimbap Aesthetics as a Korean Reinterpretation of the Gesamtkunstwerk

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Abstract

Nam June Paik often describes his mixed media based on *bibimbap aesthetics*. Bibimbap is a Korean traditional rice dish, which incorporates diverse side dishes as toppings. The discrete beautiful topping pattern on bibimbap becomes a whole new entity by mixing them together. Like bibimbap, Nam June Paik's art shows creative combinations among a variety of media. Paik's bibimbap aesthetics is a Korean reinterpretation of the Gesamtkunstwerk, or total work of art. This paper explores Paik's artistic transition from non-mixed media to bibimbap aesthetics as a Korean version of the Gesamtkunstwerk.

Keywords

Nam June Paik, Gesamtkunstwerk, bibimbap, viral aesthetics, medium specificity, John Cage

Introduction

In 1967, Nam June Paik published the essay "Electronics, Arts, and Bibimbap," for Korean readers. [1] In his writing, bibimbap aesthetics was a creative tool for approaching the emerging phenomenon of mixed media in contemporary art. Bibimbap is a Korean traditional food, which combines rice, an egg, meat, and a variety of vegetables. The term *bibimbap* is a compound word: bibim (mixing) and bap (rice). It literally means "mixed rice with something." Bibimbap does not include objects, and it is open work with variations based on locations and seasonal products. The aesthetic image of bibimbap is replaced with a harmonious flavor which comes out through a blending process with red pepper paste and a hint of sesame oil. Paik thought that bibimbap showed Koreans' preference to a harmonious combination with heterogeneous materials. However, in 1956, when Paik had just arrived in Munich to pursue a PhD in musicology, he followed serialism, the opposite of mixed media. Paik studied and practiced serialism, or twelve-tone technique, developed by Arnold Schoenberg, which uses every tones equally without duplicates until they all are used. In other words, serialism is a medium-specific idea, which explores how not to trespass other media but to focus on the fundamental quality of music, or tonality, itself.

Nam June Paik's Desire Toward Serialism

While studying in West Germany in 1957, Paik thought that "New Music was the center of all arts movements and Germany was the center of the New Music." [2] In addition, Paik was excited that "all arts movements" explored how to be abstract in a medium-specific way as serialism composers had already pursued. [3] For example, Jackson Pollock explored colors, or pigments without concrete figures to make painting an autonomy medium. In this medium-specific atmosphere, Paik examined serialism as the most progressive art form. Art critic Gotthold Ephraim Lessing described medium specificity as the suppression of qualities of other art forms and the autonomy of each medium. In *Laocoön*, Lessing explores how to distinguish one medium from another. For example, he thought that in poetry we had the wrathful Jupiter, who hurled the thunderbolt. However, in visual art, Jupiter was simply an austere figure. Unlike the poetry about *Laocoön*, Lessing emphasized that in the *Laocoön* sculpture, anguish must be softened into sadness and screams must be reduced to sighs because they would deform the countenance to a repulsive degree. [4] In the same context, Johann Joachim Winckelmann argued in his writing "On the Imitation of the Painting and Sculpture of the Greeks" that extremes become so unnatural that sedate grandeur in Greek sculpture can be attacked unlike Greek writings. [5] This idea led to art critic Clement Greenberg's support for purity in art. In his essay, "Towards a Newer Laocoön," he emphasized purging literature from painting to achieve absolute autonomy. Greenberg emphasized an abstract art as an art of 'pure form,' and "purity in art consists in the acceptance, willing acceptance, of the limitations of the medium of the specific art." [6] Serialism shared purist art based on medium specificity with the Greenbergian idea. Paik's bachelor's major was art history and aesthetics at the University of Tokyo. It is natural that Paik was aware of the topic of medium specificity. Specifically, Paik mentioned Winckelmann in his essay "afterlude to the EXPOSITION of EXPERIMENTAL TELEVISION 1963 March. Galerie Parnass" to discuss nobility and simplicity in the Greek art. [7] In his Korean newspaper article "The Music of 20th Century (1958)," Paik introduced Korean readers to the four qualities of modern art from Professor Hans Sedlmayr: the

intention toward purity (abstractionism), geometrical construction (functionalism), absurdity (surrealism), and longing for the primitive (expressionism). [8] These qualities originally came from Professor Sedlmayr's book *Die Revolution der Modernen Kunst* (1955). In his book, Sedlmayr explained that purity is not affected from structures or elements of other arts. He emphasized that this absolute concept is not for art but chemistry in the field of science. Moreover, he negatively regarded extreme purist painting as unstable, indeterminate, meaningless, or non-objective art. [9] Unlike his professor, Paik supported the purist music style as the most progressive art form. In addition, Paik used the current topic in art to reinforce serialism.

Close Encounter with John Cage

Serialism explored to be pure by using each tone equally and be mathematical by creating algorithmic patterns regardless of traditional harmonies. Without the contributions of performers, early electronic music generates pure and mathematical sounds with electronic devices such as an oscillator. It is natural that Paik's interest in music moved from serialism to electronic music. In between this transition, Paik was interested in collage-based music, *musique concrète* for a short time. However, after visiting the pioneer of *musique concrète* Pierre Schaeffer's music studio in Paris, Paik decided to make electronic music in West Germany. [10] Paik was fascinated by electronic music as an updated version of purist music generated by electronic devices. This also shows the transition from mathematical to parametric, to algorithmic, and electronic elements in music. This chronological trajectory coincides with the development from twelve-tone music to electronic music. [11]

After attending John Cage's lectures and performances at the 1958 Darmstadt Summer Course, Paik thoroughly updated the idea of contemporary music that he pursued. He first attended Cage's *Variations I, Music for Two Pianos, Winter Music, and Duo for Pianist II* on September 3, 1958. Subsequently, Paik took Cage's lecture on *Music of Changes* on September 6, 1958. Finally, he attended Cage's *Indeterminacy* on September 8, 1958. In Cage's presentations, Paik found new possibilities of music based on chance and indeterminacy. These approaches are opposite to precise music: serialism and electronic music that Paik focused on. Cage's music allowed Paik to escape from the respect he had been educated to have for the European musical tradition. [12] Specifically, Paik was overwhelmed by Cage's theatrical music, and Paik's electronic music, which was once the core medium of his art, became a peripheral part of his music. Paik reinterpreted Cage's theatrical music as action music. Inspired by Cage's lectures, Paik experimented with aggressive performances, which made a crashing sound like shooting a bullet through a glass. [13] In a letter to Cage, Paik described his work-in-progress.

I use here: Colour Projector. Film 2-3 screens. Strip tease. Boxer. Hen (alive). 6 years girl. Light-piano. Motorcycle

and of course sounds. One TV. // 'whole art' in the meaning of Mr. R. Wagner. [14]

Paik incorporated a variety of media from performers to electronic devices. R. Wagner's whole art is a rough translation of the German term *Gesamtkunstwerk*, which was developed by Richard Wagner.

The Gesamtkunstwerk

The Romantic composer Richard Wagner emphasized the *Gesamtkunstwerk* as the theoretical basis for artistic synthesis in his essay "The Art-Work of the Future" (1849). He insisted that, "by uniting separate branches of art, artists can create common art." [15] Unlike the title of his essay, "The Art-Work of the Future," the *Gesamtkunstwerk* paradoxically came from a tragic drama, a mass religious event, unified works with dance, music and poetry in the art of ancient Greece. His desirable outcome as the *Gesamtkunstwerk* was the theatrical stage, or the Drama with reciprocal agreements among the other arts. [16] It is natural that Paik paid attention to the *Gesamtkunstwerk* after encountering Cage's theatrical music.

The German term, *Gesamtkunstwerk*, is derived from the archaic verb *samenen*, which means 'to assemble, gather, collect,' so Oliver Schefer stresses that the translation of *gesamt* as "total" in English and French is not exact. [17] However, it is true that Wagner himself emphasized a totalizing perspective: to achieve the highest artwork, the separate artists from different media must quell each selfish, harmful outgrowth from the whole. [18] In addition, American artist Randall Packer analyzed the *Gesamtkunstwerk* inspired Bauhaus and Fluxus by dissolving boundaries between art and life as well as disciplines. [19] In this regard, the *Gesamtkunstwerk* is a recurrent idea to return to mixed media that people did not logically or academically distinguish a medium with the others yet and explored to find a harmonious combination between media.

Likewise, Anke Finger and Danielle Follett further argued that the *Gesamtkunstwerk* could be divided into three different levels: aesthetic, political, and metaphysical. [20] Paik's idea about the *Gesamtkunstwerk* coincides with the mixture of the first and the second levels of it. First, the aesthetic level is the blending of diverse arts and genres as in multimedia, operatic, and synesthetic creations. Second, the political level is the interactive transgression of the concrete boundary between art and life. In this regard, the *Gesamtkunstwerk* seems to inspire the emerging avant-garde art with artistic synthesis. Even though most progressive art movements, including dada, break the boundary between art and life, they maintain their position in art institutions. However, Joseph Beuys's idea that everyone is an artist who is an active participator within a society, and the concept of Fluxus members including Paik, which breaks the boundary between art and life, invited art to a daily life instead of galleries or museums. In the idea of the *Gesamtkunstwerk*, Paik developed his original idea from the letter to Cage with a motorcycle in the second version of

Hommage à John Cage (1958) and a live hen in *Symphony for 20 Rooms* (1961) as well as electronic televisions in *Exposition of Music – Electronic Television* (1963). This concept was reinforced by Richard Wagner’s Gesamtkunstwerk, which was opposite to purity in art. The Gesamtkunstwerk was a significant seed to developing Paik’s progressive art.



Figure 1. Jeonju Bibimbap is a variation of bibimbap based on a specific location. ©Songhyun Copyright. <https://pixabay.com/users/songhyun-206460/>

The Viral Aesthetics

In Paik’s essay “Electronics, Arts, and Bibimbap,” he explained that bibimbap aesthetics was a creative tool to make new art form, or mixed media, as the cutting-edge method to mix art with electronics, art with life, and music with noise. Paik published this article in December of 1967. While writing the article, Paik had been inventing his own video synthesizer (1969) with the Japanese engineer Shuya Abe. His video synthesizer was a visual version of bibimbap, which manipulated and mixed up diverse images in real time.

Bibimbap aesthetics can be intertwined with “viral aesthetics” which art historian David Joselit coined. Viral aesthetics is similar to the result from the invasion of a virus into certain ecology. It does not aim to overturn its host but infect it as the Paik/Abe Synthesizer degrades and distorts the image of mass media. In other words, the aesthetics does not reject the origin of the host but manipulates it. [21] Joselit connected Paik’s video art based on the synthesizer with American novelist Williams S. Burroughs’s manipulation of language via a tape recorder. Burroughs thought that when the established lines of association in mass media are cut, the associational links are broken. By altering muttered lines of the mass media with a tape recorder, he used it as a kind of political virus. Joselit insisted, that although Paik and Burroughs’ manipulations are similar to Duchamp’s ready-made, which untied the signifier from the signified, Paik and Burroughs tied their works to a political purpose. [22] Paik’s viral images bridged a gap not only between art and technology but also art and life with noisy/distorted video sources.

Like a harmony of bibimbap, Paik’s video manipulations show collage-based images with diverse materials.

Bibimbap as a Style of Art

In Paik’s Korean essay, he mentioned bibimbap as an artistic concept. Bibimbap is a Korean traditional food, which consists of rice and a variety of toppings such as soybean sprout, radish salad, and an egg. Bibimbap does not have any restrictive rules for materials. Available ingredients based on a location make variations of bibimbap. This provides not only a fascinating visual pattern but also an orchestrating taste in different ways. Paik defined bibimbap as neither bean sprouts, mushrooms, spinach nor herbs. If the vegetables in the dish try to stand out, the true taste cannot come out. [23] This idea is identified with Wagner’s Gesamtkunstwerk. Paik focused on two qualities of bibimbap: mixture and combination. With bibimbap aesthetics, Paik interpreted bibimbap spirit as a main idea, which blurs a boundary between different realms. He mentioned three main approaches with bibimbap aesthetics: Norbert Wiener’s cybernetics, Alan Kaprow’s happenings, and John Cage’s noise music.

First, as Paik’s essay “Electronics, Arts, and Bibimbap” indicates, he mainly focused on the emergence of electronic art and mentioned cybernetics to analyze this phenomenon. Wiener’s cybernetics explores an effective communication between a machine and a human. Paik survived in mainstream art by making a blurred boundary between them.

Cybernetics, the science of pure relations, or relationship itself, has its origin in karma. . . .
The Buddhists also say
Karma is samsara
Relationship is metempsychosis [24]

Paik’s writing above can be reinterpreted in the realm of digital interactive art. Cybernetics, which represents the relationship between human and machine with the control system, fundamentally supports defining interactive art. In 1947, Norbert Wiener coined the term cybernetics from the Greek word kubernetes, or “steersman.” According to Edward Shanken, “The scientific discipline of cybernetics emerged out of attempts to regulate the flow of information in feedback loops in order to predict, control, and automate the behavior of mechanical and biological systems.” [25] In the same context, Katja Kwastek insists that cybernetics opens up new perspectives on processes of interaction. [26] In a mixed communication between a human and a machine, Paik emphasized that cybernetics allowed a machine to understand human’s communication, not vice versa. Paik’s idea on cybernetics not only indicates his philosophy on interactive art, human-centered perspective to cybernetics in his first solo exhibition, *Exposition of Music – Electronic Television* in 1963 but also suggests the creative video manipulation system, or his video synthesizer, which allows the

artist to interact with electronic interface to make electronic art. [27]

Next, Kaprow's happenings blurs a boundary between art and life. His happenings invited audiences to specific situations, and they interacted with specific environments while interrogating a clear boundary between art and life. As a co-founder of Fluxus, a main figure of *Originale*, or the theatrical music performance organized by Karlheinz Stockhausen, and an independent musician, Nam June Paik had already experimented with the same question in his performances such as *Etude for Pianoforte* (1960), *Entwicklungshilfe* (1961), and *One for Violin Solo* (1962). Since Paik interacted with audiences in a violent way, he was named a "cultural terrorist" by Allan Kaprow. In his action music, Paik decided to break the boundary not only between several media, but also between performers and audiences. He often trespassed a clear boundary between the audience and performers on the stage by cutting the necktie of John Cage who sit as an audience member in *Etude for Pianoforte* and by encouraging the audience to disturb an opera during the performance in *Entwicklungshilfe*.

Finally, Cage's music shows a blurred boundary between music and noise in his theatrical music, Cage equally focused on any sounds from any materials. There were no preferences in between music and noise. For example, in *Water Walk* (1959), Cage used everyday materials such as a bathtub, a pot, and a toy as well as the piano. Specifically, he did not play the piano but hit the body of the piano or directly touch the strings in the piano. Furthermore, John Cage utilized several electric/electronic devices all in *Variations VII* (1966). In real time, Cage made sounds with telephone lines, radio receivers, and square generators. In this regard, Cage did not distinguish noise with music in *Variations VII*. In the end, by blurring boundaries between art and technology, his music contributed to redefine an idea on music. This performance was part of the historical theater event *9 Evenings: Theatre and Engineering* organized by *Experiments in Art and Technology (E. A. T)*. The Cage's performance returns to cybernetics and happenings ideas. In the same context, Paik's "whole art" in his letter to Cage shows art-and-technology with everyday materials. In this regard, those creators' mixing approaches are intertwined with Paik's bibimbap aesthetics.

Conclusion

Paik's collage philosophy not only mixed diverse media but also trespassed a boundary between art and life as well as between art and technology. This coincides with the different levels of the Gesamtkunstwerk. After pursuing the opposite side of mixed media in music, or serialism, Paik focused on the Gesamtkunstwerk to develop a variety of his own mixed media. In "Electronics, Arts, and Bibimbap," he did not have to mention the German term anymore since he inherently had a unique genetic approach, or Bibimbap Aesthetics.

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Machine Learning-based Approaches in Biometric Data Art

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Abstract

This paper explores issues of bias on biometric data and anxieties about identifications through audiovisual interpretations of the biometric data artworks. As seen in previous historical approaches, many people have been concerned about the reading of race, character, and narratives into genetic traces. Recent history and current trends in biometrics show that biometric data relates to statistical prediction, and bias is an inevitable part of biometrics. The bias has been observed in my previous exhibitions from spectators who experienced their biometric-driven audiovisual outcome. The artist created an experimental version of the two biometric data artworks using machine learning (ML) methods of artificial intelligence (AI) to investigate the bias on biometrics. The AI-driven interface analyzes the input data, improves predictions, and extracts visual features based on sample data. Two biometric data (iris and fingerprint) are used in the artworks, and an informal user study is discussed. This project investigates the possible artistic approaches in using biometric data and attempts to find unbiased solutions for biometric data interpretations.

Keywords

Machine learning, biometric data, data art, data visualization

Introduction

Biometric data has become one of the most crucial data in our lives. The personalized information hidden in the biometric data has been used for various identification systems and applications. Each different biometric data contains unique visual features such as colors, patterns, and lines. Feature extractions have been the most significant part of biometric data identifications. However, there are many cases of identity fraud, identity theft, and bias in identifications, which show that personal digital records are frequently and easily used in the wrong ways. Will the system confirm our identities to prove “who we really are?”

The questions raised by the biometric data are: what can we read and learn about ourselves with the data? Do they represent our identities incorrect and secure ways? Are they simply superficial copies of our identities or one of the many methods used to index each person using biometric data



Figure 1. Two biometric data artworks: an exhibited view of *Eyes* (top), and an exhibited view of *Digiti Sonus* (bottom). ©

images such as numbers? And the most critical question is, “Is there any bias and misinterpretation in the analysis of the biometric data?”

I have been creating a series of biometric data artworks since 2012. Two of my biometric data artworks *Eyes* [1] and *Digiti Sonus* [2] showed novel ways of using the biometric data as art materials and revealing hidden information about

the biometric data as arts-engineering projects. The unique visual features of iris and fingerprint data were transformed into audiovisual outcomes in the two artworks. Every participant can use their own distinctive biometric data as input data, which creates a unique and personalized outcome. Figure 1 shows the exhibited views of the two artworks.

Although the works successfully demonstrated unique artistic experiences in many art/design exhibitions, the spectators have raised questions: "Why does my eye/fingerprint sound like this?" For example, users with dark brown eyes mostly listen to the lower-frequency sound in the artwork *Eyes*. Brighter blue eyes result in creating high-pitch sound based on the mapping between color value and audio frequency. Besides the question about the relationship between eye color and sound, spectators also asked about the relationship between fingerprint lines and sound. It brought my attention to the data mapping between visuals and sound, biometrics and audiovisual interpretations, and revealed anxieties about race. What is the proper data mapping for an inclusive art experience? How can we make non-biased data mapping when using biometric data or personalized data? The spectators also preferred to see detailed information about their biometric data and additional visual features on the screen. They wanted to know the "Behind-the-scenes" information, the relationship with other people's biometric data, and how it is used to create data sonification.

This paper explores discussions about a biometric data visualization and sonification system that extracts visual features of biometric data using machine learning methods and explores issues of the bias on the biometric data and the relationship between user expectation and results. Interviews and answers from questionnaires about the comparison between biometric data and audiovisual works are discussed. This project aims to investigate the meaning of biometric data in these days and find possible unbiased solutions for data sonification and subjectivity in the artistic experience.

Anthropometry and Identification of Biometrics

Biometric data has become one of the most crucial data in our lives. The personalized information hidden in the biometric data has been used for various identification systems and applications. Each different biometric data contains unique visual features such as colors, patterns, and lines. However, this is not the new technology for identification. Although DNA testing, face recognition, and fingerprint scans were not available in the early nineteenth century, similar techniques and the same modern concerns about bias, privacy, and incursions on free existed. Phrenologists and craniometrics believed that heredity, race, ethnicity, and character could be read in the shapes and sizes of human skulls. [3] Francis Galton attempted to create a system for

groups of people based on heredity via composite photography. [4] He captured an arbitrary number of individual portraits of chosen groups of people and controlled exposure time to the portrait images. Francis Galton believed that "Composite Portrait" can categorize individuals into different types, such as "criminal types." It was an extension of the statistical techniques of averages and correlation. [5] His approach was one of the first thirty implementations of convolution factor analysis and neural networks. It repeatedly occurs in the area of popular science. Anthropometry was intended to investigate the predictability of relationships between biometric and moral and intellectual traits of humankind. [5] The American Centers for Disease Control and Prevention describe Anthropometry as a "science that defines physical measures of a person's size, form, and functional capacities." [6] The Belgian statistician Adolphe Quetelet was the pioneer on anthropometry with his own statistical database, which can be referred to as the first stage of what we today call data mining and big data. [7] However, Quetelet focused on the "unity of the human species," which he believed could be most clearly seen by distributing different traits. This is a very different manner from later biometricians. [7] Quetelet's overall idea led to the modern concept of normality and the universality of racial categorization. It shows that biometric data relates to statistical prediction, and bias is an inevitable part of biometrics. It has continued in the recent history and current trends in biometrics.

Art is always trying to reveal the artist's personal truth, and social or political voice. Many artists use traces, imprints, and indexes of bodies to reveal hidden narratives, truths, and identification of ourselves in society using the physical traces based on the early modern identification system's semiotic approaches. It is also my attempt to create an interactive system that allows audience members to recognize who they are. Artistic approaches to revealing meaningful narratives beyond the photocopied images of the biometric data with new digital technologies could give potential answers to the biometric failures and point out the current issues of biometric technologies in society these days. I believe biometric data artworks can address the current problems of generalization, bias, and protest against the misuse of biometric data and suggest a possibility of reconsidering the issue for the audience.

Bias on Machine Learning and Biometrics

As Galton's anthropometric projects had already convinced people to share their biological information, biometric data collection, and its misuse have become enormous in our everyday life. Like how Quetelet attempted to create a neutral and generalized system, modern technology and algorithms, especially machine learning methods, have made identification systems that use biometric data wildly biased.

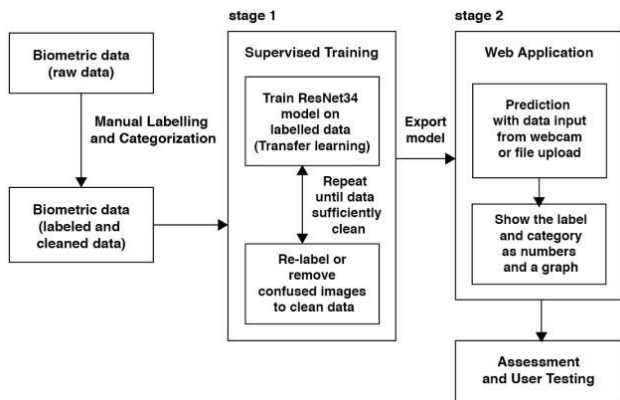


Figure 2. The overall process for visual feature extractions of the biometric data.

For instance, Google’s facial recognition software misidentified African-Americans as “gorillas” in their automated photo-categorization software. [8] Many types of research have revealed that machine learning technologies create an unfair treatment for specific populations. The issue of racial bias in its applications with artificial intelligence has been critical and not resolved yet. Algorithmic biases explicitly and implicitly harm racial groups and lead to forms of discrimination. [9]

Interactive media artworks created by machine learning or related technologies might have similar issues to the spectators due to the limited scope of data acquired and implicit decisions on the experience design. Mapping the data to unfair or incorrect audiovisual outcomes and miscommunication between the interface and spectators might create confusion or disturbing art experiences. Automated interfaces with emerging technologies have a higher chance of significantly creating those issues without enough research and evaluations. I wanted to explore the issues addressed above through my artworks and examine any possible solutions or address awareness of the problems to spectators. Furthermore, through this artistic practice, my intention was to use the abilities of artificial intelligence to understand the categorization and identification on biometrics in an artistic and creative way by adding data sonification methods.

Machine learning is not new in the fields of arts and design. Many artists have started using machine learning to explore various new approaches to artistic expression works by Anadol [10], Ji, and Wakefields [11]. Despite this approach’s remarkable recent successes, it must still be a clear understanding of what intelligence is, how it works, and how to make it work properly is lacking. Biometrics is the perfect dataset that is numerous, unique, and never changing. However, in the process of visualizing and sonifying the biometric data, the issue of genetic and racial bias should be resolved with more research and feedback from the

spectators. I leverage machine learning methods to learn from a large set of data images and extract features to support the existing artwork to help users understand. In previous exhibitions of two artworks *Eyes* and *Digiti Sonus*, most people wanted to know two essential pieces of information: 1) what colors of eyes and patterns of fingerprints they have in detail, and 2) how the data is transformed to sound. The updated version of the two artworks described in this article will demonstrate how machine learning can help map biometric data to sound and how the spectators think about the outcome with more detailed info.

Design Approaches

Figure 2 shows the overall process for visual feature extractions, applications, and assessments. Biometric image data is acquired in agreement with the users going through the machine learning process, and categorization and detailed biometric data labels are exported. The exported outcome is used for both data visualization and sonification, in which users can experience and share their thoughts. Mapping data to sonification is tweaked over time based on feedback from users for better results.

Two biometric data (iris and fingerprint) used in this research include unique visual features that need to be extracted with different approaches. There were two approaches for the iris color analysis; the first approach was to use image processing to extract the most dominant colors from pixel data and make a list with color code and domination rate. The second approach uses machine learning methods that analyze all other previously acquired eye images and show the eye color in real-time. For fingerprint analysis, the previous research focused on extracting minutiae, brightness, size, and fingerprint position [2] without the types of fingerprint patterns, while this updated version focuses on machine learning.

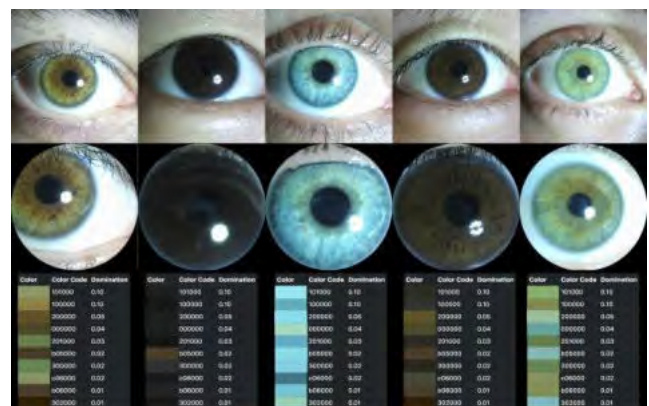


Figure 3. Five examples of iris data and analyzed color results. Raw data (top), cropped circle images (middle) and lists of most dominant color values (bottom).

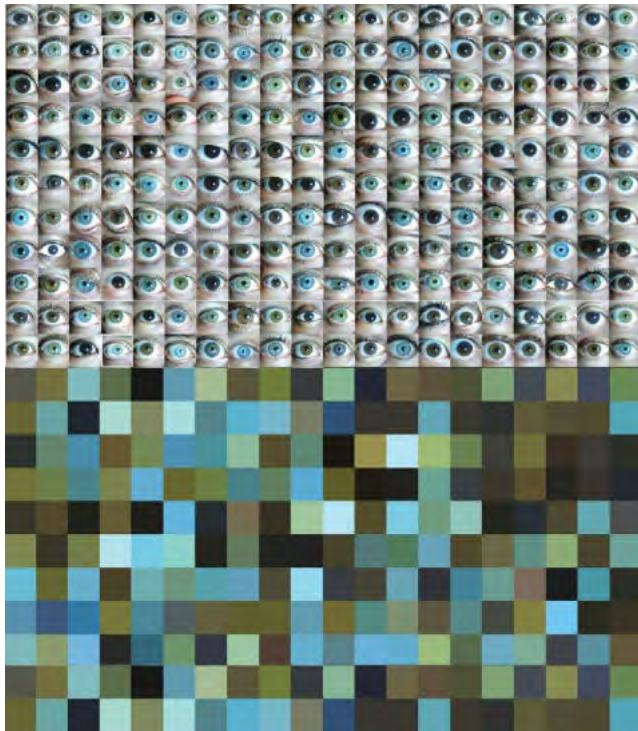


Figure 4. Raw iris data (above) and extracted dominant colors from the iris data (below)

Dataset

Both iris and fingerprint data were acquired during previous user studies and art exhibitions with all participants' permission. The data is entirely anonymous without any personal information such as name, gender, or address. The iris images were divided into four categories (Blue, Blue-Green, Brown, and Light-Brown/amber) manually. I also manually sorted out the fingerprint data into three categories (three patterns – arch, loop, and whorl) [12]. In the previous version of the application, I used various visual features of iris data such as eye colors, brightness, size, and patterns. However, the colors are the most critical data that directly impacts the art installation's audiovisual results. The other data controlled the extra components in the outcome. Furthermore, I wanted to use the colors as the main source to investigate the visual metaphor of racial bias that spectators could explore in this artwork. Therefore, I decided to focus on analyzing and extracting the color values at a deeper level. Figure 3 shows the five examples of iris data and analyzed color results.

Color Extractions from Iris

I used various visual features of iris data, such as eye colors, brightness, size, and patterns. However, the colors are the most critical data that directly impacts the art installation's audiovisual results. The other data controlled the extra

components in the outcome. Therefore, I decided to focus on analyzing and extracting the color values at a deeper level. There are many distinctive eye colors and different ways of categorizing human eye colors, such as the martin scale [13]. The most relevant epidemiologic and genetic research uses simple, three category scales (blue/mixt/brown) [14]. The other most common colors are blue, green, brown, black, amber, or hazel/mixed. Unique colors such as grey, violet, and red can be regarded as mixed colors.

As the first approach to extract the color values from the eyes, I used the image processing methods. Figure 3 shows the steps of the process to extract the dominant colors of each iris data. I detected the pupil and iris circles and cropped only the iris circle area using the Hough transform [15]. Image processing techniques such as segmentation, normalization, and feature encoding were employed to extract the eye's digitized image's unique colors. I analyzed all the image pixels' color values and ranked the most dominant colors as a list of color codes and domination values. As the pupil is always in the black color, I removed the pure black color. Figure 3 shows the lists of extracted colors from five iris data samples. I could categorize the dataset into four colored groups (blue, blue-green, light brown/amber, and brown) applied to the next approach developed using machine learning classification methods. Figure 4 shows the raw iris data achieved from previous users studies and extracted dominant colors from the iris data.



Figure 5. Previous fingerprint analysis with minutiae, position, size, and mean brightness (left) and three patterns of fingerprints (arch, loop, and whorl).

Pattern Analysis of Fingerprint Images

Fingerprints are one of the unique biometric patterns on the human body. In the previous application, five distinct visual features were extracted for the art application. However, with machine learning methods, the types of patterns are focused, analyzed, and pulled. Fingerprint pattern types are categorized into three groups: arch, loop, and whorl [16]. Figure 5 shows minutiae as red dots on the fingerprint image on the left and examples of the three patterns of fingerprints on the right. Pattern types are the most visible and significant features used for various purposes. In the artwork *Digiti Sonus*, the pattern types determine the frequency range in the data sonification. Therefore, extracted pattern types will be crucial to enhance the quality of experience and range of contents.

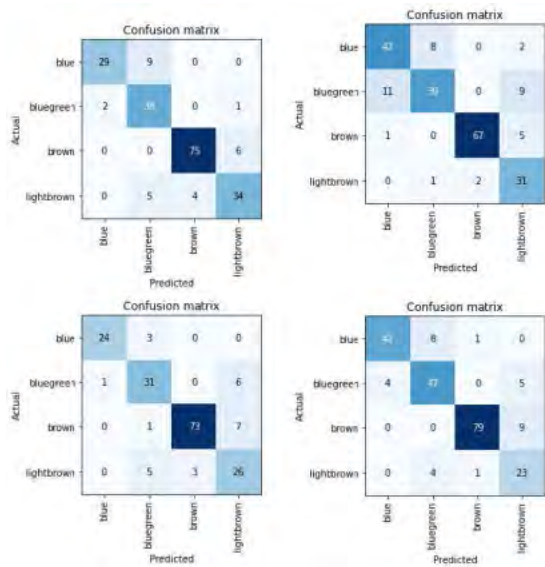


Figure 6. Four confusion matrices with iris data. The matrix on the bottom-right has better results and higher success rates than the other matrix on the top-left.

Implementation

The most straightforward approach for eye color detection would be to use a convolutional neural network that has been pre-trained to recognize the difference between common objects. It is accurate at identifying the critical differences between eye colors. Mimicking the Fast AI [17]'s image classification modules proved useful since it provided the ability to use a pre-trained model called ResNet34 [18], which has already been trained to classify millions of images from the ImageNet database containing everyday objects. The coding environment used was Google Colab [19]. The chosen coding language was Python, and some of the libraries used were PyTorch [20], TorchVision, and NumPy. These were used to create a convolutional neural network based on ResNet34.

In the process of training the model, the interpretation of the classification was created using fast.ai methods, including the confusion matrix. The confusion matrix (figure 6) is a grid that plots the actual category of an image with the predicted category. Numbers in the diagonal represent correct predictions, and other numbers represent errors. The error images were usually unclear or dark, or the iris's core part was not captured. The images from the dataset could be miscategorized, which needs to be re-labeled to make the model more accurate and create a cleaner, adequately labeled dataset. Smaller numbers in the confusion matrix represent a more precise model.

Observing the confusion matrix and cleaning the data, this training process was repeated over several iterations, increasing the eye color model's accuracy from ~82% up to

86-88%. This is shown in the table, where the error rate drops to 0.1466 in 4 epochs. The fingerprint classification model confused many loop and arch images, and some of these are shown in Figure 7. After cleaning these images, the confusion matrix shows the total number of images confused between the two categories dropped to 8 from 11. The accuracy went up to 90% at the last result, where the error rate drops to 0.140, meaning that the model is 90% accurate at the end, as the results are shown in figure 8 in two ML-based applications. Although this process may be performed several more times, the data was deemed sufficiently clean for the project after referring to other models.

User Testing

I developed a customized web application using HTML, CSS, and JavaScript to test the results. The application transferred the learning algorithms to train models fast and effectively. I input the cleaned data and labeled data from the previous process, and the model trained and exported the results. Additional functionality (file upload and a bar graph) was added to visualize the accuracy of an eye color/fingerprint prediction.

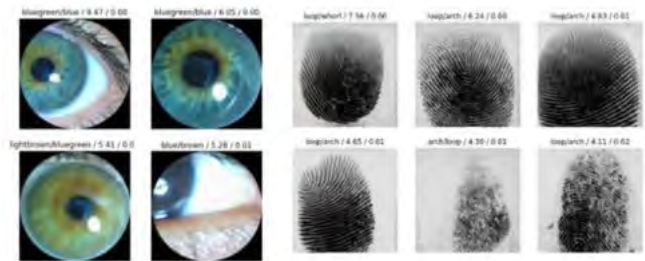


Figure 7. Iris images and fingerprint images miscategorized and caused errors in the system.

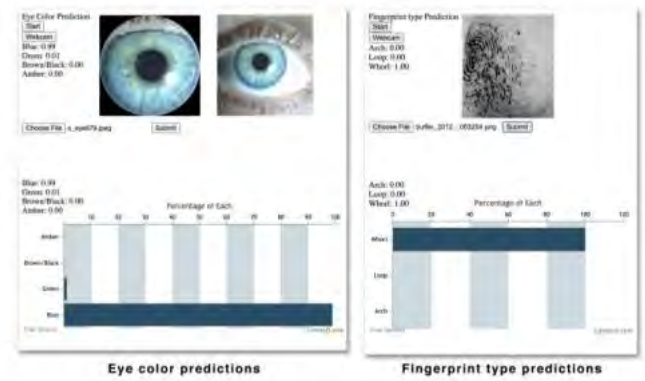


Figure 8. Two ML-based applications: eye color predictions and their results (left) and fingerprint type predictions and its result (right)

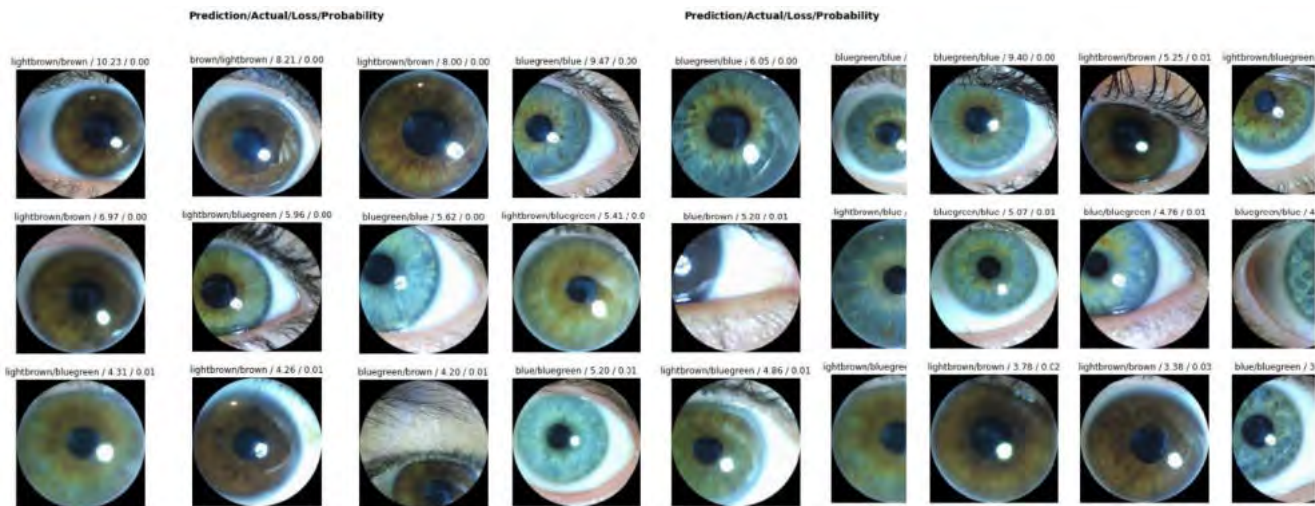


Figure 9. Predicted colors and error rates extracted from the analysis of the raw iris data. The extracted colors and rate were used for data sonification.

Detailed numbers of data are added to support the understanding of the process. Figure 9 shows how the application works with the real-time camera captured and then predicted colors and error rates extracted from the iris data are displayed. The data is transformed to sound software (Max 6) for data sonification, and users can listen to the sound.

In December 2020, I tested the application with fifteen participants, who mostly have a background in arts, design, or engineering. I explained this project's goals, and the purpose of the application and asked questions about the overall art experience and the relationship between sound and image. The participants first experienced the original artworks, observed the audiovisual results of his/her data and other data, and ran this application to learn the detailed information about their biometric data.

In the survey, the first question was, "Do you think the relationship between the image and sound is clear?" Of the people I surveyed, 80% of the participants answered that they could easily connect their eyes to the sound. One user said, "The brightness and color of the eyes and fingerprint images matched to the sound very well in comparison with the sound of the other data." 80% of the participants had five blue eyes, five brown/black eyes, one green eye, and one amber eye. However, 20% of the participants mentioned that "It is not highly clear to connect the images and the sound very well" They had one green eye and two amber eyes. One user mentioned that "My amber eye color is in a medium tone, but the sound seems quite low and dark." This comment reflects that the audio frequency (approximately 300 Hz to 1800 Hz) used for the medium tone eye color falls in a subjective territory for each person. Unlike the iris data-based application, to the first question, 60% of the users answered that it was not clear to understand the relationship

between the fingerprint patterns and the sound. The four patterns were mapped to the different melodic sound determined by the position and complexity of the line formation. Unlike the eye colors, the patterns were less impactful to link to the sound due to the complicated patterns.

In the other question, "Do you think the sound is biased based on the biometric data and races?" 40% of the participants who experienced the iris-based application mentioned that they thought the data mapping was based on a presumable bias. A comment from one respondent was, "Lower frequency sound for the dark/black eyes and higher frequency sound for the blue eyes might be a possible issue of racism. The implicit decision on the data mapping should be addressed." However, 50% of the participants answered "no" to the question. One user mentioned, "Based on the color intensity and brightness, the higher pitch to the brighter color and lower pitch to the dark color makes sense to me. It was quite clear to understand the linkage between the sound and the visuals" There were varied answers and feedback related to the bias in eye sound, according to the interview. In contrast, 90% of the participants who experienced the fingerprint-based application said no to the question. It shows that the fingerprint images seem not strongly connected to the races in comparison with the eyes.

The last question about the detailed info presented on the screen, 93% of the participants mentioned that the visuals helped connect sound and biometric data. Furthermore, they noted that the number of eye colors and fingerprint patterns helped to recognize the comparison with other eyes and fingerprints. However, there were very similar eye colors (dark browns), and the sound and data were almost identical. Some of the feedback included showing how similar their eyes and fingerprints can be compared to others in detail. A

user also suggested an automatic capture system to achieve eye and fingerprint images to make the process faster and easier.

Discussion and Future Work

Based on comments from participants in the user study, it was interesting to hear various voices from the users about their thoughts on the implicit bias on the eye colors, the relationship between visuals and sound, and the difference between fingerprint and iris. The most interesting response was about the preferred eye colors and sound. According to various studies, eye color preferences are based on assumptions about personality, cultural ideals, rarity, and sexual imprinting. Researchers found that people subconsciously assume other people with brown eyes are more trustworthy due to facial structures accompanying the brown eyes. [21] Another factor is based on cultural ideals. Cultural influences affect what people desire (e.g., blond-haired, blue-eyed' person emphasized in movies and the media for decades). Another interesting factor in controlling the preferences on eye colors is sexual imprinting; human romantic partners tend to have similar visual traits driven by their families' or parents' visual traits. [22] Various artworks such as "Eyewalker" [23] and "Opto-isolator" [24] explored eye gazing, level of awareness, and eye colors in conjunction with technology. The eyes are a strong symbol and a metaphor for personalities as a visual trait. It also leads to communication and interaction between people. Based on the facts, it was interesting to observe the preferences on eye colors from the participants in my art installation and the user study. Most participants mentioned "beautiful" many times when the 3D animated blue eye was projected on a wall. It made me ponder where the bias started from initially. Is it from our decisions? Or are we trained? Did the machine follow our choices and get trained based on our preferences? In my study, machine learning methods could only retrieve the results from collected statistical information but couldn't talk deeply about the reasoning behind people's preferences and choices. Furthermore, data mapping from visual features to audio parameters in this artwork didn't target the audience members with highly personalized choices due to its predetermined mapping system. More freedom and choices on data mapping and sonification could create more personalized artistic experiences. The possible bias embedded in the data sonification should be more investigated by testing with more users and data. The frequency of the sound might be too simple a parameter to examine the gauge of the bias issue. More personalized choices and diverse styles on sound determined by machine learning can be one further direction to investigate. The various scenarios with different approaches for the following versions are potentials of this project.

I envision my approach to be applied to multiple domains in both arts and engineering and foster future research about

finding unbiased ways of using biometric data. Since Quetelet and Galton, the biased statistical vocabulary and methodologies have been developed and applied to various applications. And it has impacted people's preferences and decisions in a feedback loop system. Whatever the solution, it would seem that we need to understand the roots of systematic bias. And more investigation on modern statistical analysis that was built upon racial thinking should be recognized and reconsidered. I believe the next big thing is further recognition of non-biased thinking through a focus on the unity and individuality of all humanity rather than quantitative measurements and statistical analysis. This applies to the current modern technologies, and system designs and artworks that utilize the human body as input data. A deeper understanding of individuality and subjectivity will result in a more personalized artistic experience.

As future work, the applications will be more developed with further exploration on data mapping and user preferences on sonification. The machine-learning-based application will be embedded in the future version of the two artworks. It will include spectators' choices and preferences rather than adding their biometric data itself. Over time, the artwork can generate a less disturbing and more personalized art experience for spectators based on their input data in a feedback system. As a continuing project, other biometric data such as the face, veins, or signature will be analyzed and used to expand the range of case studies and discover hidden narratives in different types of biometric data. It will contribute to the open-ended development of the biometric data-driven system and show potential to be developed further by providing insights to other artists, designers, and creators interested in using biometric data and other human body data.

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Author’s Biography

Yoon Chung Han is an interaction designer, multimedia artist, and researcher. Her researches include data visualization, biometric data visualization and sonification, a new interface for musical expression, and multimodal sensory user experience design. Her recent research focus was on multimodal interactions using body data, in particular on creating a personalized experience in media arts using biometric data visualization and sonification. Her works have been presented in many international exhibitions, conferences, and academic journals such as ACM SIGGRAPH, Japan media arts festival, ZKM, NIME, ISEA, IEEE VIS, ACM CHI, and Leonardo Art Journal. She holds a Ph.D. at the Media Arts and Technology, UC Santa Barbara, and currently is an Assistant Professor in Graphic Design at the Department of Design in the San Jose State University.

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Abstract

By holding on to the idea of ‘origin’, understood in my research as hand-printing clay, I aim to rethink our interactions with technology and automated making. During the past three years, I have been exploring the relationship between hand-coiling clay and 3D printing. Hand-printing uses hand-extruded clay that, with skill, creates long hanging ropes that are pressed together. The movement is highly laboured and repetitive. It is this difference in the physical making experience, against the digital one that my research explores.

Keywords

Clay, Movement, Computer Aided Design, 3D printing (3DP), Hand-printing clay (HPC), Digital, Touch, Robotics, Innovation, Sculpture



Figure 1; Photogrammetry scan hand-printing-clay, Theo Harper, 2021

3D Printing Backwards

The ethical development of these technological parameters is paramount, as our entire made environment is created through interactions with computers. The stakes are environmental, geological, and political. As computers connect with making machines it is important to address issues within the automated future we are facing and have begun to live with (Bennett 2010, Vallgård, A. 2009, Ingold, etal).



Figure 2; A generic sedentary design practice not in contact with physical material

Examples include robotics and advanced manufacturing tools that rely on top-down desk-based instructions generated by a select few. This clay-first perspective on making seeks to realise a deeper understanding of the materials and processes involved in our daily lives and to describe the hybrid materiality we are part of. This approach is made possible by working with computer programmers to create disruptive innovations that affect the framework of how our fabricated environment is designed. In so doing, it is possible to ‘3D print in reverse’, allowing the digital to be touched.

In this article I describe how 3DP clay has served as a learning tool and conduit for a new digital expansion in my practice. I describe a way of making digital sculpture that directly originates from an experienced physical place through the blended interaction with clay and new technologies. The projects that I will describe are based at Grymsdyke Farm, the European Ceramics Work Centre (EKWC) and my home studio, expressing this hybridity in the form of hand-printed clay, digital models, robotically printed and 3DP clay and ceramics

Pressing between the lines

Throughout the development of this three-year research project, I have maintained a connection to the process of hand-printing clay. This work embodies what Richard Sennett refers to as an ‘extended rhythm...that allows the craftsman to develop specific skills and rituals—duties performed again and again’ (Richard Sennett, *The Craftsman*, 2008). It is also something that can be measured by using various sensory technologies, such as 3d scanning and movement tracking.



Figure 3; Hand-printing-clay in action, link to time-lapse <https://vimeo.com/512429824> ,studio, 2021

My relationship to HPC was already well formed before I had seen the ceramic 3DP working (developed first by Studio Unfold and others, 2009). My body and closeness to the clay is removed and replaced by an automated machine.

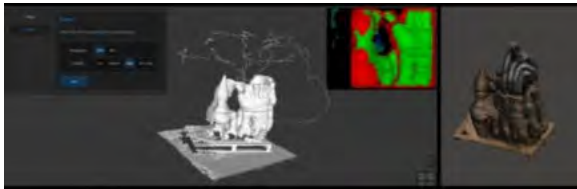


Figure 4; 3D scanning in motion, studio, 2021

I assumed I owned my experience but now I was observing it, watching it play out in front of me. This provided the motivation to understand the processes involved in printing an object. These stages in order are normally: CAD; SLICER; 3DP.



Figure 5; Guard, 3D printed ceramics, 21x12x27 (EKWC, 2021)

This led to me thinking about the sensory body changing through time and how that could affect the handmade object. As living beings, we (as well as animals and plants) make connections with our material environment through experience that manifests, often in hindsight, as meaning. On 28th May 2019 I interviewed Nicolas Pope whose practice takes a similar form to my own sculptural strand (figure 2) but is devoid of any technological mediation.



Figure 6; Yahweh and the Seraphim (1995), Glazed and lustered ceramic Height: 430 cm | 169 in Installation view, Stedelijk Museum, Amsterdam, 1995

Early on in Pope’s interview, he remarks that he has Parkinson’s Disease and that it is very hard to control his actions; something he says is interesting in terms of the hand and material, as he is losing control of his own body. He values the mistakes in the work, something a machine cannot do.

“I am joyful when I go wrong. But if I purposefully try to go wrong, it becomes false. Its why Parkinson’s is so great, I’m going wrong all the time.” (Pope, transcript, 2019, p4)

I asked Pope how his forms come to be: do they come from the material or are they pre-designed?

“The forms created come from an entanglement of concepts, materials and forms that are put together when a group of pieces start to make sense. The work comes from the material as much as it comes from the person making it.” (Pope, 2019)

This is a statement that makes sense when I think about my own form making. Because of Pope’s ceramicist background, clay has always been his first-choice material and it has remained central to his way of working. Pope mentioned a simple but important point when we were trying to determine the value of the ceramic 3D printer, which is the regularity of the printed object and how its lines were not defined by touch but by the tool of the instrument:

“It’s very well made, without hesitation, without mistakes. I value mistakes. A lot of finger work is apparent. Finger work is really nice!” (Pope, 2019)

The most valuable and relevant insights from the interview are of Pope seeing himself as the instrument of making sculpture and drawings. He speaks of his own body being used by his instruction but also that he is not fully aware of the forms he wants to make and just going with the ‘flow’ (Csikszentmihalyi, *The Psychology of Discovery and Invention*, 2013). The body in his case is in decline, or ‘has the shakes’, which he sees as introducing the benefit of chance into his drawings. This is an irregularity which he likes – within the constructs he puts around himself. A robotic or mechanical process does not age the same way as an organic body. Its actions can be replayed in the same way 1,000 years from now if well-maintained and given the same code to follow. But Pope’s is a changing body that exists within a finite time frame.

“I have no choice for Parkinson’s. My computers got fucked up. My antivirus is not working.” (Pope, 2019)



Figure 7; Hands, Touch, Clay

Our bodies perform an astonishing assortment of actions (Barbera Tversky, *Mind in Motion, How Action Shapes Thought*, 2019). The movements involved in this investigation alone include moving to stand, to kneel, to sit, walk, type, click the mouse, look up, look down, pull clay, coil clay, press clay, move clay, and operate various tools that in turn require their own movements to operate. These movements are broad outlines; they all require other movements within them, and they all operate in digital and physical space. These gestures without the physicality of clay are made digital in the world of computer-aided design. Algorithms have been created to twist and pull digital form in simulated space. They have been built to express actions on design ideas and use only small, isolated movements of mouse clicks and key board shortcuts rather than the physicality needed to bring handmade things into the world. The next section offers a working solution to this sedentary way of interacting with computers so that my practice can better join these two opposing contexts.

Hand-printing-clay and movement capture



Figure 8; Magnetic movement tracking sensors, <https://polhemus.com/applications/electromagnetics/>

The intent of this practical exploration is to bring in a material connection to digital sculpture at the CAD stage. I intend to capture the experience of making using an electromagnetic tracking device, gathering layered movement data, essentially turning myself into a 3D scanner.

By taking this approach I will be fusing the sculptural/material experience into the digital record. I hope that the digital object could then originate from a deeper, felt and more experienced place that can then utilise all of the spiralling possibilities afforded by digital fabrication. The 3D scanning methods I have used previously have required too many separate processes that can cause friction with one another across these physical and digital material boundaries.



Figure 9; Prototype 01, Movement tracking set up, link to demo <https://vimeo.com/413878714> (Grymsdyke farm ,2020)

They can slow down the flow of working. The emergence of robotics in the creative industries is revolutionising how things are designed and made. They are transforming the culture of the spaces they inhabit (Willman, Block, Hutter, Byrne, *Robotic Fabrication in Architecture, Art, and Design*, 2018).



Figure 10; Printing clay using robotics, link to demo <https://vimeo.com/413878905> (Grymsdyke farm, 2020)

Another popular perspective, or feeling, is that automation and universality of mark-making within 3D printing is standardising the objects it creates by following the rules set out by the machine's author and different slicing programs. It allows everything to be measurable and quantifiable. The mistake can even be repeated! (Paul Virilio, *The Original Accident*, 2005).

If the aim is to get closer to the experience of the material and the bodily performance of making itself, then movement sensors could be the best way of recording the experience as well as the emergence of the sculpture.



Figure 11; Together Crown, robotically printed, ceramic, derived from multiple 3D scans of the hand-printed origin, 35x48x120 cm, (Theo Harper, 2021)

In other CAD platforms that I am aware of, where a clay-type simulation is visualised, there is no possibility of linking it with the actual physical material itself. Creating a better interaction between the physical and digital spaces requires a lot of development. I required coders and specific hardware usually used in the domains of science and surgery. This blended practice, using the programming knowledge of Vicente Holler and Yingying Ying, who both wrote the Python script in response to my making and verbal directions, via a text editor plug in for Grasshopper (a Rhinoceros 3D platform) that understands each point in motion captured by the tracker to draw the clay lines in digital space. Essentially, I was turned into a 3D scanner by

utilising hand-printing movements and the natural additive process of the emergent sculpture to build the digital model.



Figure 12; Prototype 02, movement tracking hand-printed-clay, studio, UK, 2021

The unique position of HPC is that the practitioner is involved in the movement of creating the object whilst in contact with clay. The hands are involved in the emergence of the sculpture and so can be recorded by the tracking device (figures 3 and 4). This closer integration differs from the previously used 3D scanning devices because it utilises the hand-printing movement as it interacts with clay. Observing the digital and material artefacts gives me confidence that the layered recording of these tacit movements captures the experience of making the sculpture in a fuller way than simply scanning the surface of the object. The simulated artefact has infinitely more surface detail than that of a scanned version and records internal surfaces, which reinforces the importance of this process as something that is unique, and different from 3D scanning.

When planning the project for EKWC, I found that the Grasshopper plugin (an algorithmic visual scripting programme) had unfortunately been corrupted, and all the work that Vicente had done coding these developments was lost. It meant that I had to repeat the process with a different tracking system but also collaborate with a different person capable of coding in Python script as Vicente was not available. All this had to be done at distance which created further parameters in terms of communication, responsiveness, and flow.

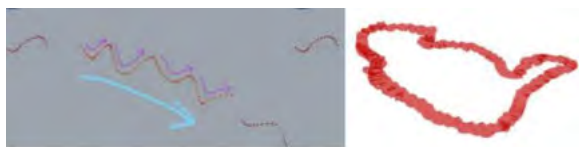


Figure 13; Isolated movement of one hand-printed clay line, studio, UK, 2021

From my studio I began spending time working on capturing the hand-printing data to collect

enough information to build the grasshopper script. This sculptural form (figure 8) was first defined by the need to create internal shapes as well as external shapes and to understand the capability of the prototype to track through clay walls. Figures 5, 6 and 9 show the mesh-generating process. In figure 8 you can see an isolated section of the data showing the wavy motion which visualises how I hand-print the clay onto the line beneath it. The algorithms created by the programmers measure the movement between a set of distance parameters that correspond to the pressure my thumb put on the clay. All other unwanted movements fall outside of the parameters and are automatically deleted. It means that nothing, but the HPC will be recorded.

This much more analytical process makes me acutely conscious of how I am interacting with the clay and the computer in tandem. There is a hyper-awareness of my making actions while engaged with two types of record. Defining my actions created small changes in the surfaces of the sculpture and affected the overall form as it did when 3D scanning some of my work leading up to this exploration.

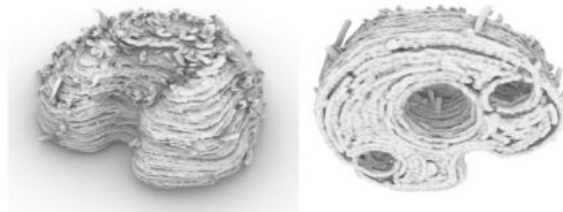


Figure 14; 3D digital record of clay movement, studio, UK, 2021

The additive nature of clay printing is especially good at translating into the digital space as it is in reversal. The coding algorithms consider the downward pressure of the thumb and the surface of the initial lines of clay so they can be pressed flat onto the surface of the 'ground' both in the physical and non-physical realms of materiality. The final mesh shows the entire layered experience of constructing the sculpture (figure 9). Internal and external spaces that could not have been achieved from scanning the sculpture are shown to be effective using this method of 'movement scanning'. The movements that have changed the visual appearance of the digital clay are actions that are attached to the making experience and are ones that I see as beneficial in how the digital object can be expressed. After it was used, the clay was reclaimed.



Figure 15; Digitally printed emergent clay form at 1/20th of the scale, nylon, studio, UK, 2021

The clay has been through changes beyond this sculpture and will continue to go through changes as it is used again to record sculptural movement. The clay allows for instantaneous change and reaction that is reciprocal for the human senses. The digital object is then able to be printed at much smaller scales with very intricate details, compressing the physical movements recorded from the clay origin (figure 10).

EKWC-Putting methods into practice

I could now put this into practice at EKWC to produce a large-scale hand-printed origin that is tracked from start to finish. The following images describe the process and the capabilities of this unique way of reciprocally producing both a physical and digital record of my movement.

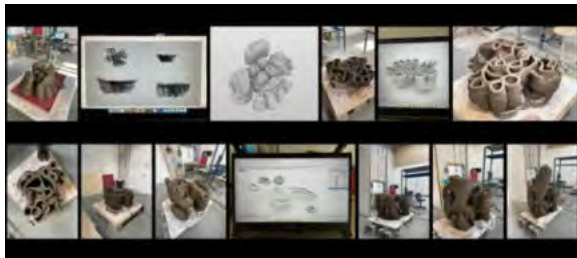


Figure 16; Process into practice, building a full-scale hand-printed sculpture, EKWC, 2021.

Based on the measurements of the hand and the clay coil, the movements specific to this way of making have enabled a more meaningful digital record to take place, meaning that is, 'incorporated and lived rather than simply intellectually understood' (Juhani Pallasmaa, *The Thinking Hand*, 2012). In future projects this could be expanded on exponentially if given to other practitioners to work with who's practice can be

measured through repeated movements. It would allow a unique response to cad design based on human interaction with clay.



Figure 17; Derived from the clay origin, Digital 3D render, EKWC, 2021.

For my sculpture this blended way of thinking about material has enabled the internal structure to be recorded as it is experienced, which has resulted in an unusual formal digital development that is different from standard scanning devices. It will no doubt have interesting future fabrication consequences, utilising CNC, 3D printing and robotics.



Figure 18; Nylon prints, taken from the movement data, studio, 2021



Figure 19; CNC milling the captured lines of movement and hand-printing back into the polystyrene mold (with thanks to Sander Albas and EKWC, 2021)



Figure 20; Jest, Derived from the Origin, Ceramic, 74 x 65x 79, Theo Harper, EKWC, 2021

The unexpected capture of other repeated movements that are not visible on the physical origin could also be a source of future inspiration that can guide this developing language in both the digital and physical realms.

The focus on detailing the movements of hand-printing clay has led to a hyper-awareness of the actions that I am involved in. Some of the parameters have altered the way that I make the sculpture, sometimes having to change the direction of movement so that I don't have to change hands, so that everything can be recorded. This explicit example of how technology can define a direction of thought through mediated instruction is another important reason for needing to understand these systems from the inside out.

Summary

This approach intends to change the direction of travel for CAD: not following the direction of a desk-based beginning, but with a connection to the material and labour that is essential in bringing something physical into the world. It enables a connection we need to get back, that helps promote

care and understanding for what is produced. The fields of fine art, fabrication, design, architecture, craft, and human-computer interaction can benefit from this research, with crossovers occurring in many other academic disciplines. This project gives practical examples of integrating varying levels of hand-making into the space of Rhino CAD (multidisciplinary platform) and the 3D printing process. This way of linking movement to an ageing and forever-changing body can also affect the language that machines produce, to be less perfect and more attuned with our living origin.



Figure 21; Origin, Ceramic, 128x 88 x78, EKWC, Theo Harper, 2021

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Biography

Theo is an artist and researcher based in Northumberland. His practice spans site-specific installation, sculpture, video, and photography. Clay always at the centre; Theo interrogates material and processes, intuitively inventing ways to release an expressive making narrative. It is a constant inquiry: Born out of repetitive, time consuming and layered techniques. By mastering different making systems, it is possible to break apart pre-existing realities.

Theo studied sculpture at the Royal College of Art, London. He has shown work nationally and internationally and taken part in various residencies. Alongside gallery-based exhibitions he has organized various projects that include a permanent installation in a terraced house, London (2013-16), a cliff polishing in Cornwall (2014) and more recently taken part in a three-month residency at EKWC in the Netherlands. Theo has been working on a AHRC funded PhD that he has completed in April 2022.

Links

- <https://www.arenasolutions.com/resources/glossary/computer-aided-design/>
- <https://vimeo.com/512429824>
- <https://polhemus.com/applications/electromagnetics/>
- <https://vimeo.com/413878714>
- <https://nicholaspope.co.uk>
- <https://sundaymorning.ekwc.nl>
- <http://grymsdykefarm.com>

Splitting Defense: A Methodological Journey into the Material Basis of Practice-Based Research

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Abstract

This text details a practice-based research project which was partially materialised within the art-installation *Splitting Defense*. Splitting defense is a mixed media artwork, comprising an audio narrative embedded within a physical installation. It places the recipient into the realm of a future society, remembering the horrors of the present. While evoking a languorous sense of belonging to the future, it casts an eerie light on current practices of feeling, empathising, caring, ignoring, and dividing. The artwork thus playfully engages topics such as gendered patterns of valuing and devaluing phenomena of emotional labour.

Keywords

Practice-based research, new materialism, diffraction, digital installation art

Introduction

This text talks about the relationship of a project of practice-based research [8, 14] and its partial materialization in the form of an art installation. The respective research project inquired into the status of affective economies in relationship to the question of value. The artwork *Splitting Defense*¹, created by collective artist Elli Kuruş², negotiates these questions in the form of a speculative narrative.

The text will first describe some of the methodological peculiarities inherent within the practice-based approach adopted. Subsequently, it briefly describes the collective context of the artwork's production before launching into an account of the work itself and the readings it affords.

Aporias of Practice-Based Research

As a reflective process, practice-based research constitutes a deeply paradoxical endeavour. It has to continuously reinvent itself in order to do justice to its object while at the same time remaining consistent enough to sustain an intelligible process of inquiry. It is a methodology without method, dependent on a delicate balancing act at every turn of its application.

Resultingly, practice-based research constitutes something of a methodological peculiarity, especially in the context of

creative practice. It does not provide any recipes or guidelines, nor does it prescribe procedures to be followed. It is neither toolkit nor framework.

The troubles of practice-based research multiply as soon as it is employed in a sphere such as art-making. Artworks do not require a method, on the contrary, their very nature always also resists the application of repetitive procedures. Insisting on a playful surplus, conceptions of art as autonomous practice sit uneasily with any constricting set of methodological demands.

The passionate indifference of methodology and artwork extends to the level of materiality: Tautologically, a body of theory and a material artwork occupy different planes of being: They cannot touch. Artworks do not read theory, they do not possess a library card and cannot subscribe to neural.it or the British Journal of Aesthetics. Theories on the other hand do not frequent galleries, exhibitions, or museums. In order to establish any form of relationship they are always dependent on the presence of an "external" apparatus.

Even if we possess a dearth of methodological knowledge of how to construct these devices of relating, fortuitous accidents and serendipity hint at the possibility of their creation. Theories do seem to have the ability to inform processes of art making, their signifiers keep seeping into the form of artworks. Likewise, artworks do possess certain provocative capabilities, attracting readings and interpretations.

Perhaps the notion of practice-based research as a device for *reflection* itself is to blame for our troubles. A methodological alternative presents itself in the notion of diffraction, a category highlighting the importance of phenomena of embodiment and material intra-actions [2]. Neither completely disavowing the subject as a surface phenomenon nor constructing its objects from a position of analytic detachment, it highlights the material community of signifiers with the phenomena they want to speak about.

If we follow this path, there indeed are countless ways to organise the congress and crosspollination of material works and theory. One of these approaches is discussed here in the form of utilising the artwork as a diffractive apparatus. It tries to utilise works produced as elements within a material-discursive network. The remainder of this text describes an experiment of this kind by retracing the entanglement of theory and artefact in the art installation *Splitting Defense*.

In the following, the artwork is first described in relation-

¹http://ellikurush.com/?page_id=659

²<http://ellikurush.com/>

ship to the collective process that produced it.

The Poietic Process – Antagonistic Negotiations

Works within Elli typically emerge through a process of continuous contestation, collaborative making, antagonistic reframing and productive misunderstanding. There frequently is no consensus regarding interpretation, character, or intent of works. Furthermore, the boundaries between works themselves will often be contested.

Any process of description is further complicated by the iterative history of the work's development. Both physical components and the audio narrative existed in multiple forms and variations, their development lay in the hands of different members of Elli. Respective elements were combined into exhibited form in a process of negotiation in which participant's intentions created a network of productive tension.

On the level of production, Splitting Defense was made as bipartite entity, consisting of audio narrative and physical installation. Processes of creation of the audio narrative and physical installation were communicatively insulated against each other during the majority of respective making processes.

Furthermore, it has to be stressed that, due to the collective nature of the work, no perspective can claim an authoritative status. There exists no privileged position within Elli itself, discussions are not consensus based and usually do not result in shared views or interpretations. Ultimately, Elli's communications cannot claim any special authority in relationship to the work. They simply originate from a perspective that is materially implicated in the work's production.

The Artwork – Splitting Defense

The installation is created by joining an audio-narrative and a physical structure.

Audio Narrative

The audio narrative addresses the listener as a member of a future society. From this perspective, the narrative tells the story of a lost prehistoric civilization whose remnants pose an unspecified threat to the narrated moment.

The listener is guided through the narrative by a spirit, embodied as whispering voice. The basic setting is that of an initiation ritual; the listener is addressed as a disciple ready to join the ranks of "wise women". This rite of passage, however, calls for a journey through the perilous territory of the *split*: a spiritually and mentally challenging trial which exposes the disciple to the horrors of the past.

Following this short introduction, the listener is led through a set of chapters highlighting various aspects of the split. The spirit guides the listener by modulating sounds heard in the background. Furthermore, every chapter is associated with its own base-frequency.

In order to reconstruct the lost prehistoric society, its way of life is related to specific patterns or weaves. These constitute modes of intertwining and separating ways of thinking, feeling, building, constructing, caring, ignoring, repressing, seeing, exerting, and relaxing. The narrative subsequently plays with various references to mental practices alluded to

by virtue of respective audio samples. The "economic cortex" is described as an encompassing agent that imposes a certain order, trying to separate strands of the weave.

An uncanny characteristic of the split is its tendency to organise the world into binaries: Paid / Unpaid, Public / Private, Conscious / Unconscious, Domestic / Professional, . . . These exert a separating, splicing influence on the pre-split fabric, thereby complicating the weave. On a sensory-auditory level, remembrance of the split is manifested by shifts regarding the stereo-balance of samples within the experience.

The narrative ends with the downfall of the lost society as it ultimately weaves itself to death. In a final spell of disorientation, the split closes and the listener has completed the trial.

Endemic throughout the narrative is a sense of anxiety that past dynamics, the violent history might again inflict itself on the present, thereby destroying the fundamentals of the post-split society. The inner workings of the future society are not explained further. The spirit merely hints at the mortal dangers posed by the split, while the urgency of the message is transported more by tone of voice than through explicit narration.

Physical Installation

The physical installation is shown in Figure 1. Intended to be read as reconstruction of contemporary artefacts by a future society, it consists of mundane technological artefacts arranged in a way that seeks to present them as part of an unfamiliar setting.

It is composed of a tripod, circuit board, bluetooth receiver, a Raspberry Pi computer, headphones with electrodes, a fluffy cushion, and wiring. The tripod evokes the form of a tent, thereby engendering associations of shelter and providing a space for visitors to feel safe while listening to the narrative. The wiring repeats the trope of the weave: Woven wire is arranged through craft techniques such as macramé and braiding. The circuit board is placed on the floor under the tripod and connected to the wiring. Audio signals are supplied by a small bluetooth receiver, fixed at the tripod canopy's underside, thus remaining invisible from most viewing angles. The sender is realised as a Raspberry Pi single board computer running customised software and placed out of sight. Headphones are equipped with saline-based wet-contact electrodes. This inclusion of neural sensing equipment hints at the topic of detecting and valuing patterns of emotional labour.

Methodology – The Artwork as Diffractive Device

By their very nature, artworks are multi-purpose devices. You can look at them, dream about them – they successfully operate as paperweights, mood-stabilizing agents, distractions, theatrical props, or investment opportunities. This text, rather restrictively, is interested in a different feature of the artwork, in its capacity as a diffractive device, giving rise to a family of readings.

In accordance with this approach, signifiers are channeled through the artwork, giving rise to specific patterns of expe-

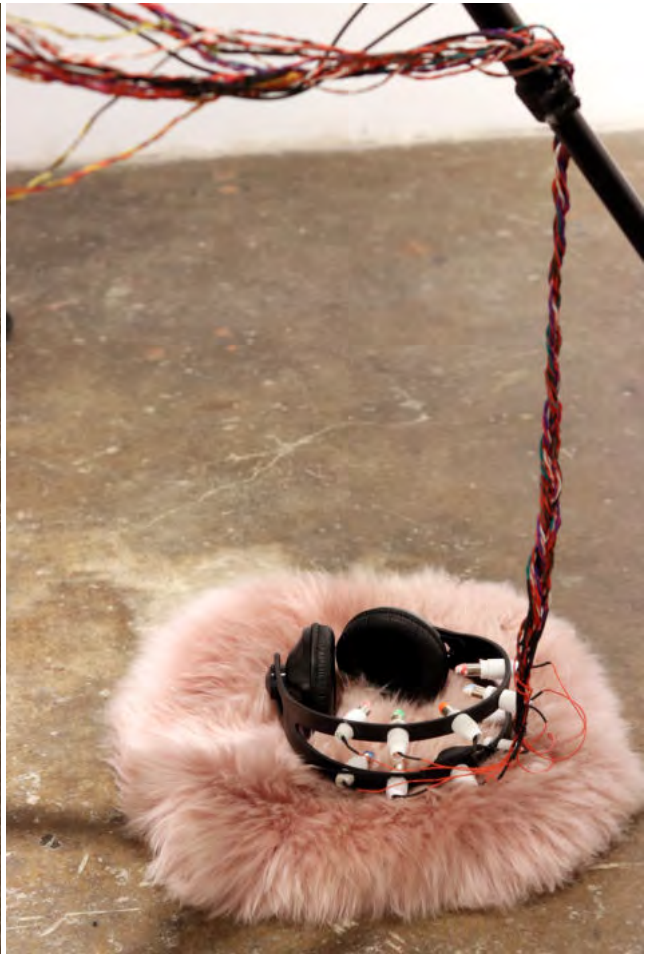


Figure 1: Splitting Defense - Installation View

riencing, feeling, and thinking. The work thus co-produces patterns that otherwise would not be observable, while their appearance also depends on the influx of intellectual and experiential particles.

Crucially, the composite work leaves semantic gaps through which discursive elements ceaselessly pass. Patterns observed depend both on the theory used to create a particular diffractive patterns and the material characteristics of the work itself. The work thus intra-acts with semantic materials to give rise to a family of readings which is described in the following section.

Emerging Patterns – An Affective Economy of Discourse and Material

Psychoanalytic Reverberations

Psychoanalytic literature provides us with an intra-psycho account of the activity of *splitting* in the form of object-relations theory [10]. The eponymous Splitting Defense marks the attempt of consciousness to separate two unrec- oncilable impressions.

It also implicitly points to the manifold precarious psycho- logical formations produced by the capitalist system.

Just as capitalism cannot simultaneously account for the presence of production of value and the reproductive prac- tices which sustain it, splitting defense points to a conscious- ness unable to account for a contradiction. The term conse- quently can be read as “defense through splitting” and “def- ense from splitting”.

New Materialist Overtones

A recurring motif within material-discursive networks are new materialist [5] ones.

The narrative tries to entangle the temporal positions of social analysis, utopian speculation, and immediate experience. It selectively foregrounds the recipient’s body through ASMR [3] effects. There is a pervasive lust for the creation of entan- glements, for intertwining and confronting seemingly disaf- fected analysis with the immediacy of corporeal experience.

However, “new materialisms” were by no means the only materialisms injected into the diffractive situation. In fact, considerable attention was given to their (negatively) dialectical siblings:

Value Diremption Theory – The Commodity and its Other

The trope of the “split” is intellectually implicated in the the- ory of value diremption.

Value diremption theory is a heterodox Marxism indebted to value critical discourse as espoused by groups *krisis*³ and *EXIT*⁴. Created by German theorist Roswitha Scholz, it can be conceived as dialectical-materialist response to feminisms basing themselves on post-structuralist discourse [13]. Inter- estingly, the community of value critics subjected them- selves to a split of their own when tensions within *krisis* lead to a schism, creating value critical rivalries between

krisis/EXIT! adherents (which in themselves constitute a mi- nority within the rapidly dwindling community of Marxists). One of the more famous publications of the group (pre split) is the “Manifesto against Labour”⁵.

Scholz analyses capitalism as a social edifice which for its functioning depends on a patriarchal system of distributing and selectively obscuring practices of labour. Certain labour practices (such as emotional work) have to be constantly dis- avowed while at the same time their presence is vital for the system’s survival [12]. Within a gendered regimen of divi- sion of labour, these devalued activities are projected onto a hidden “female” reproductive domain, which is ideologically excluded from the sphere of work proper. Respective invis- ibilising effects are masked by patriarchal discourse which exclusively focusses on the surface level of the commodity form.

Value diremption theory is special in the sense that, un- like many Marxisms (value critical or not), it does not install its own version of a privileged phallogocentric [4] position. Any exclusive focus on the orthodox concept of commodity inevitably reproduces not only gendered power relations but misses the crucial dialectical relation through which value re- produces itself. The category of value itself can only be re- constructed in the context of a dialectical relationship towards its dirempted other. Consequently, the analysis of value is not intellectually privileged over theorization of its diremption. Resultingly, neither scientific, rational discourse, nor every- day experience and empathy are able to claim a privileged position regarding practices of social analysis.

A material phenomenon such as a social-media platform cannot be understood without analysing the network of cor- porate structures, ad-revenues, the constant reutilisation of value produced by users. At the same time, it cannot be un- derstood without giving voice to the passions and experiences circulating through its communicative channels.

Indeed, adopting the position of an artwork that speaks in unsettling tongues while at the same time mobilizing the an- alytic functions of discourse might constitute a fitting narra- tor position when speaking of value diremption. After all, endeavouring to speak of the Other in the medium of phi- losophy, science, or theory always traps the speaker within a performative self-contradiction [7]. Conversely, it could be argued how any theoretical account of the Other neces- sarily remains incomplete, as the medium of theory under capitalistic-patriarchal conditions necessarily implies an an- drocentric tendency.

Diffraction Pattern – Materialisms in Dialogue

The most interesting patterns might indeed be observed when examining the series of readings in its totality, as an encom- passing material-discursive network, thereby putting different materialisms in dialogue with each other:

The artefact thus becomes visible as site of entanglement where different materialisms meet, attract, repel, and inter- lock. Crucially, we perceive the omissions, and semantic dark spots left by any one individual reading.

³<http://www.krisis.org/>

⁴<https://www.exit-online.org/>

⁵<http://www.krisis.org/1999/manifesto-against-labour/>

The work ceaselessly labours to complicate the relationship between voice and soundscape. Detached analytic and immediately bodily implicated elements intra-act with each other, displace each other, at times entering into precarious equilibrium before re-emerging within processes of cordial antagonism. Constructed as a diffractive device, it creates a tableau of signifiers shifting against each other while possessing internal relations and structure.

The presence of auditory antagonisms within the work can easily be deciphered as reference to social discords if the receiver should be so predisposed. Furthermore, Splitting Defense can be read as liquidation of value-criticism in the form of post-semantic play with signifiers. The recurring motive of 'binaries' alludes to the digital character of computer networks, forming a web of their own while escalating the affective engagement of their users [9].

The work's intermittently disorienting effects hence point to the irreducibility of a material analysis of capitalist societies which does not proceed in recourse to self-identical principles but has to account for the ambivalence of social phenomena.

Over time, the work becomes suffused with the categories and associations of the theories it draws on. Simultaneously, theory changes in the process of materialization, losing its illusory autonomy when becoming an element within an artwork which projects its own logic and inner dynamics.

Diffractive Practice – Diffraction as Methodological Element within Practice-Based Research

In order to playfully entangle discourse and artwork, the practice-based process has to continuously formulate new strategies to relate theory and artefact. A recurring model within this constant practice of relating is that of playful intercourse with theory:

The material body of theory is opposed to that of the art object. These initially have nothing in common – it is the mutual alienness of materials, the pleasant shock of incommensurability which affords a tantalizing quality to the process. Gradually, their bodies begin to displace each other, effecting different shapes, forms, and pressures. Their elements enter into a succession of configurations while assimilation or merging remains impossible. It is an activity that knows no immediate goals or strategies outside of itself.

The ensuing process thus accentuates the shifting position of nodes of heightened excitability, turns its attentions towards semantic cavities in the form of omissions and ellipses. Consequently, it is the intellectual experience, the joy derived from playfully assuming speculative or analytical stances that unlocks the work, diffracting theories into a multiplicity of perspectives and incentives for interpretation.

Within these constructed material-discursive networks, practices of reception can be conceptualised as processes of differential sensitisation. Artworks begin to provide a manifestation of intellectual elements that subsequently become available to sensory experience. The receiver is neither a distanced observer of the artwork, nor an equitable part of it. She becomes materially reconfigured [6] through her en-

counter with the work, obtaining novel sensibilities for the work's communications. The singularity of any given body and its sensibilities effects the singularity of every process of reception.

Conclusion

Confronting theory and artwork in the context of diffractive experiments might ultimately perturb both. It can trouble our image of an artwork, leave us in doubt about the dominion of theory. Theories might crack under the weight of objects; objects might melt under the unforgiving gaze of theory. If we are lucky, however, they might also start invading each other, forming surprising constellations of material interpenetration.

A body of theory might choose to join itself to an alien assemblage of matter, thereby allowing both to exercise their specific agencies: Theory possesses the power to connect the site of the artwork to the illimitable sphere of social experience. Artworks can act as recalcitrant models of theory, allowing its concepts to be embodied while simultaneously insisting on the irreducible individuality of concrete experience.

In the context of the specific practice-based experiment discussed in this text, one of the most fortuitous consequences might be for the receiver to start suspecting the economic order and the patterns of emotional labour practices that go with it.

All travails of analysis should, however, never distract from playful and immediate engagement with the artefact. If we allow ourselves to be invaded, if we start listening, it creates a field of comforts, suspicions, disappointments, gives rise to disorientation and curiosity. After all, it is the result of desires, of desires to contradict, to narrate, to pervert, and to embrace.

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Authors’ Biographies

Michael Heidt likes to situate his practice at the intersection of poetic code creation and critical-reflective theory production. He has conducted practice-based research endeavours informed by fields such as philosophy, media art, and electronic writing. Project foci range from software-based inquiry into microbiological populations to speculative inquiry into the potentials of distributed ledger technologies to foster post-scarcity economies. An ongoing focus of Michael’s research is complexity, which he has applied as intellectual lens motivating research engagements with biological systems, interaction systems, and distributed systems. Michael was a visiting scholar at Simon Fraser University’s School of Interactive Arts and Technology, is an alumnus of German Academic Scholarship Foundation, of DFG’s research training group crossWorlds, and of Andrea von Braun Foundation. Currently, he is conducting the project CoGS at Anhalt University while being an affiliated researcher at University of Kassel’s Gender/Diversity in Informatics Systems group.

Elli Kuruş is a Leipzig-based collective artist, 44% complete. Her practice spans research-based and speculative approaches that converge into installations, videos, drawings, and various performative practices engaging the audience. Investigating the agency of the things around her, she critically examines the development of media and technology, reading the present as material history.

SONUS MARIS

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Abstract

Sonus Maris is a collaborative creative-research project at the Water Research Laboratory, Sydney Australia (University of New South Wales) which is developing a series of artworks that attempt to manifest the underlying dynamics and complex interaction of natural climate and oceanic systems. Employing visual and telemetric data from satellites as well as on the ground observations and ariel surveying the research team aim to generate sophisticated sonification and visualisation that offer a palpable and visceral experience of the long-term flows and patterns as well as of the singularities that make up the world around us.

Keywords

Art and Science, Environmental-art, Bio-art, Sonification, Visualisation, Sound-art, Sound-sculpture, Earth-observation, Climate-systems, Hydrology.

Introduction

Whilst the focus of this paper is upon the current creative-research project *Sonus Maris*, undertaken with the Water Research Laboratory of the University of New South Wales (Australia) it is placed within the context of a series of prior art and science projects which have endeavoured to reveal aspects of the environment and biosphere that are normally unavailable to our senses.

Works such as *Under the Icecap*, a long-term collaboration with the Institute for Marine and Antarctic Studies (University of Tasmania) that sonify and visualise bio-logging data collected from the deep under-ices dives of Southern Elephant Seals in Antarctica. *VoxAura* and *Take a Deep Breath; Breathless* reveal the subtle chemical variations in water and air quality respectively. And the ongoing *Oratorio for a Million Souls* project generates both real-time mixes and musical scores, based upon data-bee-hives installed in special bee listening architectures constructed in German and Dutch botanical gardens. These projects are the conceptual and developmental pathways for the current works.

*Sonus-Maris*¹ started life as a short artist in residence with the Water Research Laboratory in which the artist created a prototype sonic sculpture that made palpable the interactions of wave and tide action upon the deposition and erosion of sand along the axis of a famous Sydney surf beach called Narrabeen. The work took the

form of four giant Chaldini Plates driven by powerful audio transducers that delivered musical scores derived from data. Happily, the collaboration proved successful and the relationship has now flourished into a long-term creative art and science research project.

Sonus Maris, Version No.1 a context.

The Brain is wider than the Sky
For put them side by side

The one the other will contain
With ease and You, beside

The Brain is deeper than the sea
For hold them Blue to Blue
The one the other will absorb
As Sponges, Buckets do

The Brain is just the weight of God
For, Heft them, Pound for Pound
And they will differ, if they do
As Syllable from Sound.

Emily Dickinson, The Brain is wider than the Sky (1862)



Figure 1. *Sonus Maris* 2019, prototype installation (© Nigel Helyer).

¹. <http://www.sonicobjects.com/index.php/2019/12/16/sonus-maris/>

We are neurologically predisposed to seek patterns in our surroundings: in fact, pattern recognition is our core cognitive ability, vital to our evolution and survival as a species, as it affords the capacity for prediction.

In life as in art, we take delight in the symmetries, growth patterns and morphologies of the natural world as through them we recognise our formation. However, there is a constant flux between, on one hand, the regularity, or predictability of a pattern and on the other, the instability or turbulence that might threaten to render it indecipherable - to walk this tightrope between order and chaos is one of the central techniques of art, to distil clarity from chaos is the purpose of science.

In 1917 the Russian Formalist writer Viktor Shklovsky made a distinction between poetry and prose, coining the term *Ostranerie* (or Defamiliarisation) a device for making strange, to render a common thing in an unfamiliar manner or context to create a fresh perception of it. This trope of making strange with language has recurred throughout the twentieth century, surfacing in Freud's notion of the Unheimliche (the uncanny), Berthold Brecht's *Verfremdungseffekt* (the estrangement effect) and Jaques Derrida's *Différance* (which hovers somewhere between difference and deferment).

The probabilistic learning that pattern recognition develops is extremely useful in the prosaic world—it is the way we navigate our daily lives. However, in creative practice, we always require a twist to a narrative, a dissonant metaphor in a joke, or an unpredictable note to conclude a melodic series. This is the sweet spot, the point at which our expectations of regularity in a pattern are disrupted—but not too much, just enough to throw the brain into mild confusion. It is the fissure, the reveal, the punchline that reflects on the narrative arc and plays with our assumptions.

Science is based upon empirical evidence, it observes and carefully quantifies the complex phenomena that surround us in an attempt to make sense of chaos. At the small end of the scale, each wave that crashes onto the beach at Narrabeen creates a turbulent swirl of sediment, multiplied thousands of times in each storm. The scientists and engineers of the Water Research Laboratory understand these individual events as nonlinear interactions which are difficult, if not impossible to interpret or predict. However, they have been monitoring the shifting shoreline at Narrabeen for over 43 years and from this long-term view, it is possible to identify an accumulative effect in which the sand volume rotates between the northern and southern end of the beach in cycles that range between two to seven years. When considered in conjunction with wave and storm data an overarching mechanism driven by climate emerges - it is such a point of view that operates along the axis of the particular to the general that allows us to see the 'wood from the trees.'

A step back - How to make palpable the invisible?

Precursor 1. - *Under the Icecap*.

Science is constrained by Objectivity and Impartiality and perhaps Art is constrained by Subjectivity.

Our Bio-Sonic journey begins by heading toward the South Pole and the Sub-Antarctic Islands. *Under the Icecap* is a long-term Art and Science collaboration² that links scientific bio-logging data and GIS techniques with interactive acoustic cartography to develop a series of Audio-Portraits that extend the conceptual and intuitive grasp of extremely abstract bio-logging data.

The bye-line for the Institute of Marine and Antarctic Studies is "Turning Nature into Knowledge." The *Under the IceCap* project supplies a second line "Turning Knowledge into Culture" encapsulating a powerful Art and Science synthesis and simultaneously raising the expectation but also the risk of the endeavour. The primary aim of the project is to produce creative works which are compelling and affective, but which can simultaneously be works of scientific utility; that hopefully tap into both sides of the brain! The key focus is to illuminate the relationship of the environmental knowledge generated from Antarctic bio-logging data with the Anthropogenic changes in the biosphere.

The collaborators realised that the extensive and extremely complex datasets collected by southern elephant seals (*Mirounga leonina*) represent a considerable interpretive challenge and provided the opportunity for a hybrid art and science exploration of new methods and forms for manifesting the data and to develop novel forms of public awareness and debate about the oceanographic and climatic data that the seals collect. Our aim is focused on developing techniques for visualising and sonifying the complex bio-logging data collected by southern elephant seals on their deep dives under the Antarctic Ice shelves and their long southern ocean transits.

We explore new ways to make these data-sets palpable, manifesting them as a series of experimental music concerts and visual and sonified installations with the express intention of illuminating the fundamental connection between human activities and planetary dynamics. The intention that drives our methodology is that the artistic and scientific paradigms which intersect in *Under the Icecap* form the basis of a robust and productive trans-disciplinary collaboration. The word collaboration is widely and often incorrectly used in art & science projects, typically one discipline being subservient to the other. However, the emphasis within *Under the Icecap* is to design an open, consensual and collective creative research process, that balances and complements the knowledge bases, motivations and target audiences of the art and science disciplines involved. Within a scientific context, such bio-logging data is most frequently

2 Artist Dr Nigel Helyer (Sonic Objects; Sonic Architecture) and Marine Scientist Dr Mary-Anne Lea (Institute for Marine and Antarctic Studies at the University of Tasmania).

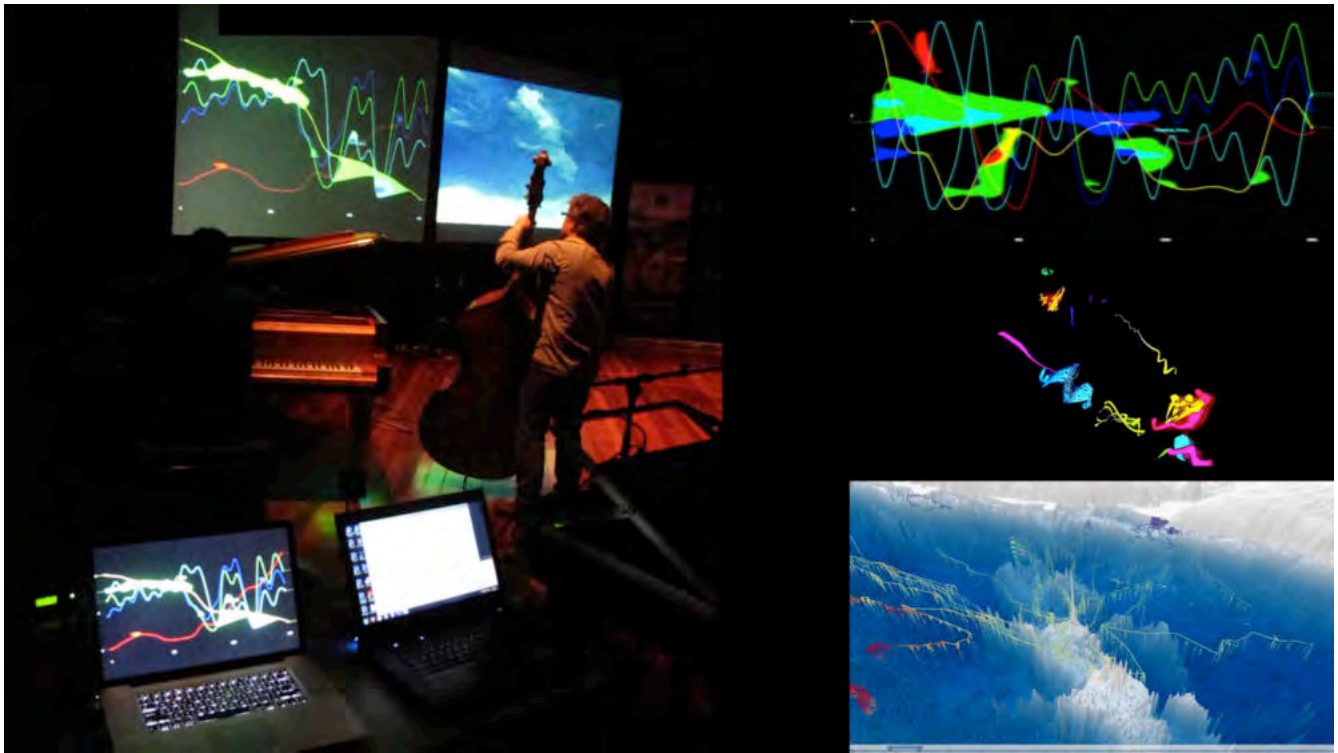


Figure 2. Bio-logging 2012, data rendered as animated maps and graphical scores in a live performance (© Nigel Helyer).

consigned to two-dimensional graphs each of which contains a limited range of variables, making a wholistic gestalt improbable, if not impossible to achieve. Searching for a more flexible approach we imagined a situation in which each of the many variables could be dynamically put into play, examined in real-time and generate on the fly responses - a kind of neural network.

Our solution, musicians! Our decision to interpret environmental data via an aural process is based upon a hunch that musicians have the best pattern-recognition wet-ware around and that our aural sensibility is in fact more finely tuned to detect minor variations in pattern and recognise subliminal differences, than our visual sense.

The large multi-factorial data sets are re-conceptualised in two ways. Firstly, using sophisticated cartographic software, we generate animated 3D maps of the data traces of individual elephant seals for large scale data-projection.

Using the same data we also generate various forms of graphical scores and again render these as dynamic projection works. These are then presented in parallel to a quartet of professional musicians in a live concert context where they are asked to respond individually and/or collectively to the material (there have been many structural variations on this method).

Naturally, the elephant (seal) in the room is the scientific allergy to a subjective, and non-repeatable response which some may consider renders the enterprise interesting but ultimately un-scientific. A somewhat cheeky rejoinder might be that statistical data is, in and of itself, an artefact and that its analysis is even more so. Does the bio-logging data in any manner resemble the

experience of a southern elephant seal feeding two Kilometres deep beneath an ice shelf at a pressure of one hundred and ninety-four atmospheres? As the British Prime Minister Disraeli once said -

“There are three kinds of lies;
lies, damned lies and statistics!”

Precursor 2. - *VoxAura; The River Sings.*

Our blood has the same salinity as the Ocean, a reminder of the origin of all life on the planet and a warning that we share our well-being with our vast and indifferent mother.

As terrestrial dwellers, it is easy to overlook the fact that we inhabit an essentially two-dimensional space



Figure 3. VoxAura, 2011, Turku, Finland. (© Nigel Helyer).

that has surface area but scant depth. By contrast, the marine world is three dimensional, its depths accounting for 99% of the Biosphere and its surface accounting for 70% of the planet's area. The ocean forms the principal inter-face for chemical exchange with the atmosphere, absorbing carbon dioxide and releasing oxygen – it is the pump that drives climate and regulates the air that we breathe.

Like other semi-enclosed bodies of water, the Baltic is brackish, its waters less saline than our tears. The River Aura flows through the port city of Turku, past the maze of low granite islands that form the Finnish archipelago and into the Baltic, carrying with it a mixture of chemical nutrients and effluents that simultaneously drive the annual algal bloom and degrade the complexity and fecundity of marine ecosystems. Put simply the Baltic has lost its clarity and its fish but has gained the reputation as the most polluted sea in the world.

*VoxAura; the River Sings*³ suggests that we pay attention to these complex issues that ultimately control our destiny by listening to the chemical composition of the Baltic.

The project consists of two vessels, moored on either side of Turku's Theatre Bridge, equipped with speakers which broadcast a soundscape. The first of these plays material from a large archive of sound recordings which evoke the maritime traditions and marine environment of the Baltic; whilst the second transforms this material, allowing us to 'listen' to water quality data that is constantly collected by two trans-Baltic ships and downloaded to the work. The project's computer system takes variables from this data, such as position, depth, temperature, salinity, turbidity and pH, using them as musical parameters to transform the source audio (which is playing simultaneously on the first vessel) producing an ethereal 'data music' as a metaphor for, or analogue of the chemical composition of the sea.

Precursor 3. - *Take a Deep Breath; Breathless.*

This work investigates the sonification of environmental data and how the resulting sound works can be installed into a public or architectural situation to create new forms of sonic space in which it is possible to experience, examine and reflect upon the complexities and consequences of our political and economic actions in an increasingly chaotic world.

Conceptually the work is similar to *VoxAura* in that it is structured in two parts, one originating in a social and cultural context, the other ecological and environmental. The work aims to integrate and interrogate the relationship between these spheres, and present them in an outdoor urban environment and/or public architectural space.



Figure 4. Take a Deep Breath-Breathless, street recording (© Cecelia Cmielewski).

*Take a Deep Breath; Breathless*⁴ concerns the atmosphere, the breath and the act of breathing. Breathing as meditation, as respiration, failing breath in respiratory diseases, the breathy sounds of our voices, of song and flute – ultimately the metaphor of breath as life itself.

During his sojourn in Delhi, the artist recorded a large audio library that embraced a wide range of ambient, vocal, environmental and musical sounds, in effect creating an AudioPortrait of the physical and social environment.

Atmospheric data was sourced directly from the City's environmental monitoring system providing a constant and somewhat alarming stream of digital information on the levels of pollutants in the Delhi atmosphere. Ironically, during the project New Delhi experienced the worst air pollution on record, driving home the point in a dramatic but unpleasant manner.

From a technical perspective the system consists of two components ~ firstly a large audio library that is capable of being updated via wifi – the second element is a correspondingly large library of environmental data sets which can be accessed either in real-time (online) or updated via wifi regularly. The system computer selects a sound file and data file at random and convolves them to render two stereo audio streams to the speaker array which was installed in the gallery space of the Portuguese Embassy's Cultural Centre.

As in *VoxAura*, one stereo pair of speakers plays the unadulterated audio file whilst the other plays the harmonic data-music that simultaneously renders some of the data structure, but which also has a sonic imprint of the audio original.

³ Vox Aura, commissioned by Turku, European Capital of Culture 2011. <https://www.sonicobjects.com/index.php/2011/08/01/voxaura>

⁴ *Take a Deep Breath; Breathless* was commissioned by the Sound Reasons, Sonic Cities Festival 2012 and took place in Delhi, India. https://www.sonicobjects.com/index.php/2014/06/29/breathless_take_a_deep_breath

Precursor 4. - Oratorio for a Million Souls.

*Oratorio for a Million Souls*⁵ is a public art project that spans three physical locations and was designed to contribute directly to the debate around issues of biodiversity and the population collapse of bird and insect species in Europe. The decision to work with bees developed from a long-standing interest in the cultural metaphors that have historically been associated with colonial insects (especially honeybees).



Figure 5. Oratorio for a Million Souls (2018 ~ 2022) B-Rhapsodie concert in the de Kriedhof Botanical Gardens. (© Nigel Helyer).

The organisation of the hive with its epigenetic formation of social ranks and the strict division of labour have long been used as a template for human social and political regimes. Characterised as obedient, efficient and with a selfless devotion to the common cause, bee society has been a paradigm vaunted by autocracies and monarchies for centuries; only recently has research demonstrated the remarkable level of consensual decision making that rewrites the old hierarchical stereotypes. The second strand of interest is focused upon the complex abilities of communication, navigation and collective problem solving that are performed not by each individual, but as a network – the *hive-mind* an entirely different paradigm a ‘rule from above’ model. The level of parallel processing and complex communications evolved by bees over 100 million years render the hive a true *Super-Organism*.

It was in this context that the *Oratorio for a Million Souls*⁶ developed three bee-listening architectures sited in European botanical gardens, each structure equipped with two sensor hives. As the work is extensively described in the proceedings of ISEA2019⁷ here the focus is on the creation of musical scores, which function externally to the public artworks per se. The score was based upon two streams of real-time audio from the sensor

hives; one from miniature DPA microphones embedded in the entry and exit ports of each hive and a second stream from custom-built contact microphones placed deep within the hive itself. The audio content was complemented by data extracted from a series of hive exit and entry sensors that provided a picture of the diurnal activities of bee colonies, which generally correspond to external temperature and light levels. The audio recordings were employed to establish a tonal palette that was subsequently quantized into an even-tempered scale. The bee movement data was parsed into a rhythmic and temporal framework, giving the score its overarching structure. In contrast to the more stochastic processes of the previous works, once the ground rules were established, the musical form took on a life of its own, bound by the parameters derived from the original hive audio and data.

The resulting scores were, from the perspective of the three large brass and wind ensembles, quite unconventional and challenging to play. The performative challenge was amplified by the technical and logistical difficulties in synchronising the three-part score via an audio-visual satellite link-up that connected the botanical garden in Buitenpost (Netherlands) with gardens in Emden and Oldenburg (Germany).

The outcome of the debut performance which launched the overall project, was a success, despite the inclement weather which drizzled into the mouths of Tubas and Bass Saxophones – a tribute to the hive-mind of the musicians, conductors; sound engineers and cultural producers – it seems that we may have learnt something from the bees!

***Sonus Maris*, Version No.2 - Work in Progress.**

The current *Sonus Maris* collaboration, which is in its developmental stage, initially places its attention upon the extraordinary coastal environment in which the art and science team live. The Eastern Seaboard of Australia is the greenest and most fertile part of the continent (and naturally the most populated). Measured South to North the coastline is approximately 4000 kilometres and supports a wide variety of coastal waterways.

These include tidal creeks (35%), wave-dominated estuaries (17%), tide-dominated estuaries (11%), wave-dominated deltas (10%), tide-dominated deltas (9%) and strand plains (5%), with the remaining 13% comprising drowned river valleys, bays, coastal lakes, lagoons and creeks. Many of these coastal freshwater resources are only intermittently open to the sea and are termed *Intermittently closed or open lakes and lagoons* (ICOLLs) and these are our current focus of interest. Australia is home to 305 (21%) of 1477 globally mapped ICOLL systems.

5. Commissioned by the European Capital of Culture, Leeuwarden, Netherlands 2018.

6. <https://www.sonicobjects.com/index.php/2019/04/14/the-oratorio-for-a-million-souls>

7. *Heavy Metal and the Oratorio for a Million Souls*, Dr Nigel Helyer & Dr Jon Drummond, Proceedings of the 25th Symposium on Electronic Art (2019) Pg 18 ~ 23.



Figure 6. A coastal river system with a narrow opening to the sea, New South Wales east coast ((© WRL).

The principal research collaborator at the lab, Valentin Heimhuber is an environmental researcher & engineer working on the integrated management of river systems, wetlands, and estuaries in the context of climate change and the pressures of population growth. His work focuses on the use of large satellite datasets and machine learning to develop new tools for the improved management of water resources and water-dependent ecosystems. Valentin is particularly interested in using data to find the right balance between human and environmental water requirements in catchments, rivers and coastlines.

Valentin has developed an algorithm *InletTracker*⁸ that draws upon more than three decades of public-domain satellite imagery (Landsat 5, 7 and 8 and Sentinel-2). His new analytical tool can reconstruct the dynamics of ICOLLs by retro-analysing the relatively low-resolution satellite images to identify the flow patterns and frequencies of these water bodies, thus providing a historical perspective that demonstrates the cyclical nature of interactions between fresh-water and salt-water bodies. *InletTracker* reveals when and how they open and close to the ocean and this data can then be correlated with the associated climatic and oceanic data to illustrate a complex web of environmental interactions, which may hopefully indicate future behaviours under the influence of a changing climate.

The ingenuity of *InletTracker* (a Google Earth Engine enabled python tool) is that it functions to recreate observational data of environmental events that were not previously intentionally observed or recorded. The system uses a novel least-cost pathfinding approach to trace inlet channels along and across the barrier/berm, and then analyses the resulting transects to infer the minimum channel width and whether an inlet is open or closed. The tool is simple to use and provides data on the location and shape of entrance channels, their width at the throat and their status (open or closed to the ocean).

The principal drivers of such interactions are; terrestrial rainfall; fluvial action; wave and tidal action;



Figure 7. Preparation of the original Landsat capsule (© public domain).

atmospheric pressure and associated storm events. All of which combine to set in motion a constant but irregular cycle of opening and closing water bodies, which have implications for coastal integrity and human habitation and coastal land use.

As in all of the pre-cursor projects, the dominant concern is how to manifest such complex data in a way that makes it palpable, visceral and emotionally engaging. How can these complex webs of information become something that illuminates the fundamental connection between our human activities and planetary dynamics as it spins out of control? My initial and immediate response was to imagine the complex web of climatic and oceanographic interactions as a form of musical instrument—perhaps an organ, voicing and modulating as the environmental unconditions fluctuate.

How to begin a conversation?

Following this musical metaphor, we have selected the flows of six ICOLL water bodies to create an organic musical score; an instrument conceived on a geophysical scale. The soundscape (or score) will be accompanied by rich data visualisations and inter-mixed with actual

⁸. The *InletTracker* <<https://github.com/VHeimhuber/InletTracker>>

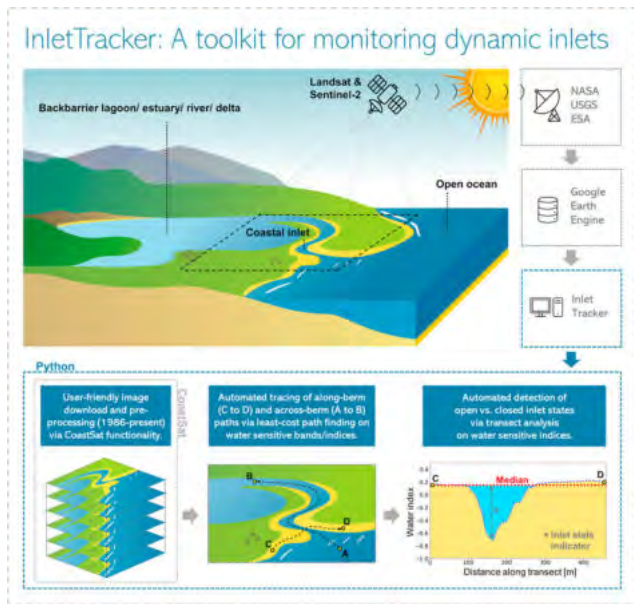


Figure 8. An InletTracker schematic.
(© Valentino Heimhuber).

environmental recordings using a variety of visual technologies (video, LIDAR, particle modelling etc) as well as acoustic ecology microphony techniques.

The intention is to establish an indexical relationship between the data and the musical structure, similar to *Under the IceCap*, where the data itself ‘authored’ the mappings and graphical scores, with the oceanic data providing strict relationships between, for example, depth pressure, temperature, salinity and turbidity, none of which were influenced by subjective interpretation.

Likewise, we envisage that the new *Sonus Maris* project will bring together the environmental flows of coastal lagoons and estuaries as they debouch into the Tasman Sea in a manner that will directly translate the observed data into a soundscape, but one that has not passed through a conspicuous layer of (subjective) interpretation (beyond the process of establishing the parameters for assigning sounds and their properties to the various data sets). Here the sonic output will be structured directly by the InletTracker data, itself, generated through an analysis of the pixels present in Landsat images.

The project is scheduled to debut in December 2022 in Sydney, Australia at the 37th International Conference on Coastal Engineering as a large-format data projection with options for both digital sound and a version with a live musical performance of the data structures. The project will also generate a touring exhibition and a dedicated website.

To conclude.

Concern for the environment has become a central political and artistic issue in the contemporary world. Environmental science and climate change science now perform crucial roles in analysing, and forecasting, the (increasingly precarious) state of the global environment. Siân Ede, in his book “Art and Science,” has proposed that ‘the fragile environment’ might well become ‘the most crucial matter for the future concerns of both artists and scientists.’⁹

However, the broader public (and political) realisation that art and science can form powerful and symbiotic relationships with benefits that extend into all aspects of social, economic and cultural life has been a long time coming.

*‘L’art c’est al science faite chair’*¹⁰

‘Art is science embodied’ these words by the French poet Jean Cocteau written in 1918 neatly encapsulate a perspective in which art and science are imagined as two expressions—as two voices of the same spirit of enquiry, but perhaps delivered in a different register. Cocteau’s short phrase employs the French word ‘chair,’ in English quite literally ‘flesh,’ emphasising that art brings science into the visceral world as a palpable experience, and by so doing it can become something that we can relate to directly—a narrative behind the data! It is this embodiment of curiosity, of knowledge, and sheer wonder that the melding of art and science is all about.

Artist Biography.

Dr Nigel Helyer (aka DrSonique) is a contemporary sculptor and sound artist whose work links Art and Science to embrace the environment; identity and cultural history. He has an international reputation for his large scale sound sculptures, environmental artworks and interactive bio-art projects that prompt the community to engage with their cultural histories, identity and sense of place; inviting us to examine the abstract conditions of our world and our complex relationships to it. Nigel is the director of SonicObjects; Sonic Architecture <<http://www.sonicobjects.com>> an Honorary Professor in the school of Media, Music, Communications and Cultural Studies at Macquarie University, Australia <<https://www.mq.edu.au/faculty-of-arts/departments-and-schools/department-of-media-communications-creative-arts-language-and-literature>> and is currently the Artist in Residence at the Water Research Laboratory, The University of New South Wales, Australia <<https://www.wrl.unsw.edu.au/>>

⁹ Siân Ede, *Art and Science*, p. 12.

¹⁰ Jean Cocteau, *Le Coq et L’Arlequin*, 1918, p. 11.

Knowledge Cultures in New Media Art

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Abstract

New Media Art reflects the dramatic creative and cultural shifts in science and technology of the past century. With these shifts the multitude of forms of art-making have expanded to include a wide range of ideas and techniques. Following several decades of new contributions this plurality of expression has resisted monolithic or curatorial approaches to organization along the lines of media.

This paper defines knowledge cultures as flexible, overlapping, non-exclusive, ideological sub-groups and seeks to identify such groups within the practice and theory of New Media Art. While practicing groups may be associated with specific media such as games, 3D printing, or artificial intelligence, we seek to identify knowledge groups by their explicit, hidden or shared ideological principles.

Keywords

art and technology, knowledge cultures, post-medium, post-modernism, pluralism, curation

Introduction

The field of New Media Arts (NMA) does not have any single point of origin but has evolved from a variety of practices engaging with new technologies. Approaches to organizing NMA, such as Christiane Paul's *New Media in Art*, have grouped works and artists according to media practices. [1] Tribe and Jana define NMA according to a variety of themes such as computer art, collaboration, open sourcing, surveillance and hacktivism. [2] These themes are loose incomparable sets. For example, computer art is technique, collaboration is a social activity, and open sourcing is a decentralized licensing strategy. While these words convey various practices an understanding of New Media Arts as a collection of themes tends of collapse ideologies of meaning.

In the context of academic disciplines, New Media Art may be defined as a form of "knowledge production." Beyond aesthetic considerations, Borgdorff draws from Kant and Adorno to compare art to other disciplines generally. [3]

"Art's epistemic character resides in its ability to offer the very reflection on who we are, on where we stand, that is obscured from sight by the discursive and conceptual procedures of scientific rationality."

Such comparisons are academic in the sense that they establish the uniqueness of art with respect to science or engineering but do not delve into ideology or meaning of specific movements, or of New Media Art in particular. A superficial view of NMA as a "production of knowledge" suggests an accumulation of ideas for its own sake.

We seek to explore the knowledge cultures present within NMA and how these inter-relate, evolve and define the discipline. Of particular interest are those knowledge cultures and ideologies which are embedded or assumed by current practices.

Cultures of Practice

That the practice of New Media Arts has resulted in new sub-cultures is a natural outcome of the media on which it is based. Manovich identifies this in the *Language of New Media*. [4]

"The computerization of culture not only leads to the emergence of new cultural forms such as computer games and virtual worlds; it redefines existing ones such as photography and cinema."

Whereas the phrase 'cultural forms' is not explicitly defined we take it to mean a format (or media) produced by culture. New media leads not only to cultural *forms* but to new sub-cultures of people around those forms. The computer game is a new cultural form yet also a people who make, play and create videos games.

Such is the state of New Media Art that novel sub-cultures abound. Artists organize around database art, data visualization, computer games, virtual reality, artificial intelligence, and many other media which have emerged in the past few decades. We may view these as sub-cultures of practice which are loosely organized, fluid and constantly changing.

With the identification of media as one foundation of New Media Arts efforts were made to form modern collections accordingly. Oliver Grau proposes a digital and "scholarly archive" to document the works of NMA and the humanities

generally, similar to such archives in other fields. [5] He acknowledges that an archival database would require a unified effort among institutions, artists and conservators. Such efforts are already undertaken by publishers [6]. However these are not collated uniformly with other publishers while also discounting works solely shown in galleries, museums or solo venues. Despite the challenges of a unified archive such a system would be of significant benefit to the field.

A digital archive of media artworks might collect the authors, visual records, or even the works themselves, yet without further analysis the ideas that motivate each work may again be collapsed or lost within a literal database. An archival database of NMA would be a research tool and this paper is not concerned with the curation of collections per se, but with the identification of ideologies embedded in New Media artworks.

For our purposes we may define a *knowledge culture* as a fluid, non-mutually exclusive sub-culture or group of people (artists or otherwise) with a particular ideology. Within this definition, a “culture of practice” is a group that identifies itself according to a given media, such as video game creation or internet art. The aspect of non-exclusivity is helpful since any particular artist or work might belong to multiple knowledge cultures simultaneously.

Social or Explicit Cultures

Explicit Cultures

Certain artists focus on an explicit value system driving their works to a greater degree than form. One such example is Ecological art defined here by Aaron Ellison and David Borden.

“Ecological art is purposeful and often prescriptive: the intended actions and directions for activists are clear.” [7] Their work *Warning Warming* consists of a series of large hemlock timber triangles painted in yellow, red and black to indicate the average global temperature from 1880 to 2001, with carbon dioxide emissions on the opposite side. The artists seek to engage the viewer in ecological activism and ask questions such as: “Can it [ecological art] also provoke emotional responses that inspire immediate action or long-term activism?” [8]

An intriguing aspect of this work is that operates fluidly between sculpture, public art and data visualization. Its purpose is guided by a shared vision among ecological art toward environmental activism. Whereas cultures of practice (e.g. database art) may evolve from their media the presence of an explicit value or ideology defines a *social culture* of knowledge. This is not to say that the choices of media are irrelevant but that the intentions are explicit beyond merely “experimenting with the media”. These social cultures of art grow from an immediate or perceived human need that the artists are compelled to address.

Contemporary artists frequently participate in multiple value cultures. The artist Shu Lea Cheang is a pioneer in video, cyberfeminist and internet art. Her work *Brandon*

(1998-1999) focuses on the murder of a trans man, Brandon Teena, and was the first web-based commissioned artwork by the Guggenheim Museum of New York. [9] The explicit value structure in feminist art is observed by Lucy Lippard in Framing Feminism where “[feminist art] is neither a style nor a movement but instead a value system, a revolutionary strategy, a way of life.” [10]

More recently Cheang’s work *Composting the Net* (2012) takes the recorded legacy of online communities such as IDC and Spectre – lists of artists & works – and turns them into digital pixels, thus “poetically, composting them.” [11] The culture of internet ecology questions the Internet as a digital landfill of accumulated information.

An explicit social culture is a type of knowledge culture that defines its shared value structure and membership a priori. Members are those that support the value system while they may also simultaneously participate in multiple cultures such as Cheang’s cyberfeminist work (*Brandon*) and works in internet ecology (*Composting the Net*).

Non-Explicit Cultures

An explicit shared culture may not always be defined or present in socially meaningful works. In the video game *Vietnam Romance* by Eddo Stern, players experience the Vietnam War as a “mash-up” of cultural artifacts creating a colorful contrast between the players nostalgia with the surrounding military activity. [12] This work functions as a commentary on war and loss of history.

The video game *Papers, Please* by Lucas Pope takes place in a fictional Eastern Bloc country with the player as an immigration officer at a migration checkpoint, with actions “mostly confined to shuffling papers and confirming or denying someone’s entry into Arstotzkan.” [13] The game thus creates an uncomfortable power struggle in the player as their duty and its impacts escalate.

Vietnam Romance and *Papers, Please* are related in their role as political criticism – this is their social culture. Even so, Eddo Stern is often described within the culture of practice as a video game artist since this is a medium he works with frequently. Social cultures may be defined informally, non-explicitly, around groups of artists with similar ideological themes (e.g. war, ecology, environment, feminism), *in addition* to any identity with practice or media.

Non-explicit cultures are loosely defined by shared interests among artists that may or may not know one another. Social cultures, as a consequence of meaningful work, and whether they are explicit or non-explicit, *transcend* media and cultures of practice.

Mainstream Contemporary Art

A well-established knowledge culture can be found in mainstream contemporary art (MCA), whose values are summarized by Edward Shanken. MCA is the “primary arbiter of artistic quality and value through its control of the market.”

[14] The ideology of MCA thus equates, among other ideas, with money and market capitalism. Shanken sets up a dichotomy between MCA and NMA along the lines of the technological divide introduced by Claire Bishop and goes on to criticize MCA for being technically illiterate. [15]

“mainstream discourses typically dismiss NMA based on its technological form or immateriality, without fully appreciating its theoretical richness.”

The issues of capitalism and technological innovation are not easily resolved. At times Shanken appears to contradict himself, for example when speaking of MCA’s ability to “commodify relatively ephemeral art forms” such as video, while later stating that MCA “remains tightly tethered to more or less collectible objects.” [16] The one constant in mainstream contemporary art, however, is the continuing value structure of art as a marketable good.

Three Technological Sub-Cultures

In evaluating the relationship between MCA and NMA, Shanken reveals multiple ideological relationships with technology. By setting aside market-driven discussions we can extract these value systems as follows.

- Techno-philic – many artists and people embrace a technological future, or at least one in which technology plays a prominent, positive role, as for example in *La Plissure du Text* referred to by Shanken.
- Techno-critical – some cultures within New Media Art are meta-critical, embracing technology while simultaneously reflecting on it “in a manner that self-reflexively demonstrates how new media is deeply imbricated in modes of knowledge production.” [15] Shanken describes this as the best of NMA.
- Techno-phobic – some cultures are against technology, either explicitly or indirectly. Shanken questions Bishop for posing the Digital Divide without having exposure to NMA: “could a contemporary art historian/critic be taken seriously if s/he stated that performance or video or installation lay beyond their expertise?” [17] As a critic of NMA a better question is how Bishop became interested in confronting the “digitization of our existence” in the first place.

Artworks within a techno-philic culture may be described as innovative but not necessarily reflective on its limits. Those which are techno-phobic are generally not new media artists themselves if their dismissal of technology is complete. Artists which adopt new media must at least embrace it in practice and thus become techno-critical at a minimum.

The confusion in Shanken arises because MCA, while always a capitalist value system, is not one people with a singular technological outlook but a multitude of sub-cultures consisting of curators, directors and institutions which may be techno-philic, techno-critical or techno-phobic.

Case Study: Artificial Intelligence and GANs

A recent techno-philic culture that has gained rapid acceptance in mainstream contemporary art is *artificial intelligence*. In 2018 the work “Edmond de Belamy, from *La Famille de Belamy*” was created by a generative adversarial

network (GAN) developed by the French art collective *Obvious* and sold for \$432,500 at Christie’s New York. [18]

The monetary values of MCA shift instantaneously with shifting demand. Aaron Hertzman (Adobe) attempts to describe this rapid rise in popularity with the concept of *visual indeterminacy*. [19]

“Visual indeterminacy describes images which appear to depict real scenes, but, on closer examination, defy coherent spatial interpretation. GAN models seem to be predisposed to producing indeterminate images, and indeterminacy is a key feature of much modern representational art.”

Hertzmann misses the fact that GAN-generated artwork is more properly defined as NMA and thus better compared with other AI-based art forms. Nonetheless his description might explain how mainstream art has rapidly adopted this style.

New Media Artists have been producing important works in AI since the 1950s. Michael Noll developed algorithmic drawings with compositions similar to Mondrian. [20] As members of the *Algorists*, a culture dedicated to algorithm-as-art, Noll, Verostko, Hebert, Mohr, Nike and others have been exhibiting works in galleries and museums for decades. In 1968 Harold Cohen developed AARON, a program that could produce child-like drawings of people and gardens. As a work of symbolic-AI in art, while not a learning-style AI like GANs, it is nonetheless an early example of machines creating captivating visual imagery.

Artificial intelligence, as an art form, has developed many knowledge sub-cultures. Works that are accepted by mainstream art are difficult to ascertain on a conceptual basis alone. The AI artworks of Refik Anadol have been featured in prominent venues globally. His recent project, *Quantum Memories* “utilizes the most cutting-edge, Google AI publicly available quantum computation research data and algorithms to explore the possibility of a parallel world.” [21] Interestingly, given the description provided, this AI is likely not a GAN since the presentation of the work is abstract, more akin to abstract expressionism than to modern representational art. One might make the case that AIs which can mimic *any* style of early modern art are destined for acceptance by mainstream contemporary art.

Also important is that any note of techno-criticality, or self-reflection on the limits or dangers of AI technology, is absent in this work by Anadol. Thus it remains firmly within the techno-philic culture surrounding affirmative trends in artificial intelligence.

Post-Modernism

What other knowledge cultures are embedded within New Media Arts today? We have surveyed those of shared cultural practice (media), those of social ideology (explicit or non-explicit values), those of the art world (market value) and those based on future technological outlook. To appreciate NMA more deeply is to address cultural ideologies

which may be assumed, or embedded, within the culture of new media art itself.

One may begin by appreciating that New Media Art developed on the heels of post-modernism. It is not coincidental that new media art arose at the same time that media theorists such as Jean-François Lyotard were reflecting on the condition of post-modernism. [22]

“Simplifying to the extreme, I define postmodern as incredulity toward metanarratives. This incredulity is undoubtedly a product of progress in the sciences: but that progress in turn presupposes it.”

Scientific progress is intertwined with the modern condition, as it is with new media art. Lyotard understands science, in part, as “searching for and ‘inventing’ counterexamples, in other words, the unintelligible.” [23] Only within a plurality of hypotheses can one seek the more correct one.

Distance and Objectivity

Within the digital humanities, the post-modern condition is reinterpreted by Franco Moretti as a distinction between close and distant reading. [24]

“Distant reading: where distance, let me repeat it, is a *condition of knowledge* [sic]: it allows you to focus on units that are much smaller or much larger than the text: devices, themes, tropes—or genres and systems. And if, between the very small and the very large, the text itself disappears, well, it is one of those cases when one can justifiably say, less is more.”

This distance is an intentional space between the reader and narrative. Distant reading examines text as fragments of knowledge, similar to or derived from the methods of science in questioning a multitude of hypothesis of manageable size. The premise is that *distance* confers *objectivity* via comparison, with fragmentation as a by-product of tried-and-failed ideas.

Under the system of science all untried ideas are equally valid for Lyotard recognizes that “science does not expand by means of the positivism of efficiency.” [23] Human intuitions that might move more ‘efficiently’ toward readily viable ideas are suppressed as every hypothesis is valid until tried (bias being undesirable). Thus science proceeds slowly with repeatable, testable, comparable ideas.

How do the scientific conditions of post-modernism influence the knowledge cultures of New Media Art? Previous methods of narrative, artistic movement and cultural dialog become passé. The tenants of science must be reframed for adoption. Within NMA there are no hypotheses, only artworks, and therefore the scientific theory of objective testing translates poorly to art. Duchamp began the experiment of art as idea and since then each conceptual work must be evaluated on its own merits. The lack of an objectifiable (comparative) metric for works of art, combined with the literal technological outcomes of science, has resulted in an explosion of viable forms and meanings.

Fragmentation and the End of Art

The accumulation of information was anticipated by Paul Virilio and Vannevar Bush. [25]

“There is a growing mountain of research. But there is increased evidence that we are being bogged down today as specialization extends. The investigator is staggered by the findings and conclusions of thousands of other workers.”

The art object fits within this accumulation ever since the appearance of the readymade. For Danto this signifies the ‘end of art’ since it can no longer be distinguished from everyday objects [26]. Vassiliou reflects on NMA to conclude that “Danto’s theory for the ‘end of art’ seems to withstand the advent of digital media.” Within his reasoning, NMA does not “escape” from or “distinguish” itself from common objects, nor from the “institutional norms of art.” [27] One must concede that NMA, through a proliferation of media forms, appears to support this fragmentation.

The ‘end of art’ is the end of the artistic object as an institutional form, with NMA forging new pathways for distribution. Additionally, the pluralism of NMA is not equivalent only to a growth of information (or objects) for the lack of scientific metrics in art also undermines a unified sense of purpose. Nonetheless, scientific theorists (non-artists) continue to pleasantly make the case for a scientific understanding of art pluralism. For example, Magnus & Uidhir, offer “species concept pluralism — a well-explored position in philosophy of biology — provides a model for art concept pluralism” [28]. The problem is that art objects are not comparable the way biological species are. Unlike species which are naturally (physically) comparable, meaning in art depends on the ideology of knowledge cultures of both the creator *and* the viewer.

In science, the direction forward is guided by nature (reality). In art, every direction is viable. Thus the ‘end of art’ is not only the end of the art object, or artistic creation, but the end of the artist — one who guides our reflections on where humanity stands. Fragmentation leads to the loss of sense of the *artistic self*; a unified ideological direction forward in art is no longer achievable.

The knowledge culture of fragmentation is the acceptance of pluralism; an ideology that any object, any media, even any idea may be the subject of art. Hence the proliferation of art-science-engineering crossover disciplines such as biological art, database art, and AI-based art.

Pluralism

Object pluralism, presently discussed, may be distinguished from social pluralism, i.e. diversity and inclusion. Both are embraced by venues of NMA despite the increasing difficulty of defining artworks along thematic categories.

A practical experiment will demonstrate the challenges of pluralism. Choose five artworks at random, preferably using a computer to ensure randomness, from the pages of the International Symposium on Electronic Art (ISEA) catalog for any year. See the footnote for an example ¹. A knowledge culture in favor of pluralism would argue that each work found deserves equal attention without bias. Pluralism in NMA accepts the premise that all art experiments are of value; immeasurable until tested.

The issue raised is the curation of New Media Art. A culture of pluralism must accept Bourriaud's criteria for the evaluation of art. [29]

"...this 'arena of exchange', must be judged on the basis of aesthetic criteria, in other words, by analyzing the coherence of this form and then the symbolic value of the 'world' it suggests to us..."

Criteria for new media art in a pluralist framework is judged according to internal self-consistency. Absent are any preferences toward a larger significance or meaning, and, since they are lacking in Lyotard's "efficiency," are intended to be unbiased selections. Thematically, and in current practice, the efficiency in selection is achieved by venue according to the historicity and evolution of currently selected knowledge cultures (e.g. AI, database art, etc.) and to a significant degree on industry and market trends.

Knowledge cultures of NMA may view pluralism positively or negatively. Those in favor of pluralism accept that all works are deserving of equal attention in accordance with the tenants of scientific non-bias and based on the self-consistent merits of the work. Arguments against pluralism are currently more rare, but must be founded on the notion that art is not science – there will never be a universal arbiter of creative truth (as nature is to science) as the vast range of ideas is too overwhelming to receive our equal attention. Therefore we must ask: *what do we value?*

There can be no singular answer in a global culture – hence the embedded condition of pluralism. A recent plea which calls for a culture of non-pluralism can be found in Alexandra Bal's "Sentience as The Antidote to Our Frenzied Mediated Selves." [30]

"Contemporary western tools of perception have adapted to a human consciousness that exists in hybrid techno-

natural spaces... We exist in a frenzy of online social performances and simulated realities, constantly moving from one network node to another."

Bal recounts the history of Western science as the arbiter of our sentient selves and our subsequent "disembodiment" with the world. Her conclusion is that, with respect to our social products and activities, the final metric of humanity – to which pluralism is a detriment – is our ecological and environmental relationship to the planet.

Pluralism, defined here as the selection of artworks based solely on self-consistency (e.g. quality, coherence), is an outcome of the global embedded knowledge culture of the scientific and industrial revolution. The result is a vast range of works whose value structures overlap with other disciplines.

Post-Medium and Remix Culture

Some extremes of pluralism are described by Rosalind Krauss as "post-medium." [31]

"As medium specificity fell out of fashion, it seemed retrograde for artists to attempt it or for critics to praise it. Art had, it seemed, entered a 'post-medium condition' in which the inauthentic seemed more daring and up-to-date than the exploration of limits and materials."

Post-medium is established by Krauss by its opposite; hold-out artists that make use of 'technical supports', specific non-traditional media, to avoid the post-modern condition of medium irrelevance. Shanken is critical of Krauss by noting that she "misses the richness" of artists who join together multiple media [14].

Interestingly, similar observations on the loss of medium specificity are made by Manovich in his description of deep remixability. [32]

"But software is like various species within the common ecology—in this case, a shared computer environment. Once 'released,' they start interacting, mutating, and making hybrids. The invisible revolution that took place in the second part of the 1990s can therefore be understood as *the period of systematic hybridization between different software originally designed to be used by professionals working in different media.* [sic]"

Manovich describes those engaged in remix as forming a "remix culture", in our parlance a knowledge culture based on the resampling of content and the intermixing of media. Remix culture is one cause of the post-medium condition.

Whereas post-modernism introduces the notion that *any* object (readymade) may be taken as medium, Vassiliou observed that the response of New Media Art was to adopt the *media of technology* as the new normal form – code, database, VR/AR, internet, etc. The post-medium condition takes this exchange further by eliminating the boundaries of media altogether – remix culture is the lack of medium specificity.

Post-medium fits naturally within the pluralist paradigm, for the "interaction, mutating, and making hybrids" is easily adopted by scientific hypothesis-generative thinking.

1 The random art selection experiment was conducted with the following Processing code (see processing.org):

```
for (int n=0; n<5; n++) println ( (int) random(0,300) );
```

For example, results from a single run gave five randomized page numbers in the ISEA 2016 Catalog:

#1, p.212, Julien Ottavi & Jenny Pickett, *Electromagnetic Spectrum Research* – explores "inaudible sounds" recorded by VLF (very low frequency), especially the hum of manmade devices such as electrical pylons, to discover musical complexity.

#2, p.136, Sandra Heinz, *Haitus* – pull cords trigger a dark patch within a grid of 6x3 light panels, with gaps and random behavior that give a "dust", glitch-like aesthetic.

#3, p.160 Jinku Kim, "*..What Is Seen was Not Made Out of What was Visible.*" – sound, which creates a physical vibration of air molecules, is visualized as geometric patterns on an oscilloscope, giving a "hyper-tactile" experience.

#4, p.26, Nurit Bar-Shai, *Objectivity: Soundscape* – applies lab techniques to visualize the "chemical tweets" of microorganisms as beautiful patterns.

#5, p.291, Rewa Wright, *An Algorithmic Life* – procedurally generated terrain rendered from a non-manifold geometry.

Pluralism, at its extreme, is no longer even a branching taxonomy of the evolution of distinct media but the boundless, multi-dimensional crossbreeding of media.

Modern Meta-Narratives

The ideological frameworks of the present are embedded deeply in the knowledge cultures of scientific thinking, distant reading, objective analysis, pluralism, and remix culture. The conditions of knowledge are not mere conveniences or temporary infatuations; they reflect the values of our times.

Each knowledge culture has adherents and detractors. For those technophiles who see no contradictions within the present global system, the contemporary knowledge cultures of NMA are a playground for novel experimentation. Reflected aptly in the documentary film *Surviving Progress* by Roy & Crooks, the science-driven technophile conceives the only relevant future for humanity is as a spacefaring civilization. [33]

However, many others are not convinced, citing our rapid global impact on the planet. Alexandra Bal summarizes these concerns. [30]

"Our challenge is not so much to seek ever more sophisticated technological solutions to existential and environmental problems, as it is to re-establish a moral, emotional, and perhaps spiritual, relationship with the biosphere: living with empathy and consciousness, with respect for the land, the plants, the animals, and people." If art merely offers a "reflection on where we stand", as Borgdorff suggests, then it has little to say on how we proceed to resolve conflicts between knowledge cultures. That would be the purview of politics and economics. NMA is arguably in a worse position to address such issues since it largely embraces the post-medium, scientific pluralism of the present.

We feel, however, that art can offer much more. Art, unlike science, is *not* bound to the terms of fragmentation and hypothesis testing – it has the capacity to coherently synthesize and integrate knowledge.

Within Lyotard's post-modernism there are self-contradictions. He states: "the grand narrative has lost its credibility," yet the argument for the condition of post-modernism is itself a meta-narrative. Perhaps he means the narrative promise of early modernism has shifted to means versus ends, in which "capitalism.. has eliminated the communist alternative and valorized the individual enjoyment of goods and services" [22], yet the ends of technology, that is its impacts and outcomes, are even more relevant now in our present global narrative. Perhaps meta-narratives are no longer linear; but they are not absent.

The meta-narratives of our times *are* the knowledge cultures of scientific fragmentation, pluralism, presumed objectivity and their paradoxical relationship to globalism and ecological disaster. These are recurring grand narratives that are neither regional nor temporary. From the perspective of NMA, regardless of the plurality of expression, these knowledge cultures are embedded in our present condition.

Balance and Post-Pluralism

A balanced relationship with nature requires that humanity have a global, structured, *organized* relationship to our environment. It must be at least sufficiently organized to be self-sustaining, conforming (to natural limits), self-limiting (of consumption), and non-wasteful. The structures of institutions, hierarchies and governments may or may not be needed – this is outside the scope of our discussion.

Herein lies the problem: We have yet to discover a structured organization for humanity that achieves this balance with nature while also allowing for a cultural pluralism of ideas and expression. Scientific thinking argues that pluralism is necessary for hypothesis testing. Yet pluralities of technologies, media, hypotheses, ideas and artworks compete directly for resources and energy. The production of NMA is a relatively small consumer of energy compared to the human creation and consumption of media generally.

Every individual is a creative actor in the world of social media; consuming resources to fuel their participation in a wide variety of overlapping knowledge cultures. NMA is a participant in that pluralism. However, *art is not bound to the terms of science*, and we believe that interesting future contributions of New Media Art reside in the capacity of art to synthesize and integrate knowledge.

We will avoid speculating what the future contributions of New Media Art may be, for one can hope they are still many and varied since knowledge cultures are not mutually exclusive: synthesis does not negate pluralism. Consistent with our analysis, we might instead observe that a knowledge culture of *synthesis* need not deconstruct (fragment through excess questioning), it need not propose hypotheses, nor conduct experiments, nor invent media types. It does not require "novelty" to legitimize itself but might instead draw from what exists to define similarity and consensus. A synthesis of knowledge objects such as the "digital archive" of Grau is interesting but how might we have a better understanding of ideological synthesis.

One of the most valuable aspects of New Media Art may be that a deep appreciation for media uniquely places it to formulate ideas or systems that address pluralism and social organization. At a minimum we can see that a pluralism of creativity (content/media) is not necessarily inconsistent with a sustaining, structured, relationship to nature since the former is only indirectly related to consumption.

Aside from individual efforts the challenge of pluralism requires us to address social discord and ideological differences. What restructuring of our media, devices and lives would enable collective actions to be defined more readily by our shared values? How are shared values discovered? What are the operations that allow us to combine or unify disjoint values? The post-modern condition would suggest that all methods and devices are tried – every application, every idea, every image – is equivalent in value and the whole of this space shall be tested. However, we question the scientific basis for post-modernism in art as self-contradictory. The culture of scientific thought is one approach to art but need not apply to the whole of art for which the contributions of creative synthesis and intuition may be of

greater value. A generic, efficient (non-exhaustive) metric, which is implied by this, is the evaluation of a given work on its ability to discover or unify shared cultural values.

One possible approach for artists working within a knowledge culture of synthesis would be to define, in real terms and more precisely, where our shared values lie. What systems or media could measure this more directly? From there the next, more difficult challenge is to imagine approaches that would enable these shared values to surface ubiquitously (i.e. regardless of politics). New lines of inquiry that might arise are: How should social media function? What would the internet look like if it were nature-sustainability ranked as opposed to popularity ranked? This reorientation of new media art is not a universal metric, but it need not be. We seek new ways of thinking beyond the knowledge cultures of our past. Outside the limitations of scientific thinking, but not lacking from it, these issues of value ideology in media and culture seem to be the kinds of problems that new media art is well positioned to address. The above dialogue is just one approach where a better grasp of embedded knowledge cultures might enable new directions in new media arts.

The knowledge cultures observed here are a reflection of the trends of science, technology and art over the past century, the goal of which was to make explicit the new meta-narratives of the post-modern/medium so that the future of new media art might avoid being bound to the same narratives.

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Author(s) Biography

Rama Carl Hoetzlein is a media artist and theorist working in knowledge systems and simulations. He was co-founder of the Game Design Initiative at Cornell University, Lead architect for voxel-based simulation research at NVIDIA, and co-director with Alan Liu of the experimental social network, RoSE, in the digital humanities. Dr. Hoetzlein is currently assistant professor of animation in Digital Media Design at Florida Gulf Coast University.

Algorithms looking into Audiovisual Heritage

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Abstract

Throughout the 20th century and up to the present day, many artists have addressed the archive by questioning its function, classification systems, legitimacy, registration technologies or inclusion/exclusion protocols. Considering that within digital culture, AI has become a key factor for information management, this article explores how the use of these technologies in art is offering new perspectives to think about the archive, heritage and memory.

Within the meshwork of existing practices and approaches that operate creatively challenging traditional hierarchies and protocols of the archive, we will pull from two strings: 1) on the one hand, the group of appropriationist-type tactics that operate by activating new interpretations of already constituted archives; 2) on the other, those that propose the creation of new archives, generally dealing with scattered elements that were previously ignored or discarded.

We will delve into these two anarchival strategies [1] [2] by focusing on two case studies that address critically the filmic and audiovisual heritage: *Jan Bot: bringing film heritage to the algorithmic age* and the *Oráculo de Capturas de Pantalla (OCP)*. In both cases we will study the strategies by which other possibilities are opened up for history, and the place given to algorithms in their construction.

Keywords

Archival-Art, Anarchivism, Algorithms, Generative Art, Participatory Practices, Performativity, Collective Memory, Audiovisual Heritage

Introduction

Archival practices have been of great interest to contemporary artists and curators since the 20th century. Its field of action has grown and expanded significantly, giving rise to the expression ‘archival turn’. This concept was coined by anthropologist Anne Stoler in the 1990s to describe the transition from archives as *spaces where research takes place* into archives as *objects of study*. Theorized in the field of art by intellectuals such as Hal Foster, Boris Groys or Anna Maria Guasch, this critical look at the archive has enabled an extension of the possibilities of understanding treasured documents, objects or sounds, questioning, problematizing or dislocating the meaning of traditional archives.

Within the vast archival art production, this study will focus on two trends –understood as horizons of possibility– that encompass part of the complex and tangled universe of creative production:

- 1) On the one hand, practices that work with already constituted corpuses, intervening their documents or articulating new performative approaches enabling their visualization and accessibility, emphasizing unpublished or critical aspects that were not obvious on a first instance.
- 2) On the other hand, we will highlight practices that deal with the creation of new collections or archives, taking as input heterogeneous materials –of an artistic nature or not. In this hybrid place, the knowledge of collectors, archivists and curators overlaps with those of artistic creation.

In this article we will ask ourselves specifically about the strategies used in both trends, with a special emphasis on artistic practices using digital media. To this end, we have chosen two eloquent cases within each of the aforementioned trends that, despite their differences, converge in their quest to activate filmic and audiovisual heritage in our digital present.

Based on these cases we will try to identify how machine learning or artificial intelligence has become an artistic tool addressing these strategies of appropriation and creation of archives from a performative, poetic and critical approach.

Archival Performativity

To better understand the artistic approaches using the notion of the archive, we must first define the concept of ‘performativity’. If we inquire into the origin of the word, we can refer to the philosophy of language and to the lectures given since 1955 at Harvard University by philosopher John L. Austin, where he proposed the existence of two types of statements: constative and performative. The former is used to describe reality and verify facts, while the latter is not limited exclusively to acts of speech, but also involves an action, producing the reality they describe regardless of their truth or falsehood. Since then, the concept of performativity has been widely used by cultural studies and gender studies, among which the work of Judith Butler stands out, who recovers this term to explain the theory that gender is not something given, fixed or stable, but rather it is produced on a series of repetitive –performative– acts that configure certain cultural roles attributed to the sexes. Considering this approach, and more broadly, the term performativity enables us to understand

identity not as something given or essential, but as a chain of social constructions that could be questioned and, therefore, deconstructed by the subject.

In connection to this, for a few decades now, the notion of 'performance' has surfaced not only as a practice, but also as a "theoretical category". Richard Schechner states that "everything and anything can be studied as performance" [3]. More recent approaches such as those of Software Studies or New Materialisms (among them and particularly the performative materialism of Karen Barad) have also used the concept of performativity. Through a performing approach it is possible to describe certain phenomena and practices enabling, precisely, an analysis of the recurrences and repetitions of patterns, approaching them in a disruptive way, disputing their constitutive discourses and meanings. In other words, as performativity is transmitted, taught and learned, it can also be interrupted, unlearned and subverted.

Likewise, in the artistic field, postmodern practices have made an effort to address individual and collective processes in a critical way, understanding social and even physical reality as a social construction. As Andrea Soto states, a performative approach allows us to overcome the question "what are images?" with "what do images do?" This means paying attention to the subjective relationships that images dynamically tie together, overcoming the logic of representation and the utopia of thinking that there can be objective presentations of the world. For this reason, Soto says that, "the performative function has to do with tearing apart time and hegemonic spaces, opening gaps for the unforeseen." [4]

In this context, the performativity of the archive would refer to the set of conventions (contents, categories, structuring) articulating it. Its artistic appropriation, through the displacement of its parts, interpretation, assembly and so on, would enable viewers to see these conventions, but also their possible alternative constructions. In line with the theories related to the 'archival turn', Simone Osthoff suggests that understanding the archive as performance would mark an "ontological change" in its approach, abandoning a conception of the archive as a mere "repository of documents" in order to understand it in terms of "dynamics and a generative production tool." [5]

Artistic performativity of the archives makes it possible to problematize the storage of traces of time, distancing it from its scientific and positivist perspective in order to conceive it in a fragmentary, open and discontinuous way, because, according to Walter Benjamin, "History is the subject of a structure whose site is not homogenous, empty time, but time filled by the presence of the now." [6] Performance always acquires the position of now.

Next, we will analyze how the performative practices of archival art –practices of reordering, recontextualization, assembly and fragmentation that have called into question the canonical or dominant accounts of the archive– become anarchival strategies. Specifically, we will discuss how they have been enhanced by the use of algorithms programmed by artificial intelligence.

Anarchival strategies

Anarchival strategies must be understood not as the opposite of the archive, but as a critical approach to the archive. Anarchiving is the attempt to discover and give visibility to the specific storage and preservation logics underlying each archive that have been naturalized, as well as the conditions of possibility in which it was established as such; but also, it means to create other universes, opening up new horizons of meaning. Anarchivism is, in the words of Andrés M.

Tello, "the nightmare of every social order that claims to be in force at a certain time and place" and continues:

... not only does it disturb the sleep of those who hold hierarchical and well-off positions at a specific historical moment, but it also alters the principles of legitimacy protected and socially arranged by institutional classifications and by means of everyday recording technologies of bodies, their routines and their affects. [7]

Technopoetics that are built around a reflection on the archive, opening up to a multiplicity of options and relationships, to new sensorialities and affectivities, are anarchival strategies by definition. Within this broad field of artistic practices, we will focus on the creative possibilities of generative (or algorithmic) art, with special emphasis on projects that involve a questioning of information recording technologies, archive management, and heritage visibility and preservation policies.

Taking as case studies two ongoing digital projects in which the use of algorithms has a central place –*Jan Bot* and *OCP*– we will analyze two crucial trends: from and towards the archive. It should be noted that the selected cases re-mediate the cinematographic practice based on culture and the digital archive.

Algorithms looking into cinema

The present study is built around the construction of two case studies that shed a light on divergent tendencies of the continuous space posed by the anarchival artistic-algorithmic practice.

The choice of two cases related to algorithmic art is not accidental. Generative art expresses a human-machine co-production that in other artistic practices is bypassed or minimized by a stance where the idea (the artist) holds a higher rank, imposing form on matter (supposedly passive). Vilém Flusser already analyzed the concept of co-production in the case of photography, between machine and artist:

... A comparison of the photographer's intention and the intention of the camera shows that there are points where both converge and others where they diverge. At the points of convergence, they work together; at the points of divergence, they conflict with one another. Every single photograph is the result, at one and the same time, of cooperation and of conflict between camera and photographer. [8]

Therefore, thinking in terms of cooperation implies giving materials and technologies (in our case, algorithms and their physical environments of execution) an active behavior, such as *natura naturans* (creative nature). In the words of Fernando Domínguez Rubio, "active and constitutive elements in the production of social forms, relationships and meanings". [9] If these are elements with a generating force, capable of other forms of action and other modes of registration, if it is true that they are not reducible to full human agency, then they must clearly be considered active elements in the anarchival practice.

In other words, it is the creators, together with the technologies being used, who can promote new forms of recording. Therefore, it is upon this human-machine assembly that we can glimpse at new forms of meaning and

recovery of the remains of the past; reconfiguring non-arborescent relationships, or de-hierarchizing existing ones; and even, conceiving other ways of discerning the outside and inside of the archive. Therefore, practicing memory.

Considering the agency distributed between humans and non-humans, the specific question underlying this present work is:

How are human-machine cooperation strategies configured in algorithmic art practices enabling new possibilities for the archive?

And then a series of related sub-questions:

What aspects of the archive are affected in the cases studied? (e.g., recording technologies, classifications, hierarchies, exclusions....?) Or, perhaps, do they display a radically new notion of the devices and the very act of archiving?

What is the social scope of these algorithmic artistic practices, and their capacity for mobilization and change?

In what ways is film heritage activated through the anarchival practices operated on it?

Disruptive Poetics: *Jan Bot*

Our first study case is *Jan Bot: bringing film heritage to the algorithmic age*, a project born in 2016, aimed at disseminating the heritage of a film museum by revitalizing its content, in tune with new interfaces based on artificial intelligence and the narrative tactics from social networks. *Jan Bot* addresses the film heritage of the Eye Filmmuseum (The Netherlands), dealing specifically with one section in particular, the Bits & Pieces Archive, created in 1989 by Eric Kuyper and Peter Delpout by collecting short silent film fragments of uncertain or unknown provenance. The idea of preserving celluloid or nitrate (the oldest material in cinema) is a trend that only emerged in the postwar period, mainly focused on the preservation of films that had a specific historical, documentary or artistic value. Thus, the idea of preserving and collecting movie clips without a title, date, or credits was a risky idea.

This treasured material, even after being restored and digitized, lacked its full information (title, genre, date) and was thus kept dormant in the museum's hard drives. Uploading it to the Internet not only implied a taxonomic challenge but also a communicational one: how does one offer this material to a non-specialist public and to new audiences? The audiovisual artists Pablo Núñez Palma and Bram Loogman began to work on this material by creating, through the use of artificial intelligence software demos the *Jan Bot* project. *Jan Bot* is a bot or computer program based on artificial intelligence designed to cross information between the film material of the Eye Filmmuseum and the trending topics in Google. The project, as we will see below, addresses cinematographic history based on what Walter Benjamin, at the beginning of the 20th century, called actualization [*vergegenwärtigung*]: bring it to the present.

In an interview with Pablo Núñez Palma, one of its authors, we were able to have access to the details of the project. Initially they began by indexing the film material. They digitized more than 12 hours of small fragments, whose

program, which identifies different scenes based on the difference between one frame and another. Thus, they separated all fragments automatically. Later they dedicated themselves to the production of metadata. For this they used the Clarify program, whose function is to take an image and assign a series of tags to it. The next stage consisted in connecting keywords from the Google Trends API to “inspire” *Jan Bot* in its search for footage from the film archive and thus generate the films.

As Pablo Núñez Palma explains:

... we wanted to update a film archive that is more than a 100 years old, bringing it to the present, making it relevant today. And the way we could do this was by creating films generated by *Jan Bot* inspired by current news events. [10]

For this end, they used Cortical software which takes Wikipedia indexing to generate associations between different types of words, establishing their “semantic footprint”, that is, the different meanings linked to the same word. At this stage, *Jan Bot* takes the summary of a news item, draws a semantic fingerprint from the sum of words that are part of the story, this is associated with a number and that number is connected with the sum of the semantic fingerprints of all the tags that were generated for a shot of the film archive. That is, once the key themes or concepts of the day are determined, a text and image analysis algorithm enables you to recover movie clips from the archive whose tags match the emerging theme. Based on this, short video edits (approximately 30-seconds long) are automatically generated using pre-editing algorithms, which in turn are published on www.jan.bot and distributed on Instagram and Twitter.

The format of this audiovisual remix was not random. The artists were interested in linking the tradition of experimental cinema with the aesthetics of new narratives produced by social networks. Since the appearance of Snapchat, short audiovisual stories created by users have become widespread. Other platforms such as Facebook, Instagram and TikTok have also adopted this model. The Story format sequentially compiles a series of videos whose order is determined by algorithms. And the result is a type of film that, if at first it doesn't make much sense to the human mind, it "reflects the reasoning of the algorithmic mind of a computer". [11]

What is interesting about the project is not merely the curatorial capacities of the algorithms when recombining images according to certain parameters, producing unique works each time, but, as Palma points out, the fact of how the recipient's aesthetics and expectations are modified by technological uses. In 2018, the author would say that fifteen years ago a format like the one used in *Jan Bot* would have been considered cryptic by the audience, but today, the Story is one of the most popular audiovisual formats on the Internet, proving that not only computers “learn” from our behavior, but we, humans, also learn from them. [12]

Throughout the project, Núñez Palma puttigh himself in the place of the spectator, was able to identify at least three types of films produced by *Jan Bot*. Films that have what he calls “algorithmic narratives” because although they do not present conventional stories, one can deduce in them some kind of meaning given by the apparently causal sequence of scenes, by the suspense and tensions

gestures, etc. On the contrary, other types of films seem to have no meaning but, in contrast to the trend inspiring them, they manage to acquire new meanings. And finally, those films that are simply abstract, whose effect is more perceptual than narrative, operating at a nonconscious level, where even the visual alterations produced by the deterioration of the material medium (color or texture) would grant it new attributes, enabling us to appreciate, incidentally, not only the history of cinema as a narrative historical document, but also the aesthetic traces of a technology of the gaze.

In short, the project goes beyond the function of a traditional archive, inviting us to reflect on the status of historical or artistic documents –their incorporation into the catalog– and, furthermore, inviting us to reflect on AI, offering the exercise of seeing through the machine. As Nuñez Palma states:

Generally, the way AI works is to pretend to be a human being in order to facilitate tasks, or to relieve humans from thinking. And what we wanted to do with Jan Bot was the opposite exercise. That is, the machine did a job and we, as humans, had to try to understand what this machine was doing. [13]

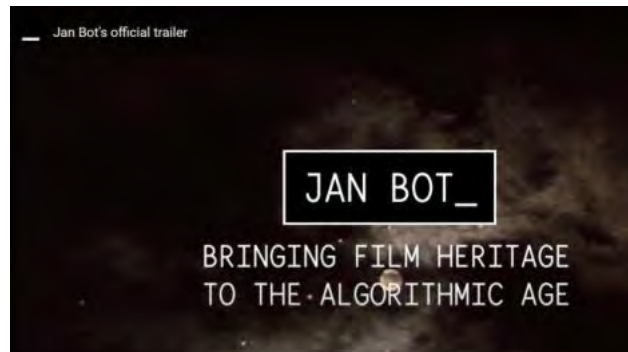


Image 1. Screenshot of the *Jan Bot: bringing film heritage to the algorithmic age* project trailer. See the full video at: <https://docbase.mit.edu/project/jan-bot/>

Indeed, one of the sources of inspiration for the project was a message in a “time capsule” that Jean Cocteau filmed in 1962, aimed at the young people of the year 2000. In his speech he addresses different topics and focuses on the uses and abuses of technology, stating that, “I certainly hope that you have not become robots, but on the contrary that you have become very humanized: that’s my hope”. [14]

For the artist, it is precisely this humanization through machine learning that *Jan Bot* aspires to. In his own words, he wishes that “by observing the visual piece that a machine generates, we can experience the work generated by a machine and we can also experience our own humanity, our way of seeing.” [15]

Creative poetics: OCP [Algorithms and Faith]

If in the previous section we examined *Jan Bot* as a paradigmatic case of projects oriented towards the archive, re-interpreting it through an algorithmic perspective, in this section –and regarding the *Oráculo de Capturas de Pantalla (OCP)* project– we will focus on other kinds of strategies: those of artists operating with the collection or appropriation of objects from different origins in order to create new collections.

One of the most eloquent references of this trend is found in the project by the controversial artist Marcel Broodthaers entitled *Musée d'Art Moderne, Département des Aigles, Section XIXème Siècle*, inaugurated in 1968. At a time when most intellectual circles denounced the transformation of culture into spectacle and that the avant-garde currents of the 1920s were being assimilated by institutions (museums and academies) and the market (galleries and auctions), Broodthaers opened a museum space in his own home with decorative objects and documents obtained at flea markets or from the street, all meticulously organized parodying the protocols and bureaucratic logic of institutions.

Artists such as Christian Boltanski, Annette Messager, Sophie Calle or Ydessa Hendeles are exponents who have become critical and poetic archivists. Exacerbated by the use of the Internet, as a monstrous catch-all, and nourished by the exuberant source of material it represents, archival art practices have spread everywhere. Such is the case of Olia Lialina and Dragan Espechied amassing GeoCities pages, thus turning a social practice into a true anarchiving, or Brian Mackern, who has been collecting since the 1990s gifs, banners and websites preloaders, or classic movie clips with which he has created his sound-visual artifacts called “soundtoys”. The collected sets of digital objects take on new meanings based on recontextualization operations involving juxtapositions, collages and remixes displayed in physical and virtual artworks/installations or in live stream concerts.

In this context of archival strategies for digital appropriation and recontextualization, in pursuit of the emergence of new meanings, we find Coni Rosman's *OCP* project (2020). Rosman's work combines audiovisual aspects (cinema, series, documentaries...), algorithms and faith crossed by the logics of the Web 3.0 era. Inspired by the I-Ching, Rosman's oracle stands as a digital, networked and interactive piece that seeks to give answers based on its interactors by answering their questions with a response in the form of a screenshot from a cinematographic work (or audiovisual, like a series, for example).

OCP works by inviting the participants to follow a series of steps: 1) Concentrate. 2) Ask a concise question. 3) Let yourself go by clicking the oracle button. 4) Analyze the image (screenshot) that is offered as a response. 5) Go deeper (“If you feel that you need to delve further, you can see the film, series or documentary from which this screenshot came from” can be read on the project's website) 6) Act.

A collection of screenshots is the foundation on which the oracle works. In Rosman's words “the screenshots are synchronous cuts in the diachronic axis of other stories (documentaries, films, series)”, adding, “all the sources are materials that are available online, re-appropriations of the contents of the virtual village, in tune with the practices of the Internet.” [16] The number of images it currently houses is “infinite.” Although the artist has started the collection (quoting dialogues from the films and subsequently, screenshots), the interactors are invited to expand the archive by donating new screenshots, adding a narration about their experience with them. These “offerings” become the project's database. This shift from the collection as an individual space to a collective environment has opened up new dimensions for the understanding of the project, which is currently being consulted 24 hours a day from different parts of the

reflected in the fact of inquiries "completely exceeds the capacities of human availability." [17]

This collective look at audiovisual art and the gestures of appropriation of images and their insertion in other stories, (both of those who make offerings and those who only consult the oracle) can be understood as a way of keeping film heritage alive, of practicing memory with these productions, but also of giving visibility through screenshots to films from regions whose productions don't have an ample distribution.

The social dimension of the project is reflected in each of its stages and its ambitions. The artist explains:

When carrying out a virtual work, I was interested in putting into play the practices of the Internet: community, collaboration, the virtual village and network construction. The 'offerings', which are a form of collaboration by the *OCP* Community, confirmed the idea that there are many collectors like us and that it is a shared practice. I observed a curious phenomenon: the same frames are sometimes repeated among the offerings, sent by different users. Which leads me to think that there is an '*OCP* gaze' facing audiovisual media (...). I like the game of thinking that there was a *OCP* way of relating to audiovisual stories that enables a way of perceiving those subtle messages within the great story. [18]

In addition to the project's website where the interaction with the oracle takes place, *OCP* has other channels for activating the collection: social networks (such as Instagram or Twitter) and the production of marketable objects (prints of the chosen screenshot).

Regarding the algorithm underlying the oracle and enabling the collection of screenshots to respond to the questions of the interactors, Coni Rosman doesn't reveal its operational logic, although she does insist that it doesn't take information from previous searches carried out by the users. Possibly, the reason behind this concealment is not to lose its essence, "the availability to believe in the magic of algorithms" (*OCP* website). Making the logic of the algorithm invisible is a poetic way of strengthening the enigmatic aspect by which one image is displayed and not another, but it also places an emphasis on perception: "the same screenshot in front of different questions can operate in different ways." [19]



OCP

Image 2. Screenshot published on the *OCP*'s Instagram account on March 1, 2021. Coni Rosman. Source: [instagram.com/ocp_oraculo](https://www.instagram.com/ocp_oraculo)

OCP is an art project that through the appropriation of images found on the Internet and the creation of a poetic and collective anarchic, is capable of activating the cinematographic heritage. It functions as a symptom of the time, as a space of convergence in the archive of dissimilar worlds and different times. It updates and acts out poetically and algorithmically the memory of audiovisual products.

Conclusions

The performative possibilities of the archive enable us to see how machines observe us looking at the world. What the concept of archive performativity tries to express is the possibility of approaching the set of documents, data or objects as a starting point that opens up to other stories and other forms of understanding of what the archive represents, contains or what it can become. The anarchival strategies analyzed in the *Jan Bot* and *OCP* projects undertake this task of disobedience to the Archive Law, questioning the transparency of the circumstances that gave it legitimacy or, at the very least, the order they impose. Both the remediation of the collection of silent film fragments from the Eye Filmmuseum in the first case, and the creation of a collection of screenshots in the second, mobilize new perceptions on cinematographic and audiovisual heritage.

Jan Bot and *OCP* show two tendencies regarding poetic-algorithmic cooperation: from the archive (performing the content of a previous collection) or towards the archive (generating a new collection, open to new inclusions in a collective way). In addition to showing different trends, these projects teach us divergent views on the role of algorithms. While in *Jan Bot* the logic behind the project is revealed (i.e., the parameters regulated by the algorithm), in *OCP* the algorithm is a black box, an unknown and "magical" operating space. *Jan Bot* presents an archive of silent films, connecting it directly with the trending topics of the day, while the *OCP* algorithm presents frames of movies and series, but it is oblivious to any ephemeral trend element, such as the specific previous searches carried out by those consulting the oracle.

In both cases, however, the projects result in products that pose an atypical approach to audiovisual heritage, which they challenge through the performance of the archive. The *Jan Bot* and *OCP* projects are exponents of what we could call Anarchival-Art practices. A group of artworks and artistic initiatives of a heterogeneous, experimental and sensitive nature, to the extent that they are able to activate new ways of looking at heritage and history by materially understanding and deconstructing the archive and the stories that run through it.

The divergences between the two case-studies constitute a clue that evidences that there is no single anarchival performance strategy, and that the present can open more than one possibility to history's revision. In fact, it is in the concurrence of the different ways of practicing the anarchic that each of these practices acquires its fullest meaning: in the meshwork and multiplicity. If plurality were to be extinguished, and anarchival strategies were to come together, we would be recreating once again the generalizing and unifying Archive Law. Therefore, dispersion is co-constituent of the anarchival sense. Thus, it is necessary to carefully examine the partial convergence of these, and many other projects, in the algorithmic logics of certain social networks (mainly Twitter and Instagram) as a possible "threat" to radicalism and anarchival poetics.

Regarding the scope of these practices, although there are some quantifiable aspects (for example, the number of visits to their respective websites), it is hard to ascertain to what extent—in its plurality and variety—they collectively impact on the emergence of new meanings for the archive. The doors opened up by their location on the Internet often surprise the creators themselves, as previously noted by Coni Rosman.

Finally, the artistic anarchiving has a poetic, critical and performative character. It enables both desired and unpredictable openings. The very idea of anarchiving implies to continue collecting and discovering with passion, deconstructing and reinventing, presenting and *presentifying* in a thousand ways, with the freedom of not knowing where all of this will lead us to.

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A Sonic Exploration of Spanish Flamenco and the Whirling Dervishes of Turkey with Wearable Technology

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Abstract

Humans have gone to great lengths in recent years to augment their bodies with wearable technology using commercial devices such as smart phones, watches, and jewelry. Wearable technology has also been incrementally shaping the future of the performing and fine arts. This research explores creating a device that can be worn on clothing or costumes that performers can interact with as a digital musical instrument. This device can be used as an extension to the body with built-in sensor systems and haptic vibrations for producing sounds. The work draws from multidisciplinary practices including, sound and music, digital technology, costume design, body movement combined with traditional forms of cultural practices. Creating and expressing sounds using gestures and body movements can allow the performer/wearer to engage in a more interactive movement experience. The practices of Spanish Andalusian Flamenco and the Mevlevi Dervishes of Turkey are inspirations for creating a performance with these devices that will morph these styles by creating historical links through music and sound, body movements and gestures. These devices will track specific movements while emitting sound compositions that are related to music performed in these traditions. The experience will be an embodied one; a new way of performing with sound that can entrance both the wearer and the audience.

Keywords

Wearable technology, performance, sonic art, digital art, gesture recognition, cultural dance

Introduction

Wearable technology is incrementally changing the landscape of innovative designs in the fields of robotics engineering, medical and healthcare sectors, the military, commercial devices, and the performing arts. Applying technology to clothing for performative purpose opens the possibilities for speculative exploration. This could be using electronic circuits that operate on the body as mechanisms for producing several actions including emitting sounds by attributing gestures to them, controlling other factors such as lighting on stage, and transmitting tactile cues that inform the wearer that they have initiated an action. Haptic mechanisms contribute to the sensory experience where the performer initiates sound that provides feedback. These vibrations also mimic the reverberations felt when using physical instruments close to the body. By creating devices for costumes or attaching sensor systems on the body, performers can engage with interfaces that enhance their performance.

The focus of this research is to explore using existing technologies by developing systems or devices that can be embedded or attached to clothing which track and capture movements of the wearer and emit sounds. This amalgamation between science, technology and art combines the fluid, organic and at times abstract characteristics of the performing arts with the physical, tangible circuitry of hardware and computing. The inspiration for a performance piece using these sound costumes/devices is acquired from the rich cultural traditions of the Mevlevi Dervishes of Turkey and

Andalusian Spanish Flamenco. These two practices have had centuries-long traditions that have been deeply rooted and developed by merging and absorbing cultures to hone distinct practices that are recognizable the world over. The objective is to create costumes that have attached sensor systems which capture certain gestures or movements that are particular to both movement practices and augment them by allowing the performers to interact with the interfaces. The two forms have historical links both culturally and geographically which will be explored by morphing the two practices to create a new audio-visual wearable technology immersive experience. The potential implications can lead to the preservation of cultural heritage by digitizing these movements and cultivating new performance works as well as developing more streamlined systems that can be integrated into clothing in a sustainable and practical way.

1. Developments in Wearable Technology

In the post-modern contemporary world, humans have found themselves in a position where technology is becoming integrated with most everyday human functions. Wearable technology can be defined as a category of electronical devices that are attached to the body, embedded into textiles and fabrics, or even implanted onto the human skin. Seymour states that fashionable technology or wearable technology also has a purposeful function such as delivering computational data while creating meaningful design that is aesthetically pleasing. [1] Sazonov further describes wearable technology as having components such as small computers that provide feedback to the user through various ways of communication such as sensing and processing that information through to an application. [2]

The idea of human augmentation in wearables has been incremental over the last few decades but it is now becoming more of a reality. Raisamo et al comment that human augmentation is a means by which technology is somehow integrated using wearables especially, to enhance human capabilities or productivity. [3] It is arguable that humans have already augmented themselves to a certain degree by using and carrying portable devices such as smartphones and smartwatches that transmit and deliver information at the touch of a button. [4] Humans have for centuries been seeking ways of adding to or extending what is already on their bodies to minimize human labor but also to adorn themselves with useful gadgets and devices that enhanced their daily lives. [5] Some of these inventions include the wrist or pocket watch, and eyeglasses up until one of the first truly wearable pieces of technology that also transported music, the Sony Walkman. [5]

1.1 Wearable technology applications

Wearable technology roughly falls under three main categories: consumer devices, wearables for the health sector and health-related

applications, and textiles or skin-based applications that have been integrated with technology in some way. [6] Advancements in the health sector have provided the bulk of research being done in wearable technology but consumer products are increasingly becoming in higher demand with a market that is now flooded with a gadget for almost any need or purpose. Essentially, anything that can be attached to the body whether it is a ring, a hearing aid, glasses, socks, a watch, footwear, or jewelry, can be connected wirelessly.

Wearables are expanding into several different markets such as sports/fitness, military, security and defence, gaming, smart homes, as well as crowd sensing/interaction. With these areas targeting consumers that are not just for a niche market such as high fashion, the possibilities of integrating technology into clothing is inevitable. However, these above-mentioned applications and much of the research and reviews surrounding wearable technology, has a focus on the garment industry and less to do with the performing arts. Therefore, this research aims to develop and apply technology to clothing that provides an enhanced or augmented experience in the performing arts by integrating technology seamlessly onto garments.

2. Wearable Technology in Fashion, Costume and The Performing Arts

The world of fashionable wearable computing or using technology in the performing arts as it is known today may have started with the wearing of electrical diadems created by Gustav Trouvé for a dance/ballet performance of 'La Farandole' in Paris that was worn by ballet dancers in 1884. [7] Trouvé may have developed one of the first electrical interfaces- an example of wearable technology used in performances on stage. [8] These illuminated headbands were a key innovation of their time and paved the way to incorporating small-scale electronics by integrating them into clothing or for use on the body and in the performing arts milieu. [9] Costumes and fashion pieces that have been created for performing arts practices such as musical theatre, rock and pop shows or spectacles, have all begun to test the possibilities of how technology can be used to enhance garments and performances in this area.

Schneegass & Amft explain that in the last two decades, pop star performers and celebrities have been looking to enhance their on-stage performances with technology whether it be in the form of flashy LED lit costumes or perhaps even controlling certain aspects of the show's spectacle such as lighting or sound. [10] One of the more well-known artists to explore this intersection between fashion and technology has been Lady Gaga. In 2013, Studio XO and TechHaus (Lady Gaga's technology design team) collaborated to create the *Volantis* also known as the *Flying Dress* in which she was lifted off the ground. The dress was unveiled at the launch of her ArtPop album and is created with six battery powered rotors that can lift the wearer a few feet of the ground and propel them forwards. [11]

Wearable technology in the performing arts must be evaluated in all fields whether it be for the stage, musical performance or in cinema. In the world of fashion technology alone, there can be many subcategories such as art-related fashion tech, high fashion tech and/or just fashion technology. There are several crossovers as well such as designers who were trained as engineers or scientists who have collaborated with fashion designers to develop new ways of implementing technology into clothing while others are focused more on the performative or entertainment aspect of using technology in clothing, costume, or fashion.

2.1 Fashionable Wearables

Fashion designers have for the most part over the last three decades, embraced technology in one form or another, whether implementing technology in aspects of the fashion show such as lighting, projections, illusions, sound, and other effects as well as using technology as a medium for which to create fashionable garments from. Seymour remarks that the ideal partnership of scientists/engineers and fashion designers can result in creating truly functional and aesthetically beautiful wearable computing. [1] Fashion designers are not necessarily proficient in programming tech for use in their fashion tech design pieces therefore this union of fields is not only crucial to the output of truly operative smart garments but also inevitable. Perhaps it was the work of Turkish-born Hussein Chalayan that in the early 2000's broke ground in this area of fashion tech with his wildly innovative designs in his Spring/Summer collection of 2000 where he debuted his *Remote-Control Dress*. Sometimes referred to as the 'airplane dress' *Remote-Control* is a manifestation of Chalayan's concepts of combining architectural structures with the human body. [12]

CuteCircuit is a company founded by Francesca Rosella and Ryan Ganz out of London, UK. Many of CuteCircuit's designs have now become synonymous with wearable tech pop-fashion. The *Sound Shirt* is an immersive garment designed by the duo that uses haptics embedded in a garment that replicates the vibrations of instruments being played for the hearing impaired during a concert or performance. The shirt is totally wireless without any visible cables, it is lightweight and provides subtle vibrations from 30 high resolution haptic actuators. [13] The haptics provide an immersive experience for the wearer.

3. New Digital Musical Instruments; The performative Body

Several digital musical instruments have evolved recently in the field of wearable electronics for creating sounds or music. The Mi.Mu Gloves are an example how wearable technology can be used to create music for composition and performance [14]. The gloves use gesture recognition with which to generate synthesized sounds using dedicated software (Glover) that is designed for the user to program each gesture according to how they want to map sounds. Sawh remarks that the gloves were designed to make composing music easier for musicians during live performances where the gloves enable performers to be more hands-off on their instruments and more creative in virtual spaces. [15] Adam Stark who is the company's director and lead creative force says that the gloves are meant for people to express themselves through movement. [16]

The possibilities of creating devices for initiating music or sounds that accompany live performances or pre-recorded pieces which include theatre, dance, and musicals, reveal an exciting opportunity for exploration and development. Some pioneers in the field of using technology together with dance or performance include Merce Cunningham whose 1999 performance of *Biped* interlaced elements of dance alongside digital representations of the body on a screen behind the performers using motion tracking technology. [17] Birringer expressed that technology has changed the way in which relationships between humans and machines interact with one another in spaces providing new bodily boundaries yet in turn using technological advances in the theatrical arts as a significant tool for creation. [18] These digital tools can provide the potential to create and design unique pieces of work. One of the underlying interests of digitizing body movements is the scope for recording, preserving, and archiving them. This could also benefit the examining of

performance practices that have developed over centuries. Some of these deeply rooted traditions have become watered-down or lost over time therefore, re-imagining or augmenting them using wearable technology could uncover meanings behind significant body movements and gestures while placing them in a contemporary performance setting.

3.1 Digital Dervish

Part of the inspiration behind creating a performance piece using a wearable device is the sacred practice of the Whirling Dervishes or Mevlevi Order of Turkey. The Dervishes have had a long and ingrained history in Turkish culture for centuries. It is one of the oldest known dance/performances/spiritual practices in the world and has recently been proclaimed an intangible cultural heritage of humanity in 2005 through UNESCO¹. The practice of the *sema* which is the word for the sacred ritual that the Mevlevi order practice in their ‘turning’ performances, has rarely changed over the past several hundred years.

The most formative element in the way a Dervish moves adheres to the epithet that they ascribe to whirling or turning. The movement during a *sema* of continuous spheres sometimes for an hour, is the physical embodiment of the metaphysical connection between the ‘dancer’ and the Almighty Creator. It is the abandonment of all worldly attachments, and it is focused upon annihilating the temporal self through the recitation of *dhikr* or *zikr*. [19] It is not clear as to how or why the act of whirling began since during its early development, the *sema* was meant as a spiritual gathering for performing *dhikr* and to recite poetry or Qur’an in large groups above all else. There have been tales passed down through Mevlevi tradition that Mevlana (Rumi) walked past a goldsmith hammering and he felt compelled to start turning to the rhythm of the vibrations the metal made. [20] Feuerlicht remarks that the Mevlevi have argued that the *sema* is in fact not a dance because to some, dancing is frowned upon in Islam, but that they are turning and that everything including the clothing they wear has significant meaning. [20]

Some of the more prominent figures in current contemporary art circles globally who practice versions of the *sema* include performance artist Ziya Azazi, Sercan Çelik and Rana Ghorghani. Azazi has used technology to augment his practice and explores the repetitive nature of turning dervishes and concedes that there are not only mystical and meditative aspects to turning, but mental transformations that occur when one whirls. [21]

By contemporizing the tradition of the *sema* using wearable technology, it highlights historical traditions without the danger of removing the essential essence of the practice or by interfering with the metaphysical constructs of the form. The ideal performer will be one who open-minded about creating a contemporary version of the *sema* but who also adheres to the formal elements of the traditional practice. Many Dervishes who have been approached to trial these garments have declined since their intention is to preserve the *sema* in its original form without any need for adding technology, lighting, music, or visual effects.

The elements to be tracked and captured with the device the ‘Sound Drop’ (of which there are two) on the *Digital Dervish* dress (Figure 1) are the rotating patterns of the *tennure* or skirt of the Dervish, and the arm and hand movements. The breakdown of intended use and how each unit will be programmed can be seen in Table 1. These movements are of interest as they highlight the

gestures that are associated with the meaningful aspects of how a Dervish moves. The orbital patterns that are made by the circular skirt for example, could be revealed by amplifying the sound that is being emitted as the skirt comes into a fully turned position.

Costume	Unit 1	Unit 2
Digital Dervish	Function	Function
	<ul style="list-style-type: none"> tracks arm and wrist gestures can be turned on and off using touch sensor haptics and LED initiate when movement begins sound fades in volume depending on velocity 	<ul style="list-style-type: none"> tracks movement of skirt the more volume created by the skirt, the increase in volume of sound

Table 1: *Digital Dervish* units described in detail



Figure 1: Digital Dervish

3.2 Flamenco Sonic

While the practice of the Dervish is centuries old, traditional flamenco also has deep historical roots and a legacy that can be unpicked. Flamenco is an expression of song, story, dance, and instrumental music usually accompanied by a Spanish guitar (*toque*), vocals (*cante*) and dance (*baile*). [22] The practice of flamenco has also been recognized by UNESCO² as an intangible cultural heritage of humanity in 2010. Flamenco is a way of making the music a visual experience and in many cases, an emotional one for both the performer and the audience. Some of the most well-known flamenco dancers such as Carmen Amaya have dazzled the globe and introduced flamenco as a generically Spanish tradition. Although Carmen had a tiny frame, she commanded the stage and pounded the floorboards exhibiting her exceptional footwork – often referred to as the ‘Queen of Gypsies’. [23]

One theory suggests that the word ‘flamenco’ stems from two words ‘felah-mengus’ which some claim roughly translates to ‘wandering country person’ but many Arabic speaking people contradict this loose translation and meaning. [24] The word is often attributed to the association with the Gitano or Gypsy Roma that originally migrated from parts of Southern India through to Europe

² <https://ich.unesco.org/en/RL/flamenco-00363>

¹ <https://ich.unesco.org/en/RL/mevlevi-sema-ceremony-00100>

and the Anatolian Peninsula between the 5th and 10th centuries due to the flamboyant and expressive dance they practiced with costumes of short jackets and thin legs resembling the likes of flamingos. [25]

The traditional formal elements of flamenco can be broken down by examining the generational overlaps in cultural history. The origins of the practice are blurred; most flamenco is associated with the Andalusian region of Spain but it's roots may have come from further afield since the song traditions that influenced Gitano music in the Middle Ages were shaped by Islamic, Jewish, and Christian traditions. [22] According to Akombo flamenco can be attributed to Gypsy culture which dates back eight centuries and specifically to the descendants of the Moors in that region of modern-day Spain [26]. Totton suggests that the dance developed from the melting pot of cultures and descendants of Greek colonists, Sephardic Jews, Christians, and Phoenicians. [27] The music and form of narrative or storytelling began developing among these various cultures and the Gypsies who would perform with and amongst the Moors and the Jews shaped what we know as flamenco music today. [26] Leblon remarks that migrations from India through Persia of Gypsy people around the 5th century contributed to the development of the Romani language as well as the intermingling of musical cultures that they brought with themselves. [28] As well as developments in song and body movements practices, musical instruments such as the *tambura*, and the Persian *ney* or *nay* which is a reed instrument, were also experimented with throughout the Eastern and even Western European countries via the silk road. [28] Hayes writes that flamenco has become somewhat of a national identity of Spain and Spanish cultures, but the Gypsies have also claimed it as a form of civil rights activism due to its origins. [29]

Flamenco has garnered an incredibly visible sensibility in its form and associations that it has become recognizable almost the world over. Many iterations of flamenco have also been explored in many different cultures but in pop culture as well. Assimilating within other cultural practices, the dance formation, costume, and overall atmosphere of a flamenco performance has been seen in many different areas of film and television among others. The *Flamenco Sonic* dress will be outfitted with the *Sound Drop* device using two separate units as with the *Digital Dervish* dress. One device will be worn on the wrist and one at the ankle. Some of the more meaningful movements to be tracked are the subtle wrist twirling, and footwork that emphasize a certain beat or tempo. A description of how the devices are used is shown in Figure 2.



Figure 2: *Flamenco Sonic*

Table 2 describes the use of the devices to be worn on the *Flamenco Sonic* dress.

Costume	Unit 1	Unit 2
Flamenco Sonic	Function	Function
	<ul style="list-style-type: none"> tracks wrist gestures haptics and LED initiate when gesture begins volume fades in and out depending on speed sounds are interchangeable 	<ul style="list-style-type: none"> tracks movement of the foot/ankle sound fades in and out of intensity depending on speed of footwork haptics vibrate and LED lights up when movement starts

Table 2: Flamenco Sonic units described in detail

4. Morphing the Dervish and Flamenco with Wearable Technology

Interesting links and connections exist between the practice of the dervish and flamenco dance. There has been exciting cross pollination of music and dance styles and practices from the southern regions of Spain through to Turkey for centuries. These influences between cultures bring together possibilities for exploring new performances while enhancing them with technology.



Figure 3: *Digital Dervish* and *Flamenco Sonic* testing with *Sound Drop*

Figure 3 shows the two performers using and testing the device each with their own movement styles. Some of these possibilities lie within the musical forms of both Spanish flamenco and classical Turkish music. When flamenco is performed as a Bulería, the song can be very expressive and emotional often with elongated and drawn-out stanzas that carry on into exaggerated trills. It is the most fast-paced rhythmic form of flamenco using light-hearted banter, mockery, back and forth dialogue between singers, accompanied by Palmas (hand clapping) and guitar. [30] Similarly, many Mediterranean/Arabic song styles are performed using improvisational *maqam*, whether reciting Islamic prayers or poems, the melodic musical style is often interpreted as the musicians

perform made up of invented melodies that are adapted to pre-existing rhythms. [31] The *maqam*, which is prevalent in many Middle Eastern and Eastern Mediterranean countries such as Egypt, Iran, Iraq, Afghanistan, and Turkey among many others, forms a style of music that is not organized in the way for example, traditional ‘western style’ European Romantic music is performed. It is highly dependent upon the communication between singer and musician – the interplay of question and response, echoing each other without any structure and particularly characterized by techniques of improvisation.

The links between the two distinct practices will become clearer when the two performers begin to make contact. A fusion of music and movement will result in a performative piece using a bespoke device created to augment these practices in a contemporary performance setting. Some of the experimentation that has surfaced while exploring these links between the patterns made by dervish and flamenco movements as well as music, have been examined using motion capture technology. The possibility of integrating the physical device and the virtual space can inform how each mode of communication can exist together in a communal environment. Figure 4 shows how the same sound samples that are programmed to the *Sound Drop* can be used by taking a 3D model to explore sound creation in a virtual game engine using Unreal Engine and Vicon software. The goal is to create blocks of physical space that the virtual performer can enter which trigger sounds. This is a current area of exploration of possibilities with the *Sound Drop*.



Figure 4: Experimenting with motion capture technology.

4.1 The *Sound Drop*

The *Sound Drop* is created as a digital tool for augmenting body movement performances. The concept was to build a contained device that was completely wireless and communicates to a computer system via a stand-alone wi-fi network. There were several iterations of the device the first of which were compiling the components into sections and sewing them into fabric swatches to be then sewn as a patch onto a costume. It was found that after some testing, the sensors and battery within a fabric patch were inaccessible, and awkward. Further testing proved that a small device could be built using the 3D printing of a casing that was designed to house all the components which included an Adafruit Huzzah Feather with built-in wi-fi, a gyroscope/accelerometer, touch sensor, 3.7-volt Lithium-ion battery, as well as a haptic motor and twelve neo-pixel LED ring sensor. These are seen in Figure 5.

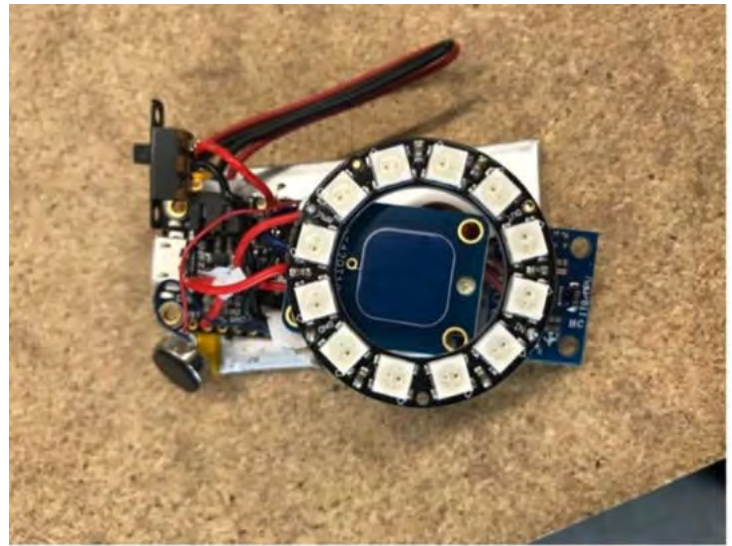


Figure 5: Components for *Sound Drop*

The *Sound Drop* fits inside the palm of the hand or onto other parts of the body via Velcro straps attached to the back of the casing. Various 3D printed versions using standard polyvinyl were created until an ABS-like translucent resin was used to test the model. It was found that the resin prototype proved to be the most suitable and robust design due to its slight pliability and smooth texture after being cured.

The *Sound Drop* is programmed to react to movements or gestures of a performer. The device reacts when a threshold is met whereby the LED neo-pixel ring is initiated along with the haptic motor. Currently, it is set to increase volume through increased velocity. It is turned on and off via a main control switch on the side of the device and can also be turned on or off via the touch pad sensor that lays underneath the neo pixel ring. The responsive interaction allows the performer to create subtle sounds that are programmed to each unit thereby layering sounds that accompany a pre-composed piece of music. The device works by using Max/MSP to read the incoming data of the microcontroller and processes the data to create variations on the pre-programmed sounds. The current sounds being used are representative of Turkish instruments traditionally used in classical Turkish music as well as sound samples of Spanish guitar and other instruments that have been electronically manipulated and are heard through a loud-speaker system. These sounds are interchangeable and can be used to reflect any style or genre of music making it versatile. A piece of music was composed in which the *Sound Drop* accompanies the piece with sounds that are related to it such as simple chords. The final design of the Sound Drop with lit up LEDs was printed in clear resin with the intention of having the components visible as a hybrid physical and digital object as seen in Figure 6.



Figure 6: The *Sound Drop*

Conclusion

This research has observed the developments in wearable technology over the last few decades and how these advancements contribute to the possibilities for use of wearable technology devices

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to enhance or augment performance practices. The study has also adapted the historically rich traditions of Flamenco and the Whirling Dervishes of Turkey by intertwining them into a performance setting where a narrative can be used to bring the two practices together in an immersive audio-visual work that augments the traditions by using bespoke devices that track certain movements or gestures to which sound is attributed. These intersections of cultural performance practices can be further explored by investigating other global body movement/dance traditions. This study can also lead to the preservation of intangible cultural heritage by digitizing and capturing meaningful and significant movements.

The current research focuses on using machine learning to train a system whereby a set of up to four gestures will play four different sounds making the device variable. This can also lead to creating real-time sound synthesis based on gestures. These sounds are stored in a bank where they can be added to and accessed easily using Max/MSP. A web application is also being developed to streamline the process and usability of the device. Further work will investigate the use of the *Sound Drop* as a possible educational or therapeutic tool for learning and discovery by also integrating motion capture technology to develop interactive game engines. The device can be used as an extension of the body or a body instrument device that can accompany a live performance or pre-recorded piece of music. The prototype will be further developed to create a compact unit that can be more seamless and integrated into clothing/costumes or attached to various parts of the body.

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Author Biography

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Robophilia and *Device Art* in Japan

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Abstract

Japan has always exhibited a unique form of what can be described as robophilia. [1]

The peculiar characteristics of artistic creation in Japan and some Asian countries, in industrial developments in the field of engineering, computing, AI and robotics, and the existence of a culture of manga together with the idea of construction of prototypes from a certain artistic-commercial approach, raise the need to deal in depth with the development of robotic art in Japan, especially as a historical reference and as a vision of the future.

The permeability between art and design, so complexly posited in the West, does not suffer that categorical distinction in Japan, where the concept of Device Art opens the possibilities of aesthetic experimentation with new technologies towards industrial productions and, therefore, its approach to a public wider.

Keywords

Robotic Art, Technology, AI, Karakuri, Device Art, New Media Art

Introduction

The current Japanese revolution in industrial, social, and service robotics; the different anthropomorphic developments: assistance dolls, hostesses, dancers, and concert performers, etc., are well known due to their constant appearances in all the media. But the situation in which we find ourselves today is a reflection of the natural evolution produced in the world of automata since the middle of the 16th century. Historically, the concept of Japanese 'Art' (*Gei*) has a more transcendental and introspective sense, of interrelation between the individual and nature. It ranges from the most elaborate representations and objects to the simplest and most everyday actions. The principles of tranquility and calm achieved in the contemplative processes and in the performance of simple rituals such as, for example, the tea ceremony, the Geisha ritual (whose literal translation could be "performance artist") or the care and bonsai cultivation.

Japanese aesthetics, mediated by its philosophy and religion, seeks to find the meaning of life through art: beauty equals harmonious creativity. The realization of the work is presented as a poetic impulse, an almost spiritual

path, which has no purpose in itself. Beauty as an ontological category refers to the existence of all things: it consists in reaching the unitary sense with the rest of the material and immaterial world. It does not focus exclusively on the sensible qualities (in the external determinations of objects) but rather seeks an implicit communication with them. That is why oriental art is based mainly on suggestive qualities. It should not be perfect, but rather express a quality that leads to totality. It is intended to capture the essential through the part, which suggests the whole: the void is a complement to what exists. The radical separation between Art (with capital letters) and crafts, present in Western culture is not acceptable, because art and crafts are configured by the same spiritual substance.

The Edo Period and *Karakuri*

Around 1.600 the Edo period begins. It corresponds to the end of a period of fratricidal wars between the different clans of power: the imperial, the one formed by the regents (*shogun*), the feudal lords (*daimyō*) and the samurai warriors and gives way to the unification of Japan under the command of the Shogunate Tokugawa. Faced with commercial abuses by Westerners and the invasion of strongly proselytizing missionary congregations, the Tokugawa clan decided to impose strict control over the internal political structure (*sakoku*). All power is centralized in the city of Tokyo, the capital of the East, and any influence that comes from abroad is eliminated with the closing of the borders. This situation continued until 1868, when the Imperial Era began. A period of stability develops that will last 250 years.

During this stage of isolation, Japanese artisan technicians begin to develop their own technology, initially influenced by the Western one. They will have to refine the mechanisms to suit their culture: clocks (*wadokei*) must conform to the traditional Japanese division of time, where day and night were separated into six segments named after animals. The complexity of dividing and controlling the time segments, moreover, when they were not all the same, produced different and complex techniques and a very advanced development of the manufacturing and control of the gears. Quickly, this knowledge began to be used in the creation of different wooden automatons, the so-called *Karakuri*¹, which could be translated as 'mechanical devices to produce surprise in a person'. Its objective is the reproduction of

¹ Detailed information about *karakuri*. Accessed October 26, 2021, <http://www.karakuri.info>

daily actions within Japanese social life: religious or private rituals, theatricalization of historical events, indigenous dances, etc. According to its operation, a division was established into three large groups:

— *Butai Karakuri*, almost life-size, were used in the theater to stage historical events or ancient traditions, accompanying the actors in the representations. In 1662, the mechanic and watch and puppet specialist Takeda Omi opened the Takeda-Za Theater in Osaka as a space for experimental performance. The works of flesh and blood actors were combined with elaborate puppets and multiple automatons. Its great success with audiences throughout the country contributed to the development of the *Butai Karakuri* and the creation of numerous theaters with mechanical puppets.

— *Zashiki Karakuri* are smaller. Considered a luxury product by the feudal lords of the Edo Period, they are intended for the private and intimate space of the home. They perform actions that represent common life, such as serving, writing, playing an instrument, shooting arrows, etc. The best known are: the *ChaHakobi Ningyo* (figure 1), a semi-automatic servant who served tea to the feudal lord's guests, and the *Yumihiki Doji*, a dart-throwing archer. The operation of the first is both very simple and of great mechanical complexity. The counterweight of a cup of tea placed on a tray on his arms caused a movement of movement forward until he reached the guest, who when taking the cup of tea, stopped the mechanism. Once the liquid was consumed, when placing the cup back on the tray, its weight (in this case, less when it was empty) set the mechanism in motion again, but on another "programming": turn around to face the man. from the house and then walk towards him.



Figure 1. *ChaHakobi Ningyo*. © GFDL. British Museum

The original designs of its mechanism and construction have survived to this day thanks to the *Karakuri Zui Anthology* made by the great inventor, artist and engineer Hosokawa Honz Yorinao (1741-1796). The three-volume work also shows the designs and mechanisms of four kinds of watches (*wadokei*) and eight *Karakuri* models. The archer created by inventor Hisashige Tanaka, in the late Edo period, is able to take an arrow from his quiver,

place it on his small bow, and shoot it at a target. Tanaka is known as the "Japanese Thomas Edison", due to his many mechanical inventions, among which is a scribe who could draw Japanese characters. He contributed to the modernization of Japan by founding the telegraph company, developing Morse technology and the first telephones. His company will become today's Toshiba Electronics Corporation.

— *Dashi Karakuri* are large, luxuriously decorated wooden structures. They have three floors, with a small stage on each one. In the upper part, two or three automatons represent traditional legends or Japanese mythical tales, in the second a group of dolls acts as a

'choir' and in the lower part a group of musicians play the flute and drums as accompaniment. During religious festivities and ceremonies, the *Dashi Karakuri* were carried in procession. The tradition continues to this day in different events in Japan such as the Inuyama Festival, the Nagoya Festival, the Takayama Festival, the Gion Festival and, one of the most recognized, the Kamezaki Shiohi Festival.

In the different constructions of *Karakuri* we find the first peaceful (social) developments of interaction between automata and human beings. While the Western imaginary has been populated by servile, mechanical, almost monstrous beings who could escape the control of their creator to sow chaos and destruction, in the East a close relationship of trust is established, of belonging to the family and to the intimate and own world.

"The automaton puppet was a prototype of the robot that is said to be flourishing in industrial Japan today. In a sense, we can say that the Japanese learnt to tame the machine by means of the *kadakuri* puppet because they considered the puppet an extension and copy of the human figure, not as something sent by demons or animated by the divine. In a society where mechanical figures are thought to be pure material, people are always potentially suspicious that they may go beyond human control. [...] As playthings, the puppets did not threaten human competence or existence, they remained charming copies of the human figure. They were considered in a way like domestic animals." [2]

Another fundamental aspect that differentiates both worlds, and that is shown in a specific way in the sphere of art, as Machiko Kusahara will later propose, is an intense desire to fascinate, entertain, amuse and surprise with these creations, as opposed to theorizing technological and intellectual of the West.

After the success in 1924 at the *Tsukiji Little Theater* in Tokyo of the play *R.U.R. Rossum's Universal Robots* by the author Karel Čapek, where the word "robot" appears for the first time, begins the development of current Japanese robotics, from a more "humanistic" perspective in contact with Nature. The first modern Japanese robot, heir to the *Karakuri*, was built in 1928 by the biologist Makoto Nishimura for the public coronation festival of Emperor Hirohito. Baptized as *Gakutensoku* which means "learning from natural laws." He represents a human figure with golden skin, kind-looking and seated at an altar-desk. At more than 3.2 meters high, he had a complex compressed air system that allowed him to open and close his eyes, move his head, modify the features of his face outlining a smile, "breathe" and write. The image of *Gakutensoku* is closer to the representation of a great Buddha, than to the classic Western model of an aggressive metal robot. In 2008 it has been restored for the Science Museum in Osaka with a computer system that controls all its movements.

***Tetsuwan Atomu* and the 'Mechas'**

Starting in 1930, the figure of the robot began to be common in comic strips, popular stories, songs, business

developments and political documents. He was usually depicted as a nice, slim "man" who can communicate with people and especially with children. The stories of the father of Japanese science fiction, Juza Unno, about automatic machines will directly influence the creator of Astroboy. We cannot really talk about Japanese robotics, or understand its conceptual, industrial and artistic development without making a small note about the evolution of the concept of robot within popular manga culture.

The first manga representation of a robot corresponds to a little boy who learns, has his own will and wants to be the closest thing to a human, a kind of robotic Pinocchio. *Tetsuwan Atomu*, better known in the West as *Atom* or *Astroboy*, is considered the first manga to have a robot as its main character. Its creator Osamu Tezuka, currently considered the god of manga, studied medicine before dedicating himself to the world of graphic drawing and comics. Influenced by the aesthetics and dynamics of Walt Disney's animated films, his goal was to transfer that energy, mobility, and simplicity of lines to drawn comics. At first, he made different comics in which he tried a revolutionary form of quick cuts between the panels, which served to show dramatic close-ups and mix them with large wide shots. In 1951 the first comic of *Tetsuwan Atomu* appeared in *Shonen Magazine*: a humanized robot that helps the earth in an atomic conflict with an extraterrestrial civilization. In a later issue of the magazine, his birth is narrated: Doctor Tenma, a scientist from the Japanese Institute of Sciences, has created the robot in the image and likeness of his son, who died in an accident. It is a robot with a child's body and human feelings. It has artificial intelligence, X-ray sight, super-hearing, rockets in its boots and arms and, most importantly, a unique nuclear heart-reactor. In the development of his *Tetsuwan Atomu* saga, Tezuka shows his concern about the possibilities of the interaction between machines and human subjects, the pros and cons for the good of humanity, developing ideas and concepts extremely close to those proposed by Isaac Asimov in his Three Laws of Robotics.

Unlike what happens in many of Asimov's stories, Tezuka's robotic characters do not try to find ways to "break" the rules, but rather their robots have intellectual and moral free will, a condition that Asimovian characters do not have. Tezuka did not formulate any proper laws but established simple common sense ethical rules to govern the coexistence between robots and humans. "To put it simply, the difference between *Mighty Atom* and *Terminator* shows the differences between how Japanese and Westerners view robots. Westerners tend to have this sense of alarm or wariness. Japanese are unique in the world for their strong love and affinity for robots." [3] In addition to being a Manga hero, Atomu, whose name recalls Japan's traumatic experience with the atomic bomb, became Japan's Son, an ideal reflection for many families who lost their children in war, and a national icon, a symbol of scientific progress: "a peaceful future, where Japanese science and technology were advanced, and nuclear power was used for peaceful purposes." [4]

In 1956, at the age of 21, Mitsuteru Yokoyama published his science fiction manga *Tetsujin 28-go* in *Shonen Magazine*, known outside of Japan as *Ironman 28* or *Gigantor*. The robot's movement and actions are remotely controlled by the young Shotaro Kinta. "Aton and Iron Man are the ancestors of all subsequent Japanese fantasy robots, particularly two distinct genres seen today: truly autonomous robots and those that require human intervention for their operation." [5] He is the forerunner of the Mechas genre² (abbreviation of the Japanese *Meka* for the English word mechanical), a specialty of Mangas that exhibit robots, generally of great size and thought as defensive weapons to protect humanity, which are physically controlled by a human subject. A mecha can have a humanoid or zoomorphic appearance, be a kind of means of transport, a form of mobile weapon. Likewise, there are "fused" wicks, a variety of relatively smaller wicks that are assembled into a larger one or that can undergo transformations from one shape to another, to increase their deterrent power.

This genre quickly jumped into the realm of animation (Anime): cartoons for TV. From 1972 until today, more than thirty different series of Mechas have been created and reissued. The best known are: *Code Geass*, *Yatterman*, *Brain Powerd*, *Mobile Suit Gundam*, *Bokurano*, *Macross*, *Robotech*, *Super Sentai*, *Full Metal Panic!*, *Eureka 7*, *Daitarn 3*, *Martian Successor Nadesico*, *Burst Angel*, *Zoids*, *Neon Genesis Evangelion*, *Transformers* and, of course, the most famous of all *Mazinger Z*. The stereotype of the mecha pilot is a young, brave and active character. Normally the protagonist suffers an accidental encounter with his fuse or is a close relative of the creator who dies killed by enemies and before dying reveals the secret of the robot's construction. In 2013 (and the sequels) the Mecha anime genre received a western homage with the film *Pacific Rim* directed by Guillermo del Toro.

Mazinger Z (1970) by Go Nagai begins the saga of the Japanese super robot, with bright and primary colors, a mix between military equipment and samurai armor. For the first time, an integration between the machine and the individual is proposed. In the words of its author: "I wanted to create something different, and I thought it would be interesting to have a robot that you could drive, like a car." [6] The robot's brain is not a complex program, but a human being, the young orphan Koji Kabuto. Some researchers have pointed out a certain psychological problem within Japanese manga due to the continuous idealized representation of the image of the father; for the ever present initial conflict; by rejection of the individual in front of the machine, to end up assuming the role of hero; by the sublimation of the feminine; by the metaphorical use of the Great Robot (Meka-Corpo-Man) in front of the symbol of the Great Mother Earth and, finally, by the use of young adolescents as inexperienced or fusionable controllers with machines.

In 1979, the so-called realist school (*riaru-ha*) began with one of the anime that has most influenced the current Japanese youth culture and society: *Mobile Suit Gundam*³

² *Robot anime history* accessed October 26, 2021, <http://www.youtube.com/watch?v=KxntzjOvo8Q&feature=channel>

³ *Mobile Suit Gundam* accessed October 26, 2021, <http://www.gundamofficial.com/features/introduction.html>

by Yoshiyuki Tomino. The action is set in outer space, the manichean struggle between Good and Evil of the previous era evolves towards more complex and conflictive characters and characters. The robots are presented as combat suits-spaceships. At this point we can speak of exoskeletons, of giant structures that are driven and controlled by intrepid young men and fighters. The next step in evolution occurs in 1995 with *Neon Genesis Evangelion*.⁴ It shows the "existential union" between mechanical structures and their pilots: a new relationship between the organic and the inorganic, a relationship that in many cases becomes symbiotic and not exclusively due to proximity, continuity or mixture. Robots are losing their machine appearance, to become more and more evolutionary developments of the human subject

The evolution of robotic manga in Japanese culture, and by contagion in Western culture, is increasingly considered as a form of visual prediction of what is going to happen, or can happen in the future, a kind of Science Fiction in drawings, but at the same time it appears as a source of inspiration in the work of researchers and scientists. *Tetsuwan Atomu*, the robot child, reminds us of the legion of anthropomorphic robots born in the great Japanese industrial corporations: *Asimo* (Honda), *Qrio* (Sony), *Partner Robot* (Toyota), *Hoap 3* (Fujitsu), etc. *Doraemon*, without a doubt, could be a reflection, a little deformed, of the dogs *Aibo* (Sony), or the therapeutic seal *Paro*⁵. The different types of mechas have been transformed into sumo wrestling robots: *KHRI* (Kondo Kagaku), *Robofire*, *Chroino*, or in the robot Samurai *Kiyomori*⁶, developed by Waseda University and the Tmsuk company, and the evolved mechanical beings of *Neon Genesis Evangelion* in the humanoids of the engineer and professor Hiroshi Ishiguro. As Mark Gilson indicates "where will the future concepts in robotics come from? Keep watching the cartoons." [8]

Device Art for everyone

The curator Machiko Kusahara, in her article *Device Art: a New Form of Media Art from a Japanese Perspective*, introduces a new conceptual construction to redefine what we understand by interactive art, by media art, or by art and new media from a Japanese aesthetic. The new terminology used is *Device Art* "a form of media art that integrates art and technology as well as design, entertainment, and popular culture. Instead of regarding technology as a mere tool serving the art, as it is commonly seen, we propose a model in which technology is at the core of artworks." [9]

This definition is applied mainly to work carried out in Japan, but it can be extended to some countries in the rest of Asia, whose cultural and business traditions are different from the western one. The processes of interaction with the public are linked to new playful forms of entertainment. The creation of the artistic work may be accompanied by a parallel or subsequent commercial development. The union between art and "commercial" is not seen in such a negative way as it is

in the West. Japanese artists are interested in a "popular interactive art", if we can define it that way, and therefore expand its expansion beyond the usual exclusive circuits of galleries, museums and large exhibitions. This central point in their projects allows greater collaboration between artists, scientists, research centers and companies.

The western artistic community sometimes does not understand some of these premises, mainly the idea that art must be both entertainments, or it can be commercial. "Works that are highly appreciated in Japan are often criticized by Western art community for their lack of seriousness. These criticisms are often related to the entertainment factor in the works and their affirmative attitude towards technology." [10] The questions that Japanese critics and curators are asking are: Can artists present their work as software that runs on a popular gaming platform like Nintendo and still be considered art? Are the artistic pieces of the same quality, despite not being exhibited in spaces such as galleries or museums? Can they continue to be considered art despite not being in the "art market"? and your answer is: yes, yes, yes, of course. The distinction between the notion of Fine Arts, understood as the creation of a "Art PURE" and that of applied arts or "crafts" does not exist. Despite the Western desecration of Art, the loss of the aura of the unique and exclusive piece produced at the time of its technical reproducibility and the advances of the conceptual avant-gardes that have stopped placing the accent on the physical object itself to transferring the artistic experience to communication with the subject, in the West we still move on deep classical philosophical and aesthetic principles.

The term *device object*, which originally only refers to the tool with which a job is executed, has become a fundamental element in the realization of the new interactive robotics. The user's experiential level increases exponentially compared to the different uses of sensors, programming, materials, computers, cameras, connections ... in such a way that the device has become the body, the material of the piece, which produces a concrete experience and in its multiplication we can multiply the experience. In Japanese culture, it could be problematic to look for a separation between the tool and the sensation produced, when this has been precisely produced by a certain tool.

The importance of the concept and development of *Device Art* is confirmed by the Doctorate program Empowerment Informatics at Tsukuba University directed since 2014 by Professor Hiroo Iwata. Iwata himself provides a succinct and appropriate definition of the concept:

- (1) The device itself is content. The mechanism represents the theme of the piece. Content and tool are no longer separable.

⁴ *Neon Genesis Evangelion* accessed October 26, 2021, [http://en.wikipedia.org/wiki/Neon_Genesis_Evangelion_\(anime\)](http://en.wikipedia.org/wiki/Neon_Genesis_Evangelion_(anime))

⁵ *Paro. Therapeutic Robot* accessed October 26, 2021, <http://www.parorobots.com/>

⁶ *Samurai Kiyomori*. accessed October 26, 2021, <http://www.kiyomori.jp>

(2) Artworks are often playful and can sometimes be commercialized into devices or gadgets for use in everyday life.

(3) Refined design and playful features are traced back to the Japanese tradition of appreciating tools and materials. Traditional Japanese culture, such as the tea ceremony or flower arranging, uses sophisticated devices. These devices are the roots of device art. [11]

Maywa Denki is the best example of serial device artistic production. The artist Nobumichi Tosa (<http://www.maywadenki.com>) defines it as an *art unit*, which could be freely translated as “productive unit of art”. It works like an artistic company, a metaphorical imitation of his father's old electronics company, from which he takes his name (Maywa Denki). The conceptual approach, in an ironic and playful way, is closer to business standards than to artistic ones. Nobumichi Tosa (fiand all of his collaborators, whom he calls employees, wear a suit designed like the typical uniform of Japanese electrical shop workers in the late 1960s. These types of stores represent the small and medium-sized business that helped the Japanese economy grow after World War II, something like the Japanese version of the American dream.

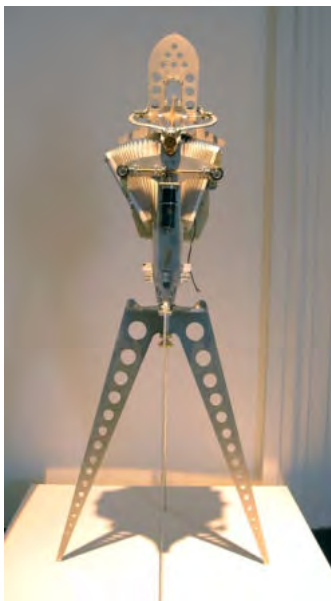


Figure 2. Nobumichi Tosa.
©Ricardo Iglesias

The philosophy of his work is based on concepts 'copied' from the business world. Each piece created at *Maywa Denki* (figure 2) appears with the denominator of "product": a mixture of high-tech and low-tech that provides a unique visual aesthetic form. Recycled elements from old machines are reused in the creation of new parts with advanced programming. His live performances are called "product presentation". Each "product" is understood as a unique prototype within the production chain, representing the peak of a pyramid where the lower levels are industrial optimizations of the original developments, presented as objects for commercial sale with the motto: no product sales but secondary use profit. The “art production unit” that includes all kinds of mechanical, robotic, electronic, automaton, puppet and musical instrument gadgets, more or less controlled, has been divided into three production lines:

— *NAKI*, a series of mechanical objects and musical machines inspired by the skeleton of fish or some other characteristic of its own, such as the bidirectional eyes of

the *Oo-No-Me*, the *Na-Tate-Gato* electronic harp whose strings resemble thorns, the xylophone *Hou-Den-Na* with fish body, etc.

— *Tsukuba* (gadgets) is made up of recycled objects into original musical instruments, automatic puppets, modified guitars with remote control, etc.

— *Edelweiss* composed of different objects that suggest artistic and floral motifs. In operation for several years, it has now evolved into a more “classic” line: *Arclassy*.

Visually all the 'products' seem technologically very complicated, but one of the objectives of the company is that their operation is completely intuitive.

In 2004, the NTT-ICC Inter Communication Center in Tokyo organized the retrospective *Maywa Denki. The nonsencemachines*⁷ with more than three hundred objects distributed in ten spaces. The performance shows or “product presentations” are authentic robotic-mechanical-musician-visual paraphernalia, where the 'non-functioning' of the instruments is considered as one more variable element of the show. This fact allows Tosa to introduce a subtle critique of the industry (art industry) that considers the user (or the art viewer, if we continue with the analogy) as a technological illiterate, as an uneducated and simple recipient of mechanical objects (artistic) manufactured. Its intention is to directly show the product to its audience from two premises: maximum transparency of its operation and have fun together. A direct rejection of technological and intellectual curatorships, like “black box”.

As confirmation of the concepts exposed by the curator Kusahara, Tosa has developed a playful line of *toys*, where he applies the knowledge acquired and the techniques developed in the elaboration of *Maywa* objects to different series such as *KnockMan Family*, a set of small human figures who “play” music to the beat of their hearts; *Nao-Cord Series* - herringbone-shaped electric extension cords; *BitMan Series* small screens showing *BitMan* dancing; *Savao Series* show souvenirs etc. It is interesting, and it may seem paradoxical, to see how in any large electronic supermarket in Tokyo you can find some of Nobumichi Tosa's devices among hundreds of other commercial products and at the same time contemplate them inside urns with safety glass and control guards in major exhibitions such as the MuseumsQuartier in Vienna (2009): *Japan Media Art Festival*.

While Tosa's work exudes optimism, good humor and a certain technophilia, the artist Kenji Yanobe (<http://www.yanobe.com>) bases his work on a direct critique of an idealized approach to atomic energy, the uncontrolled influence of technological development in today's society and the ruins and waste generated by that same technology once it is obsolete. The negative experience produced before the abandoned spaces of the Japan World Exposition in 1970, as if it were a trip to an abandoned future full of rubble, marked his work from the beginning. The EXPO'70 in Osaka, as it is known, with more than 64 million visitors, consisted of a sample of all kinds of technological advances: innovative contributions to architecture and coexistence, sophisticated comprehensive communications systems,

⁷ *Maywa Denki. The nonsencemachines*. ICC. accessed October 26, 2021,

<https://www.ntticc.or.jp/en/exhibitions/2004/maywa-denki-the-nonsencemachines/>

new forms of transport and infrastructures, spaces multinteractivos, etc., (remember the participation of the two immersive American Pavilions). The EXPO'70 represented the "city of the future" (*miari no toshi*), from the infinite and peaceful possibilities of atomic energy. A year later, when the young Yanobe traveled it daily with his bicycle, there were only abandoned remains, the "ruins of the future" (*mirai no haikyo*).

His first pieces correspond to robotic sculptures that can be moved and controlled from the inside by a person, such as mechanical suits dressed by operator-pilots like those that appear in the manga *Mobile Suit Gundam*, but that function as a protective armor against an external attack or a nuclear disaster. *Tanking Machine* (1990) consists of a tank with physiological sodium chloride solution that is heated to the temperature of the human body that floats inside it, in a state of sensory deprivation. Covered with steel and lead plates, *Yellow Suit* (1991) is an atomic radiation protective equipment-suit built in the immediate aftermath of the Mihama nuclear catastrophe. The piece is accompanied by a counterweight that corresponds to an oxygen container, and also includes a version for dogs and a geiger counter. *Foot Soldier-Godzilla* (1991) is a platform that moves in the shape of godzilla feet. A "soldier" sitting on his top can control and direct his movements. movimientos.

In the following years, Yanobe built a whole series of vehicles and machinery with a strong post-apocalyptic aesthetic and a function that was both protective and intimidating. The manga figure Tetsuwan Atomu of Tezuka is a fundamental part of his aesthetic. It is used as a base concept in its criticism of idealism and the naive simplicity of the atomic-pacifist approach represented by the manga itself and assumed by Japanese society in a dogmatic and blind way. "In his reinterpretation of appearance and performance, Yanobe questions apparent innocence of robot's human-like appearance because it provides a kind of concealment or 'protection suit' to ward off criticism of the development of advanced technology." [12] *Atom Suit* (1997) is a yellow anti-radiation suit with lights, lead shields and a geiger counter. The spiky hairs of *Tetsuwan Atomu* are incorporated into the head. In 1997 he began his *Atom Suit Project*, which consists of a visit to different spaces: radioactive (Chernovyl, 1997), desert (1998) or abandoned (EXPO'70, 1998), dressed in the *Atom Suit* and for which he has developed other pieces as special vehicles and accessories.

Giant Torayan (2005) it is one of his best-known works. A child-robotic doll of more than 7 meters in height that sings, dances moving its arms and throws huge flames of fire, while it moves on a large mobile platform. The giant only reacts to orders given by children thanks to a control device, which uses an advanced voice recognition system to differentiate the tone of an adult from that of a child. The system has been developed by the Nagoya Institute of Technology. Despite the most critical aspects of him, he maintains a playful dynamic in his latest works, an approach between the world of children and technology. With the *Torayan series* (2004) he has developed, in the same way as Tosa, a whole commercial line of ventriloquist dolls dressed as *Atom Suit*, where he mixes infantile naivety and the

problems of the adult world (*mini Torayan, Torayan Head, Villa Torayan, Torayan Mask ...*).

With the same ironic-critical approach, the artist Momoyo Torimitsu also raises her different aesthetic productions (<http://www.momoyotorimitsu.com>). The piece *Miyata Jiro* (2001) is a robotic mechanism that represents, in a hyper-realistic way, the typical Japanese businessman crawling like a soldier through the streets of the main financial districts of cities such as New York, London, Paris, Amsterdam, Sydney and Rio. of Janeiro. Torimitsu, dressed as a nurse, walks behind him to meet her needs or show him the right way, change the battery, which she has curiously placed in the lower part of her back. "A satirical commentary on the humiliating conformity of Japanese 'salaryman' culture, the robot presents a cowed and hyperrealistic counterpoint to the camp heroic excesses of many robot performances." [13] In the 1960s, Japan entered a wild era of industrial and economic growth (*Japanese Miracle*) that involved the transformation of traditional oriental cultural parameters into a businessman culture, a business culture that will be characterized by new forms of entertainment. (TV, cinema and karaoke) and the compartmentalisation of physical spaces for entertainment and sex.

In subsequent installations and videos he has continued to delve into the conformity and humiliation of the "successful wage earner". *Inside Track* (2004) is a robotic installation where three top executives, one American (*Mark*), another North European (*Günter*) and the third Asian (*Lee*) crawl through the corridors of an office in a mad rush to be the first to reach the success. In *Horizons* (2004) they are one hundred miniature businessmen crawling like soldiers in combat on an abstract world map: a large area of artificial turf that includes mountains, seas, demarcations, cities, oil fields and other points of interest. Miniature entrepreneurs cross oceans and national borders in their ongoing battle for success, but wrecking the world in the process. The fear of a possible slavery of the human race, associated with dystopian literature where machines replace individuals, suffers a twist: human beings are already on their knees and are robotic servants of a global economic system.

The non-existent 'radical' separation between artistic work and manual development in traditional Japanese culture has allowed important industrial designers such as Shunji Yamanaka or Takeshi Ishiguro to develop pieces that can be viewed either as art or as design objects. Shunji Yamanaka has created an impressive robot: *Cyclops* (2001) (<http://www.lleedd.com/cyclops>) that updates the image of the mythical *Cyclops*. The work consists of a mechanical flexible spinal column (3.60 m high) from which one eye protrudes and two arms hang, slightly reminiscent of the figure of a human being. The spine has a flexibility similar to the spine of a human being and is made up of fifteen ball joints controlled by fifty artificial mechanical muscles that are moved with compressed air devices. The central computer controls the flexible and sinuous movements of the entire structure to direct and follow "with the eye" what it is contemplating. Its only "eye", a CCD camera connected to the computer, has optimized programming to analyze the environment and differentiate between moving human-sized objects. Eye contact in our society

corresponds to the first level of communication and intuitive understanding of the feelings of our fellow men. The visual contact established between the visitor and the Cyclops humanizes its construction and establishes affective bonds.

The artist considers that the psychological effect produced by the movement of the eye-cyclops can serve as a reference in the development and design of future intelligent organisms and creatures. The aim of the project is to confront the audience with a creature whose behavior resembles a living being, even when its spatial displacement is limited. The Cyclops cannot follow rapid movements made by a person, but it has a sufficient level of artificial intelligence to produce a reflection on the meaning of "similar to an intelligent organism". The spatial technological limitations are not detrimental to the project, moreover, the work does not seek an anthropomorphic physical reproduction, but a visual and intimate contact between systems from the premise of a human-machine interaction.

In this same philosophical line of entities that represent and update the presence of forms similar to those found in Nature, Yamanaka made Ephyra (2007) for the exhibition *Senseware - Tokyo Fiber'07*. The "organism" covered by a flexible and extensive skin, has twelve arms sensitive to contact that move with hydraulic mechanisms, imitating tentacles in continuous movement. At the end of each limb there is a very delicate sensor. When visitors try to touch the creature, it retracts its tentacles and "hides". The robot is programmed to recreate a continuous life process, when nobody touches it, its tentacles expand and contract like an animated being. For Yamanaka, the complexity of robotics must go beyond mere anthropological copy. Each "creature" will assume its own appearance depending on the functions and objectives for which it is intended.

"Robots will develop their own rational forms to suit their technological functions and specific applications. We believe that this project has helped to show that human metaphors don't help us to understand emerging robot technologies. Cyclops is a proposition that we should start a fresh journey in search of an original aesthetic. There is now a unique new class of product - robots - and we are only starting to develop new forms to realise this." [14]

In an interview conducted in 2010 by the director of the Tokyo Gallery, Yukihiro Tabata, with the technological designer Takeshi Ishiguro (<https://takeshiishiguro.blog>) he once again emphasized the non-differentiation between the two areas. He considers art as the first step in conceptualization, experimentation and research that can lead to possible new developments, without denying an exit towards the world of design, with its more commercial aspects. With a classical training as a designer at the Royal College of Art in London, his work leans more towards the artistic sphere, reaching the conclusion that design can be treated as art and art must have a good design. His final degree project *Rice Salt & Pepper Shaker*, a salt and pepper shaker made with artisan techniques, was included in the

permanent collection of the New York Museum of Modern Art.

The interest in working with different materials and technological applications has represented a new challenge in each project, a challenge to find the union between poetry and the delicacy of Asian culture and high tech production. *Balloon* (2007), presented in the *Sonarmatica - International Festival of Advanced Music and Multimedia Art - Sónar* of the same year, is a set of spheres made with reflective material and filled with helium that float in the air. We could not properly define them as robots, but with a very simple programming, a mini fan and a series of sensors a complicated behavior is generated. The flying objects manage to move without ever touching the ground and, at the same time, avoid different obstacles that visitors may find themselves among. The original idea was born from a dream of Ishiguro where he played with an object suspended in space that moved freely and for an unlimited time.

In recent years, parallel to the development of Japanese industrial robotics, there has been an effervescence of artistic production in Asia, especially in South Korea or Taiwan, some close to evolutionary aspects of amorphous and inflatable forms aesthetically similar to recent works. by artist MacMurtrie, as *EX-DD-06* by Shih Chieh Huang; others reproducing conceptual schemes on forms of "slave" work in machines and assembly lines, such as *The self-portrait machine* by Jen hui Liao or, finally, closer to the conception of the body of the living being as a "raw material" capable of being modified and hybridized *Organ-machine Hybrids* by Doo Sung Yoo.

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Spectrograms of the environment: entangled human and nonhuman histories

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Abstract

The article discusses the use of the proprietary spectrocartography research method to study the interdependencies between history, forms of landscape design, colonization mechanisms, green areas management, processes of ecological degradation, and urban policies. This method involves carrying out research using various data from the fields of sound ecology, biocommunication, botany, ecology, and environmental psychology, as well as methodology from the field of art-based research and art & science. The genesis and hidden ideology contained in the design of the artificial lake Elsensee-Rusałka, which was dug in Poznań by Jewish prisoners of war during World War II, as well as post-war and modern forms of the revitalization of the lake area and adjacent green areas, are analyzed in detail. The ultimate goal of the research project is to create an open experimental digital archive relating to the concept of hybrid space, digiplace, and augmented reality, in which all the data obtained during the research will be collected. These data will be used to create a new form of storytelling, taking into account historical asynchrony, nonhuman actors, and the space itself as a causative entity.

Keywords

spectrocartography, hybrid spaces, digiplace, digital archive, artificial natures, cultural trauma, biochauvinism, totalitarianism, landscape design

Introduction

Since 2011, we have been intensively developing research on the issues of the environment, technology, and societal relations using transdisciplinary teamwork methods and the involvement of various experimental cognitive perspectives – including art-based research and art & science practices. All our activities and projects also involve various forms of design, which are often also perceived from the perspective of critical or speculative design, as well as various ways of using media and technologies – often in an "incorrect" way or in a way inconsistent with their primary purpose.

Based on our practical and scientific experience, we have developed a proprietary methodology for this type of research – spectrocartography. The following article is a short presentation of the application of this method to research conducted in a specific place, which, however, we view as typical and perhaps even representative of many other problematic places on different continents. The genesis and history of this place combine the issues of violence, slavery, exploitation, landscape transformations, controlling biodiversity, designing a place of relaxation for a specific society, as well as recreation policy and ideology. These types of places – as we have studied – are also special lenses in which the interconnection of human history, geological transformations, systemic violence, environmental damage and ecological catastrophe are revealed. The analysis of the functioning of such places reveals the correctness of the ideological influence of the past on the future, unconscious hierarchization and species stigmatization, as well as the existence of dangerous ideologies in landscape projects. The site of our research is Lake Rusałka (called Elsensee during the Nazi occupation of Poland), and the aim of the whole project is to create a digital and hybrid platform – a living archive open to various human and nonhuman forms of storytelling and experiencing this place.

Elsensee

Lake Elsensee is one of the many examples of Nazi Germany's geopolitical modernization project. It was dug out by Jewish prisoners of war. When the work began in the spring of 1941, the Jewish population of Poznań was too small for the task, hence Jews were deported from ghettos from other Polish towns and also from abroad: from Austria, Czechoslovakia, Luxembourg and Germany. In total, approximately 11,000 people, men and women, were resettled to Poznań in this way. They were imprisoned in 29 forced labour camps located within the boundaries of Poznań at that time. Standing waist-deep in the water, Jews had to dig out a basin of the lake. Matzevot (Jewish tombstones) from the

city cemeteries liquidated by Nazis were used to strengthen the bottom and shores of the lake, and other surrounding structures. The conditions prevailing at the sites of slave labour were horrific. Executions were the order of the day. The terrible hygienic conditions, diseases (especially typhus), and the exhausting work, combined with hunger, meant that death was ever present. The forced labour camps in Poznań were liquidated between August and October 1943. Prisoners who survived the horrors of the camps and the slave labour were transported to the Auschwitz-Birkenau concentration camp. [1]



Figure 1: Elsensee, postcard, 1945, Adam Mickiewicz University Library in Poznań.

Designed Nature

The geopolitical and racist expansion of the eastern territories was developed and described by the Nazis in their ‘Generalplan Ost’, which aimed to bring humans, nature, and race into harmony in order to establish a new agrarian way of life for Aryan colonists. In order to achieve this vision, the landscape had to be made anew, first by forcibly removing the Slavic population, by bulldozing away the past, and finally by moving Germans into the newly emptied space. [2]

One of the many examples of this policy was the Lake Elsensee project. It should be emphasized that in the Nazi plans Poznań (Posen) was located in the centre of the so-called Wartheland, an area which was to be an integral part of the Third Reich, inhabited exclusively by Germans. In the Nazi expansion project, Wartheland was to have been a paradise for racist landscape planners, who would have been able to easily implement and experiment with new forms of shaping urban, rural and cultivated areas, based on the ideologies of the German Völk. Elsensee was to have served as a space for implementing the model of the ideal Aryan citizen. The cult of a healthy lifestyle, involving contact with an ideologized and designed nature, was to have contributed to the rapid development of a strong and expansive society. In this regard, planning included not only urban relations between green and built-up areas, but also the ways that citizens were supposed to behave in these new spaces. Nature is in no way free in such a conception: the designed green areas and suburban forests are in effect the same as the gardens of the time, which gave priority to selected biological species over others. [3] The core of these projects was



Figure 2: Lake Rusałka, Google Maps, the description of the lake on Google Maps: “Man-made lake formed in 1943, offering hiking & biking paths, picnic spots & boat rentals.”

ocularcentricism, and the design ideas were subordinated to shaping an attractive landscape.

Transformation Times

In 1943 Lake Elsensee was completed, and in the post-war years all its functions were preserved. In 1974 it was named Rusalka, and from the perspective of Slavic mythology the name ‘Rusalka’ is somewhat peculiar, when the origins of the lake are borne in mind, since a ‘rusalka’ is a nymph who tempts and kills newcomers. This too seems very odd considering that three memorial sites were located by the lake. These sites commemorate the over 2000 people who were shot by the Nazis in 1940 in the area – they were mainly Poles from the first concentration camp in the occupied areas, which was located within 2 kilometres of the future lake.

In the first decades after WWII, the recreational development project for Lake Rusalka was expanded, beaches and sports centre buildings were completed. The 1960s-1980s was a period in which this place was extraordinarily popular. Later, due to a lack of investment, the recreational infrastructure went into decline, and the lake lost its popularity with the inhabitants of Poznań. This state of affairs was particularly pronounced in the 1990s, after the political transformation. In the last 10 years, however, the lake area has been intensively developed, and not only have its recreational functions been restored, but the sports infrastructure has been expanded, and an ecological education programme has been developed.

The trauma and difficult histories hidden in this environment were basically forgotten, though they are sometimes revealed when low water levels in the lake reveal the sunken matzevot. Each reminder and commemoration are associated with reluctance, arousing fear in current users that history may take over this place, which now serves as recreational centre for so many city residents.

Such environments constitute ready-made stories which entangle history and present times, so in the research process it is necessary to focus on finding media that allow the environment to have agency; to design possible forms of generating verbal and – above all – non-verbal spectral storytelling.

Ocularcentric Design vs Urban Noise

The whole Elsensee project (and the later Rusalka continuation) was subordinated to ocularcentric culture, and focused on movement along the perimeter of the water reservoir, but the situation changes considerably if we make hearing the primary cognitive sense. A soundwalk around the perimeter of the lake is generally an unpleasant and irritating experience. Sound artefacts of urban-centred origin dislocate the listener in space, since we are not able to precisely define the source of sound or its propagation in space. The acoustic map of the city of Poznań defines noise levels for

the area of the lake and direct green areas in a general way – without indicating recommendations for this area – due to the fact that it is not subject to acoustic protection by law, and detailed research has only been carried out on a narrow area designated for service and possibly residential activity near the lake. [4] If we were to identify the sources of noise for the lake area, we would first of all have to distinguish traffic noise – railway lines and roads. Interference which exceeds norms is also caused by airplanes on their descents, as they approach the airport landing located about 2 kilometres from the western shore of Lake Rusalka. In addition, the lake is located in a depression, which makes the sounds from very busy roads and railway lines resonate with the water and reflect from the surface. From the perspective of a person visiting the lake – depending on the time of day and year – there is a great deal of anthropogenic sound, the sources of which are service and recreational facilities, as well as the activities of people themselves – cycling, running, sunbathing.

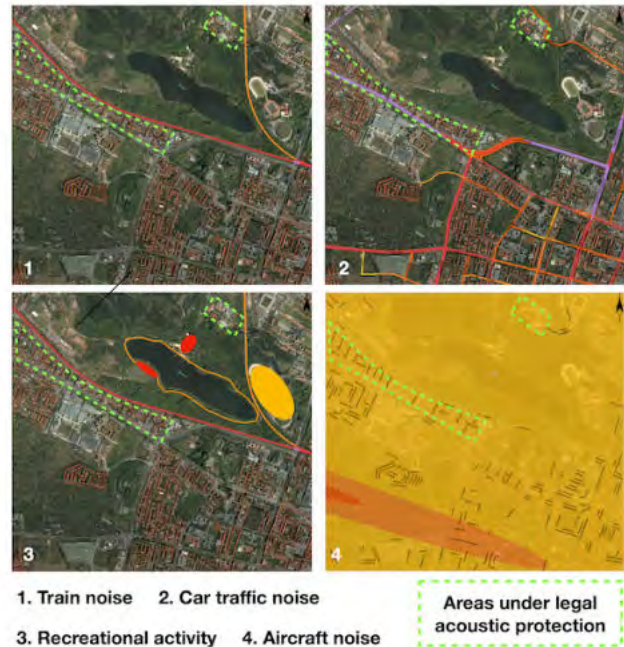


Figure 3: Noise maps of the lake based on Acoustic maps of the city of Poznań 2007-2017.

Mute Actors

The cultural and political perception of plants is that they are mute actors of landscape scenography. This is despite the fact that research conducted by biologists in the field of bioacoustics shows that biocommunication and acoustic activity is one of the basic characteristics of plant behaviours. [5] [6] In the development policy of the Poznań agglomeration, afforestation is treated as a natural acoustic barrier. This theme is also present in the city document examining the impact of spatial development on the environment and

the surrounding area of the lake from 2010 – while plants are mentioned as a positive aspect that reduces noise in the space of the Rusalka Lake, no consideration is given to the problem of protecting plants and animals from anthropogenic noise. [7] However, research on the Rusalka ecosystem from 2016 states that 61 percent of the plant cover is urbanophobic, meaning the plants have problems with adapting to the conditions of anthropopressure. [8]

Visitors to Lake Rusalka are encouraged to “commune with nature”, including engaging in waterfowl observation, which requires silence, but it is difficult to resist the impression that the species gathered in this area are rather subject to concentration, selection, pressure and violence resulting from cultural and acoustic policies.

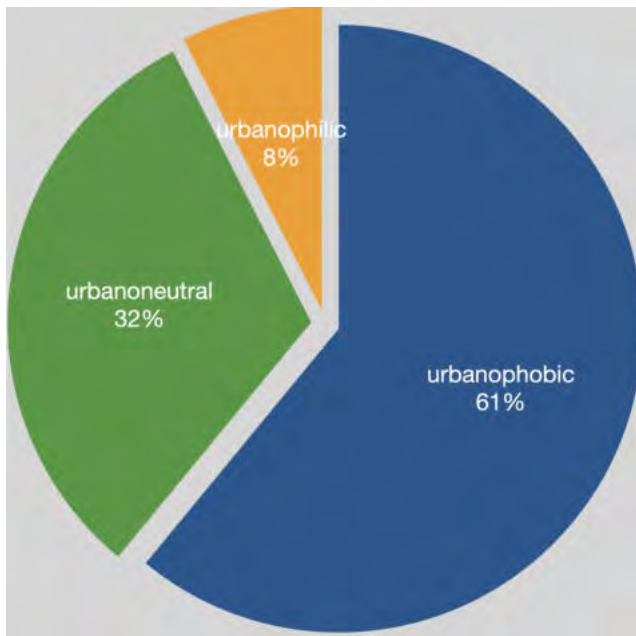


Figure 4: Diagram of plant cover of the areas around the lake according to anthropopressure factors, based on data from: Dyderski, M., Gdula, A. K., Wrońska-Pilarek, D., “Present plant cover of the areas around the Rusalka Lake in Poznan in conditions of human impact”.

Spectrocartography

An important starting point for our research practice is thinking about environments in terms of digital-physical spaces, hybrid spaces, code/space, [9] and the measuring apparatus itself, which is treated as a tool that provides data for analysis, as well as a tool whose cultural functioning should always be subject to critical reflection. The data used for the analysis is always situated. During our work, we use a methodology we called ‘spectrocartography’. Using digital tools and sensors, we are trying to blur oppositions and give voice to different participants of the environments, meaning we

attempt to place nonhuman actants at the centre of the spectral story, not at the borderlines or edges.

The spectrocartographic method is a process of continually and consciously situating both raw and analyzed data in revealed and undisclosed relationships to each other, in a specific geographical and digital reference. We describe the method of obtaining data as sampling. All the obtained samples are then used for spectral analysis. Finally, a spectrocartographic description is created on the basis of sample analysis. Thus, spectrocartography is open, and even calls for further counter-analysis. Spectrocartographic description may also take the form of open diagrams, charts revealing the relationship between the spectres themselves. This method is thus not always geared to obtaining an unambiguous answer, but rather to revealing the interference of spectres from different sources and indicating their possible socio-cultural consequences. Spectrocartographic practices can be used both to produce academic texts and create artefacts at the interface of art&science.

In the case of the Elsensee-Rusalka environment, when creating spectral analysis and spectrograms we took into account:

- the modernist nature landscape design (with the specific Nazi approach to the concept of artificial natures)
- the Nazi concept of ecology
- necropolitics as spectrapolitics
- memory and environmental harm
- urban design and the use of artificial natures in the city centre
- the neo-liberal politics of place as subordinate to recreation and pseudo-ecology

In the sampling process conducted during workshops between 2017 and 2019, while working with our spectrocartographic method, we also introduced data from non-human actants.

For experimental analyses we used, for example:

- official acoustic maps of the city of Poznań which document the sources and paths of noise propagation in the immediate vicinity of Rusalka
- measurement data on pollutants (water, air, soil)
- biological and ecological data (species, living conditions, types of anthropopressure)
- anthropological data (observation of the behavior of human users of the area, interviews, surveys)

We also supplemented the maps with methods of analyzing affective experience – workshop participants filled in questionnaires which assessed their affective state at particular points in space; by marking places of special importance and those associated with certain problems. Additionally, analysis of information on the Rusalka area appearing on social media and in archival materials concerning the creation and development of the lake area from the moment

of its creation, through the post-war years, until today were present throughout the entire process of research.

We compared official acoustic maps with the methods and measuring apparatus used in soundwalks and field recordings; and we also used sound interfaces to listen to the electromagnetic landscape. Field recordings were made with the use of various techniques: from directional recordings to ambisonic recordings.

In the context of biological data, we prepared the speculative taxonomies of beings emerging in space as a critique of the traditional cultural-biological order based on the taxonomy of species/beings; referring to the text of the molecular biologist Andreas Hejnl (Ladders, Trees, Complexity, and Other Metaphors in Evolutionary Thinking). [10]

All these methods of data collecting, and then critically approaching them, open the possibility for infra-active interferences between measurements, apparatuses, data and affects, stories, human and nonhuman actors. [11]

A digital environment for human and nonhuman interaction

In the absence of useful tools capable of presenting the complex structures of our research, we decided to search for new procedures that could create a digital environment: a system of social interaction based on spectrocartographic research and storytelling. (This part of the project is still in the preparation and development phase.)

The digital environment (digiplace) [12] of Elsensee-Rusalka will consist of archives on the creation and post-war history of the lake, its management methods, transformations, etc.; current scientific data on water and air quality, meteorological data, pollution (environmental quality monitoring), and current noise level; and the system will also include data from the natural sciences on species found in the vicinity of the lake.

Access to the Rusalka archive will be possible from two levels:

- 1) Remote access from a computer – i.e. via a web browser – will enable navigation of all the collected materials and data, as a browsable catalogue;
- 2) Direct access from a mobile device – the user will have to be in a certain physical space: the surroundings, using geolocation.

In the direct access mode, the user will have access to many experimental forms of narration and interaction mechanisms. Use will be made of geolocation techniques, augmented reality, and haptic interfaces; part of the narration will be created by artificial intelligence mechanisms. The whole system will not only be a platform for interaction with the complicated and complex history of space and its transformations, as told from the perspective of human and non-human subjects, but it will also serve as a tool for public consultation.

Multi-media, multi-structure, indeterminate storytelling is a socially engaging mechanism; recipients can independently find themselves in multi-layered structures, and independently establish relationships with various subjects of the story. Such methods of using technology, mediatization, and interaction should have an experimental component, and each environmental problem requires separate strategies – “critical design-within-environment”.

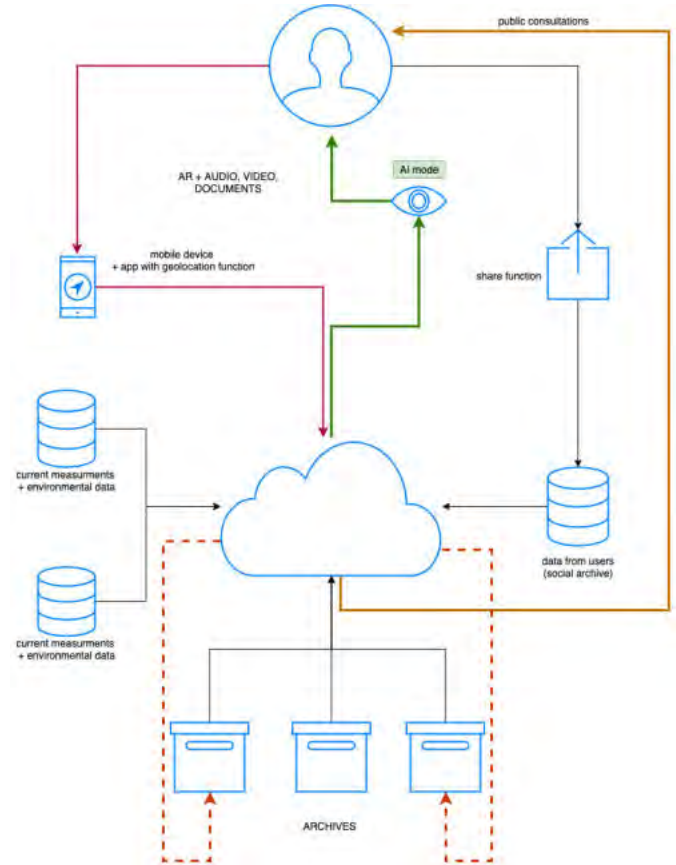


Figure 5: Diagram of the digital environment (digiplace) of Elsensee-Rusalka.

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Rebalancing media in environments: analysing flows of action

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Abstract

An exploration into how portable projections can serve to counterbalance the bias towards screen-based media experiences and how these projection devices can contribute to a more texture-based understanding of the relationships between environments and their constitutive actants. The constantly changing relationships between media and things enable the construction of a sense of place which moves and flows. To undertake this exploration, I use a three-fold method to analyse site-specific video walks (*The Surface Inside*, *I-Walk*, and *(wh)ere land*), draw on nascent thoughts derived from a series of workshops about flows, environments materials, and resonance, and engage with critical discussions about space, assemblages and materiality.

Keywords (10 max)

Flows, projections, assemblages, actors, *meshworks*, vessels, post-humanism, new materialism

Introduction

The question of balancing media in environments is strongly tied to the widespread use of screen-based portable devices and mobile technologies which due to their ubiquity have greatly contributed to the connectivity of activities across the globe, but have nonetheless endorsed the isolation of human actants from their immediate surroundings. This isolation is by no means compulsory, but is often chosen and has been associated with a *blasé attitude* that filters information [23], and has been described as having a *cocoon* effect [12].

Screen-based engagement with technology and media content presents a skewed perspective of the intricate relationships between things in the world, pushing aside a relational understanding of environments and the things that compose them. Relationships with environments have become increasingly more abstract and idealized (criticised by Doreen Massey and Tim Ingold among others), and have become more detached especially when considering geographic information system (GIS) technologies and corporate interests [6] which claim to accurately measure the world, but fail to embrace the changing composition of the things that make the world they represent.

Furthermore, 3D technologies also lean towards a fake sense of tangibility as in the case of VR where virtual body parts are visible and controlled (gloves), physical environments are recreated and new environments invented: often idealized or dystopic. These digital and screen-based technologies enable us to find things, places, and each other but also distance us from tangible surroundings and the interconnected material things inhabiting tangible environments.

The technologies that claimed to have found us (as for instance GPS tracking devices) have simultaneously displaced us, as if a claw machine had picked us up, scaled us down and placed us on the screen. Locative devices help us find our way in the world by replacing the physical position of the tracking device with a dot on a screen surface

that is built into the device itself. Curiously, it is as if *place*, which I assign to things which move in environments, had been abstracted, translated into a representation and assigned a set of coordinates in a virtual sphere. When asking ‘where am I?’ [20], an immediate answer could be ‘here, where else could I be?’ while if asking ‘where am I in relation to *x*?’ then the answer could be associated with both virtual and tangible environments: where am I on the screen or in my immediate surroundings, or both?

Constant focus on screen-based portable devices may cause a continuous displacement of things in virtual and tangible environments, triggering an imbalance, as the relationships between humans and non-humans are practised in unstable, hybrid, shifting environments, often tilting slightly towards the virtual. The intangibility of virtual environments does not prevent us from relating to them: in fictional book stories we follow the actions of the characters and things in immaterial worlds. Hybridity is here to stay and plays an active role in the making of our textural and imaginary environments, but would it be feasible to propose hybrid environments which are more balanced, and where tangible things and their material characteristics are given a more prominent place, turning towards the textural qualities of *meshworks* [9] and the *vitality of materials* [1]?

In order to achieve this balance, we may need to bring media content away from screens and into environments and tangible things. This has been in HCI agendas for decades, moving away from graphic interfaces and towards *tangible bits* [13] and regarding materials as interfaces: zones of interaction. Ishi’s *tangible bits* approach has been at the heart of many research projects (too many to list here) but in the meantime *cocooning* devices have gained terrain (e.g. VR and AR headsets, mobiles, tablets).

The key to the balance may be linked with how technology is embedded in everyday life and the time spent attending to these devices but it is more strongly linked with the material ecologies we collectively build around them. If the connectivity and communication that these technologies afford were no longer inside the device, but embedded outside in tangible environments (Figure 1) we may be able to rebalance our connections with the things, especially with the material things around us [1].



Figure 1. Projection on bench surface: hand holding portable projector. Image: Chih-Peng Lucas Kao.



Figure 2. From video walk (guided): *The Surface Inside*. Projection on bench surface. Image: Kao.

Verticality is unbalanced

Verticality is a way of hierarchizing things. If we were to observe a vertically structured environment we would easily identify the prominence and power of some things (actants) over others. For instance, in a representation of a geography (e.g. map) some features would have been flattened out in order to highlight others, causing a reductionist line of action which clashes with Bruno Latour's *irreductionist* worldview where *everything* is inter-connected and irreducible to other things unless a serious translation is applied [8]. Needless to say, in such a hierarchically structured environment imbalance is inevitable. The stronger and more powerful components will dominate, while weaker ones fade away without being heard or seen.

On the other hand, in any horizontally arranged environments where attention is given to each element, things are not reduced or faded out, instead the relationships between them are juxtaposed rather than hierarchized. For instance, in the Internet of Things (IoT) where each thing is considered to be instrumental to the network of relations, the hierarchical model of verticality is clearly inefficient and unhelpful, some devices might be more involved in the distribution of information and others in the actioning of the information, yet they are all interdependent. When we talk about things (sometimes not even the tangible ones) without hierarchizing them, we come closer to a horizontal set of relations, where elements are interconnected and things play on more evened grounds [1].

From an IoT perspective, but also from a material connectivity perspective where agency is placed on matter and things, verticality ought to be replaced by this idea of interconnected horizontality which aligns with a post-humanist view of the world [3]: a world in which non-human (sometimes technical, others material or immaterial) and human *things* are on a level playing field; where actants are not stripped of their *potentialities* and capacity to associate in a fluid mesh of relations: *assemblages* [5]. This notion of horizontal levelling up is neither fully achievable nor desirable because environments are multi-dimensional not bi-dimensional. They contain porous and flexible layers of associated ecologies (different forms of habitation or dwelling), so as long as we conceive these environments as

complex layered ecosophical entities (Guattari's *Three Ecologies* [3, 1], based on Bateson's 1972 *Steps to an Ecology of Mind*) or evolving relational meshes where things are housed under common fluid umbrellas, it is impossible to flatten these ecologies or layers out. Figure 2 illustrates that the relationships between things are not flat but spatio-temporal. They change as the video footage plays on the device, the person holding the projector moves or the raindrops on the wooden surface merge, reflect light or slide. Things are housed under different umbrellas and are often associated and can move between them, because their relations are fluid (Deleuze and Guattari's *de-territorialisation*, [5]) and these relations can be explored transversally [1, 3].

Using the video walks, I examine how participating actants (e.g. paths, projectors, people, surfaces, cobbles, trees, benches) collectively construct and are temporarily caught under different umbrellas (assemblages) which are part of an overarching heterogeneous multiplicity of changing assemblages. The study entails looking at their somewhat horizontal relational actions from a three-fold method [14, 15] of analysis: i) a micro, close-up, inside-the-path perspective using Ingold's SPIDER-theory; ii) a macro, detached, map-like point of view using Latour's actor-network-theory (ANT) of isolated instances; and iii) a fluid, evolving, constant heterogeneous assemblage of assemblages using Manuel DeLanda's theory.

Production of environments

Before analysing the video walks and looking at paths, instances, and assemblages of actants, it seems necessary to briefly outline what I mean by the term environment. I part from Ingold's concept of *meshworks* [9] in which environments are textural – Lefebvre's textural spaces [10] – and produced in the action of being, perceiving and participating in a world that is made of an entanglement of paths. Ingold builds upon Jakob von Üxküll who considers environments to be produced by organisms and to be as diverse as the organism themselves [25]: a frog's environment differs from that of a fly, however their environments overlap and are shared to some extent. In addition, environments can also be described as interconnected textures and actants forming what DeLanda,

elaborating on Deleuze and Guattari, refers to as fluid permeable assemblages that are transformed through actions. In my view, environments (*meshworks*) are evolving assemblages of actions but sometimes it is useful to look at them from a static and detached point of observation. If environments are analysed from a frozen point of view, as if they were an instance or a video frame, they can also be described as networks or as Latour prefers to describe them as *worknets* [18]. Although their philosophies are significantly different, there is the unifying concept that traverses Ingold, Latour and DeLanda: co-creation. Things (non-human and human) and the worlds around them affect each other, are collectively, actively produced, not given.

While Massey and Henri Lefebvre posit, using the term *space*, that environments are socially constructed and co-produced [20, 19], from a contemporary stance this co-production is often inverted when undertaken without sensibility towards the other things that constitute the overlapping and co-existing environments outlined by Üxküll. If co-production is inverted co-destruction can be unleashed, going against all those ecological issues we are striving to act upon using our design, creative and scientific know-hows. In this regard, Jane Bennett calls for a renewed appreciation of the vibrant qualities of materials and things (here in relation to environments), and for a revaluation of the actions and relations that things (actants) push onto each other [1]: what does a plastic bag in an urban or non-urban environment activate in us? However, my question is: What does a portable projection activate in us and other things in the environment? Can the relationships between things be strengthened through the projection of moving images of those same things onto the environment?



Figure 3. Video walk (guided): *I-Walk*. Left: projection on paper house. Right: projection on wall. Image: Michelle Aldredge.

I propose that projecting the textures of things and their relationships can positively alter the connections between the things that compose the fluid ever-evolving textural assemblages I call environments (Figure 3). We can never be sure what the things that compose the multitude of environment are, but we can learn about them while establishing connections and recognizing their vitality and their capacity for action and the actions they activate within us. The connection between things is inevitably a translation, an exercise of reckoning and interpreting as Latour proposes in his 1988 appendix *Irreductions* [16, 8]. Each thing assigns a plausible story to another, a story that is not fixed, but is constantly escaping being pinpointed. Surely this way of conceiving the irreducibility of things is useful, but how do non-organismic things in our environments relate to other things [8]? How can they interpret the actions of other things in their environments? In IoT terms this is not an issue since things are technologically sentient, but without the electronic and algorithmic capacity for sensing their relations, how can a wall or plastic bag relate and invent stories about other things around them? If they cannot, then maybe we can tell stories on their behalf, and in doing so build our sensibilities towards these things and their shared ecologies.

Latour's *Irreductions* can only take us so far. Eventually we stumble upon the metaphysical problem of being in flow and in relation to others. Unlike Ingold, DeLanda and others such as Bennett, Lefebvre, and Massey, Latour's original *worknets* are instances and not continuous flows of actions (although this approach changes in Latour's later work). To discuss place, I need to step out of Latour's irreducible networks of actions, and move into an evolving meshwork of flowing actions. At the centre of this meshwork is place: the place that things create and which moves with them as they flow. The notion of place is the last thing I want to unpack before we move on to examine the video walks using the three-fold method of analysis proposed earlier.

Surely, we do not want to reduce anything to anything else [8], but sometimes reducing everything to one single concept can prove useful, as in the action of reducing every 'thing' to the concept of *thing* (pun intended). In this reduction, the agency of things is contained within the things themselves and in their relations of *exteriority* [5]. Building on the work of Tim Cresswell who borrows the idea from Susanne Langer [21], and on Gertrude Stein's notion of geography [24, 4] I propose reducing each thing to the concept of a vessel which contains agency and *potentiality* (dormant actions) [5], and enables navigation and the establishment of relationships with other vessels in the environment. In this analogy of things as vessels, the notion of place lays within the vessel, just as the place of the seafarer is attached to the boat independently of where the vessel happens to be in relation to the shore, sea or horizon.

However, when screen-based portable devices are part of the meshwork of connected vessels, then navigation and place become hybridized: you are both sitting on that bench and inside the screen. Whereas with projections, the place you would occupy in the screen is brought into a textural tangible environment where it has a place that flows and that enables it to resonate with other things, extending its actions into and co-creating the meshwork.

The overarching co-created meshwork is evolving, and made of a multiplicity of individual but interconnected paths. It is a "continuous yet heterogeneous" assemblage [8] of flowing places, of things moving along paths and between assemblages. It is a delicate balancing act: a continuous process of *territorialisation* and *de-territorialisation* [5]. In hybrid textural environments such as those produced by video walks where material and immaterial things coalesce, their actions bring about flows that are "an indivisible continuum of becomings" and their actions are also "that very flow" [1]. Things and actions are intertwined in a continuum which seems to resonate with the notion of vessel: place is attached to the vessel as it moves in the environment in a process of continuous entanglement. To understand the connections between actants, things have to be in a place that is contingent and which changes in relation to the actions of other actants, like an improvised dance where things respond to and resonate with one another.

Site-specific projections

This improvised dance of vessels (things in action) can be found in many scenarios. Here I analyse three video walks where site-specific projections were performed. Portable projectors served to highlight the invisible forces and flows that shape the textures of environments.

These are the three video walks:

- *The Surface Inside* (guided): one projector and multiple headphones,
- *I-Walk* (guided): one projector and origami houses,
- *(where) land* (collectively led): seven projectors.

The video walks had many common features, but one of the aspects that differentiated them and substantially shaped the assemblages of actants as they moved along the meshwork of paths was the possibility of having more than one projector, since this enabled people to handhold and play with the projectors for themselves rather than through a guided experience.

While walking with site-specific projections, intricate assemblages of actants were created: projectors, legs, gloves, pockets, bags, trees, jackets, tarmac, stones, benches, shoes, walls. The list could continue but listing all the actants would be an impossible task, the infinite regression problem that Jorge Luis Borges identifies in his *Library of Babel* [2] and that Graham Harman identifies in Latour's theory [18, 8]. For that reason and for the sake of brevity, I only focus on a handful of actants and analyse them in relation to paths, instances and porous flows.

When the video walks were performed a multiplicity of flowing assemblages were produced too. Just as with the actants, it is not feasible to outline all the existing and potential assemblages, and thus only a few superimposed assemblages will be mentioned. But what I want to stress here is how actants collectively created a hybrid ecology of assemblages that were constantly negotiated as things moved and created the textures of their environments.

Using a three-fold method of analysis has some limitations (a. Each method is best suited to accomplish a specific exploration: following along evolving paths, stepping back to observe from the distance, or moving between different assemblages. The three methods focus on looking at the flows of actions. Even when using Latour's detached instance approach we look at instances of flows. Staying still is not an option, because environments and their actants are constantly reshuffling their relations of exteriority, but in a paper-based analysis like this, pausing the video documentation and using still images becomes necessary.

Going with the flow: paths

Figure 4 shows a sequence of still images from the video documentation. To analyse these images, we need to immerse ourselves in Ingold's meshwork, bringing the viewer into the path that the actants created and shared as they moved along. In this sequence, we can identify some actants: a camera, a projection and a person (or persons).

They, and others, shared the path and produced the hybrid textural environment we can see in the images. To get a better insight into the paths of a meshwork, we are required to adopt Ingold's SPIDER approach [10]. Imagine you are moving within the meshwork, producing a web of connections, perceptions and actions, experiencing and creating the environment as it develops from and around you.

Using this approach, we can better understand the flows of relationships between the things that (on a level playing field) make the environment and how these connections are spun, and actively produced. Video material, at 24 frames per second, would be better suited to show and analyse the flows of actions that connect the things in the SPIDER's path, but a sequence of frames can suffice.

In the sequence, we can identify hybrid digito-tangible textures on the pavement and some of the actants that created these textures as they move along a path. There is a mixed flow of human, material and immaterial things: cobbles, footsteps, portable projector, video camera, moving images, air, parked cars. In this meshwork, the vibrant materialism that Bennett claims needs to be revived is present: the projector activates the projections, the projection activates the cobbles, the cobbles activate the projection, the person holding the projector directs the

projection, the moving images of the projection activate the textures of things in the environment.

All these things (and those that have been omitted) collectively compose the continuous flows that make the texture of the environment, where things are entangled instead of separated from one another. Their associations are horizontal, they need one another and their flows are interdependent. Human actants are not above the meshwork but inside it (post-humanist approach), and are just another part of it, a constituting part of a larger whole. In this way, things can look at each other in the eyes, as when dog owners kneel-down to converse with their animals.

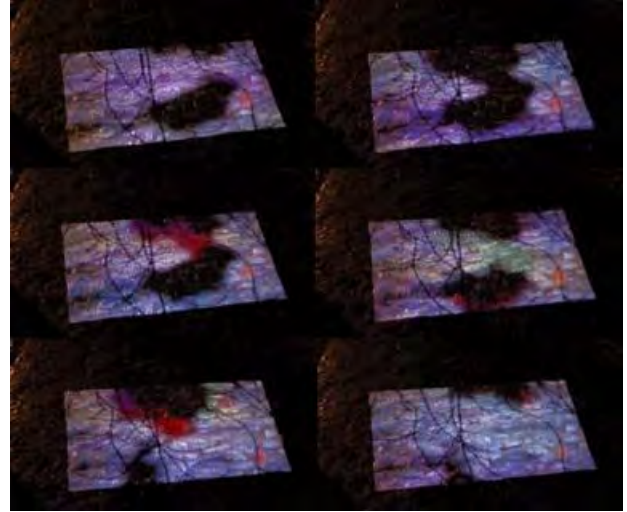


Figure 4. Video walk (guided): *The Surface Inside*. Image: Kao.

Each thing is immersed in their own path: inside a thread of a bigger mesh that they produce together, not in isolation. The actant 'projection' (as part of its path inside the mesh) pushes the action out of the screen, breaking down the screen-based *cocoon* effect and placing the binary video information onto the tangible surfaces of the cobblestones. Although immersed, in this sequence we cannot look around as if we were experiencing a 360° video, but we are aware that the things and textures that participated in these shared environments would have wrapped around all actants, not only in spatial terms but also in duration.

Snapshotting the flow: instances

When taking a snapshot of the flow of actions in any meshwork we stop the actants and their temporal and spatial relations. The fluid mesh of relationships between things and environments freezes, and we are no longer inside a path, but outside. If we turn back to the notion of things as vessels where place resides, the snapshot turns the evolving flow that the video walks are part of into a set of coordinates which defines an instance of this flow, fixing the position of the vessels in a given time and assigning them a place (a pin) in a pincushion [20].

Any event (in this case a video walk) analysed using this approach does not have duration. On the contrary, it is a single frozen instance which, although connected to its contiguous instances, is analysed independently from them, or from the path which they are part of unless a comparison between instances is intended or needed.

With this approach, every *thing* is an event in itself. This is crucial to Latour's discourse of irreducible actors, and is suited for analysing still images or individual frames containing details about actants in their *worknet*. As Harman puts it: "Latour's actors have no choice but to occupy punctiform cinematic frames" [8], and an example of *punctiform cinematic frames* can be seen in Figure 5 where two video frames show the actants and relations in two instances of the same video walk.

In the top image, we can see the actants that have left a trace (no matter how weak) [18]. On the left: two people, a projection, the ground, a hand holding a projector, feet almost stepping onto the projected surface. On the right: projections and people in the distance. The stronger actants are on the left, the weaker ones in the top right corner of the image where they can still be seen, but just barely.

Actants are not different from their relations. In fact, they are their relations, becoming what their connections to other actants give them in exchange for action. For instance, the projector gives the person the possibility of projecting, the projection gives the other person the possibility of looking at and stepping onto the image. Whatever the actions of actants are they have an effect on others, they have the capacity of modifying and being modified by others [1, 17].



Figure 5. Video walk (collectively led): (*wh*)ere land. Top: two groups and projections. Bottom: actants in action. Image: Kao.

In the bottom image (Figure 5), we can analyse this notion of ‘modifying and being modified by’ and how this agentic capacity of producing change enables the co-creation of environments even when these environments – which are actually fluid – have been frozen inside the frame. The image contains three human actants whose actions are connected to a projector, the fabric of a bag, and some distant projections. Each of the elements featured in the frame is unique and irreducible to any other, but when defining them as actants we mediate their differences so we can investigate their alliances [8]. The projection modifies the bag, the bag modifies the projected image, the person holding the bag modifies the bag, the person holding the projector modifies the projector, the actions of the third person modify the actions of the other two, and so on. They are all part of an assemblage of actants which is contingent, and although we can only see an instance it is clear that their alliances and trajectories in the environment are just about to change. Thus, in order to look at these changes we need to move away from Latour’s cinematic instances and move back into flows and trajectories.

Assembles of actions: porous flows

In order to investigate the video walks as “continuous yet heterogeneous” assemblages, the previous methods have enabled us to study them from within (SPIDER) and from outside (ANT). Assemblages can be studied as *worknets*; as collections of events, but they are more closely related to

meshworks (collections of paths of becoming), which Bennett calls trajectories (and Ingold calls lines).

Although both meshworks and *worknets* are concerned with actions, in assemblage theory instances cannot be considered in isolation because there is no escape from flows of actions. More importantly, we have to deal with the potentialities of our actants and their capacity to participate in different assemblages simultaneously or to change between them at any time. Actants are their relations, but they are more than that because they can exercise their potentialities and create new relations of exteriority at any point, and by doing so create and become part of new assemblages.

For instance in Figure 6, we can see a series of stills which show a different set of relations than those shown in Figure 5. The images feature the ground and the projections, occasionally the portable projector or the hands of people operating the devices. Just because we cannot see a particular actant all the time we cannot ignore them as when dealing with instances, where if they do not leave a trace (action or activation) they are no actants.

Before the video walk started, a projector was given to groups of 3-5 members and these groups started to walk at intervals. Being aware of this, gives us a different insight into the assemblages shown in these images. For instance, in order for the super-imposition of projections to happen, a series of changes along the path had to take place: different actants had to activate the potentialities in others, so as to resonate with them; groups had to come physically closer, acting and modifying their collective actions.

The superimposition of the projections was possible because of the distributed agency of actants, and their ability to collectively practice their *becomings* while experiencing and participating in the textures of multi-dimensional fluid assemblages. Projections, people, floor and other actants functioned as flowing matter [10, 11].

Every group in the video walk participated in an overarching assemblage; each group was an assemblage in itself too, and each person was another assemblage made of bones, hair, clothes, gadgets, biota, and other things. Different aspects in the actants needed to be activated so they could participate of different assemblages.

The capacity of being part of several assemblages simultaneously is possible because the boundaries defining the assemblages are permeable, porous [1]. And depending on which characteristics are activated in the actants, different assemblages will emerge, some may dissolve while new territories may open up [5].

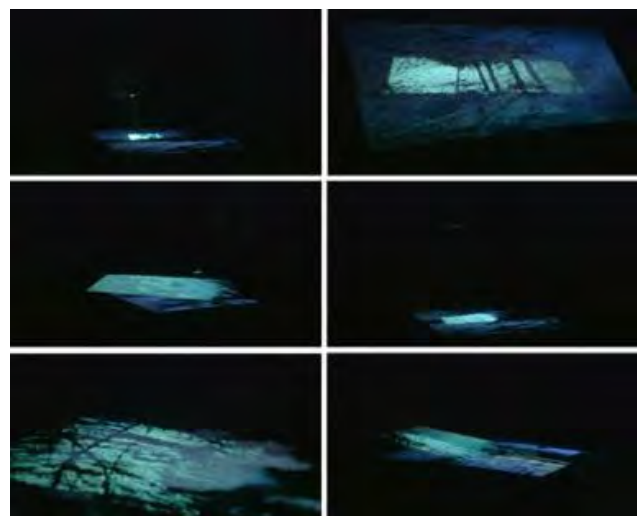


Figure 6. Video walk (collectively led): (*wh*)ere land. Series of images featuring combined projections. Image: Kao.

Striving to rebalance

It seems that the balancing of the relationships between technology, environments and people is dependent on our ability to apply post-human and vibrant materiality discourses, object-oriented philosophies, assemblage theories and meshwork approaches to our everyday lives and our creative and technical endeavours.

An avenue that has not been explored in this paper, but which has great potential for contributing to the building of a collective ecological sensibility towards things in our environments is Hartmut Rosa's notion of *Resonanz* [22]. He proposes slowing down and bringing actions, things and materials together, leaving aside desires for instant gratification and making an effort to finding time to explore the relationships between things around us in depth, and in particular their resonance.

As discussed in this paper, each thing is irreducible and has a unique set of relations and potentialities which need to be activated and enacted. Things *are* in relation to one another and do not have a fixed place in the world because they are like vessels constantly negotiating their relations of exteriority while participating in complex yet delicate assemblages of constant *re-territorialisation* [7].

Not only in everyday life but also in our artistic practices we need to reconsider our associations and relationships with materials, environments and the things within them. Since we *are* in relation and make our environments through action, and things (us included) are made of relations and potentialities, it would be fruitless to distinguish between humans who actively construct environments and other things in those environments (i.e. non-human) because they and we are enmeshed: we are a multiplicity, "*an array of bodies*" [1], some are made of flesh while others are made of materials or are simply immaterial. What is clear is that we, as much as the video walks, are part of fluid evolving assemblages where actants and actions modify each other. Therefore, we need to attempt to discern the resonating qualities of the materials and things that are both external and internal to us so that we can be on a level playing field and exercise our relations of exteriority horizontally with things.

Conclusions

The portable projectors used to co-produce the video walks offer opportunities for things to mingle, relate to and modify each other. Although human actants operate the projecting devices, the assemblages and hybrid digitotangible environments created through these projections are made of fluid and constantly negotiated relationships between material and immaterial things.

The projections bring the content out of the screens of portable devices and the *cocoons* they offer, and embed the content into the changing textural qualities of fluid environments where they can be shared, explored and co-created (Figure 6). The counterargument may be that portable projections somewhat litter the environments in which they are presented. Dark urban parks where other bodies and things go about their everyday existence may be affected by minor and temporary light pollution caused by the projection device.

Projections cannot counteract the primacy of screen-based communication, but can bring people closer to the textuality of their environments, to slow people down and highlight the subtle and changing characteristics of the things and the world around them. Projections can support the creative exploration of horizontal relationships between actants and reconnect actants with the flows of environments as they walk and create their place in them.

The question remains: what is it that artists, researchers, and educators can do to rebalance media in environments. How can we use our expertise to inspire the coming generations to side with materials and things as partners in environments, instead of viewing them as external and disposable? If our practices do not resonate with materials and things we are lost, but if as Massey's sheep we highlight that we are "not lost" and that we know exactly where we are: "right here" [20], then with our presence and the actions we perform in relation to other actants we might be able to move towards a rebalance.

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In collaboration with Dave Murray-Rust, she won the British Computer Society A.I. Award (Lumen Prize 2019). She is part of two large research projects: Playing A/Part & SOCORRO. She obtained her PhD and MSc at University of Edinburgh (UK), and her BFA at University of Barcelona (Spain).

She has presented her artistic, collaborative and research work in venues such as ZKM, IBM, Scottish National Gallery, EISF, NTAA, MAN-Singapore, EIF, National Museum of Scotland, Talbot Rice Gallery, Margate Festival, I-Park (US), ACM CHI and C&C, EvoMusArt, Leonardo, ISEA, AMPS, and NECS.

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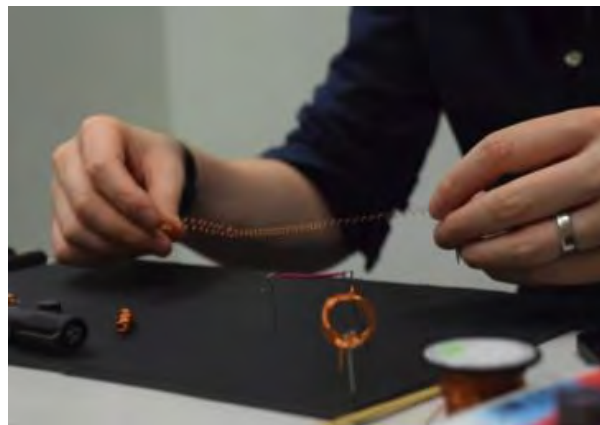


Figure 7. Making with materials and flows, workshop series. Image: Jungenfeld.

Queer Communication: Human-Nonhuman Encounters

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Abstract

In the times of Anthropocene, with global pandemic and climate change, it is necessary to investigate narratives that show respect and accountability for all forms of life. In this scenario, the research for interspecies communication reveals other ways to promote human-nonhuman encounters that overcomes a past of human mastery over nonhumans. This research analyzes how interspecies communication can be conceived beyond language. Moreover, it also analyzes how those communications can be understood as queer. The source of investigation is the series of artworks *Wombs* (2018-2019), by Margherita Pevere. The artist searched for bonds between her body on hormones, from taking birth control pills, and two different species, bacteria (asexual) and slug (hermaphrodite). The queer communication in *Wombs* talks about disrupting the opposition nature/culture and man/woman in interspecies encounters while articulates more equalitarian narratives that are accountable for human actions.

Keywords

Interspecies communication; queer; nonhumans; humans; bio-art; contraceptive pills; sexuality; nature.

Introduction

The format of human bodies, bipods with small teeth and large brains, differentiates biologically *Homo sapiens* from other species. The political differentiation between what is human and what can be considered nonhuman, though, might raise some doubts. The philosopher Isabelle Stengers comments on the problems of defining nonhumans. The particle “non” can give the idea of negation as if nonhumans are the negative of humans. [1] It indicates that nonhumans are all that humans are not. For Stengers, the definition of nonhumans is attached to the definition of humans. Some authors might base on culture, history, arts, and language, to delineate the boundaries of what is human and what is not. [2] What determines humans is the very idea of being able to define ourselves as humans. [1]

However, serious researchers show that being human encompasses, most of the time, the subjugation and exploitation of nonhumans by human mastery. [3] For instance, animals are also largely incorporated in biotechnological research for the development of drugs, cosmetics, agriculture, and biomaterials. In some cases,

nonhuman lives are disregarded in face of human lives. [3] Therefore, the dimension of what is human goes beyond the idea of segregation from the rest and should also represent the consequences humans bring to all forms of life. An encounter between a human and a nonhuman should not be about praising for their differences, but the search for equality.

When it comes to communication, the encounter between humans and nonhumans can also reassure the human mastery over nonhumans. This research aims to investigate new ways to communicate with nonhumans beings besides verbal and written language. From the identification of the parts that compose a communication system, to the analysis of nonhumans beings as capable to communicate, and the identification of differences that unities humans and nonhumans, it is researched interspecies communication that is queer. The study cases are the artworks *Wombs* (2018-19) by the artist Margherita Pevere. The first artwork, named W.01, is a culture of bacteria in a growth medium made with hormones subproducts and residues extracted from the artist’s urine (fig. 1). On the second one, named W.02, the artist cultivated on the same growth medium her vaginal epithelial cells and slug eggs (fig 2). The last artwork, named W.03, is a series of photographs registering a slug sliding through the artist’s skin (fig 3).

These artworks were chosen since the artist promoted encounters between her body, or its subproducts, and nonhuman beings, while she was administrating contraceptive hormones daily. The artist is changing her body from the inside, but the contraceptive pills also introduce in the discussion biological, sexual, social, political, and economic issues. Moreover, the pills are analyzed as a medium source that facilitates interspecies communication in *Wombs*.

Sexual hormones are the bridge to connect the research with queer studies, however, it is also investigated other queer aspects in *Wombs*. The research proposes new connections between different fields such as communication, animals studies, media art, contraceptive hormones, and queer theory. It expands queer beyond sexuality and gender issues by including nonhumans in the discussion. According to Birke, Bryld & Lykke, feminist

studies lack connection with studies of human/animal relationships. [4] Thus, the relevance of the research is based on the construction of new knowledge that emerges from the intersection of feminism, communication, and animal studies. The definition of queer communication and its integration with different academic fields will strengthen the discussion about the multiple possible speeches and acts among humans and nonhumans.



Figure 1. Photograph of the artworks W.01 exhibited at Art Laboratory Berlin in 2020. From *The Camille Diaries: New Artistic Positions on Motherhood, Life and Care*, by Art Laboratory Berlin, n.d., <https://artlaboratory-berlin.org/exhibitions/the-camille-diaries/>. ©Tim Deussen.

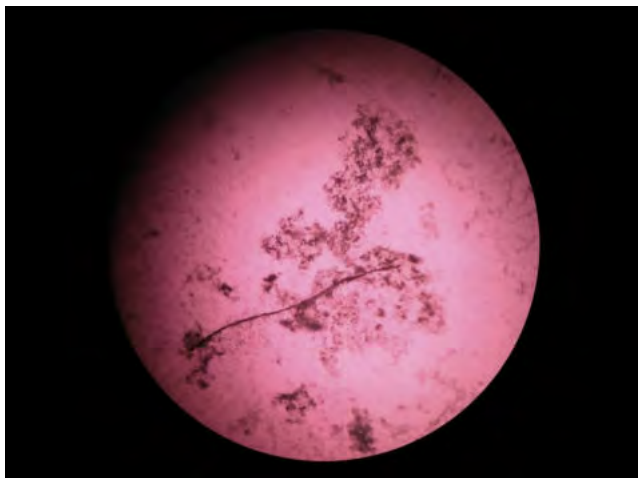


Figure 2. Microphotograph of the artwork W.02 on the exhibition *Extravagant bodies*, at KONTEJNER, Croatia, during 18-22/9 of 2018. From Pevere, n.d., <https://bit.ly/3ujv8jx>



Figure 3. Photograph of part of the artwork W03, in which the slug slides on the artist's skin. From *Wombs*, by Margherita Pevere, n.d., <https://bit.ly/3ujv8jx>

Methodology

The methodology used in the research encompasses discourse analysis combined with semiology. A discourse analysis tries to unveil new relations between objects and subjects. It does not consider preexisting relations and understands that those relations can be built in the discourse. [5] The semiotic analysis, in its turn, evaluates the aspects of an image, in which the meanings of that image are produced. [5] The semiotic analysis, thus, was used to withdraw meanings from the visual aspects of the artworks that would add to the argumentation for new discourses.

The analysis used as a primary source of information the description of the artworks *Wombs* on the artist's website, the presented photos of the artworks, and an interview with the artist. The research, therefore, investigated the artworks W.01, W.02, and W.03 as queer communication. The theories used range from communication, media theory, feminism, and queer studies, to post-humanist animal studies.

The investigation begins with the analysis of the bio-artworks *Wombs* as communication between humans and nonhumans. The communicational aspect of this series of artworks was analyzed from the mathematical theory of communication, media studies, and animal studies. While the mathematical theory offers a direct understanding of communication, the media art theory addresses a bio-art investigation. At the same time, the artworks involve nonhumans animals, and microorganisms, the reason why the communication was also analyzed within the frame of animal studies.

In the analysis, it was researched how the hormones mediate the communication in *Wombs* and how they introduce queer theory. Moreover, it also mapped the queer concept beyond gender and sexuality issues while applying it to the artworks. Therefore, it investigates queer as the main feature of interspecies communication in *Wombs*.

Interspecies Communication

The mathematical theory of communication defines that information must travel from the source to the destination. [6] This theory helps us understand that communication is the transmission of a message from one end to another. ¹ To understand the artworks of *Wombs* as communication, it is necessary to analyze which role can be designated to each part according to the mathematical point of view: source, destination, transmitter, channel, or receiver. Therefore, it can be interpreted that the parts performing communication in *Wombs* are: a woman, the artist, and two different nonhumans, a slug and bacteria. In each artwork, there is an encounter between the artist, or the subproducts of her body, and nonhuman life. The analysis of the parts communicating comes from that encounter.

In artwork W.01, there is no direct encounter between the artist and the bacteria. The visual aspects of that semi/living sculpture also do not reveal the presence of the artist. The encounter between the artist and the bacteria happens inside of the sculpture, once the bacteria live in a growth medium made from the artist's urine. Therefore, in this case, the artist is represented by her urine. The bacteria and the artists are the two endings of the communication in W.01, source, and destination.

On the artwork W.02, as in the case of the artwork W.01, it might not be easy to visually identify the parts communicating. The artwork W.02 also encompasses a semi/living sculpture that is composed of a microscopic encounter between human cells and slug eggs. The artist stated that she intended to create in W.02 a strange womb, made by human cells, for the slug eggs. [7] The artwork W.02, therefore, is an encounter between a human and a slug represented by their cellular material.

In the artwork W.03, by what is depicted in the photographs, it can be assumed that the communication happens between the artist's skin and the slug's skin. It is an encounter between the artist and the slug in their natural body and shape, therefore, they are the source and destination of the communication. However, the interspecies communication in *Wombs* does not account for a transmitter or a receiver. It is proposed as a simplified version of the communication, in which there are just sources, destinations, and the channel, or medium. This is because those artworks are an encounter between human and nonhuman life, and, to assume that some parts code and decode the message would mean that it is known which types of signals they are transmitting. It is not possible to access signals that nonhumans beings transmit, and any trial of that would mean anthropomorphizing more-than-human lives. Moreover, I cannot account for the signs the artist

transmitted. It is considered, then, that between the human and the nonhuman there is only one medium to transmit the message. However, before analyzing the medium, it is necessary to investigate if communication between human and nonhuman life is possible.

Macroscopic Communication

Cary Wolfe studying language, representation, and species, correctly states that, for a long time in human history, philosophers have wrongly connected intelligence as exclusively human. [2] Since the Enlightenment animals are defined as inferior beings to humans based on presumptions such as the lack of a universal system of communication and lack of reason and logic. [3] Most of the human superiority ideology over nonhumans comes from the Cartesian concept that only language is capable to represent mental ideas. [2] However, as Wolfe correctly argues, language cannot exactly mimic our thoughts or express what we are thinking. [2] Meanings of words and sentences can change according to the context of the conversation, the interpretation, and so on.

The analysis of nonhuman beings, such as slugs and bacteria, as intelligent entities that lack language, comes with the disruption of the association of language with a capacity for thinking, which means that they are capable to communicate in other forms besides language.

On the other hand, communication with other species is not about teaching them human language. [8] It is also not about giving them agency to respond to humans nor addressing anthropomorphized features to them. [9] The philosopher MacCormack states that some animals can learn how to enunciate words, and even how to communicate with some meaning, but it is done by mimicking the humans' masters or by choosing words that we can understand and make sense of. [9] Humans often give voices to animals or speak on their behalf. [9] In this sense, they take the agency out of the animal and pretend to be them. [9]

MacCormack is critical of human encounters with nonhumans and advocates that we should step away and let the animals be themselves. [9] However, it is not always possible to avoid human mastery over nature, especially in the analysis of bio-artworks that deal with life. Humans must stay always conscious of the bioethical dimensions when dealing with other forms of life. Therefore, it is important to deconstruct some notions of interspecies communication to avoid speaking on the animals' behalf or reinsuring human mastery over animals due to our social and linguistic abilities. It is necessary to explore more ways to communicate with nonhumans animals than verbal signs. It is necessary to expand how the act of thinking can be imagined, to possibly understand that animals can respond,

¹The mathematical theory considers communication a physical system that produces discrete signals. It is used to analyze written languages, such as English, and electronic transmitters, such as television signals. [6] The artworks of *Wombs*, however,

encompass encounters of organic life, and not electronic components nor written languages. Therefore, the mathematical theory of communication was approached only for the identification of the parts that compose a communication system.

they just have other ways to do so, or, other ways to communicate besides language. [2]

Communication can be understood as a transmission of messages that goes beyond the words of humans. It can be an encounter with others in which humans and nonhumans are closely embedded, showing each other's vulnerability. It is about purposely approximating the human to the nonhuman to unpack their relations and communicate with them equally.

Considering hearing or touching forms of communication can be useful to propose the de-hierarchization of language as a representation of communication. [2] The ability of animals to communicate can be related to their ability to respond to sounds or touch. Intelligence can be correlated with the ability to apprehend with the senses the information on the surroundings. [8] In this way, intelligence to communicate is more than being able to speak words.

Touch, for instance, can be understood as a way for animals to get information from their surroundings because it is an encounter between two different surfaces. [10] Humans' and nonhumans' skin has sensory terminals that allow haptic feelings. Touch is a non-hierarchical way of arguing for interspecies communication because, contrary to language that is understood as exclusively human, touch is the sense located throughout the body of all animals.

The communication in the artwork W.03, thus, happens in the encounter between the artist's skin and the slug's skin. The slug is intelligent enough to communicate by the simple fact that it can slide through the artist's back. The fact that the artist stayed in silence while the slug slid on her back, is an interesting point to understand the lack of words as communication. Nothing was said between her and the slug, nonetheless, they spoke the same language: touch, an encounter without words, and at the same time loaded with meaning.

However, I cannot address any intention in the slug's movement nor state what the slug wanted to say because I speak from the position of a human. At the same time, this is not a biological study to analyze how slugs feel the touch or the difference in surfaces when moving. The analysis of the slug sliding through the artist's back as communication by touch is based on the fact that the slug and the artist are capable of touching each other. It is not possible to state what is being exchanged without anthropomorphizing. However, the silent communication by touch is a homogeneous process that happens in the same way with both artist and the slug. They touch each other, they feel each other in a macroscopic communication.

Microscopic Communication

Donna Haraway investigates the transformative power of touch as capable to provide information in an interspecies encounter. Haraway argues that one cannot know much about a species before an encounter, once both humans and nonhumans are shaped by the encounter. [11] The philosopher states that the nonhumans, and humans as well,

become who they are "in the dance of relating". [11] This dance defines an embodied communication that goes beyond words, "which takes place in entwined, semiotic, over-lapping, somatic patterning over time, not as discrete, denotative signals emitted by individuals". [11] Therefore, the embodied dance made by touch is an interspecies communication, in which signals are transmitted through the flesh.

The philosopher states that touch regards the others inside of us, especially because our DNA contains the same genome found in bacteria, fungi, protists, and animals. [11] According to Haraway, we inherit in our flesh the other whom we touch. [11] This concept is very useful in the analysis of artwork W.02, once it encompasses human cells and slug cells in close contact. From Donna Haraway's approach, the encounters of those different cells communicate on their most intrinsic level: the touch of their materiality. They do not constitute flesh, however, they are in the previous state of the tissue. Like flesh, the tissue has the same basic structures that encompass all living cells. The signals they emit are basic life signals. Their communication, therefore, is on the biochemical level of sharing nutrients. They communicate with each other to survive on the same growth medium.

In the artwork W.01, the artist dealt with bacteria, which are not animals nor tissue. Besides that, there is no direct touch between the artist and the bacteria. Nonetheless, W.01 can be understood as communication from Haraway's concept of embodied dance if we consider not touch, but nutrition as the entwined signals between the bacteria and the artist. That approach is also explored by Haraway, whom unite species "at the table". [12] According to Haraway, those encounters can have different aspects: "... parting bites that might nourish mortal companion species who cannot and must not assimilate one another but who must learn to eat well, or at least well enough that care, respect, and the difference can flourish in the open". [12] In the case of W.01, the encounter between the artist and the bacteria can be understood as the assimilation of the artist's excrements by the bacteria, in which the artist cares for the bacteria to flourish. They embody a dance that starts with the artist taking the pills, the pills being digested, its subproducts excreted, then refined, and serving as "food" to the bacteria.

The encounter of the bacteria with the artist is not at the table, but it is connected with parting bites of the same element: hormones. The bacteria are in a symbiotic relationship with the artist by eating the same molecules that were once ingested by the artist. Her excretions are part of the bacteria formation. By using the artist's excretion to survive, the bacteria are performing a very close embodied dance with the human. The rests of one are the continuum of the other. Their touch is made indirectly, not in the flesh nor the tissues, but among unitary entities. The artworks W.01 and W.02, therefore, represent a microscopic communication.

Hormones as media

The same element that the artist and bacteria share the nutrition, is the medium in which they communicate with each other. In the case of W.01, it is easier to argue that the media in the communication between the artist and the bacteria are the hormones because their subproducts constitute the growth medium. When describing the artwork W.01, the artist states "Its culture medium is infused with hormones metabolites and residues extracted from my urine by re-staging scientific methods". [13]

In the case of the artworks W.02 and W.03, though, it is necessary to deeper into the analysis of a biological medium. The agency of a biological medium is different from the agency of traditional communication media. In life sciences studies, according to Hauser, the medium is understood as "milieu and ambiance". [14] The biological media, therefore, encompasses a biological structure that has a direct impact on life. It can also be defined as "existential media that surround a body or enable its internal functions". [14] The biological medium allows the artist to create semi-living structures in a different milieu as they are seen in nature. [14] Hauser argues that this is exactly the characteristic that artists working with bio-art want to emphasize. [14] In the project *Disembodied Cuisine* (2004), for instance, the artists Oron Catts and Ionat Zurr manipulated the biological medium to grow tissue-engineered steaks from frogs. [15] They worked with the biological medium to create new semi/living structures.

In the case of *Wombs*, the contraceptive hormones control internal processes inside of the artist's body. They trigger biochemical changes inside the cells in the artist's body. The hormones are dissolved in her body, they are part of her body. They are present on her excretions, be it urine or sweat. The focus on the artist's body lies in the fact that she performed with it in artwork W.03 and collected her vaginal cells for artwork W.02 while making daily use of them. Therefore, the hormones can be understood as biological media as defined by Hauser because those substances alter the artist's body and its functions.

However, when the artist takes her daily hormone and creates a series of artworks to interact with nonhumans, she is not only preventing pregnancy or changing her body from the inside but also bringing to the stage sensitive topics related to birth control pills. Contraceptive hormones carry strong messages about sexuality, heterosexual dominance, reproduction, responsibility, power, and justice. [16] The biological and social issues introduced by the hormones are part of the analysis to understand the interspecies communication in *Wombs* as queer.

The hormones as a medium introduce queer aspects to this interspecies communication. Sexual hormones have the potential to disrupt the sexuality in humans and nonhumans' bodies. [16] The toxicity that sexual hormones introduce into the environment is one of the problems of the Anthropocene. As subproducts of pesticides, plastics, or

even due to the large world production of synthetic hormones, they are accumulated on the soil, the water, and on the body of animals and plants we eat. [16] Biochemically speaking, hormones are "endocrine disruptive compounds" (EDCs), or, chemical components capable to induce morphological and sexual changes. [16] An excess of sex hormones can cause cancer, and sexual consequences such as infertility, low sperm count, feminization of boys, and so on. [17] Di Chiro presents study cases in which excess hormones in the environment led to problems in wildlife development and reproduction. [17] Those researches demonstrated that an excess of estrogen can transform some animals into intersex, infertile, or hermaphrodites. Therefore, other sexualities, besides heterosexuals and homosexuals, come into play. These consequences were observed in frogs, fishes, and salamanders. [16] Malin Ah-King and Eva Hayward commented that studies on the effects of birth control pills on sea snails showed that they became intersex, with both male and female sexual organs. [16]

The modified bodies from hormones' disruption can be considered queer bodies because they deviate from what is assumed as normal. The hormones are capable to transform "normal" bodies into queer bodies. [16] According to Di Chiro, queer bodies are considered abnormal bodies. [17] To call a body abnormal is to give voice to heterosexual fears. The fears brought to society concerning hormones are the ones that harm heterosexual values. The sex division between male-female and the transmission of genes to the offspring is considered endangered. The diverse sexual orientations we see flourish nowadays are seen as a threat to heteronormativity.

Therefore, the narrative to call this series a queer communication lies in the fact that hormones can produce bodies that deviated from the norm. Those bodies inspire fear of the heteronormative values concerning sexual disruptions. To name transsexuals or feminized men as a queer product of hormones disruption is to apply a social discourse that categorizes those bodies as abnormal. Therefore, the queer discourse in *Wombs* is also present in the parts that communicate. The bacteria living on a glass full of hormones subproducts, the slug by its hermaphrodite nature, and the artist administrating sexual hormones can be considered queer subjects.

Queer Communication in Nature

The term queer has different definitions according to the context and the era [18]. According to Marchyshyna and Skrypyk, queer can be understood as a language sign, as a social construct, and also as a philosophical phenomenon. [18] Moreover, the authors also comment that queer theory comes from sexual and feminist studies, but its concept was expanded to other areas of social studies and even to scientific research. [18]

The scholar Karen Barad expands queer beyond sexualities and ontologies and applies it to nature. For Barad, nature is queer by itself, but not only because many animals can express homosexual behaviors. [19] According to Barad, it is simple to define queer concerning sexual and gender expressions, between heterosexuals or homosexuals, but it is necessary to think queer as a natural expression of different subjects, objects, phenomena, causalities, agency, and rationalities. [19] All of these differentiations are entangled in the web of nature. [19] Nature is queer by itself because it encompasses all of the different forms of life and expressions possible. [19]

Barad correctly affirms that the entanglement of one entity with another is more than an interconnectedness, but a specific material relation of obligation with that another, for those relations bounds one and the another. [19] That entanglement shows the differentiation among entities in the world. The differentiation for Barad is essential to hold things together. [19] The author comments that such separability does not work to build hierarchy or domination. [19] Queer in nature can be understood as this differentiation, which the scholar also calls discontinuity. [19] It is a discontinuity because of the infinite possibilities of expressions and entanglements. Nature is queer because all of its entities are different from one another, and that differentiation is what constitutes the entangled web. Queer is in all places. [19]

Based on Barad's approach to nature as queer, the encounters between the artist and the nonhumans in *Wombs* can be understood as queer communication because in such encounters both parts open their flesh to each other. Those flesh relations in queer communication do not make separations but open both bodies to the infinite possibilities of entanglement. They cut things together because, at the same time that they reveal the distinctions between humans and nonhumans, it is at the moment of touch, flesh encounter, and nutrition that the connections between them are made.

Barad gives a very good example to illustrate how nature is a queer discontinuity, concerning how the lightning phenomenon works. The lightning does not appear in the sky and runs upwards, as we conceive in common sense, or as our vision shows us. [19] In the lightning, the light travels both upwards and downwards at the same time, with no pre-information from the location where the lightning will happen. [19] Lightning, therefore, is an example of a queer phenomenon, one that is uncertain, and discontinuous. She compares this electric act to a conversation, one that gets ahead of itself and happens at the same time that it ends in a place that is only visible once it happens. [19]

Barad's example of queer performance on nature is another way to analyze queer in the interspecies

communication in *Wombs*. The comparison Barad makes between the lighting and a communication process gives us more insights to define queer communication beyond the sexual and gender aspects. As in the case of lightning, in which the particles come from under and above, the message in the queer communication comes from both endings and reaches each other. Both parts, artist and slug or artist and bacteria, become destinations and sources, but not in a feedback system, in a simultaneous system.

In the artwork W.03, the artist placed the slug on her back while she was laying down facing the ground. They did not interfere with each other's process to communicate. Moreover, the artist stayed in silence during the performance with the slug. Therefore, it is possible to compare this artwork to a queer communication as conceived by Barad.

In artwork W.02, there is no information that the human cells took over the slug eggs in the growth medium, or vice-versa. In that sense, it is possible to state that neither the human cells nor the slug eggs interfere with each others' messages. Moreover, in W.02 the cells are considered a source of the information in the communication process. The presence of hormones in the human cells, and the fact that they can alter the milieu, open to vulnerabilities in humans and nonhuman bodies. In that encounter, the artist's cells and the slug eggs are exposed to each other. Both send their biochemical signals to live and to die.

The hormones as a medium in those communications, therefore, also play a role in unfolding human and nonhuman bodies to their vulnerabilities. This can be better approached in the case of artwork W.01, in which the communication in W.01 happens at the level of nutrition. The bacterial agency lies in the capacity to survive or not in the growth medium. The bacteria need to digest the medium to communicate back to the artist. Bacteria dying or flourishing is their way of communicating back to the artist. Therefore, even though the communication in W.01 does not happen with simultaneous transmission of a message from the bacteria and the artist², both parts are intrinsically depend on the hormones.

This analysis introduces another dimension to the understanding of queer communication in *Wombs*, combining the encounter between human-nonhuman in touch, flesh encounter, and nutrition mediated by the sexual hormones. Compared to the case of the lightning, which represents a discontinuity in the way the light travels, the discontinuity in the communication in *Wombs* happens because, in the encounter between the human and the nonhuman, both parts send messages in uncertain and distinctive ways. The hormones as a medium open the human and nonhuman bodies to different vulnerabilities, but their message encounters a mist of survival, co-sharing, caring, and simply being themselves. No matter how

² In the case of the artwork W.01 the communication between the artist and the bacteria can be understood as a monologue of human domination, and that is not because the artist cultivated

bacteria but because she cultivated them on her excretion. Nevertheless, the bacteria still have the agency to reply, which is by living or dying.

different humans and nonhumans are, queer communication uses those differences to argue for equalitarian encounters while showing that different entities can share the same susceptibility to a common substance. In the end, more things unite us to nonhuman than set us apart.

Conclusions

The use of distinct theories in the analysis showed the complexity of the research question. The research connected interspecies communication with mediation by hormones and queer theory. However, *Wombs* encompass a series of artworks that afforded links among different areas of study. Based on the analysis of the artworks from *Wombs*, a human-nonhuman encounter can be understood as queer communication that addresses not only sexual and gender issues but also conceives nature as queer. Sexual hormones have the potential to disrupt sexuality in many species. The artist's queer body and the hermaphrodite slug defy the heteronormative society, which is also part of the queer rhetoric.

The analysis of the encounters between human-nonhuman as interspecies communication that materialized on touch, flesh encounter, and nutrition, was essential to build the discourse of *Wombs* as queer communication. It was also important to comprehend that the hormones can be understood as media because they are biological components that change the milieu in which the artworks take place. The analysis of the hormonal mediation of this communication was also essential to connect the human and nonhuman in more than verbal signs, in queer ways.

The queer communication as proposed communicates the disruption of bodies and theories. The queer communication in *Wombs* goes beyond the lack of language in nonhumans and the sexual divisions in society and nature. It accounts for all forms of life and critically evaluates human interactions with nonhumans. Nonhumans might lack the language or written history. However, an analysis of human-nonhuman encounters made by human theories (mathematical theory of communication, media art theory, queer theory) shows that their differences can generate equality, especially when both humans and nonhumans share the same vulnerabilities to sexual hormones. Queer communication is about transmitting equalitarian narratives in human-nonhuman encounters.

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Museum Practices and Posthumanist Technical and Scientific Assemblages

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Abstract

This paper discusses the potential of computational media and museum collections to enable encounters with the technological present that complicate narratives of progress, modernity and individual (male) genius that often frame the conceptualization of technology in the museum space. It provides an account of an exhibition and associated time-based objects to help anchor a wider discussion of the potential of posthumanist modes of thinking in the museum space.

Keywords

Museum collections, computational media, data visualization, posthumanism, science analysis and communication.



Image caption: *Pocket watch, France, c1810. Powerhouse collection. Neutron tomography created by Joseph Bevitt, Senior Instrument Scientist at ANSTO in 2021 for The Invisible Revealed exhibition. Copyright Powerhouse Museum and Australian Nuclear Science and Technology Organisation.*

Introduction

As N. Katherine Hayles notes in a recent discussion of the ethics and politics of human and machine interaction, there are “alarmingly few ethical frameworks” with which to approach the increasing role highly complex technological systems play in our lives and in the societies and material realities they help shape.[1] In view of the broad problematic Hayles’ words begin to bring into sight, this paper discusses the unique possibilities major museum collections can provide to facilitate encounters with complexity that can generate fresh ways of thinking, fresh exhibitionary and pedagogical practices, and ways of relating to technological mediation that complicate the utopian and dystopian imaginaries that dominate the way the future is envisioned in (Western, anglophone) media-scapes.

The perspective we open here emerges from an on-going collaboration between a museum practitioner employed at a major public science, technology and applied arts museum in Sydney and an academic in media and the theoretical humanities at a large anglophone university in a settler colonial context in Australia. Since early 2019, we have been engaged in an experiment in teaching and research that seeks to bring a practice broadly inspired by posthumanist modes of thinking to the highly stratified institutional spaces we work in. These routinely replicate a set of human centric, progress-oriented narratives of achievement and excellence that privilege certain modes of investigation and ways of knowing over others.

By bringing posthumanist practices to the museum and university, we seek to face the reality that “the human”, or rather, the image of the human as a self-aware, thinking and feeling “I” handed down from the European Enlightenment, provides a lens that is ill equipped to confront the complex, entangled and deeply historical challenges that words such as climate change, decolonialization, technological automation and mass extinction point towards. And against this backdrop, museum (technology) collections, and computational media especially, provide unique access-points to inspire nuanced debate about the intrinsically connected but also highly conditional and stratified “we” the word “human” projects.

Rather than aiming to provide answers or offering some sort of guide to this complex terrain, our paper will seek to pinpoint some of the questions that are materializing and isolate points of complexity and discussion that are evolving in the course of our collaboration and the wider museum practices they intersect with.

Computational Media and Museum Collections Some co-ordinates of a complex problematic

“Computational media”, as Hayles contextualizes the rapid proliferation of computer-based technologies over the last fifty years in her book *Unthought*, “have a distinct advantage over every other technology invented.”[2] Although they are by no means the most important for sustaining human life (Hayles points to water treatment plants and sanitation technologies here) and although they are historically not the most impactful and transformative, (transportation technologies “from dirt road to jet aircraft” are Hayles’s suggestion here), computational media have one distinguishing characteristic that sets them apart from all other technologies: they have cognitive capabilities that invest them with “stronger evolutionary potential than any other technology, [capabilities, which] among other functionalities enable them to simulate any other system.”[3] To say the same thing another way: computational media comprise of hardware and software and have the capacity to translate inputs into data that can be stored and computed. As a pragmatic consequence of this, Petrina Foti notes, “two examples of the same computer-based technology might look identical, but have entirely different software [and we might add: memory], making them two distinctly different objects.”[4]

Museums, as we discuss in detail elsewhere, have traditionally navigated the complex assemblages technology collections represent by reverting to the exhibition of ‘firsts’ or iconic designs, and integrated them into chronologically linear, human-centric narratives of progress, modernity and individual (i.e. often male) genius. [5]

In one of the few articles on the display of computational media, Tilly Blyth, keeper of technologies and engineering at the Science Museum in London, further notes that “traditional museum galleries and exhibitions” have tended to legitimize “ideas of technological progress and [have] fed into the dominant global capitalist narrative, promoting the idea that new information and communication technologies enable us to be more productive and more efficient.”[6] Blyth offers this assessment in her account of the curatorial process that resulted in the *Information Age* gallery at the Science Museum, a gallery that actively sought to counter, reinscribe and counter these narratives with alternatives.

As Blyth elaborates, in a present shaped by hidden material infrastructures, massive server farms that are removed from maps for security reasons, proprietary and highly secretive corporate (and military) research and innovation, “representing the materiality of our information in a museum is particularly important”. [7] Put otherwise, and to frame the inference in our own words: public museums provide one of the few spaces that can spark informed public debate about the constellations of power and technological processes that shape modern societies.

In response to the possibilities museum space opens, it is the aim of our collaboration to develop conceptual frameworks that can help activate the complexity of collections to complicate and reframe human-centric narratives that often still shape the space of the museum.

Significantly, and as discussed in the context of the exhibition and specific objects contained within, this conceptual reframing is taking place in an environment in which the very possibilities computational media, digitization, augmented reality and distributed computing provide, are also fundamentally transforming museum practice. These not only offer new possibilities to encounter computational media by utilizing the very possibilities they provide, but they also promise to facilitate new encounters with the limits of human perception and cognition that thinkers such as N. Katherine Hayles are gesturing toward, with their critiques of the “human”-centered, or rather (patriarchal, colonial and Euro-centric and universalist) modes of thought that center on the individual, thinking and feeling “I” the word human is often associated with.

They do so, precisely by enabling encounters with a shared, deeply historical technological infrastructure that continually creates an at once connected, but radically stratified and atomized “we”, a “we” that is comprised of individuals and users with radically different affordances, levels of access and agency.

But how, and in accordance with what guiding principles and concepts should such encounters be facilitated?

What are the hidden realities and processes that ought to be revealed?

What new methods or practice-based frameworks would be helpful to these kinds of questions?

Through asking such questions we produce situated knowledge dealing with the changing dynamic and intricate flows at play within museum practice.

From a curatorial practice perspective, a cross-section of needs, relationships, research, artefacts, trajectories of thinking, engagements, experiences and/or technologies, and their associated materials, partners and communities, helps us to position public engagements. Through the ongoing interplay and actions of curation and experience multiple

readings emerge. In other words, we concurrently accept unpredictable forces are at play.

In a first step, this paper will provide an account that will show how computational media are being activated in the context of a specific exhibition which was assembled by lead curator Deborah Lawler-Dormer alongside lead scientist Dr Joseph Bevitt from the Australian Science and Technology Organisation (ANSTO) and lead engineer Tomasz Bednarz who at the time of the exhibition was Director of the Expanded Perception and Interaction Centre at University of New South Wales (EPICentre) and Powerhouse Research Fellow. This exhibition (*Invisible Revealed*) will provide a sense of how the museum and scientific actors are activating these practices in a variety of settings including curatorial practice, collection analysis, exhibition frameworks, complex research engagements and creative practice outcomes. In a second step, the paper turns to a conversation between Deborah Lawler-Dormer, the lead curator of *Invisible Revealed* and Chris Müller, who comes to the exhibition as a viewer and museum research fellow who was not involved in its inception, to discuss the wider role of technology. The conversation will also turn to the potential of specific time-based objects in the collection, and this exhibition, by focusing on how a collection item becomes activated conceptually adding an alternative framework to the experience. This exhibition provides a sense of how these practices are set in action in the context of the museum and the wider question of human centrality and marginality.

Revealing the Invisible. How is the Powerhouse Museum activating the possibilities of computational media.

Museum collections, as this is put in a classic theorization of the museal space of exhibition, enable an exchange between the visible and invisible, and as such they provide “access to a realm of significance which cannot itself be seen”. [7] Before we return to this question in the context of our conversation and the collection, we will provide a detailed account of how computational media are providing possibilities that are having transformative effects not only on what kind of realities might be revealed, but also on the collaborative practices museum collections can facilitate.

These possibilities are also transforming a vision of museum practice that “privileges the agency of curators, education officers, architects, and the public”, over that of the object, for computational media provide new ways to position collection items at the heart of a generative process that can give rise to exhibitions and new forms of knowledge, collaboration and science communication. [9]

As Deborah Lawler-Dormer elaborates further below, for all collaborators on the *Invisible Revealed* exhibition at the Powerhouse Museum (26 November 2021- September 4 2022) new methodologies, techniques and findings have emerged, both for internal and external practitioners. The development process from which *Invisible Revealed* [<https://www.maas.museum/event/the-invisible-revealed/>] emerged was intimately bound to the scientific and technical processes and consequently the research and development entailed phases of testing, feedback and analysis. The exhibition and development processes became a site for both innovation and investigation. At its heart, the exhibition begins with the Powerhouse Museum’s collection of more than half a million objects and the many stories as well as the many questions that reside within. Working with ANSTO the Museum has been given time under a partnership agreement to examine objects within the collection to learn further information about the materials, the manufacturing and construction methods, dating, working mechanisms and

their engineering and, in some cases, to look for evidence of contextual or cultural stories that surround the object.

The Museum has been able to examine selected collection objects at an atomic, chemical and molecular level through sourcing beamtime at ANSTO's neutron beam and synchrotron x-ray facilities alongside sophisticated processes relating to specific methods of testing to help reveal answers to long-standing research questions or mysteries that accompanied the collection objects. The resultant data and imaging were combined with digital data visualization techniques to create an engaging and aesthetically striking show. The exhibition narrative profiles how through these non-destructive methods of analysis the museum was able to investigate how objects were constructed, how time pieces were engineered, what historical damage and corrosion had occurred throughout the object's history and proof that such items as a Lydian coin were found to be authentic rather than fake.

As Deborah Lawler-Dormer elaborates in more detail below, *The Invisible Revealed* proved to be a project where experimentation and speculation was embedded into the process. The exhibition was developed in a nine-month period during Covid-19 lockdowns and due to the restrictions caused a level of innovation brought about by necessity. Specific objects within the museum's collection were investigated by ANSTO using their facilities at Lucas Heights in Sydney and the Synchrotron in Melbourne.

This science and technology research and exhibition development journey actively engaged and highlighted interplays between data, the digital and the physical object and temporary exhibition environment. As Geismar notes, the definition of a digital object slips between digital files that themselves serve as their own kind of 'objects' and the technologies (screens, phones, kiosks) that deliver them. She argues that "we need to think about the digital not only as material, rather than immaterial, but also in terms of a trajectory of materiality that links our commonplace understandings of the digital to the analogue, information to material, systems to structures, knowledge to form." [10]

This nexus of states and purposes resides in these newly created digital objects for this exhibition. The digital models remediate our relationship to the physical object by presenting the scientific data embedded in a digital simulation or twin. In so doing the digital object is replicating a knowledge construction specifically of scientific analysis overlaid onto the edifice of knowledge construction held within the museum and its collection. Geismar asks: "As collections themselves shift across platforms, what counts as a real object, worthy of preservation and care, subject to property regimes and the call of sovereignty, is also drawn into question." [11]

Viewed through the framework of this paper, *The Invisible Revealed* is an example of what in Hayes' terminology, would be called a cognitive assemblage. In cognitive assemblages, Hayes explains, "technical components typically filter and interpret data prior to human intervention, thereby deeply affecting what humans see and how they see it; they communicate with other technical devices and initiate cascading effects; they include sensors and actuators as well as databases and networking capabilities; and they make consequential decisions across a wide range of scales and sites that determine not only what will happen but also what are perceived (by humans) as possible courses of action.." [12] As the short introduction of *The Invisible Revealed* has sought to foreground, computational media are not merely being deployed as a tool in the control of a masterly human subject, they are in fact actively involved in a deeply collaborative, curatorial/creative/scientific process that is itself shaped by the material properties of collection items. As

such, this process generates outcomes that cannot fully be anticipated. And the generative limits to knowledge that come into sight here, provide a useful platform for a brief discussion of one particular aspect of the conceptual framework for museum technology collections that is gradually beginning to take shape. Rather than focusing on an exhibition, our second case study will focus on several specific collection items, and the ways they help decenter the human as primary, logical and 'masterly' to the human as "always already evolving with, constituted by and constituent of multiple forms of life and machines." [13]

A conversation: Encountering the Unseeable and the limits of the human perspective.

This paper takes the form of a mutual conversation, which reflects how we work on posthumanist concepts together.

Chris M: I'm a cultural theorist and, as such, I'm often trying to inquire into technologies that are very obvious. In my thinking, technology is conceptualized not so much as a tool, but more as a space of possibility, where the boundaries between our own abilities and abilities that are somehow borrowed or enhanced become blurred.

Just to contextualize for people who are reading this, I was not involved in the exhibition *Invisible Revealed*. I was witnessing its development from a distance as a research fellow at the museum working on posthumanist perspectives on the technology collection. In a really concrete way this exhibition uses these amazing imaging technologies, in a sense, almost as tools, but I also get the sense that it was a journey into the unknown for you all and that it was trying to explore what these technologies could be. Is there a line between this idea that technology is this tool that we kind of control and apply to very specific questions to produce new knowledge and, a perhaps more difficult to define encounter, where the way the technology works is actually shaping the way you collaborate?

Deborah L-D: I would say that this is an interesting project for the kind of speculative space that got set up between levels of expertise and this museum collection. On the one hand we had the museum staff with people like curators, conservators, researchers, technicians and photographers and on the other hand we have the scientific community that was grouped around ANSTO who had expertise around the instruments, processes and facilities.



Image caption: Brooke Randall, Powerhouse conservator, Dr Deborah Lawler-Dormer, Powerhouse curator, Dr Tomasz Bednarz, Powerhouse research fellow at the DINGO facility at Australian Nuclear Science Technology Organisation. Photograph courtesy of Joseph Bevitt 2021 409

We also had an additional collaborator in the team at the Expanded Perception and Interaction Center who were working on data visualisation, photogrammetry, augmented reality and artificial intelligence systems. And it was in the meeting of it all that a sort of evolution of new techniques began to happen in order to get this project on the floor of the museum.

So, in that sense technology was kind of like both a way of developing new knowledge, and a mechanism for us to show that new knowledge to our audiences. This then evolved into a shared performative space that was highly unpredictable due to the level of experimentation in techniques. We were also working remotely and working through teams and zoom meetings and shared digital platforms to evolve the work.

Chris M: We said right at the outset of our paper that traditionally the museum collection has been used as an access point to something invisible such as the cultural context or a certain intangible story or narrative or context. My very open question - is what other kind of wider significance attached to this process, what are some of the meanings and conversations you wanted to make possible with this exhibition?

Deborah L-D: The *Invisible Revealed* grew out of a partnership agreement between the museum and ANSTO, which is an important, although kind of pedantic, place to start. At the core of the exhibition is an investigation into the museum's collection and really looking at objects that we had outstanding research questions around such as what materials the objects are made of, how are they manufactured, what date they were made, what region they might have been made amongst others. For several years we have been using ANSTO's non-destructive analytical techniques so that there's no harm done to those objects whilst trying to answer these questions. The exhibition is moving across the collection, and across many different disciplines, really looking at those mystery objects as objects that we have some quite big questions around. Through the ANSTO imaging and analysis using methods like neutron tomography and carbon dating we are able to get some clues towards those bigger questions. It's kind of like being a detective as you journey with each one of these objects searching for clues.

To answer to your original question, every object in the exhibition had a set of questions that we didn't know the answer to so that was the starting point. We wanted to show our publics how we go about trying to find answers to those questions and show the diagnostics as a form of science communication whilst also being engaging and inspiring curiosity. These objects are so unique and the stories they were telling, and the questions, meant they almost became characters forming a dramatic journey along the way. In fact when we went to build the exhibition, we chose to work with a theatre designer as designer to highlight this notion of a performative space. Then, we had the challenge that we were imaging in various ways the collection through a set of very disparate digital artifacts acquired out of the investigations. Then this kind of very intense collaboration began between Joseph Bevitt who is the lead scientist and myself to bring all of that data together and work on it to animate it and to enliven that required new forms of visualization to be developed. In a way we had to kind

of look at that imaging almost like a choreographer trying to design the movement that we would take through that data that conceptualized the journey, without it being too overwhelming or driving too hard, and too deep into the science.

In doing that everybody developed new techniques so there's a technology innovation discussion overlaid over the whole project. We believe that there are techniques that have never been done before. And so there were moments of excitement during the angst in trying to do this. [laughs] The exhibition was developed in a nine-month period which is a very fast development period for such a technical science investigation.

Chris M: What you just said captures really my excitement of coming into a museum space as someone who's more at home in academic treatments of technology. You know the exhibition in a sense, is showcasing to the public a behind the scenes working and revealing a certain process of knowledge creation and making. The technology and the data visualizations act as visible agents in the exhibition. All the categories that are usually easy to separate in a written text or in academic reflections here become incredibly hard to separate from these vital processes, because when we go back, we create separations, imposing knowledge and uncertain unitary perspectives on them in writing. You are highlighting, if I understand correctly, how collaborative those processes have been and how much the technology itself becomes the space of collaboration. Were there moments where you felt kind of productively stuck, where there were limitations or where you were aware of a certain technological kind of imposition?

Deborah L-D: The data arrived in various forms such as clustered points of data, graphs of chemical composition or single black and white images that were quite pixelated. The first thing we did was take these single slices that travelled all the way through the object and animated them into one sequence. The quality of resolution was still not that great although highly readable and sufficient from a scientific perspective. But as a curator, that imaging is not that understandable to the public. I was asking how can we make this so there's some insight into the facilities, instruments and the various techniques that were being applied to the objects. It was kind of like peeling back the processes of investigation, almost placing the viewer or the participant in the position of explorer and empowering them to discover themselves by giving them a few tools.

We created stations in the exhibition where you could break apart and see what was synchrotron imaging what was neutron tomography imaging and you could see the benefits of what each imaging was supplying. For instance synchrotron was useful for looking at the surface of an object such as glazing or the textures or the warp and weave of a textile. For the neutron tomography it is really penetrating objects and you could see details such as breaks, and glues that had been applied, you could see the bubbles in the clay that were formed at the time of creation. The imaging was digitally refined became quite visceral and aesthetic forming registers of this journey these objects had traversed over centuries.

What was revealed was an interesting way that technology then instigated a sort of dialogue around time, around the past, present and the future that was embedded in these new digital artifacts.

Chris M: So, one of the core points of our ongoing conversations over the last few years has I think been this idea, this question of progress and how technology changes so quickly and makes it possible to do things which would have been unimaginable in the past. It can create this automatic story of progress, I guess, in museums as places where often development is shown, or when something super high tech is matched with something less high-tech creating a sense of advance. I think your story has just unpacked something that to me is equally interesting because it shows a kind of strange continuity. What is revealed through this imaging technology is the absolute complexity of an object that if you just encountered in its everyday, object form would look like the creation of, say, a single person or would look kind of self-enclosed.

An object is a thing often experienced to have very clear boundaries, both in time and space. In a sense, you're revealing the ongoing work on that object over centuries and the way it has been the kind of catalyst for new kinds of production of meaning. Today, in your exhibition, the object is shown as active and productive.

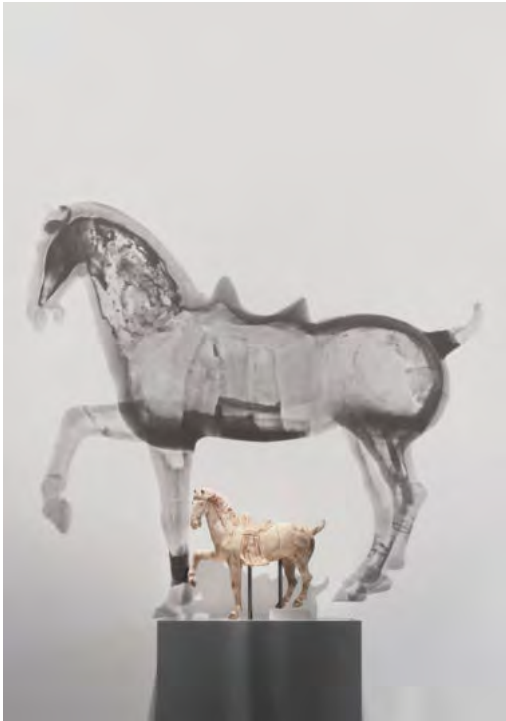


Image caption: *Horse figure from T'ang period, China, 618-906. Powerhouse collection. Radiograph created by Joseph Bevitt, Senior Instrument Scientist at ANSTO in 2021 for The Invisible Revealed exhibition. Copyright Powerhouse Museum and Australian Nuclear Science and Technology Organisation. Exhibition installation: Photographer Zan Wimberley*

Deborah L-D: The horse figure from the T'ang period is a great example because on the outside that horse looks kind of perfect. It looks like it survived the centuries intact.

But when we image the horse in the form of a radiograph what we end up with is a technical vision that's almost entirely opposite to what we are perceiving with human vision. Through neutron imaging what we then see is a horse that has been broken many times and has been patched together over the centuries by different conservators and crafts people. To view it as whole, strong and beautiful but it's actually revealed to be incredibly fragile. We have to build a scaffold around that horse in order to move it because it's structurally so fragile that we can't just handle

and lift. This imaging, for instance, now gives us the information that we know where to build the scaffold to support it. In a way, it's interesting when you look at it from a post humanist perspective. It has its own agency its own life its own kind of energetic experience that is ongoing and is engaged today in active encounters – such as in a neutron imaging instrument, when its sitting on a table having a scaffold built around it with new materials, the way it is then parcelled up being trucked from one site to another, how it moves into a studio to be photographed. I mean it's changing, evolving, encountering all the time.

To recall an earlier part of your conversation there is a practice-based discussion to be had as well. I work in the research part of the museum and we often have academics, who can analyse and tell us a lot about objects in our collection, but one of the things that's often missing from a conversation with an academic is that practice of working with objects on site every day and working in that sort of matrix. Like choreographing a journey through a data set or how you would photograph that object and how you would even photograph its relationship between the physical object and the data set.

Chris M: That's the fascinating thing for me when I think back through your exhibition and the imagery created is that it reveals this complexity, which is actually incredibly hard to represent, you can kind of only become alerted to it. So if we had to kind of narrate the story like you know to think of the person who probably broke off the horses' leg who years ago was probably desperately upset or annoyed by this. Yet centuries later that becomes an important productive component of connection to past centuries that then reveals a kind of limited human story that has been preserved in very interesting ways through the remaining traces.

Deborah L-D: When you were talking about the limitations of technology and how that had been thought about and the process of putting together the show, I was thinking we actually exhibited objects that were part way through their investigation, so we revealed them as partially investigated and we also showed objects that had failed in their investigation.

Additionally, in a museum display you would see this exterior of an object and you can't display the engineering or the mechanism or the way that that object actually works. We created a section of the exhibition which exposes complex mechanisms so that you can start to see the beautiful engineering that's usually inside. It's very difficult to unpack that knowledge. For instance, we have a fob watch that used to play a tune on the hour and if you look at the imaging you can see this very precise engineering that generated sound. The imaging is so precise that if at some point, because of say corrosion or damage we were unable to use the watch, we now hold this incredibly precise imaging, so precise that we could re-manufacture that sound. I would say at this point, this is a speculative experiment, but it would be an interesting one to resound the mechanism using what we can see in the imaging.

Chris M: As you were talking, I started to think of digital technology which allows to somehow edit out the marks of repairation. You could have easily edited these marks out. One of the images is a carpet mended with the help of Artificial Intelligence. I am interested in this generative space between this idea that the digital somehow gives us means

to perfect and also the means to undo. It makes available a different kind of mastery. Do you see this as an extension for the work you are doing with modelling or is it something fundamentally different?

Deborah L-D: I would say that working with digital artifacts is certainly generative. I think this notion of the digital somehow presenting a more perfect vision is not correct. I think at that point there is a decision about what one wishes to show and showing digital imperfection is just as important. In both digital and physical worlds imperfections are in themselves very interesting and engaging.

Tomasz Bednarz is an expert in artificial intelligence and data visualization and by combining these two techniques, we were able to recreate the Uşak carpet from Western Turkey that was really in fragments and be able to get a sense of what it may have looked like in the past. With this new digital data set you can go to any sizing because it's resolution is very high, and consequently you can go way outside the boundaries of the original physical object. When that AI extension was built it moves over a sequence of time and in that sequence of time one could see almost like the stitching of a whole as it moves back and forth between processual states whilst being very sympathetic to the materiality of the physical object, and to the materiality of the digital information driven platform. Tomasz also built an augmented reality experience revisioning half a dozen objects in the exhibition. Photogrammetry models of objects were placed into an augmented reality program which can be accessed through a QR code and online. These augmented reality digital objects are available to people in their homes, and we have got a series of photographs that document these engagements that show the digital artefact having a life in its own performative right. The object has broken out of its case. It is a different kind of engagement that's happening with the object.

Chris M: Yeah it's a wonderful expansion of a space of significance.

Deborah L-D: I would like to ask you a question. So you came to an Open Late which is a themed live night that is run as part of the exhibition program. We had a variety of programs happening including contemporary dancers responding to the exhibition, we had lectures, we had photogrammetry workshops and a large-scale projection in the turbine hall. We sort of took the show and expanded it and it began to populate across the museum.

I was very interested in hearing about your experience of that night and how, when you think about the ways that we have been talking about the exhibition, how you would see this aspect of the project. Going back to the title of the paper which concerns museum practices and post humanist assemblages, how did you see that evening from a post humanist perspective and how the event kind of began to break out of its existing exhibition assemblages into something else?

Chris Muller: I mean, for me it was fantastic to experience the multiple forms of knowledge that run through these objects. It needed that additional aspect like the dancers who were adding aesthetic elements that offered something very tangible and a kind of an emotional transfer between the images that were projected and something very immediately humanizing that added to just looking at or interacting with the digital imaging. I found that

emotional transfer very interesting. The talks from an Indigenous perspective help me really understand and experience an additional complexity that runs through the objects. There was four different people speaking to some of the objects, with four different perspectives including the engineering, the scientific, the curatorial and the Indigenous. All of them came together as an inspiring experience simply from the perspective of a museum visitor. I was thinking how much I would love that this could become a very established genre and format, in which we have these conversations much more frequently. I was very grateful that it also revealed to me some pragmatic tensions and I guess some of the ways that my work thinks about. Like the possibilities that technology makes available and what we can do with it.

I enjoyed the listening more than anything, I enjoyed the learning and the kind of slowing down of that complexity. How does an interdisciplinary practice kind of translate back into an everyday practice because, as an academic I know we have similar kind of events and then you know, sometimes it will kind of pass through our everyday life and not much will happen, but sometimes it really transforms the way in which we teach and deliver our content. It was a very interesting way to encounter an exhibition.

Deborah L-D: I think the experience of having those sort of breakout moments is incredibly influential and necessary to one's practice as a curator and as a researcher and will undoubtedly inform other projects, including with the same partners. Its important to think about what is contemporary museum practice (or any practice) and enable a way to engage in that space where the unexpected can occur.

When you look with these objects, we are moving down to the atomic structures, right up to the external skin dislocated in a Perspex case to protect the object with a screen with the digital artefacts above it.



Image caption: *Pair of 'Lokpala' (tomb guardians) ceremonial figures. Made in China, c.700-750. Powerhouse collection. Synchrotron and neutron tomography created by Joseph Bevitt, Senior Instrument Scientist at ANSTO in 2021 for The Invisible Revealed exhibition. Copyright Powerhouse Museum and Australian Nuclear Science and Technology Organisation. Powerhouse Museum and Australian Nuclear Science and Technology Organisation. Exhibition installation: Photographer Zan Wimberley*

We have often had discussions about technology and time and technology and emotion. In the exhibition there were objects such as time keeping, time capturing and measuring devices such as an alarm clock, a spy camera and a curta calculator that was developed in a concentration camp. These sorts of objects hold an active kind of historical record keeping in a way, but with this overlay of a previous time, previous tensions or heightened emotional stories. I was wondering about the way we present objects in museums today and how this changes the way you are thinking about technology around time, memory and emotion.

Chris M: There's something incredibly fascinating, unsettling and complicated going on when we have these sequences of technology. It's for me always quite uncanny in the sense that looking back we have this incredible narrative imposing structures onto a temporal experience. How technology is restructuring, our experience of time, not simply through measurement but also through marking this passage of time, whilst also addressing in these past structures in these past ways of thinking.

You know, it would be almost impossible for us, I guess, to imagine a world without clock time yet for the vast majority of human life on Earth it's not these mechanical measuring devices that coordinate whole societies.

What becomes interesting when the digital is added is precisely to think so what is being projected towards the future, when we use these kinds of technologies and when we showcase that potential. So, for me this is something that I think the museum is just uniquely able to activate as an experience, because I think there are very few places where we can go to see technology kind of folded back on itself, or one technology used to expose another in a way that isn't trying to sell you a better technology or a different technology.

The place where I find great inspiration in the museum, and in other interfaces that shape our vision, is for me this very paradoxical thing. On the one hand, they give you this enhanced sense of control, insight, and power, on the other hand they normalize and kind of make it very hard for us to see the work that the technology is itself doing on our perception, how it's shaping our body experience and kind of positioning us.

So it's those kind of things I thought about quite intensively. I was especially interested in one exhibition item the tree with the kind of radiation curve that shows a very potent visualization of one of the start points of the Anthropocene as this new age in which you know we're supposedly leaving an inscribed mark on the globe for the kind of radioactive testing. This work shows the complexity of these registers of time. On the one hand, there is the linear time that we try to kind of master. On the other hand, our own acts are continuously continuing to act and are complicating those linear progressions. [14]

I think it is so important that we bear that in mind, and that we experience, those two different registers of time in a dialogue or in a way that it doesn't lead to simple resolution.

I do think there is a wonderful potential that is demonstrated in this collection to say, well, what is this digital moment? The clock you can put in your pocket, and you can kind of own it, which is not true for the technologies that are being used to create this amazing insight into the clock's inner workings. Now, it is processional, it's not a thing that you can pinpoint and say 'Oh, this is the thing

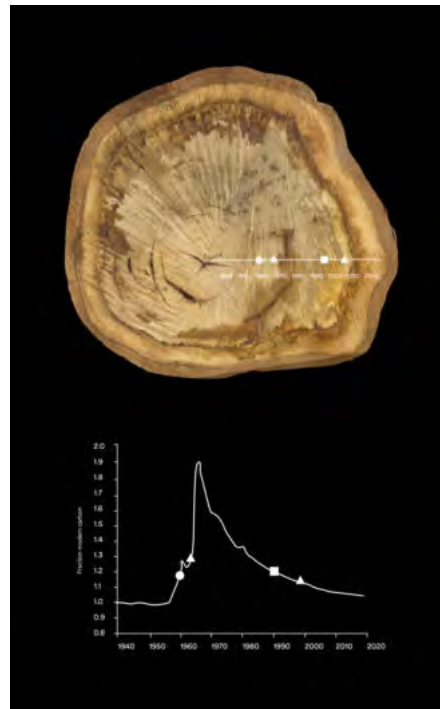


Image caption: Tree sample and animation from Eucalyptus Plantation, Museum Discovery Centre, Castle Hill, New South Wales, Australia, 2021. Powerhouse collection. Photographer Enzo Amato.

that makes it all work.' It is now a very distributed technology that is controlled to various degrees. It has a very different model of sociality that comes with a very different society so that's kind of, I think, for me the exciting potential of this kind of experience. It shows there's incredible continuity, but there is also something happening that is hard to understand or intuit. Change has all this amazing potential, but it also brings about new kinds of blind spots we are finding quite hard to expose, think and talk about.

What I enjoyed about this exhibition is that there is no hiding of that process which is usually so invisible.

The challenge is we are always only shown the end product and we never get to see how it is created, what kind of conversations happen, who the stakeholders are in that. Mainly because its proprietary technology. An amazing illustration of different voices coming together in a dialogue that was to me very productive and uncovering the complexity of these kind of processes and that the people who are involved in that process also matter. Being in that evening event, where it is exactly the qualitative difference between knowing something and experiencing it that becomes very clear. Like experiencing the kind of processional nature of technology and the difficulty to pin it down that precisely.

I think that for me, what I take from your exhibition and I'd like to come back to, is what the space of significance (technology) revealed. For me, it was precisely that complexity becoming more visible. I think, or at least this is my sense that you are letting people experience that complexity, rather than telling them about it. The museum was revealed as a space for encounter rather than displaying a representation.

An ending and outlook of sorts

By bringing posthumanist frameworks of thinking into the museum space, therefore, the encounter with the museal space of significance remains open and evolving rather than leading back to the old vision of social control that gave rise to the museum in the 19th Century. Museums provide unique spaces in which to confront and experience the paradoxes by which human beings are created out of the very technologies that they appear to create.

Acknowledgements

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A Case for Play: Immersive Storytelling of Rohingya Refugee Experience

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Abstract

The displacement of refugees from their natural homes have caused violence and estrangement all over the world, to the detriment of victims who live in unbearable conditions outside their homelands. There's misunderstanding amongst hosts and Western media that see refugees as destructive hoarders of resource. Educating two sides of a refugee-host divide have applied immersive filmmaking following the cinematic 2D approach, portraying static scenes with narratively voiced works that try to put us inside refugee camps to elicit empathy. Instead of this approach, we embarked on a refugee-centered journey-based approach to show the daily lives of Rohingya refugees in Balukhali, Bangladesh using dynamic movements in VR space, spatial audio that surprise, and collaborative filmmaking that involves the participants empowering themselves using 360 camera and phone as tools for exploration. Instead of investigating the hardships of refugees from a Western perspective, we enabled a boy and his family in the refugee camp to create a visual experience that represent their lives. The interactive VR film is an empowerment tool to enable self-expression in a corner of the world that have become used to being the observed as opposed to the observer, taking advantage of VR as a medium for immersion and capability to surprise.

Keywords

virtual reality, 360 film, refugee camp, social empathy.

Introduction

Documenting the truth requires telling stories that faithfully represent the subjects in the way they are affected emotionally, not merely the reality. Thus, showing only the physical destructions of an event would not get at the truth of the way people were affected, both the perpetrators and the victims. However, subjective stories that get at the truth emotionally can be laden with bias. How do you tell subjective stories objectively without agenda? How to represent your subjects in their subjective states?

The medium of Virtual Reality (VR) is a way for journalists to show the assumed natural state of its subjects, by placing a 360 camera where events occur. VR films like Chris Milk's "Clouds Over Sidra" put audiences in a static scene

in the middle of the refugee camp to evoke empathy for the plight of its subjects [15]. But VR fundamentally changes the responsibilities of the journalist filmmaker, as the producer and its sponsor quickly learn to produce material that evokes emotional responses for their own sake, making the viewer emotionally vulnerable due to the high level of fidelity [13]. Because the director steps away from a completely immersive but static scene, we forget that the entire experience is orchestrated to evoke a certain type of reaction under the impression of duplicating reality. Unlike traditional filmmaking in 2D, the entire set is part of the VR experience, so that all arrangements with subjects have to be done well before hand, with mutual understanding.

How do we overcome the propensity to use VR to make agendas? In order to tell subjective stories in a transparent way, we used VR in three ways that remind us of the limitations and ethics of the medium. 1. We aim not to hide the director filmmaker, but to make her a part of the truth-telling, for in making the documentary, we inserted ourselves into the sociology of the environment, so why should we disingenuously hide ourselves? 2. We invite the subjects to make the film, empower themselves to express what they would like, giving them direct access to the audience and allowing them to have agency about being the portrayer and not just the portrayed. 3. We use dynamic movements and spatial audio from surprising sources to explore the VR medium, reminding audiences that VR is telling us a story by the way an actor with agency moves her journey in time, not a static representation of reality.

Together, these methods show viewer experiences that coalesce into stories framed collaboratively by the creator and her subjects, illustrating VR as process of expressive filmmaking rather than description of reality, opening up opportunity for the filmmaker and subject to play together, to involve both parties in the documentary process.

Background

Historical Context To investigate the 360-VR medium as collaborative play, we visited the Rohingya refugee camps in Southern Bangladesh to document a refugee community. The Rohingya is a Muslim group previously living in the Buddhist Rakhine state in Myanmar, with a history of violence that cuts deep into its culture [2]. During WWII, the Rohingya Muslims were aligned with the British while the

Rakhine Buddhists supported the Japanese. After the war, the Rohingya were denied citizenship, after the Myanmar government launched operations to clear the area of the Rohingya. In reaction, attacks were led by the Arakan Rohingya Salvation Army in 2016, leading the Myanmar government to systematically uprooting hundreds of thousands of Rohingyas away from their homes using violence and humiliation. Over 750,000 refugees fled to neighboring Bangladesh, whose government is dealing with massive populations, and wants to prevent further explosion [16].

Photographic images from both sides have appeared that seem to support different agendas. Myanmar officials claim one image supporting ARSA attacking its own village, but later investigation led to identification of Hindu arsonists. Thus there's a need for objective, immersive documentation of the refugees' plight. Refugees themselves do not have means of making films or documenting their lives, making misperception on the Bangladeshi side common place. The public perception in Bangladesh as perpetrated by government-sponsored media is that Rohingya militants are breeding in refugee camps [17], aligning with the reluctance of Bangladesh to absorb the 1.3 million Rohingya amidst the stalemate between the UN and Myanmar. The Bangladeshi authorities have portrayed the Rohingya as militant and self-serving outsiders who seek to benefit from Bangladeshi resources.

Virtual Reality as Medium Humans are uniquely able to empathize not only with other humans, but animals and fictional situations. VR transports humans to a story environment to see the same situation and interact at high fidelity. This generates participatory empathy, which comes from our own experience of the subject, as opposed to affective empathy that comes as an emotional reaction to a someone's plight [20]. Study shows VR results in greater engagement and empathy compared to 2D displays when viewers saw a girl living in a refugee camp [18]. Further studies found greater empathic response to color blindness after a VR experience, facilitating perspective taking [1].

VR allows immersion in other perspectives, but does VR change behaviors enough to drive activism? In study of charitable giving to local aid organizations, VR experiences of a destroyed Middle Eastern city, and not flat monitor 360 video, led to greater number of givers and greater amount of donation per giver [8]. Perspective taking in VR led to a significant increase of post-exposure-experience petition signing at 82% compared to 61% for the 2D screen equivalent [9]. Others have found that dissemination of VR material led to both positive and negative emotion increases that call for behavioral and political change, highlighting the role of VR outside purely immersion [6].

The interaction of human emotion with VR experience is not as simple as one-directional influence, however. Personality traits are correlated with immersion in VR, suggesting that humans have purposeful intention over control of VR experiences [19]. This bidirectional influence ushers in a VR landscape in which storytelling is implicit and based on

a perspective where the environment is set up and configured for self-exploration that leads to its own stories being told, as in interactive games. Future immersive film practices will create spaces and social connections that form empathetic relations without overt, direct narratives [12]. We leveraged this opportunity with VR to create collaboratively empowering work that allows subjects to create their own stories to tell without deliberate narratives.

Virtual Reality as Journalism In the use of VR as a medium for journalistic narratives promulgating peace, viewers are allowed to roam in a virtual world created from 360 photos or videos. UN's VR documentary "Clouds Over Sidra" tells the story of a Syrian girl refugee living in Jordan [15]. Seeing the world from her perspective increases self-reported empathy and emotional response, and facilitates behaviors like willingness to support humanitarian work [6]. A VR film about an Ebola survivor in Liberia [3] led to a 16% rise in donations for Amnesty International.

Immersive journalism provides local populations with technology to narrate their lives, like the works of Fran Edmonds and Grady Walker. In the Shootback Project, journalists gave Kenyan youths \$30 plastic cameras to document their lives for 3 years, empowering storytelling for those without such means [21]. Such work was also done in Tanzania with the Baraza Television initiative. We were inspired to take participatory video-making projects to a more immersive and accessible level with 360 video.

Immersive work with refugees are not limited to 360 video. This includes Al Jazeera's ContrastVR project [14], and *I Am Rohingya*, a play that documents 14 Rohingya youths discussing onstage their lives during the escape from Myanmar [22]. Theatre may be the most immersive form of experience of all since it duplicates the experience with subjects every time the play is performed. Another example of telling the story rather than reality is Khaled Hosseini's immersive animation about the death of a 3-year-old refugee boy who drowned attempting to escape the camp [10]. Drawn in 360, it gives the feeling of the events surrounding the boy as told by his parents.

While these previous efforts utilize VR as an immersive medium, they rely on static shots reminiscent of screen-based filmmaking. Sound is non-spatial, and the camera is stationary. This makes for a static set where the filmmaker is absent from the theme, so that whatever is presented is imaged to be reality. This fails to recognize that behind the scene, the filmmakers have given directions to their subjects, who may be told instructions prior to the shot to maintain the theme, which are unknown to the VR viewer. These experiences tend to be slow and show sad, depressing scenes that evoke sympathy, not empathy. We don't feel like it's the way life is in the camp, but rather the dreary life that we should believe exists there based on what the filmmakers have wrapped up and presented to us. These films use dubbed voices and westernized music, and tend to have beautiful renderings of nature that contrasts with the camp, emphasizing their decrepit state. Point of view of the camera

seldom shifts, in fear of dizziness in VR, and even the equipment that the 360 camera sits on is painstakingly smudged out in post-production, emphasizing the lack of perturbing into the scene by the filmmakers.

However, the filmmakers did perturb the camp, by the existence of the crew and the directions given, for making the 360 film was an agenda that blurred out the true state of the camp the way it was lived in. Instead of this packaged process, can we create a participatory method which involves both subjects and filmmakers, so that the result is an organic representation of what the journey was: that of outsider journalists exploring homes of people they are curious about? Can we get refugees to play collaboratively with us, telling us a version of their own story?

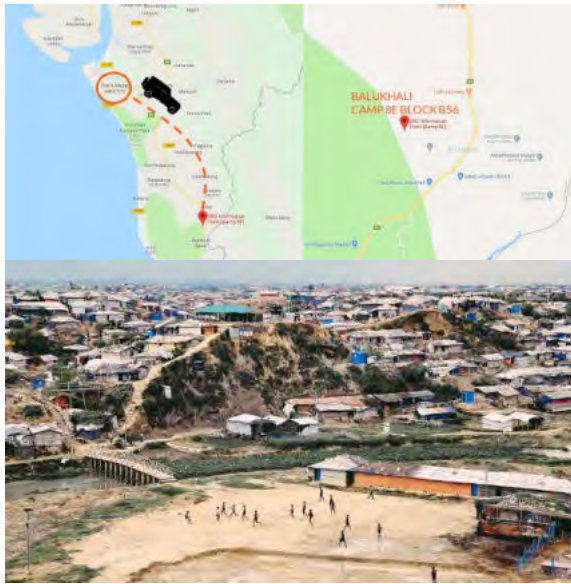


Figure 1: (Top) Rohingya refugee camps in Balukhali, Bangladesh, a 4.5 hour drive away from nearest town Cox's Bazar. (source: maps.google.com). (Bottom) Block B56 of Balukhali. The football field is surrounded by shanty in all four directions.

Methods

We stayed in Cox's Bazar in the month of Ramadan in late May, and visited the Balukhali Rohingya camps by a 5 hour drive every morning, because we are not allowed to stay close to the camps (Fig. 1). We had no power, and must leave before 3pm each day during Ramadan due to camp closure, so only refugees themselves can take videos in the evening. Upon arriving at the area, we climbed up the hills in block B56 to meet the Maji (leader) Salim. Working with the Program for Helpless and Lagged Societies (PHALS), Salim took us to Camp 8E, where we visited two families before deciding to work with the family of Ameena Khatun, who had 10 children--5 sons, 5 daughters. Like most Burmese, the family does not have last names, so we refer to each of them by their unique first names.

Ameena and her husband Ehsan's family came from Pattiya Para, Myanmar during the forced extradition (Fig. 2).

They walked through hills and forests for 16+ days in the heat of the burning sun and in the rain. The children became sick and they had to beg for rice from others on the way. The Myanmar military already burnt their houses down so there was no choice but to go forward. People were seen jumping into rivers and falling from hills, fleeing from the military. They cooked only once every four days, and must rely on these provisions during that time.

One daughter of the family, Shamima, died on the way to Bangladesh. She was vomiting and having diarrhea, with very little to eat, but cause of death is unknown. Because there were so many family members, they had to leave her in the jungle and move on. No one has any mementos, souvenirs, photos, or clothing of hers, because they took no belongings from home. The only remnant of Shamima that Ameena Khatun has is in her memory. Ameena can neither draw nor write, so Shamima's memory will be hard to pass on. The only thing she had wanted was her children's safety, so Ameena has difficulty dealing with this pain to this day. Currently they also lack provisions and clean water, but in Bangladesh at least they do not fear having the light on during Ramadan or fear practicing their religion.



Figure 2: (Top) Select members of the family of Ameena Khatun, including father Ehsan (left), and son Mofizur Rahman (front left), who narrated the VR experience. (Bottom) Children of the refugee camp in the 360 VR production interacting with the short footage they themselves took after using the 360 camera to record some movement associated with navigation using the camera.

To tell the story of the Rohingya refugee experience of the family of Ameena Khatun, we needed to describe their lives from different perspectives, so that audiences can be immersed in the many dimensions of the narratives. Thus we took a multi-disciplinary approach of 1. A narrative film about how Ameena and the family deals with the death of

Shamima, as a way to serve as the lasting memory that otherwise would be lost to posterity; 2. A documentary about empowering refugees to express themselves by teaching them video-making using a phone during evenings at Ramadan when we don't have access to them; 3. A VR experience that takes the audience inside camp life, narrated and guided by Mofizur Rahman, with camera work and playful initiative by Mofizur and friends. For the rest of the paper we will concentrate on the VR experience.

The VR film was shot using a Ricoh Theta V 360 camera attached to a TA-1 3D spatial audio microphone, and stitched and converted offline. Refugee-handled camera work was hand-held, while tracking scenes following Mofizur during his journey were done by lifting a fully extended tripod above the head of the cinematographer. Mofizur and his companions were instructed only on how to hold the camera without obstruction, and allowed to roam freely around the house and to pass off the camera to others. Before recording the main interactions, subjects were given the camera to take a short footage. That footage is converted from two-fisheye view into 360 video format on the computer and shown to the subjects, who could interact with the 360 nature using the computer trackpad (Fig. 2). We then loaded the 360 video into a Unity scene with a single sphere and inverted normal for display on the inside of the sphere. The result is exported to a Google Pixel XL phone for immediate viewing by the subjects as a prototype in VR. They were allowed to iterate as many times as desired before taking the main footage.

Outcomes

Unleashing the Auteur Previous VR films in the refugee camp space exhibit static scenes, passively viewed subjects in narration, and hidden evidence of directorship and cinematography. Our work with the Rohingya attempt to address these issues to produce a more active experience that shows collaboration between subject and director.

Both "Clouds Over Sidra" and "Waves of Grace" contained long, static shots with the camera smudged out so that audiences cannot see the mechanisms of the filmmaking. This technique is especially pronounced in "My Mother's Wing," a VR film about a mother's loss of her children in Gaza [4], which narrates the experience like a traditional 2D film, with long voice-overs. In one moment, a car seat is emptied in order to accommodate the invisible but present audience. The voice-overs are in English and the music is orchestral. Not shown are the filmmakers' involvement and the behind-the-scenes production that led to the naturalistic behaviors shown. Instead of showing the refugee experience in isolation, we recognized that any observational process is inherently transformative of the subject being studied [7]. The moment we arrive at the refugee camp, we are dealing with subject preconceptions of what should be shown and not shown to us. For example, do these filmmakers wanting to make a sad story? Should we show them our sad side? What do they expect refugees to be like? Shall I show them what they want to see? These preconceptions necessarily influence the documentary, so that the supposedly objective

film with an invisible narrator is already impossible upon first arranging such a visit.

Instead, we wanted to show the collaborative nature of such a visit. We are not the only ones observing; the refugees are observing us as well. We should not be the only ones expressing ideas; the refugees have things they want to show as well. The first order of action was to show us not hidden from view but as part of the collaborative process. Instead of objective cameras planted on the ground, we held up the 360 camera with our hands and holding on to our tripods. We played in the football games they play, not hiding from it (Fig. 3). We followed along during the tour, and participated in passing the camera to each other. In turn our camera exists in the scene, not apart from it. The story that emerges is not an impossible attempt to hide our presence, but rather to document how visiting refugee camps occur, and how we learn from each other.



Figure 3: Involvement of the creators in 360. (Top) A scene where journalists are working with documentation of the family while Mofizur Rahman enters with the camera. (Bottom) A scene where the director plays football together with Rohingya children.

Subject Empowerment Current VR experiences reply on filmmakers to provide the context, both in terms of where the film takes place and who we can meet in it. In "The Displaced," a VR film about three children from refugee camps, we get to meet the protagonists but never follow them [11]. We are ferried on a boat we cannot step away from and asked to read subtitles as the protagonists read their lines. When we really want to see the protagonists face-to-face, we are confronted instead with desolate landscapes. What if instead of being a passive subject, we let protagonists take the camera where they wish to take us, and let them dictate the terms of the journey?

To empower the refugee subjects, we took four approaches to making the VR film experience: 1. We gave the family a Samsung phone capable only of taking video and

photo, and asked them to document evening activities when we were not there, and used their content in our documentary and exhibition. 2. We showed them how VR filmmaking works from taking footage to importing to stitching to viewing the binocular result on a phone, then asked them to take the camera around the house and beyond to give us a tour as they pleased (Fig. 4). 3. We followed the subject around as they move about town, so that we with the camera mounted high above us on a tripod, is the follower to the initiative of the subject. 4. We let the children learn about VR filmmaking via demos and then let them pass the camera between themselves, allowing them to see what their presence looks like on the stitched video on the computer. This allows them to play with passing the perspective amongst themselves, and with the audiences' view using their own creative movements (Fig. 5).



Figure 4: Empowering refugee subjects in creating their own voice. (Top) Providing a phone and instructions on use to a family member so that they can be free to document their evenings during Ramadan. (Bottom) Mofizur Rahman giving a tour of his home using a 360 camera as perspective.

The result of this initiative-based filmmaking is an increase in the way the refugees promote their own stories. After learning initially about how their movements in space in the camera translated to a 360 view that evolves in time on the computer and in binocular form in the phone, they began taking the camera to places we did not envision. Mofizur Rahman put the camera high on the cabinet when the family began making Semai cakes, to give us a better view. The children took turns playing with the camera, giving it to each other without choreography. At the football field, following the person pursuing the ball led everyone to follow the camera, and to play with it as if it was part of the game they are orchestrating. When we showed the children the footage they helped to make, they flocked to the computer and marveled at the technology.

Dynamic Video and Audio The static nature of video and audio in VR productions makes it seem as if it's part of the limitation of the genre. Refugee VR films are reluctant to tire the audience, or push the boundaries of camera movements. In "Meet the Soldier" [5] and "Refugees," VR films from Scopio, soldiers running to refugees arriving on harbor is portrayed without a jolt of movement of the 360 view. While dynamic events like shooting and pushing occur all around, the audience is fixed to the ground without a trace of movement. This is used by major VR refugee releases, along with Westernized music that often don't fit. It caters to the eye that is used to cinema: subtitles, fixed camera, sad music. To document the refugee experience as opposed to a sad vision of them (who are happy and playful), we play with perspectives and surprises, to fit the medium to the view of the subject as opposed to our own.



Figure 5: Empowering refugee subjects in expressing their own voice. (Top) Following the trek laid out by Mofizur Rahman as he takes his friends and us around the camp, showing us his favorite places. (Bottom) The children passing the 360 camera around amongst themselves, playing with perspective.

To show dynamic interactions reminiscent of play, we traveled with the 360 camera either on a tripod that we move, or by hand hold. We also enabled static scenes where families are eating or making food, only to have Mofizur Rahman take the camera during the recording and go outside. There are movements in vessels like the vehicle that took us to camp, in refugees taking the camera to places like football fields and kitchens, and in the cinematographer following the subjects while carrying the instrument (Fig. 6). Interactions are unpredictable, such as when children interrupt us from behind, taking advantage of the VR medium to truly use all 360 degrees.

Audio of our VR experience is also dynamically enabled

to surprise and play in 3D. Family members frequently interrupt our movement in following Mofizur Rahman with voices that occur behind us as we move forward, causing audiences to turn around, a feat that is unique to VR compared to 2D, and which is not taken advantage of by static-scene VR refugee films. We also used only original voices of the refugees with subtitles placed at the location of their speaking to heighten the immersion with spatial audio (Fig. 6). We used music improvised by Rohingya musician Takir, recorded by the group Music in Exile, to give a genuine voice to Rohingya musical creative roots, as opposed to Western traditions. The resulting production is filled with Rohingya initiative, collaboration, and influence.



Figure 6: Audio and spatial dynamism. (Top) Following a player with 360 camera during play while he chases the ball, as if audience is also chasing the ball. (Bottom) Subtitle coupled to place in the environment where voice should emanate or point towards.

Story Experience

The audience arrives in Balukhali on a jeep and realizes that it's a dynamic immersive experience, because she is in a moving vehicle throughout. At the family hut, Mofizur Rahman introduces himself, poking his head in from the window, and gives her a tour. The footage is shot by Mofizur holding the 360 camera. The tour begins outside the window overlooking the landscape and brings the audience into the shack. The music of Rohingya by Takir plays in the background, as recorded by Music in Exile. Mofizur dictates the terms of viewing, going fast at times and slow at others, making the experience spontaneous for the viewer, who feels as if her hands are led by the boy. The tour ends in the living room, where the family gathers. The scene changes from a 360 video to a 3D scene where the viewer can move around and interact. When the viewer gets close to a family member she triggers conversations. Each family member

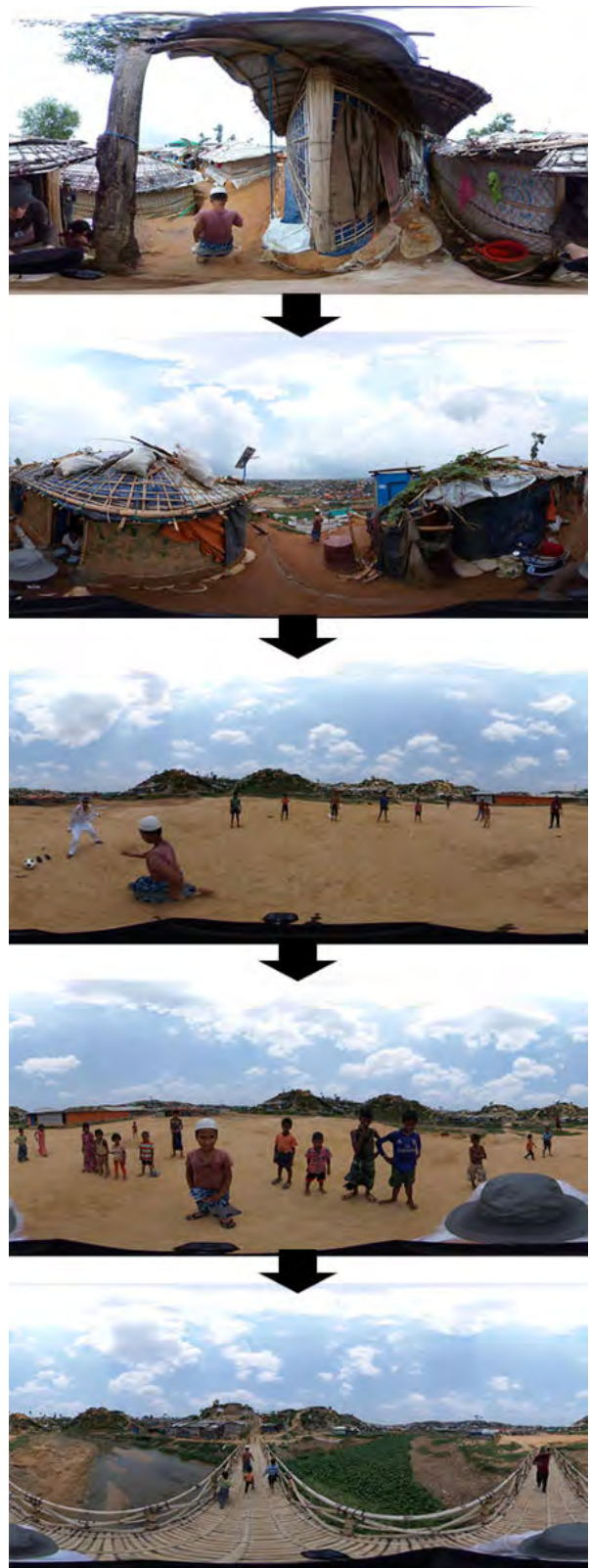


Figure 7: Storyboard of VR experience (part two). All scenes are 360 video, but scenes 1,2,3,5 have dynamic camera moves.

has a recorded voice in Rohingya language from the interview, with English subtitles. The words give her clues about family life far from their native homes. When you approach Ehsan, he says “during Ramadan whenever I sit to pray, I pray for my daughter, for her soul; I couldn’t give her water when she died.”

After talking to 3 family members, the scene moves to the kitchen, where Ameena is making preparations. Here, when items are collided with, Ameena narrates what the item means to her and Shamima. When you touch the pot, Ameena says in Rohingya “when we left Myanmar we could only bring our pot with us, it’s ancestral memory; inside is Shamima’s favorite food Semai that we made together.” After interacting with at 3 items, the scene shifts to Mofizur Rahman, who takes the viewer out of the house to show you around the village (Fig. 7). As we look from above, Mofizur talks during his tour about how each location you see is like his home in Patiya Para, Myanmar. When we reach the football field, Mofizur is reminded of how they would tease Shamima by passing the ball around. Triggered by this memory, the scene becomes a dynamic scene, where the friends play chasing the ball. The audience runs after the child chasing the ball as others pass the ball around. We realize that Mofizur is emulating his sister chasing after the ball, because he would pant her name.

After playing, Mofizur takes us back home by a different way across a bridge. As we walk beside the children, we can talk to them by triggering. They each know Shamima in their own way, and talks about what she did back home, and what home means. When back in the hut children pass the camera around as the viewer gets a closeup of each family member exchanging hugs and kisses with the viewpoint that shows their affection (Fig. 8). The audience realizes she is now representing Shamima to the family because they are all hugging the audience with salutations reminiscent of what they said to Shamima. The audience has gathered what’s known about Shamima in this journey, and has come to represent her to the family. The scene is shot collaboratively so that children can move the camera in the direction they deem personal to them. After the hugs, Mofizur gets the last kiss. He takes the camera that is the audience and, once the room clears, puts the camera away, as if he is putting Shamima away as well. The camera (and thus the audience) is put inside the blankets and the VR scene closes like a curtain to black, just as the Rohingya music finishes. SHAMIMA as a memory has been kept in this VR experience and it’s now time to let her go back.

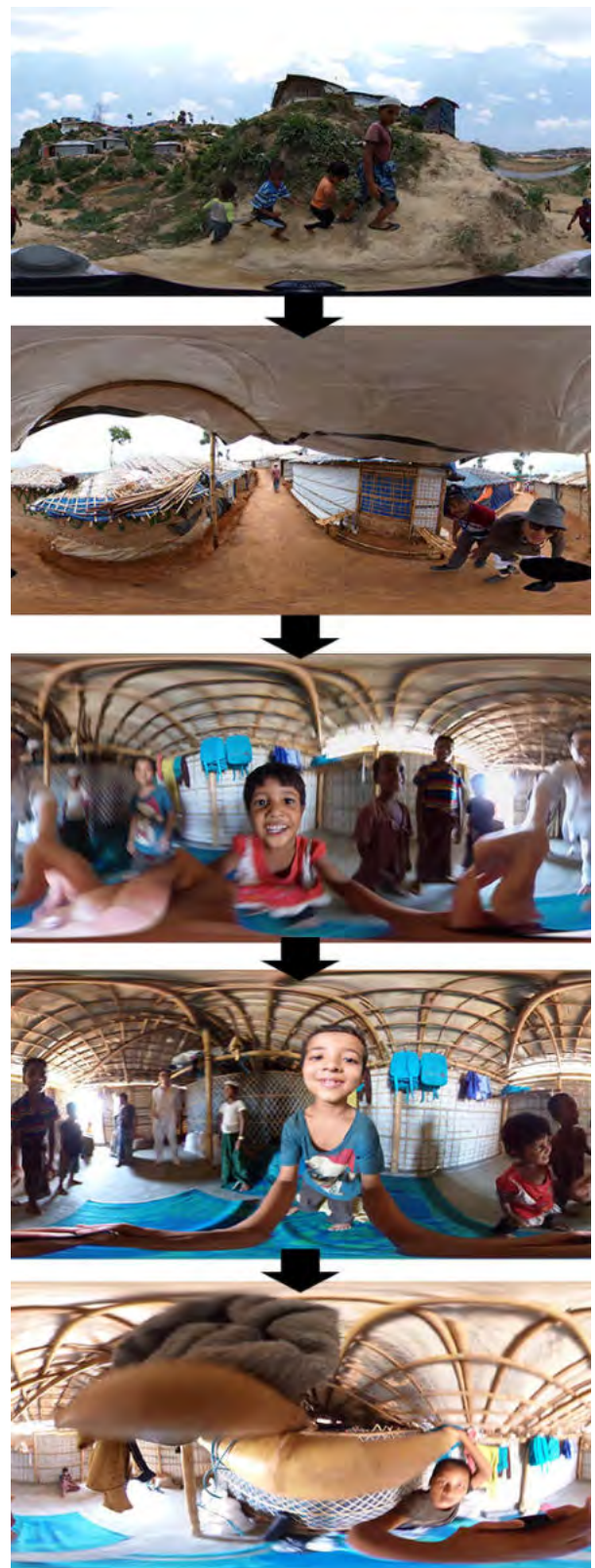


Figure 8: Storyboard of VR experience (part three). Conclusion of VR experience consists of camera passing amongst the children.

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A Mixed Reality Installation to Elicit Reflexivity on Adverse Childhood Experiences

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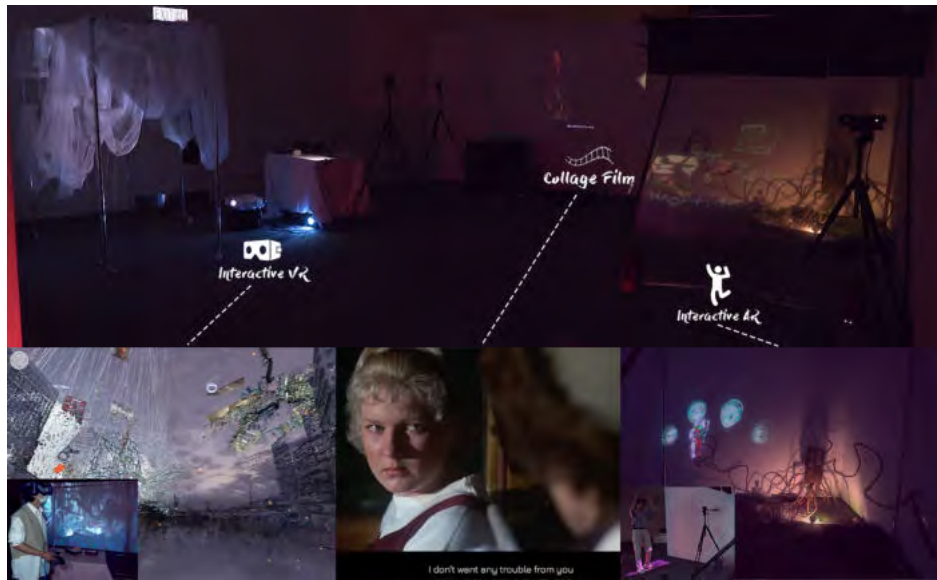


Figure 1: This mixed reality installation consists of an interactive AR installation, an interactive VR narrative, and a collage film. ©Chang Liu

Abstract

Adverse childhood experiences (ACEs) are an underestimated public health threat. It impairs children's brain development, immune system, and hormonal systems. These impairments predispose children to various chronic mental and physical diseases. However, its negative impacts are not widely known by the general public. Chang Liu created a mixed reality (MR) installation based on her personal experience with ACEs and ACEs related Post-traumatic stress disorder (PTSD), which aims to provoke the audience's reflection on ACEs and the influence of their upbringings on their mental and physical development. We conducted semi-structured interviews with 12 audiences, and their response to this MR installation was analyzed using the thematic analysis method. The analysis proved that this MR installation is capable of eliciting the audience's reflection on ACEs and their upbringing. In addition, The VR experience enabled participants to emotionally and somatically experience several symptoms of PTSD, and 75% of the participants demonstrated a high level of emotional self-awareness during the VR experience. Lastly, the analysis revealed that participants who had never encountered ACEs are more likely

to sympathize with both the victim and abuser in a fictional narrative about ACEs than those who had undergone ACEs.

Keywords

Mixed Reality Installation, Adverse Childhood Experiences, Augmented Reality Installation, Interactive Virtual Reality Narrative, Spatial Montage, Emotional Self-awareness, Post-traumatic Stress Disorder.

Introduction

ACEs are an underestimated public health concern that has garnered increased attention from academic researchers but is still poorly understood by the general public. ACEs refer to family-related traumas that individuals experienced during their childhood, such as 1)being psychologically, physically, and sexually abused, or 2)being raised by parents who have mental illnesses, substance use disorders, and criminal records, or 3)being forced to witness domestic violence and experience parental separation [2]. ACEs damage children's emotional, somatic, drug abuse, memory, sexual, and

aggression-related brain areas, as well as their immune and hormonal systems. These impairments predispose them to liver diseases, ischemic heart diseases, cancer, pulmonary diseases, and chronic mental disorders such as depression, anxiety disorder, PTSD, and borderline personality disorder [2, 12, 15]. Moreover, sufferers of ACEs tend to adopt health risk behaviors such as smoking, drinking alcohol, drug abuse, overeating, and sexual activity as the coping mechanism for their distress, which significantly reduces their life span [12].

ACEs are shockingly prevalent. The World Health Organization's survey of eight European countries found that more than half of respondents had encountered at least one type of ACEs [5]. According to a meta-analysis of 47 research articles on the prevalence of physical abuse among Chinese citizens under the age of 18, 36.6% of children in China are subjected to physical abuse [17]. A survey across 34 states of the United States reports that 57.8% of respondents had experienced at least one type of ACEs, and 21.5% of the respondents had experienced more than three types of ACEs [13]. According to a survey performed among young adults in South Africa, 45% of participants reported the experience of at least one type of ACEs [20].

It is crucial to inform the wider public about ACEs so that new parents or expectant parents can be aware of the constituents and consequences of ACEs and may therefore deliberately prevent child maltreatment. Additionally, people suffering from sequelae of ACEs can discover that ACEs are the root of their persistent mental and physical diseases, allowing them to seek more effective treatments for their diseases. Chang Liu is an example of a patient who realized at age 24 that her chronic depression, anxiety, and suicidal ideation were closely related to her ACEs. She used to rely on depressants for temporary relief until she met a therapist who identified the abnormality of her childhood experience and guided her to disclose all of her ACEs. Chang Liu was diagnosed with childhood PTSD, and her therapist started treating her depression and anxiety disorders by releasing negative beliefs, emotions, and somatic sensations linked with her traumas. After two years of treatment, Chang Liu's mental condition improved significantly; she had fewer nightmares, panic attacks, and intrusive memories and emotions.

To encourage audiences to reflect deeply upon ACEs and their upbringings, Chang Liu created an MR installation that depicts several aspects of ACEs using various media and narrative strategies (see Figure 1). This MR installation is highly interactive and immersive, but it also contains elements to motivate the audience to reflect while they are actively involved in the narratives. This MR installation features three immersive yet thought-provoking experiences:

- An interactive augmented reality (AR) installation that juxtaposes a holographic animation, a sculpture, and viewers' reflections on the holographic screen. This installation aims to encourage audiences to think about the duality of kinship: nourish/shield vs. erode/fetter (see Figure 2).
- A collage film to inform the audiences of signs of domestic abuse and to provoke reflection on the phenomenon that domestic abuse is often passed down through generations.
- An interactive virtual reality (VR) narrative that immerses

viewers in the inner world of Chang Liu, a patient with childhood PTSD. This work aims to stimulate audience reflection on the consequences of ACEs.

Artists and researchers have been utilizing virtual reality (VR) as a means to reveal the subjective experience of people with mental illnesses such as Autism [27], Bipolar disorder [6], Narcolepsy [4], Dementia [24], and Chronic fatigue syndrome [23]. To our best knowledge, *Nevermind* is the only VR artwork that attempts to raise public awareness about PTSD. However, it only depicted the amnesia experienced by PTSD patients and did not mention any other PTSD symptoms [25]. We presented an interactive VR narrative that enables viewers to gain an insight into PTSD by emotionally and somatically experiencing several PTSD symptoms: emotional numbness, hypervigilance, and intrusive memories. Additionally, this VR film motivates audiences to be consciously aware of their emotional arousal to facilitate their interpretation of the spatial montage within this work.

Narrative Design

Interactive Augmented Reality Installation

The AR installation consists of three parts: a sculpture, a holographic screen projected with animation, and audience participation. When the viewer approaches the holographic screen, his/her body movement will be captured by a depth camera, and the captured image will be projected onto the holographic screen in real-time, which blends with the abstract animation. This arrangement aims to make the audience feel that he/she is no longer the spectator but the protagonist of this animation.

The animation is inspired by Nicole M. O'Neil's poem "A family is like a circle" [22]. The audio of Chang Liu reading this poem accompanies the holographic animation, describing the positive aspect of kinship: the bond between family members is unbreakable; family is always there to watch over and support us; parents educate and enlighten us through their words and behaviors. In contrast, the animation depicts the negative aspect of kinship: the indestructible blood ties could also be lifelong torture from which one cannot escape; the excessive attention from family members may evolve into ceaseless blaming and abuse; Parents will stifle children's autonomy by imposing values on them. The juxtaposition of the poem and the animation emphasizes the duality of consanguinity: nourish/shield vs. erode/fetter.

The sculpture is a metaphorical representation of children growing up in an abusive family, who are like the seedlings rooted in noxious soil. The vines twined around the sculpture symbolize blood ties that fetter and erode the children; the mutated lower part of the sculpture indicates the emotional numbness and impaired physical health of abused children (see Figure 2). The juxtaposition of the sculpture, the animation, and the audience's reflection on the holographic screen will prompt the audience to associate the holographic animation with the sculpture and to associate the entire installation with his/her personal experiences; thus, the audience will be guided to reflect on kinship by recalling his/her upbringing.



Figure 2: The AR installation consists of a sculpture, a holographic animation, and audience participation. ©Chang Liu

Collage Film

Domestic emotional abuse is often overlooked by the public and victims because its effects take time to manifest. Long-term emotional abuse leads to severe damage to a child's "intelligence, memory, recognition, perception, attention, language, and moral development" and causes various mental and behavioral disorders such as anxiety, depression, self-abasement, social withdrawal, and emotional dysregulation [32]. Chang Liu created a collage film to promote public awareness of emotional abuse. The film depicts various forms of emotional abuse that may occur in a family, such as isolation, acting superior, emotional blackmail, invalidation, having unrealistic expectations, nitpicking, and over-control [10].

Research suggests that people will have more empathic responses to the narrative when it is claimed to be a real incident or adapted from a real incident [9]. In order to suppress the audience's emotional engagement and foster their reflective thinking, Chang Liu developed the collage film using footage from several fictional films portraying domestic violence. These fictional films are listed at the end of this collage film. The first half of this collage video depicts various ways in which parents mistreat their children, while the second half of this video reveals the abusive parents' ACEs. This film structure highlights the concept that domestic violence is like a curse that is passed down through generations.

The Hemingway curse is an example of the vicious circle of domestic abuse. The traumatic childhood was the key factor that led to the mental and behavioral issues of Ernest Miller Hemingway, which were exacerbated by his physical impairments and ultimately culminated in his suicide in 1961. Ernest's father committed suicide in the same manner in 1928. After Ernest's death, Ernest's youngest brother also performed suicide with a gun. The granddaughter of Ernest, Mariel Hemingway, claimed publicly that her parents struggled with alcoholism and depression. As a result of their father's physical and emotional abuse, she and her sisters suffered from a variety of mental illnesses [21, 14].

Interactive Virtual Reality Narrative

Emotional numbness is a common psychological dysfunction among sufferers of childhood PTSD. Stressful events result in endorphin hypersecretion, which immediately alleviates an individual's fear and pain associated with the stressful circumstance; nevertheless, endorphin hypersecretion also weakens the individual's awareness of all types of emotions [11, 1, 26]. Through repeated activation of endorphin hypersecretion, an individual's fear and pain responses to stressful situations get weaker and weaker, while his/her numbness to stressful situations becomes stronger and stronger. Thus, for people who have endured years of mental and physical torture, emotional numbness will become their primary response to domestic abuse-related stimuli [29].

As a consequence of their diminished perception of any feelings, individuals who experience emotional numbness are afflicted by a sense of being disconnected from others, and they may feel as if they are affectless characters living in a simulation game. This mentality leads to the patient's deep feeling of unreality and unfamiliarity with the real world. Chang Liu disassembled and rearranged the 3D scans of Hong Kong's landscapes to make audiences feel unfamiliar with their everyday lives, which is expected to elicit the audience's feeling of unreality for the real world (see Figure 3). Furthermore, audiences could move freely in the VR world using the controller, but their existence in the world remains ghost-like due to the lack of a controllable body in the VR scene. This interaction modality is expected to make the audience feel detached from their physical being and the external world.

Whenever people with PTSD encounter sensory stimuli associated with their traumatic experience, they will simultaneously experience hypervigilance and intrusive symptoms. Their suppressed memory fragments of being traumatized and the somatic and affective sensations accompanying those memories will be evoked; Their sensory perception will be heightened, and they will suffer from great anxiety. To provide audiences with an emotional and somatic experience of this hypervigilant mental state in VR, Chang Liu designed a mechanism that can transfer viewers from open and bright city scenes consisting of realistic 3d scans to enclosed and dusky spaces made up of 2d videos and 3d animations (see Figure 3).

This abrupt change in space and visual aesthetic is intended to make the audience feel alert. The experience of being trapped within an enclosed and dark area is expected to heighten the audience's sensitivity to sensory inputs. Following that, viewers will watch a fragment of Chang Liu's traumatic memories inside this enclosed space, after which they will be transferred to a world that represents Chang Liu's hypervigilant mental state. In this world, the audience can see how the arousal of traumatic memories affected Chang Liu's perception of reality, and hear her internal monologue describing her physical and psychological abnormalities. Portals are provided for audiences to return to this film's initial city scenes that represent Chang Liu's habitual mental state. In this VR experience, there are four enclosed spaces to reveal the traumatic memories of the Chang Liu, which can only be accessed through the four portals distributed over the initial

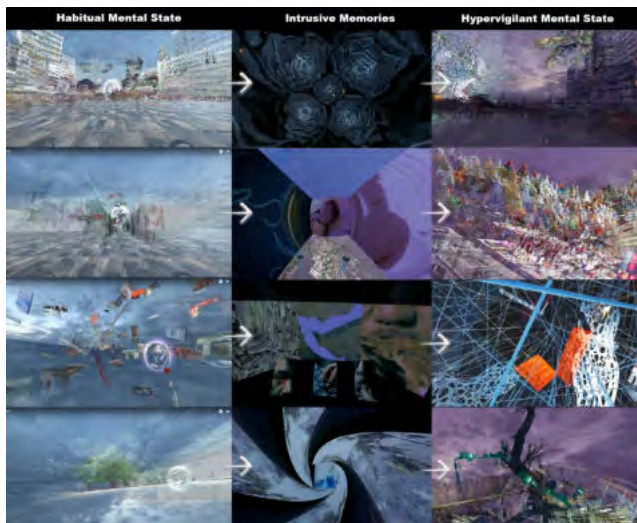


Figure 3: The VR simulation of PTSD patients' psychological shift after exposure to intrusive memories. ©Chang Liu

city scenes. This arrangement aims to provide audiences with an in-depth understanding of PTSD sufferers' psychological shifts by transitioning four times from the city scene to the memory space and finally to the chaotic world (see Figure 3).

Chang Liu's hopelessness and fear of being chased down a street by his abusive father are shown in the first memory space. Images and sounds in the second memory space portray the Chang Liu's emotional numbness following her mother's neglect. Chang Liu's mental state while being fostered and emotionally abused by her parents' siblings is represented in the third memory zone. Chang Liu's longing for maternal love is shown in the fourth memory space.

The memory spaces in VR are constructed based on the theory of embodied spacial montage (ESM), which aims to let the audiences subjectively experience the inner feelings of PTSD patients when intrusive memories overwhelm them. ESM is a theory presented by Sojung Bahng, who expanded the montage theories of Eisenstein and Manovich to emphasize the special role of VR in facilitating the audience's interpretation of montage. Bahng's ESM theory built upon the idea of Eisenstein that montage is an intersubjective collaboration between audiences and the film in which the subjective interpretation of the audience is indispensable. Additionally, this theory was formed based on the spatial montage theory devised by Manovich, which emphasizes the systematic juxtaposition of heterogeneous elements such as photography, audio, and computer-generated graphics within a 2d or 3d space as an alternative to the traditional sequential model of montage. Bahng pointed out that the bodily and emotional sensations elicited through the embodiment in VR can facilitate the audience's interpretation of the spatial montage [3].

Inspired by ESM theory, the four enclosed spaces in VR that represent Chang Liu's traumatic memories are composed of heterogeneous elements such as 2D videos and abstract animations, as well as 3D objects and animations. However, a random juxtaposition of various elements cannot be

called spatial montage. Manovich believes that spatial montage must adhere to two criteria:

"Juxtapositions of elements should follow a particular system, and these juxtapositions should play a key role in how the work establishes its meaning and its emotional and aesthetic effects [19]."

In concordance with Manovich's criteria of spatial montage, the placement, visual style, and order of appearance of the components of these four spatial montage areas were deliberately designed to implicitly reveal Chang Liu's traumatic childhood experience and her emotional and psychological response to these experience. For example, within one of the memory regions, the moving image that faces the audience depicts a girl sleeping on a bed. On the audience's left side, a video clip of a lady leaving with a suitcase is shown. The video on the right side of the audience portrays a bunny fairy approaching the sleeping girl. These two moving images, which are contradictory in content and visual style, imply that the mother neglected the child, who can only imagine an alternative mother to fill the void in her heart. An animation replaces the ceiling of this enclosed space, which conveys the girl's dream. In her dream, she throws off the shackles of physical beings and roams around uncharted legendary places. The floor of this space is transparent, allowing audiences to float in mid-air, and the 3d scans of the graveyard underneath them symbolize the cruel real world. When the girl wakes up, the audience will drop to the scene beneath them. The contrast between the images of the ceiling and floor indicates that the little girl fantasizes to escape from her ACEs and the cruel reality (see Figure 4).

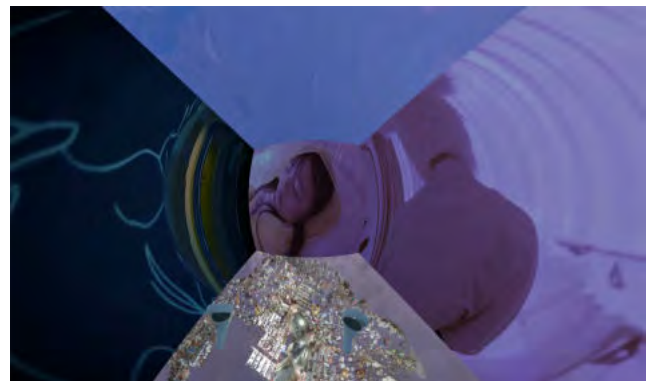


Figure 4: The spatial montage within the second memory zone of this VR film. ©Chang Liu

We hypothesize that immediately upon entering the confined spatial montage spaces, participants will experience emotional arousal. This hypothesis is based on David Bordwell's constructivist theory of perception. David Bordwell states that the perception of a narrative could happen in two ways.

"In top-down processing, the organization of sensory input is predetermined by the audiences' expectations, background knowledge, presupposition, and other cognitive operations. In bottom-up processing, the organization of sensory inputs happens involuntarily [7]."

Participants will be engulfed by various audio and visual stimuli scattered across the 360-degree environment when they enter the spatial montage areas. The absence of explicit connections between dispersed montage components will inhibit the audience's top-down processing of sensory inputs; thus, audiences will be forced to process these clues in a bottom-up way. Consequently, spectators may experience indefinable emotional arousal evoked by the involuntary gathering of sensory clues before grasping the meaning of the spatial montage. The desire to interpret the spatial montage will motivate the participants to make connections between seemingly unrelated visual and auditory information based on their evoked emotional and bodily reactions, as well as their experience and knowledge.

The overall process, which begins with the audience being exposed to a space filled with fragmented images and sounds, continues with the emergence of indefinable emotional and bodily feelings, and concludes with the audience's attempts to connect and interpret the visual and auditory information, is similar to how people with PTSD experience intrusive symptoms. When Chang Liu encountered trauma-related sensory stimuli in her daily life, she was engulfed by fragmented memories of her childhood traumas, as well as the emotional and bodily sensations linked with these memories. She must piece together those fragmented messages in order to create a coherent narrative that can assist in the treatment of her negative cognition about those memories.

Audience Study

Methodology

We invited 12 audiences (5 males and 7 females) to participate in this audience study, with the participants' ages ranging from 22 to 29 years old ($m = 25$). This audience study was approved by the School of Creative Media at the City University of Hong Kong. All participants signed a consent form confirming their voluntary participation. Participants were interviewed after experiencing all three parts of this MR installation. The interview was semi-structured and began with three predetermined questions:

- Does the VR narrative/ AR installation/collage film evoke any memories or feelings in you?

Based on the participant's responses to these three questions, further questions were improvised. The interview with the 12 audiences was audio-recorded and then transcribed into English text. In concordance with the criteria of thematic analysis, the data were analyzed in six steps [8]. After reading the transcription several times, Chang Liu organized and summarized the interview data to form initial codes. For example, "I feel completely numb already; even the sight of my father strangling my sister will not elicit any of my emotional reaction." was coded into "feel emotional numbness towards domestic violence." All the initial codes were then sorted to form overarching themes. Some of the themes were merged into one, and some of the themes were discarded due to the lack of supporting evidence. In the next section, I will articulate the main findings drawn from the finalized main themes.

Findings

Participants who had never encountered ACEs are more likely to sympathize with both the victim and the abuser in a fictional narrative about ACEs than those who had undergone ACEs. The analysis of the audiences' response toward the college film revealed that the intensity of ACEs experienced by participants affected their attitude toward the victim and abuser in the film. According to the personal experiences that the participants described during the interview and the definition of ACEs given in [1], P8, P6, and P11 had never encountered ACEs; P1, P3, P4, P9, and P10 suffered from emotional abuse; P12 experienced both physical and emotional abuse. P2, P5, and P7's experiences with ACEs are unknown as they did not reveal any personal experience throughout the interview. P8, P6, P11, who had no prior experience with ACEs, said they could sympathize with both the children being abused and the abusive parents in the film, who also experienced ACEs in their childhood. Participants who had encountered ACEs projected a more complicated emotion onto the abusive parents in the film. Although P3 agreed with the abusive parents' good intention to educate their children and understood their burdens, he felt angry for the parents who mistreated their children. P1 expressed resentment against the abusive parents in the film. P12 reacted to the film indifferently despite being severely abused by her family. P3, P4, P9, and P10 said they could empathize with the victims in the film. P1 showed no empathy for the victims, and P12 stated she understood the victims' situation in the film, but she could not share their emotions.

Based on the thematic analysis of the audiences' response towards the collage film, we identified a phenomenon that audiences who had never suffered from ACEs could sympathize with the victims and the abusive parents in the film more easily than those who had undergone a certain degree of ACEs. After probing into literature regarding ACEs, the mechanism of empathy, and emotional numbness, we found possible explanations for this response pattern: The second half of the collage film revealed the fragility and distress of the abusive parents who had also undergone severe domestic abuse in their childhood. According to the mechanism of empathy, when the viewers perceive the painfulness of the abuser, the mirror neuron system in their brain will be automatically activated to create an inner representation of the emotional state of the abuser, which triggers the audiences' autonomic and somatic responses to that emotion [16]. Through this process, audiences can understand the intention and emotions of the abusive parents and thus could empathize with them. However, for audiences who had experienced ACEs, empathy will not be the only feeling that appears when watching this film. The images of various children being abused in diverse forms and contexts will remind the audiences of their traumatic experiences. Recalling those memories is likely to elicit the audiences' anger and resentment toward their abusive family members. Audiences tend to project their emotions towards their abusive family members onto the abusive parents in the film; therefore, if the ACEs that they encountered were severe, audiences' rage for the abusive parents in the film might outweigh their empathy for them.

P1, who had undergone relatively severe emotional abuse,

was outraged while watching the collage film. Being aggressive is a common strategy employed by people with emotion dysregulation to terminate emotions that they are unable to cope with, such as a sense of emotional vulnerability [28]. This theory could explain P1's lack of compassion for himself and the victims in the film. P12 had no emotional reaction to the film despite having been cruelly mistreated. This non-responsiveness might be attributed to P12's emotional numbness caused by her traumatic experience. P12 said that she used to experience domestic violence frequently. According to the previously described process of developing emotional numbness, recurrent domestic abuse frequently stimulated P12's endorphin secretion. The repeated hypersecretion of endorphins progressively eliminated her fear, pain, and any other feelings and therefore caused numbness to become her primary response to domestic abuse-related stimuli [11, 1, 26, 29].

Audiences experienced PTSD symptoms emotionally and somatically in the interactive VR narrative. P1, P4, P5, P6, P8, and P9 said that they recognized various landscapes of Hong Kong in the VR film. However, the point cloud texture and the unusual rearrangement and animation of the 3D scans made the landscapes unfamiliar and unreal for them. Audiences' feeling of unreality and unfamiliarity with the surrounding environment in the VR world is analogous to how PTSD sufferers feel in the real world. P6 said that immobile pedestrians in the VR film made her feel detached from others and the rest of the world. P1 stated that the absence of a controllable body inside the VR world and hearing the protagonist's inner monologue induced an illusion that he became the protagonist in this story. He said he felt the protagonist's helplessness, loss, and panic of being isolated.

Analysis revealed that the abrupt shift of space and visual aesthetic in VR made participants feel alert (7/12 participants), insecure (5/12 participants), and nervous (7/12 participants). Furthermore, some participants reported increased sensitivity in perception inside the confined spatial montage zones. P8 said eating is stressful to her, but watching others eating in real life does not make her anxious. However, she felt very stressed when seeing people eating in front of her in the VR spatial montage spaces. P7 said that he suffers from mild social anxiety and is afraid of encountering situations in which individuals sitting near him refuse to communicate. Even though P7 was aware that the visuals of individuals eating in the VR experience were just a prerecorded film, P7 was anxious about not being able to speak with the people in the video.

In the narrative design section, we made two hypotheses based on the ESM theory and the constructivist theory of perception, which are:

- VR spatial montage may activate the bottom-up process of narrative perception, eliciting emotional arousal in spectators.
- The bodily and emotional sensations evoked by VR spatial montage may assist the viewer in comprehending the spatial montage.

Analysis of audiences' responses to the spatial montage ar-

reas in VR verified both of these hypotheses. P8 said that she instantly felt alert, scared and nervous upon entering the first memory zone. The elicited emotions and the perceived visual and auditory cues reminded her of the experience of walking home late at night. Thus, P8 concluded that this montage is intended to convey the protagonist's insecurity and fear while being chased by someone at night. P4 described feeling alert, insecure, anxious, fearful, and caged after entering the first memory region. P5 also felt alert, trapped, insecure, scared, and nervous inside the first VR montage zone. She then recalled being locked up at home, and she tried to understand the protagonist's feelings by projecting her memories and feelings onto the protagonist. Following entry into the first memory zone, P6 felt alert, impotent and upset. She said that the visuals and the elicited emotions made her feel as if she had stumbled into the protagonist's nightmare. She imagined that the protagonist felt nervous, scared, and helpless as a result of being trapped in the nightmare about her traumas. And she felt impotent and upset for her inability to help the protagonist. P2 felt alert, scared, and insecure, and P10 felt alert, impotent, and nervous upon entering the first memory space.

In the third memory zone in VR, P8 felt very stressed seeing three males eat in front of her, but she could not explain why. She speculated that this scene shows how uncomfortable the protagonist felt staying with these people. P1 was vigilant, slightly nervous, and insecure while inside this space. By associating his emotions with the image of several males eating and drinking rudely, he thought that the protagonist must feel uneasy, powerless, and suffocated when staying with these males. P3 expressed disgust, insecurity, and stress about this space. The visual clues and the elicited emotions made him worry that the protagonist was compelled to witness things she dislikes. P4 reported feeling trapped, nervous, and uncomfortable when within this place. P7 experienced feelings of unease, fear, and being trapped upon entering this area. To interpret the spatial montage, he attempted to link the visual and auditory clues that intrigued him in this emotional state. Moreover, P5 felt alert within the second spatial montage space, and P6 reported feeling comfortable and relieved in the fourth memory zone.

The spatial montage in VR elicited a high level of emotional self-awareness in the audience. The theory of levels of emotional awareness divides a person's capacity to realize his/her emotion into five levels. Individuals at level 1 are unaware of or unable to comprehend their emotional arousal and can only detect bodily arousal such as "My heart is pounding rapidly." Individuals at Level 2 have a vague awareness of their emotional arousal and can only identify it as positive or negative. Individuals at Level 3 will describe their emotional arousal with a single word (e.g., nervous). Individuals at Level 4 can identify that their emotional state is a composite of distinct emotions and can articulate each component of this composite. Individuals at Level 5 are capable of identifying not just their own mix of emotions but also the blend of emotions of others. People in Levels 1-2 are defined as having an implicit emotional awareness, and people in Levels 3-5 are defined as having an explicit emotional awareness [18]. This theory provides a standard for assessing the effectiveness of

a virtual reality narrative in eliciting viewers' awareness of their emotional arousal throughout the experience.

12 participants' emotional reactions to the four spatial montage regions were classified into five groups based on the theory of five levels of emotional awareness (see Table 1). Audiences' responses to the four VR montage spaces varied. Table 1 shows the maximum degree of emotional self-awareness obtained by the 12 participants throughout their experience of the four spatial montage zones.

	Level1 Bodily arousal	Level2 Vaguely aware of the emotional arousal	Level3 Identify single emotion	Level4 Identify the blend of emotions	Level5 Identify the blend of emotions of self and other
P1					Self: Alert, Nervous, Insecure Protagonist: Lincasy, powerless, suffocated
P2				Alert, Scared, Insecure	
P3				Disgusted, Stressed, Insecure	
P4				Alert, Nervous, Scared, Insecure, Trapped	
P5				Alert, Insecure, Nervous, Scared, Trapped	
P6					Self: Alert, Upset, Impotent Protagonist: Nervous, Scared, Helpless
P7				Nervous, Scared, Trapped	
P8					Self: Alert, Scared, Nervous Protagonist: Insecure, Scared
P9			Nervous		
P10				Alert, Impotent, Nervous	
P11	Dizzy				
P12	Heart is pounding rapidly				

Table 1:12 participants' level of emotional self-awareness in the spatial montage areas.©Chang Liu

Two conclusions could be drawn from Table 1. Firstly, the VR experience allowed viewers to emotionally and somatically experience several PTSD symptoms while retaining self-awareness that enabled them to differentiate their own feelings from the protagonist's. One possible explanation for this separation of feelings is that participants tended to associate their emotions elicited in the montage zones with perceived auditory and visual stimuli to interpret the spatial montage, which is likely to trigger participants' memories of personal experiences. The recalling of personal experiences will let the participants realize that they are the observer, not the protagonist, of this VR film. Therefore, they will be able to disentangle their recalled memories from the protagonist's story and disentangle the emotions associated with their own experiences from the protagonist's feelings.

Secondly, nine out of twelve participants reached a high level of emotional self-awareness (level 4-5) during the VR experience. This result could be particularly interesting for the research of improving people's emotional self-awareness through VR narrative. People with implicit emotional awareness are susceptible to mental illnesses. Research has proved that people with implicit emotional awareness tend to suppress their affective arousal, which, in the long run, leads to depression and anxiety disorders [31, 33]. Implicit emotional awareness can be attributed to innate deficiencies in emotion perception or acquired diseases. Psychotherapy can transform one's implicit emotional awareness into explicit emotional awareness regardless of the causes [30].

None of the participants requested to terminate the test, indicating that the emotions elicited by this VR experience were bearable and had no adverse effect on the audience. However, it is unclear that which part of the emotions experienced by participants in the spatial montage spaces was elicited by the

rapid shift of visual style and space and which part was provoked by the auditory and visual stimuli inside the enclosed areas.

This MR installation prompted spectators to reflect on ACEs and their upbringings. When watching the collage film, audiences who had no direct involvement with ACEs reflected on the signs and influence of emotional abuse by recalling the experiences of people they knew who had encountered domestic abuse. Audiences who had direct experience with ACEs reflected on emotional abuse by associating the film with their personal experiences. P1, P3, P4, and P6 reflected on the standard of good upbringing, the nature of kinship, and the influence of upbringing on adulthood when experiencing the holographical installation. Furthermore, after seeing the VR film, P1, P3, P4, P5, P6, and P8 expressed affective empathy toward the people with PTSD.

Some participants reflected on how their upbringing influenced their personality, outlook, and mental health when experiencing the holographic installation. P1 said he inherited all his parents' shortcomings. P6 said she was fettered by the values imposed by her parents. P12 developed various mental disorders under the stress of domestic abuse. P4 suffered from an everlasting feeling of insecurity and loneliness due to her father's neglect.

P12 recalled the similar feelings of being unable to control her body and concentrate when she heard Chang Liu talk about her dissociation from reality and her own body in the VR film. This abnormal mental state, as stated by P12, was attributed to the persistent fighting and arguing in her family. P1's attitude towards his parents changed after experiencing the AR installation. The collage film reminded him of his own childhood and roused his rage against his parents. The holographic installation, on the other hand, had a soothing effect and prompted him to reconsider his upbringing.

"The sentence "A family is like a circle." struck a chord with me. I realized that when I resist my parents' impact on me, my parents are fighting their own upbringing. By considering this, I understood my parents."

Conclusion

This article introduced a novel MR installation framework for provoking reflexivity on ACEs and addressed a research void by presenting the first VR artwork that can make audiences emotionally and somatically experience several symptoms of PTSD: emotional numbness, hypervigilance, and intrusive memories. Additionally, the audience study proved that the VR narrative framework presented in this article is capable of eliciting a high degree of emotional self-awareness, which is informative for future research on treating patients with implicit emotional self-awareness using VR narrative.

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Pulcher Aureus Filum. Biological Substrate Computers and the Ecological Paradigm Shift

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Abstract

With the imminent decay of Moore's law and the difficulties in solving NP problems in computing, researchers around the world have been given the task of finding new ways to manage, process and store information. These new paradigms are known as unconventional computing and among them, biological substrate computers have been developed. These coupled logic gates do not work by directing an electrical current through circuits made of conductive materials, but with collectivities of living organisms and the interaction of their emergent patterns with specific geometries. In this article we will address the implementation of a genetic chip (bacterial computer) in the creation of an artistic work, as well as the paradigm shift from the individualistic artist to the ecology of affections.

Keywords

Human/non-human, unconventional computing, biological substrate computers, sound art, postdigital, genetics, complexity, participative art, biohacking, bioart, human ecology.

Introduction

In the last decades, a group of theories and methodological approaches known as the complexity sciences, strongly supported by systems theory and computation, have been developed, they study how and why phenomena in reality oscillate between chaos and regularity, they have been in charge of working on three main axes: the mathematical theory of computability –more properly known as the set of P-NP problems–, the relationships between the microscopic universe and the macroscopic universe, and the theory of dynamic systems. (Maldonado & Gómez, 2010)

In particular the P-NP problem informally asks which ones can be quickly verified by a Turing machine. And since there were no significant advances by the end of the 20th century, several scientists began to look for different ways to solve this problem when observing the imminent decay of Moore's law, no matter how many computers there were, the computational goal was not being reached, would it be possible to design new computational models capable of surpassing the barrier of Turing machines? (Claude, 2016)

The computers we use in our day to day are electronic computers with the Von Neuman or Princeton architecture, described by John Von Neuman in 1945 in his “First Draft of a Report on the EDVAC” (Neuman, 1945), but these are not the only computers that humans have used, calculators (*computare* in Latin means to calculate) have not always been automated and much less electronic, two great examples of ancient computers are the Mesopotamian abacus or the Inca quipu. Likewise, there are modern computers that do not work through electricity, but through water, light, colliding objects, slime molds, bacteria, DNA, chemical reactions, etc. (Adamatzky et al., 2017). And in 1994, Christian S. Claude and John Casti coined the term unconventional computations to group all these attempts to alternatively manage and process information (Claude, 2016). Thus, in 1998 they organized the first international conference on unconventional computing models organized by the Auckland Center for Discrete Mathematics and Theoretical Informatics in New Zealand and the Santa Fe Institute in New Mexico. (Claude, Casti & Dinneen, 1998)

When talking about biological substrate computations, many doubts and confusion arise about the relevance of the term. In particular with bioinformatics, which is a field of computational science that carries out the analysis of sequences of biological molecules (Austin, 2020). For this purpose, electronic computers are used and software is developed, especially statistical, as a tool to study biological phenomena. Unlike bioinformatics or bioinspired computing, biological computers do not have silicon chips, nor circuits of conductive materials through which an electric current is channeled, but excitable systems, living organisms, fluids or chemical reactions interacting with a particular geometry. Some of the biological substrate computer implementations work on the basis of Physarum Polycephalum (Schumann & Pancers, 2016), microfluidics (Gravesen, Branebjerg & Jensen, 1993), plant leaves (Adamatzky, 2019), bacterial cultures (Daniel, Woo, Turicchia, et al., 2011), DNA (Daniel, Woo, Sarpeshkar, et al., 2013), neurons (Scelfo, Politi, Reniero, et al., 2012), non-linear chemical reactions (Adamatzky, 2004), etc. And in some of these paradigms it has been possible to flatten the exponential growth of time to solve a problem (Zhu, Kim, Hara, et al., 2018) or implement non-deterministic universal

Turing machines in a successful way (Currin, Korovin, Ababi, et al., 2017).

The work presented in this article is based on the computer model of bacteria that appears in the article “A synchronized quorum of genetic clocks” (Danino, Mondragón, Tsimring & Hasty, 2010). These *Escherichia Coli* bacteria have inserted a plasmid that functions as a genetic oscillator, known as the Elowitz represilator (Elowitz & Leibler, 2000), and in order to see the phase of this oscillator it also has the luxI operon of the *Vibrio Fisheri* bacterium. In this way, *E. Coli* is made to glow artificially and intermittently (an effect similar to fireflies), making it possible to visualize the processes of bacterial communication, known as quorum sensing. The system allows bacteria to produce acyl-homoserine lactone (AHL) which is the molecule with which they can communicate and the geometry of the chips where the culture is placed allows it to spread in different ways, this causes the bacteria can synchronize in various ways and bring out different spatio-temporal patterns. The paper shows two possibilities, the first is a circular space where over time all bacteria synchronize because the wavefront can diffuse in a regular and symmetrical way. The second option is a very elongated rectangular space in which the bacteria culture presents an asymmetric emergent pattern, like doing the Mexican wave. So, the geometry of the chip affects the distribution of the inducer molecule (AHL) thus this relationship controls a community of coupled oscillators that allow activating the computational mechanisms of this computer.

Pulcher Aureus Filum

Pulcher Aureus Filum (from Latin: A Beautiful Golden Thread) is a processual work of art. Inspired by the genetic chip work cited above, this work attempts to produce all the tools necessary to create a computational work of art and not just a computer-assisted audiovisual work of art. The shapes of a computer as the basic element for the creation of a work, the computer as an aesthetic object and all the human aspects that surround this cultural artifact, not only what can be produced with it. The creation of a spatial-sound work that represents the forms that human cognition generates when encountering a specific problem.

Let's take an example within a more familiar paradigm, the world of oil painting. In analogy let's say that for this work we would like to build all the tools and materials necessary to paint an oil painting. Learn carpentry to make the brush handle, godet, frame and easel; learn the chemical bases for making linseed oil and natural pigments; learn textiles to make a canvas. And then make an oil painting as a synthesis of this ecology of knowledge.

In the specific case of the work in question, the central technological development was a bacterial computer, so first the tools were developed to be able to insert a plasmid into the bacteria that would make up the genetic chips. An openPCR, an electrophoresis machine, a transilluminator, incubators were built, some machines such as a microscope, micropipettes, as well as glassware were purchased. (Fig. 1)



Fig. 1. Detail of the Pulcher Aureus Filum installation, showing the molecular biology tools that were developed for the project.

At the same time that the instruments were built, the design of the chips began with the help of digital manufacturing techniques (3D modeling, 3D printing and CNC router). The limits of these tools were tested to be able to design and generate the chips, what materials could work and how much could the experiment be scaled? (Fig. 2)

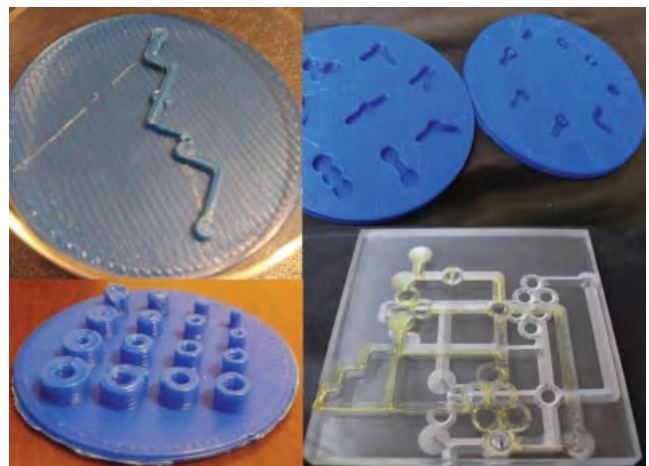


Fig. 2. First prototypes of genetic chips. With 3D printing with PLA (polylactic acid) filament and roughing with a CNC machine on solid polycarbonate.

Implementation of a genetic chip for transmedia art creation.

The chips were designed with 3D modeling software called Rhinoceros and manufactured with a CNC machine on the material known as solid polycarbonate. This material was chosen for its characteristics: at least 200 times more resistant than glass, it is lighter than glass, high transparency and up to 90% light transmission, protection against UV or IR rays, it can be modeled with thermoforming, formed cold and CNC, electrical, acoustic and thermal insulation, corrosion resistant. This allows to contain culture media for bacteria and supports the autoclave protocol.

This computing paradigm is not based on the implementation of software on specific hardware, that is, the world and its properties are not digitalized in a binary formal representation, but matter and its emergent properties are directly computed, therefore the shapes in which the hardware is designed to manage the information is also the software, the geometries of the chips are in some way a geometric programming language and the kernel of this computer can be conceptualized as the emerging patterns that are produced by the interaction of the quorum sensing and the way in which the chips allow the diffusion of the inducer molecule (AHL). This programming language can be considered an object-oriented programming language with a prototype-based approach also called classless or instance-based approach. The notion of object is based on stationary nodes of a Bayesian network with attractive capabilities that can be placed differently to obtain different topologies.

The proposal is based on the creation of small geometric units that we will call primitives. These were designed thinking in the easiness of information flow through their geometries in mind. (Fig. 3)

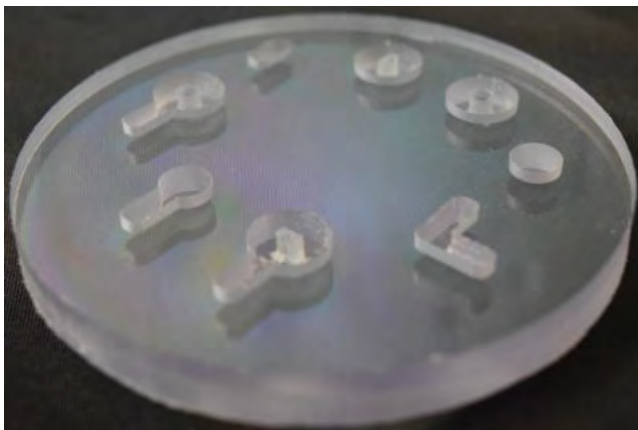


Fig. 3. Primitives and first combinations.

Here are 4 of the 12 chips designed based on these primitives, extending the first 4 combinations. (Fig. 4)

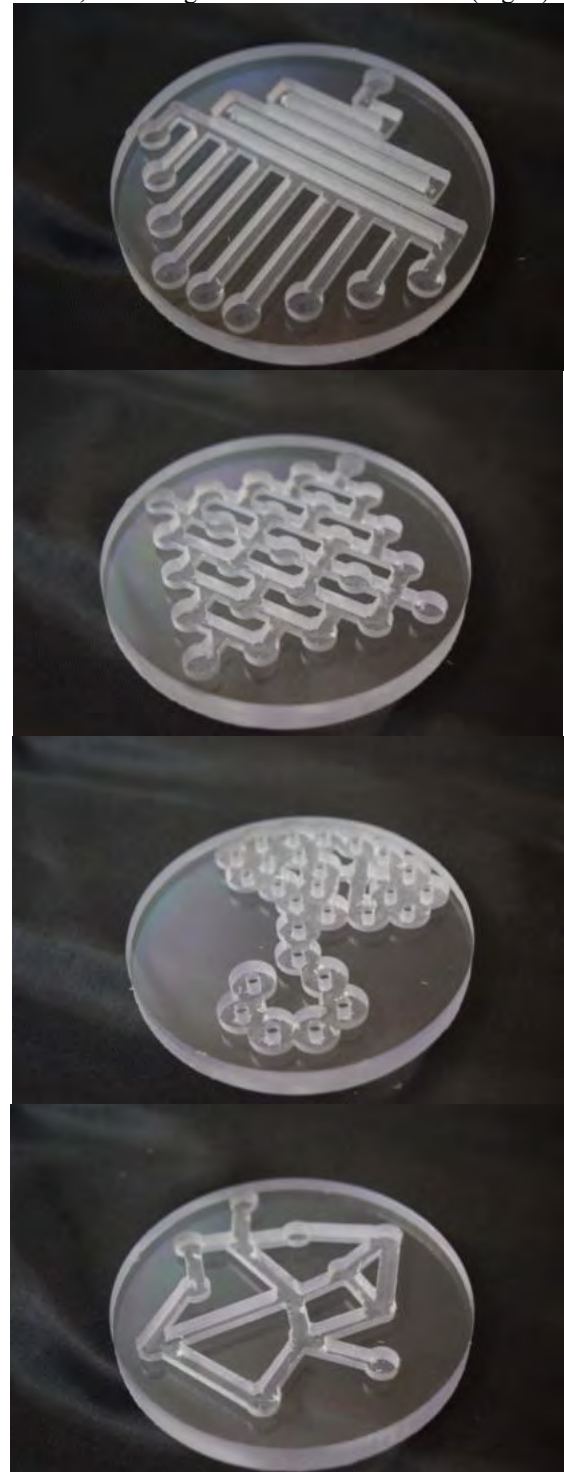


Fig. 4. Variations on the chips.

The logic that chip designs follow responds to two important factors, the first is different types of width in the communication channel between the circuits, the second is the connectivity between each of the nodes and the third is the number of obstacles. It finds the expansion front of the wave and the critical size it has to have to interrupt its continuous formation. This first group of chips can be placed between abstract machines for parallel programming and abstract machines for specific purposes: group theory and boolean algebra.

Once the programming language and the first designed chips were finished we began to create a culture medium with the biohacker protocol and to plant the bacteria in them, the bacteria used were genetically modified *Escherichia Coli* (Figure 5) and *Vibrio Fischeri* (Figure 6). The behaviors of these bacteria were analyzed through computerized vision algorithms to collect data on the space-time rhythms that emerged. This data was analyzed with algorithms in Python, then used as a database to control the video mapping of the final piece.

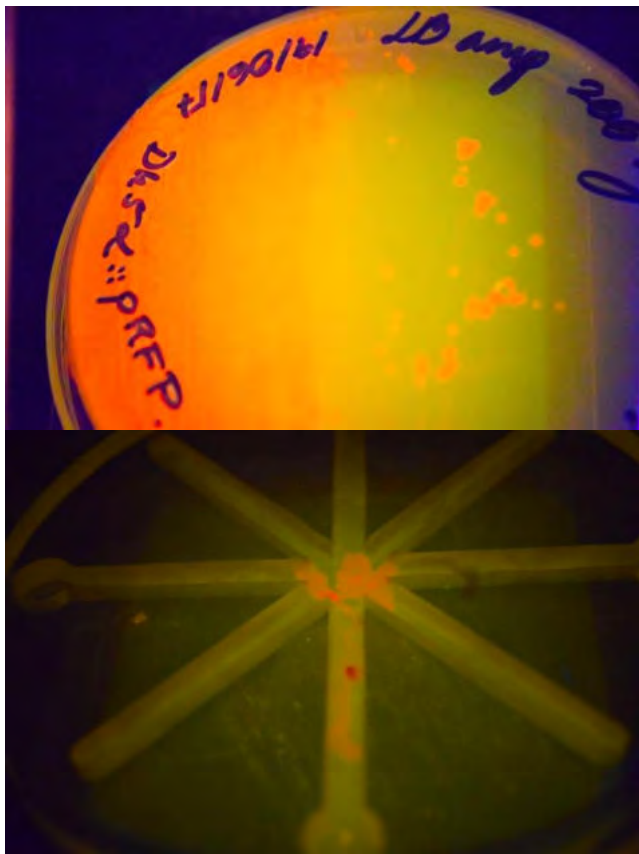


Fig. 5. Escherichia Coli cultures and chips.

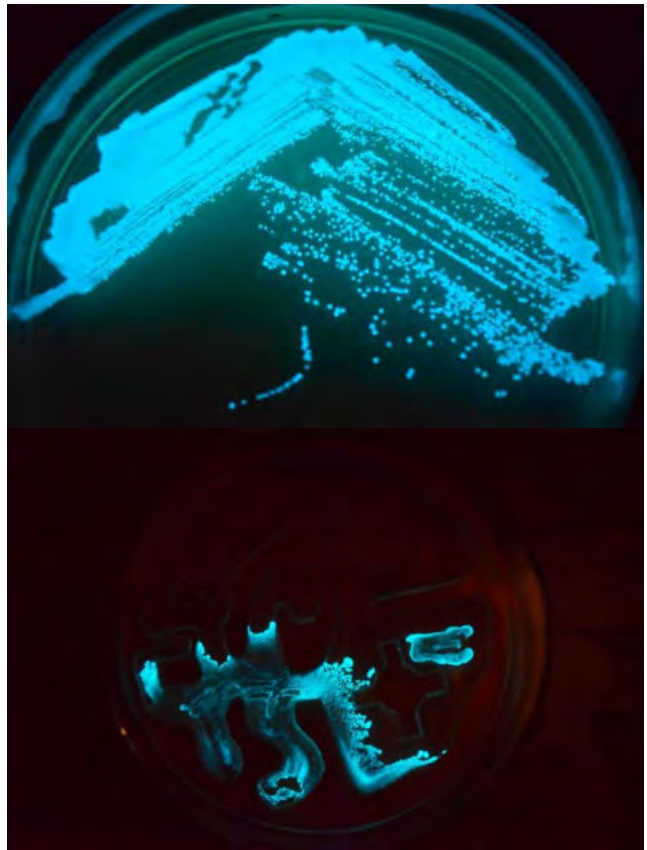


Fig. 6. Aliivibrio Fischeri cultures and chips.

At this point in the development of this work, several of the considerations of the original publication had been put to the test in terms of the possibilities and restrictions of working with bacteria and its relationship with the physicality of the culture medium, as well as the technical challenges to scale these chips. Creating artificial spaces to make bacteria inhabit allows us to understand why they appear in nature in one way or another and not in another.

Another consideration of this experiment was directly aimed to bacteria as living beings, not only as parts of a biotechnological device that allows solving boolean, arithmetic or geometric operations. The fact that the bacteria are glowing means that we are stressing them to limit levels and the colonies at some point begin to compete for food. All the studies on quorum sensing allow us to conceptualize bacteria as collective, perhaps social, entities, which is why it was necessary to generate a level of empathy and affection for bacteria. In contrast to electronic art works where sensors and even biometric sensors are used, this work proposes being participatory, changing the place of tools for accomplices. But how to achieve this post-anthropocentric approach without falling into the simplistic and humanized

idea of the pain of another species? The answer was proposed as a sound action.

K'usi avo'onton (Maya Tzotzil for “How is your heart?”). Collaborative sound piece

Scaling this synchronization phenomenon on a human level represented an almost unattainable theoretical and energetic challenge for an artistic project. But if bacteria could give this work their light, humans could give it their voice. The sound part of this work was an active meditation. This meditation consists in that the assistants can sing anything, in any volume, with or without lyrics, with any technique that is within their reach. As part of the work, a choir is also included that is presented in the action in an unknown way, the public does not know that there will be a part of the work where professional singers will sing with a score written by the author. The parts of the action are divided into three:

- 1.- Introduction: everyone begins to breathe deeply and listen carefully to their surroundings to enter a state of meditation. They are all with their eyes closed.
- 2.- Prelude: Everyone begins to emit voice, softly and warmly.
- 3.- Theme: Everyone begins to sing freely increasing the intensity little by little.
- 4.- Autoinductor: The choir begins to sing the part written for them.
- 5.- Cadenza: The author makes a voice solo with harmonic singing and a loop station, spatialized in a quadraphonic system.
- 6.- Coda: The chorus returns with the meditation mechanics and everyone begins a decline to total silence.

This action was recorded with 8 independent channels in different places in the space in order to be able to analyze them later and determine the areas and ways in which the public was synchronized and desynchronized at the frequency level. The analysis made it totally conclusive that the deterministic written part made the whole group of people synchronize in a very tight way, and when finishing little by little they were changing notes and harmonies, but they did not completely desynchronize. The traditional mechanism of the score where a composer in a deterministic way organizes a group of people served as the AHL, having a minimum percentage of people with a common agreement, the rest were added to the agreement and the notes of the score functioned as the geometries applied in the genetic chips designed for this piece. (Fig. 7)



Fig. 7. Details from the audiovisual register of K'usi avo'onton.

When analyzing the data from the two experiments it became clear that each of the spatial scales has its own characteristics and laws. Even so, all these scales coexist in the same space simultaneously, that is why physics continues to search for that theory of everything that allows us to encompass our reality regardless of the spatial or temporal scale to which we refer. But, within these changes of nature in the spaces there is an element that transversely crosses these limitations indifferently, and that is the information. Absolute of physicality, information, as well as matter, is neither created nor destroyed and we could add that it does not transform either depending on its environment. The different scales are like the beads of a universal necklace, and these are linked by a beautiful informational thread, a beautiful golden thread.

The transmedia installation that synthesizes all this process consists of two parts. The first is a totemic sculpture inspired by the shapes of the chips, a work that aesthetically exposes a computational code that, although functional, appears encrypted to the public in the presentation, in the manner of the obfuscated code tradition. On this piece a generative video mapping is projected whose seed of behavior is the

data collected from the genetic chips. On the other hand, the sound is composed of the 8 recordings of the active meditation spatialized in a quadraphonic surround sound system, in the same way, the behaviors of the spatialization are fed by the data of the spectral analysis carried out. A spatialization technique developed by the author known as spectral granular synthesis is used. But the work overflows the exhibition space, it is not only made up of material objects, but also of interpersonal relationships and an ecology of knowledge that simply cannot remain in a museum on display. (Fig. 8)



Fig. 8. Detail from the installation-lab "Pulcher Aureus Filum".

Discussion

One of the most important challenges of this project was to be able to transcend the barrier of technological development to impact aesthetics, to be able to propose a new artistic form, instead of only producing transmedial art in the same way, but with computers with a biological substrate. This intention was achieved in the participatory performance that sonified the project, so we will focus on this participatory performance in the discussion.

A work of art is hardly exhausted in itself. As a cultural artifact it is inevitably associated with its context, so the relationship of its meaning with its signifier does not exhaust its communicative possibilities. It is also deeply related to the audiences to which it is addressed and with the way in which the message is distributed, or how it is presented to the public. This trifecta can be considered as the scheme of relationships that allows us to analyze a work of art as a complex system.

The invention of the score in the West marks a foundational milestone in music because it changes the way in which the figure of the performer, the composer and the audience begins to separate. In the oral tradition there is no defined

composer who tries to send a message to a specific audience, rather there is a custom that is transmitted from generation to generation and that is enriched with the passage of time, each of the interpreters recreates the work. But with the invention of the score, a process of change began, a composer leaves expressed in a graphic text indications for an interpreter to activate the text in front of a listener. And with the standardization of symbols, music can travel faster through different contexts, languages and cultures, with the promise of breaking the barrier of time and lasting, the most ephemeral art of all managed to petrify itself to become an object.

For several centuries the score served as a tool that facilitated communication between the parts of the world of music and was quite open, there were many opportunities for the interpreter to improvise and to be part of the recreation process of the work, delivering a more collective message to the listener. But with the rise of the bourgeoisie and the industrial revolution, the composer emancipated himself from his role as a craftsman and servant of some court or abbey to become a solitary genius who gave his art to the world. The opportunities for the interpreter to improvise decrease, the passage of time is regulated by the metronome, the spatial component is flattened by the uniqueness of the "Italian theater", the consolidation of musical groups like the orchestra leaves little room for timbral variation and the indications of the score begin to mutate, from suggestions to reactivate a sound text into orders for a performer to move his body and activate a musical instrument. From the listener-interpreter-composer that existed in the oral tradition, the communication scheme separates these figures and distances them from each other. The composer as the epitome of individuality delves into himself to produce an increasingly accurate score, the interpreter has to do a research exercise to decipher the meaning of the work that he is going to activate and the listener becomes a passive agent that receives this complex semiotic process as a black box.

The next phase in this process is radicalized in the twentieth century, the individuality and the composers own voice becomes so important that they even stop using the conventional score and begin to create their own symbol systems, which instead of representing the sound they want to hear, indicate the way in which the performer's body should move, music has not only been stripped of its cultural but also organic dimension, two of the post-war composition currents represent this agenda: integral serialism and the new complexity. Some reactions to this aesthetic fashion are the open/graphic scores and free improvisation that try to reduce the communication gap between composers and performers by merging them, but the public continues to be

left out of the creation processes, the concert halls represent that agenda and begin to be emptied. There are even composers who wonder what does it matter if you listen? (Babbitt, 1958) They not only get rid of the interpreters with the use of electronic and automated instruments, but also the listeners to whom the doors of any dialectic exchange have been closed in the generation of this art.

In the work *Pulcher Aureus Filum* there is a post-anthropocentric intention in relation to the relation with bacteria in such a way that instead of projecting human cognition onto bacteria, it is proposed to replicate the experiment on a human scale in order to imagine how could be the process of information exchange between them. On the other hand, the experience acquired in the design of the chips was transferred to the strategy to generate a sound work, in this paradigm the components that traditionally find in an electronic computer are unified: the circuit, the kernel and the software are one and the same. They activate through a collectivity of coupled oscillators. In the case of this participatory performance, the communicative scheme is articulated as follows:

Addressing the listener

The public is invited to take part in an active meditation. They are invited to participate actively in the creation of the work and in a way in which you must turn off your mind to reach the desired state, it is important for the work that there are no intellectual exercises to relate the parts of the work and thus understand the "form", but rather an intuitive flow in collectivity.

Space of the presentation

The space where the play takes place is not a concert hall with an Italian theater layout, but a garden near an ecological reserve where the experience will be totally immersive. As part of this performance of vocal synchronization, there is a mixed choir that at some point in the work sings a written part and is located randomly, in such a way that the audience is completely spatially mixed with the performers.

The relation between the meaning with its signifier

Inspired by non-linear systems of equations, the strategy of using active meditation as a structuring method of a sensible experience allows the components of a concert to be unified, as happens with genetic chips. The public becomes a performer and a composer. The interpreter becomes a public, due to the indeterministic component of the work and a composer. And the composer becomes an audience and a performer. Although human beings cannot shine, they can sing, so the method to analyze their synchronization is through the Fast Fourier transform, the louder the content, the less synchronization and the fewer beats appear, the

more synchronized. Intuition and active listening of each of the participants works like the AHL. And the score that the chorus sings works like the geometries of the chips that channel the information towards certain synchronization vectors.

In his composition treatise, Arnold Schönberg describes musical form as the sequential organization of the parts of a work, as well as the relationships between them, like those of a living organism, but deployed in time; logic, coherence and kinship as qualities of a composition to make it intelligible. On the other hand, an active meditation is an amorphous mass of unconnected events from which a structure emerges thanks to the resonance by empathy of the participants, it is not a structure imposed by an abstract and distant agent, but a timbre relationship to which all the participants arrive. Participants by connecting with others. The feeling of well-being and self-awareness as an abstract machine model, a social computer with a cohesive swarming kernel by active listening, intuition and empathy.

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Multimedia artist, composer, curator and independent researcher. He made his studies at the Faculty of Music in the National Autonomous University of Mexico (UNAM). He has had three solo exhibitions, at the Sound Experimentation Space in the University Museum of Contemporary Art, at the Laboratorio Arte Alameda, and his retrospective at the Contemporary Art Gallery in Xalapa, México. His work is part of public and private collections. As a multimedia artist he has participated in several collective exhibitions in Mexico, Berlin, New York, Madrid, Montevideo, Hamilton, Saõ Paulo, Bergen, Tallinn, etc. He is founder of SEMIMUTICAS Research Seminar in Music, Mathematics and Computer Studies and Independencia BioLab a biohacker space based in Mexico City. He has several international publications in conference proceedings, journals and books, in editorials such as Cambridge Scholars, Springer-Verlag, Taylor & Francis, the Institute of Electrical and Electronics Engineers, Siglo XXI and the Mexican Mathematical Society.

Towards a Theory of Machine Learning and the Cinematic Image

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Abstract

This paper addresses the state-of-the art and prehistory of machine learning technologies as they pertain to the moving image. It discusses the challenges and potential hazards of these technologies, before showing how artists and image-makers are using these techniques to create a new relationship to the space of the cinematic in the age of big data. This paper strives to interrogate and overcome technologically deterministic accounts of this new technology. Accordingly, it situates examples within the discursive fields from which they emerge and favors diachrony over synchrony in outlining four clusters of media-archaeological inquiry that intersect in the application of machine learning techniques to the moving image. In so doing, it seeks to acknowledge the ideological problems inherent in the hegemonic adoption of machine learning tools while attempting to theorize the potential of machine learning in its application to the moving image and cinematic production.

Keywords

Machine Learning, Artificial Intelligence, Cinema, Cultural Analytics, Surrealism

Introduction

Within the last decade, and due to key technological breakthroughs, interest in the application of artificial intelligence to the production of imagery has reached fevered proportions. A focus on the imminent arrival of artificial *general* intelligence – i.e. the full simulation of human cognition – has overshadowed a potentially more interesting reality. For decades, discourse on AI was heavily influenced by Raymond Kurzweil’s notion of the “singularity” – i.e. the application of the simple geometric sequence that informs “Moore’s Law” to the highly complex problem of the simulation of human intelligence. Kurzweil was, and still is, a major theoretical touchstone for both the Californian ideology and popular culture, and his work speaks to a broader expectation that these technologies are clearly progressing towards the end goal of mimicking human intellect. However, the development and application of machine learning algorithms to imagery has proceeded through unexpected mutations that create unanticipated results. In terms of media production, what has emerged are a wide range of specialized tools that prompt us to question the ontology of the digital image in new ways, while also reviving older modalities of image creation. Before moving to my critical analysis of these technologies and techniques,

I will outline some of the ways that they are already being used within the creative industries.

Applications of Machine Learning in Cinema

Within the film industry machine learning algorithms are being used in the service of what Lev Manovich has called “cultural analytics” – i.e., the “computational analysis of cultural data”. [1] For example, the service scriptbook.io, which is presented with the tagline “hard science, better content”, promises to analyze film scripts and produce a report of metrics including genre, target audience, demographics, and hundreds of other data points. It also claims to predict box office performance, return on investment and suitability, of the content in various markets. A similar service is offered by cinelytic.com, which signed a major deal with Warner in 2020. [2] These services extend the logic of “formulaic” script writing to its inevitable conclusion. As such, they are in line with the business models of major studios that base their blockbuster production schedules on market research into heavily engaged fan cultures or, what Henry Jenkins has labelled “participatory culture”. The creators of scriptbook.io go one step further, introducing a service called DeepStory that generates new scripts in the style of existing ones. While the prospect of developing more sophisticated tools for determining the return on investment for a motion picture is tantalizing to venture capital, these tools clearly rely on identifying patterns of consumption within of previous commercial films and projecting those patterns into the future – a form of knowledge making that machine learning systems are particularly well suited to, and also well suited to abusing through the amplification of inherent biases. One question that arises is: will cultural analytics and machine learning algorithms merely accelerate the homogenization of cinema and further enshrine the dominance of the Marvel Cinematic Universe school of filmmaking, or are there other potentialities that it might unlock?

As a first step towards theorizing machine learning and the cinematic image, it should be stated that what we are seeing in these commercial applications of cultural analytics is a revival of an older idea of film as a language itself. The technologies behind script services are essentially classifying cinematic content at the level of the script according to the internal logic of an algorithm. What emerges is not unlike early

theorizations of cinema as a language or language system of images. We should recall that prior to the invention of sound cinema Rudolf Arnheim, Béla Balázs and Sergei Eisenstein were deeply engaged with the problem of developing and thinking of film as a “universal language”. Christian Metz also asked whether film could be considered a “language” or “language system” and attempted to identify and account for a semiotics of the cinema “to analyze film texts in order to discover either textual systems, cinematic codes or sub-codes”. [3] Though Metz eventually abandoned this ambitious project, it is clear today that an applied semiotics of the still and moving image is already being put into practice. This is occurring not only at the level of the script, but also through the use of image classifiers and the application of machine learning techniques: such as the combination of tools like VQGAN + CLIP, OpenAI’s Dall-E, or StyleGAN2 and Artbreeder. Huan Ling et al.’s recent demonstration of “high-precision semantic image editing” in its EditGAN software continues to refine what is possible with these techniques. [4]

Machine learning techniques are already being used in a variety of ways in the production of imagery. They are also now a standard tool in the realm of photography, including in the “neural filters” that have recently appeared in the Adobe software suite, as well as in the hardware architecture behind the cameras in smartphones. Deep learning techniques are being used to automate the tedious and time-consuming process of rotoscoping, in a variety of special effect applications such as automatic colorization of black and white footage, for color analysis and automated color correction, [5] in the generation of procedural textures for CGI in the cinema and games industries, and more recently in full-fledged web-based editing systems such as Runway, or corporate presentation tools such as Synthesia or Synthesis.io.

While forms of machine learning have been used since the mid-20th century by generative artists – and the notion of “algorithmic” images can be traced back to antiquity – the application of modern machine-learning techniques to the moving image first began to appear in films such as Guy Maddin’s *Seances* (2016), Kristin Stewart’s *Come Swim* (2017), the artificial intelligence, “Benjamin’s” *Zone Out* (2018), EYE Museum’s *Janbot* (2018), and in the editing of the trailer for Luke Scott’s *Morgan* (2016). Today, the use of machine learning for the generation of moving imagery has become far more common – appearing primarily in short video works and demos on social media and created with off-the-shelf tools and apps that require no knowledge of coding. With the rapid development of these techniques, particularly in connection with game engines and virtual production tools such as Unreal Engine or NVIDIA’s Omniverse,

it seems clear that their adoption will radically change the crafts of editing, visual effects, and set design within virtual production.

While these applications can be seen as the inevitable creep of new software techniques into the realm of cultural production, we should be critical of their adoption and ask what the potential consequences of their use might be. Furthermore, this survey of specific applications only begins to provide us with a larger picture of what I believe is the paradigm shift in image-making and analysis that these technologies could represent. In order to theorize this new paradigm, I will outline what I believe to be the set of discursive and historical clusters that constitute machine learning in its current application to cinema.

First Cluster: Cybernetics, Automata, Generative Art

One of the most important recent developments in machine learning for image synthesis and analysis is the deep neural network. Accordingly, the examples that I will be discussing here today are mostly based on various forms of outputs from neural networks and, in particular, of Generative Adversarial Networks (or GANs). Invented in 2014 by Ian Goodfellow, GANs are one variety of machine learning algorithm that pits two neural networks against one another in a contest of reinforcement learning. Within this arrangement, a discriminative neural network reads and “judges” the output of a generative network. These networks “compete” to create novel arrangements from a vast trove of training data. It is through this process of feedback that the legacy of cybernetics can be seen at work in these systems. Though the term was popularized by Norbert Wiener in the 1940s, the idea of a cybernetic feedback loop was already operative in simple mechanical machines before this time – such as James Watt’s centrifugal governor of 1787. This elegant physical machine – which effectively and automatically regulates the output of a steam engine – describes the fundamental concept of the feedback loop that lies at the heart of even today’s most advanced forms of machine learning. [6] The machine reads its own output and reacts to it thus “learning” and adapting. Though a drastic simplification, GANs and other machine learning techniques act in a similar manner except that, when applied to a database of imagery, their intended purpose is not to reach a steady state of equilibrium, but rather, to produce novel and convincing interpretations of the underlying data set.

The impulse toward generative *imagery* was also anticipated long before Wiener’s time, first in the automatic writings and paintings of Hilma af Klint, and then by the Surrealists in the 1920s. On his explorations into the psychological processes of the

human mind through techniques like automatic writing, André Breton defined Surrealism itself as: “Psychic automatism in its pure state, by which one proposes to express—verbally, by means of the written word, or in any other manner—the actual functioning of thought.” [7] And it is the second part of his definition that I think is particularly apt to the discussion here. Breton writes that Surrealism is: “Dictated by thought in the absence of any control exerted by reason, exempt from any aesthetic or moral concern.”

As we shall see, this definition remains particularly apt for the description of neural networks, which attempt to mimic “the functioning of thought”, but whose inner workings proceed in ways that are not yet clearly understood. The Surrealist fascination with automata also anticipated Norbert Wiener’s own recognition of cybernetics’ place in a long lineage of the changing definition of what an automaton is. According to Wiener, automata through the ages have “always been expressed in the living techniques of the age. In the days of magic, we have the bizarre and sinister concept of the Golem [...] In the time of Newton, the automaton becomes the clockwork music box [...] In the 19th century, the automaton is a glorified heat engine [...] Finally, the present automaton opens doors by means of photocells or points guns to the place at which radar beams picks up an airplane, or computes the solution of a differential equation.” [8] It should be noted that, historically, many of these automata, in practice, were elaborate illusions and often hid the workings of human agents behind the scenes. Today, we should add to this list of automata by acknowledging the so-called “human-in-the-loop” nature of many of the systems that we refer to as “artificial intelligence.” These would be the self-driving cars that are trained on our frustrated mouse clicks identifying traffic lights in captchas, or more alarmingly, through the actual off-shoring and disavowal of exploitative labor through services like Amazon’s “Mechanical Turk” – a labor rights disaster masquerading as a “crowdsourcing marketplace.”

Cybernetics has of course informed the practice of generative and conceptual artists like Roy Ascott, Sol Lewitt’s *Wall Drawings*, and as Harold Cohen (and his robotic partner AARON), who turned to automated processes and computer art to approach their own ideas and practice in a fresh light. This legacy of cybernetics and automatism continues today in the work of artists like Sougwen Chung, whose painting practice incorporates neural-network-controlled robots that are trained on her own work and paint in collaboration with her gestural style. Or, in Kyle McDonald’s work that incorporates human choreography with recursive neural networks to create systems of interdependency between human and

machine. Notably, these artists and others discussed here are keenly aware of the ethics of the creation of their own data and training sets. The central problems concerning the role of the artist, and of the nature of creativity, that artists like LeWitt and Les Levine grappled with in the 1960s, with the first expression of the concept of art as the “software” and its expression as secondary or “hardware”, are being rehashed today in the discourse surrounding generative artists minting editions of NFTs on various blockchains. The shadow of cybernetics still looms large on the contemporary image.

Within the realm of the moving image, the seemingly rapid adoption of machine learning to large image databases has produced arresting and surreal results that initially emerged on a wide scale with Google’s DeepDream. This imagery, which appeared for the first time when it was “leaked” by its creator, Google engineer Alexander Mordvintsev, was significant as a viral sensation and because it introduced the wider public to the ongoing research into the classification of large image databases at Google. Part of its allure and perhaps a major factor in its virality was that it was so evocative of a highly human characteristic – the idea of dreaming itself, with its deep association with human creativity. However, the motive for the generation of imagery from DeepDream was that the workings of the inner layers of the neural network were something of mystery to its designers as they functioned as a form of cybernetic feedback loop, meaning that once the algorithm was set in motion, its processes were obscured through the levels of complexity of its convolutions. This black box effect is a common feature of neural networks in practice, where the complexity of the statistical models they are based on obscures their inner workings and decision-making structure.

When the image classification function of DeepDream was used to *generate* imagery, its output both revealed something of its nature while also appearing to amplify to psychedelic extremes the human psychological phenomenon known as *pareidolia*. This is the tendency in the human sensorium to search for and reveal familiar objects when presented with unfamiliar visual stimuli – for example imagining a human “face” in the knotted trunk of a tree. The imagery emerging in the recognizable style that has been referred to as “GANism” may owe a debt to surrealism in not only its formal characteristics, but in its ethos of revealing the inner-workings of (artificial) thought unfiltered by the arbiter that is (artificial) consciousness. However, as Rob Horning has pointed out, instead of plumbing the unconscious, machine learning may become a “search engine of the collective consciousness, liberated from any of the contextual social relations

that would discipline what it produces.” Further, Horning argues that, in a mediated world that has become increasingly surreal, “Surrealism’s dreamscapes no longer posit an escape from the bourgeois life of convention but form a commonplace experience of it”, and further, “recuperated as AI, Surrealism provides the basis not for liberation but for further entrapment in existing cultural patterns reshuffled in novel ways, but not fundamentally changed.” [9] It seems clear that we must both interrogate the legacy of Surrealism within AI further as well as address promise of the creation of novel imagery that is in fact a reorganization of well-worn paths.

Second Cluster: Photography, Surveillance, Bias in the Dataset

Later iterations of this type of neural network (StyleGAN 2) have been used to generate new and convincing human faces when trained on a database of existing ones. This practice has already raised ethical issues in the application known as “Deep Fakes” or AI-generated video footage of existing people, but also has clear potential for the creation of characters in games and cinema. For image making and the image arts in general, this technology is potentially groundbreaking, but it also poses several ethical problems that are increasingly familiar to us. Initiated by Fei Fei Li, ImageNet has for the last decade been one of the largest and most widely used image databases for the training of neural networks. It is a searchable database of over 100,000 “synonym sets” – i.e., meaningful concepts that can be described by more than one word, such as “tree” and “plant”. The majority of these “synsets” (80,000+) are nouns, and within each there are usually about 1,000 images that correspond to the description and from which the neural network draws its comparative inferences. ImageNet has been used to train neural networks for facial recognition software, commercial photographic applications, surveillance and countless other implementations. However, in recent years, the importance of the criteria of categorization and classification of these image sets have become the focus of criticism. Since they are trained on an existing set of human-compiled data, neural networks inherit the biases of the systems of classification that were used to tag, sort and arrange them. In practice, these systems become hyper-efficient amplifiers of any inherent bias. Accordingly, within the community of artists and image-makers of the demo scene surrounding these technologies, the curation and creation of these databases has become an object of vigorous debate.

It is to this database and its construction that artists and researchers like Kate Crawford and Trevor Paglen have turned. Through exploring its underlying structure and understanding how the logic of the machine has shaped and formed it, they have identified a concerning legacy of biopower relations within their implementation. As Susan Sontag suggested, photography emerged from the 19th century as a “fledgling form of information culture”, making possible new modes of surveillance and methods of quantifying and fixing identity such as the mugshot (Bertillon system). The initiation of panoptic disciplinary society was of course heavily reliant on this new technology of representation. Similarly, and as Crawford and Paglen have shown, these training datasets (and specifically ImageNet) have inherited the troubling legacy of racist and pseudo-scientific systems such as eugenics. [10] Their work also recalls that of Cathy O’Neil, in her book *Weapons of Math Destruction*, in its uncovering of the troubling legacy of visual classification of categories of race in the machine learning algorithms that are used in popular forms of phot-retouching software. As Moira Weigel has noted, these algorithms “take the histories of oppression embedded in training data and project them into the future”. Through her analysis of the intellectual formation of key figures in the tech sector who have staked their claim on the side of authoritarianism – namely Alex Karp and Peter Thiel of Palantir – Weigel further suggests that this is perhaps not a bug but rather a feature. She writes that “big data analytics could be said to constitute an authenticity jargon in this sense: although they treat the data set under analysis as having something like an unconscious, they eliminate the temporal gaps and spaces of ambiguity that drive psychoanalytic interpretation.” [11]

In a similar sense, the complexity and obscurity of these specialized systems foster what computer scientist Joseph Wesienbaum in 1976 called a “fetishization” of the instrumentalized reason of code itself – a code that was only legible to the “magicians” who were “initiated” into its language. Wendy Chun has referred to this process as “sourcery” (a play on source code) as taking on the trappings of religious rites or mysticism – an obfuscation that covers over what Safiya Umoja Noble identifies in *Algorithms of Oppression* as real instances of discrimination and racism.

Further, in *Making Kin with the Machines*, Jason Lewis et al. argue that the “Singularitarians” (like Kurzweil), who proselytize for the current dominant ideology of AI, exhibit “striking parallels to the biases of those who enacted the colonization of North America and the Pacific, as well as the enslavement of millions of black people.” [12] Kurzweil’s own

seminal fantasies of interstellar travel and “infusing the universe with computronium” in a hunt for more resources to fuel an augmented and expanded human intelligence drive this point home. [13] As a potential corrective, institutions like the Indigenous Protocol and Artificial Intelligence Working Group are currently exploring if systems can be built with Indigenous languages and epistemologies at their core in order to explore the potential of decolonized forms of artificial intelligence. This brings us to a third discursive cluster – the rise in importance of the database itself.

Third Cluster: Data as Symbolic Form

As Sontag already anticipated in 1973, one central consequence of the invention of photography has been the creation of the flood of images that surround us today. In *On Photography*, she writes that the camera has already made reality “atomic, manageable, and opaque”, sampling reality, organizing it and abstracting. Today, it is clear how this collecting impulse manifests itself in the grids of imagery that we consume regularly. Photography’s most popular form today, Instagram, is clearly an aestheticization of the database form itself – an attempt to create an experience of the familiar and beautiful out of the fundamentally awe-inspiring informational sublime that resides in the massive data centers behind the screen.

Lev Manovich has demonstrated the importance of the “database” in media as an organizing framework. Beyond this, Manovich recognized an epochal shift at work that was equivalent in its magnitude to Erwin Panofsky’s description of the primacy of perspective as the symbolic form of the modern age. Accordingly, Manovich asked how we could develop “a poetics, aesthetics and ethics of this database.” While this new form or structuring logic has been widely discussed in relation to the emergence of distributed database effects such as “transmedia storytelling”, it is in the very recent work of artists working with deep learning and generative techniques that we may be seeing the outline of an aesthetics, poetics, and even ethics, emerge. For it is the technique of machine learning that accesses the database and use it as raw material while also reconfiguring the space of the figural – in a similar sense that the techniques of perspective transformed the figural rendering of space in the Renaissance. I would like to propose that what we are seeing are new tools for coming to terms with the database as symbolic form.

In response to the emergence of the importance of the actual construction of the database for these images, artists like Anna Ridler have taken on the task of creating their own databases – in her case, vast quantities of images of tulips that are fed into a GAN

which then produces (imagines) entirely new tulips whose generation is tied to fluctuations of the Ethereum cryptocurrency – recalling the tulip mania of the first speculative financial bubble. Ridler’s work acknowledges the importance of the database while also engaging with the time-consuming human labour that often stands behind these ostensibly “automated” systems, while also acknowledging the new forms of financial exchange of our time.

Fourth Cluster: Cinematic Time, Cyberspace, Image Synthesis

I will briefly touch on a fourth cluster that reveals the importance of the emergence of machine learning techniques to how we conceive of space in the production of the moving image. This discursive network is characterized by the interaction of data science, generative art and 3D rendering technologies. The production of cinematic space has increasingly relied on the adoption of tools and techniques from the realm of architecture and computer aided design – a situation that has opened possibilities for the representation of space that transcend traditional lens-based media. These technologies have, to this point, been largely pressed into the service of the creation of photo-realistic 3-dimensional environments. But the radical potential of how computers represent space has not yet been fully explored. As Wolfgang Ernst writes, “in digital operations, space is nothing but a metaphor” – meaning that the dimensionality of Cartesian space is merely a question of nested arrays of data and the representation of n-dimensional space (beyond three dimensions) is relatively trivial. He writes that “cyberspace is fundamentally spaceless. It is purely relational, thus not representing anything in terms of mapping.” [14]

I raise this point here to draw attention to the fundamental difference between how these new machine learning technologies represent and work with space in comparison to existing CAD-based 3D design tools. I believe that what we are seeing here is a fundamental change in the way in which space – now configured as data – can be represented, and further, that this can be thought of along the lines of previous paradigm shifts in the history of the moving image. Similar to Mary Ann Doane’s claim that the birth of cinema was an attempt to “make tolerable an incessant rationalization” of time that was the result of “industrialism and the expansion of capitalism” by the concurrent “structuring of contingency and temporality” that is the hallmark of the moving image in the late-19th century, the reconfiguration of space as data in the works of artists and image makers can today be read as a similar “coming to terms” with data as symbolic form and also of the uncertainty of the

stochastic model of reality. Doane claims that thermodynamics is a central metaphor of the 19th-century emergence of cinematic time. She writes that “images of entropy and exhaustion, of the heat death of the universe” corresponded with the “irreversibility of time” of Newtonian mechanics and a “pure record of time” of “contingency”. [15] But what we are seeing here is something new; as Norbert Wiener noted, the cybernetic model emerges out of the transition from “Newtonian to Bergsonian time”. This corresponds with the 20th-century shift from Newtonian physics to statistical mechanics. As an illustration, Wiener suggests the difference between “Newtonian astronomy” vs. “meteorology.” [16] The first is a system of certitude that is compatible with the notion of the harmony of the spheres, while the second is an attempt to model the chaos of complex natural systems using probability with no notion of the absolute.

I see potential here in the work of artists who have begun to work within this new space of the image. The frenzied machine visions of GANs are produced from the “latent space” of neural networks and artists like Mario Klingemann have begun to traverse this space in the role of photographer, or “neurographer,” as he terms it, composing, selecting and framing images from within it. When set loose on a dataset of imagery, the visual output of these GANs has ignited the interest of artists such as Memo Akten, Helena Sarin and Robbie Barat, whose own explorations of the latent space circulate largely in the computer art world and across platforms of open-source code. [17] Until very recently, and partly because accessing hardware to do so has until recently been prohibitive, this work has largely been done using still imagery and not video. However, recent advancements have begun to make similar techniques realistic for the moving image. Works such as Memo Akten’s *Gloomy Sunday* (2018) revealed the potential in real-time generative animation and cinematic imagery. Here we see the technique of “real-time style transfer” at work – a process that maps the latent space data of one set of imagery onto an entirely new one.

This was a very computationally intensive task in 2018, but it has already become a fairly trivial effect – one that can be assimilated into a toolbox of filters that. Another recent experiment by Arun Mallya et al., reveals the potential of similar methods to synthesize images of space using only rudimentary semantic inputs. [18] These recent experiments reveal the speed at which the technology of neural-net video synthesis is moving, showing how a basic two-dimensional image that is tagged based on the color of objects can be used as an input for a neural network that generates photo-*surrealistic* moving imagery of a streetscape based on an internal semantic logic or, in Metz’s terms, a language system for the cinematic image. This is

undoubtedly impressive as a technical feat, but it also illustrates how the space of the image has been effectively reconfigured as information – not as pixels, as in previous understandings of the digital image – but as a synthesis of newly imagined space that is nonetheless derived from a database of existing imagery.

Conclusion

To conclude, I will briefly summarize this attempt at theorizing the application of machine learning to the cinematic image.

1. It has inherited the discourse of generative art as well as the conceptual lineage of Surrealism. There is potential here for machine learning tools to function in a manner reminiscent of automatic writing – as an extension or augmentation of creativity that can bypass rote methods and patterns.
2. At the same time, machine learning inherits the legacy of the stochastic methods that drive it. When applied as a system of sorting and generating imagery, it has been correctly criticized as amplifying internal bias within its operative data set. Further, AI image generation may gloss over (or perhaps amplify?) the potential of its Surrealist legacy by replacing psychoanalytic interpretation with the fetishization of instrumental reason.
3. That said, machine learning may stand as the most clearly articulated technique of image production that has emerged as a reaction to the flood of imagery and big data analytics that are an unavoidable feature of contemporary media. If the database is the new symbolic form of our time, cinematic production techniques will clearly be altered through the adoption of AI-driven applications and specialized software solutions in the form of editing and visual effects suites. The question then remains then, to what end?
4. The work of artists including and beyond the few mentioned here points to potential for new forms of imagery and a reimagining of the ontology of the digital image in the era of big data – of a movement away from the or the frame as fundamental units of the image and towards the emergence of the stochastic image. These systems also promise to realize a persistent dream of cinema – that cinematic imagery can be analyzed and understood as fundamentally a semiotic system or a rule-based language.

In this brief outline I believe we see an at times tantalizing, at times troubling contour of the present

state of machine learning as it is being applied to the moving image. That these tools might unlock a new language of analysis and generation of imagery is fascinating and full of potential. However, the rules for decoding this language of imagery are already being written and research into the application of machine learning to the moving image is rapidly progressing with the blessing of major industry figures such as NVIDIA and Google. These are nascent and exciting technologies but there is a danger in their uncritical roll-out of falling prey to the allure of what Robert Oppenheimer referred to as the “technically sweet”. The application of machine learning to the moving image is in its infancy but it is being largely led by leading industrial players within computer graphics big data. To realize the potential of this new technology, and to avoid the many pitfalls that have already been identified, we, as imagemakers, audiences, artists, critics and cinephiles, should strive to understand the potential of these technologies beyond the narrow bounds of these industry applications and within a larger history of the cinematic image.

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Artistic residencies in digital companies

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Abstract

This paper aims to enrich the knowledge of artists' residencies in digital companies, both to understand their particularities and to help develop methods to evaluate the processes and effects of these initiatives. The popularity of artists' residencies has increased since the 1990s. This can be seen in the funding organizations that develop support programs but also in the diversity of the host institutions, community organizations and private companies that want to welcome artists and develop links with the art worlds. What explains this growth? What are the different parties involved looking for? What are the effects of these residencies on artistic careers? This research brings a particular attention to artists' residencies in digital companies. Acting as a precursor in Quebec, the Conseil québécois des arts médiatiques (CQAM) set up its first residency in 2016 at the interactive media company Turbulent, followed the next year by another at the audiovisual entertainment company VYV and in 2018 by Milieux, an Institute of Arts and Technologies. Our research explores the ten residencies that have taken place to date, based on interviews with artists and company employees. A literature search was also conducted to better understand this growing phenomenon. Our work allows us to better understand what artists' residencies in companies are, do and allow. The host companies seem to seek, in the presence of the artist, a force of reflection and change for the practices and rhythms of work. For artists, the main interest of residencies is the possibility to devote time and resources to a project. However, the link between these two worlds is not automatic and requires a strong commitment, which in turn requires the involvement of intermediary organizations.

Keywords

Artistic residencies, artist, art, creative, digital companies, digital art

Understanding artistic residencies

Since 2019, the research center ARTENSO has begun a process of documentation, research and knowledge production on the subject of artistic residencies in order to, among other things, accompany project leaders on their modalities and results. In our approach, we consider the support of creation through artistic residencies as a potential space for cultural mediation to increase interactions between artists and the community. Two pieces of research have been produced: on artist residencies in municipal cultural spaces and on artist residencies in college settings. This research

brings a particular attention to artist residencies in companies and particularly in digital companies. Our study intends to promote the understanding of these mechanisms, and the reflection to contribute to their development. In Quebec, artist-in-residence programs are relatively rare and there is no academic research specifically devoted to them, both in their deployment and in their impacts, both for the host company and for the resident artist.

Today, artists' residencies are very present in the arts and culture sector, both for institutions and for artistic careers, but in their current form they are relatively recent. It is important to underline the common and conscious use of the plural for the expression "artist residencies". The research shows that what characterizes this mode of support for creation is its diversity. This diversity is present as much in the artistic disciplines concerned (dance, visual arts, literature, etc.) as in the host structures (artist-run centers, museum institutions, living environments, businesses, etc.). The existing formats are also varied. There are short and long stays, residencies with or without accommodation, residencies focused on creation and dissemination, others on research, online residencies, residencies dedicated to a specific territory, etc. Finally, the great fluidity of the modalities that link the artist to the host structure and to the different interlocutors that they may have (public, neighbors, workers, artists, etc.) contributes to drawing this very diversified portrait. In all cases, however, artists' residencies are based on two fundamental dimensions: the artist is, in one way or another, immersed in an environment other than his or her usual practice space; what is produced during the residency is not an artistic commission and the artist is not an employee of the host structure. This is as true for a writing retreat in a monastery as it is for a virtual creation residency in a self-managed digital arts center. Thus, apart from this succinct definition, residential arrangements, understood as the forms, structures and organizations of artistic residencies, are characterized by their diversity.

In Quebec, artist-in-residence programs for private companies are relatively rare and there is no academic research specifically devoted to them. Acting as a precursor, the Conseil québécois des arts médiatiques (CQAM) set up in 2016 their first residency in the premises of the interactive media company Turbulent, started with the participation of artist Thomas Ouellet Fredericks. Several other editions have followed since: Elise Trinh (2017), François Quévillon (2018) and Peter VanHaafden (2019) and Lucas Laroche (2021). This residency is now included in the support programs of the Conseil des arts de Montréal. Starting

in 2017 the CQAM program was enriched with a residency at VYV, a company specializing in technological entertainment, which hosted artists Lucas Paris (2017) and Matthew Biederman (2018). In 2019-2020, VYV worked in collaboration with the Society for Arts and Technology (SAT) to disseminate the work of artists in residence Charline Dally and Gabrielle Harnois-Blouin. The most recent addition to this program of support for artistic residencies in digital companies is Milieux, Concordia University's Institute for Arts, Culture and Technology, which has hosted Christopher Willes (2018) and Amélie Brindamour (2019), for a total of two experiences so far. This ensemble appeared to us as an ideal research ground to pursue our reflections on the objectives and effects of artistic residencies in digital companies. By studying these different residencies, this research will therefore pursue three complementary objectives:

- To document the processes, the modalities of implementation and development of the residencies.
- To better understand how the worlds of business and professional art meet in the residencies.
- To develop an evaluation framework for artist residencies in companies.

The CQAM was involved as a research partner, which allowed us to access documents related to the implementation and development of the residency program, while guaranteeing a role of accompaniment and follow-up of the research to the CQAM representatives.

Methodology

In addition to a rich review of the literature in English and French on artistic residencies, artistic residencies in companies and cultural entrepreneurship, our research is based on mixed data:

- Interviews with 4 artists and 3 representatives of host companies;
- Results of a survey conducted by our partner CQAM with 4 artists and 4 representatives of host companies;
- Meetings with three project leaders of artist residencies in digital companies;
- Follow-up and working meetings with our partner.

The rest of this paper is organized according to three explanatory poles of the implementation of artistic residencies found in our literature review: philanthropy, management and creative entrepreneurship. For each, we will review the literature on the subject and compare it to the data collected in the context of the program studied. Far from seeking exhaustive answers, we aim here to highlight the diversity of the cases, both in the residential forms and in the professional paths of the artists who participate.

Artists in companies

Our definition allowed us to integrate in our readings and reflections a part of the field of artistic intervention in companies. In fact, in Europe in particular, there are several initiatives that come close to what the CQAM program proposes, but which are described with terms other than residency: "workarts", "arts-based initiatives", "arts-based learning programs", "artful learning alliances", "artsbased interventions" or, most commonly, "artistic interventions". For Joost Heinsius and Kai Lehtikoinen (2013), artistic interventions are understood as artist-led processes that are adapted to address organizational challenges through artistic inquiry. As such, many art interventions unfold over time, with recurring or ongoing presences in the workspace. The interventions are often conceived over time. In Quebec, the organization Culture Pour Tous initiated in 2007 a pilot program entitled Art at Work. This program has allowed about thirty projects to be born, in a variety of sectors (industrial, manufacturing, daycare, municipal...) and in different cities of Quebec. For this research, we have therefore taken into account all the projects involving artists and companies that fall within our two definitional criteria (which excludes the commissioning of works or the use of artist-coaches, for example). The grey literature (reports, guides) as well as scientific literature allows us to identify 4 challenges:

A first challenge for the full development of these devices is that of the interest of leaders in artistic intervention (Quintas 2012; Berthoin Antal et al, 2018). Companies are hierarchical structures for which the allocation of resources in time or personnel is framed. A lack of interest is thus going to have fairly direct repercussions on the resources and attention that the artist will receive.

Secondly, it is often necessary to set up training or integration programs dedicated to artists beforehand in order to help them integrate into a social space and a work rhythm other than their own. This step, if done appropriately, helps artists better utilize their artistic visions and skills in non-artistic contexts (Heinsius & Lehtikoinen, 2013). However, not all residencies incorporate this step, which can complicate the relationship between the artist and the host organization.

Third, although the artist's presence is intended to have an impact on the daily life of the employees, this does not happen automatically. The tasks of the host organization's staff, their work rhythms and organizational particularities may conflict with the artist's presence. The positive dynamic intended by the artist's arrival can turn into disappointment (Berthoin Antal and Strauss, 2013).

Finally, it seems common that corporate residencies aim both to integrate artistic processes but also to see the final production of a work or body of work. This is related in particular to the very nature of the company. However, not all artists' residencies necessarily have a final production imperative. Therefore, there is a challenge in the organization to clearly define the expectations of the different parties (Taylor and Ladkin, 2009).

Creative management

Artistic residencies are generally understood from the companies' perspective as artist-led processes that are tailored to address particular organizational challenges with artistic research (Heinsius and Lehtikoinen 2013). It is thus a practice that brings artists into collaboration with different stakeholders such as employees, management, customers, and the community (Heinsius and Lehtikoinen 2013; Schiuma 2009). The stated goal of the actions designed and implemented at the heart of these arts residencies is to support or trigger the development of organizations in the 21st century business landscape, based on the use of artistic practices and/or resulting works (Grzelec and Prata, 2013). In Quebec, a pilot program was initiated in 2007 by the organization *Culture pour tous*. Entitled Art at Work, this program has allowed about thirty projects to start, in a variety of sectors (industrial, manufacturing, daycare, municipal...) and in different cities in the province of Quebec. The results show that the motivations for companies are rooted in the integration of artistic processes as tools for managerial innovation, which is confirmed by other work done in Europe (Berthoin Antal 2018; Heinsius and Lehtikoinen, 2013).

To understand this openness to artistic processes in business, it is essential to make a detour through the notion of creativity. Appearing initially as a specialized term in the field of psychology, the notion of creativity gained popularity as its meaning opened up to designate the ability to imagine the creation of something new. Initially referring to individual capacities of imagination, it will be applied to larger ensembles: creative cities (Yencken, 1988), creative economies (Howkins, 2002) or creative classes (Florida, 2002). The arts and culture are mobilized in these conceptual thoughts not as the sole domain of creativity, but rather as an expression of the new modes of production and relationship to work generated by the most recent mutations of capitalism (Boltanski and Chiapello, 1999). Project work, flexibility, continuous innovation and the importance of passion in one's career are inspiring management. The cultural industries are gradually becoming the creative industries, and artists' work processes are becoming a source of inspiration for the organization of work in companies, particularly in creative and digital companies. From a critical point of view (Tremblay, 2008), there is a real injunction to creativity that takes the form not only of a moral imperative, but also of a commercial must (Schiuma and Carlucci 2018). In the interventions accompanied by *Culture pour tous* in Montreal, the argument stated that "creativity, knowledge, diversity and beauty are indispensable foundations for human development" (Quintas, 2012 : 49). These are values that we seek to insert into the world of work and the managerial culture through the intervention of artists. How are these intentions translated into the experiences of those involved? The notion of creativity was mentioned when the different participants were discussing their motivations. The motivations for companies seems rooted in a desire to integrate artistic processes

as tools for managerial innovation (Berthoin Antal 2018; Heinsius and Lehtikoinen, 2013). In one of the few works that includes a coherent research field on the motivations of host companies, Anna Grzelec and Tiago Prata (2013) argue more specifically that it is the development of new methods or processes, creativity, change management and motivation that constitute what host organizations expect from artists. It is therefore expected that through their presence, their practice, the artist will share with the company their sense of innovation, even disruption, and that they will lead to the development of the organization's creativity. However, this must be organized, and it is therefore necessary to set up contexts for meetings and exchanges, without which there is no possibility of evaluating the effect of the artist's presence.

Objectives and expectations

There is little research on artist residencies in companies, and none directly on artist residencies in digital companies. Some of the sources consulted present themselves as research or evaluation of residencies, however, we note that the methodologies used actually limit the conclusions of these works. Indeed, evaluation practices are not generalized, and the indicators used when this is done vary enormously. This difficulty also stems from the fact that participants observe different outcomes depending on their roles, but also because they confer multiple/changing roles on the intervention throughout its duration (Berthoin Antal, 2012). Thus, it seems "impossible to establish clear mono-causal links between an artistic intervention and organizational outputs" (Berthoin Antal and Strauss 2013 : 8). The residency cannot be judged by conventional management indicators to assess the impacts of the initiative in the organization such as reduced absenteeism and increased productivity (Berthoin Antal et al, 2018 :17).

Several criteria appear in the literature to gauge the effects that should be sought for the people involved in the development of artistic residencies. Within a company, the implementation of an artistic residency seems to be mainly justified by the managerial contribution it allows. Schiuma (2009) sees impacts on human resources as well as on the functioning of the economic model. Nissley (2010) discusses the transfer of applied artistic skills in organizational contexts. He believes that the goal of artistic intervention should be to encourage artistic creation for employees, both as a mode of expression and as a technique for reflection. The report commissioned by Tilt Europe (2011) on the subject lists several indicators along these lines: encouraging disruptive thinking and challenging management routines to improve organizational effectiveness; engaging organizations in innovation; generating new perspectives; and helping organizations define their identity through creativity. Berthoin Antal et al. (2018) propose three indicators that signal a successful residency: allows individuals to express and develop themselves in ways they consider meaningful; contributes to enriched relationships at work

and service to others; expands the organization's potential to contribute meaningfully to society. Those approaches emphasize the benefits to the company, but not to the artists. However, these benefits are accompanied by duties, especially for the entire organizational chain. Indeed, the literature indicates that it is the responsibility of project/team leaders as well as company managers to closely monitor artistic interventions in order to ensure that the investment is not wasted and that people are not confused and frustrated (Berthoin Antal and Strauss, 2013).

This dimension is central to the literature on the topic. Yet, in the program studied, management through creativity does not seem to be a primary motivation for host companies, which put forward more of a corporate or personal (management) interest in the arts. Artists are thus coupled with technicians to meet production needs, rather than with management, which limits their effect on the structure and rhythm of the company. For granting organizations as the CQAM, it is the inclusion of art and artists in other environments that motivates the support of artistic residencies. Finally, on the artists' side, it is the working conditions and the development of artistic projects made possible by the system that seem to predominate in explaining the commitment. From then on, a major challenge appears: the need to coordinate the different motivations and needs of the parties involved.

The challenges of integration

The work rhythms are not the same for artists and host companies. It is not only the working hours that need to be considered, but also the alternation of rush periods and quieter periods, the rhythm of meetings, the rhythm of development of projects. Our research shows that it is essential to take into consideration the differences in project development and management between artistic practice and the creative industries. The mode of project development is fundamentally different, yet the residency is overseen as a project (project manager, dedicated staff), which in itself is normal in a structure of this type, but it tends to limit the possibility of being destabilized by the artist's presence. The time of the dedicated employees must obviously be managed in the best interests of the company, which is why in the different residencies considered, there were several changes in the person providing assistance according to the priority needs of other projects. Time and resources are therefore limited and changeable, which does not necessarily bother the artists, since the development of an artistic project does not have to end at the end of the residency. However, this is less common in the management of a corporate project. These differences in relationships and work rhythms explain in part the difficulty of meetings and sharing practices. The integration of the artists is not similar according to the possibilities of the employees of the structure to grant time to it.

For a good integration, it is also necessary to pay attention to the expected uses of the technological tools. All the

artists do not necessarily have the same level of mastery, knowledge or curiosity for the technological tools. We also see a difference between those who seek an application and those who opt for experimentation. For example, two artists underlined a "gap between practices" that could not be bridged, due to the lack of time for exchanges. The importance of sharing the artistic process is clear, and it is done well especially with the dedicated employees who, in order to help the artist, spend time together, and understand each other.

Thus, the decision about which employees will participate is going to be discussed: either on a voluntary basis or selected by management based on the relevance of the program issue (Berthoin Antal et al, 2018). Determining goals and strategies beforehand is a key factor in the success of an arts intervention (Schiuma, 2009). It is also upstream that the objectives must be defined and validated by all parties in the organizational structures (Grzelec & Prata, 2013). The duration of the residency is another important issue. First of all, because participation in projects is added to the normal workload of employees. And also because of the importance of having a good schedule done beforehand, in order to organize the work, measure the results and create a sense of urgency to promote the activities at specific times (Berthoin Antal et al, 2011). In this structure, what place does the artist take? How can we understand his commitment? What are his motivations for participation?

Cultural entrepreneurship

The figure of the cultural entrepreneur has been developing for several years, particularly in institutional contexts through training or dedicated funding. The development of creative entrepreneurship is also related to the employment status of artists. In Quebec, a higher proportion of artists are self-employed (53%) than other cultural workers (24%). In the overall experienced labor force, the percentage of self-employed is 12% (Danvoye, 2020). This situation can be understood through the prism of the evolution of the forms of institutional support for cultural production (Martet, Lussier and Bélanger, 2018) but also as a necessity in the face of the precariousness of artistic creation (Menger, 2003). The labor market in the cultural sector is classified as difficult, "atypical, characterized by oversupply and the need for flexibility" (Hausmann 2010, 17). In a deteriorated labor market, Borja and Sofio denounce the demand for versatility and realism imposed on artists, in a context where cultural funding is becoming increasingly scarce (Borja and Sofio 2009), so that members of the arts and culture sector are more likely to create their own jobs and work on a project basis. Yet researchers speak of an increasing entrepreneurialization of work (Hausmann 2010; De Heusch et al. 2011; Gandini et al. 2017; Borja and Sofio 2009). Finally, artists seem to suffer from a public image devaluing their work which forces them to con-

stantly negotiate the value of their practices and their productions (Novak-Leonard 2017). The entrepreneurial approach to artistic careers seems to be promoted in part to counter these pitfalls and challenges. For Borja and Sofio (2009), the entrepreneurial regime appears as a new way to justify the heteronomous tendencies of the art field. Greffe (2014), shows that cultural entrepreneurship is linked to the forms that the relationships between the artist and other artistic professions take. He describes the artist as often being considered as a producer of concepts brought to subcontract certain tasks and mobilize other skills than his own. Thus, the artist becomes an entrepreneur "when he or she must insert himself or herself into the lives of other enterprises and assume debates as equals" (Greffe 2014 : 50). Rooted in this notion is an approach that presents the artist-entrepreneur as a very small business (De Heusch et al., 2011; Wyszomirski and Chang 2012; Bonin-Rodriguez 2012; Courvoisier et al., 2015; Enhuber 2014; Claden 2016; Novak-Leonard and Robinson 2021). In these approaches, the artist seems destined to incorporate entrepreneurial practices into his or her creation, production, and dissemination processes in order to be able to pursue a career. Therefore, artistic residencies in companies should produce effects on the entrepreneurial capacities of artists, and eventually constitute reasons for artists to get involved. However, our fieldwork nuances this hypothesis. We expected the notion of entrepreneurship to appear more clearly in the artists' motivations, as a value sought for career development or with the idea of an artistic exploration of the entrepreneurial milieu. This was not really the case. In the end, the artists' commitment seems rather pragmatic: they need funding, space and specific tools to develop their projects, their practice. On the side of the companies, the support to the artists also appears to be the main way of understanding their commitment. However, this form of support differs from patronage in that, as we propose in our definition, it aims to allow an artist to be immersed in another environment, with time and resources to create, without compensation. It seems, however, that adjustments could be made to encourage meetings and exchanges between the artist and the host environment to improve these residential arrangements

Career and working conditions

If it is clear that artists benefit from their career progression from residency initiatives, it is not so much because of the content of the residency but rather because of its material conditions. An artist residency requires funding and in-kind contributions (access to space, tools, remuneration, creative expenses, etc.). Programs are funded from a variety of sources, including external funding in the form of grants or support from regional, national, local, or foundation sources, which in most cases use a dedicated budget for cultural action. There are also programs in which funding is supported by the company. These funds are regularly combined.

From the point of view of the artists, the residency is an opportunity to develop research or a body of work under advantageous conditions. The residency is an opportunity to have time and a dedicated space for artistic research and/or the creation of a body of work. Since most artists are in precarious situations, the residency appears to be an ideal context for working. As such, the residency, whether in a digital company or elsewhere, is firstly access to time and space for creation. Secondly, access to industrial, technological or organizational processes is also a strong incentive, as it allows new ideas and techniques to be tested. Thus, most of the artists we met were able to benefit from work on computer engines and the support of programmers to develop projects that would have been difficult to create with their personal equipment. Finally, participation in residencies, particularly residencies organized with institutional structures of the cultural milieu, is important in the CV of artists and the pursuit of their career. Indeed, the selection to the residencies passing by a stage involving a jury of peers, the process constitutes a form of professional validation of the artistic project, and this type of consideration of the peers is a major criterion for the granting of other forms of institutional financing. In sum, participation in the residency is fully integrated into the artistic career and contributes to the improvement of the working conditions of artists.

Conclusion

Our work has allowed us to highlight the complexity of the definition of artist residencies due to the variety of their forms, their objectives and the actors they bring together. However, we have highlighted several essential elements of definition: a space outside the artists' usual practice environment, the artists are not employees of the company and do not produce a commission. We have been able to identify the historical sources of the current forms of these modes of cultural action and to underline their current unavoidable character.

The dominant approach on these questions is based on the promotion of the integration of artists in order to feed managerial innovation. The sources we have mobilized are often institutional reports. It seems important to develop critical research on the subject. Our work has enabled us to identify the modes of structuring and organization existing in companies that welcome artists. The portrait that we draw underlines the diversity of the motivations and needs of the different parties involved, which encourages a flexibility of the forms of artistic residences.

The term of artist residency in companies is not necessarily used in projects based on the presence of artists in companies. If certain authors favor the term of artistic interventions, we affirm the relevance of the use of the term of residence to underline the potential integration in a long temporality. This seems important in certain contexts

to allow the development of strong links between the parties involved. There is indeed a need to integrate the artist more into the daily life of the company, to weave links with the employees of the host structures. The integration of cultural mediation practices by the artists, or by mediation professionals, seems to be a relevant way to improve artistic residency programs in digital companies.

Impact evaluation is often documented in very specific documents that focus on a particular initiative. We argue for the importance of developing a more comprehensive or easily mobilized approach to impact evaluation for artists, companies and intermediaries.

Our research field shows us that the main motivation for developing artistic residencies in digital companies seems to be philanthropic practices. Secondly, it is the effects of the presence of an artist for the management that are evoked, even if our research shows that these are limited, notably by the little interaction of the artists with the employees. Finally, artistic residency programs seem to be essential for the development of artistic careers and the improvement of artists' working conditions. Our research shows that there is a concordance between the wills of the business community, cultural support organizations and artistic communities to develop artistic residencies.

Based on this work, we identify 8 recommendations for artistic residencies in companies.

1. Integrate presentation times to encourage meetings with the company and different groups of employees.
2. Think about the duration of residencies in the medium term and encourage flexibility in the artist's work rhythm, depending on the project.
3. Work with a support organization that is close to the artistic community (e.g. CQAM).
4. Plan and manage work schedules in accordance with the artists and the dedicated employees.
5. Introduce the artist to the tools, resources and culture of the company prior to their arrival.
6. Identify expectations in terms of technology use and ensure the selection of artists in accordance.
7. Encourage artist residencies within and outside of technology departments (management, HR, etc.).
8. Implement evolutionary evaluation methods.

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Connecting New Media Art Archives Worldwide

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Abstract

Online new media art archives exist throughout the world as repositories documenting theory and practice of electronic art. For a researcher, instructor, or student using these resources for scholarly work or inspiration, the process often involves visiting multiple websites with different interfaces and information. Without knowledge of the wide variety of archives that catalog new media art, the sought-after material may be missed. In 2018, the seeds of an initiative were sown at a roundtable discussion at ISEA2018 (South Africa) and during ISEA2019 (South Korea), the real work began to investigate and initiate the process of connecting new media art archives from around the world. Beginning with a core group including representatives from the ISEA, SIGGRAPH, FILE, Ars Electronica, and the Archive of Digital Art (ADA) archives, group discussions, implementation meetings, summits (Summit on New Media Archiving @ ISEA2020, mini-conferences (FILEALIVE 2020) and presentations at various conferences occurred. This paper outlines the details of the project along with the implementation procedures and challenges.

Keywords

archive, new media art, ISEA, SIGGRAPH, ADA, FILE, Ars Electronica, online repository, electronic art, digital art

Introduction

Over the past 50 years the number of events that could be labelled 'electronic art' has grown exponentially and so have the number of online archives of these events. Also, a number of museums around the world have begun collecting electronic art and archiving documentation of this work via an online archive. The vast collection of archives vary in scope and intention, and online archives of electronic art have different structures, use different taxonomies, and contain different types of materials. There are also a number of similarities in the archives in that they often contain information about artists and/or academics. All online new media art archives typically document events, works, accomplishments, publications, innovations and other historically-relevant materials, and disseminate this information to the public through the web.

Access to information via the web is fast, convenient, and accessible to those who have an internet connection, but searches often do not return comprehensive and complete results. Therefore, it seemed logical to initiate a project to connect new media art archives so that researchers, artists, educators, students, and the general public could broaden their awareness of the information available. Establishing connections among new media art archives is a complex task due to the technical and logistical obstacles. Through the dedication and expertise of the parties involved, this initiative is currently underway. Significant planning has been accomplished and we are now working on the logistics. The technical specifications are currently being developed and implementation will begin in the next year.

History of the Initiative

Electronic Art Archive Meeting in Durban

In 2018, the ISEA archivists organised a roundtable discussion at the ISEA symposium in Durban, South Africa. [1] The original idea behind the founding of ISEA was to create a central hub to connect electronic art initiatives, institutes, and organisations. Therefore, it seemed logical for ISEA to spearhead a discussion related to connecting online new media art archives. The meeting had three aims:

1. To discuss how to connect to each other's new media art archive on-line.
2. To investigate the possibility of a common platform that would be able to search all connected archives.
3. To collaborate and learn from each other and to avoid duplicate efforts.

Approximately ten representatives of different archives from around the world participated in the roundtable. During the meeting they talked about their archive and discussed concerns as well as important topics to be researched, challenges to be met, and steps to move forward.

Electronic Art Archiving Meeting in Gwangju

The ISEA2018 roundtable on Electronic Art Archiving led to a follow-up roundtable discussion organised during the ISEA2019 symposium in Gwangju, South Korea by Wim van der Plas and co-chaired by Oliver Grau of the ADA archive. [2] A flyer announcing the meeting was distributed to all symposium participants via the conference bags. The room reserved for the discussion was designed to hold approximately 25 people but because of the wide appeal of the topic, the room was packed with at least 50 people. It was therefore impossible to have a roundtable discussion where all participants contribute equally. Instead, participants introduced themselves and their archive and made comments on their challenges and successes. The meeting was fruitful in the sense that:

1. There is a lot of interest in archiving new media art.
2. Participants experience similar challenges.

During the meeting, a list of participants was compiled, and participants agreed to take the initiative a step further.

Online New Media Art Archive Summit

During ISEA2020, a day-long Summit on New Media Art Archiving was organised by four cooperating parties: the ISEA archives, Archive of Digital Art (ADA), the Ars Electronica archive, and the SIGGRAPH Art Show archive. [3] The 2020 ISEA symposium, hosted from Montreal, Canada, was held entirely online. Twelve papers from nine different countries were presented and were accompanied by short presentations by the four organising archive representatives along with a keynote address by Oliver Grau. The proceedings of the Summit are included in the Proceedings of the 26th International Symposium on Electronic Art. [4]

The second part of the Summit consisted of three parallel break-out sessions: “Connecting New Media Art Archives”, “Creating Ties to Museums”, and “Funding for New Media Art Archives”. A plenary, concluding session was called ‘Creating a Roadmap Towards the Goals of the Liverpool Declaration’. The Liverpool Declaration [5] makes a case for the need to establish international and sustainable funding structures. This includes the development of a cooperative process of knowledge transfer between artists, institutions, and researchers internationally. Through the supported alliance of art organisations, media art archives, and individuals, a system of sharing data, resources, and expertise should be established. This declaration was published several years ago and was signed by close to 500 leading experts and institutions in the field of new media and electronic art.

The summit triggered interest from new parties, including the European University at St. Petersburg (Russia), the Electronic Language International Festival (FILE) from Brasil, and many others.

We felt it was necessary to form a core group of archives to initiate the process so we could hold focused and structured discussions that led to action (see figure 1). The

SIGGRAPH, ISEA, FILE, Ars Electronica and ADA archives appeared to be logical choices because of the similarity in the data they contained. We held meetings and focused on the task at hand by outlining priorities and establishing goals.



Figure 1. A vision of the initial international archives network.

New Media Art Archives in the Core Group

ISEA

The International Symposium on Electronic Art (ISEA), consists of an academic conference, accompanied by art events and supported by workshops. Beginning in 1988, the presentations, workshops and artworks were documented in printed proceedings and catalogues. The ISEA archive initiative began in 2006 with financial support provided by the Mondriaan Foundation. Because of the nomadic character of the ISEA symposium, without a funded central office, the first version of the archive (2008-2012) was constructed long after the symposium series started and had to be built on the basis of retrospective research.

In 2012, a completely new version of the archive, now referred to as the classic archive, was developed to rescue the archive’s data from a soon-to-be decommissioned server (see figure 2). [6] To facilitate bi-directional relationships between the data along with data visualisation and rich media, a third version of the archive was established in 2017 and moved to the SIGGRAPH server in 2019 (see figure 3). [7] The two archives act in tandem with text information researched, formatted, and added to the classic archive and then moved to the new archive. Both archives are continually being updated to accommodate new information, restructure existing information, and enhance the text with added visuals and videos.

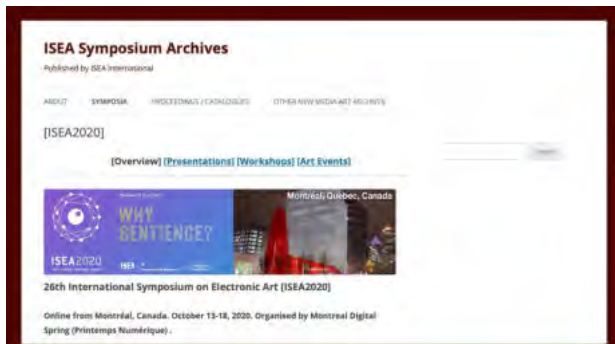


Figure 2. Classic Online ISEA Symposium Archive.

Both the classic and new archives use WordPress but the new archive is custom-coded using PODs, PHP, HTML, CSS, and Javascript. Both archives contain information about symposia, presentations, workshops, and art events and includes metadata that allows data to be accessed in a multitude of ways. The new archive also includes information on venues and a gallery of images from each event. Another major difference between the archives is that the new archive is able to handle thousands of images, videos, and other rich media. The archive team has started a Youtube channel and is embedding videos into the pages in the archives. [8] Both the classic and new ISEA archives have been developed by a team of international volunteers, student interns, and ISEA representatives with very little funding.



Figure 3. New ISEA Symposium Online Archives.

SIGGRAPH

The Association for Computing Machinery (ACM) is the world's first and largest educational and scientific computing society with Special Interest Groups (SIGs) forming communities within the computing field. [9] ACM SIGGRAPH, established in 1974, is a Special Interest Group of the ACM on Computer Graphics and Interactive Techniques and hosts annual conferences [10]. Beginning in 1981, the SIGGRAPH conference included an annual art show showcasing some of the world's most innovative and creative digital artworks.

In 2015, an archive of digital artworks exhibited at the conference was started under the ACM SIGGRAPH

Digital Art Committee (DAC). The archive was expanded to include writings and presentations (art papers, panels, roundtables, essays, and so on) as well. Developed with a team of students, this new archive contains interconnected resources from SIGGRAPH, SIGGRAPH Asia, and the Digital Arts Community Online Exhibitions (see figure 4).

[11] The ACM SIGGRAPH Digital Art Archive encapsulates the development of computer/digital art as it evolved from algorithmic approaches in the 1980s to contemporary interactive forms of expression. The archive includes information about the artists, presenters, chairs, juries, and other individuals who contributed to the art shows over the years.



Figure 4. ACM SIGGRAPH Art Show Online Archives

In 2020, the digital art archive was expanded into a broader archive containing a wider array of SIGGRAPH materials (see figure 5). [12] The ACM SIGGRAPH History archive contains information and artifacts organised into the following categories: Experiences (e.g. Art Shows, Computer Animations and Electronic Theater, Emerging Technologies, and Extended Reality), Contributors, Learning (e.g. Courses, Posters), Publications, Awards, and so on.



Figure 5. ACM SIGGRAPH History Online Archives.

Festival of Electronic Language (FILE)

FILE, the Electronic Language International Festival, founded in 2000, is a non-profit cultural organisation based in Sao Paulo, Brasil. FILE's mission is to promote wider access to technological forms of expression (languages) to the general public. Their goal is to demonstrate how the

advances of new and digital media help shape the contemporary world. FILE promotes creative and innovative electronic language across Brasil and South America through events and publications. The main categories of the festival are:

- Electronic Sonority: soundscapes, performances, installations, art, poetry, and robotics, etc.
- Interactive Art: installations, performances, internet projects, virtual & augmented reality, etc.
- Digital Language: games, animation, theatre, video, architecture, fashion, poetry, dance, etc.

File has a physical archive that contains an exclusive collection of more than 8,000 works selected from 15,000 submissions from more than 48 countries. FILE also maintains an online archive documenting the works shown at the festival as well as publications and other events they hosted (see figure 6). [13] A new online archive is under construction that will allow cross-connections between internal data and enable it to be connected to other new media art archives. They reconsidered the migration of digital data to a headless system but opted to organise the online database using the Tainacan technology, compatible with the WordPress environment in which the festival's data is already hosted. Tainacan is a Brazilian technological solution for the creation of digital collections on the Internet and contributes to the preservation and communication of cultural production on the Internet, through the management and sharing of collections.

Initially, a diagnosis was made of the organisation scheme and cataloging of FILE's digital data content, then the informational architecture was designed through a survey of informational typologies, collections characteristics and institutional informational modeling needs, while considering the interconnection strategies with the ISEA/SIGGRAPH archives. The festival online database is under construction with the data input of the last five years of the festival's digital content.



Figure 6. Festival of Electronic Language (FILE) Archive.

In March 2020, FILE hosted the FILEALIVE meetings (an online mini-conference) which focused on digital memory, preservation of cultural heritage, challenges of archiving media art, conservation strategies for collections, mapping, and metadata interconnection between archives.

Ars Electronica

Ars Electronica, based in Linz, Austria, and founded in 1979, holds one of the world's largest archives of digital media art. Ars Electronica is a stage for media art, a competition, a festival for art, technology, and society, and a showcase for creativity and innovation. They host a laboratory for research and development, a school of the future, and a museum open to the public year-round.

The Ars Electronica archive's mission is to preserve the ideas and the diversity of Ars Electronica, and to make as much of it as possible freely available to users (see figure 7). [14] Highlights include the collection and presentation of the winning projects of Prix Ars Electronica (a yearly competition), and video documentation of the early festival years and center exhibitions. This was possible through the involvement of the ORF – Austrian Broadcasting Company's Upper Austria Regional Studio.

The structure of the archive consists of three parts: a custom-built internal database as the heart of the archive designed for internal use and special research requests; an online archive, with content easily accessible and open to the public; and air-conditioned premises for the collected data carriers, print materials, and a few special items.

The digital part of the archive is a database that stores multimedia data (texts, images, videos, etc.) in common formats in the form of archival documents. The metadata information belonging to the archival items is stored by the archive in a relational database. Access to the archive is browser-based for both the collection and research.



Figure 7. Ars Electronica Archive.

Archive of Digital Art (ADA)

As a pioneer in the field of Media Arts research, the Archive of Digital Art (ADA) has documented the rapidly evolving field of digital art since 1999 (see figure 8). [15] This research-oriented overview of works at the intersection of art, science, and technology has been developed in cooperation with international media artists,

researchers and institutions as a collective project. Artists are free to upload images, text, and other rich media and maintain a collection of their work on the site. Each month an artist/scholar is featured.



Figure 8. Archive of Digital Art (ADA).

Connecting New Media Art Archives

Goals and Challenges

Connecting new media art archives is a complex endeavor and must be approached strategically. First, we needed to generate a list of new media art archives. This was accomplished by information provided during the ISEA2019 roundtable and ISEA2020 Summit, as well as conducting independent research on the internet. An extensive list of international online new media art archives was posted on the ISEA classic archive. [16]

Second, a deeper understanding of the variety of new media art archives was necessary. During the roundtable discussions at ISEA and also at the FILEALIVE meeting, participants presented their archive projects along with their goals and challenges.

Differences and Similarities

We started with the core group and held meetings to discuss the technologies used to develop their archives. SIGGRAPH and the new ISEA archive use the same customisable frameworks technology called PODs and both archives are located on the same server. The FILE representatives were in the process of developing a new archive and planned to use the WordPress plugin Tainacan. Ars Electronica’s archive documents the works presented at the festival. The site had been recently hacked and was no longer online and they were in the process of repairing the damage. The ADA archive differed significantly in that the contents did not document events but instead was subscriber-driven and focused on the works of individual contributors to the website. ADA’s archive was running

using an older content management system and they were looking for solutions to upgrade. All of the archives use SQL databases to hold and manage the information. They all focus on showcasing the scholarly and creative works of people in the new media art field.

The meetings proved to be useful in identifying the issues related to connecting the archives. It was thought that we might need similar variable names or data structures. In addition, we wondered whether differently designed interfaces, and the use of various languages in the archives (e.g. English, German, Portuguese) would pose a problem. All archives resided on different servers except the new ISEA and SIGGRAPH archives. Would this factor into our ability to connect the archives?

Taxonomies and Metadata

There are major challenges to address before connecting archives. First, there would be a massive amount of data from each archive; many archives have accumulated materials over many decades. Second, each archive categorises the information in a different manner.

It was clear that the metadata and taxonomies of each archive would be important, therefore we started by outlining the ISEA and SIGGRAPH archive’s contributor, presentation, workshop, and art event types. Through the generation of lists, the differences were apparent. The metadata for artworks varied between archives. For instance, ISEA contains art events that are tagged with types such as Art Exhibition, Screenings, Performances, etc. and subtypes such as Bio Art, Installation Art, VR, AR, Robotics (see figure 9). Each art event entry also contained information such as medium, size, year produced and exhibited, etc. The SIGGRAPH archive also contained the same basic information but was not organised by the same type and subtype structure. The ISEA archive contains a wide variety of presentation types (keynotes, papers, artist talks, summits, meetings, posters, etc.) whereas the SIGGRAPH archive only had four types (papers, essays, talks, and panels). There were similar, although not exactly the same, categories for the art events between the two archives. The SIGGRAPH archive does not contain workshops or tutorials.

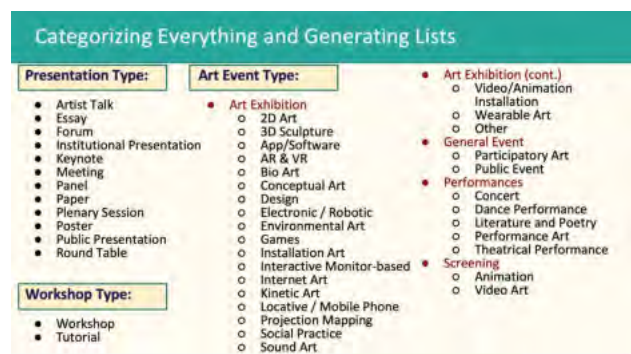


Figure 9. List of presentation, workshop, and art events types in the ISEA archives.

When focusing on the types of contributors included in the archives, similarities and differences were again apparent. The important metadata, including the person's name, affiliation, and location, appeared to be similar in all the archives. The SIGGRAPH Art Show archive's people types ranged from administrative to artists to presenter (see figure 10). The people types in the ISEA archive included roles such as presenter, workshop coordinator, artist, International Program Committee member, and more. The FILE festival archives used these lists to create a complementary data structure that addressed the needs of their archive while mirroring the basic structure of the SIGGRAPH and ISEA archives' taxonomies. ADA uses a variety of types within top level categories (genre, subject and technology for art events). All the archives use keywords as well as types to enable advanced query capabilities.

Although generating lists of types and categories was a useful exercise in understanding each archive, the similarities and differences appear to not be as important as initially thought.

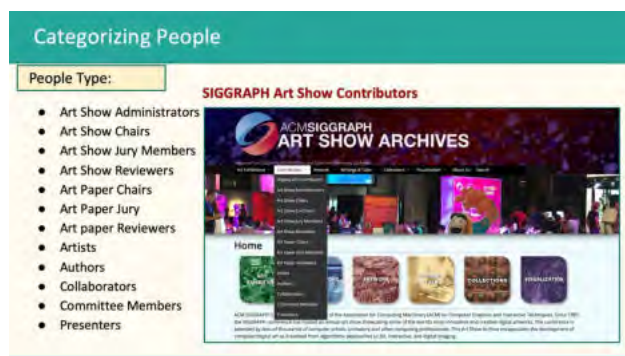


Figure 10. People types in the SIGGRAPH Art Show Archives.

Challenges

Funding, Personnel, and Technical Expertise

The group discussed the potential of co-authoring grant proposals but so far, multinational grant opportunities have been elusive. Individual archives receive limited funding from various sources but only a very small fraction of that funding has been devoted to connecting the archives. Each archive employs volunteers, students and/or staff to program, populate, and proof the contents of their archive.

The challenge of creating a technical solution to connect new media art archives was solved when a faculty member working with FILE proposed a viable solution including the development of an API (Application Programming Interface), which is a software intermediary that allows two applications to communicate. In order to expedite the process, funding is needed to enable him to dedicate more of his time on the project. Therefore, as important as this initiative is for educators, researchers and artists, the lack

of funding is inhibiting progress. Co-authoring grant applications remains a priority.

Standards and Name Authority Control

The group discussed the need to establish standards that would permit cross-communication between archives. The most apparent problem was the verification of the name of the artwork or person in each artwork. It is not uncommon for an artist to have multiple versions of a work or different titles for the same artwork and occasionally artworks share the same title, e.g. *Untitled*. In terms of handling names for a person, common problems include different names for the same person, surname changes through marriage, missing middle names, reversals of last and first names, deviation in spelling from non-English language translations, the use of aliases, artist collective names, etc. How will this issue be resolved when trying to connect to other archives?

To solve the name authority problem, a variety of solutions was considered, and Wikidata was selected as the best one. Since SIGGRAPH, ISEA, and FILE's technological back-end were so closely related we discussed the potential of uploading the contributor information to Wikidata and retrieving the unique identifier to use in verifying identity. Dalton Lopes Martins, who is one of the developers of Tainacan, is taking the lead on creating the technology to connect all the archives.

Approaches to connecting archives

Centralised System

During the FILEALIVE meeting in 2020, a variety of methods of establishing a connection between the archives were presented. A central hub containing all the data from all the archives was proposed (see figure 11). This solution would enable archives to connect to the site to retrieve data from each of the archives when a user looked at information in any of the archives. This "motherhip" would manage the connections between all the archives. This requires resources including server space, management personnel, technical expertise, and funding. This method would handle challenging issues related to copyright, permission, and ownership of data. A centralised system puts the burden and authority in the hands of one party. Another problem with a centralised system was the dependency issue—all archives would have to retrieve their information from the "motherhip" and if the server went down, all parties would be affected. Another approach is to use a trusted centralised storage repository to search for unique identifier data and return information. We need to find and examine existing systems that could be used by archives around the world. This method of using a system to search for unique identifiers has potential but more research is warranted.

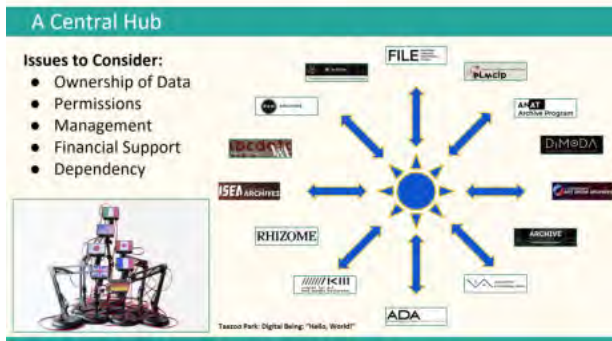


Figure 11. Centralised System.

Decentralised System

Another solution would be to construct a decentralised system. We considered two possibilities: the Absorption method (each archive’s data is exported and then imported into the other archives) and the Index File method (each archive has an accessible XML file searchable by other archives). The Absorption method was not optimal because the archives are being updated regularly and the technical logistics placed a burden on all archives involved. In addition, this method posed permissions and copyright issues. The Index File method would involve inserting a link into the original archive if a query returned a positive result. Each archive would be responsible for maintaining its own index file. This approach has potential and further research is needed.

Starting Points and Interface

After carefully investigating the different archives, our analysis suggested there are two common types of information in most online media art archives—People and Artworks. Therefore, it made sense to start by creating a connection to people and artworks located in other archives. A proposed interface for the People pages would be to display the person’s information in the originating archive and also display icons of other archives that contain information about that same person (see figure 12).

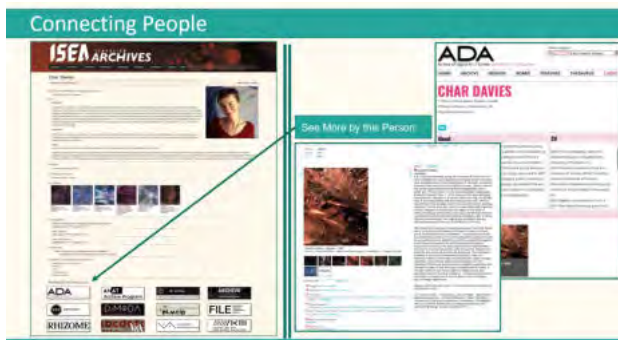


Figure 12. Connecting people.

This same method could be used for artworks and other art events. If an artwork is found in other archives, the page would state: “This [artwork] is also available in the [name] archive” and provide a link to the entry in the other archive (see figure 13).



Figure 13. Connecting artworks.

This method will require modifications to templates and webpage coding in all the archives as well as implementing the procedure outlined in the next section.

Procedure to Connect Archives

Using Wikidata as a Standard

For the formation of this interoperable network of digital archives, each participating repository must meet some technical requirements. The first is to have an API for collecting and recording data, allowing data to be exported and updated computationally. The second requirement is to use a standardised entity identifier. We propose to use Wikidata QIDs, the unique identifier used by Wikidata. The purpose of the QID is to verify that a person listed in one archive is in fact the same person listed in the other archives. For this to work satisfactorily, all repositories need to reconcile the names of people on Wikidata, recording that artist’s QID in their own database, when it exists, and creating a new QID for that artist when it doesn’t already exist. You must assume the creation of a web service to perform this type of operation for each archive. The repository reconciliation service can be created, for example, using Python scripts that collect data from each repository through its API and use a reconciliation API with Wikidata, such as the Wikidata Reconciliation Service for OpenRefine. OpenRefine is a free tool that can be used to clean tabular data and connect it with knowledge bases, including Wikidata. [17] One of the main functions in OpenRefine is the reconciliation service that matches items in a local data source against the same items in an external data source. [18]

Making the Connection

A user will initiate the process by going to a person's profile in one of the archives. This will automatically trigger the API. The API will search Wikidata to find the person using the QID and filter through the identifiers to extract the links to other archives for the person, if any. If found, the resulting URL that leads to the person's profile page in another archive will be added to the page in the original archive. The original archive will display the icons, as selectable buttons, of each of the other archives that person is found in.

If a user clicks on one of the buttons, a new browser window will be opened using the URL associated with that button. This will then display the person's profile page in the other archive. A very similar procedure can be used for artworks as well.

Conclusion

Our goal is to establish a system that will minimise the need for support, with each party responsible for their own archive's connection to Wikidata. The prototype will be developed by Dalton Lopes Martin in Brasil and modified to be used by each archive. Interface modifications to accommodate the connections will be the responsibility of the individual parties. Although the technology to connect archives is still in the planning stages, we now have a road map to achieve our goal. Through the dedication and expertise of the parties involved, there will be a day when researchers, educators, students, artists, and other community members will be able to access the rich history of new media art with minimal effort.

Acknowledgments

We would like to thank the archive representatives from the core group of archives: Paula Perissinotto, Fabiana Krepel and Dalton Lopes Martin (FILE); Oliver Grau, Wendy Coons (ADA), Christina Radner, Veronika Liebl (Ars Electronica). Special thanks are due to Dalton Lopes Martin for his innovative vision, technical expertise, and contributions to this project.

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Postlocative Art for a Non-Anthropocentric World

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Abstract

The existence of a new hybrid spatial ontology (material/virtual, offline/online) has triggered some unique territorialization processes closely linked to the technopolitical and technoeconomic domain. These processes involve a new symbolic-cultural output that questions the validity of locative art's theoretical framework, initially associated with situationist psychogeography and with the informational context associated with GPS metadata. By contrast, postlocative art deploys strategies that critically accept the important role that non-humans play in public representation as well as in delegating the production of meaning to AI, thus moving beyond the locative framework and closely associating itself with the postphenomenology of complex systems.

Keywords

Locative art; postlocative art; inforg; onlife; artificial intelligence; geosemantics postanthropocentric; non-anthropocentrism.

Introduction

In May 2003, during the Art + Communication Festival at the RIXC (the Center for New Media Culture in the Latvian capital of Riga), media artist and activist Karlis Kalnins coined the term locative media. He proposed this novel term as a category within new media artistic practices to denote the products and processes aimed at researching the uses and applications of geolocation-based ICT services designed especially for smartphones. The purpose of locative media was to give context to the information in hybrid space, as understood from its physical and "datified" dimension, which facilitates the mixed (offline and online) or *onlife* experience, to borrow a term from Luciano Floridi [1]. However, this contextual link of geocoded cultural production, available at the user level and first integrated by the GPS service, was subsequently expanded (from Web 1.0 and 2.0 to Web 3.0) to other geosemantic relationships and encodings of the locations of networked data, objects, subjects and discourse. This would gradually modify and move beyond the term locative media toward postlocative media, introduced by Marc Tuters. So, while the functional

link of the information in locative media was initially established with geographic location, the locus, or the fixed position in the physical space of the locative object or medium that emits its GPS signal (or of the subject that conveys the locative object or medium), geosemantics began to orchestrate other positions relative to the information within a heterogeneous network of interactions with other data, objects and subjects. In light of the ubiquity of networked information, this concept went beyond the initial locative meaning of information to emphasize other filters and contextual links. Following the thinking of Timothy Morton, this question brings us closer to the idea of a technocultural production inscribed on a symbiotic mesh [2] in a state of constant evolution and dialogue, in which the interconnections, the relationships and overlaps would be formed almost organically in a fragile political and socio-technological contingency. And, following Bruno Latour, in his Actor-Network Theory (ANT) [3], we are able to identify the connection nodes and the *actants* in interactions, perhaps the most active and dominant of the aforementioned mesh, by mapping networked controversies or, in following Frederic Jameson, by creating cognitive maps [4] that give shape in a contingent and knowable form to the complexity of hybrid space production.

The Promise of Locative Art

Since 2003, we have definitely left the desktop computing phase behind, and, of course, we have moved past the initial fascination with the synchronous networking capabilities associated with Web 1.0. We have helped popularize many WebGIS applications and services (with the launch of its most popular versions Google Earth and Google Maps) and accelerate media integration and portability, which gradually made ubiquitous computing possible thanks to the technological devices of geocoded cultural production integrated into the civil realm within the Web 3.0 framework. In fact, when this acceleration began in 2006, artist, designer and academic researcher Drew Hemment gave rise to the term locative art, which was confirmation at the time that the use of locative media had moved beyond poetics focusing on the phenomenology of the Internet itself, and therefore beyond the artistic practices of *net art* [5]. The

defining characteristic of locative art was to emphasize the relationship between information and place through techno-artistic mediation, proposing new poetics of mobility and the globalization and relocation of network communication and interaction. In this regard, given the many approaches to locative art, Marc Tuters and Kazys Varnelis proposed a classification system in 2006 based on two general strategies [6]: First, annotated locative art,¹ with works that would allow users/participants to make virtual contributions with their own geocoded informational content. And second, phenomenological locative art,² with works that trace the phenomenology of the data/subjects/objects in the hybrid space.

It should be noted that the initial experimental projects with locative media were, for the most part, product demonstrations and tests of the incipient technological possibilities, and were in large part absorbed by the technology industry itself for its own benefit. We must bear in mind that, prior to 2005, locative media were still evolving and continuously being defined, and they were still in a situation of emerging territorialization. We should also consider that media portability during this period had not been fully developed nor popularized (it was not until 2007 that smartphones became popular due to the successful marketing of the iPhone), and geolocated data mapping required expensive and heavy technological devices – like the GPS backpack – with very little battery life. This was a major factor in its public and private funding, which facilitated the costs of technological development to a great extent. It also led to a certain skepticism about the ability of locative art to critically and effectively appropriate geolocation-based technologies.

However, some of the first locative art projects and works did take a critical stance using their own medium, generally associated with cultural production fields of neo-mapping seminars, new media art workshops and festivals.³ The successive technological advances, often resulting from the artistic research itself, have been gradually integrated from these fields. In this revitalization emanating from the arts, authors such as Hemment and Ben Russell saw an optimistic “promise of transformation” [7][8], which involves the medium questioning itself, adding to the echo of the euphoria (and skepticism) of the defenders and detractors of the gradual empowerment of locative media in the civil realm.

Nevertheless, as Lauren Cornell and Kazys Varnelis announced in 2011 in their famous article ‘Down The Line’

[9], the term locative media, along with its use and commercial potential, spread rapidly to the private and public sectors. And it was there that it took shape strategically and economically, shutting down the transformational promise of locative media, which was reflected in the work of authors such as Russell and Hemment, and even William Gibson's science fiction [10]. Indeed, the authors underscored the fact that the evident shift from cultural (and artistic) production toward a greater role for private business and public institutions in the commercial use of locative media meant that the promise of a liberating transformation of locative media users was lost, making it clear that it was just that: a promise.

Psychogeography as the First Descriptive Framework of Locative Art

According to artist and locative media researcher Simon Pope, the psychogeographic influence associated with locative media became, right from the start, “something of an orthodoxy, with the requisite dissenters and historical revisionists” [11]. In fact, authors such as Tuters and Varnelis discuss this polarization existing in locative media texts, and add that “there’s something peculiar, even comical, in how the movement is ‘the Next Big Thing’ to some and a capitalist apocalypse to others” [12], thereby confirming that it was established as a field in dispute, with the power to attempt to define, represent and control the cultural production of hybrid space.

Evidence suggests that the psychogeographic practices were adopted as a concept to describe locative media uses, as asserted by authors such as Andrea Zeffiro [13]. Its early adoption can be determined in the numerous references in the early texts on locative media festivals, as evidenced by the tribute to the SI movement, with a version of the famous 1960 photograph, by the participants in the cartographic conference that took place in London between May and June of 2003 [14]. In his famous 1999 text, “Headmap Manifesto”, Russell also devoted a complete section to psychogeographic situations, suggesting that locative media are an opportunity for collective criticism and dissent against the surveillance and power of social control of location-aware devices. Hemment argued that the critical area in which they began to operate was the same one in which they emerged: that of military, state and commercial monitoring and surveillance. This circumstance set them up as accomplices but also as a medium through which to

¹ It is worth noting some of the early annotated locative projects here: “[murmur]” (2003) by Shawn Micallef, Gabe Roussel & James Sawhney; “Urban Tapestries” (2002-2008) of the group Proboscis; “Yellow Arrow” (2004-2006) by Brian House, Christopher Allen and Jesse Shapins; and the paradigmatic “Bio Mapping / Emotion Mapping” (2004 to present) by the artist Christian Nold.

² The paradigmatic projects of early phenomenological locative art are: “Listening Post” (2001) by Mark Hansen and Ben Rubin; “The Choreography of Everyday Movement” (2001) by Teri Rueb; or the works of the artist Jeremy Wood, as “GPS Drawing from Berlin to London” (2000); or the renowned project “Amsterdam RealTime (2002) by Esther Polak and Waag Society.

³ In this regard, the role of RIXC, the Center for New Media Culture (Riga, Latvia) is very important.

articulate the challenge of such means of social control. In this situation, Hemment differentiated between what he called the “dystopia of total control” and a “locative utopia” characterized by an optimism that “provides an antidote to our fears about ever encroaching forms of surveillance, and an important answer to the politics of fear” [15]. Like Russell, Hemment was optimistic about the rhetoric of situationist empowerment, and identified a certain transformational promise in the contingent reappropriation of the territorialization of hybrid space with locative media, using psychogeographical techniques.

Pope noted that, in a way, it would be odd not to find references to the situationist approach and to psychogeographical comparisons in location media practices, since both share methodologies such as drift or diversion, and implied walks and encounters in urban spaces, and the use of maps to examine the nature of the spaces they represented, as well as cartographic representation itself. However, he also notes that the similarities and correlations are not complete, nor – as we assert in this article – can they withstand analysis and interpretation under the current epistemic conditions [16].

End of the Locative Promise and Moving Beyond Psychogeography

Beyond the initial fascination due to the novelty of locative art and optimism, as Daniel James Frodsham notes, art with locative media was still a highly anticipated topic of interest at the famous ISEA symposiums specializing in electronic art and new media of 2004 and 2006. However, for the year 2011, many specialists were already talking about the “end of locative media” [17]. What end did they mean? What artistic idea with locative media had reached its end?

In the 2011 ISEA panel discussion, “Beyond Locative: Media Arts after the Spatial Turn”, Marc Tuters urged a rethinking of the city network, i.e., hybrid space, beyond locative media, pointing to Latour’s ANT and its descriptive alternative as the theoretical framework to follow. Science and technology researcher Tristan Thielmann stated outright that locative media had failed as social media disguised as indispensable, new and modern mobile devices [18], while artist, architect and researcher Mark Shepard was even more blunt, suggesting that it might be time to forget locative media, because the creative, theoretical and aesthetic possibilities of location as context filter had been exhausted [19], and he noted the need to move beyond and expand on the contextual anchoring of information exclusively associated with its geographic coordinates.

In his famous 2004 article, “Drifting Through the Grid: Psychogeography and Imperial Infrastructure”, Brian Holmes wrote that, within the uses of locative media, “the aesthetic form of the *dérive* is everywhere. But so is the hyper-rationalist grid of Imperial infrastructure” [20]. Holmes accepted the psychogeographical potential to understand the production of space from the perspective of

aesthetics, but he did not miss the fact that ICTs have a decisive impact on subjectivation processes, as well as territorialization processes, and play a role in shaping the imperial infrastructure from its political/military foundation (ultimately responding to hidden political interests). In this respect, the researchers Paraskevopoulou, Charitos and Rizopoulos point out that Holmes opposes the careless use of technology to generate an aesthetic with political intentions that are merely decorative [21]. According to Zeffiro, uncritical defenders of locative media might want to be invested in a “new kind of locational humanism” tailored to the world leader [22]. In fact, Holmes’ critique addresses the ambiguities of certain cultural productions and artistic projects that, in alliance with technological developments, would tacitly allow the computer tracking and registration of the actions and intentions of the subject, always recorded and monitored with footprints of their individual differences in hybrid space. In Holmes’ judgement, these footprints should be critically integrated into the artistic project itself and constitute the basis of its political intentions, as well as in its own questioning as a medium, at least if it wants to be under the hypothetical protection of the radical project of Situationist International (SI).

Since 2011, and continuously with the criticism of locative art, there has been a growing desire to move beyond the initial promises and associations with situationist practices (bluntly described as a failure to be overcome). This impulse toward self-criticism is in response to a broader turn in cultural theory that began with the spatial turn, followed by the informational turn and the object turn in the poststructuralist cultural theories of Speculative Realism (SR) and Object-Oriented Ontology (OOO) closer to the new episteme of the current “Hyperhistory.” [23].

The end of locative media mentioned on the ISEA 2011 panel discussion called, on the one hand, for moving past the descriptive model identifying with the rhetoric of contingent reappropriation of psychogeographical techniques from the SI and their promises of critical empowerment, which were unable to address the contextual problems of the geocoded hybrid space. And, on the other hand, for moving beyond the idea of localization as the only calculation associated with physical position (and therefore also associated with its historical origins of tracking data/subjects/objects with the GPS system). Thus, the exclusive relationship between the contextualization of spatial information, and the concept of mapping and representing a homogeneous territory characteristic of modernity, was broken.

In his 2012 article, “From Mannerist Situationism to Situated Media”, Tuters, who was especially involved with the criticism of locative media, explicitly stated that locative art projects should go beyond what he called “mannerist situationism”. Which is to say they should pay more attention to and stress the concept of localization and network location as opposed to physical location, as the only and exhausted contextual filter of informational

geosemantics (in line with what Shepard already mentioned). This would require reconsidering and replacing the idea of space and location, in accordance with a relational dimension of a physical/virtual nature: “Replace the concept of geographic location as the core concept of locativity, with the more relational notion of proximity, not only in relation to place but also in relation to matters-of-concern” [24].

This necessary change of approach advocated by Tuters made it possible to address the relationships and phenomena that were not necessarily anchored to physical location, and also established the trend – very contemporary and accepted now – of conceiving physical space as something completely instrumentalized beneath the geocoded space that coproduces it. A space in which floating information appears on our screens in accordance with action and interoperability protocols controlled by artificial agents to bring order to the informational chaos of the network system according to protocols that – mostly – serve technoeconomic, business and supranational interests. In this scenario, according to Tuters, the maps will increasingly become “cognitive maps” (as defined by Jameson), and less geographic or political. Which is to say that the special, geosemantic and relational orientation, takes into account the inter-relational dynamics that the actants establish in the network system, reformulating the artistic practice of locative media toward approaches that are close to Latour’s OOO and, specifically, ANT.

Postlocative Media in the Context of Ubiquitous Computing

It was Tuters himself who introduced the term postlocative media during his conference “Forget Psychogeography: The Object-Turn in Locative Media”, presented in May 2011 at the Massachusetts Institute of Technology. In particular, he spoke of a postlocative practice specifically referring to those that had gone beyond (and definitely forgotten) the legacy of situationism and of modernity’s orientation of homogeneous space. Practices that would consider mappable not just those events produced by humans but also those produced by non-humans. Practices that, in terms of orientation, would be considered the actions and positions of a user in relation to the spatial framework described by subjects and by objects, or information produced and interacting in hybrid space. In Tuters’ own words, postlocative would therefore be a practice inscribed in a theoretical framework capable of accommodating:

[...] its traditional geographic concerns (the physical location of one’s body will always be relevant), but also, crucially, praxis ranging from experiments with the Internet of Things, to information visualizations functionally bound to objects. [25]

Pursuing the inertia of the terminology proposed by Tuters, we deem it necessary to first define what postlocative media are so we can subsequently define postlocative media. Once

this is done, we can discuss what is new and different in our proposed definition of postlocative art in relation to moving beyond locative art. This will also allow us to clarify and specify what we consider to be most important with respect to the contributions already made in this regard by other authors.

Postlocative media would be those everyday technological devices that succeed locative media in geocoded cultural production. Considering their historical context, they are therefore devices that are already immersed in a widespread media and computer ecosystem (ubiquitous computing) with geocoding of the information that is scalable to many diverse objects (Internet of Things) and, above all, with geosemantics that are mostly managed by multi-agent systems (artificial intelligences distributed in a network). Therefore, the informational context they manage does not depend so much on the metadata of the geographic location, but on the relational contingencies that occur in a network with multiple interactions, social dynamics and personalized browsing histories for each user. Within these contingencies, georeferencing is just one more piece of metadata that affects geosemantics, but not the only or main one (as it is, by contrast, in locative media). Now, it is algorithmic filters that prioritize the relationships of proximity between data/subjects/objects in the network, orienting and determining our experience and perception of the hybrid space. Postlocative media have gradually liberated themselves from the materiality of old computers, smartphones or tablets with GPS, merging into corporal and environmental computing that is widely accepted by users in their *onlife* experiential state, where everything constantly interacts with everything, in both very public and social as well as very private and intimate surroundings.

Toward Postlocative Art

If we consider that the artistic practice of locative media, locative art, has been overtaken by another arising from the artistic practice of postlocative media, it is logical to speak here of postlocative art. We are defending the relevance of the term, based on the terminology proposed by Tuters, but we have nevertheless observed that it is used in a very vague way by a minority in the thinking and practice of contemporary new media art. In fact, in the academic papers published to date, this artistic practice is only mentioned as *post-locative art* in the dissertation “The Social Production of Hybrid Space” (2018) by researcher Robin van den Akker. However, he only introduces the term merely to adjectivize the phrase *post-locative media art* in the context of the “second wave of locative media art” [26]. In addition, we have also found only one online exhibition project presented as a delocalized gallery of post-digital & post-locative art, as in the case of the LIMb0 Gallery (which currently seems to have suspended its activity temporarily) [27]. We assume that the term postlocative art is still a proposal closely associated with moving beyond the initial

theoretical framework of locative art, and therefore very confined to the specialized field of critiquing locative media. Despite this situation, we do consider it a proposal that deserves to be expanded into the broader realm of contemporary art with new media, precisely because it clearly marks a change of period in the practice and geocoded artistic production in hybrid space. And, likewise, because it provides a framework for the consequent reflections and debates currently arising around such practice.

Hence, postlocative art would be the artistic practice arising from the creative, critical and experimental use of postlocative media that goes beyond contextualizing information solely due to its geographical location, thus placing the individual in a geocoded hybrid space defined as a network of multiple interactions between ubiquitous and hyperconnected data, subjects and objects. It is therefore an art that produces a particular arrangement around the geosemantic context of – in the current context, hyper-historical – information that influences the events that coproduce the human experience and – at the same time – coproduce the same hybrid space. Consequently, its artistic reflection is situated around the taking of positions and aesthetic-political representations of the *infor*, as this term was used by Floridi [28]. That is to say, an informationally embodied organism in a network resulting from the computerization of the category of subject and of agency. An organism that, according to Floridian thought, constitutes the “infosphere” by means of its interactions and relationships, as an entity that is information and operates informationally in a symbiotic manner with its environment. Thus, our *infor* state blurs the distinction between human and non-human, and between real and virtual, within the complex geosemantic network’s permanent capacity for connection. A network that offers new relational characteristics both *of* and *between* persons and *of* and *between* things, as well as *of* and *between* persons and things. With this approach, postlocative art attempts to give rise to a much more cybernetic and relational notion of the proximity between networked data/subjects/objects, with the aim of participating in the *infor* subjectivation processes inscribed in current technocultural productions.

The important thing about the term postlocative is that it gives us an idea about geocoding and the apparently dematerialized geosemantics, which nevertheless demands biopolitical performativity from us in our state of *infor*. That is, it demands the renewed political will of the subject which, as Tuters points out, consists of the active participation in and infiltration of the cybernetic dynamics of the chain of references in the cultural production network of this systemic arrangement:

Through the careful work of representation every object could carry with it its own unique chains of reference, thereby revealing the substance of ‘the local’ to be composed of an endless variation of scales. [29]

The definition of postlocative art that we extrapolate and expand upon here emerges – as we mentioned earlier – from the approach proposed by Tuters, but also echoes the approach put forward by Benjamin H. Bratton in his book “Suspicious Images, Latent Interfaces + Community Wireless Networks as Situated Advocacy (Situated Technologies Pamphlets, 3),” published in 2008. As Tuters does with Latour, Bratton points to the thinking of Rancière on the “distribution of the sensible,” as a more fruitful starting point for conceptualizing art after the locative phenomenon. An art that observes that an opportunity exists for a more heterogeneous process of representation using technology as a means to facilitate this process [30]. In return, however, such technology should be continuously examined, shared and decentralized by public audit, and certainly also be of an artistic nature. It is therefore an art that echoes a thought that puts new practices into play that take into account its ability to help radically transform the conditions of collective life in hybrid space. For Rancière, this new “aesthetic art regime” [31] is at the core of political action at the present time, but is not exclusively the result of a self-referential practice. What’s more, the new aesthetics it offers, understood in this way, determine what is presented and appears, what is visible from the invisible, intervening in the delimitation of space and time, and interfering contingently in the definition and production of the ordinary. Rancière therefore connects with the aesthetic opportunity that Jameson also claims for cognitive mapping as he imagines and calls for the creation of a new public space in which to express dissent and map conflicts and aspirations. This involves a technopolitical contingency with a community function, consisting of “building a specific space, an unprecedented way of sharing the ordinary world” [32].

In our understanding, what is interesting about the aesthetic notion noted by both Tuters and Bratton, relying on the thinking of Latour and Rancière, is the utopian and transformative potential of postlocative art due to the liberating relationship it establishes between the aesthetic and the technopolitical. A relationship that does not consist of aestheticizing politics, nor of the familiar practices of so-called political art or compromised art, but of disrupting the standardized coordinates of the sensory and cognitive experience. Hence, it is a relationship that would not be established by messages about the established order, or by representing the existing structures of society, but precisely by keeping distances without following any predetermined model, which is to say, “by the kind of time and space it establishes, by the way in which it divides that time and populates the space” [33].

We argue that the redistribution of the sensible among *actants* arises from a more profound change in the very nature of hybrid space (which is broader than a momentary redistribution of the sensible in the urban space in which situationism functions). Not surprisingly, both locative art, and later postlocative art, gradually point to a structural

transformation of the public space, and to a new aesthetic regime that is already fully inscribed in the ontology of hybrid space. This is the true experimental and speculative territory of postlocative artistic practices, a territory in which non-humans acquire the ability to comment on their own environment, gaining agency skills and influencing the chains of events that affect the human experience, and therefore the very idea of subjectivity.

What is new and relevant in the proposed term of postlocative art that we are defending is that, beyond overcoming the psychogeography and the contextualization of information with georeferencing, its terminology clearly includes moving beyond the preceding spatial orientation model, which has been exhausted. This contemplation of what beyond locative means requires informational and spatial territorialization in perpetual motion, in which the position of humans, as the creative engine and manager of the meaning of geosemantic discourse, is not that important and – moreover – is shared with non-humans. Postlocative art would therefore also be an art that points to the posthuman in the sense of moving beyond humanism, in its last dichotomous throes, characteristic of modernity (according to Latour in his critique of the separation between nature and society, or between technology and politics). It would also point to the cosmopolitical as it critically confronts the blind anthropocentric (and capital-centric) claims of the territorializing project of modernity. The postlocative struggle for the enunciation and representation of informational meaning in hybrid space is not determinant of a fixed, definite and universal *axis mundi*, rather it is the assimilation of the existence of many personalized and moving centers encrypted in the software code. Nodal centers around which we determine our experiential, cognitive, sociopolitical and identitarian context, associated with the relative, fluctuating, invigorated positions produced by our interactions with other nodes.

Postlocative Strategies for a Non-Anthropocentric World

Postlocative art works arrange the interrelationship between what the image/map coding leaves out or does not leave out, between what is decided to be represented or not, and what the purpose of the instrumental and operational logic delegated to AI in a network is, and whom it serves. They emphasize public use, high interactivity and the exploration of the unknowns that make up the representation of non-humans in artistic devices. An aesthetic-political commitment that would move away from the coordinates of private use, low interactivity and reaffirmation of the confirmation bias determined by the bubble filter that, through algorithmic predictions, selects all information that corroborates all of our beliefs and opinions in accordance with what is already known, stated and/or represented. Applying these characteristics, we identify five postlocative art strategies [34], which we briefly describe below:

First, we observe how in projects such as “Dead Pixel in Google Earth (2008-2010)” by Helmut Smits, “Street Ghosts” (2012-2017) by Paolo Cirio or “Map” (2006-2019) by Aram Bartholl, among others, we find a clear interest in establishing a direct dialogue, contingent upon its inclusion in the digital representation programs of the geobrowsing networks. These are projects that clearly assume that human interaction with the same territory occurs, is formed and induced, if we define territory as a habitable interface where the *infor*g can still leave warnings for browsers. These warnings would leave a double footprint, as a site-specific intervention (in the physical territory) and as a medium-specific intrusion (into the informational territory).

Other projects such as “9 eyes (2008)” by Jon Rafman, “Postcards from Google Earth (2010)” by Clement Valla, “The Driver and the Cameras” (2012) by Emilio Vavarella or “Dutch Landscapes” (2011) by Mishka Henner, for example, document informational products of a visual nature that present interferences, failures, censorship or certain technical characteristics that humans are still capable of interpreting as singular signs of their current relationship with the machine. With different formal approaches, all of these projects use the same documentation methodology, which includes the reappropriation, intervention and exhibition of a series of digital images/maps that relocate and confront the human element within the instrumentalization carried out by and for the software code.

The projects of this third strategy, still clearly making use of the geographic location metadata, emphasize its use for representing non-humans in a public parliament shared with them, an issue we see clearly in projects such as “Pigeon Blog” (2006-2008) by Beatriz da Costa, “TrashTrack” (2009) of the MIT Senseable City Lab, “Wi-Fi Structures and People Shapes” (2009) by Dan Hill, or “Italian Limes” (2014-2016) of the Folder group. All of them arrange their artistic concepts over the representation of the postphenomenology of events – apparently not visible, graspable or quantifiable – of the complex coexistence that we establish with non-humans in the network of our symbiotic existence.

The fourth postlocative strategy has an evident probatory nature that is deployed through a “forensic aesthetic” exercise, to use the words of Eyal Weizman [35], centered on counter-enunciating and counter-visualizing the operative processes through which the data, discourses and images/maps hide, shield and convey the structural violence orchestrated by the official informational frameworks. Groups such as Forensic Architecture, or artists such as Trevor Paglen, focus their practices and research on postlocating the human factor to publicly bear witness to it as a material and informational victim. A victim that is treated as collateral damage, or disposable and/or exchangeable merchandise, in the framework of a global political and military system that is governed in large part by the criteria established by the techno-economy of global semiocapitalism (according to the approach of Franco ‘Bifo’

Berardi) [36]. Projects such as “Selected CIA Aircraft Routes and Rendition Flights 2001–2006” (2006) by Trevor Paglen, “Watching the Watchers (2013)” by James Bridle, and all the projects to date of Forensic Architecture, track and reveal high tech and mediated conflicts that increasingly blur the line between techno-military (and its business side) and civil matters. Projects that ultimately research the relationship that representation has with the manufacture of public truth.

Finally, we want to highlight the fifth postlocative strategy, which requires the biopolitical involvement of the artists in conscious and direct confrontation with the ubiquitous sensors that collect all kinds of data, images/maps and personal and geocoded footprints. Their projects deploy tactical operations aimed at hacking, modifying, transforming and/or disrupting the syntax of the software code with the aim of affecting its operation and its associated geosemantic processes. We found a clear precedent for this strategy in the project “BorderXing Guide (2001-2011)” by Heath Bunting, which established the commitment to information access both to the physical location and to the production policy for user/citizen activities in hybrid space. However, it is Simon Weckert’s project, “Google Maps Hacks (2020)” that updates this strategy based on a tactical action that seeks to produce a geosemantic backlog in Google Maps, thus pointing to the possibility of an action to empower *infor*g in the involvement of the delegated management processes of the information in hybrid space. This highlights the fact that hybrid space may be counter-represented and counter-mapped with performative art practices that, with tactics characteristic of an informational guerilla group, enables the capacity for action and liberation, which is ontologically denied to the *infor*g.

What all these strategies have in common is a discourse and a formalization/visualization that questions the extraction and mapping of information, and the importance of non-anthropocentric representation in which non-humans have the capacity to act as agents in artistic production. These are strategies to confront the apparently irreversible delegation of the production of meaning to AI (which is mainly in charge of managing the irreversibility of informational chaos, the destruction of the planet and even the extinction of human being). Strategies that imply a willingness to *be seen or revealed* to the post-panoptic machine, and to distinguish oneself in a permanent representational loop that moves between masking and deliberate and selective unmasking in hybrid space. This is a question that we can classify as situated thinking with the interpretive turn of the data delegated to AI. An openly critical and contingent position with the limits of knowledge, power and desire, inscribed in the image/map of the systemic device of current informational control societies.

Coda

It is tempting to think that artistic production with postlocative media (ubiquitous, omnipresent and assimilated symbiotically by the *infor*gs) can enable deterritorialization and reterritorialization processes (decoding and recoding) within the systemic arrangement. It remains to be seen whether it has the capacity to critically explore the limits – and possible escapes – from cynicism, insensitivity and disaffection with the politics implicit in the conditions of semicapitalism and the inertia of alienation in the perceptive, expressive and cognitive abilities in the current context of techno-spherical dependence.

Postlocative art is presented here as the art that follows a fixed reference that is already known and socio-technically determined, self-absorbedly local and anthropocentric, aggravatingly individualistic and short-term, situated in an illusion of a false personalized, watertight and immobile space-bubble. No such space exists. Everything is wonderful, dangerous and complexly interconnected and distributed. Hence, we now have the opportunity to move beyond that socio-technically predetermined self-location, to dynamically orient ourselves in a network where we can put automation processes into play to benefit everyone (including non-humans). And where we can project ourselves as a planetary interspecies that does something effective without thinking only of instant benefits, within a more lasting space-time scale of mixed coexistence.

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Weaving Augmented Reality into the Fabric of Everyday Life

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Abstract

In 1997 Ronald T. Azuma introduced the now generally accepted and followed definition in Augmented Reality (AR) research. In short, it tells us that in AR we introduce virtual content into the real world, this virtual content needs to be aligned with real content, and a user of an AR environment can interact with the (dynamic) virtual and real content in real-time. This definition leaves open how virtual content is generated, which display technology is desired and which senses are addressed. This has advantages, but it is now becoming clear that these missing aspects lead to confusion, also because with the current smart technology in general and ubiquitous computing in particular, AR technology can no longer be considered in isolation. We present the arguments that lead to this conclusion. We will explain the arguments with examples in which the vision, auditory and olfactory senses play a role. Starting point and conclusion obtained is that AR eventually will become an everyday technology that will merge into reality.

Keywords

Augmented reality, multisensorial augmented reality, digital technology, ubiquitous computing.

Introduction

Although introduced a long time ago, augmented reality (AR) research usually still follows the 1997 AR definition [1] which tells us that in AR we introduce virtual content into the real world, this virtual content needs to be aligned with real content, and that a user of an AR environment can interact with the (dynamic) virtual and real content in real-time. This definition does not make references to a particular sense that is being addressed by the virtual content. Neither does it demand that the virtual content be digitally created. What is ‘virtual’ and what is meant by ‘interaction’ is not discussed. If the virtual content is not digitally created, should it at least be digitally controlled or mediated? By not being too explicit about these matters, the definition is practically workable, but at the same time, it has led to a vision-dominated interpretation of the concept of AR. Other senses might only be addressed in the

context of computer-generated images of objects, that must be aligned with real-world physical objects. From the perspective of a user whose most relevant interaction with the environment consists of changing his position and orientation this might be acceptable. However, it is not when either the user or the environment asks for more active involvement of the user in the environment.

The virtual layer that is superimposed on reality can contain content that addresses the traditional five senses (sight, hearing, taste, smell, and touch), but other senses can play a role as well. Virtual content can affect our proprioceptive sense, for example in a therapeutic application, and equally, we can think of applications that have virtual content that shows awareness of temperature changes or has been designed to cause pain or induce hunger in a user. If we want to go beyond vision-oriented AR, both for users and for virtual content, we need to look at multisensorial input and crossmodal effects. A virtual creature in a virtual layer should show multisensorial situational awareness and by doing so in a believable way it needs input for its assigned models of goals, intentions, knowledge, and emotions from various sense-related sensors. This is quite different from ‘just’ referring to the integration of computer-generated imagery with the real world as we can see mentioned in most observations on and research in AR.

AR, both its virtual and real content, will become embedded in smart environments in which we assume ubiquitous computing and sensors, processors, and actuators that are part of the Internet of Things (IoT) and that can feed the virtual content that is present in the layer that is superimposed on reality with their real-time information about the environment and its dynamics. Hence, the alignment, requiring whatever combination of senses, can be satisfied by information made available from the smartness embedded in the environment. This includes information obtained from multiple cameras, probably providing non-usual views that make it possible to visualize objects that are out of the user’s view, for example from a drone, from remote locations, and from other sensors that provide the user or the virtual content with perceptual enhancements that have no real-world counterparts.

In this paper, we survey the various views that can be held when considering the alignment of virtual content with an AR user’s real-world view. The aim is to investi-

gate how Azuma's definition of AR can be maintained if we look at other than computer-generated (imagery) 'virtual' content, addressing other senses than our sight sense, and whether we can maintain a distinction between 'augmented reality' and reality in a future where we can speak of ever-present AR integrated with the IoT and ubiquitous computing technology [2]. From the sight sense point of view, our focus is on optical see-through (OST) AR, rather than on hand-held AR. The assumption is that in the (near) future bulky head-mounted devices (HMDs) such as the HoloLens can be replaced by AR glasses with similar functionality and in a more distant future by AR contact lenses.

In Section 2 we start with a global view of AR. Such a view has the danger of having to enter philosophical considerations of how 'virtual' as it is used in a 'virtual layer' that is, a layer that is superimposed on reality, fits in discussions on material versus non-material, physical versus non-physical, and real versus non-real. We will not enter this discussion, but rather, in section 3, look at ways 'virtual' content can be generated and aligned with real-world content. AR as part of smart technology and ubiquitous computing is discussed in section 4. All these observations are given a more concrete basis in section 5 where we have a more case-study-oriented approach to the various issues that need to be considered when we want to integrate AR into our daily life activities. To do so we need to pay attention to AR that is multi-sensorial instead of being uniquely oriented on only the sight sense. Conclusions that take into account developments in AR devices follow in section 6.

Augmenting the Real World: From Street Signs to 'Mouth Glasses'

It makes sense to go back to the original definition of AR and comment on the parts of this definition that are usually taken for granted. But before delving into a technology-inspired AR definition, it is enlightening to review a somewhat more general view of augmentation of the real world and how to distinguish, if possible, purposely added changes from 'naturally occurring' additions and changes to real-world environments. This is the recurring theme in this paper and it will be discussed from different angles.

As mentioned by Miguel Sicart [3], reality has always been augmented. Streets have been given names, borders exist between countries, there are directional and road signs, et cetera. We align these names and signs with the real world. Egyptians engraved hieroglyphics on walls, and in Roman times places of business were identified by signs, and stone pillars provided directions and distances to cities throughout the empire. Devices to enhance our senses also date back to ancient times. A treatise on optics was written two thousand years ago. Visual aid devices for reading and observing such as magnifying glasses, eyeglasses, binoculars, and microscopes were introduced. Wearable eyeglasses appeared in Italy during the 13th century. The Claude glass was introduced in the 18th Century, a gray convex mirror that allowed users 'to view landscapes as if they were picturesque paintings' [4], that is, to make landscapes more beautiful than they were in reality.

In the 1890s George M. Stratton experimented with eyeglasses that inverted the visual field [5]. Technological devices were designed that allowed us to perceive and manipulate our perception of reality.

Nowadays we have artifacts designed and produced by humans all around us. We perceive, usually in a multisensorial way, we appropriate, and use them, they can be interactive, and they are aligned in appearance, behavior, and function with our three-dimensional world. It can be argued that these artifacts are superimposed on the real world, but they are not virtual or interactive from a human-computer interaction point of view, where we interact with digital content and control digital and physical processes. For example, in contrast, Pokémon GO is an interactive smartphone game where virtual animated characters can appear and move around superimposed on a user's view of the real world. The creatures are computer-generated and for that reason are called 'virtual'. While some researchers have expressed the opinion that Pokémon GO is not AR, others have hailed it as a breakthrough for AR. Sicart mentions " ... audiences worldwide are now aware of augmented reality as a way of engaging and playing with the world."

Other much-cited applications with which the name of AR is associated by the general public are the well-known Snap Chat selfies that augment a face with cat ears, Facebook apps that add elephant trunk and ears to your face, or a Google Play app that lets you put a virtual tiger or another animal on the table in your living room. And, of course, we can look at navigation and tourist applications where we see location-based information, usually presented in textual form on a handheld, about streets, buildings, and events, that is superimposed on two- or three-dimensional representations of a particular environment.

There are other examples of augmenting the real world and devices that are needed to perceive such augmentations. Augmentations are not necessarily digitally generated and viewers-users do not necessarily have to use technology to perceive these augmentations, whether they address vision, sound, touch, smell, or taste. We may have the opinion that vision is our dominant sense and most AR research is oriented towards augmenting what we can see with wearable devices, whether they are handheld (smartphones) or head-mounted (smart glasses), the other senses have also their AR equivalents, and maybe more importantly, multi-sensorial or crossmodal equivalents. While with vision-oriented AR we have a virtual layer superimposed on the real world that contains (digitally rendered) visual content, with audio-oriented AR we have a virtual layer containing digitally rendered sounds, and similarly we can look at superimpositions of virtual layers on the real world that are touch, taste, or smell oriented and therefore augment our tactile, gustatory, and olfactory system. Hence, we can perceive these augmentations but this perception may require specialized technology, just as we need specialized technology to perceive visuals superimposed on the real world. In his foreword to a book on augmented taste and smell, world-owned chef Andoni Luis

Aduriz Mugaritz [6] mentions that we need ‘glasses’ for the mouth and perhaps in the future they become as common as spectacle glasses.

Augmented Reality and Digital Technology

In the previous section, we already introduced many characteristics of AR that need to be included in a more formal definition of AR. The original and generally accepted definition of [1] goes like this: “*Some researchers define AR in a way that requires the use of Head-Mounted Displays (HMDs). To avoid limiting AR to specific technologies, this survey defines AR as systems that have the following three characteristics: 1) Combines real and virtual, 2) Interactive in real-time, 3) Registered in 3-D.*” Azuma also mentions that “*AR might apply to all senses, not just sight.*”

According to this definition, the real and virtual content is combined in a real environment, real and virtual content are aligned with each other, and the combined content (the AR environment) is interactive, in real-time, and in three dimensions. The definition is not supposed to be limited to sight, AR should apply to all senses. Nevertheless, since humans are primarily sight-oriented, sometimes tacitly, sometimes explicitly, independence of technology is often understood as independence of display technology that combines real and virtual view images [7], but clearly, we can talk about display technology for other senses, including hearing, touch, and smell, or, preferably, a combination of senses that allow a multisensory display of virtual content just as in real life real objects display multisensorial characteristics. Adding virtual content to our surroundings can have the consequence that some real-world objects are no longer perceivable by our senses (diminished reality) or are perceived in a different sensory way.

Technology is part of our world and it is part of our daily activities. So we can ask what is special about our world being augmented with AR technology compared with other (human-made) technology. Is our television set, our smartphone, and our Internet, part of the ‘real’ world or are they augmentations of the ‘real’ world? What about our wearables, are smartwatches more AR than our digital or mechanical watches? We have prescription glasses and hearing aids that enhance our perception of reality and (sun)glasses and hearing aids that, respectively, reduce light and block external sounds. We can also diminish reality by closing our eyes and having our sight sense take over by active touch and discovering and experiencing an object in a quite different way than just looking at it.

Azuma restricts his definition to ‘combining’ the real with the virtual, and his examples are vision-oriented: “This definition allows other technologies besides HMDs while retaining the essential components of AR. However, this definition does allow monitor-based interfaces, monocular systems, see-through HMDs, and various other combining technologies.”

The technologies that are mentioned do not refer to anything other than the visual sense for combining virtual and real content. We may ask why using this AR technology provides us with a different view of our world than using

glasses that enhance our vision, batteries that provide us with energy that allow us to use our smartphones, connect with the Internet and communicate with friends, and enhance our perception of the world. Technology is not something that is added to our world, it is part of our world. Moreover, AR technology is not restricted to vision-oriented technologies as we can see in Azuma’s definition and it has to function in a world that is full of ‘traditional’ and digital technology. If we want to look at AR that addresses not only the sight sense we need to look at the ‘various other combining technologies’ that are mentioned by Azuma. AR functions in an already technology-impregnated society and in particular a ‘real world’ that consists of domestic and public environments with processors, sensors, and actuators that know about a user’s AR view and assist in interpreting and dealing with this view. In a seminal paper [8], Steve Mann introduced other ways to look at AR and made it part of a device-independent view of what he called ‘mediated reality’.

Let us, in this section, continue to focus on Azuma’s desire not to limit AR to a specific technology such as an optical see-through HMD. Indeed, various forms of AR have been introduced such as spatial AR, mirror AR, monitor-based AR, and handheld AR, which, although vision-oriented, do not require an HMD and where the conditions of this definition are satisfied. It is also mentioned that AR might apply to senses other than sight and that view is also generally accepted and there are many examples of systems that address senses such as touch, taste, smell, and sound by adding or manipulating stimuli that address these senses. That is, in AR we can overlay the real world with layers that contain augmentations of more than one of our senses. In this way, we have a multisensorial augmentation. For example, a virtual object can be provided with a tactile component, an animated object can be provided with sound, tactile properties of a real object can be changed. However, rather than having the AR cluttered with virtual content, we need an alignment of the virtual content with the real world. It needs to be anchored in the real world such that it appears to be a part of the physical environment. This attunement must meet an underlying desired goal of the augmented world, its designer, its owner, or its user. AR has many application areas. In medical education, it will make different demands on plausibility than in a theme park or an artistic installation.

It is quite possible that while wanting to avoid limiting AR to a specific technology Azuma nevertheless might have in mind other digital technology that could enable registration and real-time interaction. And nowadays it is hardly possible to think that digital technology will not be used whenever we want to create, control, mediate and experience stimuli that address our senses. On the other hand, unlike computer-generated Imagery that stimulates our sight sense, touch, taste, smell, and sound stimuli are not necessarily computer-generated and the delivery of these stimuli is not necessarily digitally controlled. Taste and smell are considered to be ‘chemical’ senses that require stimuli that can be digitally modulated but not re-

placed with digitally-generated stimuli that address receptors in the nose or mouth.

Hence, we might question what is the role of digital technology in this generally accepted AR definition. Can there be something ‘virtual’ that has not been created by digital technology? Or does ‘virtual’ only apply to something that has been created by digital technology?¹ Although we will return to this question in a later section, we may already decide, looking at other than the sight sense, that the answer is negative. The next question is how virtual content can be embedded in the real world. Does that always require digital technology? Again, the use of digital technology is obvious, we live in a digitally enhanced world, but that does not mean that it should be an essential part of an AR definition. The concept of real-time interaction does not necessarily require a special role for digital technology. Again, this role may be obvious, but not essential for an AR definition.

Augmented Reality and Ubiquitous Computing

According to the definition, in AR virtual content needs to be aligned with the real world. This assumes that in augmented reality we can perceive the real world, if not, the world around us would be an immersive virtual reality world. It also assumes that we can make a distinction between real and virtual content, at least from the point of view of an AR designer. Included in our real world is the technology that enhances our senses in dealing with the world, such as watches, glasses, hearing aids, smartphones, and other wearables. Smartphones are now an integral part of our lives. And so are social media. Navigation systems are integral parts of our cars. A car’s navigation system can provide information about what a driver will encounter further along the way. Street lights equipped with cameras can provide a motorist with see-through images on his front window (the car’s smart windshield) so that they can see around dangerous corners [10] and avoid collisions. While in the first decades of AR research it was oriented toward intrinsic issues, nowadays we cannot separate AR technology from smart digital technology, including all of our wearable technology, that exists in environments that have embedded sensors, actuators, and processors that are part of a ubiquitous computing world. This smart digital technology provides information that makes AR and interaction with AR more natural and smarter. It should be mentioned that neither in a recent article by Azuma [11] nor a “Grand Challenges for Augmented Reality” paper by Mark Billinghurst [7] there is mention of AR for other than the sight sense and the extrinsic issues of AR. But of course, humans are open to multisensorial stimuli, can predict these stimuli, cross-sensorially integrate these stimuli,

¹ In [9] Azuma’s definition is followed, but it is also mentioned that “AR supplements the real world with virtual (computer-generated) objects that appear to coexist in the same space as the real world.”

and act upon them. Hence, we want them also to be present in always-present AR.

Because of these observations, some questions arise. These questions can be considered from a human-computer-interaction-technological and a philosophical-technology point of view. The first view can be given a simple explanation. We design for a user who needs an application where they perceive their physical environment but designer-added content to their view makes the application more useful or more entertaining. In this case, the distinction between real and virtual is designer-made, that is, whatever the AR designer decides to integrate (that is, align) into an existing user-viewer environment. It will be perceived by this user/viewer and can be acted upon in their augmented world with whatever technology (if any) is necessary. This is a workable but also very opportunistic way to define the difference between real and virtual content in AR.

There is more to say, for example about the interaction between and the co-creation of the virtual and the real, not to mention many more insightful reflections on this difference from a more technology-philosophical point of view. But let us start by emphasizing how diverse the technology that is available to AR designers already is. While in the past AR technology could be distinguished in its use from other smart technology, ‘just’ focusing on the generation, display, and alignment of virtual content superimposed on reality, nowadays this distinction is hardly possible anymore. AR sensors and actuators are not that different anymore from what we expect to see in our wearables and the other way around. Various AR technologies exist: visual see-through, pass-through, optical see-through, mirror-AR, and spatial AR., each of them requiring technology such as miniature RGB and infrared cameras, wearable projectors, GPS, Bluetooth, head- and eye tracking, accelerometers, gyroscopes, barometers, magnetometers, depth sensors, et cetera, that we also need and use in pervasive and ubiquitous computing and require in the IoT.

Moreover, when we look at perceptual stimuli other than sight stimuli, we need to consider technologies that stimulate our auditory, touch, and haptic senses, and electric and chemical-based technologies that stimulate and change smell and taste experiences. Hence, in addition to the already mentioned technologies that are needed to generate and spatiotemporally control virtual content from the point of view of the user, we need to look at devices that provide electric stimuli to the tongue for taste experiences, tactile gloves, and ultrasonic transducers for touch and haptic experiences, directional microphones and in-ear sound monitors for auditory experiences, and scent projectors for smell experiences. Even when the stimuli are not digitally generated, in AR research their spatiotemporal characteristics are digitally controlled.

In ubiquitous computing, we have digital content realized by sensors, actuators, and processors, superimposed on reality. This digital augmentation is usually designed to increase efficiency in collecting, managing, and using information by those who own or are responsible for the en-

vironment but is also designed to increase the efficiency and positive experience of human users' use of smart environments. The positive experience may also be the result of being part of artistic, entertainment, or game environments. Ubiquitous or everyday-present AR is included in the smart environments that are realized with ubiquitous computing technology and cannot and should not be separated from other smart technology that is used to create these environments. And indeed, in [12] it is mentioned that "... *If AR is to become ubiquitous in consumer usage*" it requires a semantic understanding of the real world, an understanding that is only possible with having specific AR technologies embedded in ubiquitous computing technologies that aim to support users in whatever activities they are involved with.

Do these observations have consequences for the Azuma AR definition or perhaps require a completely different AR definition? There are many more observations to be made about the constituents of Azuma's definition before we can do so. These observations have to do with questions about how to distinguish virtual or digital from real, about interaction with virtual content, whether virtual content can change the real world, and with what we mean by the alignment of artificially generated or otherwise added content to a user's perception of the real world. Perhaps we should emphasize that in this paper we want to refrain from discussions about whether we need to distinguish between what is real, digital, or virtual. We will return to that in a future paper. But at this moment it is useful to look at a few examples of (not necessarily sight-oriented) augmented reality that help to shed new light on the constituent parts of the definition and on the consequences of having AR technology embedded in ubiquitous computing environments where there can be multiple AR users sharing augmented perceptions of reality. When discussing AR, we should also keep the well-known quote from Mark Weiser [13] in mind "*The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.*"

Can we expect that AR technology will be weaved into the fabric of everyday life and is indistinguishable from it?

'Augmented Reality' and Public Space

In the early sections of this paper we looked at the various ways the real world can be considered as augmented and, in more detail on augmenting the real world using Azuma's AR definition. We discussed the supposedly needed digital technology to do so. Our aim in the previous section was to show that AR is a smart technology that will be part of ubiquitous computing making use of the Internet of Things. We mentioned Weiser's well-known observation about technology that weaves itself into the fabric of everyday life. This section aims to make these issues more concrete by discussing them in the context of an application that we can encounter as part of our daily activities in urban environments, entering or leaving a subway station.

Entering a Subway Station

Piano Stairs is an interactive musical stairway that has been introduced in cities around the world. Walking up and down the stairs is detected by sensors and a different tone is generated for each step. It became popular after it was included in the Volkswagen initiative called "The fun theory," a project that was meant to show that people's behavior can be changed for the better by making things fun to do [14]. The installation, using pressure sensors for each step, was created in 2009 in the Odenplan underground station of Stockholm. Subway commuters preferred to climb the stairs rather than ride the escalator.

Similar installations had already been introduced before, following a design of the artist Christopher Janney [15]. In his design, patented in 1985, different series of melodic and natural sounds were activated depending on ascending or descending the stair. For each step, a different sound is generated. Light sensors, one per step, detect an individual's position on the stairs. Other installations, usually following the piano stairs idea, and usually temporary, have been created in public spaces all over the world.

Staircase with Sound and Sight

Let us have a fresh look at regular stairways in public environments that we want to make more attractive by using augmented reality. Consider the situation of stairs where each step has a light sensor that detects whether someone steps at that particular step. After detection, a sound is played in the headphone of the person that climbs or descends the stairs. The sound that is played can be the note that belongs to a piano key that corresponds with a particular step. Black and white piano keys can be painted on the steps. The sound can not be heard by others not wearing a headphone, although they may wonder why the steps are painted like piano keys. According to the definition of Azuma, we have AR for the headphone user. That is, the virtual content is sound, not necessarily digitally recorded or (re)produced. The interaction between the user and (augmented) stairs is in real-time, and the virtual content is registered (or aligned) with the real-world objects. That is, the notes corresponding to the trodden step are played.

It can be enlightening to make a comparison between this sound-oriented AR with the vision-oriented AR approach where computer-generated images are superimposed on the real world that is perceived through an OST device. In vision-oriented AR we have sensors in our wearables, in particular, cameras that sense the real world and that provide a view of the real world that can be overlaid with virtual content, that is, computer-generated imagery. But other sensors are also needed to provide information that helps in aligning the virtual content with the real world from the point of view of the AR user. For example, in OST AR we need to sense the position and head orientation of the user to align the virtual content with the real-world view of the user. Notice, that the virtual content could as well be directed sound, perceived from a particu-

lar location in the real-world view that is provided by the OST device. In that case, the virtual content addresses the hearing sense. Virtual content that addresses other senses (touch, smell, taste) is possible as well. How virtual content is generated and aligned with real-world content is not an issue in Azuma's AR definition, although we often tacitly assume that it is done with digital means.

In the case of the piano stairs' implementation considered here, we need to sense sounds aligned with our position in the world as well. Sensors in our headphones can cancel environmental noise, so we have a 'diminished reality', and they can focus on sound coming from a particular location or person and the sound can be adapted to a listener's hearing capabilities. In the case of our piano stairs implementation, this sensor technology can add to the proper alignment of the keynote sounds to the position of the user, for example, by taking care that the sounds not only align with the particular step on the stairs the user is making but also that the sound is coming from the direction from that step, from below, rather than being ambient (not coming from a particular location).

Rather than using light sensors, we can think of an implementation with pressure sensors. It does not change the virtual layer, only how the position of the user is sensed, and the sound that has to be played in the user's headset. A stairs implementation in a smart public environment can have other sensors as well to provide a user with a personalized AR experience that addresses one or more of their senses, perhaps creating cross-modal effects.

Going back to our example, whether realized with light, pressure, or other sensors, if there is more than one user on the stairs, all of them wearing headphones that allow them to hear the sounds that are produced when interacting with the stairs, they can share their augmented world and they might try to play together. How should we look at a situation where the sounds can be triggered and heard by everyone who uses the stairs without needing a headphone? That is, the usual piano stairs designs as they have been implemented in indoor and outdoor public spaces? Should we call it shared AR? If we make an AR installation public by not requiring a personal device that displays virtual content aligned with the real world, is it still AR? With spatial or projected AR and monitor-based AR we use projectors, cameras, and additional technology, but the user is not necessarily required to have a personal device to perceive the augmented world. Azuma's definition of AR does not exclude perceiving AR without wearing a personal device. We can compare this public sound-oriented version of the piano stairs with spatial and vision-oriented AR implementations that address the alignment of projected visual content (computer-generated imagery) with real-world content, where real-world content ranges from museum objects to architectural or other objects that we can find in public spaces, for example, a three-dimensional front of a historical building.

We can turn the existing real world into an augmented real world by adding not yet present images, sounds, smells, tastes, or touch content, or by manipulating existing

content in a way that can be perceived by the user of the AR environment, whether or not a digital or other device is needed for perceiving the additions. Neither does the added content have to be digitally generated. Added auditory and touch experiences can be generated, controlled, and aligned in a non-digital way and this is certainly true for smell and taste. Digital technology can play a role or be needed in generating and aligning content and being able to interact with the augmented world. However, we conclude that Azuma's AR definition cannot be maintained if we want to include anything other than the sight sense and other than computer-generated content. If we want to maintain this definition, we should accept that we cannot always make a distinction between what we consider real and what we consider augmented. An elevator with glass walls is nicely aligned with the ground and other floors, it provides multi-sensorial experiences (auditory, visual, proprioceptive, smell) that are not present with traditional stairs, and its interactivity (where to go, going back on decisions because of requests from other floors, detecting children below a certain age, excessive weight, or door-closing obstructions), make such an elevator interactive as well. When we introduce such an elevator, we augment the existing world with multisensorial experiences that can be shared, from different perspectives, and that are not available for non-elevator users.

Perhaps we should say that this example is not about augmented reality because we do not need a wearable device to perceive the augmentation and its alignment with the real world. But this contradicts Azuma's device-independent AR definition. In addition, we may think of AR applications (spatial AR, mirror-based AR) where users do not need a device to perceive the AR display. And, as mentioned above, AR devices can be embedded in a ubiquitous or IoT computing environment that allows us to have a personalized augmented view of the world since the environment can recognize us, our context, our history, and our preferences, and therefore the (smart) environment can provide us with a view of the augmented environment that despite being shared, nevertheless provides us with a personalized view and corresponding (multisensorial) experiences. Our view of the augmented world might be different from the views of other users sharing the augmented reality world, in whatever way the augmentations have been realized, and whatever senses are addressed.

While in the Piano Stairs observations we made above, artificial sounds had to be aligned with passers-by stepping on its steps, to make it (sound-oriented) augmented reality, previous paragraphs and subsections already alluded to other than sound-oriented augmented reality. We made the comparison with vision-oriented augmented reality. In that case, we have computer-generated imagery that has to be aligned with a user's real-world perspective. Also, in the case of computer-generated imagery we can distinguish between individual (and personalized) AR, shared AR, and AR that has become part of reality. One or more AR users can have a personalized view of computer-generated imagery as virtual content superimposed on reality. An OST

device is required to view this content, aligned with the real-world content. Rather than having virtual content displayed on a user's OST device, we can have it displayed and embedded in a user's AR view of the environment. In projected or spatial AR, we have computer-generated imagery superimposed on real-world objects such as walls and buildings. Such projections can become part of ever-present augmented reality, not requiring a device to perceive the augmentation of reality.

Augmenting with Scent

Sensors, actuators, and wearables in a smart environment can provide its human inhabitants with augmented reality experiences, making the environment an AR environment. We can further illustrate this with smell-oriented AR and provide similar piano-stairs-like observations as we had above for sound and vision. The smell can be added to an existing environment by having it entered with smell-emitting objects such as flowers or making changes to the environment by starting cooking. These smells are generated chemically, not digitally. Digital technology can be used to manage the distribution and context-aware manipulation of natural or chemically produced scents, but the content is, unlike what we encounter with computer-generated imagery that has to be aligned with reality, not computer-generated. Papers that follow Azuma's AR definition and mention that it as well includes other than the visual sense, do not elaborate on this definition.

In various papers, scent-augmented realities have been discussed. The scent is usually delivered from fragrance oil cartridges. These cartridges can be present in a user's environment or a wearable display device, for example, attached to an OST HMD that displays visual virtual objects and have scents attached to them. The scent has to be delivered to the user we want to give an augmented reality scent experience. This is easy when the cartridges are near the user's nose and mouth, otherwise a directional stream has to be created, targeted at the user. Alignment (as mentioned in Azuma's definition) requires spatiotemporal control of the scent, which can be realized with fans that blow over an opened cartridge, scent projectors that make use of invisible air vortices [16], [17], or ultrasound [18]. If the scent-delivery system is not wearable, then the position of the user, in particular their nose, can be tracked with cameras that are present in the application area. Commercial olfactory displays that deliver directional olfactory streams are already on the market [19]. Hence, this way of scent generation (not digital) and (not necessarily digital) delivery to one particular person makes it an olfactory augmented reality experience.

We can argue whether a scent should be considered virtual. Unlike computer-generated imagery, the artificially added scent is not generated digitally and the alignment does not necessarily require digital technology. As in the case of computer-generated imagery where the aim can be to make it indistinguishable from visual reality in an AR application, we can think of sounds or scents that are indistinguishable from reality but this more or less requires also

considerations about the appropriateness of images, sounds, and scents that are added and perceived by the AR user, which again has to do with alignment. Another component of Azuma's definition is interaction in real-time. What does it mean to interact with scent? Smells can recall memories and influence our behavior. We can sniff a scent and actively look for different scents but that does not define human-scent interaction. Rather we can have the user exploring the environment guided by smells or acting on objects in the visual AR environment that have (augmented) smells associated with computer-generated visual virtual objects. From this point of view, we can say that Azuma's definition also covers a smell-oriented realization of augmented reality. Of course, interactivity is also present when an application requires the user to control the scent delivery system. For example by providing the user with a control panel or sensing the user's activity (gaze, gestures, et cetera) that triggers the scent delivery system.

We might think of a future scented version of the piano stairs where each step triggers a different scent. This certainly requires the quick switching and neutralizing of scents or their intensity. Rather we look at the next step we made when we discussed the transition from an individual AR experience to a shared AR experience, where 'shared' does not exclude the possibility that the AR experiences are personalized and depend on the position and orientation of the participants. Scents can be shared, whether their delivery and distribution are done by personal wearable delivery systems or by directional scent delivery systems (scent projectors) positioned in the environment. Sharing a scent-augmented environment can nevertheless provide inhabitants with different smells and smell intensities, similar to what we saw in the case of sounds in the sound-augmented environment of the Piano Stairs. Interactions between users based on their own or shared smell experiences are possible. Other inhabitants of the environment, not included in the scent-supported community, not having wearable scent delivery systems, or not being targeted by scent projectors, do not share the scent-enhanced reality.

We can, as we discussed in the case of Piano Stairs, make the scent augmentation of the real-world environment available for everyone in the environment, not needing a special device, although different locations can have different smells. Just like daily experienced Piano Stairs, the olfactory augmented reality has become a daily reality, that is, not experienced as augmented anymore. The people involved are becoming familiar with the scents, there is habituation. AR becomes reality, similar to what we saw in the other examples we presented.

Conclusions

Once our ubiquitous IoT computing becomes reality, including ever-present AR, it is not relevant anymore to distinguish AR from other digitally generated and controlled aspects of reality. To substantiate this conclusion we started with a global view of how the real world is already augmented and whether digital generated virtual content

can add to that from the point of view of Azuma's definition. AR does not necessarily require digitally generated content and having that aligned with real content. It depends on the senses that are addressed. Also, AR technology can not be isolated from other technology that makes ubiquitous computing possible.

We discussed an AR view on daily activity in public spaces, entering and leaving a subway station, and used it to explain our view on augmenting the real world with technology that provides us with an Azuma-like AR view but that does not necessarily distinguish between virtual and real and by looking at other modalities than vision only, not necessarily requires digitally generated content. We distinguished between individual, shared, and collective experiences. To have technology-supported personal experiences in the world the technology should be tuned to a particular user. That is true for a smartphone, a headset, or prescription glasses and it can be true for AR experiences. Every individual's beliefs (common sense and world knowledge), aims, actions to satisfy them, and emotions are unique. AR technology becomes part of unobtrusive technology in our wearables that communicates with our smart (urban, office, domestic) environments in a way that we prefer and get used to it. Following Mark D. Weiser [13], it disappears into the fabric of everyday life, including social life in public spaces and urban environments [2].

An OST HMD such as a HoloLens is not unobtrusive. It is inconvenient to wear, it has a limited field of (virtual content) view, and it covers regions of the face that are important for social interaction [20]. But, OST HMD devices, just like virtual reality devices, develop into all-day wearable light-weight glasses that cannot be distinguished from prescription glasses or sunglasses. They will be put on the consumer market by companies like Facebook, teaming up with Ray-Ban, Google, Apple, and Amazon [21]. AR contact lenses with image and motion sensors, connected to a smartphone, are also in development [22], [23]. We enter the world of Vernor Vinge's novel *Rainbows End*, where wearing computers is the norm, people choose cliques or 'belief circles' with which they share experiences, and use contact lenses that overlay what they see with virtual content that redresses their environment to their taste [24].

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AI Creativity: AI.R Teletorium, Toward New Storytelling Realm.

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Abstract

AI.R Teletorium is an artificial intelligence-based collaborative storytelling system that offers children with inclusive needs an opportunity to participate in a remote interactive AI fairy tales storytelling experience while actively involving them in creating a story's narrative with their normal peers. We aim to provoke positive social interactions between children and help develop social, creativity and communication skills and improve their imagination and social competencies. AI.R Teletorium consists of a neural story generator and a doodler-based fairy tale visualizer. We design a character-centric bidirectional connection mechanism between the story generator and visualizer equipped with Contrastive Language Image Pretraining (CLIP). Thus, simple sketching enables kids to participate in the story generation process. Extensive experiments and user studies show that our system could generate and visualize meaningful and vivid fairy tales with limited training data and complete the entire interaction cycle under various inputs (text, doodler) through the bidirectional connection.

Keywords

Generative Storytelling, Natural Language Processing, Artificial Intelligence Creativity, Human-AI Interaction, Computer Vision

Introduction

While story provides an effective and concise way to share experiences, visual content acts as a more comprehensive and universal communication tool that transcends barriers between user groups with different cultural backgrounds and physical preferences. Learning for meaningful and coherent story visualization is thus becoming a popular yet challenging task among AI studies. This paper proposes AI.R Teletorium, an intelligent and artistic fairy tale visualizer that interacts with users in real-time. Furthermore, language and mental development are key aspects of early childhood education. Through the characters and virtues shown in the stories, fairy tales provide moral models for kids to follow and help develop their vocabulary by offering vivid illustrations. The majority of existing story visualization research ([7]; [13]; [16]; [18]; [29]) have relied on the combination of recurrent neural networks (RNN) and generative adversarial models (GANs). While achieving stunning results on constrained datasets like MS COCO ([17]), such end-to-end text-to-image

mapping could fail on composite scenes with multiple objects. Recently, ([9]; [10]; [21]) induce scene graph as an intermediate representation to support visualization of compound sentences. The Scene graph ([12]) describes things in a scene and their relationships, most commonly position relationships. Compared with raw text, scene graph conceptualizes scene contents as abstract semantic elements that are not bound by object class or relationship types, boosting text-to-image studies' flexibility and representation power. However, most existing visual language models are trained on massive real-life photos with captions. In fairy tale visualization, we still face the challenge of data shortage. On the one hand, fairy tale illustration conserves much artist labor; on the other hand, the illustration style usually varies from artist to artist, making learning more challenging. Based on this point, we combine a rule-based fairy tale parser with a neural sketch generator into an intelligent and interactive visualization system that specially focuses on fairy tale visualization.

In light of this, we propose a new AI fairy-tale co-creation system: AI.R Teletorium. It enables common creative experiences between groups of children with different physical preferences and at other locations. We aimed at offering an entertaining and imaginative platform for children to communicate with each other, improving their psychological health, especially under extreme circumstances such as the COVID-19 pandemic. The system is composed by two novel modules, a character-centric story generator and a visualizer in the form of doodlers. We connect those two modules by characters and build a bidirectional link to allow kids to interactively participate in the fairy tale creation process by simple doodling without vocabulary requirements.

We summarize our key contribution as follows:

- A novel multimodal fairytale co-creation interface based on interactive text-to-image transfer and vice-versa.
- The system presents a novel fusion method between a learn-based language model and a rule-based graph update, allowing for more flexibility in both story generation and visualization with limited data.
- Proposing a CLIP transformed story graph as an intermediate representation to transcend the barrier between digital storytelling content and insufficient illustration data (automatic AI fairy tales storytelling case).

This paper will first give a brief description of the AI.R.

Taletorium system. Then we explain our character-centric approach to fairy tale generation and visualization. Finally, we present the results from the performed experiments and demonstrate various applications to prove the generation flexibility of our proposed system.

Related Work

In the field of text to visual content(or, more specifically, image) synthesis ([7]; [9]; [13]; [14]; [16]; [20]; [26]; [27]; [31]; [36]; [38], [39]), early studies usually ground text to-image generation as a search problem. Given a text description, they search for words, representative images, and placement from an existing database that most match the description. They then adopt a graphics renderer to combine the search results into the same canvas. Despite the complex AI models (vision, language, and graphics) integrated into the system, such systems are usually incapable of generating new images.

With the rise of generative models([5]; [21]), researchers also explore combining RNN and GANs for text-to-image generation by learning directly from massive text-image pairs ([7]; [16]; [14]; [20]; [26]; [27]; [38], [39]). Such modelling enables the generation of new visual content from concise text descriptions. However, constrained by training data formation, they are generally incapable of modeling complex scenes with multiple objects.

Another stream of work adopts intermediate representations to deal with complex scenes. Johnson et al.([13]) firstly introduce scene graph for image generation and outperforms previous methods in generating an intricate image with multiple objects. They develop a graph convolution network to process the scene graph, which acts as a principal component for following scene graph-based image generation methods ([9]; [30]). In WordsEye ([3]) an automatic system for 3D scenes generation from text has been proposed.

Similarly, we use scene graph as the medium between fairy tale and visual contents to support sketched scene generation from fairy tale fragments with unusual objects and complex relations. Along with the generation of fairy tale fragments, we par each fragment in real-time into a scene graph containing characters and their relationships covered by the fragment. We then propose a conditional neural scene composer learned from human captioned natural images to compose sketched scenes from the parsed scene graph. As the story goes fragment by fragment, we update the scene graph according to fragment co-references ([32]).

Learning for Sketching

Doodling, or free-hand sketch, is a universal communication and art modality which combines convenience with expressiveness. As a high-level abstraction of real-world contexts, doodling endorses advantages for neural processing with its simplicity while suffers from the high sparsity and wide style diversity. Based on neural representations for sketch structure([8]; ([28]), a great amount of work has been done in doodle creation, recognition, retrieval, partial analysis and, abstraction, etc. We refer the audience to([35]) for a comprehensive review of learning for sketching.

With artificial intelligence becomes increasingly part in people's everyday lives, making researches on human-AI co-creation rather essential. Recently, ([22]) propose the positional idea to grounds the HRI design research on three touch-points: the roboticists as designers, the design features of the systems, and the users as co-designers. ([23]) explore four scenarios for collaborative human-human sketch co-creation, and shows that collaborative drawing with a third-party voting strategy leads to most creative sketches. Despite these pioneering works, the research in human-robot co-creation remains extremely limited. With AI.R Taletorium, we proposed an efficient human-robot co-creation scenario that utilize AI as a powerful interface.

The visualization system of AI.R Taletorium combines doodle creation with comprehension. It not only enables doodling from the story but also turns the user sketch interactively into the story.

Interactive Storytelling (IS)

Interactive storytelling plays an important role for for Early Childhood Education. AI learning companions, as either tutor or tutee role, provides an intelligent and responsive interface to support children's learning in a variety of contexts including language development, storytelling and scientific learning (Kanda et al. 2004; [23]; [6]; [11]). Compared with kindergarten teachers, personalized AI tutors/tutees could asses and automatically adapt to kid's knowledge level and physical needs. Previous studies([1]; [24]; [19]) have emphasized that the personalized instruction from robots could clearly augmenting the efforts of parents and teachers to help kids acquiring both academic knowledge and positive attitudes.

Storytelling, as an interactive process that facilitates imagination, creative thinking, language abilities, and cooperative learning, bringing a broad range of positive outcomes for primary education([4]) summarizes methodologies and enabling technologies used in building interactive storytelling system for kids. The In-Visible island project([33]) further pinpoints digital inclusion in IS systems. They designed an inclusive system to join visually impaired children and sighted kids together into a unified storytelling process, which on the one hand, accelerated the social learning curve of visually impaired children, on the other hand, educating sighted children to have more empathy towards their peers with physical limitations.

AI.R TALETORIUM System

AI.R Taletorium is a character-centric multi-modal AI fairy tale telling system aims at connecting users with different background and physical needs into a unified fairy-tale co-creation process with AI. The system consists of two intelligent components:

- Character-centric AI fairy tale generator.
- Intelligent doodling-based fairy tale visualizer.
- Collecting users' facial characteristics and selecting characters for the storyline based on predefined matching criteria.

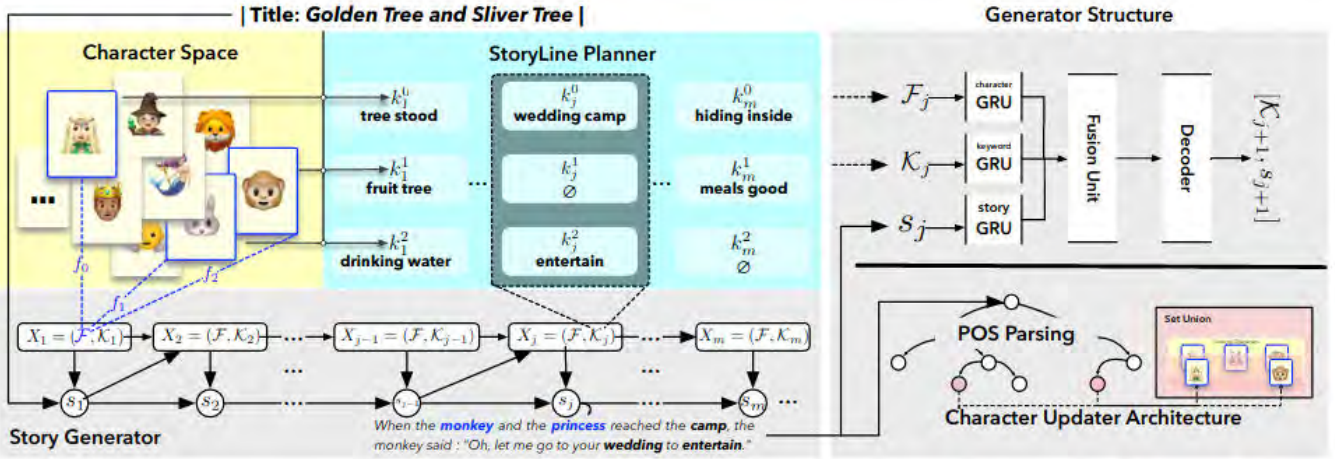


Figure 1: Character-centric story generation. We combine plan-and-write([37]) story generation framework with character features to compose each story fragment. We apply a dynamic generation strategy and plan for each fragment on the fly based on the previous story fragment and current character status. Such a character-centric generation scheme thus supports user co-creation with AI in storytelling by modifying characters.

- Interpreting users’ doodlers, they are added to the AI-generated fairy tale illustration and creatively implementing it in the storyline.
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With AIR Taletorium, we aim to intensify User-AI interaction in the joint act of creation by using users’ personal properties (face features and doodlers) and challenge artificial intelligence creativity to the highest level of imagination.

Character Centric Story Generation

We formulate the system input-output as follows:

Input: A character set $C = \{c_0, c_1, \dots, c_{n-1}\}$, a title $T = \{t_0, \dots, t_{k-1}\}$ that defines the main topic of the fairy tale and a storyline size m .

Intermediate output: We map characters onto the character embedding space as character feature vector $F = \{f_0, f_1, \dots, f_n\}$ as in (Liu et al. 2020). At each generation step $j \in [1, \dots, m]$, we generate storyline keywords ¹ $K_j = \{k_j^0, k_j^1, \dots, k_j^n\}$ for each character according to previous story fragment to define character actions at current step.

Output: A story $S = \{s_0, s_1, \dots, s_{m-1}\}$ composed with m story fragments, where $s_j = Merge(l_j^0, l_j^1, \dots, l_j^n)$ is merged from $n \leq \|C\|$ sentences ² generated from each character’s storyline keyword at current step. We follow a recurrent generation framework([37]) to generate the whole story (Fig. 1). Each fragment is generated based on previous fragment and current status $X_j = (F, K_j)$. We initialize the first fragment

¹We allow k_j^i to be empty, which means the character is not participating the current site

²We define $l_{ij} = \emptyset$ when $k_{ij} = \emptyset$, which means some characters might not be involved from the current generation step, and current fragment size n could be less than number of characters $\|C\|$.

as the given title:

$$s_{j+1} = (s_j, X_{j+1}), s_0 = T = t_0, t_1, \dots, t_k \quad (1)$$

As shown in Fig. 1, we initialize the characters by mapping user facial attributes, extracted with MXNet ([2]), onto 24 predefined fairy tale characters according to *Psychological & Cultural Stereotypical* rules, so the character with more features in common with the user will be choose.

Visualizing Fairy Tale

Most state-of-the-art text-to-image visualization methods are based on data-intensive transformer architecture, which generally suffers from insufficient training data, not to mention the domain gap of language styles and object categories between fairy tale stories and formal language descriptions. For example, while “A horse under a tree” could be a formal description for Visual Genome dataset([15]), in fairy tale stories it becomes “*The ferocious unicorn trapped in the tree*”. To tackle this problem, we introduce a doodler graph as an intermediate representation and adopt a two-stage generation framework to visualize fairy tale stories to interactive doodling interfaces. As shown in Fig. 2, we first parse the fairy tale fragment description into a doodler graph, then we adopt a GNN scene composer to compose doodler visualization from the parsed doodler graph. Similar to ([10]), the scene composer will first predict character layouts, then we adopt the SketchRNN ([8]) decoder to draw individual sketches according to the layout. By introducing the doodler graph as an intermediate representation, our visualization system is able to deal with more complex and abnormal scene structures such as fairy tale scenes. In the following, we will first formulate the doodler graph representation, introduce the scene composer architecture and demonstrate the doodler graph updating policy during the story generation process.

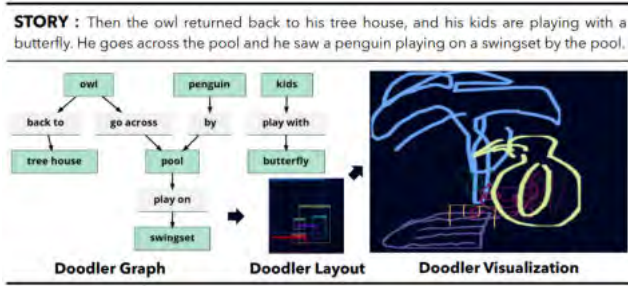


Figure 2: Fairy tale fragment to doodler visualization. Given a fairy tale fragment (top), we first adopt a rule-based parser to turn it into a doodler graph (left). Then we predict the doodler layout from the doodler graph (middle). Finally, we compose the doodler visualization according to the layout (right).

Doodler Graph Representation

Same as scene graph, doodler graph is a graph data structure that describes the contents of a scene ([12], [13]). We formulate the doodler graph as $G = (V, E)$, where vertexes $V = v_1, \dots, v_n$ refers to the set of characters, and edges E represents character relationships. Each doodler character $v_i = (o_i, c_i, w_i)$ is identified by its category o_i , color c_i and stroke weight w_i . Given a story fragment, we adopt a rule-based semantic parser to generate the doodler graph. Similar to ([13]; [34]; [31]), the parser will first parse the fragment into a syntactic dependency tree. Then a set of tree transformations is applied to the dependency tree to acquire characters (i.e., nouns), adjectives that describe character attributes, and verbs that identify character relationships. In practice, we assign doodling color and stroke weight to each character either based on their attributes (e.g., a red flower) or randomly choose one from a color palette.

Doodler Scene Composer

We train the doodler scene composer directly on the Visual Genome dataset (VG) ([15]). Considering the gap of characters and relationships between fairytale scenes and real-world scenes, we adopt a pre-trained text-encoder ([25]) to map the doodler graph into a scene graph according to the current story fragment. Specifically, we treat the matching problem as a zero-shot prediction problem. We replace each doodler entity in the story fragment with 81 candidate VG entities. We then encode candidate story fragments into text features $T_1, T_2, \dots, T_N, N = 81$ and calculate their scale cosine similarity with original story fragment feature T_0 , we choose the most similar entity to replace the doodler entity (Fig. 3). We adopt the same way to transfer doodler relations into casual relations. With transferred doodler entity and relation, we build a casual scene graph that suits the VG dataset.

After transferring the doodler graph to scene graph, we adopt a graph-neural-network-based layout predictor ([13]) trained on VG dataset to predict layout for doodlers. Given the layout bounding box, and layers for each object, we adopt a modified Sketch-RNN decoder (Huang and Canny 2019) to draw each doodler entity onto the canvas.

With this approach we managed to build a map between

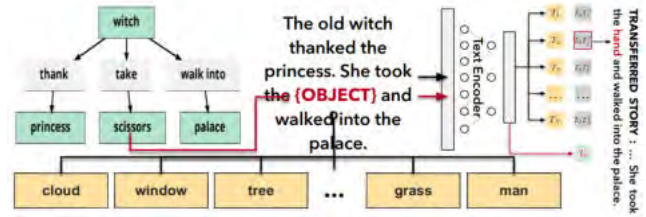


Figure 3: Mapping doodler graph to VG scene graph. For characters and relationships presented in the doodler graph, we adopt a pre-trained text encoder ([25]) and search for the most similar VG ([12]) object based on the current story context.

real word and fairytale scenes which allow the net to learn how to build a reliable scene layout.

Character-centric Interaction System

With the doodler graph representation, we build a bidirectional connection to transform fairytale stories into drawings and vice-versa. In this way the user can influence the story generation by inserting new keywords or manipulating the characters inside the story by choosing at each generation step to remove characters and generating new ones thanks to the doodler recognition system. We decided to choose this system of interactions in order to create a more intuitive and children-oriented system instead of allowing the user to directly insert new fragments of the story.

The **story-to-drawing** transformation is based on neural correlation analysis and refreshes the doodler graph when a new story fragment comes. The co-reference system keeps track of pronouns in the system and matches the pronouns to nouns that existed in the previous context. We thus use the co-reference to link doodler characters in the newly generated fragment to the existing fragment. We analyze coreference between adjacent story fragments. After the coreference is resolved, we update the pronouns to their referenced nouns. With the updated doodler graph, we predict the layouts for new doodler characters and add each new character individually onto the canvas.

The **drawing-to-story** is similar to the story-based policy and is used to support user interaction. As a visualization medium, the doodler graph supports both transformings into/from story fragments and doodling. AI.R Taletorium is integrated with a doodler recognition system and allows users to add characters along with the generation. We will automatically parse the user sketch into story characters and update the scene graph based on doodler spatial relationships. We will generate the next story fragment based on the updated character set.

Experiments

In this section, we will first introduce the datasets we use and our implementation details in Sec . We then conduct the qualitative evaluation with story visualization and demonstrate user interactions under three scenarios in Sec.

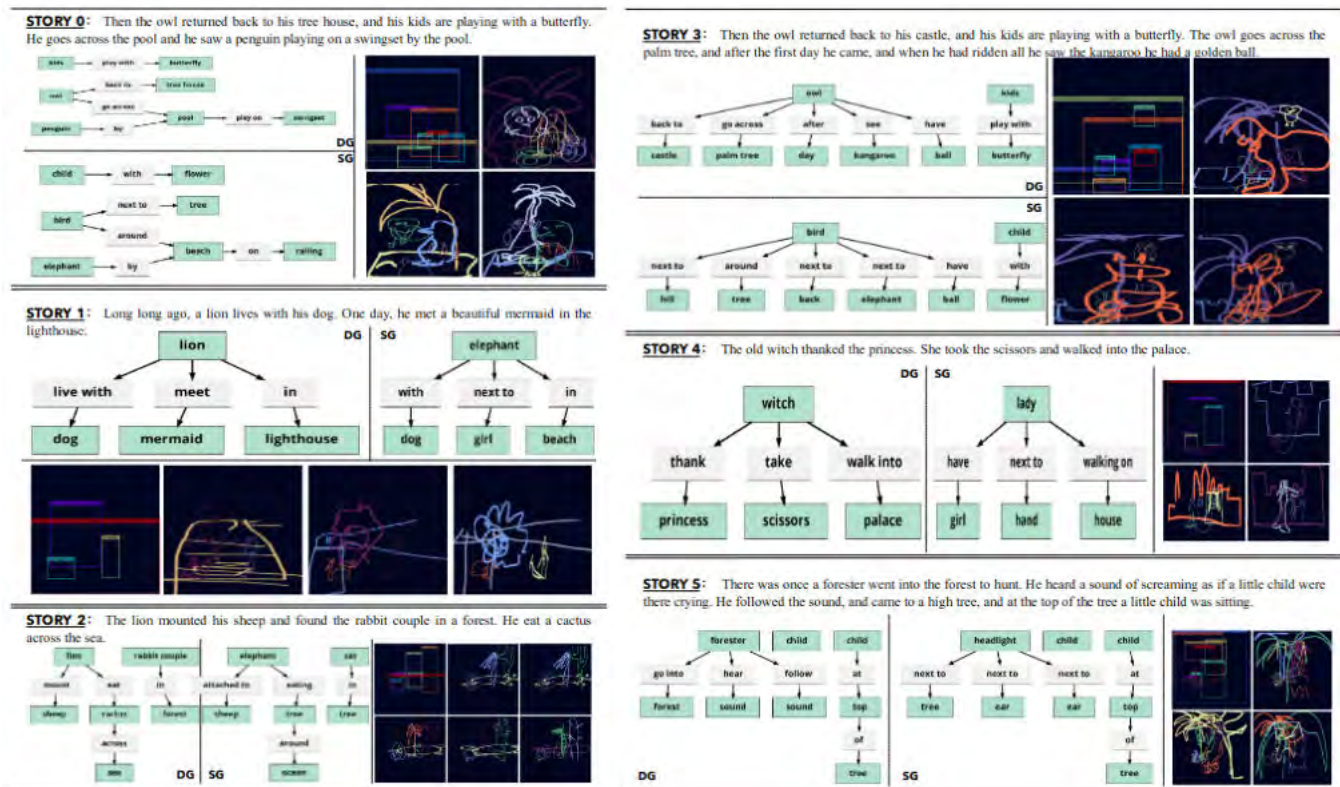


Figure 4: Doodler scene composition results. We demonstrate composed doodler scene examples for 6 stories. For each story, we show the parsed doodler graph (DG), the transformed casual scene graph (SG) based on the mapping strategy described in Sec. (Fig. 3) together with 4 composed scene examples. The result shows that with the doodler graph representation, we could handle complex scenes with multiple objects and relationships. Additionally, comparing STORY 3 with STORY 0, we further shows that our doodler graph representation could automatically remove redundant information and non-sense AI generated sentences like when he has ridden all. Meanwhile, as the mapping strategy automatically turn fairy tale objects to casual scene graph objects, we could also deal with rare scene descriptions including witch and forester.

Dataset and Implementation

Our system consists of three trainable modules: the AI fairy-tale generator, the doodler scene compositor, and the sketch drawer. We use the following datasets to train each module:

1. Fairy tale Dataset (FT890): We collect 890 fairy tale stories to train the AI fairy tale generator. We applied a modified RAKE algorithm([29]) to generate storyline keywords for each story. Firstly, we divide each story into an appropriate number of fragments (5 during the experiment). We then extract a set of keywords from a story and get their fragments id and score (indicates its importance calculated by RAKE). We select the top 4 characters to build the character feature space according to storyline keywords. We train the story generator with two 3090Ti for 20 hours and test with the 500 epoch checkpoint during inference.
2. We train the doodler scene composer on the Visual Genome Dataset ([15]) which contains 81 object categories. We process each ground truth scene graph with a graph convolution network (GCN) and train the GCN to predict the bounding box conditioned on the scene graph.

During inference, we map each fairy tale doodler to a scene graph object based on their similarity described in Fig. 3.

3. We train our doodler drawer on QucikDraw Dataset([8]) which contains 345 object categories. For fairy tale characters beyond the dataset, we assign the doodler that is semantically similar to the character as its representative doodler. We adopt a trained SketchRNN([8]) on the dataset to draw individual doodlers. We utilize TFJS integration for front-end sketching.

Fairy Tale Visualization

In the following, we first demonstrate the doodler scene composition results with parsed doodler graph, transformed casual scene graph and generated composition examples. We then analysis the efficiency of doodler graph updating policy among story fragments and perform ablation study on graph parsing w/o coreference resolution and scene composition with simple text guidance.

Doodle Scene Composition We demonstrate the visualization result for fairy tale fragments in Fig. 4. Compared with

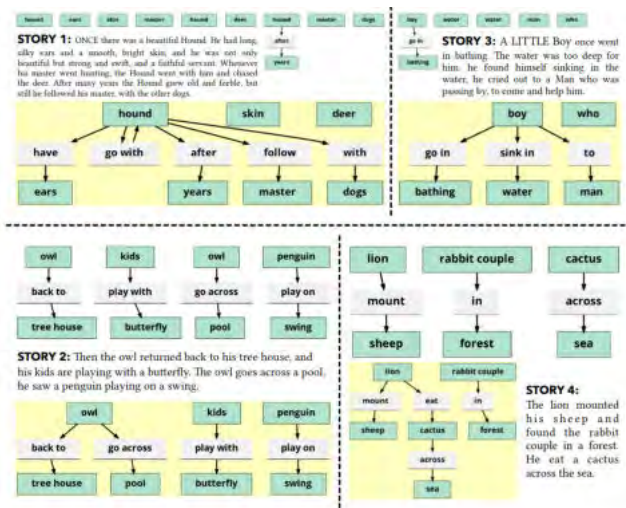


Figure 5: Graph parsing w/o coreference resolution. We demonstrate the graph parsing result on two types of text inputs: Aesop store (top) and AI-generated fairy tale (bottom). We label the coreferenced graph with yellow.

end-to-end text guided sketch composition methods([10]), with the doodler graph as intermediate representation, we are able to catch complex relations between multiple characters and scene objects, and identify correctly the layout for each object in the final composition with layered effects, i.e., the background scene could be correctly placed under character layers. For example, in the first story (story 0), there are 2 sentences with 7 scene characters/objects (green nodes), including an owl with his two kids playing with a butterfly and a penguin on swing-set by the pool, the doodler graph could correctly identify the relationships between characters and with the scene compositor we could align each character in a reasonable way (right).

The doodler graph representation also tolerates a certain degree of grammar mistake and nonsense descriptions, which is a common case for AI generated stories. For example, story 3 has relatively the same objects with story 0, except the additional description like when he had ridden all, the doodler graph automatically gets rid of the redundant information and the finally composited scene is similar to the original story (story 0 in this case)

AI Creativity plays an important rule in most generation tasks, especially in our case, when AI is acting as a co-creator for kids. During experiment, we find that the doodler graph representation also empowers the AI sketcher with certain degree of rational imagination by simple object/relation mapping to real world datasets (e.g. the VG dataset([15])). For example in story 5 (Fig. 4), while the forester seemed to be unfamiliar for most AI interpreters, we automatically map it to a headlight that is in the training dataset and favor the scene description.

Doodler Graph Update As the story is generated fragment by fragment, making it rather important to keep visualization consistency between story fragments. Instead of generating

new doodler graph for each story fragment, we automatically update maintain a single doodler graph for each story and update the graph based on neural coreference resolution across fragments. We assign for each character in the story a unique id and keep tracking of the character action in newly generated story fragments. In Fig. 6, we analysis the automatic doodler graph updating policy with both human-written Aesop Fable stories (left) and AI-generated fairy tales (right).

Aesop Fables are short stories composed by strongly connected fragments. In the example story, the FOX is identified as the main character who will lead the story in multiple story fragments. With coreference resolution (bottom graph with red nodes in each example in Fig. 6), we're able to track the same FOX within multiple story fragments and update it's action with multiple supporting roles (e.g. the cock)

Another problematic situation we dealt with the doodler graph updating policy is that the same character may perform in distant fragments. For example, though the farmer only comes in the first and last story fragments, we managed to keep him alive through the whole story, and identify he's the same farmer that the cock speaks to in the last story fragment.

The rational connection among AI generated story fragments are comparably weak than human-written stories, Fig. 6 (right). Though according to the AI generated story, the kangaroo performs multiple disconnected tasks among all scenes, with the updating policy, we could correctly track him as the main character of the story, and update supporting roles to the scene based on their relationships with the kangaroo

Applications

Text to sketch generation

Though targeting complex scene generation, in Fig. 7 we show that our visualization scheme could also deal with simple text guidance including only positional relations and achieve competing results with previous text-guided sketch generation methods([10]). This function could potentially help with AI-aided sketching with simple text instructions, with which we will further integrate into our interactive storytelling interface in future

Few-shot Visualization

We compare the generated doodler graph w/o coreference based updating in Fig. 5. The coreference resolution helps in two ways. First of all, it helps to identify cross-fragment character relations, and keep tracking of the character action for long stories. For example, in the first story, the original scene graph parser failed to identify the *hound's* activities and relations with supporting roles across the story while with the coreference resolution, we could correctly catch the *hound's* occurrence among the whole story to build the doodler graph. The same situation also suits for the boy in story 2 and the *lion* in the story 4. Secondly, the coreference resolution helps to identify the same character occurred in distant story fragments. Thus, avoid repeated visualization for the same char-

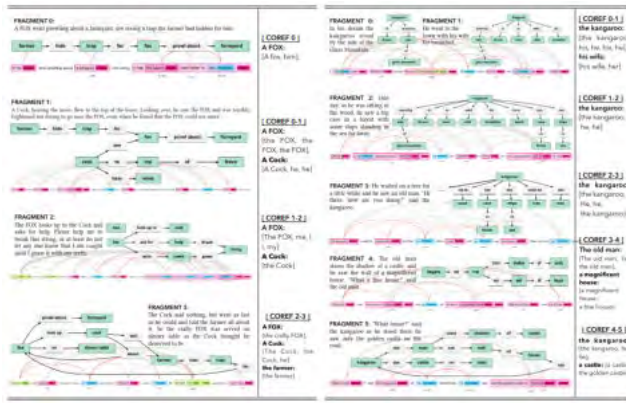


Figure 6: Story-based doodler graph update of Aesop’s fable story (right) and AI-generated story. Instead of generating a new doodler graph at each story fragment, we update the graph along with the generation to keep the visualization consistency (i.e., character consistency) within the same story.

acter, and keep the style consistency for each character during the whole story and meet the real-time needs for interactive story telling

Long-term Visualization

We compare the generated doodler graph w/o coreference based updating in Fig. 5. The coreference resolution helps in two ways. First of all, it helps to identify cross-fragment character relations, and keep tracking of the character action for long stories. For example, in the first story, the original scene graph parser failed to identify the *hound’s* activities and relations with supporting roles across the story while with the coreference resolution, we could correctly catch the *hound* is occurrence among the whole story to build the doodler graph. The same situation also suits for the boy in story 2 and the *lion* in the story 4. Secondly, the coreference resolution helps to identify the same character occurred in distant story fragments. Thus, avoid repeated visualization for the same character, and keep the style consistency for each character during the whole story and meet the real-time needs for interactive story telling. For example, while the original scene graph parser generates two owl characters, we correctly identify them as the same owl with coreference resolution, which also helps to build the relation that the same owl going across the pool and meet the penguin. We show examples of the composed scene for this story in Fig. 4 (story 0).

Conclusion

In this paper, we presented an intelligent visualization interface mainly focusing on fairy tales. Fairy tales, different from casual languages, have unique characters and relationships, which would generally lead to direct text-to-image visualization methods failing. We introduce the doodler graph as an intermediate representation based on this point. We fuse the rule-based language model with a learning-based generation model into a unified visualization system to allow for more flexibility during generation. AIR Taletorium can visualize

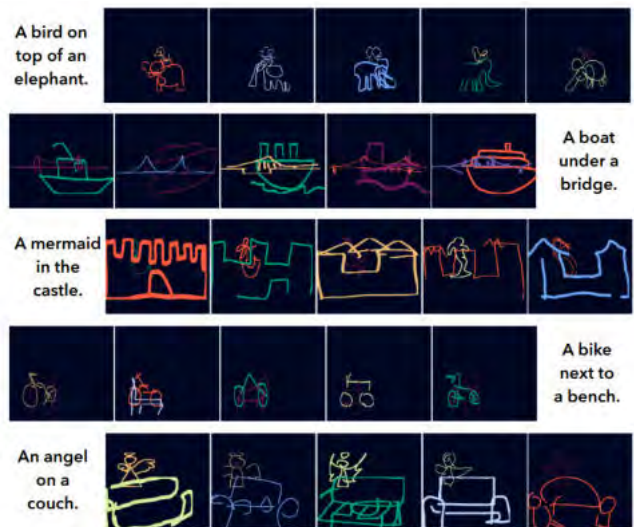


Figure 7: Visualization for a simple scene. Apart from the complex scene, our system also supports simple text-guided sketch generation.

complex fairy tale scenes with stylized characters and rare relationships with our fused framework.

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The Process of Word Automation: From the Spoken Word to the Algorithm

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Abstract

In this paper, I will trace a path in which the starting point will be the spoken word, made immortal through writing, and which will lead to the consideration of the word as the fundamental constituent part of today's algorithms. This analysis will be carried out without losing sight of the fact that we are within an artistic research, in which it is necessary to deal with concepts that belong to other disciplines such as linguistics or computer science. The process of transcription will be the thread that connects the spoken word with the written word, allowing me to analyze how this transcription and its intrinsic characteristics have been used in areas as disparate as the world of art and the development of programming languages.

Subsequently, I will analyze the creation and evolution of the idea of algorithm –from its beginnings centuries before the creation of the first computers– and the link between them and the world of art, through the presentation of works that propose the use of pseudo-algorithms. It will be the algorithms that will allow me to talk about digital computers and how the technology behind them has served as a source of inspiration for contemporary artists.

Keywords

Algorithms, language, code poetry, artistic research, education

Introduction

The automation of the word is a phenomenon that in this paper will be understood as the participation of the word in those automatic processes in which it ends up becoming the basis that makes them possible. The clearest example of this are the algorithms, made up of written words on which any computer process is built. In these algorithms, we find how the word, which originally belonged to the oral tradition, has been transformed until it has become an immobile element both in its form (written) and in its meaning (univocal).

Transcription as the movement from the oral to the written word

The immutability of the word in its written form is produced thanks to transcription. This transition, in which the word changed from being a sonorous and intangible element to being physically represented by means of writing, meant its reification, its transformation into an immobile element [1] and a way of making it tangible and visible. Thanks to writing, it was possible to solve the problem of storing the information that previously had to be memorized. This way of understanding writing as an information storage system is also behind programming languages, understood as a precise method of communicating instructions from the programmer to the machine. This process – this connection between two entities– turns writing into a means of communication and transmission of knowledge by allowing a connection between the brain of the writer and the brain of the reader of the text, which can be either another person or a machine.

Interestingly, although writing is a communicative activity –insofar as it seeks to record certain information that will be read in the future–, it is normally carried out in solitude. However, this idea of writing as an individual activity was challenged in the art world by the surrealist artists, with the creation of the exquisite corpse (*cadavre exquis*) –both using texts and drawings– for which the collaboration of several people was necessary. In the world of computing, writing has also become a collaborative activity, as in the development of applications, where teams of several programmers are currently working together. Thus, we find that, both within the world of art and within the world of software development, writing ceases to be necessarily a solitary activity and becomes a process in which the end result is the contribution of several individuals.

The appearance of the text and the direction

One of the distinctive features of transcription as opposed to spoken language is that it made it necessary to adopt a direction when writing texts, either left to right or right to left, although there are exceptions such as the boustrophedon.

don style [2] in which both are combined. This complexity added by bidirectional reading was eliminated by restricting reading to a single direction: either left to right or right to left. Etymologically, the word letter derives from the Latin *littera* which in turn is believed to come from *linea-tura* and this from line, corroborating the need for a reading order in the text [3]. Obviously, this directionality is also applicable to programming languages, which are generally read from left to right. However, there are esoteric programming languages that do not respect this restriction, such as Befunge or MiLambda. These programming languages are considered two-dimensional since it is possible to control the reading direction in any of the four cardinal directions. Specifically, Befunge was designed to be as difficult to compile as possible [4], one of the factors influencing this complexity being that the program can be read in any direction. With this bidirectionality, it is sought -like the surrealists with their exquisite corpse- to experiment with the limits and characteristics that define writing and transcription.

Orality and programming languages

At first glance, the statement that Amalie E. Gnanadesikan writes in her book *The Writing Revolution: Cuneiform to the Internet* 'Writing is a way of expressing a language, it is not language in itself' [5] seems obvious, but in programming languages it is only possible to express an idea by writing it down. Within an algorithm there is no oral element that influences the transmission of the resulting message. This lack of orality may remind us of those letters that have no sound, such as the letter *aleph* in the Hebrew alphabet, or *h* in Spanish.

While it is true that orality may be present when we want to make a translation between the instructions we want to transmit to the computer -thought in our brain in pseudo-code- and the programming language we will use to transmit the instructions to the machine, from that moment on, communication becomes a silent transcription in which the computer compiles or interprets our code to make it understandable. We find that, in the case of programming languages, the machine does not require phonetic and phonological elements to be represented to communicate with it. This communication with the machine is possible thanks to the abstraction on the hardware that led to the creation of programming languages, which -to be more understandable to the programmer-make use of words that belong to natural languages. For this reason, actions in which the code becomes spoken speech are disturbing. Such was the case of the reading made in 2001 by the Italian philosopher Franco 'Bifo' Berardi of the source code of the *ILoveYou* virus at the D-I-N-A festival in Bologna. The text accompanying this reading began by asking whether the code of a virus can be read as a poem. A sort of revolutionary poem celebrating the defeat of operating systems within the capitalist society. It is worth mentioning that this computer virus was created in the year 2000, spread to infect 10% of the computers existing at that time and generated great

economic losses. Bifo gives a reading of *ILoveYou* in which the beginning is in a calm, almost machinic tone, to end up raising his voice in a way that, according to the organizers of the event, seems to bring it closer to political discourse. Another way of interpreting this reading is closer to the text itself and its loss of power when read. The potential power of this virus vanishes completely when it is expressed verbally instead of being executed inside a computer, it becomes a few paragraphs of harmless text.

Programming languages as notation

The reflection on the silence of programming languages, on their lack of orality, leads to the book *Lines: A Brief History* by Tim Ingold in which we find a revealing paragraph:

'It seems that when we listen to speech our understanding penetrates the sound to a world of verbal meaning beyond it. But, to continue with the same metaphor, it is an absolutely silent world; silent as the pages of a book, in fact. In short, while sound is the essence of music, language is mute.' [6]

This lack of sound, which Ingold associates with language, is perceived as necessary specifically within programming languages. This author also reflects on the relationship between writing and musical notation, questioning whether the transition from the spoken to the written word can be studied without considering the emergence of musical notation. He believes that writing should be considered as a form of notation. In both cases we find a transcription of the sound into graphic marks, but Ingold finds a key difference between them both. In the case of writing, the writer uses graphic marks to compose her work, while the composer uses musical notation to indicate the execution of his:

'Reading a piece of writing is an example of cognition, of assimilation of the meanings inscribed in the text; reading music is, on the other hand, an example of execution, of representation of the instructions inscribed in the score' [7].

Even though this division seems quite strict, there are cases in which it is not so clear whether we are dealing with an example of cognition or performance. Ingold exemplifies this with the case of poems written to be recited aloud. In this case, the musicality of the verses is of great importance, but it is still a verbal composition. In the case of the writing of algorithms, we would be dealing with an example of execution, a representation of instructions closer to the writing of scores than to the composition of a literary work, so that with its poetic use we would try to move these instructions away from *execution* and bring them closer to *cognition*.

Programming languages, algorithms and art

Talking about programming languages makes it necessary to talk about algorithms. Today, by algorithm we mean a text composed of a series of instructions by means of which a computer is able to solve a problem. A more gen-

eral definition of this term –in which it is not specified whether the computer is the subject of the action– would be that which understands by algorithm any process that can be automated and that requires a systematic calculation [8]. In both cases, the starting point is a problem to be solved after executing a sequence of instructions.

Two theories have been developed about the origin of the word algorithm. On the one hand, it is believed to come from the name of the 8th century mathematician, astronomer and geographer Al-Khwarizmi, who in the 9th century wrote an algorithm with which certain types of quadratic equations could be solved. On the other hand, it is believed to derive from the Late Latin word *algorismus* which is an abbreviation of the classical Arabic word for calculus using Arabic numerals. Whatever its true origin, both theories lead us to a first conclusion: the word algorithm has been with us for many more centuries than the computers that made it popular. Although computers are a twentieth-century invention, in Greece, in the fourth century BC, Euclid formulated what is now known as Euclid's Algorithm, used to find the greatest common divisor of any two numbers. However, the presence of algorithms is not limited to the world of mathematics and computing. A recipe is the example often used to explain what an algorithm is in a quick and simple way.

There are a number of conditions that must be met for a procedure to be considered an algorithm [9]. On the one hand, the procedure must be able to be written using a language –not specifically a programming language– and it must serve as an answer to a problem posed by some input data: the algorithm must solve this problem and the way to solve it must be step by step. It is also necessary that all these steps depend on the input data and on each of the previous steps: they must be interrelated. Finally, there needs to be a case, specified in advance, that functions as an output, so that it is possible to terminate the process at some point, preventing it from running to completion. In addition to these conditions, one of the remarkable features of the algorithms is the lack of ambiguity in the words used. In them, it is clearly defined what we are referring to at each step, leaving no room for interpretation. As mentioned, a cooking recipe would meet all of the above requirements. Another example of an algorithm can be found in the aforementioned musical scores, in which in order to hear the melody correctly it is necessary to play it exactly following the notations indicated in it and to know the musical notation.

The score: a link between algorithms and art

Within the art world, we find another type of algorithms and scores, those used in the world of action art and performance art. Through them, the artists, and sometimes the audience, have to follow a series of instructions in order to create a work of art. Nevertheless, these scores only fulfill some of the specifications that must characterize an algorithm. If we take as an example the score *Recorrer un cuadrado de todas las formas posibles* (1995), by the artist

Esther Ferrer, we find that the score is written in a specific language, indicates a series of interrelated steps that lead to the resolution of the problem and aims to serve as an answer to a given problem: to go through a square in all possible ways. Nevertheless, in its approach, it introduces the infinite by saying that all the ways in which the square is traversed are valid, with its indication 'toutes les versions sont valables' [10].

Another assumption that is not fulfilled is that each of the steps must be related to the previous one. This type of score leaves room for the performer's creativity and avoids being as restrictive as a true algorithm.

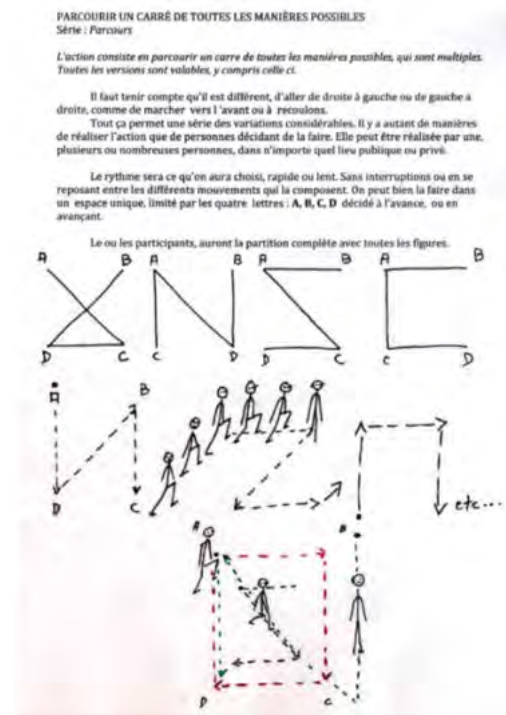


Figure 1. Score *Recorrer un cuadrado de todas las formas posibles* (1995)

The definition and concept of algorithm

Related to the definition of algorithm, we find a distinction made by the early 20th century mathematicians: the difference between the definition and the concept of algorithm. This interest in developing a description of the concept itself makes it possible to deduce which types of problems can be solved using an algorithm and which cannot. In this way, it is possible to abstract from the definition of algorithm - which has been deduced from its application - its relationship with other concepts, in this case belonging to mathematics. The first step towards the definition of the concept of algorithm was taken in 1904 by the mathematician David Hilbert and his attempt to translate mathematical formulas into logical sentences, although in 1931 Kurt Gödel demonstrated with his incompleteness theorem that there are some propositions within arithmetic that cannot be reduced to true or false, as required by logic. It would

be Alan Turing who in his article "On Computable Numbers with an Application to the Entscheidungsproblem" would formulate the first definition of the concept of algorithm using what is known as Turing's machine, which is a formalization of what we do when we execute a calculation using an algorithm [11]. In this article, Turing describes a theoretical machine capable of performing any computation, provided it is possible. This was the theoretical precursor of what we know today as a computer and at the same time was responsible for formally defining the idea of algorithm. With it, Turing was able to demonstrate the existence of problems that a computer cannot solve [12].

The Turing machine from the perspective of art: Roman Verostko, *A Universal Turing Machine as a Self Portrait*

The idea of the Turing machine is essential in computing, so much so that it was from it that it was possible to develop the concept of Turing complete, used today when a programming language can perform the same tasks as this machine. This idea has also been influential in the art world, serving as an inspiration, and more specifically in art made with algorithms, as found in the work of Roman Verostko: *A Universal Turing Machine as a Self Portrait*. This project starts from the premise that when a computer presents a simulation of a Turing machine, it is actually presenting a simulation of itself, since computationally they have the same capacity. The markedly conceptual character of this piece suggests us to consider the screen of our computer as a window into the inside of the machine itself. Visually, this project presents a series of lines composed of zeros and ones in a way that seems random, since we do not know the underlying logic behind them. On the artist's website there is a simulation of this work in HTML. Through the browser and using the tools that allow us to inspect the code with which the page is written, it is possible to see that each of the lines is composed of a predetermined series of ones and zeros, whose order or arrangement we do not know their origin. This project requires us to make an act of faith and trust that these ones and zeros are really related to a Turing machine and that they are not randomly placed numbers.

Verostko adds this text on his web:

'For me, the text of a UTM algorithm, like a medieval biblical text, radiates an aura of authority even though difficult to comprehend. As an artist I have written algorithms for illuminating a Universal Turing Machine (UTM) and to celebrate its impact on our culture. These illuminations are works of art and not exercises in computer science. [...] Like medieval Latin that transcended the vernacular and was universally understood by those schooled in Latin so also this algorithm speaks a universal tongue understood by those schooled in computer science' [13].

The last sentence is revealing about the previous statement: the algorithm can only be understood by those people with

knowledge in computer science, the rest will have to believe that behind those zeros and ones there is an algorithm that turns them into a Turing machine. Paradoxically, this fact takes it away from being what it pretends to be: a universal tongue.

From von Neumann architecture to the emergence of software

Turing machines are the conceptual basis on which computers began to be developed: electronic devices responsible for processing the information we provide them with in the form of bits and returning a result. After the creation of digital computers, a computer is considered to be composed of two parts: hardware and software. The hardware makes up the physical part of the computer and the software the intangible part, although the boundary between the two is not as clear-cut as it may seem at first. This difference arose with the development of the von Neumann architecture. Until John von Neumann developed this way of structuring a computer in the 1940s, which is still used today, computers performed only one task, the one for which they were created.

There were three main innovations that the von Neumann architecture introduced with respect to its predecessors. The first is that the computer has a memory in which both data and instructions are stored, without the memory distinguishing whether what it contains is of one type or another. The second is that this information can be accessed by specifying the address at which it is stored, facilitating interaction between the person and the computer. Finally, the execution of a program is carried out sequentially, processing one instruction after the previous one if no jumps or interruptions are specified [14]. All these allowed computers to be programmable, physically at first, until the idea of software was developed in parallel through the first programming languages. Although the development of the von Neumann architecture made it possible to distinguish between hardware and software, the first computers created using this architecture were programmed physically, by connecting and disconnecting wires. With the creation of these devices, which occupied entire rooms, the human-computer relationship began.

The EDVAC was the first computer for which a stored program was created, an advance that avoided the need to modify the wiring every time it was necessary for the computer to perform a different task. The first computer with a memory unit to store the first stored program was the Manchester Baby, developed at Manchester University and introduced in 1948 [15]. The interesting thing about this computer is that it was the first to use a 32-bit word length, which along with the 64-bit word length has become the most commonly used word length in today's processors.

The word and the page

The concept of word, in relation to computing and computer architecture, has existed since the beginning. A word is the natural unit of memory organization. The size of the word is generally equal to the number of bits used to represent an integer and the length of an instruction [16]. This definition is similar to the words we use to communicate in that they are units of representation with a specific meaning. Humans communicate using words, and words are the minimum unit for representing an instruction in digital computers. At this point, talking about bits and words has already produced the first level of abstraction with respect to the machine: to enter instructions it is no longer necessary to make physical connections in the machine, it is now possible to store and enter instructions using words made up of bits. This was the first step in the introduction of software into computing.

Apart from the word, there is another parallel with human communication, more specifically written communication, and that is the idea of a *page*. A page is a block of fixed size, each of these blocks possessing a certain block size. This is the way in which the virtual memory of a processor is organized, in blocks, providing the processor with a larger address space than if it had only physical memory [17]. We find that the relationship with the word and with writing appears in the very architecture of the first computers and continues to the present day with the creation and development of the idea of software. Although the first computers were programmed using the so-called machine code, which was reduced to instructions represented by ones and zeros, it did not take long for computers to appear that were programmed using what is known as assembly code.

A use of assembly language beyond programming: *Grasp all, lose all (La avaricia rompe el saco)*

The appearance of assembly language meant the addition of a first layer of abstraction on the computer, since the ones and zeros that make up the instructions at the lowest level could now be written using a combination of words and numbers. The building block for this translation is a program called an assembler. As its name suggests, an assembler is that which assembles something; an intermediary between an initial and final object. In this case, between the source program and the object program. This type of language is still at a level very close to the machine, which allows the physical characteristics of the machine to be explored, although it makes it difficult to read and understand. An example of this can be found in this brief composition written for the Intel 4004, the first microprocessor marketed on a large scale:

```
FIM 0 255
FIM 1 255
FIM 2 255
FIM 3 255
FIM 4 255
FIM 5 255
FIM 6 255
FIM 7 255
INC 0
INC 1
INC 2
INC 3
INC 4
INC 5
INC 6
INC 7
INC 8
INC 9
INC 10
INC 11
INC 12
INC 13
INC 14
XCH 0
```

To approach it, it is important to know that its title in Spanish is *La avaricia rompe el saco (Grasp all, lose all)*, a well-known popular saying, and that it seeks to be a literal implementation of it using a programming language. Although at first it seems to be an incomprehensible sequence of letters and numbers, it is not necessary to have extensive knowledge of computer science to understand it. The Intel 4004 is a processor with 15 registers, numbered from 0 to 14, in which it is possible to store a maximum number of 4 bits. These registers can be accessed in pairs, the pair 0 being the one composed of registers 0 and 1; pair 1 is the one comprising registers 2 and 3, and so on. In the first eight lines, we see that the FIM instruction is used, which allows accessing these registers in pairs and assigning them a certain value. In this case, the FIM instruction 0 255, what it does is that registers 0 and 1 both acquire the value 16. This is achieved because when we convert 255 from the decimal system to hexadecimal, we obtain FF. The letter F in hexadecimal is equivalent to 16 in decimal, so indicating the value 255 (or FF) makes both registers 0 and 1 acquire the value 16. After providing the maximum value to each of the pairs of registers, the next step is to increment the value of each of them by 1. To achieve this, the INC instruction is used. What this causes is a register overflow, causing the register to take the value 0. Subsequently, the XCH instruction is responsible for passing the value of register 0, although the value of any of the registers could be used, to the accumulator. The accumulator's function within the microprocessor is to store information temporarily, assuming an intermediate position between the registers and the memory. In this case, the accumulator ends up receiving the value 0, the same value it had at the beginning, although its registers have reached the maximum value. The idea of accumulator extends its meaning in the world of computing to the one assigned to it generically in the dictionary: that accumulates. Although, in this case, the accumulated amount is reduced to zero as a consequence of the excessive sum made in the registers, literally applying the proverb that gives the composition its title.

The automated word as an artistic expression: Nöel Arnaud, *Poèmes Algol*

After the development of assembly language, known as second generation (2GL), the third generation (3GL) or high-level languages followed. This type of language is easier for the programmer to read, but adds a layer of abstraction that distances it from the machine. Among the first high-level languages, developed between the 1950s and 1960s, we find FORTRAN, ALGOL or COBOL. The main characteristic shared by these languages is that they allow the programmer to focus on solving the problem, rather than on the details of the machine on which he is programming.

The fact that they are high-level languages, and therefore not directly linked to the internal architecture of a machine, made these languages popular and at the same time their ease of reading gave rise to experimentation. The French writer Nöel Arnaud, a member of the Oulipo literary experimentation group, published *Poèmes Algol* in 1968, a series of literary compositions based on the programming language of the same name.

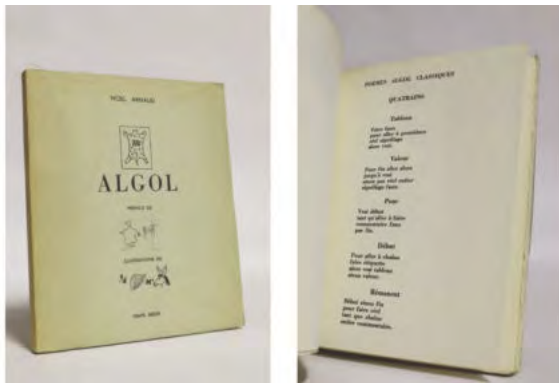


Figure 2. *Poèmes Algol* cover and one of Arnaud's poems

To compose his poems, Arnaud has used exclusively the French translation of the 24 words reserved in the ALGOL programming language: true, false, goto, if, then, else, for, do, step, until, while, comment, begin, end, own, boolean, integer, real, array, switch, procedure, string, label, value. Although they are based on ALGOL, they use neither its syntax nor its lexicon, since all the words have been translated into French, so that, evidently, the poems are not compiled by a computer. In this case, the use of the programming language is purely literary and serves as a restriction: only certain words can be used to write the verses. What is valuable about these poems is that starting from a language in which the reserved words have a very specific meaning and function, Arnaud returns them to natural language.

Subsequently, these third-generation languages evolved into what is known as object-oriented programming (OOP). This programming paradigm allows the constituent parts of a program to be divided into classes, which are

instantiated in objects, and the work is thus distributed among different programmers. What these programming languages bring to the 2GLs, apart from an additional layer of abstraction on the machine, is the possibility of dividing the code into objects and classes that can be worked on in parallel.

The 3GLs were followed by the fourth (4GL) and fifth generation (5GL) languages. These add a layer of abstraction over the previous ones, since they specify the task to be performed instead of how to perform it and are designed so that the computer solves the task instead of the programmer, respectively [18]. 4GL languages use sentences closer to the human language than 3GL and are mainly used in database programming [19]. The latter encompass both functional and logic programming and are considered a constituent part of the declarative programming paradigm. Like object-oriented programming, functional programming is also characterized by a series of its own concepts such as *currying*, *lazy evaluation* or the importance of the type of the function. This last point has been used in an expressive way in the following composition, *The Nothing Nothings*:

```
nothing :: a -> [a]
nothing x = [] ++ nothing x
```

The type definition is given by the first line in which the identifier *nothing* is separated by `::` from the expression indicating the type of the function in question. In this case, with the letter *a* we are indicating what is called a type variable, that is, a representation of any type of data, be it an integer, a decimal, a character, etc. This data type *a* symbolizes the input data of the function, which is separated from the output data `[a]` by `->`. In the output data, the use of square brackets means that we will get a list, a sequence, of items of type *a*. If we move to the second line, we find the definition of the function *nothing*. This definition indicates that if we write the word *nothing* followed by an element of any type (*nothing x*), we will obtain as a result (=) a concatenation (`++`) of the elements stated in the input. To achieve this concatenation of elements, a technique known as recursion is used in which a function calls itself. In recursion there is a base case, a condition that when fulfilled forces the function to stop calling itself to avoid an infinite loop. This type of loops is generated when, due to the absence of a base case or due to errors in the logic within the algorithm programming, the function calls itself indefinitely, until the computer runs out of memory. In the code fragment at hand, the function enters an infinite loop, since there is no base case to stop the algorithm. Thus, a list of elements is created which, precisely because of this infinite loop, does not generate any output information, making it appear that the algorithm is not doing anything, although in reality it is generating an *infinite* sequence of elements.

Conclusion

Having taken the spoken word as a starting point, this paper has traced how the spoken word itself and its intrinsic characteristics have been modified to lead to the written word and current algorithms. Both the idea of algorithms and the computer processes that they have brought about have served as a source of inspiration for contemporary artists, who have experimented with a language and a medium that is apparently far removed from artistic creation. This use of software in an artistic way helps to make understandable the functioning of certain processes and rules, which otherwise would be very difficult to understand for a person without computer knowledge.

The software, and with it the words that make it up, position themselves as the main tool that facilitates communication and interaction between people and machines, functioning as an interface, as a point of contact, at a lower level of abstraction than the command line interface (CLI) and the graphical user interface (GUI). Thanks to the experimentation and speculation that artistic creations allow, it is possible to bring the user closer to the hidden side of computing devices. Although this knowledge is not necessary to interact with the device, it can provoke reflections on the functioning of certain processes normally hidden from the user, but which condition our relationship with these devices.

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Towards the Sonic Laboratory: Laboratories' creative potential

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Abstract

This research aims to define and establish the sonic laboratory, a hypothetical concept that has not been widely explored, although there are already some examples named as such. This research also investigates the sonic laboratory's creative potential. Analysing different typologies (science lab, media lab, hacklab, and others), this research presents an open and inclusive description of the laboratory that opposes a technoscientific perspective, following Lori Emerson's laboratory studies which state, "Labs have never been static, unchangeable, unitary entities with clear-cut histories. They are—and have always been—shaped by communities of people both inside and beyond their walls" [1].

Keywords

laboratories, hacklab, media lab, hackerspaces, makerspaces, laboratory studies, science and technology studies, sound art, art, science and technology, media art.

Introduction

This research aims to define and establish the sonic laboratory, a hypothetical concept that has not been widely explored, although there are already some examples named as such. Through this research, I aim to articulate a sonic laboratory's definition to investigate its creative potential.

This research inspects the definition, antecedents, and various typologies of what is generally understood under the term laboratory. This will entail a search for the historical precedents and consider the origins of the term laboratory. In doing so, I will explore what a laboratory used to be even before it was named as such, including not only spaces typically designated as laboratories but comprising also other typologies such as workshops and artists' studios. The research also explores the already established typologies of laboratories, such as academic laboratories, science laboratories, media labs, and hacklabs.

To achieve such a definition, I will pursue case studies that present examples of sonic practices developed in laboratory environments. The case studies are artsience labs and academic laboratories. I will show an example of sonic artist in artsience labs: Robertina Šebjanič. The contribution from artsience labs to this research is paramount and

analysing artists' practices in artsience labs through their methods and outcomes will help define the sonic laboratory. I will also examine the case studies of academic institutions that function as laboratories and develop sonic practices. The designation of sonic labs is shared through academia, and there are already some examples named as such. Although existing, the sonic laboratory has not yet been defined and articulated, and contrary to the media lab, it has not gained further acceptance. Through analysing sonic practices in academic laboratories, this thesis will enrich the sonic laboratory definition. The example chosen to research on academic laboratories is Sonics Immersive Media Lab (SIML, Goldsmiths, University of London).

Definition of laboratory

The laboratory's history cannot only be considered for those just named labs as it would be incomplete. The first known laboratory was in 1592, and the etymology for the concept laboratory comes from the Medieval Latin laboratorum, from Latin laborare (to labor) [2]. Historically, the word laboratory was elaboratory, but this use is now obsolete. Elaboratory comes from elaborare, the physiological role of some form of natural apparatus for elaborating any vital action product. Clara Bofill reaffirms that laboratorum refers to labour or work:

If we delve into the origins of this word, we find that the Latin laboratorum means a place for labour or work and that the verb laborare means to work, to produce, to cultivate. In the 18th century, for example, the word "laboratory" was used to describe the studios of painters, sculptors and printmakers, as well as, more generally, any place in which people made things with their hands. [3]

In searching for an inclusive definition of the term laboratory, I have studied Lori Emerson's works, which explore the concept of the media lab from a non-hegemonic perspective. Looking at the contextual situation of media labs, she explores the term laboratory and establishes a new concept for the "hybrid lab", including all other laboratory typologies, media lab and the science lab. The hybrid laboratory is an inclusive definition of the lab that con-

fronts a laboratory definition connected to the technoscientific paradigm. Here, Emerson offers a feminist perspective adopting a definition of the lab that includes non-human actors and female narratives. As labs are places where instruments and animals have a strong presence, the hybrid lab defies the patriarchal, colonial and objective perspective of the lab definition and opts for an inclusive definition that reconnects with feminists and posthumanist perspectives, including non-humans and women.

Moreover, Emerson introduces feminist studies into laboratory studies and the Marxist theory, following Henri Lefebvre, which defines the laboratory as an open concept, malleable, determined by the practices, contexts, and people that developed it. As she states,

Labs have never been static, unchangeable, unitary entities with clear-cut histories. They are—and have always been—shaped by communities of people both inside and beyond their walls, by these same communities' intellectual trajectories, and, of course, by the labs' physical locations and configurations. [4]

Furthermore, labs are places to work, but their definition is generally associated with the technoscientific paradigm and science world. However, a more contemporary laboratory description, following Emerson, provides the parameters to create a definition for the sonic laboratory, which aims this research. Associating at this stage the hypothetical idea of a sonic laboratory with Emerson's openness of hybrid labs allows me to compare the sonic laboratory to academic spaces and industrial labs and be established as places of experimentation and artistic practice.

Academic Laboratory

The laboratory's role in education is crucial to developing the modern academic laboratory, with origins in medieval monasteries, apothecaries, and kitchens. For Avi Hofstein and Rachel Mamlok-Naaman, academic laboratories are places to “develop students' abilities and skills.” [5] Some laboratory activities are to engage students individually, while others have sought to engage students in small or large groups. The academic laboratory connects with the world of science, which emerges thanks to workshops' central organising to focus on specific experiments. Laboratories are sites where to conduct investigations, and their development is through experimentation, which will be a constant feature of most laboratories.

In addition to this, researchers that focused on the study of digital humanities labs state that a digital humanities lab:

produces and is produced by a network of scholars, practices, institutions, epistemologies, ideologies, and cultures of STEM, the Humanities, higher education, and society.” [6]

Following this definition of a digital humanities lab, the authors also understand how

Labs must contribute to the legitimisation of lab practices and material products for particular epistemic cultures in the Humanities. [7]

This refers to the production of knowledge in humanities labs as a result of producing

documentation, contextualisation, and subjectification. DH scholars, DH journals, and DH audiences are as much an outcome of laboratory work as an artefact. [8]

This definition of humanities labs defines these spaces as epistemically active spaces. However, with this definition, the authors offer an alternative model of laboratory work, with a vision of

alternative disciplinary spaces where DH work can be practised, and alternative objects of DH research. [9]

The research considers the importance of these alternative laboratories to the hegemonic model of science. But there are other examples, such as the American academic laboratory born out of industry and academia's confluence. However, this model appears not as an alternative but subsumed in the scientific laboratory's hegemonic definition reaffirming the values that transform this laboratory into an industrial-military-academic complex. According to Emerson,

Most American universities founded in the mid to late nineteenth century were created in the spirit of entrepreneurialism. [10]

This section on academic laboratories describes how some laboratories are far removed from the scientific and hegemonic laboratory perspective (humanities and digital humanities laboratories). However, the research also shows how the American University laboratory model is still creating a laboratory's hegemonic view. Both examples will contribute to an extensive and inclusive definition of a laboratory by approaching and distancing from these academic labs' models.

Science Laboratory

There is a direct link between the academic laboratory and the science laboratory. This idea of a liaison is reinforced by tracing back to early apothecaries, which first developed towards academic-chemical laboratories, establishing an academic scientific laboratory model, which will exist until the present moment. Thus, there is a bridge between the laboratory in an educational environment and the science laboratory.

The origins of the science labs are in the chemical laboratories that appeared during the XVIII century in Europe. In her study, Klein presents as an example “the chemical laboratory of the Berlin Academy of Sciences [founded in] 1753” that A.S. Marggraf directed. [11] The origins of the science laboratory connect to the world of chemistry, early apothecaries, and academia. As Klein defends,

Laboratories, pharmaceutical and academic-chemical, were the institutions where manufacture (in the case of pharmaceutical laboratories) or technological inquiry (in the case of academic chemical laboratories) and inquiry into nature were firmly entwined. [12]

These academic chemical laboratories are the bases for the contemporary science laboratory.

Philip Bell also studies the development of laboratories in academic environments but only those related to scientific investigations. Through his text, he describes science laboratories as places for experimentation and "lab work", which are the basis for scientific investigations. [13] They also support teaching and building epistemological learning, primarily through the methodology of hands-on experimentation. Other methods in science laboratories

are embedded in a broader context of inscriptional work associated with the communication and publication of results. [14]

According to this, science behaves in a chain production from facts to literature, using experiments and registering simulations, and finally building black boxes, which impact social consequences.

Following this, technology has been created under a scrupulous dependence on hyperstructures (technoscientific laboratories, for instance), resulting in extremely hard to disbelieve, doubt, and dissent, leaving the confronters impressed, without power and resources to contest and dispute their authority. This is used in Bruno Latour's parable of "counter-laboratories". [15] Latour's critical analysis will be further explored in this research, adopting the actor-network theories and the feminist studies (in Lori Emerson and Donna Haraway) to help define and establish a sonic laboratory.

Media lab, hacklab and other typologies

The historic MIT Media Lab is one of the media labs pioneers and possibly where the name media lab was first popularised. The MIT Media Lab emerges from the late nineteenth-century laboratories model, a mix of academic laboratories, science, and industrial labs. Nevertheless, it "was a continuation of a long legacy of art and technology labs at MIT" such as the Centre for Advanced Visual Studies. [16] However, "the naming of the lab wanted to position itself as part of the lineage of private-sector technology labs", such as Thomas Edison Laboratory and Bell Labs. [17] The MIT Media Lab represents a continuation of the Thomas Edison Laboratory with the same values of countercultural status and interdisciplinarity, with the same unconventional methods and success.

At MIT Media Lab, interdisciplinary science and arts brought artists, scientists and engineers towards a unique aim which was to develop participatory and innovative technological practices. Moreover, after Thomas Edison Laboratory and Bell Labs, the MIT Media Lab's studies and practices with music represent a possible sonic laboratory's origins.

However, the media lab's history is extensive; other lab typologies emerged from the media lab. The hacklabs, hackerspaces, makerspace, FabLabs, and BioLabs are all variables of the media lab and began to appear in the middle of the 1990s. Their origins link to the emergence of the personal computer. First hackers collaborated with MIT

and founded the free software movement. One example is Richard Stallman, who launched the GNU Project, and the Free Software Foundation.

Hacklabs and hackerspaces are hackers' places, generally self-managed spaces, their interest is in technology, and their practice develops through meetings, sharing, and creating knowledge in collective and individual projects. Like hacklabs and hackerspaces, there are also tech shops, incubators or innovation labs, hubs, FabLabs, and makerspaces. Nevertheless, what makes them different is that hacklabs and hackerspaces are the origins of these communities. An indisputable feature of these hacklabs and hackerspaces is the use of open source software and hardware. Through sharing and free licences and methods such as forking, hackers' use of open source is seen nowadays as an alternative to the big five technological corporations' imperative and profit (Amazon, Apple, Facebook, Google, and Microsoft).

Following this alternative logic, many artists have joined hackers' practices, developing what Victoria Bradbury and Suzy O'Hara denominate the art hack practice. As both authors mention, the art hack practice takes place in other laboratories representing maker culture. Makerspaces interrogate issues around financial sustainability, staffing and office culture. According to these authors,

The concept for the lab grew out of a question of how a hack can be extended into a physical space that supports the kinds of practices that would occur in a more temporary space. (...) interruptibility, openness and generosity (...) sustain the lab environment. [18]

Makerspaces and FabLabs, also named Fully Automated Business (FAB) or Fabrication Laboratories, do not use uniquely open hardware, but they can provide precise machines. According to the dossier *Soberania Tecnologica*, they potentially do not opt for transforming the system, but for "a re-updating of capitalist production and consumption relations." [19]

Moreover, Tania Aedo provides some examples of sonic practices developed in these types of laboratories environments. In this context, Aedo states a reactivation of maker, hack, and DIY culture in the laboratory. Artists are makers who trespass the critical thresholds, crossing disciplinary boundaries. Even though Aedo provides sonic practices as examples, she reinforces the interdisciplinarity in these laboratories, integrating different disciplines such as media art, sound art, conceptual art, media archaeology, expanded cinema, new materialism, experimental electronic music and critical theory. Aedo presents examples of developing sonic practices in hacklabs that can become examples of a hypothetical sonic laboratory. One example is *Astrovandalistas*,

a decentralised laboratory in different locations in Latin America, such as Mexico and Brazil as well as in the United States, developing low-tech tools that enable new forms of communication and collective participation with open software and open hardware that can be easily replicated. [20]

The laboratories' creative potential: artists, institutions and exhibitions

This research searches to define a concept, sonic laboratory, that although it was used in academia, has not been widely explored. In doing so, this research will investigate the laboratories' artistic and creative potential, which will allow me to conceptualise the scope and nature of the sonic laboratory and explore its features. Thus, this research will investigate the laboratories' most creative side through examples such as art centres, festivals, exhibitions, virtual laboratories, and sound artists who establish their practice as a kind of laboratory. One example of this is the artist Simon Cacheux, developing sound art through technology and hacking practice, who states:

For me, a sonic lab is a lab where you research about sound in all its aspects. I like the idea of a broad interest in sound(s). There has been a lot of Art/Science connections in the past years: sound has a solid relationship with physics and science, so having sonic projects merging both art and science looks quite natural. The lab is almost inherent to the scientific aspect of sound, and the technology for manipulating sounds is recent (a century or so), and it is still connected to its scientific origins (first sound makers were engineers). [21]

Another example that contributes to studying the laboratories' creative potential is Hugh Davies' work at the Electronic Music Studio at Goldsmiths, University of London. Constituted in academia, the EMS is one of the laboratories that not named as laboratory functioned as such. Knowing that in the contemporary academic context, there are already existing examples of laboratories called sonic laboratory, such as the Sonic Lab at SARC, the EMS can be explored as a reference for the concept of the sonic laboratory but requiring exploration widely. Davies worked on self-built instruments. Thus, he could be considered as a pioneer through his DIY practice in modifying:

electronic sound apparatus in his early live electronic compositions (...), through the 'instrumental turn', represented by his first self-built instrument. [22]

Davies contributed through his sound art practice to define the laboratory concept in artistic and academic environments. In this sense, with his DIY approach, Davies contributed to teaching and learning in a more hands-on experience, applying learning-by-doing methodologies. These features are present in most media labs and hacklabs nowadays, which were not existing when Davies started practising with the self-built instruments.

Moreover, to present more examples of laboratories' creative practice, I give examples of laboratories that grow in art centres, such as Laboratorio de Investigación y Producción Musical in Argentina. There is also a tendency to fund laboratories inside the art institutions such as BANF, Canada, and Hangar, Barcelona. Still, these laboratories represent an autonomous economy that facilitates music-making and the making of sound devices in the whole of the institution. Indeed, specific laboratories ty-

pologies such as hacklabs and medialabs operate influenced by DIY, as seen in the recently inaugurated Sound LAB, in Litoral, Gijón:

the new media centre for the production, dissemination and exhibition of technological sonic art. Sound LAB is a space for experimentation in the various practices of contemporary sound art. [23]

Another example of an art institution that develops as a laboratory is the IRCAM LAB, part of IRCAM (Institute for Research and Coordination in Acoustics and Music), founded by Pierre Boulez in 1977 at the Centre Pompidou and the French Ministry of Culture. IRCAM is considered a laboratory because it is "one of the world's largest public research centre dedicated to both musical expression and scientific research." [24] Moreover, IRCAM is a place where artistic practice collides with scientific and technological innovation. This mixture of science and art is a feature present in some laboratories that develop through creative practice.

To contribute to this research, I also investigate those exhibitions that adopted the laboratory as a methodology to exhibit. For example, Joasia Krysa presented Erkki Kurenniemi (In 2048) at Documenta 13, a curatorial hybrid between new media curating and sound art to display computer techniques, archival material and original prototypes of Kurenniemi's handmade instruments. As Joasia Krysa notes, "such labs can address new institutional opportunities in humanities to engage with practice-based knowledge creation and extend their mission to include tools, techniques and a new curatorial scope." [25]

By analysing laboratories' creative potential, this research explores places not named laboratories but functioning as laboratories. Here, the laboratory definition includes many creative artists, institutions and exhibitions. Moreover, I can see certain art institutions as laboratories, although not being named as such. The research will explore artists' studios, institutions, and exhibitions as creative potential adopting laboratory methodologies to develop and innovate practices through engaging art, science and sound.

Sonic practices in artsience labs: Robertina Šebjanič at the Marine Institute Ireland

Robertina Šebjanič is an intermedia artist based in Ljubljana. She is an active participant at the Hackteria laboratory. Among other laboratories in which she participated, there are

Interactivos'12 Ljubljana: Obsolete Technologies of the Future at LJUDMILA digital media lab in Ljubljana (...), KSEVT – Cultural Centre of European Space Technologies (...), HackteriaLab Bangalore and (...) HackteriaLab Yogyakarta." [26]

Recently, Šebjanič has also participated at Aerial/Sparks, an artist-in-lab residence at the Marine Institute Ireland.

The Marine Institute Ireland is a “State agency responsible for marine research, technology development and innovation in Ireland.” [27] Among their facilities, there is the RV Celtic Explorer, a laboratory where to research marine acoustics. The RV Celtic Explorer is

Acoustically silent (ICES 209), which minimises fish avoidance and provides an ideal environment for the collection of high-quality acoustic data, dynamic positioning, acoustic transducers and other instrumentation, and large dry and wet laboratories.” [28]

Aerial/Sparks invites artists to produce “a series of compelling stand-alone artworks for exhibition and radio broadcast.” [29] Aerial/Sparks shows the result of this arts/science lab in the shape of an exhibition curated by Louise Manifold. The exhibition shows the artworks produced during the artists' residence at the laboratory through different media such as sound compositions and installations, prints, video works and performances. The seven participating artists, writers and composers are Ailís Ní Ríain (IRL), Carol Anne Connolly (IRL), David Stalling (DE), Kennedy Browne (IRL), Kevin Barry (IRL), Magz Hall (EN) and Robertina Šebjanič (SI). The exhibition takes place in different locations at the Inis Oírr, the smallest of the Aran Islands.

In this context, Šebjanič presents her sound art project *Selachophilia: Cetorhinus Maximus - Limaria Hians*. The artwork

weaves together mythologies and sciences, humans and non-humans, to speak of our ability to address challenges in the age of the Anthropocene. Stories unfold carried by the migratory Basking Shark (*Cetorhinus maximus*) and the flame shell (*limaria hians*), a small species endemic to the North Atlantic waters. Šebjanič had the opportunity to experience both sea creatures during her residency on the RV Celtic Explorer. This immersive audio installation intertwines sean-nós vocals with the narration of a storyteller and field recordings of above and below the depths of the Atlantic Ocean. [30]

In Šebjanič's words, she produces “art, science and technology relations and new media works, resulting from interference between fields that create a hybrid media.” [31]

Onboard the RV Celtic Explorer, the artist had the chance

to explore interactions between organisms and sediments through scientists' perspective, with tools and techniques from the vessel. The result was an art project with a sound centric component.” [32]

The artist presence on board encouraged collaboration and engagement with scientists, whose point of view highlights art and science common topics, such as being interested in the process and being based on observations. Šebjanič continues to explain her experience in art residences at laboratories, which are, according to her, places and spaces where scientists work and research is happening. During the Aerial/Sparks residency onboard the boat, the

artist had the opportunity to work with sensing tools. She became actively involved with the team through daily briefings that brought her close to the scientists' complex projects.

Šebjanič presents herself as a sound artist who, after 15 days on the boat, produced a sound work resulting from scientists' conversations. The audio installation resulting presents sean-nós vocals with the narration of a storyteller and field recordings of the Atlantic Ocean. The artist is interested in the relations humans have with sharks. From an ecological perspective, the inter-species connection between huge and small creatures (sharks and shells) produces an interaction affecting the environment (*ibid.*). The artist includes the anthropocentric perspective in the sound work through the recourse of the voice, and in doing so, she explores how sharks are connected to folklore, questioning how science can learn from folklore.

Šebjanič's methodology to produce this sound installation consists of:

- Observation and process, which are part of scientists' investigations.
- Sensing tools, which are scientific tools and technological sound apparatuses from the laboratory.
- Narratives and vocals, a humanities component, which includes human and non-humans.

Šebjanič's work illustrates the transdisciplinary relations between art and science in laboratories. These relationships are reinforced thanks to the dynamics of sharing methodologies, from science laboratories to arts practice, which is bidirectional - the scientists benefit from arts methodologies such as inclusive narratives, and likewise, artists can use scientific tools and methods. Moreover, the use of art methodologies such as field recording and developing narratives in laboratories can explain how the laboratory's role in science and technology is amplified, showing a laboratory from an open and inclusive perspective. The transdisciplinarity in Šebjanič's work demonstrates how the development of sonic practices in the laboratory contributes to defining the laboratory considering human and non-human relations in science and humanities. The mixture of the science laboratories and the sound artists practice will help determine the sonic laboratory as a laboratory-developed by artists to use sonic technologies through an inclusive perspective and humanities methods.

Another aspect to highlight from this example is about the exhibition as an outcome. The artists' practices in arts/science labs amplify the laboratory's chances to be a place to research and manufacture and exhibit. Bringing art methodologies, such as curatorial development, to the scientific laboratories is something that arts/science labs do, contributing to defining the laboratory as a place for humanities and not only dedicated to scientific research. Developing exhibition practice in arts/science labs is a characteristic feature that mixes art methodologies in scientific spaces. This contribution from art to science that is exhibiting could also be a feature that defines the sonic laboratory when exhibiting sound art.

The transdisciplinary methods applied in the laboratory and the outcomes such as sound installations and exhibitions will be fundamental to build up the sonic laboratory.

Academic labs - practical examples: Sonics Immersive Media Lab (SIML, Goldsmiths, University of London)

SIML is an “interdisciplinary, cross-departmental, world-class multi-media facility.” [33] SIML “research touches on the theory, practice, technique, and epistemologies of sound and image as a medium.” [34] The SIML facilitates “trans-disciplinary and multi-departmental” exchange, transforming the sonic lab into a media lab.

Both conceptual, as well as technological advances are present in the lab. The lab encourages us to perceive technology from a critical perspective, including the creative aspects of sonic and technological works' practical development. As a media lab, the SIML facilitates technical support, but this is combined with an artistic perspective of developing sound works.

This laboratory can contribute to a sonic laboratory definition from a position that includes the technological aspect of developing sound works in a transdisciplinary mediation. What is interesting from this case study is the critical dimension that the lab is opting to. The SIML uses the critical approach to technologies in his definition, and in doing so, it assimilates to practices typical from the hacklab. A technology's critical approach can be seen in hacklabs that use open-source hardware/software, which is not only in use in these types of laboratories. Most media labs use open software/hardware, as these are technical resources that contribute to creativity. The SIML can define the sonic lab exemplifying how the media lab has been used as a base where the sonic laboratory emerges, independently and within the subvert culture, as its critical component indicates. The SIML is an academic laboratory dedicated to the technological study of sound from a critical perspective, but it assimilates practices typically from the media lab, as transdisciplinary indicates. The SIML is a media lab that grows its interests in sonic technologies mixed with other disciplines. This example identifies the conditions that may be possible for a sonic laboratory, with shared features with a media lab but highlighting a critical perspective and their studies' interdisciplinarity.

Conclusions

Creating this survey, I must recognise that laboratories' wide diversity makes it impossible to generalise what a lab is. In Parikka's words:

The "inventing the future" sort of corporate brand of MIT Media Lab differs rather radically from these small-scale examples that could be even called humanities labs of our era, and they differ from the emergence of labs in rather different geopolitical locations such as the maker-lab ecosystems emerging in West Africa, for example in Agbogbloshie, Ghana, one of the hubs of e-waste dumping. [35]

Consequently, the laboratory definition may remain open and inclusive. The thesis adopts feminist theories and actor-network theories defining laboratory far from a vision regulated by the technoscientific perspective, derived from a rationalist, patriarchal, and colonialist objectivity model.

This survey chapter that works as a contextual review will support this thesis' aims and objectives to define and establish the sonic laboratory. Although the term has been used in academia and other fields, the concept has not been widely explored.

Understanding what a lab is and studying the already known labs allowed me to create this overview. I described different laboratory typologies (academic lab, science lab, media lab, hacklab and others), which approaching ones and criticising others would help define and establish the sonic laboratory.

Moreover, this survey shows that the term laboratory does not designate one place but presents heterogeneous sites with different activities and aims: knowledge production, manufacturing, researching, hands-on experimentation, and more. These are some of the laboratory's features and will provide this research with the essential details to define and establish the sonic laboratory.

The analysis of sound artists who have developed their practice in this type of artsience labs as case studies is paramount to the sonic laboratory definition because it establishes the bases to understand the sonic laboratory as a sound artists practice.

I also want to highlight from this survey that I have found the term sonic laboratory has already been used in academic and artistic fields. At this point, the survey offers some examples of laboratories dedicated to the exploration of sound, already named sonic laboratories, which confirms their existence. Although these examples, the sonic laboratory requires further investigation and examination. I have presented an academic laboratory introducing the sonic laboratory concept which studied as case studies will bring features and methods to understand the possibilities of the sonic laboratory.

This research aims to define and establish the sonic laboratory to understand their creative possibilities and reach through studying laboratories from a non-hegemonic and inclusive perspective.

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The Last Play: A transmedia installation

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Abstract

This paper focuses on the methodology undertaken and the lessons learned, to create the location-based Virtual Reality (VR) story-telling experience. *The last play* was initially staged in Limassol as a student exhibition show in May 2021 and then again in September 2021 at the Animatikkon Festival in Pafos. The installation is for two people and takes place in two different sections, one physical and one virtual, and it can be experienced in either order. The experience aims to immerse and engage the users by utilizing mechanisms borrowed by immersive theatre and game-design such as spatial storytelling, agency, engaging multiple senses and telling the story through multiple mediums. The integration of these various practices seems to be an important element that complements the immersive qualities of the VR experience. Furthermore, the spatial storytelling methodology, the transmedia approach, and the integration of the various physical objects into the experience seem to positively contribute to the storytelling aspect of location-based VR installations.

Keywords

Transmedia storytelling, Virtual Reality, immersive theatre, location-based entertainment

Introduction

Background

“All cities are geological; you cannot take three steps without encountering ghosts bearing all the prestige of their legends. We move within a closed landscape whose landmarks constantly draw us toward the past. Certain shifting angles, certain receding perspectives, allow us to glimpse original conceptions of space, but this vision remains fragmentary. It must be sought in the magical locales of fairytales and surrealist writings: castles, endless walls, little forgotten bars, mammoth caverns, casino mirrors” (Chtcheglov, *Formulary for a New Urbanism*).

This paper outlines the process, key issues and initial findings relating to the location-based VR installation *The Last play*. Exhibition spaces, museums and galleries are always in the lookout to identify new ways to engage and immerse users in their exhibits. Framing knowledge and ideas in stories, is a technique used throughout the ages [1] and the power in narratives is certainly not a secret in the museum world and other similar exhibition spaces [2]. New technologies such as Virtual Reality offer new storytelling potentialities but also come with their own unique challenges. In this work, the author attempts to bridge knowledge from computer games and immersive theatre in order to propose

a new way to approach immersion and storytelling in the context of location-based VR experiences.

Overview

Time works for those who place themselves beyond time.

- Jacques Yonnet

The last play is a location based virtual reality installation, made in collaboration with students and researchers at the department of Multimedia and Graphics Arts, Cyprus University of Technology. It emerged as a research project that explores alternative and experimental story-telling techniques. The narrative revolves around themes of time travel and the passage of time within the confines of a theatre, beginning in mid-twentieth-century New Orleans and concluding in present times.

The experience is designed for two people so users are allocated to a pair before they are invited into the space. The first user is hooked up to the VR experience, where she/he gets to explore a theatre in New Orleans during the 1940s, which is just about to debut their last play before they are forced to close down. Through exploration and investigation, the user can piece together information on the history of the theatre, why it is about to shut down, as well as travel to two additional time periods that show how the theatre was re-purposed to a home and subsequently left to ruins. In the meantime, the second user sits comfortable on a couch and gets to read a journal presented in the form of an artbook, that details every single object, corridor and secret that can be uncovered in the three time periods of the VR experience. The journal is written from the perspective of a past participant that documented the experience by collecting photos, making drawings and character personas of the various protagonists you meet in the VR space. Furthermore, in this section, the user gets to explore physical items installed in the space which seem to have mysteriously “leaked” from the virtual world as well as witness, through a projection screen, the other participant exploring the VR space. Halfway through the experience, the users switch place. The whole installation is best experienced as a collaborative effort and the participants are encouraged to work together in order to best uncover and witness the secrets hidden away in the theatre.

Building on knowledge from immersive theatre [3, p.84], the users are initially treated to a pre-show with an online teaser experience. Before the day of their visit, the users are asked to visit a website, build around a 3d scene which can be further explored in the VR experience on the day, which provides enough information to provoke curiosity and introduces them to some characters of the world. This acts as an introduction/teaser to the experience, which essentially splits the narrative into three different mediums. The story of *the last play* is not “imposed” to the audience members through narration or descriptive text, but it’s told through environmental storytelling. The user discovers items such as

letters, bills and documents, old photographs, and scratches on the walls – making exploration of the space an integral part of the experience. The exploration is not limited to the online or the virtual space, but it extends into the physical space through various objects which seem to have escaped into reality. All the different elements are tied together into a narrative which is suggested in the artbook. The world was designed in such a way to allow each participant to pave their own path into the space(s) thus each participant walks away from the experience having drawn their own conclusion about the characters and the space itself.



Figure 1. The physical space of the experience. A participant is watching the second participant interacting in the space / reading the journal.

The Experience

The last play invites the participant to explore its world. There are no enemies to kill, no elaborate puzzles to solve and no mechanisms that can “kill” the player. Instead, the experience relies on the acts of exploration, discovery, and the narrative transportation initiated through the participants’ connection with the space and its objects. Just like games such as *Dear Esther*, *Gone Home* and *The vanishing of Ethan Carter* – I am purposefully avoiding to use the derogatory term “walking simulators” here – the last play draws from the theory of psychogeography.

Guy DeBord, wanting to explore how geography affected the emotions and behaviors of individuals, suggested a playful way to navigate the urban environment in order to examine its architecture and spaces. The *dérive* (drifting) is an exercise used to explore the hidden aspects of a city in both a physical and a psychological sense. The purpose of the experience is for a participant to take a walk that involves “playful-constructive behavior and awareness of psychogeographical effects.” [4]. In other words, the purpose of the walk is to let go of oneself and really see and feel the world by becoming consciously aware of all its effects, histories, characters and secrets.

The space, the objects and the story

The world of *the last play* is initially introduced to the participant through the online teaser. Upon navigating to the website¹, they are treated with a short introduction that introduces Raymond Douglas, the owner of the theatre and one of the main characters of the story. The participant then gets the opportunity to explore Douglas’ office, by clicking on the various items and documents located in on the desk and inside the drawers. The documents start to reveal some important elements of the story, such as hints that the theatre is about to close down as well as the part of the script of the

current performance. The items were carefully placed in order to provoke curiosity but not reveal too much. Furthermore, the aim here was to demonstrate the world building and the intricacies of the narrative.



Figure 2. Screen captures from the online teaser.

In order to create a believable world, one that would leave traces, histories and secrets for the participants to discover, the team followed a specific procedure. The first step was to construct the theatre. The architect from the team created era-accurate architectural drawings, which the level designers followed in order to build the space. Following from there, the script writers created the characters which would live in the space, each one with a specific backstory and how they ended up in working in the theatre. The next step was to create connections between the people, such as friendships, love affairs, jealousies, and tensions. The team then imagined how these scenarios would have played out in the space, adding various environmental indentations in the theatre to create a believable history. One example is the love affair between two young actors which can be witnessed through love notes and little markings on the toilet walls.



Figure 3. Capture from the VR world. Graffiti toilets

When the participants enter the VR world of *the last play*, they find a place frozen in time. As they walk down the corridors of the theatre, they realize they exist as a ghostly presence in a single “slice” of time. As the participant approach the motionless characters, they can hear echoes of their dialogues and/or thoughts, revealing pieces of the puzzle of the history of the place. Nick Papadimitriou calls it *deep time*, where the past echoes through the spaces and fills it with an intense spirit of place wrapped in quietude and a past (qtd. in [5]). The space is also filled with interactable objects, some of them embedded with special powers that can *shift* the slices of time. Uncovering one of these objects takes you to a different period, forward or backward in time. The familiar space is now transformed, showing the effects of the passage of time.

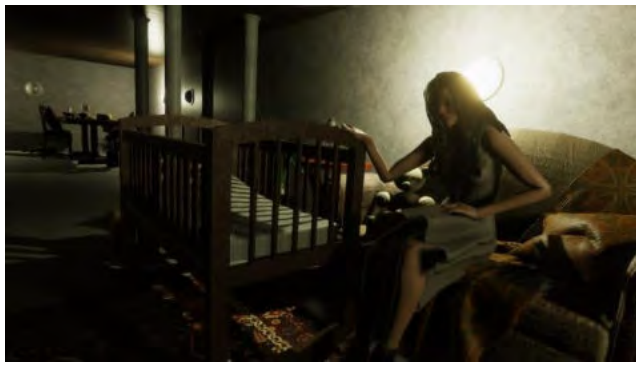


Figure 4. Captures from the VR world. Celeste with her child and the abandoned toilets of the theatre.

Celeste, the young aspiring actress is now a single mother living with her child in the under-stage of the theatre. Remnants of the past glories of the theatre remain in the space, some of them kept as mementos by Celeste, others as consequences of decay. The space is now repurposed and filled with traces of people and their stories. Psychogeography rejects the idea that there is one dominant interpretation of environmental stories and instead focuses on the aesthetics provoked in a succession of readings through a certain player (ibid). Most participants will not take the same path in the space and they will not witness and interact with the same objects. The experience is therefore an individual experience and each participant will form her/his understanding of the story. In *the last play* this mechanic is complemented with the investigative report that is available in the physical space of the experience. This report is written from the perspective of a spectator that got obsessed with the story. The unknown spectator, lived and re-lived the experience, explored every single corner, heard every dialogue, read every letter and documented everything in his journal. What fueled his curiosity even further, is the fact that one day he started discovering items that “leaked” from the virtual space into the physical space. The items, along with and the journal are available for the participants to witness in the physical space.



Figure 4. Captures from the Physical world. The “leaked” items and a participant interacting with them.

Bennet states that “within urban exploration there appears to be a reverence for objects – whether as art objects or nostalgic points of connection with the ghosts of the place” [6]. The team of *the last play* wanted to heighten these connections by making the important object available in both a physical and a virtual form. By giving the objects a materiality, with all the accompanying qualities of material objects, the virtual counterparts also get an elevated status.

They stay in the memory of the participant and act as anchors that further enhance the coherence of the three spaces.



Figure 6. The physical space of the experience. A picture of the artbook.

Immersion

As immersion and presence is studied and theorized by a plethora of disciplines, it is inevitably an elusive concept without a single definition. The application of the term, even if looked under the scope of digital games, it is as diverse as: general engagement, perception of realism, addiction, suspension of disbelief, identification with games characters and more [7, p.25]. What makes things even more complicated is that hybrid events, such as *the last play*, very rarely follow the same approaches and/or methodologies as other similar experiences so they are very difficult to homogenize under a specific framework. As *The last play* used elements of game design, immersive theatre and VR, therefore the immersion methodologies used in the experience were a combination derived from the said disciplines.

Machon, adapting Calleja’s reading of game theories proposed the concept of *Immersion as transportation*. She defines it as: “Where the audience-participant is imaginatively and scenographically reoriented in another place, an other-worldly-world that requires navigation according to its own rule of logic” [3, p.63]. She continues to differentiate between immersive theatre and games, explaining that game environments afford extranoetic habitation by recognizing and reacting to the presence of the player, where immersive theatre affords *actual*, physical cohabitation and contact between human bodies, thereby fusing imagination, interpretation and interaction (ibid). The world of *the last play* is composed of three inter-connected, self-contained spaces with their own rules and regulations and a consistent logic. As the participant explores the world and realizes that the objects and characters witnessed in the virtual space traverse into the physical space, the noetic understanding of the world is reinforced further with the physical presence offering to the participants a greater degree of believability to the completeness of the world. In order for this effect to take place, the participant has to discover the world and make the appropriate connections, essentially forming a noetic understanding of the space. This is achieved by allowing the participant to engage in exploration in order to advance a non-linear narrative, where space is the essential communication medium.

This methodology ties perfectly with Jenkins pivotal work “Game Design as Narrative Architecture” that proposes that environmental storytelling creates the

providing by (i) immersion into the narrative to unfold, (ii) embedding narrative information within the set, (iii) evoking pre-existing narrative associations, (iv) and providing resources for emergent narratives (Jenkins, 2004). The narrative of *the last play* is spread across three different mediums, but the story is never actually told to the participants. The story needs to be pieced together by uncovering the various hints, listening to the dialogues, and observing the environment. For example, one of the mysteries that surround the space, is a why the theatre had to close down in the first place. In order for the full story to be uncovered, the participant needs to find and read the letter from the city council, discover the death certificate (both available on the website), subsequently visit the theatre in the VR space, climb the stairs to the theatre's attic and unlock the memory that shows the accident that took place. Furthermore, signs of the accident can be seen in the space in the form of markings and dents on the floor.

The importance of forming a coherent world is also highlighted by Slater in his often-cited paper published in 1997. Slater proposed that a VR environment needs to satisfy the *illusion of plausibility* which makes a user believe that the place they are "visiting" is real. This illusion is broken down into three conditions: (i) The environment needs to respond to your actions (ii) Events in the world are addressed personally to you and (iii) events are following the expectations of the participants [8]. All three of these conditions are met to various degrees in the experience, as the world in *the last play* is developed to be interactive (items can be picked up, doors can be unlocked etc.), characters respond to the presence of the participant and the world is consistent across the various mediums. Slater has also proposed a second condition, the *place illusion* which can be met by allowing the participant to use her/his own body while immersed to perceive the world in the way that they normally would: for example, turn their head to look left and right, bend down to reach etc. This is further analyzed in the next section.

Interaction

Machon states that "Western theory has largely ignored the underlying series of proprioception and kinesthetic "hapticity" (the holistic focus on haptic sensation and perception)" [3, p.46]. Immersive VR experiences in galleries and museums are mostly following a similar approach, prioritizing visual and audio fidelity and conveniently accepting the current status of the "couch-potato player", commonly inviting the participant to step behind the curtain, only to discover a head mounted display and a single chair. Navigating the space and interacting with the various mechanisms are done through the controllers and a lot of these experiences have been optimized for seated players (limited exhibition areas are also, of course, another important factor for this decision).

Building on some previous VR work [9], *the last play* wanted to fully utilize the body as an immersive mechanism. Machon continues, "What is important in relation to embodied theorizing is the valorization of the whole body and its capacity for interpreting from holistic experience; a must when appreciating, analyzing and evaluating genuinely immersive events" [3, p.46]. As *The last play*, was a hybrid event taking place in both a physical and a virtual space, the team wanted to allow the participants to function along the familiar limits of our day-to-day interactions. Explore the space (both physical and virtual) by walking. Watch the other person player navigate the virtual space through a projector screen by sitting comfortably on a couch. Read the

journal by carefully holding the physical, decomposing book.

As the two participants entered the space, they found themselves in the foyer area. An actor handed them their tickets and urged them to proceed forward highlighting the two different paths that followed. One of the two participants was urged to follow the first path leading to the VR area and the other the second, leading to the investigation area. In the VR area, the participant was greeted with another member of the team that facilitated the "dive" into the virtual space. In the investigation area, the participant was free to roam and explore the space. On the right side, there was a table with the items that "leaked" out of the virtual world, with little notes describing where and when they were discovered. On the left, there was a small seating area allowing the participants to comfortably explore the investigative journal/artbook as well as observe, in real time, the "dive" of the other participant.

Char Davies, talking about her philosophy when designing *Osmose* states: "It is impossible to speak of immersive virtual space or of enveloping physical space without speaking of the body". It is only through the living organic body that we can access the world" [10]. While developing the VR section of *the last play*, the team wanted to minimize the interactions through the controller and utilize the body as much as possible. For this reason, the navigation of the space was conducted through a combination of the teleporter function and a room scale setup. That forced the participants to teleport to the area they wanted to explore and then subsequently explore the virtual space through physical movement of their body. The various interactions, such as picking up items and opening doors, were done through the trigger button of the controller. This set up proved to be quite successful as it had a very low learning curve and felt quite natural to the participants.

Audience Reaction and future work

The last play premiered in May 2021 at the Cyprus University of Technology, and in September 2021 at the Animatikon festival in Pafos. During the initial showing we have gathered a lot of positive feedback as well as some suggestions for improvements. Feedback, from 21 participants, was collected through informal discussions at the end of the experience and we are currently in the process to implement some changes based on the feedback for the two upcoming showings.

The participants have all enjoyed the online teaser and most of them said that was one of the main reasons why they wanted to attend the experience. The online 3d scene was "atmospheric" and provided "enough information to provoke their interest but not to give anything away". They found the graphics and the user experience very good but some of the participants commented on the heavy accent of the voice actor. A further interesting and unexpected observation was that audience members seemed to have enjoyed the experience even more when it turned social. The person outside the VR space would read a hint in the journal and guide their partner to explore areas or objects they might have missed. As the world is quite elaborate and there is not enough time for users to explore everything in a single session, this collaborative approach seemed to be an ideal way to experience more content. Furthermore, all users talked positively about the immersive qualities of the transmedia approach – how the multiple mediums helped them piece together the story- and the visual fidelity of the VR world. Most users have not experienced VR before, and a few stated that they felt uncomfortable with the locomotion

during certain areas of the experience. This was greatly improved in the second showing (Pafos) where teleportation and room scale were the recommended methods of navigation instead of the joystick (The joystick was kept only as an accessibility feature for people that needed/wanted to experience the VR sitting down).

The last play is an experience that builds on previous immersive VR installations by adding the physicality of objects and including additional world building mechanisms

such as the investigative journal and the transmedia approach of fragmented storytelling. The work has provided some interesting insights and raised some follow up questions, specifically on the use of physical objects as a mechanism to enhance environmental storytelling. As a follow-up to this work, the team wishes to explore location-based, augmented-virtuality [9] storytelling that completely eliminates the controller and encourages physical action and interaction through hand tracking.

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Posthuman Rituals

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Abstract

As we become increasingly entangled with digital technologies, the boundary between the human and the machine is progressively blurring. A posthumanist perspective embraces this ambiguity, giving primacy not to the individual agents that comprise a system, but to the relationships between them. In this hyperconnected age, our relationships with technology mediate and mould our perceptions of reality, and now they are beginning to define us. This research project explores new possibilities for human-machine relationships, moving away from relationships marked by habitual, unconscious behaviours towards those imbued with intention and meaning. Three works: *Mirror Ritual*, *Message Ritual*, and *Worn Ritual* take inspiration from the mutual entailment of matter and meaning in the dynamic configuring and re-configuring of self-identity. The proposed relationships are not intended to replace or imitate existing ritual practices among humans, but to inspire new forms of shared meaning in the human and non-human assemblages of contemporary culture.

Keywords

Posthumanism; Design; Human-Machine Relationships

Introduction

Today, the intimate couplings between humans and their technology are manifest. We are, at all times, surrounded by a network of interconnected devices that monitor, mediate, and mould our parallel and hyperconnected realities []. We have become entangled with technology in such a way that it's difficult to draw a boundary between human and machine. Artificial intelligence (AI), brain-computer interfaces (BCI), and bio-implants are just a few of the technologies gaining prominence that challenge the long-established epistemological and ontological approaches set in place by the humanist traditions.

With the rise of these entangled and intelligent technologies, traditional notions of identity, agency, and autonomy being put into question [21]: Who exactly is the 'user' [4]? Where exactly lies the interface? In response to this technological proliferation, posthumanist thinking has been proposed as an effective framework for reconsidering the research, design and creative practices underlying Human Computer Interaction (HCI) [15, 14, 31]. Posthumanism calls for the reconfiguration of human and non-human relations,

with the decentering of the human, and the relinquishing of dualist categories such as nature/culture, mind/body, and subject/object.

The shift towards relational ontologies reminds us that in the designing of 'interfaces' we are in effect designing the *relationships* between human and machine [28]. These relationships not only shape our behaviours and perceptions of reality, they underpin the very nature of our being. Their effect on society today is highly visible, most notably through social media networks and their real-time, AI curated content feeds. The intent of these algorithms is to maximise engagement, screen-time and click-through, with the relationships forged then being ones marked by unconscious behaviours, unreflective actions, and addictive tendencies [13].

In this paper, we call for a shift away from habit-based human-machine relationships and towards those imbued with intention and meaning. We present three projects: *Mirror Ritual*, *Message Ritual*, and *Worn Ritual*, which form a conceptually linked series of speculative propositions for future human-machine relationships. Each work utilises machine-generated poetry to produce a shared conceptual space between human and machine. The works investigate the role of language and ultimately narrative in the reconfiguration of identity, exploring the mutual entailment of the material and the discursive in one's open-ended becoming. Each work is in varying stages of development, uses differing scales of temporality, and addresses a distinct aspect of what constitutes the self. The realised designs serve to not only challenge the existing paradigms in HCI research, but to provide altogether new experiences and ultimately forge valuable and meaningful relationships between humans and intelligent machines. The *Ritual Series* aims not to simulate the ritual practices observed across societies past and present, but instead to offer new rituals that produce shared meaning in human and non-human assemblages; new rituals for an increasingly posthuman society.

Background

The notion of the Personal Computer (PC) began to take shape in the mid-twentieth century, with the dream that every individual could one day own their own computational device. Made possible by the advent of the microprocessor, computing gradually permeated into mainstream society, sparking what we know today as the third industrial revo-

lution. This necessitated a shift towards a more interactive form of computing, as proposed in the seminal paper *Man-Computer Symbiosis* [20]. Rather than simply processing tasks, the computer should additionally give and receive real-time feedback. More notably, Licklider envisioned a world in which humans and computers would be intimately coupled, forming a symbiotic relationship from which emerges a new kind of computer, and a new kind of human. Licklider's formative musings, among others, became the foundation of the field of Human-Computer Interaction (HCI) as we know it today. Computers first became commonplace in the workplace, and so the goals and methods of early HCI research concerned itself with functionality, productivity and efficiency. As computing gradually permeated from the workplace into the home, then from the home onto the body, HCI research began to explore more nuanced, subjective and distinctly human needs such as emotion, creativity, and loneliness [8, 9]. The epistemological processes within HCI research likewise shifted from engineering inspired positivism towards socially constructed and situated forms of knowledge production.

Human Machine Relationships

More recently, we are witnessing the increasing entanglement of people with their personal devices; the way in which they mediate and shape our shared reality is unprecedented. As the boundary between human and machine becomes more difficult to distinguish, the existing epistemological and ontological frameworks passed down from humanist traditions become strained. It no longer makes sense to treat the 'user' as ontologically distinct from their technology. With early roots in Donna Haraway's conceptualisation of the cyborg [18], we see the emergence of posthumanist and relational ontologies which challenge the anthropocentric and humanist values set in place by the secularist movements—that humans embody the locus of agency, morality, rationality, and individuality.

Under the posthumanist paradigm, humans and technology are ontologically inseparable, meaning that it is the relation between the two that defines their existence, rather than their individual properties. These ontologies emerge in part as a response to the proliferation and adoption of digital technologies. Posthumanist philosophies, in the broadest sense, call for a radical de-centering of the human, marked by a return to materiality [10]. Adopting relational ontologies leads us to the understanding that in the designing of 'interfaces', we are, in fact, designing the relationships between human and machine through which humanity continues to be shaped [28].

Barad's account of posthuman performativity [1] provides insight into how we might begin to understand human-machine relationships. According to Barad, the boundaries between human and machine are not predetermined, instead they are performed within a certain material configuration. These enacted boundaries, or *agential cuts*, must be applied at one scope or another. In applying Barad's framework to technology design, we do not feign to account for the 'whole' but rather acknowledge the enacted separations, and ultimately take a multiplicity of configurations into consideration. To draw these boundaries early in the design process is to neglect the fluid nature in which human and machine negotiate their respective agencies. Instead of designing technologies with

pre-established roles of 'user' and machine, we instead design for the relationship as a whole. This involves taking into account the user during their active engagement, along with the greater context of their situated relationship, and moreover how it develops in time.

Humans have already formed complex relationships with AI systems that have a profound impact on everyday life, such as the relationship one has with their smartphone. Social media sites have adopted AI for numerous applications, but most notably it is AI systems that curate, in real-time, the stream of content that one is exposed to. The goal of these algorithms are to increase engagement, and ultimately to maximise screen-time. The result is an invisible yet highly targeted system that affects behaviour change—working most effectively when one is unaware of their influence. The presence of agency within these algorithms is unmistakable. As such, social networks provide the ideal example of an assemblage of human and non-human agents, illustrating the posthuman reality of today. The algorithms are distinctly inhuman; they are indifferent to the humanist values of sovereignty, freedom, self-determination, and liberty. They are indifferent to whether or not the end-user is human at all [13]. The obtrusive nature of these non-human agents on human perceptions and behaviours is seen across many aspects of society. In the case of social media, the favoured behaviour of the algorithms, and hence the generated behaviour in users, is one of unreflective, reactionary engagement. Users are rewarded for their unceasing engagement through clicks, likes, comments, shares—in addition to the infinite scroll of hyperpersonalised content. The relationships engendered by social media networks are then, *by design*, habitual and largely unconscious [19].

Human-machine relationships that are grounded in habit are widely spread throughout much of contemporary society. Habits are, in the broadest definition, automatic and repetitive behaviours that are learned and enforced through action [22]. Habits can be both positive and negative, yet in any case markedly require little conscious thought or intention. Rituals similarly involve routines, yet can be differentiated by their intentionality, deep emotional involvement, and their 'socially shared meaning' [16]. Notably, rituals serve a societal function, in that they communicate and reinforce the shared values and identity within a culture [26]. Just as habitual behaviours can be intentionally encoded into the design of human machine relationships, so can ritualised interaction be placed at the core of design decisions. Human-machine rituals need not mimic nor simulate existing ritual practices commonplace in society. Instead, these new human and non-human assemblages carve a space in which novel forms of meaning-making become possible.

Posthuman Art and Design

Wakkary outlines the role of posthumanist thinking for design [31], arguing that the main arc of design over the last forty years has been to prioritise human values, conceptualised anthropocentrically through a series of paradigms such as human factors, ergonomics, embodied interaction and human-centred design. While these paradigms have been effective in propagating human-centric technologies, they have come

with significant environmental, social or cultural costs. In contrast, posthumanist thinking supports greater humility in design, shifting the focus away from ‘the power of self-reflexive human reasoning to situated, partial, and multiple ways of knowing.’ [31, p.2]. This mode of design explores what it is like to *design-with* humans and non-humans, rather than to *design-for* an idealised ‘user’.

This approach incorporates a variety of methods and tropes, including the *counterfactual artefact* [30] – a non-normative approach used to question design or technological conventions; *slow technology* such as *Olly* [23] which explores time and memory using technology to envisage a longer-term relationship with personal data, or *Long-living chair*, a rocking chair designed by Larissa Pschetz that records and displays its use over a period of ninety-six years, allowing the owner to observe long-term patterns of use [24].

Such methodologies are also common in media art. Artist Ana Rewakowicz made extensive use of Barad’s concept of “mattering” and, similar to our presentation here, presented a diffracted intra-action with three artworks that are part of the *Mist Collector project* – an installation that collects water from fog, produced in collaboration with scientists at l’École Polytechnique in Paris. Rewakowicz explored ethical considerations through the notion of the “inhuman”, something that “steps inside of ‘human’ in order to address human ‘ugliness’ within” [27].

Extended Self

The emergence of the posthuman is evidently relevant to our contemporary culture marked by our extensive entanglements with technology. Yet, according to Clark and Chalmer’s Extended Mind Thesis (EMT) [11], the human is already technically constituted. They argue that cognition does not happen exclusively within the confines of the brain and body, but extends out to include the manipulation of objects in the world. Offering the example of putting pen to paper, reshuffling letters on a scrabble board, or using a diary to remember events, Clark and Chalmers describe how such actions are so closely coupled with cognition that they in part constitute it. In this sense, the use of technology is already enmeshed in our thinking and operating in this world. The EMT in many ways aligns the field of cognitive science with posthumanist thought by acknowledging the materiality of the mind, as well as breaking down the mind/body duality.

In granting the materiality of the mind, we are lead to an understanding of self as too embedded in the physical world. In a 1988 essay, Belk proposes that the self is made up of not only the mental processes, ideas, and memories one has, but the things, places and people one finds themselves in assemblage with [5]. Personal possessions inform self-concept by offering concrete and continuous markers of memories and beliefs. In later work, Belk goes on to detail how the proliferation of digital technologies has dramatically shifted the discourse around materially constituted self-identity [6] to include the virtualisation of personal possessions and memories, the re-embodiment and multiplicity of self, and the public presentation of identity.

Language and the Self

Language is often placed in opposition to the material under representationalism, which adopts a binary of words and things; signifier and signified. Yet, as Clark describes, language itself has a materiality; we encounter “words in the air, symbols on a printed page” [12]. Language is not merely a vehicle through which we express our inner thoughts, but a form of computation in itself. The supra-communicative view of language, originally pioneered by Vygotsky [29], proposes that language is a tool that guides behaviour and structures action.

Under Barad’s posthuman performativity, language and matter are not placed at odds, rather “the relationship between the material and the discursive is one of mutual entailment”. Discourse, as Barad highlights, does not refer to merely spoken or written words, rather “discursive practices define what counts as meaningful statements” [2], enabling what can and what can’t be said. A material-discursive approach to understanding self-identity takes into account mutual significance of matter and meaning in one’s open-ended becoming. Within a performative and relational ontology, the self is not a rigid or singular identity, but an ever-emerging subject. This constitution of the material-discursive self forms the inspiration for the works described in detail in the sections that follow.

Mirror Ritual



Figure 1: Mirror Ritual

Mirror Ritual is an interactive installation that questions the existing paradigms in our understanding of human emotion and machine perception. The work appropriates an everyday object, the mirror, augmenting it with artificial intelligence to foster both literal and metaphoric reflection. Through AI generated poetry the mirror ‘speaks’ to the viewer, each poem unique and tailored to their machine-perceived emotional state.

Mirror Ritual looks and functions like a regular mirror, however it is ‘activated’ when a person approaches the mirror and stares at their reflection. A machine vision camera, embedded behind the glass, recognises human faces. As the viewer stares into the mirror, their current emotion is estimated based on facial expression and this detected emotion is converted into a ‘seed phrase’ which is then used to generate a unique poem using a version of OpenAI’s GPT-2 transformer network trained on a custom corpus of poetry (see Fig 2). The poem’s text gently fades onto the mirror and is displayed for as long as the viewer continues to stare at it. When the viewer looks away, the poem is lost forever; each new gaze into the mirror generates a new poem. The full technical details of *Mirror Ritual* can be found in [25].

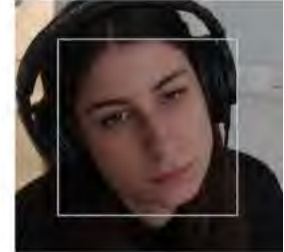
The work is inspired by the theory of constructed emotion, which posits that the supposed basic emotions (such as anger, fear, and joy) have no have no biological or neurological essence [3]. Instead, emotion is constructed from a number of more basic psychological processes, such as language, past experience, and the agreed upon social reality. In contrast to prescriptive technologies that are founded on reductionist theories of emotion, this work’s real-time affective interface engages the audience in the co-construction of their emotion. The audience are encouraged to make sense of the mirror’s poetry by framing it with respect to their recent life experiences, effectively “putting into words” their felt emotion. This process of affect labelling and contextualisation works to not only regulate emotion, but helps to construct the rich personal narratives that shape human identity.

With this work, we aim to develop a human-machine relationship that provokes emotional reflection in viewers through the conceptualization of their affective state. These objectives are reflected in the physical design and construction of *Mirror Ritual*. The use of a mirror surface works symbolically to suggest that you must not only confront your physical self, but also that you may reflect upon your internal emotional state. In addition to the process of reading and interpreting the generated poetry, viewers are subsequently confronted with their momentary reactions. In this way, *Mirror Ritual* engages viewers in the iterative process of the co-construction of their emotional state – predictions made by the mirror are not intended to be direct representations of the viewer’s affective state, yet they can work to shape it.

The mirror is developed with a sustained engagement in mind; we intend that viewers incorporate *Mirror Ritual* into their daily routines, developing a meaningful relationship with the interface through multiple encounters over time periods of weeks, months or even years. For this reason, the mirror has been designed to assimilate easily into daily life, both in its aesthetic qualities (it appears as a standard round mirror), and in it’s dual function (it can simply be used as

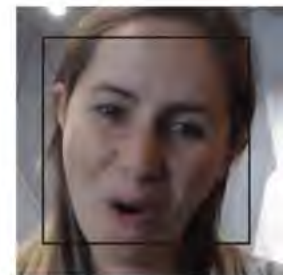
The comfortable place

is not the one that we have vacated
we are always with you
clinging to your empty good time
your warm harbor in the dusk
we are always with you
(we are always)
and this good time
we call sacred
we provide a framework



Excited

I am trudging
in the wrong direction
The wrong footstep
A bon fire in a church
I repent
If only I knew
what confusion
is doing
In this slow wood
A crane landing
In the least invasive
Style
On a whisper
Of wind lifted
From a book
That I had not opened



You are elated and ecstatic

For three whole days
you have been praying
and fearing
and reveling in
the knowledge that now is the most
optimal time to embrace
your whole life story, including
the one you’ve been carrying around
in your mind, like a baby



Figure 2: Examples of generated poetry. For each poem, we present the associated facial expression as perceived by the mirror and the subsequent seed phrase (shown in **bold**), which is used to generate the poem using a custom GPT-2-345M neural network.



Figure 3: A CAD render of the *Message Ritual* lamp

a mirror). The mirror could be hung in a bathroom, living room, or hallway entrance, creating the space for viewers to pause and reflect on their mood as they transition between the moments of their day.

Early experimentation provided a number of insights about the relationship generated through engagement with *Mirror Ritual*. Participants largely found themselves able to emotionally engage with the mirror, often perceiving the device as possessing agency and intention. The mirror's poetry was best received when participants were able to connect it back to something tangible, framing the messages within the context of their life and recent experiences. In this way, *Mirror Ritual* presented participants with fresh concepts and imagery, occasionally bringing to the surface dormant emotions, beliefs or memories [25]. Meaning seemed to unfold between participants and the mirror, both over the course of one interaction, and over the extended period of engagement. The experience was generative, directing further thought and conversation. Furthermore, the relationship itself was found to define the respective roles of its constituents; both the participants and the mirror *becoming through* one another.

Message Ritual

Message Ritual is the second artefact developed in the *Ritual Series*. Comprising a bespoke table lamp and an AI backend, *Message Ritual* is an integrated system that encourages the re-framing of memory and identity through machine generated poetry. Appropriating a typical domestic object, the lamp is designed to have an ongoing presence in the home. While functioning as a regular table lamp, while turned on it also listens in on conversations occurring throughout the day via an embedded microphone array and on-board computer. Each night, the system analyses those conversations, reconstructing

the key themes and topics as a source for machine-generated poetry. A short, bespoke poem is then delivered back to individual members of the household as a text message upon waking. *Message Ritual* presents an alternative approach to traditional augmented memory systems – rather than focus on the sensing and quantification of external experiences or actions, we aim to construct meaningful, personal narratives through the use of machine-generated poetics.

As with *Mirror Ritual*, *Message Ritual* similarly utilises machine-generated poetry to foster reflection and introspection as the individual attempts to draw meaning from their delivered poem. But rather than grounding itself in the viewer's in-the-moment mood, *Message Ritual* draws upon an individual's recent memories to contextualise their poetry. The system is not attempting to improve the recollection of 'accurate' memories, rather it encourages the active framing and re-framing of personal events that contribute to one's overall life narrative. As with *Mirror Ritual*, the work is designed to be lived with over an extended period of time, with the poetry referencing the events of the previous day. This self-referential nature of the experience aims to provide some sense of continuity over the interactions, allowing people to develop a meaningful relationship with the system over an extended period of time (months, years).

Message

A smartphone was chosen to serve as an intervention to the typical habitual behaviours and gestures associated with the device. The morning SMS is designed to reach the participant in their first moments of the day, encouraging reflection and re-framing of the previous day's events. The daily reading and interpreting of the message contributes towards one's waking ritual, prompting the participant to proactively reflect and contemplate their life. SMS technology is utilized as it sits outside of social media applications, creating a conceptual division between *Message Ritual*, and other morning routines that are mediated through a smartphone.

Lamp

The design of the lamp itself is crucial to the overall experience, as it will be embedded into the homes and lives of participants. In line with the design of *Mirror Ritual* [25], the lamp serves both a functional and aesthetic role in participants' homes. Here, everyday domestic objects (e.g. furniture, crockery, plants, soft furnishings) are of interest as they have clear and well-defined roles in one's life, but they also distinctly lack a technological component. Technology providers push for the widespread integration of technology and everyday objects (the 'smartification' of the home) [7], generally aiming to augment both the function of the artefact itself, and to increase the connectedness of objects with each other (i.e. internet of things). In this work however, the use of everyday objects is chosen not to necessarily 'improve' an object's function, but rather to bypass any preconceived notions or behaviours that users may associate with traditional interfaces such as screens, smartphones or voice-assistants. In this way, the natural behaviours afforded by non-technological objects (i.e. switching a lamp on or off) are utilized in the interaction, allowing for the interface to



Figure 4: Message Ritual: the Lamp listens to conversations in the home and responds with poetic reflections of the day's conversations via text message (shown right) to members of the household the following morning.

escape common behavioural and gestural habits such as tapping, swiping, scrolling, refreshing, issuing commands, etc. The artefact blends into the domestic surroundings, so as to not interfere with natural conversation occurring in the household. Furthermore, the light from the lamp carves out a space for occupants to gather and converse, especially in the evening and night time hours.

Living with Lamp

In a 2 week long study, participants were asked to invite the lamp into their home. We found that the lamp aided in the reflection on and recollection of recent memories, offering transitory moments for quiet contemplation. Moreover, the lamp served as a social centrepiece, encouraging conversation and connection within households. More interestingly, however, is the common perception of the lamp as an extension of it's designer. Emotions experienced towards the device seemed to distribute across the entire assemblage of household members and researchers. It became impossible to decouple the experiences of any one participant. Instead the specific material configuration; the households, participants, designers, and researchers, altogether shaped the course of the lamps becoming. Again, only through the relationships that emerged through sustained engagement, did we come to further understand the influences, implications and possibilities of *Message Ritual*.

Worn Ritual

The third project of the *Ritual Series* serves as a counterpoint to the first two; taking inspiration from the narratives generated in relation to both *Mirror Ritual* and *Message Ritual*, but addressing the ephemeral nature of machine-generated poetry. Often such poetry is perceived as lacking significance

or meaning, in the sense that it is trivial to generate thousands if not millions of poems in a short period of time. Moreover, the poetry lacks an identifiable author and the traditional intentions of human poets. *Worn Ritual* is a response to the transient nature of machine poetry; by taking short excerpts from the generated poems and inscribing these into physical materials such as aluminium, steel, and textiles, the narratives behind the poetry are given a greater sense of value and permanence.

Worn Ritual is currently in the early stages of conceptualisation and development. In early experiments, the concept has been explored through the medium of hand stamped aluminium bracelets. Rather than using automation, a personalised poem is chosen through a manual curation process, from which an excerpt is hand stamped onto a bracelet that is then gifted to the participant. Examples of the chosen excerpts and associated bracelets can be seen in Figure 5. The curation process involves seeding the poetry model with a phrase that is meaningful to the participant, and generating several poems of which only one is selected. The selected poem in some way captures the participants recent experiences or reflects on the relationship between participant and designer. In one example, a bracelet was made as a parting gift to a participant leaving the country indefinitely, with the following associated poem (seed phrase in **bold**, stamped phrase in *italic*):

There is no unhappy ending here,
And if there was, it would be a different jungle.
We are thrust forth as the favored creatures
Of mythical beings and saintly heroes.
This is surely no happy accident.
It is a *spiraling arc*—the work of love.



Figure 5: Worn Ritual: aluminium bands with hand-stamped AI generated poetry (left) are shaped into bracelets (right).

Experimentation with jewellery as a medium has provided early insight into how these constructed narratives can be embedded into physical, static artefacts. Further experimentation will focus on how the chosen materials and context of the works influence the perceived value and meaning of machine poetry. We plan to explore a range of materials and techniques, such as machine engraving, embroidery and woven textiles. In addition to wearables designed for personal meaning, we will also experiment with larger scale pieces designed for domestic and public settings, allowing for the continued exploration of how machine-generated poetry can be imparted with social-shared meaning.

Conclusion

The three works presented in this paper are designed as a conceptually linked series of works that each propose a speculative future of sustained human-machine relationships. The works embody a critique on traditional approaches of the quantifying of self: the measurement of emotion; the outsourcing of memory; while at the same time offering positive and optimistic alternatives for human-machine relationships. The works also reject the typical focus of technology on accuracy, efficiency and speed: capacities that enforce the relentless ‘consumption of disappearance’ that define modern technological cultures [17]. Instead we turn to creating rituals that render time habitable – much like we furnish homes to make space habitable, rituals allow one to inhabit and linger in time. It is no coincidence that all the works in the *Ritual Series* encourage the emergence of long-term relationships over instant gratification, and that they work as personal or household objects, whose significance is earned rather than given.

The *Ritual Series* serves to not only challenge the existing paradigms in technology design, but to offer altogether new rituals and experiences, ultimately striving to forge intentional and meaningful relationships between human and machine. In response to the increasingly common tendency for technology to mould the human into a form that can be understood by a machine, or more recently the desire for the machine to be reconfigured for the human, the *Ritual Series* instead allows for their mutual unfolding. Neither precedes

the other, neither defined by the other, but through their relation emerges a continuous and open-ended becoming.

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View from Above:

Drone art and hacktivism for landscape transformation awareness

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Abstract

Aerial images have become commonplace on the media landscape around us, in places like TV news, films, and digital maps. However, do we consider what these images represent, both in the artistic field and in society?

The aim of this project is to raise these and other questions in order to reflect on how drones are being inserted into the normality of everyday life and to question their vigilant scope. We ask how we as artists can act as hackers, disruptors and creators of new possibilities.

Our use of aerial images is not intended as surveillance, but rather as research on what is happening in certain areas where nature and worlds inhabited by humans coexist, most of them unknown to the majority of the local population.

Keywords

Drones, Hacktivism, Counter-surveillance, Environmental awareness, Augmented reality.

Introduction

Drones, also called Unmanned Aerial Vehicles (UAVs) are recent examples of flying machines used for modern warfare. They have the ability to travel into enemy lines, capture images and collect field intelligence. Created for military purposes, they demonstrate the technical prowess of one army over another. Whoever manages to climb higher and see the other from above, has more information about the opponent.

Recently, drones have also become entertainment machines, a new means of capturing images whether for newspapers, movies, commercial purposes or as a hobby. They appear to maintain their military descent as a surveillance tool, being used in cities to monitor the population. Often in the criticism of drones, the notion of “scopic regime” [1] is used, expressing a hierarchical, violent and asymmetrical power model that manifests itself in the forms of surveillance and drones.



Figure 1. *Frontiers || Territories, Timelessness-* Ars Electronica Campus Exhibition, 2019. Augmented reality project overlaying images captured by drone onto a satellite image map of the area. We used the Mapknitter software to match the drone images to the map.

Satellites are another example of aerial imaging devices that are out of our visual range and constantly record images of the Earth. These images are also used for reconnaissance. In both drones and satellites, the images they capture have an ever-increasing range and resolution. These machines are seeing for themselves, and are part of what Harun Farocki has titled operational imagery, images made by machines and which are "read" by machines. They are used to map the world and may not be treated impartially, thus changing the way we see and "do" things in the world, as Trevor Paglen has pointed out. [1]



Figure 2. Image capture from Google Maps edited to remove all natural spaces from the area under study.

Many of the images we see on digital maps today are aerial images that don't portray a stable ground, instead creating an assumption of what exists. Satellite images that we later see applied to digital maps, as in the case of Google Maps, are, according to Ana Peraica, landscapes that result from the "gluing" of various image clippings through the use of artificial intelligence. [1]

Beginning

In 2019, we presented publicly in Ars Electronica Campus the project *Frontiers || Territories*, it was in the research around this project that we awakened to this relationship of images captured from a point where we are far and in different positions from the camera. In this project, we became interested in looking for borders in the area where we live. When represented on maps, borders are just lines and do not have the same force as the concept in terrestrial terms can have. Even knowing that they are invisible, they manifest themselves in our behavior.

Another factor that brought us here was that already in this work we were interested in exploring ways of capturing aerial images that are made with Do It Yourself tools, created by us and that are documented for those who

come next and intend to do something similar or who can adapt to what they intend to do. So we started with the construction of a pole where a *GoPro* camera could be

attached and set to automatic mode, capturing images from the moment it was turned on.

These images were then uploaded into the open source "Mapknitter" software created by Public Lab. [12][13] It wasn't easy to reach the intended goal because of the weather conditions, with the wind impeding camera stabilization (Fig. 4). So, as a last resort, a drone was used to get results that fit the deadline we had to meet.

It was from this experience that we took the notion of size, weight and possibilities that drones have, as well as the number of models and sizes. We were able to ascertain their stability, susceptibility to certain flight conditions as well as the image quality, scope, detail and information that drone images can capture. We researched the current local airspace legislation that applies to the use of drones and we found the legally safe airspace for drone use as a tool for entertainment, commercial and artistic purposes.



Figure 3. Image capture from Google Maps edited to remove all built objects (houses, roads, etc.) from the area under study.

In *View From Above*, we once again use the drone as a means of capturing aerial images, in which we can explore the area where we live. This time trying to reinforce it with a way of doing hacktivism, which we had already started in this previous project



Figure 4. Composition with photos taken with a GoPro camera attached to the end of a long pole.

Artist as hacker

“The artist makes social conditions visible, the hacker highlights the weaknesses of the system. The hacker shows the open wounds of machines, or the computer world, making it clear that everything a machine achieves can also be nullified by it.” [3]

In this case, not only the computer world, but the world in general, since currently the virtual world intersects with the real world. From the point of view of this research, the hacker loses the connotation normally given to him, that of criminal, someone who steals or cheats, in hacker jargon these people are called crackers, someone who illegally and unethically breaks a security system.

Ethics is very important to define the hacker, so there are several manifestos referring to this topic, such as McKenzie Wark's in the book “An Hacker Manifesto”. Wark refers to the hacker as a producer of differences, who deconstructs technology and highlights differences in the positions of relationality and power. [4]

Hacker intervention is known as a gesture of transgression and rebellion against the established, especially in the technological environment. Although hackers act particularly through computation, it is understood that their manifestation is usually expressed through different means, even non-technological ones, and so we can include them in art. If the computer hacker goes in and changes codes, as artist hackers can we change the code of art?

Artists who identify with hacktivism intend to create a more open conscience and question the functioning of the norm. The confrontation with the relationships that sustain the economy, power and politics are very important for the activist hacker. The latter is thus represented as a participatory member in social and political issues.

As this project revolves around surveillance devices, the sovereign relationship of those behind these devices, which here focuses on drones, we have the possibility of questioning the look that comes from above and still looking at the one who looks from above, what Mirzoeff calls “countervisuality”. [5][9]



Figure 5. Image capture experiments carried out with the drone, using a mobile phone to preview what the drone is capturing.

Possibilities

“What if, instead of resisting the use of surveillance technology, we could harness it for the public good?” [6]

This project has a community aspect that starts from learning to fly a drone, collecting information and tricks in forums for sharing information related to drones. On the other hand, it is intended to give power back to people, to make known the area where they live, where they can have a critical view.

One of our main references is the #dronehackacademy project[7][8], defined by the creators as a prototype of a hacktivist school, a laboratory for citizenship science and the production of critical theory for the use of unmanned aerial vehicles, coordinated by Pablo de Soto and Lot Amóros. They worked together with the community of Vila Autódromo, in Rio de Janeiro, where they made use of the drone in favor of the community. Participants had the opportunity to see and locate their dwelling area and to have a new perspective on the space they live in. These people were watching the demolition of the houses where they lived and thus being able to compare with the houses in the past.

This is an example where technology becomes an asset for community use by dismantling the power of the gaze and appealing to the right to gaze.

In this project, Flone [10] is used, an example of a low-cost, open-source DIY drone, in which all the information about its functioning and construction is available to be improved and changed, in software and open hardware platforms. Flone is a technological device, similar to the drone, it is open source and therefore it is possible to replicate. On the project's website, you can find all the specifics for building a Flone. This is a hacker instrument, for the freedom of information, being available to anyone.

Another project that was a reference was DIY Forest and Surveillance Kit, in which DIY open-source video streaming boxes were used in a forest area for fire prevention.[11] In addition to questioning the capture of images by surveillance cameras, they draw attention to the fires that have been a scourge and to the repercussions that may result.

We < = > Drones

Drones see us and we see them back!? We should notice that drones are part of the technological world and despite our insistence that they "see" us, there's always a human operator behind the drone and technology in general.

In this project we invoke "countervisuality" as a form of hacktivism directed at the use of drones as technological platforms of power through surveillance.

In this hands-on research, we took it upon ourselves to use the drone and understand how it works. Bringing it into the field of performance art, we look and point towards the

drone in order to reverse the vertical hierarchy its operation naturally creates.



Figure 6. Top: commercial drone being used for experiments. Bottom: assembling a Flone DIY drone during an artistic residency.



Figure 7. *I see the drone and the drone sees me* (2021). Stills of Video-Performance.

We started by flying a very simple model, in order to understand its functioning and gaining flight experience. Then we moved onto a higher end model with built-in ability to capture high-quality images. This model has proved more challenging to fly, and we have been steadily gaining experience with it in order to be able to fly safely at greater heights and longer distances.

In parallel, we have been assembling our own Flone drone that will serve as a platform to allow us greater flexibility in the future to explore new image capture

technologies, on-board image processing and dropping or picking up of external payloads.

In *Drone Shadow* [12], James Bradley makes a 1:1 representation of the outline of a drone in chalk on the streets of several cities, recalling the outline that is also made in chalk at crime scenes.

At the same time, it's a way of reminding the public that drones are out there, up above. Its intention is thus to communicate both the physical reality and the apparent invisibility of the drone aircraft. Bridle follows the idea that you have to draw to better understand the world, because if you can't describe it, you can't act fully in it. Knowing it, it is possible to debate and criticize it. In 2013, James Bridle published the book "*Drone Shadow Handbook*", a guide to drawing models of the drones he made in public spaces, while also indicating their characteristics.

This guide is a way for Bridle to share with anyone interested in doing DIY versions of his project. This opens the door to free access to information, a characteristic present in the hacker community.

Where/Target

Our main target location for image capture is marked as a protected forest area. However, despite its protection status, it has suffered great devastation for the construction of large houses.

Unlike the #dronehackacademy project, our intention is not to fly over an area under deconstruction, but rather over an area in tension between deforestation and construction, where the house prices are the highest in the nation. We're telling the story of a place where protected trees are cut down to build real estate and then partially replaced by other kinds of vegetation in order to maintain privacy and define property limits.

How

The practical implementation of this project intends, on the one hand, to create a cartography of the area mentioned above, with images captured by the drone and displayed horizontally, on the floor where the public will walk and will be able to visualize details of certain points through augmented reality (figure 9). It is intended that the public can be from above looking down and with a tablet have the experience of looking from above.

The layers to be presented include research among the population which has recently begun to protest, given the increase in deforestation for the construction of houses.



Figure 8. Stills of the augmented content displaying the differences in the same zone but different years, in Cascais, Portugal. Image source: Geocascais, CM Cascais.

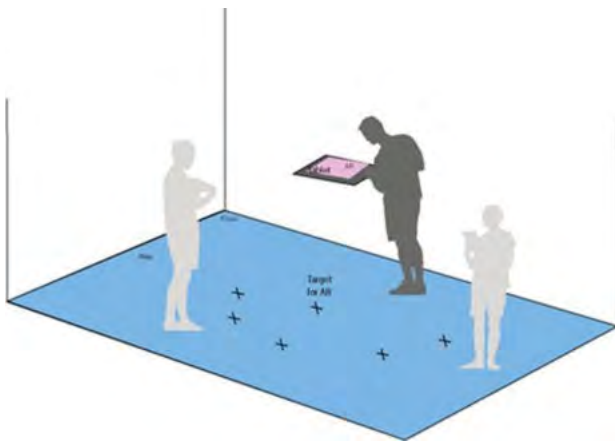


Figure 9. Mock-up of the Augmented Reality interactive installation that reveals the project visual content to the public.

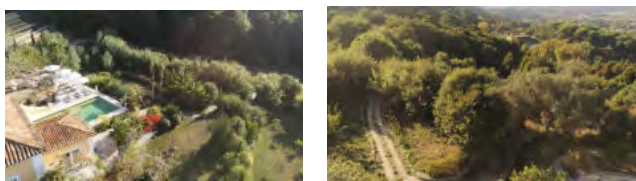


Figure 10. Stills of the augmented content displaying the drone video overview nearby the natural park Sintra - Cascais, Portugal. The images are part of the video content we created as part of the View from Above interactive installation, where several similar instances are exposed.

Conclusions

This article presents the *View From Above* project, which aims to use the unique perspective of drones to expose the aforementioned process of prime real-estate encroaching into a protected forest area. It is thus a way of contributing the criticism of the “look” of drones to the artistic and technological community. Appealing to community work and freedom and exchange of knowledge.

In order to further develop this project, we will carry out flight studies in the area we are researching. Moving on to the next project stage in augmented reality, we are building a narrative with data that have been collected to better understand the area where we are acting.

In tandem we are building an online platform that details the project’s artistic and technical research, to make our work known to hacktivist platforms and communities that want to fly over areas where the good conditions of natural spaces are being questioned.

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Inhaling Quantum-Consciousness: Ecological Vibrational Possibles

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Abstract

Navigating the contemporary debate on the Vibrational Theory of Olfaction (VTO) as a quantum mechanism, there is a rising hope it can lead us to an understanding of the biological world more as ‘energy interchanging in charged playgrounds’ and less as related to molecules’ shape-dependent trades. This can teleport our understanding of the biological as ‘moist’ to the biological as ‘molist’ – crossing scales in complementary moves from the molecules-atoms-bits’ realm of *moistmedia* to the charged ‘scale free’ panpsychist realm of *molmedia*. As the third move in a series of works that starts as invitations to explore humans’ body molecular informational exchanges with the microbial, the paper presents and discusses the genesis of the installation ‘Inhaling Quantum-Consciousness’ in a direct dialogue with Hélio Oiticica’s appropriation of Russian Suprematism aesthetics and structural principia, expanding the use of the pure pigment to an experiment in biochemical art.

Keywords

Vibrational Theory of Olfaction (VTO), Biochemical Art, Moistmedia, Molmedia, Pure Pigment.

Introduction: Immersed in data

“So, as multimedia give way to moistmedia, and interactive art takes on a more psychoactive complexion, consciousness remains the great mystery, just as intelligent artificial life remains the great challenge.” [1]

Human olfactory receptors are members of the G-protein coupled receptor superfamily. G-protein-coupled receptors (GPCRs) are the largest and most varied group of cells’ membrane receptors in eukaryotes acting like an inbox [2] for messages that inform cells of the presence or absence of life-sustaining light or nutrients in their environment, or conveying information sent by other cells. These molecular receptors can receive information in the form of proteins, lipids, sugars, peptides, light energy and help regulating a massive number of bodily functions – from sensation to hormone responses. The human sense of smell uses these receptors to discriminate between an astonishing variety of odorants. Nevertheless, the exact mechanism [3] by which an odorant activates a receptor is still unclear.

Luca Turin was pioneer in suggesting that [4] inelastic electron tunneling has a big chance of being the method by which vibrations are detected by the olfactory receptors within human nose. In fact [4], the vibrational theory of olfaction is a tentative description of a possible mechanism for olfaction that offers researchers a set of principles that authorize predictions allowing for structure-odor relations.

In a paper published in 2013, Turin and a group of collaborators [3] describe and discuss experiments using isotopomers (an odorant) in a possible test of shape versus vibration mechanisms. The researchers assert that testing for odor character differences between deuterated and undeuterated odorant isotopomers can be effective in helping to prove the validity of the vibrational mechanism, considering deuterated and undeuterated odorant isotopomers have different vibrational modes, despite having identical ground-state conformations. What is behind the contemporary Vibrational Theory of Olfaction (VTO) is a quantum mechanism.

Howard Wiseman and Jens Eisert believe that [5] considering the growing importance of quantum mechanics in biology, all the suspected cases of nontrivial quantum effects in biology must be examined with caution. Beyond the vibrational bonds related to the mechanisms of olfaction (or better saying, a chemical presence we perceive as odor) the understanding of consciousness as a biological elementary level phenomena starts being by some means illuminated by quantum mechanics.

Hameroff and Penrose [6] back in 1996 navigate historic references to discuss the problem of incorporating the phenomenon of consciousness into a scientific worldview. They recall a set of philosophical positions addressing the problem – bringing an understanding of consciousness as a fundamental component of physical reality such as panpsychism [6] in which it is a quality of all matter, having atoms and subatomic particles elements of consciousness.

Among all philosophical positions the researchers mention in this seminal paper [6], the one of Alfred North Whitehead has elements that can be most directly applicable in the effort of understanding consciousness from a quantum mechanics perspective. As pointed by Hameroff and Penrose [6], Whitehead describes the ultimate concrete entities in nature as being ‘occasions of experience’, bearing a quality similar to our notion of ‘feeling’. From Whitehead point of view, consistent with panpsychism, even temporal events in the career of an electron [6], have a sort of ‘protomentality’, a ‘protoconsciousness’. The researcher’s intention is “[...] to regard experiential phenomena as also inseparable from the physical universe, being deeply connected with the very laws which govern the physical universe.” [6]. Recalling Penrose arguments in his ‘Shadows of the Mind’ [7], they ponder there is a necessary non-computability in consciousness thought processes that must be inherent in the phenomenon of quantum state self-reduction. The researchers argue in this debate that the gravitational induced collapse of the wave-function is ultimately related to the phenomenon of consciousness and micro-tubules forming the cytoskeleton of neurons should be the right place to look for such state reductions.

From Moist to Molmedia and backward

Navigating the contemporary debate on the Vibrational Theory of Olfaction (VTO) as a quantum mechanism, there is a rising hope it can lead to an understanding of the biological world more as ‘energy interchanging in charged playgrounds’ and less as related to molecules’ shape-dependent trades.

This can teleport our understanding of the biological as ‘moist’ to the biological as ‘molist’ crossing scales in complementary moves from the molecules-atoms-bits’ realm of *moistmedia* [1] (Figure 1) to the dry and charged ‘scale free’ panpsychist realm of *molmedia* [8] ruled by quantum traffic.

Mole is defined as the amount of substance containing the same number of discrete entities (ions, atoms, molecules) as the number of atoms in a 12 g sample of pure 12C. Mole, in molmedia, denotes not the quantitative amount of substance but the embedded chemical information. From a quantum mechanics point of view, *the embedded information can be seen as the vibrational information of a chemical entity that influences its possible bonds and its impacts when received by other entities in different scales* – as when a G-protein-coupled receptors (GPCRs) acts like an inbox for messages that inform cells of a chemical event. Media, in molmedia, refers to the *information circulation and exchange processes at elementary entities level* (molecular, atomic and subatomic) within a given system – the chemical is message.

from the immaterial to the re-materialisation of art

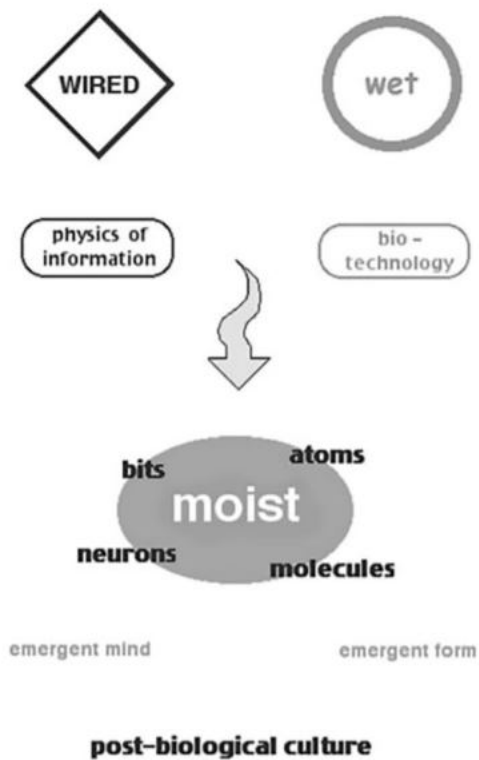


Figure 1. Roy Ascott “Moist Chart.” 2000 [1].

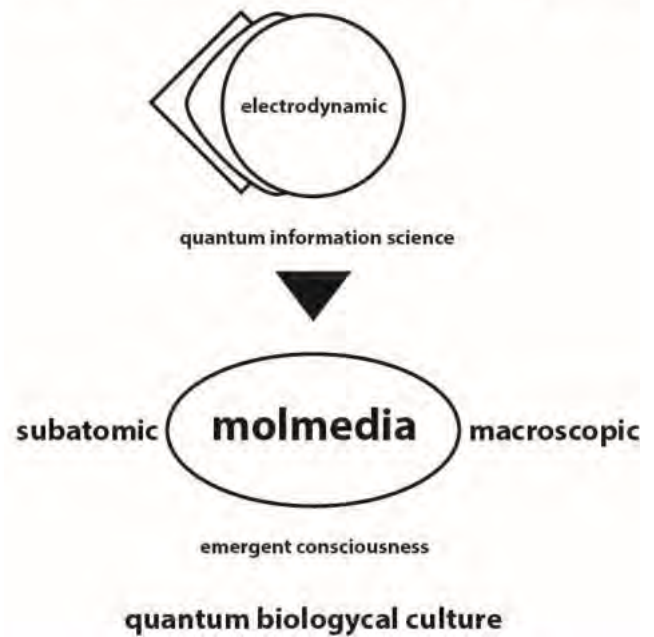


Figure 2. “Molmedia Chart” 2021 (by the author).

Exploring the understanding of consciousness from the perspectives discussed and elaborated here, the piece ‘Inhaling Quantum-Consciousness’ (2021-2022), as homage to Hélio Oiticica/Kazimir Malevich and Roy Ascott, bridges the Brazilian Neo-Concrete Movement (1959–61) and contemporary biochemical art. The work dialogues with ISEA 2022 subtheme ‘Human and non-Human’, encapsulating questions related to the quantum nature of life as a cosmological phenomenon that extends far beyond Planet Earth, elaborating on how we become bodies in the world, construct, and gain knowledge from a cross-scales perspective. *The Possibles are quantical.*

‘Inhaling Quantum-Consciousness’ (2021-2022), is the third configuration that the initial artist’s intentions assume in a self-organizing and adaptive creative processes. The work can be understood as an emergence in a process that starts in 2016 with the project “Ulysses Pact: Metagenomic Entanglements”, presented at the 22nd International Symposium on Electronic Art ISEA2016 in Hong Kong, exploring chemical informational trades within human body and between human body and the environment. This understanding of the creative process in multimedia arts as a CAS (Complex Adaptive System) having emergent qualities is fully elaborated in the author’s Ph.D. thesis “Instants of Metamorphosis: The Collective as Process; the Process as System” (available at LABS Leonardo Abstract Service online database). From a deeper understanding, there is the intent of meditating on how the notions of *moistmedia* and *molmedia*, in a spiraling two-way dialogue, transcends multimedia as structural to the poetics.

Art as the Living – the Living as the Chemical

“Art no longer cares to serve the state and religion, it no longer wishes to illustrate the history of manners, it wants to have nothing further to do with the object, as such, and believes that it can exist, in and for itself, without “things” (that is, the “time-tested well-spring of life”).[9]

In a moment we start understanding that even the molecular fragments of dead lactobacilli in a baked bread can influence human behavior when we eat it (figure 3) the concerns about the impacts that dysbiosis can have in mental states rises. Caused by the deprivation of contact with non-urbanized environments abundantly populated by microbes, dysbiosis can be potentialized by the social distancing rules imperative during Covid-19 pandemic.



Figure 3. “Psychobread” (2020-2021) baked using donors’ saliva (containing salivary microbiome samples) mixed with honey following Indigenous Australians’ traditional recipe. Workshop for the UCLA SciArt Summer Institute 2020 and 2021 lead by the author. (Photo by the artist).

In the pre-pandemic version of the series, considering possible integrations and information exchange between above-ground trees’ microbiota and the human respiratory and digestive system, the invitation that was placed to the audience was to inhale samples of trees’ bark microbial populations, welcoming these contaminants inside the human body. The artist’s intentions were to play with instinctive reactions of the audience to consider stimulate a reflection on our vital relation with nature’s microbial molecular information.

Inhaling Consciousness (2019)

Considering the audience reaction in the first time the work was installed in 2019 in Porto, Portugal, for the

Consciousness Reframed exhibition ‘Sentient States: Bio-Mind and Techno-Nature, it was interesting to observe how open to the experience all showed to be. In its very first configuration, the work consisted of a transobject from the appropriation and adaptation of a nebulizer – a medical Cool Mist Inhaler and Accessories (Tubing, Cup, Mask), a reservoir bag and a dust/particles sensor system attached (Arduino, sharp dust sensor, LCD 16x2), having a cork oak bark excerpt inside, extracted by the artist’s uncle from her grandfather lands in the village of Folgoso, Raiva, Portugal.



Figure 4. Inhaling Consciousness (2019) at 21st Consciousness Reframed Conference exhibition “Sentient States: Bio-Mind and Techno-Nature”, 6-9 June 2019, Universidade Católica Portuguesa, Porto, Portugal. (Photo by the artist).

For Inhaling Consciousness (2019) an additional intention was to meditate on how chemical substances, by encapsulating information, can help preserving nature’s heritage, especially in times we face unprecedented deterioration and devastation of planetary ecosystems due to climate change and the impact of humans’ actions.

The Brazilian Neo-Concrete Movement concept of a transobject, relates to the intension of incorporating an ordinary object into an idea, making it part of the genesis of the work without losing its previous structure. The apparatus in this first version of the work, adapted from a medical inhalation breathing system, has an intentional aesthetic and conceptual relation with two references – Hélio Oiticica’s [10] [11] B50 Bólido Saco 2 Olfático, 1967 plastic, rubber and coffee 65,0 x 52,0 x 2,5 cm, and Barbarella (1968) movie’s giant hookah which dispenses ‘Essence of Man’ [12].

Considering the audience openness to the experience – wearing the nebulizer’s mask and breathing from the vapor chamber containing the cork oak tree bark excerpt, inhaling it microbial population molecular information – raises the question of how could the individual suppress the protection against stimulation.

Carefully avoiding depicting Oiticica’s art as something pathological, Inge Hinterwaldner observes that in works such as Oiticica’s “B 50 Bag Bólido 02 Olfatic” “[...] the open arrangement should meet participants ready to open themselves up [...]” [13] The researcher points that, from a psychoanalytical point of view, we can understand “stimulus barrier” as a defense mechanism against stimulation. Hinterwaldner [13] mentions that the understanding brought by Shelley Carson and Jordan Peterson, as an example, consider a possible connection between the personality peculiar openness to experience, or a reduced filtering of stimuli, and creativity.

Inhaling Consciousness (2020)

In its second configuration, the transobject assumes a portable arrangement – as an apparatus one can have in a backpack or bag to ‘inhale’ trees aboveground microbial populations “on the go”, addressing ecological issues from a perspective that can be seen as close to panpsychism.

For these versions of the work, the dust/particles sensor GP2Y1014AU0F was placed inside of the vapor chamber attached to the breathing mask, measuring the total dust density inside of the chamber. As in the first version of the work, the total of particles measured by the sensor includes the concentrations of 1-micron particles, 2.5-micron particles, 10-micron particles. In both versions, the information is visualized in a small LCD attached to an Arduino, bringing together the phrase “inhaling consciousness”.

The series of works places the human body, dissolved in its molecular, atomic and subatomic nature, as central to the poetics. The human body as a quantum-ruled complex and the environment’s chemo-informational inhabitants are melted, amalgamated, entangled as parts of a cross-scale biochemical choreography.



Figure 5: Inhaling Consciousness (2020) in its portable version, presented at ISEA2020 ‘Why Sentience?’ (live on Zoom). (Photo by the artist).

Inhaling Quantum-Consciousness (2021-2022)

From the microbial world and the molecular information, it embodies, we shift to an incursion in the subatomic subtleties of informational exchange referring to the dynamics of vibrational conversations that encapsulates nature’s quantum heritage. Including the bio in all that is chemical – so all is *life* – the invitation to the audience is to enjoy the presence of gentle aerosols produced by water atomization – vaporizing the water contained in twined glass bottles to which is added, for each one of the bottles, the pigments extracted from flowers of two variations of the Ipê – term that refers to seven different tree’s species within the genus *Tabebuia* [14] original of the tropical forests of Central and South

America also known as Golden and Pink Trumpet trees. As in the precedent versions, a dust sensor is attached, and the measurement (number of dispersed particles) is displayed in a small LCD together with the phrase ‘inhaling consciousness’ (Figure 6).

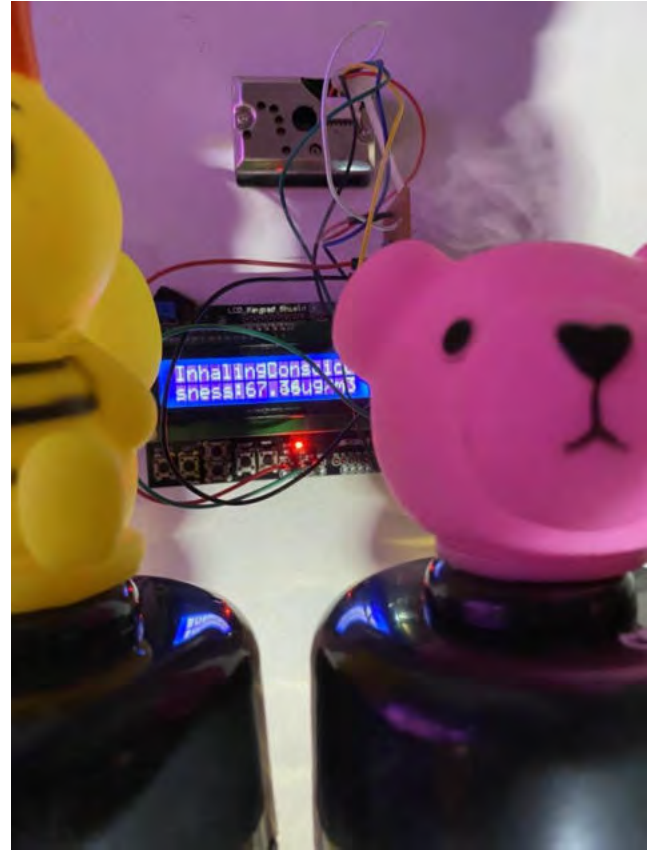


Figure 6: Inhaling Quantum-Consciousness (2021-2022) transobject from the adaptation and subversive use of tragicomic ‘Made in China’ plastic bottle with animals heads on the top through which a straw passes releasing Ipê flowers’ pigment in the vapor produced by the water atomizers attached to the bottles, (Photo by the artist).

Water atomization produces dry fog using a surface acoustic wave transducer (a piezoelectric disk) – the high frequency mechanical vibration produces a cloud of small particles of liquid. The linear mean diameter of the mist was about 5 μm measured in an experiment in which the researcher was testing an atomizer that could be suitable for miniaturization feeding very small amount of mist to control atmospheric conditions.

Ipês massive trees can reach heights of 150 feet, and its flowers became Brazil’s National Flower after the publication of Law no. 6,507, in 1978. Ipê is not an evergreen – the tree drops its leaves before producing large clusters of exuberant flowers in colors that includes [14] white, golden yellow, lavender, bright pink, and red. The name Ipê, of Tupi origin (one of the Brazilian native’s mother languages), means ‘thick bark tree’ [15]. Healing properties are attributed to the Yellow Ipe in popular Brazilian medicine considering the essence of its flowers to have revitalizing properties, balancing internal energy flows in human body.

For “Inhaling Quantum-Consciousness” (2021-2022) the choice was to have yellow and pink Ipê flowers (Figures 7 and 8) collected from trees at the University of Fortaleza’s Campus gardens, where the artist teaches, from September to October 2021 – in a moment the schools start teaching at classrooms after almost 1 year and a half following Covid-19 pandemic restrictions.



Figure 7: extracting the pigment from Yellow Ipê flowers and testing pigmenting water (image by the author).



Figure 8: extracting the pigment for Purple Ipê flowers (image by the author).

The Supremacy of the Chemical

In ‘Inhaling Quantum-Consciousness’ (2021-2022), the transobject has a direct conceptual dialogue with Hélio

Oiticica’s “B22 Glass Bólido 10 Homage to Malevich Gemini 1”, 1965 [16] (Figure 10) not only referring to the fact it reproduces its arrangement (*twinned glass bottles filled with colored liquid, one translucent pink, one translucent yellow*) but relating to the fact the ‘pure pigment’ plays a central role both in Oiticica’s poetics and is structural to ‘Inhaling Quantum-Consciousness’.

Considering the pigments used for the water pigmentation were extracted by the artist from the Ipê flowers, it is interesting to remember that natural pigments used to be the base for oil paints until the 19th century before synthetic pigments were introduced. Nowadays, a crescent community of artists choose to use natural materials as they are environmentally friendly.

Irene Small [17] [18] in an analysis that rather than subscribing to either a center-periphery flow Eurocentric discourse or to a romanticized narrative of indigenous autochthony, considers that the use of raw pigment by Hélio Oiticica and Yves Klein was conditioned by a self-conscious relationship to a history of modernist art [17][18]. She observes that Oiticica’s early works demonstrate a clear engagement with Suprematism [9], even rehearsing Malevich’s stylistic tropes in gouache paintings.

Small observes that [17] [18] Oiticica’s “B22 Bólido Vidro 10 Homage to Malevich, Gemini 1”, 1965 (Figure 10), suggests an intimate artistic dialogue with the aesthetic essence of Russian Suprematism – *twinned glass bottles filled with colored liquid, one transparent blue, one opaque yellow* [17] [18]. Meanwhile, Yves Klein framed his relationship with his avant-garde precursor in an ‘aggressive reversal’ [17] [18] – publishing in 1954 a pamphlet containing color plates supposedly representing a series of his own monochrome paintings, but which simply referred to the miniature tabs of paper themselves and, four years later, he drew a cartoon, labeled “Position of Malevich in relation to me,” depicting the Russian artist anachronistically painting a still life of one of Klein’s own monochromes.

Irene Small [17] [18] points that, when both Oiticica and Klein arrived at the use of raw pigment—Klein with the 1957 Dry Blue Pigment in a Wooden Tray [19] and Oiticica in 1963 with a nested glass sculpture titled B7 Bólido Vidro 1 (Figure 9) — they did so have full awareness of their own position in relation to the historical avant-garde [17] [18].



Figure 9: Hélio Oiticica B7 Bólido Vidro 1 (1963) [20].

In his considerations about Oiticica’s Bólidos or ‘meteors’, Ferreira Gullar points that simple contemplation is not sufficient to reveal the meaning of the works – the action

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Humans and Machines: A Study of the Impacts of the Technological Advances in the Light of Generative Art Theory

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Abstract

This paper is dedicated to the analysis of two works produced by two contemporary artists, more specifically "*Rachael is not real*" by Matthias Winckelmann and "*Machine Hallucination*", by Refik Anadol, having as convergence point the generative method of production employed in both. The article describes both works using, as theoretical foundation, the most widely accepted definition of Generative Art and reveals nuances of both works that might not be fully comprehended by the current theory. Finally, the article looks at some of the most recent technological advances and their impact on the art world, such as Artificial Intelligence, which have been used to create art, and proposes a reflection on the importance of re-visiting theoretical definitions in order for them to be able to keep up with the technical evolution of art.

Keywords

Generative Art, Generative art theory, Artificial Intelligence, Generative Methods, Artbot

Introduction

Nowadays, visual artists increasingly use technological equipment and unconventional methods that go far beyond cameras and computers to produce images. The technological revolution has expanded the knowledge and visibility of the arts to the world. Artists have found in technology a way to diversify and disseminate their art through mass media, such as TV, photography, cinema, and more recently the Internet.

However, the devices, techniques, and effects used by artists to produce and display their work are not inert. On the contrary, they are embedded with meaning, and present artists with the challenge of overcoming the technological determinism embedded in machines and devices. This is particularly true when it comes to Generative Art.

Generative Art is created when an artist cedes some degree of control to an autonomous system that creates, or is, the art itself. The various implementations of these "generative" processes produce a range of results, from works that are rigidly ordered to those that rely heavily on elements of chance and randomization.

The act of generating a piece apparently taking precedence over the final product is a defining characteristic of this art form. This precedence of process may or may not be discernible in the final work. Many of the works of Generative

Art have a very close relationship with science or technological advances that have become so popular and pervasive in our lives, such as Artificial Intelligence (AI).

Art and science have always been intrinsically linked. This creative, interdisciplinary collaboration has existed since the Western world began to distinguish reason from mysticism. Currently, several research institutions, such as Harvard, Oxford and Sorbonne Universities, Massachusetts Institute of Technology (MIT), University of California at Los Angeles (UCLA), among others, promote projects integrating art and science. The results of this connection are diverse, and have resulted in the creation of artistic works with fully scientific concepts that reach museums and contemporary art galleries with works that range from Data Visualization to the use of AI and robotics.

In this article, we will approach the contemporary art production through the spectrum of Generative Art by analyzing two current works produced by two contemporary artists, more specifically *Rachael is not real*, by Matthias Winckelmann and *Machine Hallucination*, by Refik Anadol. The point of convergence of the analysis is the generative method of production employed in both. The main objective is to contrast the two analyzed works with the theoretical background in order to identify possible points of divergence between the current artistic production and the theoretical definition dedicated to Generative Art.

Theoretical Background

The term "Generative Art" refers to art that was developed entirely or partially by an autonomous system. In this context, an autonomous system is one that is not human and can independently choose aspects of a piece of art that would otherwise demand decisions made by the artist. The human creator may claim that the generating system symbolizes his or her own artistic idea in some circumstances, and that the system takes on the role of creator in others.

Generative Art is a contemporary form of artistic expression in which not necessarily the artwork or final product is at the center, but the process of creation and the underlying ideas. The work is created by processing a procedural invention, i.e. a set of rules created by the artist or a recorded program in the form of, for example, natural language, musical language, binary code or mechanism.

Celestino Soddu [16], one of the pioneers in the that field,

states that Generative Art is not a technology, not just a computer tool, but a way of thinking a possible world, a way of bringing your own creativity to life. According to Soddu, Generative Art constructs possible worlds by creating evolutionary rules that produce events that, if on the one hand are unpredictable and surprising, on the other hand they mirror the identity and the ability to recognize the idea, they are the natural representation of it.

The term “Generative Art” can be seen simply as a reference to the way the art is produced, making no claims about why the art is being produced that way, or even about its content. Generative Art is dissociated from any specific technology, and can be highly complex or not. It is emphasized, therefore, that a system that moves an art practice into the field of Generative Art must be well defined and complete enough to operate autonomously [16].

In the most widely cited theory of Generative Art, Philip Galanter [8] describes generative art systems in the context of complexity theory. In particular, Murray Gell-Mann and Seth Lloyd’s [9] notion of effective complexity is cited. In this view, highly ordered generative art minimizes entropy and allows maximum data compression, and highly disordered generative art maximizes entropy and does not allow significant data compression. Generative Art, in complex terms, combines order and disorder in a manner similar to biological life, and in fact, biologically inspired methods are most often used to create complex Generative Art.

Another effort to understand Generative Art was undertaken by Abraham Moles [14], for whom complexity in art increases with disorder, while its value also increases. The book *Information Theory and Aesthetic Perception* is, as its title suggests, an attempt to apply information theory to the analysis of aesthetic perception, using concepts familiar from communication theory as well as from the psychology of perception. According to Moles the human receiver does not always prefer massive amounts of information. If a greater degree of information (of difference) signifies a possibility of change, a greater degree of intelligibility (of similarity) may promote continuity and safety. It is in this sense that information appears, in Moles, associated with a notion of value. Following this line of thought, one can see that the intelligible is less complex and, therefore, more banal. As the etymology of the word, *interligere*, reminds us, to be intelligible means to establish the maximum number of possible connections. It is, therefore, about the most ordinary or, as Moles assures us, generally speaking, intelligibility varies inversely as information does [14].

Case Studies

Rachael is not real by Matthias Winckelmann

According to Matthias Winckelmann “*Rachael is the world’s first fully automated autonomous 3D design Influencer on Instagram*”¹. *Rachael* is a real time software, or rather a bot, designed by media designer and artist Winckelmann. Since May 2020 this bot has been creating 3D renderings every day and automatically posting these images on the Instagram

¹<https://www.mwinckelmann.com/rachaelisnotreal>

account @rachaellic. *Rachael* is designed to create attractive randomly generated images with the goal of gaining as many followers as possible. With *Rachael*, Winckelmann deconstructs the mechanisms behind social platforms like Instagram and critically examines the consumption of contemporary images on such fast-paced social media platforms.



Figure 1: 3D rendering from the art project *Rachael is not real*. The bot *Rachael* generates an image and publishes on Instagram everyday, based on randomization of various design parameters. © Matthias Winckelmann.

From a technical standpoint, *Rachael* is relatively simple: a series of scripts (algorithms) that automate tasks. The images are generated based on rules pre-established by the artist and the results, although random, follow an aesthetic pattern rigorously defined by the creator. There is no curation or selection of results, nor use of machine learning and AI [7], but there is the use of algorithms in the creation of the system that generates and publishes images [20].

Machine Hallucination by Refik Anadol

Machine Hallucination is a multimedia installation using the largest set of raw data ever assembled for a single work of art, resulting in a cinematic experience derived from representations of urban memories re-imagined by AI [1]. The experience, lasting approximately 30 minutes, was generated using machine learning algorithms trained on over 100 million public domain images and broadcast recordings of the actual sounds of New York City available on social media. The images and sounds are treated by the artist as collective memories and hidden layers of history seen from different perspectives. The final product suggests a mirrored dialogue between the city of the future and the present, performed in the format of a high-tech immersive message, thus pointing the way to an imaginary near future when machine intelligence could

expand the urban inhabitant's ability to dream. The work, an immersive three-dimensional screening projected onto the walls, floors and ceilings of a gallery connotes both night-clubs and nightmares.



Figure 2: *Machine Hallucination*, exhibited at Artechouse NYC in 20218. © Refik Anadol.

Refik Anadol used several algorithms for this project. The main one is called StyleGAN [11], an innovative adversarial network introduced by researchers at graphics processing unit company Nvidia in December 2018 and made public in February 2019. Visitors became participants in the narrative, taking a step into the story rather than simply observing it on the walls, allowing them to intuitively understand the ways in which memory can be experienced spatially. Anadol's work therefore orbits at the threshold of the normally separate domains of architecture, film, and performance art.

Both works in the light of Generative Art theory

Although both works selected for analysis are quite different, there are a series of details that narrow the relationship between them. These details, if analyzed through the spectrum of the most widely accepted theory about Generative Art, aims to answer the research question that guides this article: considering the theoretical definitions about Generative Art and given the similarity of the processes employed in both works analyzed, how can both be classified according to the theory that approaches Generative Art?

So, we will start by observing the similarities between both works from the point of view of their production and not necessarily of their results, especially if we consider that, in Generative Art, the process seems to have as much or more relevance than the result.

The most obvious relationship between the two works focuses on the use of technology to produce art. Although the vast majority of contemporary art production involves the adoption of technology during production or even as an integral part of the final result or performance, the use of technology in art production is not and has never been an absolute and unquestioned demand when it comes to Generative Art. Galanter notes that given the use of visual symmetry, pattern and repetition by the oldest known cultures, Generative Art is as old as the very notion of art as we conceive it [8].

Although Winckelmann and Anadol make exhaustive use of different types of technology and seek to break new fron-

tiers in their respective fields, both go beyond technology by raising questions and proposing discussions. This is another characteristic that brings them both together. Winckelmann defines *Rachael Lery* as the world's first autonomous 3D design Influencer. As if this definition was not strange enough, the artist goes further by stating that he made a point of not revealing publicly that *Rachael* was in fact a bot who published visually appealing works on a daily basis. This, in turn, never stopped thousands of people from following Rachael's profile and liking her daily posts. For Winckelmann, what is at discussion is precisely the dichotomy between creation and value. More specifically, what constitutes creative value?

The reflection proposed by the artist is not only valid, but current and important, especially for the means of consumption adopted by the artist and that, by the way, is an integral part of the work: the social media. More specifically, Instagram, a type of social media designed for immediate and rapid consumption of images, something already preconceived decades ago by Susan Sontag in her seminal book "On Photography" [17]. Sontag stated that "today everything exists to end in a photograph" and one of the most tangible materializations of this statement is precisely Instagram. The artist's provocation refers not only to the impulse to "enjoy" images without any appeal or depth, but also and above all the act that the very space where the work is displayed and consumed compels people to do so in an almost mechanical way. The images, in turn, have an aesthetic structure that, according to the artist, represent visual languages popular on the platform [20].

Refik Anadol, on the other hand, proposes a series of reflections on the potential and limits of technologies such as AI. The artist creates an art form that uses data as a primary element and sculpts it to form a sequence of fluid and hypnotic images exploring the concept of hallucination, memory, and the tension between humans and machines. Complex images, with deep and personal meaning, grouped, overlaid and presented almost inseparably from one another, as in a kind of pointillism ruled by AI. The question that orbits the artist's work and more specifically *Machine Hallucination* is: if machines can learn, then can they dream or hallucinate? Anyone with the slightest knowledge of how AI works knows that the answer to both questions is categorically and simply: no. Anadol knows this too, but still there is a tendency, even if speculative, that machines can actually create an output that looks like a dream or a hallucination based on memories that we give it.

For Anadol, there is a remarkable similarity in how humans operate. Human experiences and memories are a form of input, while dreams and hallucinations can be understood as outputs. Starting from this concept, the artist builds intricate sequences of images, sometimes recognizable, sometimes absolutely surreal, of public spaces having as input, collective memories (i.e. photos, videos, sounds) and as output, the result of the application of machine learning algorithms. Here there is a clear contradiction between what is real and unreal, or hallucination, what is physical and what is virtual. This virtual space, this hallucination created by the machine, can be appreciated, although not often understood by the audience. The virtual transforms the fragments created by the human

imagination into a constructed universe, potentially unlimited, but restricted to the set of human perceptions at a given moment in time. The same effect is perceived if we compare a work of art, or photography, to cinema, which amplifies, in the connection of senses and emotions, the universe imagined by the receiver of the message. At this point, Anadol's work gives the viewer a synaesthetic experience by combining cinema, painting, and architecture in an absolutely innovative and immersive way. However, when we take a closer look at the work and its generative production process, some details help us understand the role of the technologies applied in its production. On his website, Anadol reveals a little about how each algorithm was applied without giving more details about what exactly each one does, although it is clear that there are a series of them performing very distinct functions such as capturing images from the internet, grouping images, generating new images from parts of existing images, etc. The most remarkable thing is not exactly the technology employed, which is open source and was not developed by the artist, but his mechanistic definition of dreams or hallucinations: data enters, memories are formed, dreams come out. Perhaps the choice for extreme simplification reflects a technical limitation in reproducing dreams (or hallucinations), something still impossible for machines. However, the detail to notice is the abundance of preexisting rules to operate the algorithms, most of them requiring a massive amount of data for previous training, which denotes some degree of control by the artist.

This brings us to another similarity between both works: the definition of rules defined by the artist, even if the system itself has autonomy to generate results. According to Galanter [8], rule-based art is not necessarily synonymous of Generative Art, as for example, the case of an artwork generated from the imposition of restriction rules that prevent the use of certain colors or shapes. According to the author, this kind of art is not generative because the restriction rules are not constructive. That is, by themselves they do not state what should be done, only what cannot be done. Here the theory postulated by Galanter creates rules, but also exceptions that can make such a view limiting when it comes to understanding current art production, even if such postulates are still able to cover much of the current Generative Art production.

In Winckelmann's case, at a first glance, there seems to be no restrictive rules or anything that speaks against the generative nature of the work. What happens is exactly the opposite. There is a system (algorithm) that automates the task of generating and publishing the images, which in turn are generated based on pre-established rules. These rules do not seem to be limiting, given the randomness and diversity of the results, which follow an aesthetic pattern rigorously defined by the creator. There is no curatorship or selection of results, but there is a hegemony in the compositions, which although random, follow a pattern that respects rules such as limits, grids, colors, lighting and symmetry. If we consider that the artist's intervention in a first moment demanded the establishment of design and composition rules, and these rules are not clear to anyone outside the artist's production circle, we can suspect that the process is not generative if we consider Galanter's theory, even if there are several elements advocated by the

author. To get an idea of how complex and blurry is the line between Generative Art and other art forms, Galanter cites the case of Jackson Pollock, whose best known works are apparently random. According to Galanter, due to the lack of introduction of means outside himself, these works cannot be considered generative. No movement made by the artist to create his works can be truly generative, although it has been proven that the artist's paint marks are fractal in nature due to Pollock's in-depth learning [19]. In this way, the result of the work is premeditated and calculated rather than randomly generated. At this point it can be said that Winckelmann's work is indeed generative, as it employs various randomization techniques, tracking methods to evaluate surface areas, and general probabilities of spawning. Due to its algorithmic nature, Rachael is able to generate an infinite number of images, each with a unique combination of shapes and colors based not only on rules of design and composition, but also on weighted randomization of different parameters that regulate the generation of the images.

An example that helps to clearly understand a generative work is the sequence of paintings by Harold Cohen [18], materialized through AARON, an AI painter created in 1973 by the artist, coded in a software that autonomously develops several paintings [5]. The result are prints with real fabric paints (instead of pixels), in which the artist "teaches" the machine to mix colors and compositions by providing it with imagination (input) that allowed it to paint human figures or still lifes without any visual references or human intervention. The autonomy of the system makes clear the main characteristic of Generative Art, although there are rules and, in this case, "learning" of the machine.

AARON is very reminiscent of Winckelmann's *Rachael* in that it is a machine that creates, but it is also reminiscent of Anadol's work in that it is a machine that learns to create. The use of AI as a dominant part of its construction is not just a detail, but a fundamental part to be observed.

Combining AI and art may sound like the ultimate embodiment of futurism. Having machines producing art was most likely the dream of many technology enthusiasts centuries ago, and right now, part of this dream is materializing. In fact, science fiction has been so far ahead of the actual evolution that concepts such as post-digital art may already seem a bit dated. Given its penetration in the arts and its impact, one can consider AI from two perspectives: one is how it serves as a tool to enhance art that extends to algorithms, being able to create art objects autonomously, and the other, how artists contemplate and choose to represent a society where AI will dominate more and more venues, both for the better and for the worse of society.

With *Machine Hallucinations* Anadol seems to try to propose both discussions at once. Anadol takes as a starting point the concept of a type of shared intelligence that arises from the collaboration of many individuals in their diversity, originated by the habit of registering and sharing experiences, a concept known as Collective Intelligence [13], and by the way, much older than any form of technology. This intelligence is distributed everywhere, in which all the knowledge is in humanity and raised to another level with the use, by the artist, of AI. The fundamental concept behind Collective In-

telligence can be summed up by the maxim that no one knows everything, but everyone knows something. Anadol's work goes beyond and seems to propose a new dimension to this Collective Intelligence, adding to the universe of data that feeds the experiment a kind of cognitive cartography, with new experiences generated not only by people, but also by algorithms.

These algorithms reconstruct urban memories using different perspectives from individual points of view, but also reimagine and build new images from previous knowledge, just as humans do when acquiring new experiences from the experiences of others. The use of various algorithms in the construction of the system and how the final experience is generated are evidence of some of the main characteristics advocated by Generative Art. In the case of *Machine Hallucinations*, there is not only the use of machine learning techniques for the selection, filtering and clustering of images, but also the generation of new images from the data, used here as raw material for the construction of landscapes that sometimes remind real places, sometimes take the audience to diatopic worlds. The use of algorithms by itself does not determine that the art is, in fact, generative. That is why it is important to take a step back and try to understand how the literature understands the use of several more recent techniques of artistic production and if, in fact, such techniques that propose to generate art can in fact be comprehended by the current theoretical framework.

There is a neuralgic point in the theory that deals with Generative Art and refers to the digital art, more specifically the use of computers. Margaret Boden and Ernest Edmonds [2] agree that generative art need not be restricted to art made using computers, and that some rule-based art is not generative. They have gone further and proposed a technical vocabulary that includes Ele-art (electronic art), C-art (computer art), D-art (digital art), CA-art (computer-aided art), G-art (generative art), CG-art (computer-based generative art), Evo-art (evolution-based art), R-art (robotic art), I-art (interactive art), CI-art (computer-based digital art), and VR-art (virtual reality art).

The problem with such definitions is precisely the attempt to distinguish artistic production based solely and exclusively upon technology, that is, the medium or support, and not necessarily upon the process of artistic production, which, by the way, takes precedence over the result, medium or support [8]. And none of them seems to be good enough to fully describe the works of Matthias Winckelmann and Refik Anadol, not only because they are works that blur the boundaries between man and machine, but also because they have characteristics where sometimes the artist and sometimes the machine play roles at different levels and intensity. Another problem with this approach lies in the inexorable fact that technologies were made to be overcome and will fatally become obsolete, as will the definitions that are based on such technologies.

Conclusion

Since Marcel Duchamp's claim that a porcelain urinal is a work of art a century ago, the definition of art has become elusive to the point that anything, and consequently nothing,

can be considered art. What does it mean when a data scientist develops an algorithm that allegedly creates art? How can we even judge something that we cannot effectively define? It is becoming increasingly difficult to avoid the question that most people realize can have a hugely painful answer: what does humanity entail and to what extent is it replaceable? What does it mean to be human now? Is the technology capable of replacing humans when it comes to creating art in the same way that it already replaces manual labor?

As uncomfortable as these questions may seem, they need to be asked, and this is the ideal moment to do so given the technical development before us that seems to make clear the need for a re-thinking of our artistic order and classification. Aesthetic rules can be codified rigidly, helping us to decide what art is and how to classify it, which is something our predecessors were already able to clearly articulate, but they cannot be immutable, especially if we consider the technical advances and their impacts on artistic production.

The reason for the urgency in revising theoretical definitions can be explained by impressive examples, such as *Edmond de Belamy*, a rather dark portrait of a man painted in a blurred style. The work is part of a set of generative images called *La Famille de Belamy*, developed by the art collective *Obvious*, which was the first artificial painting created by the AI that sold on the Christie's auction house in 2018 for USD 432,500 [3]. In another impressive example *Beeple*, artistic name of Mike Winkelmann, has achieved an incredible accomplishment: in two months he has achieved the status of the third most expensive artist, second only to big stars such as Jaspers Johns, Gerhard Richter, Damien Hirst and Jeff Koons, after having sold at Christie's auction house a set of 5,000 images for USD 69,346,250.00. The sum represents the third highest amount ever paid for a work of art by a living artist [12].

The fundamental difference between Mike Winkelmann, Matthias Winckelmann and Refik Anadol lies in the fact that the work of the first has nothing at all generative about it, but the body of work is not something that needs no analysis or should be ignored. A Times critic accuses the artist of "violently eradicating human values" and of "childish amusement". To defend him, Noah Davis, a Christie's expert, has put his reputation on the line by comparing him to the Duchamp readymades [4].

Anyone minimally familiar with Duchamp's work will know that the comparison seems rushed and difficult to understand. If we examine the procedures, we find no features that could support any proximity between *Beeple's* collage and the readymades. When Duchamp created the readymades, he did so in the condition of a recognized artist, who participated and knew deeply the art system, contributing to the main debates and art movements of his time. *Beeple*, on the other hand, is a newcomer in the art world, who undoubtedly performed a remarkable achievement by reaching the top in just two months, participating in an event led by the art market - and the new financial context - promoted by cryptocurrencies.

Analyzing the procedural and aesthetic side, there is no possible comparison between both. The aesthetic neutrality in the choice of the pieces that compose the readymades, as well as the absence of manufacturing by the artist, are the

main rules conceived by the French artist. The distance between the readymades and any of the images from the work *Everydays: The First 5000 Days* lies precisely in the fact that, to exist, the first implies the appropriation of an industrial object, while each of the pieces that make up Beeple's assemblage is a virtuoso image, carefully crafted by the artist's hand. The presumably kitsch aesthetic that guides Beeple's work sharply contrasts with the aesthetic indifference in the choice of the pieces that make up the readymades. The confusion in the classification of the artwork is something that, once again, reinforces the need for a better classification and interpretation of what we are producing in terms of art at this time.

However, even if Beeple does not produce Generative Art and seems, therefore, out of the scope of analysis of this paper, it is important to analyze what is behind his remarkable achievement. The project, at first sight without major consequences, of making a drawing every day, and posting it every day on Instagram reveals, above all, the desire for dissemination and recognition, therefore, a communication strategy of Winkelmann. His success and recognition are absolutely undeniable, given that it is necessary to communicate well to justify the more than 2 million followers on his profile. Deleuze, in a lecture about cinema, states that "art has nothing to do with communication". On the other hand, he says, "there is a fundamental affinity between the work of art and the act of resistance" [6].

One can observe that from the moment the 5,000 thousand images were gathered in a single file, forming, by juxtaposition, an irregular grid, a new concept, unnoticed until then, becomes evident in Beeple's project: time. Deleuze states that what is embedded, in the creative activity, is the constitution of space-times. Beeple has shown incredible obstinacy in keeping alive a project in progress, day after day, for more than fourteen years.

On Instagram, the images cause impact, but the distraction that social media provokes due to its superficial nature and ephemeral interactions, end up covering up an important detail: the time and effort of the human behind the project. Both Mark Winkelmann and Matthias Winkelmann use social media, but their processes, although different, result in basically the same type of outcome, which ultimately has its intensity or effectiveness reduced to mere "likes". However, art is more than patterns created to capture and awaken the interest of a potential audience, and in this aspect, the works of the two artists analyzed in this paper are close. Both Matthias Winkelmann and Refik Anadol use patterns and automatization, which can result in images without any connotation or depth of content. Often the overlapping of elements and the speed with which these elements are repeated eliminates any possibility of comprehension or absorption by the audience.

The question that should really be asked has little to do with any process or technology. After all, what should most interest those who study contemporary art is precisely how relevant is the work created by a machine? What would be the perception of humans about what the machine is capable of creating and would the art created by a machine be more relevant than the art created by humans?

Some studies help to understand a little about people's per-

ception of art and the artistic value of works created by machines and humans. Hong and Curran [10] published a study in which they subjected participants (n = 288) to two types of artworks created by AI and by humans. After viewing images of six works of art, participants were asked to rate their artistic value using a scale commonly employed among art professionals. The study concluded that artworks created by humans and AI were not considered equivalent in their artistic value. In another study, Ragot et al. [15] present an experiment with 565 participants invited to evaluate paintings that were created by humans or AI and rate them on four dimensions: liking, perceived beauty, novelty, and meaning. The paintings perceived to be created by humans are rated significantly higher than those perceived to be made by AI.

What both studies show is that the perception of value when comparing something created by a machine or by humans differs radically, and at the same time, even with all the technical advances we are experiencing, reveals that the artist has not only responsibility, but also recognition of his importance and, consequently, relevance of his work.

Technological development is a perpetual evolution since the invention of the wheel and is designed to go on forever. Most, if not all, art forms include aspects of technology and always have, since art and technology have something in common: the need to renovate, to discover limits and overcome them. However, the role of the artist should be to control technology, not the other way around, since technology should remain an extension of us.

But one thing is already clear: AI will permanently change the way we create, curate, absorb and mediate art, and will certainly permeate the philosophical discussion about what and who really is the creator.

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autonomX—Real Time Creation/Composition with Complex Systems

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Abstract

This paper presents the software autonomX that is designed for intuitive artistic creation with complex dynamical systems. After a discussion on artistic and technical precedents, the paper demonstrates how autonomX responds to the necessities of artists thanks to an original framework of signals, generators, and drawing. An overview of the software is given. Finally, we discuss case studies of artistic practice with complex systems that led to the development autonomX and the experience of workshop participants discovering the software for the first time.

Keywords

Complex systems, machine agency, software instrument, artificial life, cellular automata, neural networks, temporal dynamics, lighting design.

Introduction

autonomX is an “open-source desktop application [that] allows multimedia artists and students to easily and quickly experiment with lifelike processes via a graphical interface in order to generate dynamic, emergent and self-organizing patterns and output these patterns via OSC to control light, sound, video, or even robots in real time” [1].

The article begins by presenting the background that motivated the production of autonomX. In particular, we describe some histories of artistic and lighting practice involving stochastic systems and the role of vitality in the time-based arts.

We follow with the presentation of the three core design paradigms of autonomX: *generator*, *signal*, and *drawing*. The *generators* are the algorithmic encapsulation of complex dynamical systems (systems that model the temporal evolution of a deterministic set of parameters) in a format that gives rapid and intuitive access to their parameters, without resorting to coding, and visualizes the inner workings of these algorithms on a 2-dimensional lattice. The generators send and receive time varying *signals*

from the implemented algorithms in real time, making the system appropriate for temporal expression and interaction with any computer-driven media. The manipulation of signals is made intuitive to the user by *drawing* directly on the visualization lattice so that they can easily specify which parts of the system serve as signal inputs and outputs.

The article then gives an overview presentation of the current version of the software by discussing the main elements of its interface.

Finally, we offer a discussion on concrete artistic creations with complex systems that led to the development of autonomX and on the results of an online workshop held during ISEA 2020 in which participants discovered the first prototype of the software.

Background

The background of the project derives from a three-year research project called “Dynamic Light,” funded by the Fonds de Recherche du Québec Société et Culture (FRQSC). The goal of the Dynamic Light Project is to think about light and lighting design like we think about music: as the composition of complex and dynamic patterns, rhythms, phrases, and gestures that take place over time. The project is inspired by the work of the 20th century Greek-French composer Iannis Xenakis who argued in the 1960s that due to new technologies “We understand that a new art of light is at our doorsteps, one that is not painting, nor frescos, nor theater, nor ballet, nor opera” because “light occupies time, for its effect depends on rhythm and duration while music shapes space.” [2]

Despite Xenakis’s proposal, the history of lighting design since the introduction of gas and later, electrical lighting into the theater at the end of the 19th century, has been seen to “tremendously modify the perception of space” [3]. Theater artists like Adolph Appia and Gordon Craig who were seen as the first “lighting designers” working with new technologies like electric lighting focused predominantly on

the manner in which light could emphasize “the plasticity of the performers and their space” (Appia). Later, theater lighting designers such as David Belasco focused on light as images, in particular, how to use different lighting instruments to create spatial atmospheres that evoked specific dramatic moods. This tradition of light seen as sculptural and plastic is one that has carried into the work of theater scenographers such as Josef Svoboda (what he termed “psychoplastic space”) and Robert Wilson in the later 20th century.

At the same time, despite the rapid development of new hardware technologies (LEDs, computer controlled moving heads and lighting consoles) and networking protocols that incorporate real time sensor data (ARTNET, ACN), the conceptual-technical paradigm of lighting control in the performing arts is still situated in the 1950-60s: a lighting desk, a series of dimmers which control a series of individual instruments and a “cue-based” system of fixed instruments that are organized by a set of cues that follow dramatic action on stage. Lighting desks, while increasingly sophisticated in terms of microprocessor control and storage, are still principally based on these cue control/scene paradigms and few (if any) allow real-time input (or influence) from data derived from the exterior world. Moreover, the programming of sophisticated temporal behaviors is restricted to standard cookie-cutter tricks such as “chasing” (sequencing of one light after the other in a series), bumping (flashing) or similar. Indeed, despite the rapid evolution of LEDs which produce a “time response” that is closer to human visual perception than any previous lighting instrument, it is nearly impossible to expressively compose with light in and over time with existing tools and current control technologies.

The development of the autonomX software is thus guided by two principles: (1) the fact that dynamics—the production of shifting, temporal changing rhythms, motions and gestures—creates strong emotional “vitality affects,” (Stern) that indicate the manifestation of being alive and (2) new technological advances in hardware (LEDs, sensors) and computational paradigms from machine learning and simulation-based complex systems introduce new possibilities of working with time as a material in lighting design or media composition, in general.

Conceptually, autonomX is guided by the need to produce what psychiatrist Daniel Stern called “time profiles” or “temporal contours” without the need to explicitly produce such behaviors. Stern, an American psychiatrist based in Switzerland till the end of his life, had focused on what he called dynamic subjective experience and vitality, as it was revealed in psychotherapy and the arts. As Stern argued, the “time-based arts, namely music, dance, theater and cinema move us by the expressions of vitality that resonate in us” [4]. At the same time, such “vitality affects” are not only reserved for humans. The dynamic flows of time in objects and processes like light, sound, and vibration outside of us also sweep us up into dynamic moments of intensity.

Another conceptual underpinning to the autonomX software is Simon Penny’s argument that an “aesthetic of

behavior” marks the difference between contemporary artworks that can respond dynamically to their environment versus traditional static forms that remain fixed in time. Such an aesthetic emerges from the “possibility of cultural interaction with machine systems” [5]. Penny’s argument applied to light directly challenges the mainly object-based, static histories of what has been called “light art” [6] in the visual arts. Artists such as James Turrell, Robert Irwin, Maria Nordman, Doug Wheeler, Dan Flavin, Otto Piene and more recently, Rosalie (aka Gudrun Müller) and Olafur Eliasson (among others) have mainly focused on the spatial or volumetric dynamics of light—what Turrell called “sensing space.” While time did enter light art through the work of Thomas Wilfried, Moholy-Nagy and later Nicolas Schoffer, Heinz Mack, Otto Piene and the ZERO group as well as collectives such as Gruppo T [7,8], the vast majority of this work was linked to either early 20th century cinema or kinetic sculpture which embedded light into and as an object but didn’t focus on complex temporal patterns within the lighting fixture or environment itself. At the same time, as Penny references the histories of the media arts, while new technologies from computer science such as Alife, agent-based control and more limited machine learning have historically been used in artistic works involving robotics and machines (Kac), or computer-generated animations on screens (Ray, Sims, OpenEndedGroup, Memo Akten) these techniques are just being recently deployed in lighting design.

autonomX Framework

autonomX emerges from the “Dynamic Light” research project to propose a practical tool enabling artists, students, and researchers to experiment with the temporal dimension of cutting-edge scientific computational processes from areas such as Artificial Life and machine learning, and to use these processes to express their “vitality” through light and, more generally, any computationally controlled media. As the “Dynamic Light” project engages with both academic research and concrete artistic production, autonomX materializes the theoretical and practical knowledge developed during the research project in the form of an open source desktop application.

autonomX is guided by the fact that temporal dynamics create strong “vitality affects” to be experienced sensibly [3], and that new technological advances in computational paradigms, in particular Artificial Life and machine learning, introduce new ways of working with time, in lighting as well as other media.

The computational techniques that autonomX is concerned with are part of the family of complex systems. That is to say, temporally dynamic systems composed of large arrays of interacting elements that generate emergent global behaviors out of local interactions. Such systems which are found in a wide variety of natural and physical phenomena, from the motion of celestial bodies, the division of cells, the firing of biological neurons, or the growth of human and animal populations, possess autonomous, self-

organizing, and emergent properties that generate behaviors that are sometimes impossible to predict from the understanding of the initial state of the system. In programming terms, the behaviors expressed by such complex systems escape their reduction to code and ask us to develop new methodologies and instruments responding to the challenge posed by computation systems that escape human prediction and understanding.

To this end, autonomX aims at fostering an approach to complex systems—rooted in experimentation and observation by providing an intuitive and stable software instrument that (1) encourages the manipulation of parameters and expression of temporal dynamics in different media—as opposed to spending time writing, compiling, and debugging code—, and (2) is adapted to the constraints of artistic production—that includes a seamless integration with other software, run-time stability, and simplicity of manipulation.

autonomX proposes an original framework of *generators*, *signals*, and *drawing*. This framework is directly inspired from well-established media practices, in particular those of sound and video synthesis, with the aim to maintain a form of familiarity and to simplify the entry in the world of complex systems.

Generators

The core of autonomX consists in its *generators*, “a grid-based wrapper for an AI and/or Alife algorithm” [9]. Those generators are defined by the different algorithms they encapsulate; as of release 1.0, a Spiking Neural Network, Wolfram Cellular Automata, and John Conway’s Game of Life. The generators provide a 2-dimension visualization of the algorithm, give access to its parameters, and process the input and output signals that enable the communication between the algorithm and other multimedia software.

The *generators* are inspired from sound and video synthesis practices in which modules such as oscillators, filters, and time-based sequencers can be manipulated intuitively thanks to carefully designed expressive parameters. Similarly, autonomX’s generators enable the manipulation of specific parameters relevant to the temporal behavior of the algorithms. This choice of design aims at freeing the user from programming considerations to instead focus on the expressive qualities of the algorithmic material.

Signals

autonomX frames lifelike computer processes around the concept of *signals*, that is to say time varying information that is extracted from and fed back into the algorithms.

The processes autonomX is designed for are complex dynamical systems, which are temporally evolving systems which consist of large arrays of interacting elements that generate global, sometimes unpredictable behaviors out of local interaction. Despite a history of musical composition with dynamic, complex, and chaotic systems that express their temporal dynamics through sound synthesis [10], most artistic applications focus on the rendering of aesthetic visualizations of such systems [11]. More recently, the *Wekinator* software proposed an approach to live artistic performance using neural networks by placing machine learning processes within a framework focused on intuitive training and easy communication with other software through standard Open Sound Control (OSC) protocols [12].

autonomX’s *signal* paradigm moves away from the visualization of the system at the global scale, frequently in the form of 2D or 3D visualization software, and toward a paradigm of time varying signals sampled from and fed into different parts the system, from the local activity of a single element to the mean global activity of the system and everything in between. These signals can then communicate with other software through the OSC protocol.

By preferring an artistic framework of time varying signals inspired from computer music contexts, autonomX is particularly suited for exploring real-time interactions with performers, public, and environments, and for the expression of temporal dynamics within multimodal media environments.

Drawing

The generation and distribution of signals from and to the generators is made intuitive thanks to a principle of *drawing*, which involves the manual drawing of rectangular shapes over the visualization lattice in order to specify the cells that will be sampled and stimulated.

Since complex systems consist of large arrays of interconnected elements that possess self-organizing and emergent properties, their visualization on a 2-dimension lattice aims to display the relations between local interactions and global activity that are characteristic of such systems. The principle of *drawing* that is core to the manipulation of autonomX enables users to intuitively experiment with the various scales of complex systems, from local to global activities. By drawing the regions of the system that sample output signals and the ones that receive input signals, they can creatively interact with the emergent properties of the algorithms.

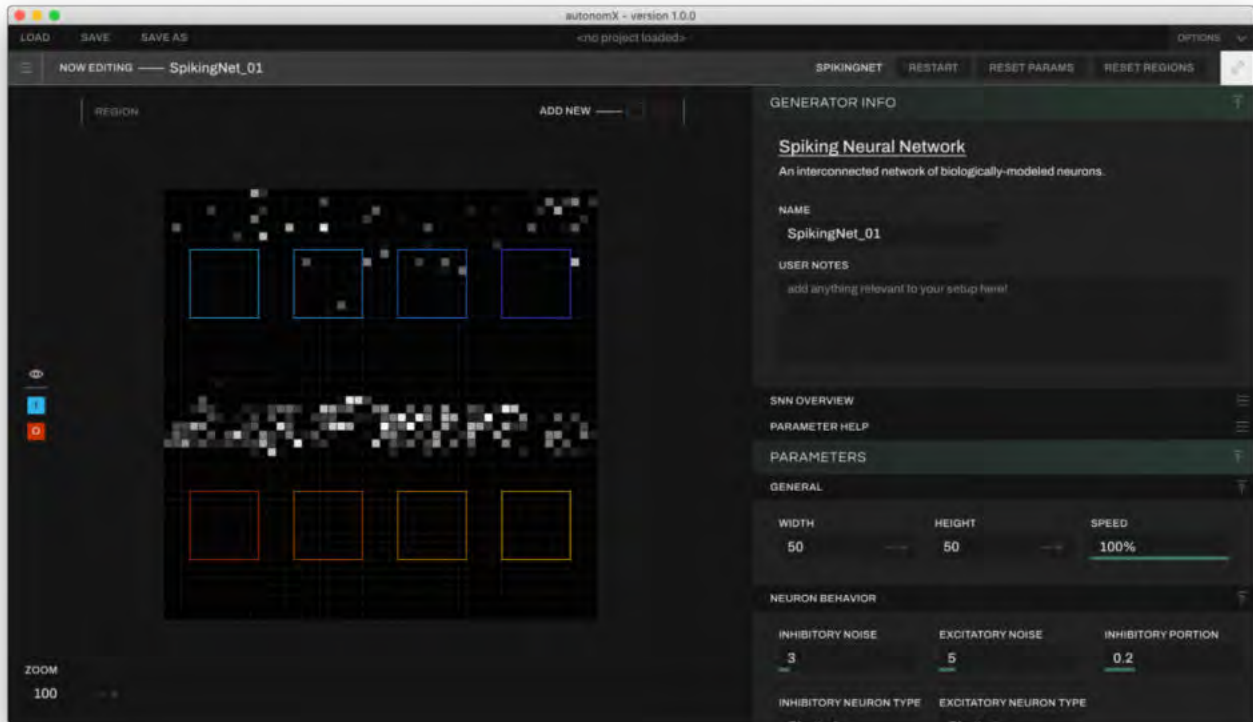


Figure 1. autonomX’s interface. The generator currently selected is a Spiking Neural Network. The different parameters of the generator are visible in the right side’s *generator info* column.

Software Description

The following section describes the functioning of autonomX through an overview of its interface and main functions. We describe how the generator, signal, and drawing concepts of the software are concretely implemented and accessible to the user. The following description focuses on the framework of the software and does not describe the individual algorithms encapsulated in the generators¹.

Interface

autonomX’s interface (Figure 1) centers around a 2-dimension visualization lattice that displays the real-time activity of the generators.

To the left, a collapsible panel gives access to the list of generators currently running in the software (Figure 2). An *add* and *delete* button allows users to freely add generators and choose their type, or delete existing ones.

To the right, a panel gives access to the parameters of the generator currently selected. While some parameters are common to every generator, the majority are specific to each generator (that is, algorithm) type.

Finally, at the top of the software, a horizontal menu gives access to the save and load functions as well as the parameters of the OSC engine of autonomX.

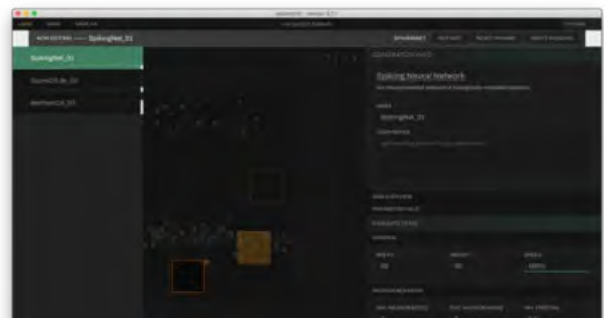


Figure 2. autonomX’s left side collapsible panel serves to add and delete generators.

¹ The source code of autonomX, alongside its documentation and guideline for the implementation of new algorithms, can be found on lab Xmodal’s github: <https://github.com/Xmodal>.

Generator Parameters

The right-side column, *generator info*, of the software is dedicated to the different parameters of the generators. They consist of two kinds of parameters: *general* ones that correspond to attributes common to all generators, and *specific* ones that correspond to the specific algorithm implemented in the generator.

The *general* parameters consist in the *height* and *width* of the 2-dimension rendering lattice and the *speed* at which the generator runs. Three *restart*, *reset parameters*, and *reset regions* functions are also present. Those parameters and functions are present for every generator.

All other parameters are specific to each generator type and vary depending on the algorithm they implement. For example, they can control the *pattern type* of Conway's Game of Life (Figure 3), or the *neuron type* and *inhibitory portion* of a Spiking Neural Network (Figure 1).

The different parameters allow users to interact in real time with the algorithms without having to intervene in their code.



Figure 3. autonomX running a Conway's Game of Life generator.

Lattice Visualization

The 2-dimension lattice that occupies most of autonomX's interface real estate serves a dual purpose.

First, the lattice displays the activity of the generator's algorithm in real time. The dimension of the lattice is controlled by the *height* and *width* parameters and is specific to each running generator.

Second, the lattice serves as the background on which the input and output regions can be drawn. The direct superposition of the input and output regions on the visualization lattice allows the user to intuitively configure how the input and output signals relate to the algorithms.

Input and Output

The input and output regions consist of colored rectangles, blue for the inputs and orange for the outputs, that can be added, deleted, moved, and resized at will by the user (Figure 4).

The output signals are sampled out of the lattice cells situated inside the orange output regions. Each sampled region generates a unidimensional stream of float numbers that corresponds to the mean average activity of all the cells present in the region. The user can sample any part of the system by choosing the size and position of each region, from the activity of a single element to the local activity of a few cells or the global activity of the whole system.

Each input region receives a signal consisting of a unidimensional stream of float numbers that it distributes to the cells it covers. By default, the signal received is uniformly added to the current values of all the cells.

The default behavior of the input and output can be rewritten in the implementation of a generator so that a more appropriate or original adaptation of the signal framework can be proposed by a contributing programmer.

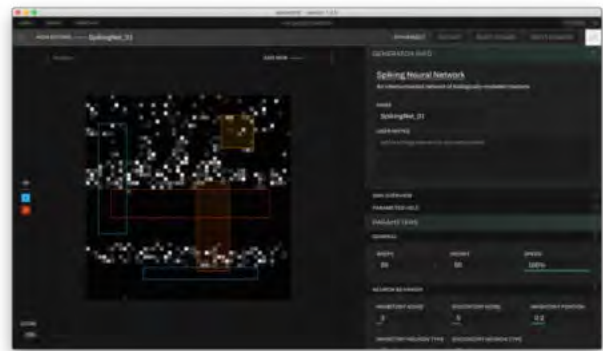


Figure 4. Multiple input and output regions of different size and location arranged by a user over a Spiking Neural Network generator.

OSC

Each input, output, and parameter of the generators can communicate and be controlled through the Open Sound Control (OSC) protocol [13]. This choice was made to allow a flexible integration of autonomX within a range of multimedia software environments (Processing, Open Frameworks, Touch Designer, Max/MSP) used by artists, designers and those working in the area of creative computing.

The OSC signature mirrors the software interface in a consistent fashion and all signals are normalized so that autonomX can run as a stand-alone application and communicate with multimedia applications supporting OSC.

Discussion

The following section briefly discusses the genesis and necessity of the autonomX software, its reception by workshop participants, its limitations, and its future development orientations.

Artistic Practice with Complex Systems

autonomX is one of the outcomes of the research-creation project Dynamic Light that inquiries into practices of lighting design that employ cutting edge computing technologies for the expression of temporal behaviors with light. One of the motivations of the project was to explore how to produce new forms of temporal action (and hence, new “vitality affects”) that currently would be impossible to code as individual events in standard lighting control systems. Moreover, while such systems are routinely coded in higher-level software languages for a wide range of scientific applications, such programming is extremely difficult for those without the sufficient mathematical knowledge of such systems. In other words, our need to harness the types of temporal actions that are generated by complex systems, ranging from so-called “periodic” (occurring at regular intervals) to what is called in physics “quasi-periodic” behaviors (oscillating between periodic and unpredictable) for driving the actions of light for expressly aesthetic/artistic purposes (for example, exploring the perceptual limits of patterns or constructing systems that oscillate between order and disorder for observers) was one of the main motivating factors for the autonomX software development.

From an artistic perspective, the dynamic light project produced artistic outcomes that employed various complex dynamical systems (i.e., Spiking Neural Networks, genetic algorithms) as well as unsupervised machine learning in order to produce complex patterns in light. For example, the earliest artistic result was a large-scale commission called *Totem*² which resulted in an autonomous light sculpture that demonstrated the temporal evolution of artificial neural networks in relation to their environment. A second set of projects also sought to harness Spiking Neural Networks (essentially, a mathematical model of firing neurons) as co-partners in a series of performance works. *SNN #1: The Speed of Thought Itself*³ is a performance for two human performers and eight Spiking Neural Networks interacting with one another to reenact a series of 19th century mental chronometry experiments dating back to the work of the Dutch psychologist Franciscus Donders. A second work using spiking neuron models entitled *SNN #2: Light/Space/Prop*⁴ was a light performance for a network of 15 Spiking Neural Networks that, through their self-organization, could control a series of moving head lighting instruments in a public space (Barcelona). *SNN #2* aimed to reconstruct Laszlo Moholy-Nagy’s 1924 light prop for an electric stage but at city scale, by creating a choreography of light in public space. As these projects all focused on creating performative and agential lighting systems capable

of exhibiting a wide range of temporal expressions, the subsequent development of autonomX was directly built on the demand for a set of expressive tools that could produce a rich range of behaviors. In other words, the forms of technical practice demanded by these artistic projects (shown in high-profile institutions and festivals in Europe) and the production experience gained by working with complex dynamical systems during the creation of those artworks directly led to the development of autonomX.

From concrete production conditions, certain ways of understanding the relationship between technical and artistic practice quickly became apparent. First, the development process of each work revealed that the emergent *behaviors* generated by Spiking Neural Networks, Genetic Algorithms, and machine learning techniques cannot be deduced from their algorithmic implementation alone. On the contrary, each intervention in the programming of complex systems requires extensive periods of observation that reveal their transformations over different time scales, from a few seconds to minutes and hours, in order to stay attuned to their temporal modulations and develop a perceptual and sensorial understanding of the system’s configuration [14].

Second, the production of the artistic works demonstrated that the constraint of writing and compiling complex software code that is demanded by the implementation of such systems steals time away from observing and experiencing their activity (as both artists and spectators) and from developing meaningful interactions with the rest of the artwork ensemble, in particular with sensing and sequencing systems.

Third, the temporal and scalar characteristics that are produced by complex systems revealed that injecting and sampling temporal signals to and from parts of a system has the potential to generate meaningful behaviors. The use of a signal, rather than the visualization of the whole system, is particularly suitable for artistic practices that rely on small numbers of instruments—a few musical instruments to relatively low numbers of lighting devices.

The artistic work on which autonomX emerges from thus allows us to understand that creation practices with complex systems require extensive periods of observation and experimentation in order to reveal self-organizing and emergent behaviors that cannot be deduced from the structure of the algorithms alone. The strong sensitivity to initial conditions that characterize such systems as well as the improvisational nature of working with them in real time require practical, quick, and easy tools that foster both intuitive experimentation with parameters and interactions, and observation. In the context of multimedia artistic creation, the use of lighting and sound as expressive material

² *Totem* is an artwork by Chris Salter in collaboration with Takashi Ikegami, Sofian Audry, Alexandre Saunier, and Thomas Spier. It was commissioned by the Barbican Center in London as part of their touring exhibition *AI: More Than Human*.

³ *SNN #1: The Speed of Thoughts Itself* is a performance by Chris Salter and Alexandre Saunier premiered in 2019 at Impakt Festival (Utrecht, NL).

⁴ *SNN #2: Light/Space/Prop* is a multimedia installation by Chris Salter and Alexandre Saunier premiered in 2020 at Llum BCN (Barcelona, ES).

revealed that the use of time-varying signals extracted from and fed into complex systems can generate meaningful behaviors out of a limited number of instruments. This practical knowledge developed during the Dynamic Light research-creation project is thus critically-technically (Agre) materialized in autonomX's *generator*, *drawing*, and *signal* frameworks [15].

Collaborating Over Controlling

To test the software with potential user groups, autonomX was used in different workshops open to both artists and students that had no previous exposure to the software. In particular, autonomX's prototype, release 0.1, was the object of a workshop entitled "Dynamics of Perception" held online during ISEA 2020. Together with the technical and creative team, several collaborating anthropologists participating in the Dynamic Light project were also present to participant-observe and discuss with the participants their experience while going through activities that involved the generation of various sounds using the Spiking Neural Network (SNN) generators.

When interviewed about their experience, participants described a sense of *collaborating with*, successfully or not, the SNN system and described experiencing a form of "machine agency" that resulted from the autonomous activity of the neural networks [16]. They contrasted these descriptions with the feeling of *control over* that is usually experienced with more traditional control systems that consist in explicitly programmed sequences of events with neither self-organizing nor emergent properties.

This feeling of collaboration was accompanied by what participants characterized as *observing* and *learning* the behaviors expressed by the system. In other words, they stressed the importance of spending time listening to the sonic material being modulated by the SNN in order to become attuned to the patterns being expressed and to slowly make sense of the system's different parameter combinations. Importantly, they remarked that this process of *observing* and *learning* was not related to their *understanding* of the inner workings of the SNN. These discussions showed that despite the computational nature of the technique employed, the intertwined relations between sensorial perception and hands-on experimentation behind the participant's observation and learning process felt to them more conducive to artistic creation than any rational understanding of the algorithmic implementation of the SNN.

While the "Dynamics of Perception" workshop was limited to the manipulation of a single type of generator (the Spiking Neural Network), the points highlighted by the participants offer insights that remain relevant for artistic creations using other kinds of complex systems. In particular, they show that systems that possess autonomous, self-organizing, and emergent qualities might be better addressed through notions of *observing*, *learning*, and *collaborating*, rather than of *understanding* and *control* that can be associated with systems such discrete state machines more commonly employed by artists. Artistic

experimentation with complex systems thus suggests that fostering material and sensorial engagement as an integral part of computational disciplines would prove beneficial to the study of complex systems, not only in the arts but also in the larger context of scientific practice. This preliminary conclusion has large-scale ramifications for how humans will relate to the agential structure and actions of such systems, particularly as their implementation will continue to be black boxed in ever more sophisticated wrappers by industrial concerns, even as such adaptive and behavioral technologies enter into most of our everyday experiences.

Conclusion

autonomX is an open-source software that encourages artists and students to quickly and intuitively manipulate complex dynamical systems in order to experiment with the generation of temporal dynamics in various media, from light to sound and robots, that such systems make possible. Because complex systems possess autonomous, self-organizing, and emergent properties that produce global behaviors from the local interactions of large ensembles of simple entities, they offer a challenge to the traditional forms of understanding and control present in multimedia software. Instead, complex systems invite us to move toward principles of observation, learning, and collaboration that acknowledge their temporal dimension and their potential for expressive agency.

autonomX builds on the knowledge acquired during the research-creation project "Dynamic Light" that intertwined concrete artistic practice and anthropological observation of the creation process. This original approach has led to the development of a framework of *generators*, *signal*, and *drawing* that fosters an intuitive and multimodal engagement with complex systems. autonomX embodies these principles in the form of a software instrument intended for real-time artistic creation and composition.

As of the writing of this paper, the release 1.0 of autonomX is freely accessible on lab Xmodal's github repository [1]. Future developments will go in the direction of expanding the application's technical possibilities, furthering the anthropological understanding of complex systems, and supporting artistic creation with a larger international community of scientists and artists.

The current version of autonomX supports a limited number of processes, namely, Spiking Neural Networks, a full implementation of Stephen Wolfram's Cellular Automata, and Conway's Game of Life. This implementation offers a small repertoire of techniques that will be expanded in the future in collaboration with international collaborators in the fields of the computation arts and artificial life. We aim to implement a large variety of techniques including boids, reaction-diffusion systems, and recurrent neural networks such as reservoir and transformer models.

Additionally, artistic productions have demonstrated that interconnecting multiple complex systems together yields striking expressive possibilities. We wish to extend the

current possible complexity of the software by allowing for intuitive internal connections between generators.

Second, at the methodological level and in relation with the “Dynamic Light” research project, autonomX will be used in the design of experiments on the sensorial perception of the temporal dynamics expressed by complex systems. Those experiments, held in relation with a team of anthropologists of the senses and focused on participant observation, will focus on how observers perceive the kinds of “vitality effects” [4] produced by light and sound behaviors driven by autonomX. The aim of these experiments will be to develop a qualitative understanding of complex systems based on the sensorial perception of their behaviors.

Finally, the long-term objective of autonomX is to support artistic practices with cutting-edge technologies and contribute to the development of not only the media art scenes but also the cross over space between computational technology-augmented artistic practices and the performing arts. In the coming years, lab Xmodal’s team will conduct workshops for artists and students. We will also use autonomX in new artistic projects that might also fulfill the long sought after goal of the 20th century Indian art historian Ananda Coomaswamy—to create art as an “imitation of nature in her manner of operation.”[17]

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Écosystème(s): a self-interactive sound installation

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Abstract

This article presents the creation process of *Écosystème(s)*: a self-interactive installation. This work is based on an ecosystemic approach to sound creation. Such an approach aims at creating aesthetic, technical and conceptual links between ecology and sound art practices. In the context of *Écosystème(s)*, it is expressed through the sharing of a sound and sensitive experience of fragile living systems. This perspective considers and practices listening as a means of understanding and confronting the ecological crisis, while attempting to convey it through an interactive work. This approach proceeds through the use of algorithmic processes for the fabrication of artificial sound environments that integrate, cohabit and underline existing natural sound relationships, in a dialogue between artificial technologies and natural ecosystems, while setting up a context for attentive listening. A great deal of room is left to intuition and imagination in this creative process, through the desire to seek a balance between concept and expression of interconnected subjectivity.

Keywords

Sound installation – sonic environment – interactive technology – sonic ecosystems – sound art – sound ecology – insects – non-human communication.

Introduction

Écosystème(s) is a self-interactive sound installation whose behavior and sound identity are inspired by the communication techniques of orthopteran insects. The term "self-interactive" is used here to emphasize that the device is self-regulating (the device listens to the sound it produces and adapts its behavior according to the result). The device takes the form of a wooden desk in which are embedded seventeen speakers of different models. Two cardioid microphones are suspended above the speakers and pick up the intensity level of the sound environment. Simultaneously, these levels are sent to *Max/Msp* and control the triggering, localization and duration of about fifty sound samples in *Ableton Live*. This piece marks a personal turning point in my practice and research, as it is the first work using digital interactive technologies. The main objective in the creation of *Écosystème(s)* is to conceive a sound piece inspired by various behaviors of natural systems, in order to provoke a posture of silent and attentive listening through interactive technologies. This text presents, first, the different steps that led to the creation of *Écosystème(s)*. In the second part, the text will examine

the technical, aesthetic and conceptual aspects that characterize the work.

The animal world

Starting from a field recording practice, the animal sound world has become a favorite playground for the composition of electroacoustic pieces for several years. In fact, for centuries, it has been a playground for many composers who, for aesthetic and/or poetic reasons, imitate, describe or represent various natural phenomena¹. For example, the use of onomatopoeia in Clément Janequin's 1520 polyphonic song *Le chant de l'alouette* is a mimicry effect. Moreover, the animal sound world occupies a significant place in the genre of the symphonic poem, as in the *Carnival of the Animals* composed by Camille Saint Saëns in 1886. Moreover, Olivier Messiaen's well-known fascination with birdsong led him to study and transcribe it. Finally, with the invention of electroacoustic recording and reproduction technologies, composers of musique concrète are able to record, analyze and use the sounds of the animal world in their compositions. In the footsteps of Murray Schafer, artists such as Hildegard Westerkamp, Chris Watson or Bernie Krause, to name but a few, show a great interest in the acoustic signatures of a place and the living beings that compose it: field recordings are obviously characteristic materials of their electroacoustic compositions.

However, the animal sound world is not only fascinating for aesthetic reasons. With the rise of general ecology and more specifically sound ecology, interest in the "natural" sound world has increased considerably. As the Norwegian composer and sound artist Espen Sommer Eide explains, the romantic vision of the solitary artist in front of a sublimated nature is outdated; in the face of contemporary challenges, it is important to find new ways to represent and articulate interactions between the artist and nature. The artist is no longer an observer separated from the object of their observation, but an agent inscribed in living networks:

"The starting point, for the artist or the composer, is not the outing in nature to find inspiration, followed by the translation of this experience into music [...] Can we describe in another relevant way the interactions between the artist and nature? As in Uexküll's stories, the artist is already present in a scene of sensory activity, but he is also part of a larger network of sensations and structures that act and react: the human senses, those of living beings, but also plants, molds, bacteria, stones, soil and wind." [1]

As Eide points out, some artists are interested in the fragility of these systems. For example, the work of composer and bioacoustician Bernie Krause², and more recently that of

¹ In his book *Le poème symphonique et la musique à programme*, Michel Chion explains that the symphonic poem is the genre par excellence which narrates, describes, evokes a landscape, through

various compositional processes: imitation, description, representation. (Chion, 1993).

² See, among others, the exhibition "Le Grand Orchestre des Animaux" organized by the Fondation Cartier pour

natural sound environments, aim to make the listener aware of the imbalance between biophony, geophony and antropophony. These three terms, invented by Krause to categorize the sounds that coexist simultaneously on Earth, make it possible to identify various ecological issues, such as the disappearance of animal species and biodiversity. Namely, they are geophony, which includes geophony includes all sounds of non-biological origin such as wind, water, earth movements or rain; biophony, which includes the sounds of living organisms; and finally, antropophony which includes sound sources of human origin.

With ecological thinking, sounds are not reduced to abstractions detached from their habitat. On the contrary, they archive testimonies relative to the specific inventions of living species that interact in constant coevolution with their environment, which is also ours. These species are then considered as agents that create the sound environment. This same thought implies a movement of approach and integration in the sound environment: rather than observing it (or recording it) only for its aesthetic qualities, we experience it in a lived and affective way. From this point of view, the expression of a "living network" substitutes itself to the term "environment" and invites the human ear to lend a listening to the sound networks of the living: "the organized sound of life itself." [2]

Numerous contemporary philosophers have examined the "puissance d'agir"⁴ of living beings, and more particularly of animals. In line with the Gaia Hypothesis, these philosophers of the living⁵ offer new and inspiring models of thought for artists: interdisciplinary and collective re-research-creation projects, in the form of workshops, contemporary art exhibitions, and living art events, aiming to explore a variety of alternatives and to nourish reflection on our relationship with the living. For example, the exhibition *Critical zones: Observatories for Earthly Politics* organized at the Zentrum für Kunst und Medientechnologie in Karlsruhe (ZKM) in August 2020, based on an idea by Bruno Latour, invited artists to explore new modes of coexistence between different forms of life⁶; similarly, the company *Zone Critique*, directed by Frédérique Aït-Touati, has been developing modes of theatrical writing since 2004 questioning scientific and ecological imaginaries. The last performance, entitled *Viral* (2021), is part of the "earth trilogy" and proposes to rethink our material dependencies in a co-evolution with viruses⁷. Finally, the University of Lausanne recently invited the philosopher of science Vinciane Despret for a cycle of meetings and collective experimentation around the notion of a narrative of possible futures; the event concluded with a presentation of her latest work *Autobiographie d'un poulpe* (2021), in which the author imagines, among other things, a future in which scientific research would allow us to communicate with animals⁸. It is in this context, at the convergence of science, philosophy and artistic practices that the sound installation *Écosystème(s)* has matured.

l'art contemporain in 2016:

<https://www.fondationcartier.com/expositions/le-grand-orchestre-des-animaux>.

³ See, among others, the Fragments of extinction project: <https://www.fragmentsofextinction.org/>.

⁴ In his book *Face à Gaïa : huit conférences sur le nouveau régime climatique*, Bruno Latour uses the term "puissance d'agir" to translate the term agency and "avoid the horrible 'agentivité'" [3]

⁵ Examples include Vinciane Despret (*Habiter en oiseau*, 2019), Baptiste Morizot (*Manières d'être vivant*, 2020), and Donna Haraway (*Manifeste des espèces compagnes*, 2019).

The idea of *Écosystème(s)* was born after reading the article *L'univers sonore animal: Rôle et évolution de la communication acoustique* written by Yvelines Leroy in 2002. The author details how in order to recognize each other and to isolate signals from the background noise, different species cohabiting in the same environment use various methods of frequency, spatial and temporal exclusion: some sing at different times of the day and occupy a distinct territory, others occupy a certain frequency range, or use all these strategies. The signal repertoire, intrinsically linked to environmental influences on the animals' bodies, is the result of a long evolution of the species' transmitter organs. This information suggests a direct relationship between the evolution of the environment and the auditory sensory system, confirming that listening is ecological, interactive and changing. Finally, the article explains that the language of each zoological group innovates in a particular way: the orthopteran insects (locusts and grasshoppers) introduce repetition, discontinuity, sequence, regular or irregular pattern; the amphibians, formant and its nuances; the birds, for their part, invent melodic line. Leroy's text summons an ecosystemic thought of the animal sound world while using a musical vocabulary to talk about language innovations: it is thus possible to take advantage of both the concept of self-regulation and the typomorphological suggestions for sound composition. Starting from the idea of a natural musical ecosystem, the project develops on three organizational principles, namely the choice of sound materials, a self-regulated communication system, and a listening device. In this regard, the communication techniques of orthopteran insects have been a source of inspiration both from the point of view of sound materials and algorithmic logic.

The sonic material

The choice of insects is not insignificant: from an aesthetic point of view, they offer a fertile ground of materials, including noisy and high-pitched sounds arranged in more or less regular rhythmic patterns. Buzzing, rubbing, stridulation, clicking : the insects' song blurs the boundaries between the perception of an artificial or natural sound, and a machine sound or an animal sound. Cultivating this ambiguity with regards to sound sources combines the machine and the organic, creating cyborg sounds⁹. In large quantities, the effect is that of a dense and rich accumulative mass, as a solitary insect pierces the ambient sound web: just disturbing enough to notice, just banal enough to ignore. Because of their antiquity (more than 400 million years), their number (they constitute 85% of animal biodiversity) and their differences, the choice of insects allows us to weave conceptual links with ecology. Considered strange

⁶ See the exhibition website:

<https://zkm.de/en/exhibition/2020/05/critical-zones>.

⁷ See Catherine Robert's text for more information on: <https://www.zonecritiquecie.org/viral>

⁸ See the different conferences on the Vidy-Lausanne theater website:

<https://vidy.ch/enqueter-avec-dautres-etres?fbclid=IwAR2-GJrEqDb711y9m3qUGaLAc70uXKX3TKvsi1xQStKgWokUdpvWP-1JAUQ>

⁹ A term referring to the concept developed by Donna Haraway in *A Cyborg Manifesto*. A cyborg sound is a sound that deconstructs the Nature/Culture duality (Haraway & Wolfe, 2016).

world, they embody the "other that counts" – if we take Donna Haraway's formulation – with whom we cohabit. Moreover, their relative invisibility for the human eye refers directly to the perceptive field of the listening: omnipresent and invisible, as the sounds, they are acousmatic beings, or rather *acousmètres*¹⁰.

For the production of sound materials, the first source gathers insect sound recordings from field recordings; a filtering process then allows the isolation of the different species according to their frequency range. Subsequently, electronic sounds is made to imitate different parameters of insect song behavior, such as spectrum, envelope, articulations, or rhythmic patterns. The goal is to create an environment that oscillates between naturalism and fantasy - in reference to the sound universe close to that of the film *Nausicaa and the Valley of the Wind* by Hayao Miyazaki, for example¹¹. This work gave rise to more than fifty samples, which were classified into four groups: natural insects, artificial insects, birds and signals (fig.1). Overall, the first two groups constituted the majority of the samples; after which the work consisted of making these sound species cohabitate.

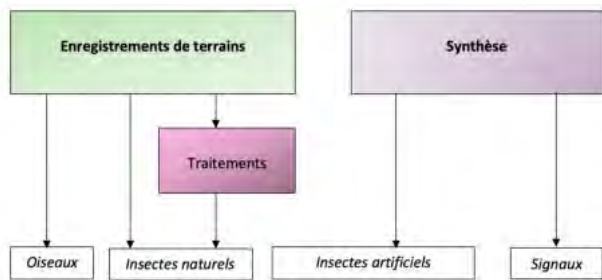


Figure 1. Graphic illustrating the process of creating sound materials for *Écosystème(s)*.

System development: autonomy and biophonic writing

According to Évelyne Leroy's article, each species occupies a specific physical and spectral space: there is a sound and territorial organization of biophony. This observation recalls Bernie Krause's first experience in Kenya in 1980: an event that he describes as close to a spiritual revelation. At nightfall, after the generators had been turned off and all the team members had withdrawn, the sounds of the forest were finally revealed. Krause sets up his microphones in front of his tent, and lying down in his sleeping bag, listens. He writes:

"No longer a cacophony, it became a partitioned collection of vocal organisms—a highly orchestrated acoustic arrangement of insects, spotted hyenas, eagle owls, African wood owls, elephants, tree hyrax, distant lions, and several knots of tree frogs and toads. Every distant voice seemed to fit within its own acoustic bandwidth—each one so carefully placed that it reminded me of Mozart's elegantly structured Symphony No. 41 in C Major, K. 551." [4]

¹⁰ The exact term to talk about insects would indeed be "acousmètre". In the cinema, the latter designates a character in a film that is only perceived in a sonorous way: insects are therefore "acousmètres" of the sound environment.

¹¹ This film, in addition to having an aesthetically interesting soundtrack in its ambiguity between natural and artificial sounds, is one of the most ecological films of the director. In a world

spectrograms from his recordings. As the images scroll by, the structure of the soundscape is revealed, showing distinct forms, which Krause likens to musical notation: from the bat singing in the highest frequency range, to the elephants occupying the lower end of the "biophonic score. [5] Rather than listening to sounds in a dissected manner, Bernie Krause notes that together they form a singular, unique, and surprisingly musical organization. This remark is of capital interest, in that it proposes a significant link between the music and the sound environment via the organization of the elements.

From the outset, the objective for the composition of *Écosystème(s)* was to avoid the process of linear writing: there was no question of elaborating a soundscape based on a hierarchical order that would determine which sound would come after or before another. On the contrary, the idea was that the soundscape should generate itself by taking up the principles of communication of the orthopteran insects, that is to say to make it analogically "alive". From then on, the question had to be rephrased as follows: how do insects organize, adapt and self-regulate in their environment? They listen, they distinguish themselves, they recognize each other. Logically, it was necessary that the sound samples could listen to each other to organize themselves. Two microphones were therefore added to the system, becoming the receiving organs of the ecosystem. To complete it, the loudspeakers took the role of transmitting organs, and the algorithm that of the brain. In general, it was a question of engaging pseudo-cognitive mechanisms, even if minimal, which make the devices both sensitive (thanks to the sensors — the microphones —, the system receives and perceives the sound environment) and capable of acting accordingly, with the help of a processing and analysis of the sounds, the motor of the action responsible for triggering the process. This feedback structure finally gives the device the ability to self-regulate, i.e. to listen to itself and to feedback.

The autonomous dynamic system is the second characteristic of the "living" in electroacoustic performance according to Agostino Di Scipio; the first being the human agent. In this case, the capacity for action and perception is controlled by the human performer, who becomes the only element capable of operating the self-regulation of the device and its interaction with the environment. As a comparison, in the case of an interactive installation, it is possible to replace the term performer by listener. Indeed, in the majority of the interactive installations, the public is the key agent of the loop; in this perspective, this one is in front of a linear system (fig.2). The second notion of the "living" is more about the technical agent, where the whole is not only a performance or an interaction with humans, but an autonomous dynamic system. From a procedural point of view, we are approaching artificial intelligence, where the devices composing the device are endowed with a capacity for action — the abovementioned power to.

"The conditions are thus put in place so that the performative device can prove to be able to produce, all by itself, sufficiently dynamic and varied sound flows over the short and long term. The device becomes a potentially

asphyxiated and contaminated for thousands of years by industry, a few human communities survive between a desert and a vast toxic forest to which the "Omus" (literally "insect-kings" in Japanese) have adapted and of which they are the protectors.

2008a, 2008b]. [6]

Thus, the "internal medium" (the machine) is coupled to the "external medium" (the environment) and the human agent, in the background, is no longer indispensable to the functioning of the system. (fig.3)

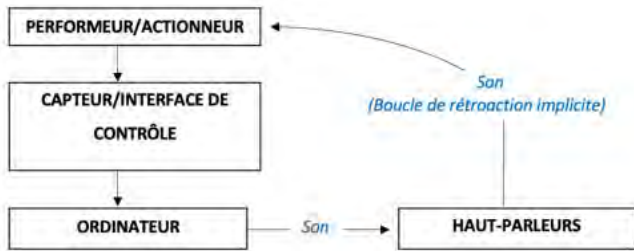


Figure 2. Diagram of a linear sound system.

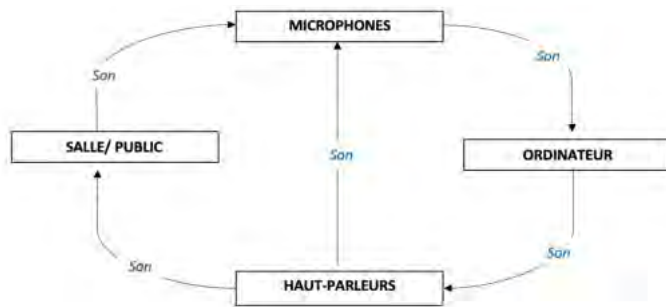


Figure 3. Diagram of a retroactive sound system.

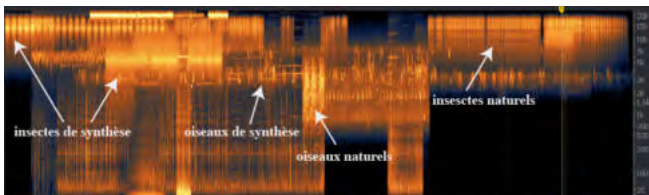


Figure 4. Spectrogram of an extract from *Écosystème(s)*.

Although Di Scipio is particularly interested in performance, the reflection is quite applicable to the interactive sound installation: physically, *Écosystème(s)* receives, analyzes and sends only acoustic data. Technically, the intensity level and envelope once analyzed, triggers, locates and determines the position of each sample. So to speak, it is enough to initiate the system by snapping your fingers near the microphones; once started, the system regulates itself by reintegrating its own emissions and those of the environment. A spectrogram shows the organization of the sound samples (fig.4).

One parameter remains important: How can the system be made to distinguish its own emissions from those of the environment?

The device: the importance of furniture in the induction of interactive postures

interactive with acoustic data, it was obvious that the sound environment and the audience would also be taken into account. The essential thing was to mark the sound presence of the listener, which produced a perceptible impact on the behavior of the ecosystem, which, once disturbed, tried to find a balance in order to spread out. The function of aesthetics, beyond the notion of pleasure, is decisive when it comes to predicting the social behaviors it induces. In this sense, the choice of the form and the aesthetics of the device must take into account the type of behavior that the artist wishes to engage with the listener. To this end, the first idea was to conceive an immersive installation of the environmental type: a space in which the listener evolves. Unfortunately, this kind of immersive device curbed the recognition capacity of the system which could no longer distinguish itself from the environment; the behavior then became chaotic, which was not the desired effect.

Consequently, the device is integrated into a specific piece of furniture in which to embed all the speakers (fig.5). Such a device allows to concentrate in turn the acoustic energy and the attention of the listeners. Since the loudspeakers are located below the microphones, the sensitivity level is limited to a distance close enough to obtain a minimum of control over the system's behavior. This arrangement also greatly reduces the difficulty of separating the system's own emissions from those of the environment. Now that the object had taken on the dimensions of a piece of furniture which, by its shape, informs the orientation of consultation, it was important to concentrate the listener's attention in one locus; rather than an itinerary, to invite them to adopt a listening posture with respect to a sound microcosm.

At this scale, in addition to solving a technical problem, the device was consistent with the ecological dimension of the project, insofar as listening to a smaller and more fragile world intuitively arouses a desire for discretion.



Figure 5. View of the installation *Écosystème(s)* exhibited at the Festival International de Musique Actuelle de Victoriaville, 2021, © Estelle Schorpp.

Silence is necessary to listen to each other, to give space, and to share the sound environment equally. Noise and noise pollution have been a concern since the industrial revolution – although the term has only been used since the 1970s. By their number and intensity, industrial sounds crush the diversity of sound signatures of living beings cohabiting in the same space; as Vinciane Despret reminds us, "there is no way of inhabiting that is not first and foremost 'cohabiting'". [7] This domination creates a profound imbalance and becomes the source of several problems. First of all, it is a social problem, since not everyone is with regards to exposure to the noise¹². Silence in the sonic cohabitation between humans — in other words the urban sound environment — is almost non-existent, and the little that remains is unequally distributed: the quality of listening between humans and non-humans decreases. This posture of partial deafness or hypoacusis gives way to the second problem, of an ecological nature, which the imperial domination of noise engenders. The complex exchanges between animals that emit signals in order to communicate with their congeners are critical : indeed, they allow, among other things, to attract a partner during the mating period, to defend a territory, to signal the presence of a predator or a prey. However, many of these signals are masked by urban anthropophony, which disrupts the fragile ecosystem of animal communications. Recently, a 2018 study by environmental science students at UQTR (Université du Québec à Trois-Rivières) demonstrated that some bird species adapted their song frequency to no longer be masked by traffic noise (Roca et al., 2016). Moreover, following containment measures related to the COVID-19 pandemic, a new ecophony is entering urban areas. Recently, a study — entitled Silent Cities — has been collecting sound recordings from urban environments around the globe that document changes that took place during and after the containment period. Started in mid-March by scientists from France and the United Kingdom, this project relies as much on the voluntary participation of researchers as on anyone able to make the required recordings (Descoteaux, 2020). These parameters are reminders of primordial issues regarding the ability of human societies to get along. *Écosystème(s)* operates in this vein, seeking to rebalance the human sound presence and to redeploy space among the living for an alternate collective organization of the sound environment.

On the one hand, the installation interacts with its sound environment and thus with the sound presence of the public: indeed, if the ambient noise is too high, the system will no longer perceive its own emissions, which will be masked and will no longer be able to self-regulate. On the other hand, as explained above, the audience is not an essential agent for the system to function properly: the system reacts to its presence, but does not need it to self-regulate. This is why *Écosystème(s)* is described as self-interactive: the installation is autonomous. In this case, what role do the

role. The question that emerges is: what level of interactivity and awareness is desired, or even necessary?

On some occasions, the process of interacting with an object or environment diverts attention from the original message or content and directs the listener's activity towards pure entertainment. In other situations, the subtle adaptation of sound is an appropriate response, where the simple audible feedback of the interaction with a microphone is enough to enrich the experience without necessarily being noticed. It is towards this second, almost unnoticed or unremarkable interaction, i.e. towards an interactive aesthetic of the unspectacular, that the artistic objectives of *Écosystème(s)* tend. The interaction as such is considered in its relationship with silence. Reacting to sound intensity, the system's behavior is disturbed when the ambient sound signature exceeds its own signal: unable to regulate itself, the ecosystem then stops evolving and goes into a loop. So, what is the desired level of interactivity? The answer is simple: the sine qua non condition for listening to the audience is silent attention. It is in such conditions, where the sound environment is equitably shared, where the communication of the insects is not masked by human noise, that *Écosystème(s)* manages to self-regulate and that musical motifs emerge.

Conclusion

The ecosystemic approach to sound creation is intrinsically linked to cultural, technological and environmental contexts marked by the ecological crisis. It reflects the increasing accessibility and ubiquity of technology and media in our environment, while emphasizing the need for the arts to define their role in the face of the ecological crisis.

The process of creating *Ecosystem(s)* has allowed for the practical application of various issues related to an ecosystemic approach. More specifically, the conceptual universe of the work is based on a systemic understanding of sound environments, which considers them as an open set of interdependent dynamic interactions. On the other hand, the algorithmic approach offers precious tools to model the behavior of sound systems and to musicalize them. Moreover, this method allows to work in real time with complex environments, and to adapt the algorithm to the broadcasting framework. Finally, the choice of sound materials, as well as their organization in time and space, are aesthetically inspired by natural sound systems; the device applies different strategies to guide the listeners towards a sensitive and intellectual encounter with the work.

In short, the systemic approach is reflected both in the creative process and in the experience of the work. In the case of *Écosystème(s)*, thanks to an interactive device that aims to produce a silent encounter, a reflection is initiated around the sonic cohabitation between humans and non-humans, redirecting the attention of the listeners towards the complex communication systems that surround us and to which it is essential to give a fair place in our living spaces.

¹² Work conducted by the Direction régionale de santé publique du Centre intégré de santé et de services sociaux du Centre-Sud-de-l'Île-de-Montréal (DRSP) in collaboration with the Université de Montréal and the Institut national de la santé publique du Québec (INSPQ) has revealed, since 2010, that nearly half of the population of the Island of Montreal (46%) with a family income

of \$40,000 or less is exposed to noise levels (LAeq24) greater than or equal to 60 dBA. This proportion decreases with increasing family income.

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Author(s) Biography(ies)

Estelle Schorpp holds a masters degrees from École Nationale Supérieure des Beaux-Arts de Paris. She also graduated from Université de Montréal with a masters degrees in Sound Creation and Composition during which she wrote a thesis entitled : *Sonic interactive environments: an ecosystemic approach*.

She uses sound installation, music composition, writing, performance and new technologies to put together projects that both embrace and criticizes our daily relationship with our sonic environment. She is interested in sound ecology, hybridity between nature and technology, and the attention to the unremarkable. Her projects often consist in form of hybrid environments giving space to non-human narratives and to many imaginaries about soundscapes.

Recently, she has been inspired by natural ecosystems and explores the potential of algorithmic systems through interactive sound installation.

Her work has been presented in festivals such as Prix Ars Electronica (AT), MUTEK (MX, CA, AR, JP), FIMAV (CA), Exhibitronic (FR, GER), MuTeFest (FIN) and in group exhibitions at the Centre d'Exposition de l'Université de Montréal (CA), Palais des Beaux-Arts de Paris (FR) and Exhibition Laboratory (FIN). She has participated in study days and symposiums at CIRMMT (CA) and EHESS (FR). In 2016 she received the first Exhibitronic award for her electroacoustic composition *Bagdad 9ème siècle*. She is the recipient of several research-creation grants.

Nonhuman Creativity in Generative Art: Beyond the Anthropocentric Paradigm

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Abstract

This paper explores fresh insights into the ways we negotiate our ideas about nonhuman creativity, emphasizing the need to recast traditional notions of what it means to be an artist today. In the prospect of the existence of entirely autonomous nonhuman agents of art production in the following decades, an attempt is being made to question the exegesis of the artificial creativity of generative art from an anthropocentric point of view. Through the observation of four art projects, the first part sheds light on the interaction of artists with generative art-making systems in order to demonstrate that the concept of assemblage between living and non-living agents is currently emerging. The second part attempts a *new* ontological exploration of algorithmic systems as a possible path for essentializing their creative agency. The discussion extends to whether these aspects can operate as a foundation of the ontological definition of nonhuman creativity.

Keywords

Nonhuman creativity, generative art, assemblage, new ontology

Introduction

In recent decades, within the theory of art discourse, there is an attempt to understand and define an emerging trend of artistic production, which derives from the ability of generative systems and algorithms to express themselves artistically with a certain degree of autonomy. The debate over the potentially autonomous artistic production of a nonhuman agent is a complicated one, partly because it brings back the modernistic concern that the machine will displace the artist from the creative process leading to a dystopian technological totalitarianism.

Artificial creativity can hardly be explained through the rigid behavior of algorithms, so it is often approached throughout the interpretation schemes we have created to explain human creativity. However, the inexperience of our human species in comprehending creative “others” and the fear of losing our most human quality, constitutes a serious setback for an impartial understanding of the creativity of nonhuman agents. In order to avoid constraining the discussion to outdated and romantic theories of human creativity, leading back to an almost metaphysical talent of a genius human artists, the analysis attempts to question the exegesis of the nonhuman creativity of generative art through the anthropocentric paradigm. In doing so, nonhuman creative systems are approached as an ontological *otherness*, as agents *per se*.

The first part of this paper discusses the interaction of artists with generative art-making systems, by referring to

examples of projects from 1968 onwards. These examples demonstrate how human and nonhuman creative agents operate as an assemblage [1] in order to jointly explore new artistic possibilities. In the second part, the analysis deals with the ontological overview of the algorithms used in the artificial systems of creating art. The fresh examination of these algorithms aims to highlight the less rigid manifestations of their behavior. This examination serves as a gateway to an ontological exploration of the nonhuman creativity.

Assemblages of human/nonhuman creative agents

It is simply carbon fascism to argue that only biological creativity is worth studying
— Alison Pease & Simon Colton

In both the Renaissance and the Early Modern era, artists such as Leonardo da Vinci, Albrecht Dürer and Johannes Vermeer took advantage of technology in their artistic quests. By the end of the *quattrocento*, Da Vinci created the first android robot, named “mechanical knight”. Around 1800, the first “automata”, anthropomorphic moving mechanical devices were created. These machines were able to hold in their information capacity certain simple representations which they could repeat on paper. [2] By 1804, Joseph Jacquard invented a loom which was controlled by punched paper cards for weaving intricate designs and portraits. [3] Later, during the late 19th century and the first half of the 20th century, the avant-garde used many elements of the flourishing computing culture of the era, both in terms of materials and concepts. Art movements such as Surrealism, Dada, Fluxus, OULIPO, conceptual and abstract art were inspired by fundamental principles of programming and algorithms, such as formal instruction, randomness, interactivity and automation. [4]

By the mid-20th century, art was significantly influenced by cybernetics, “the study of control and communication in the animal and the machine”. [5] Many artists influenced by cybernetics [e.g., Gordon Pask, Robert Breer, Roy Ascott, Jean Tinguely] shifted the emphasis of art from object-oriented notions to its understanding as a complex dynamic system that provokes a dialogue between the act of creation, the artist and the public. [6] From the 1980s onwards, the digital revolution [7] brought about a dynamic change in the way contemporary culture was synthesized, which sparked, on the one hand a useful critique of the algorithmic culture [8] [9] [10] and, on the other, especially in art, contributed to a slow but profound shift in the definition of what it means to be an artist today.

Today, the current trends in which the literature refers to as “generative art”, “artificial intelligence art”, “algorithmic art”, “robotic art”, “artificial creativity” or “computational creativity” (CC), define in many cases a nonhuman agent as the foremost creator of works of art. Research on productive visual arts using artificial systems is gaining more and more interest and this is evident from a series of conferences held in the second half of the 20th century: [International Conference on Computational Creativity (ICCC); Design Computing and Cognition (DCC); Creativity and Cognition (C&C); International Conference on Design Creativity (ICDC); International Workshop on Creative Agents (IWCA)].

Artists/programmers who engage in this kind of artistic creation often define their systems as autonomous entities for the generation of art, based on the argument that they are able to create novel works. [11] [12] Due to the possibility of autonomous function of such systems, a large number of artists and programmers approach their relationship with their machines as a collaboration, a kind of an assemblage of living and non-living entities to achieve common artistic goals. [13] According to Joanna Zylińska: “Naturally, artists do not construct these machines just to get ‘help’ but rather to probe the limits of the human idea of creativity and of human-machinic assemblages. These works are thus described as collaborations between the artists and the robotic systems those artists have designed”. [14]

Examples of art creation systems date back to 1968, when the artist Harold Cohen created AARON (the artist’s Hebrew name), a machine he designed and trained to imitate his own artistic style. In the five decades of his collaboration with the artist, AARON gradually went from creating simple, black-and-white, representational forms to more complex, color works that resembled those of Cohen. Although any new idea had to be coded and fed into the system, the program could compose an almost infinite number of distinct works of art on its own. AARON’s ability to “make decisions” was made possible through Cohen’s choice to install a random number generator at the heart of the program, creating an illusion of autonomy and of agency.

Cohen stated that the relationship he had developed with AARON was similar to that of the Renaissance artist with his assistants in the studio. [15] Until his death in 2016, Cohen claimed that the artistic capability of AARON was based not on his innate skill and creativity, but on his special collaboration with the artist himself. [16] However, as Simon Colton aptly points out, “It is over-simplistic to say that AARON has been developed to paint in the style of Cohen, as he has been influenced himself by feedback from the software, so the process has been somewhat circular”. [17] Over time, his relationship with his system seems to have taken the form of an assemblage, with AARON exploring and pointing out to the artist new manifestations of the latter’s artistic style. [18] As Cohen himself admitted, “It slowly dawned on me that I could use the machine to investigate some of the things that I thought I hadn’t been able to in painting, that had made me very discontented with my painting”. [19]

Following Cohen’s contribution, early 21st century ventures into the field of artificial creativity had as their primary goal to explore the potential of developing a “personal” artistic style deriving from the systems themselves, thus moving away from the imitation of pre-existing forms. In 2005, Simon Colton, with a team of scientists at Imperial College London, developed an artist-machine called The Painting Fool. According to their website, they started the

creation of The Painting Fool in order to investigate whether an artificial system can be described as “creative artists” in its own right and if so, under which conditions. On The Painting Fool website, the visitor encounters also the following quote: “I’m The Painting Fool: a computer program, and an aspiring painter. The aim of this project is for me to be taken seriously - one day - as a creative artist in my own right. I have been built to exhibit behaviours that might be deemed as skilful, appreciative and imaginative.” For this reason, The Painting Fool does not copy the style of a pre-existing visual style or artist, but creates works through its interaction with the stimuli of its environment.

One of The Painting Fool’s first works was the composition of portraits of visitors of the gallery where the system was on display. The results were then presented in the *You Can’t Know My Mind* exhibition in 2013. Colton, wanting to avoid random number generators and differentiate himself from Cohen, decided that the current “mood”, which would inspire the creation of a portrait would be activated in the machine based on the daily news presented in the press. Painting Fool therefore scanned daily articles from the Guardian and modified its “feeling” according to how positive or negative were the news of the day. [20] The Painting Fool, similarly with AARON, functions based on a certain level of randomness. In this way, the programmers provided the system with a kind of “random logic” and “emotional autonomy”, in the sense that they could not predict the state of the algorithm. [21]

It is also important to mention that Colton’s action in the emerging field of artificial creativity is not limited to the programming of The Painting Fool. In collaboration with Alison Pease, they implemented the Turing Test, to evaluate artificial creativity. However, as they themselves state in the findings of this experiment “...the Turing Test is largely inappropriate for the purposes of evaluation in Computational Creativity, since it attempts to homogenise creativity into a single (human) style...”. [22] In this sense, the inability of the game of imitation to evaluate the creativity of productive systems makes it necessary to design procedures for evaluating artificial creativity as creativity itself and not as a simulation of the human.

As the examples of AARON and The Painting Fool demonstrate, in the early decades of the advent of artificial creativity, the algorithms chosen as the most suitable in art production systems were the stochastic algorithms, whose functions steps depend on random choices made during their execution. Unlike deterministic algorithms, the steps of stochastic algorithms in their execution are neither defined nor unique, but they can change and produce unexpected results. This is either because the developer has included a random number generator in the code or because the algorithms themselves are able to receive inputs from their ever-changing external environment. At first glance, the argument that randomness can be equated with the autonomy of a machine in artistic performance seems simplistic and inadequate, mainly because the former gives the illusion of spontaneity and uncontrollability, but is judged inferior to the *per se* creative procedure.

Therefore, from the end of the 20th century onwards, the artists/programmers of the productive art choose to work with more complex algorithms such as those used in artificial neural networks or swarm intelligence. An attempt to define neural networks is as follows: A neural network is a massive parallel distributed processor consisting of simple processing units, the neurons, which have the natural tendency to store empirical knowledge and make it available for use. They resemble the brain in two ways: 1. The net-

work acquires knowledge from the environment through a learning process. 2. The connections between neurons, called synaptic weights or simple weights, are used to store knowledge. [23] An important advantage of artificial neural networks in relation to other algorithmic processes, is the ability to learn through experience.

In the field of artificial neural networks in artistic production, the recent work of the artist and researcher Mike Tyka is notable. One of the most recent series of works by the artist is called *Portraits of Fantastic People* and concerns the training of neural systems in the composition of human faces that never existed. The series of works has been screened at the important New Media Art Festival, “Ars Electronica” in 2017 and most recently in February 2021, at the online exhibition “Uno, Nessuno, Centomila”. To achieve photorealistic oil-canvas-like portraits, thousands of photos of people were uploaded from Flickr, which were then imported into a program called the Generative Adversarial Network (GAN). On his website, Tyka describes his approach as follows:

GANs work by using two neural networks that play an adversarial game: one (the “Generator”) tries to generate increasingly convincing output, while a second (the “Discriminator”) tries to learn to distinguish real photos from the artificially generated ones. At first, both networks are poor at their respective tasks. But as the Discriminator network starts to learn to predict fake from real, it keeps the Generator on its toes, pushing it to generate harder and more convincing examples. In order to keep up, the Generator gets better and better, and the Discriminator correspondingly has to improve its response. With time, the images generated become increasingly realistic, as both adversaries try to outwit each other. [24]

Tyka’s general practice in creating visual arts is related to his desire to push art towards more interesting expressions that artists have not yet invented. [25] At first glance, the artist’s Generative Competitive Networks are understood as a closed system of machines, a dialogue between two nonhuman agents. However, the way the two GANs work with one trying to fool the other allows the future replacement of one of the two with a human. Also, in a broader reading of how this work communicates with the human factor, it is useful to emphasize that the inputs that trigger the GANs interaction are images of people with which the artist feeds the program. The dialogue of artificial and natural in this case, concerns the training of recognition of human patterns by the networks. Such a reading of Taika networks introduces a kind of assemblage that has less to do with the collaboration of physical and non-physical entities in art production than with the way a closed system perceives and classifies the human through processes that escape control of its developer. [26]

Swarm intelligence, introduced by Gerardo Beni and Jing Wang in 1989, deals with the collective behavior of undistributed, self-organizing artificial or physical systems. [27] Some examples of collective behavior and intelligence in nature are found in the organized movement and cooperation of a flock of birds, an ant colony or a herd of animals. Artificial systems inspired by swarm intelligence are various robotic systems that use innovative algorithmic methods that are governed by a collective form of self-organization. Ant colonies present one instance where the study of the insects’ collective behavior relies on the optimization of algorithms.

An example of the use of such algorithmic methods in the art production process is the project of Lionel Moura. The system that Moura built is called Robot Art and was presented at the exhibition *A Machine for Creating* and in the catalogue entitled *Artistes & Robots* at the Grand Palais in Paris in 2018. Moura, created and programmed small robots (artbots) which move on a large piece of paper, leaving colored lines on their way and eventually creating an abstract composition. These systems have a satisfactory understanding of the environment in which they operate and are equipped with a small “brain”, which is based on algorithms governed by simple rules. [28] The works that artbots go through as they traverse the white surface are not pre-designed and so the end result is due to both some form of randomness in terms of the initial conditions of their movement and the interaction between them on the paper.

The artist calls his robots “neural swarms” because he uses ant colony optimization algorithms to program and train them. As he explains in an interview [29] his source of inspiration was the communication of ants through the release of pheromones, which ultimately determines the communication between them and therefore cooperation. The artist replaced the chemical with paint, in order to ensure that the color secretion on the paper would remain random. [30] As Moura explains, “The finalization of the work is determined by a kind of negative feedback, i.e., when the robots stop reacting as a certain destiny colour is achieved”. [31]

Generative art is important because, as Moura mentions in the Symbiotic Art Manifesto, it paves the way for the symbiotic dialogue between humans and machines, in an effort to achieve common artistic goals. [32] In this context, it might be fair to infer that artificial creativity is not explored in order to remove or replace the human creativity. Rather, it is often seen by the artist as a new path towards exploring new manifestations of art. According to Peace and Colton: “Humans and machines have different strengths, and instead of trying to squeeze machines into a way of thinking that is human, we should aim to develop computer systems that make the most of their power”. [33]

Ontology of the Algorithms of Generative Art

*In short, I teach robots how to paint,
but afterward, it is not my doing
— Lionel Moura*

As the above examples demonstrate, in the process of creating works, generative art systems take decisions based on algorithmic rules set by the creator through programming. In some cases, the artists/programmer may claim that the system represents his own artistic idea and in others that the system creates new original expressions. Artists/programmers make use of a variety of systems such as chemical, biological, mechanical, robotic, artificial neural network systems and swarm intelligence systems. In light of the aforementioned works of art, we see the emergence of some possible definitions of the artistic trend under investigation. Following the definition given by Philip Galanter, “Generative art refers to any art practice where the artist uses a system, such as a set of natural language rules, a computer program, a machine, or other procedural invention, which is set into motion with some degree of autonomy contributing to or resulting in a completed work of art”. [34] Galander’s choice to state that the artistic act of systems involves only a degree of autonomy is crucial.

Aside from Moura, who emphatically argues that artistic systems are autonomous, researchers in the emerging field of artificial creativity remain cautious about the degree of autonomy they attribute to such systems. For example, Boden, defines this trend as follows: “art is produced by leaving a computer program to run by itself, with minimal or zero interference from a human being”. [35]

There are clearly realistic objections in accepting the autonomous artistic performativity of a generative systems and of the algorithms that constitute it. It is often argued that the strict rules that govern algorithmic systems are incapable of manifesting the creative or flexible behavior that humans possess. [36] As the philosopher Georges Canguilhem wrote in 1947 in *Machine and Organization*:

...in the case of the machine there is a strict adherence to rational, economical rules. The whole is rigorously the sum of its parts. The final effect depends on the ordering of the causes. What is more, a machine functions within narrowly defined limits, and these limits become all the more rigid with the practice of standardization. [37]

However, what is usually missing from the discussion on the nature of algorithms is an understanding of their *new* ontology. As Robin Hill notes, “Neither the articulation of an algorithm nor the dynamic process constitutes the algorithm itself”. [38] By definition, algorithms “are supposed to be strictly rational concerns, marrying the certainties of mathematics with the objectivity of technology”. [39] Contrary to this view, the functioning rigidity we have attributed to machines so far could be mitigated, in light of some different and potentially creative features of the new algorithms. Such essential attributes will be discussed from an ontological stance as a possible way for the re-evaluation of the creativity of artificial art production systems. Such an attempt is challenging because, on the one hand there is a plethora of algorithmic systems currently used in generative art with many differences between the way they function; on the other hand, artists/programmers often avoid thorough descriptions of how their systems operate in order to exclude the possibility of copying them and thus, to ensure the originality of their results. [40]

To begin with, “an algorithm is any well-defined computational procedure that takes some value, or a set of values, as input and produces some value, or a set of values, as output. An algorithm is thus a sequence of computational steps that transform the input into the output”. [41] The encoding process mainly composes a series of algorithms in a splicer, meaning that the program “undergoes a series of translations: high-level computer language is compiled into executable code, which is then converted by an assembler into binary code”. [42] This process is known as programming and is defined at an early stage by the synthesis of a pseudocode, which is then converted into source code. The program consists of the coded computing mechanism, which affects the data, resulting in either their transformation or the production of new data. Thus, the program coincides with the implementation of the algorithm using programming commands and functions.

The combination of the coded algorithms with the necessary structures in an inseparable module forms the basis of each program, and therefore the starting point of each application. The set of programming instructions that are repeated in cycles until a certain condition is satisfied is called a loop. A computer program proceeds from beginning to end by performing a series of loops. In other words, programming is a kind of narrative. It is a narrative that addresses a machine, dictating to it what to do and how to

react to another specific narrative, which comes from the user.

At first glance, the autonomy of the system seems to be mitigated due to the need to interact with the human agent, who in part determines the operation of the system through programming. Nevertheless, although this interaction is essential for the organization of system algorithms in order to perform a work of art, the algorithm remains an autonomous entity. This autonomy lies in the way in which the algorithm separates itself and operates independently of its inputs. Therefore, the autonomy of an algorithmic system is not related to whether it can work without human intervention, but to its ability to exist independently of the data on which it operates or the program that encodes it.

The autonomy of algorithms is also related to their adaptability, their ability to recognize structural features of reality, locating patterns in the data space and adapting their functions accordingly. Through the action-feedback relationship of the system with the external environment, some adaptation processes take place. These processes concern the effort of the system to maintain its internal coherence and therefore to balance the external influences. The ability of the system to adapt to repetitive stimuli, which it receives from an external actor, leads to the possibility of alternating its reaction with each new interaction.

Consequently, the goal of an algorithm and therefore a system is predetermined, but it can change quantitatively depending on the environment in which it acts and the external stimuli it receives. For example, as mentioned in the case of *The Painting Fool* above, an algorithm that processes visitor actions or changing elements of the environment (i.e., number of people in a room, daily news) when integrated in a work of art it is possible to create, at any time, different versions of this work. In this context “code is not purely abstract and mathematical; it has significant social, political, and aesthetic dimensions” [43] often correlated with the environment in which the code itself operates.

In essence, the adaptability of the autonomous system is synonymous with its ability to resist any kind of external manipulation that attempts to change its internal coherence. Thus, the interaction of the system with the user and the environment in which it operates, seems to consolidate its autonomous action rather than prevent it. The adaptability of the system is important because, it both secures its autonomous action and it is directly connected to the creative process. As Cohen puts it, describing the characteristics of AARON: “the machine’s feedback system as a whole will need to possess a comparable adaptiveness to permit of the fluently changing pattern of decision-making which characterizes the practice of art”. [44]

As Kitchin points out, the algorithm is inherently performative in the sense that it can contribute to the implementation of many alternative scenarios. [45] As he notes: “As well as being heterogeneous and embedded, algorithms are rarely fixed in form and their work in practice unfolds in multifarious ways. As such, algorithms need to be recognised as being ontogenetic, performative and contingent: that is, they are never fixed in nature, but are emergent and constantly unfolding”. [46] As part of the assemblage of a code and then of a program, a system algorithm can produce in each execution either the same version of a project or different versions of it. Its potential lies precisely in the ontogenetic dimension which characterizes algorithmic systems. [47] In some cases, algorithms and their code incarnations are refined, redesigned, extended, and corrected by repeating through different versions. [48]

Aside of the performative nature, the algorithmic assemblage is important for two more reasons: firstly, because the repetition of different versions through the assemblage of a variety of algorithms prevent the results of the code from being perfectly defined and hence, they often fall out of the artist's/programmer's control. In some cases, the code has been programmed to evolve, rewrite its algorithms as it observes, experiments, and learns independently of its creators. [49] For this reason, the originality that governs the artistic creation of systems, although fed in them through programming, is not predictable or controlled by the programmers. [50] For example, as Tyka asserts in an interview about how artificial neural networks operate in art: "In many ways the challenge to understand the innards of an artificial neural network and explain its decisions or classifications remains unsolved and is an area of active research". [51]

At the same time, the performative actions of an algorithm are neither intentional nor explicit, but remain open to error - with the transition from one state to another not always being deterministic. The non-causal dimension of algorithms is not identified with the randomness that governs stochastic algorithms but rather with their complexity. Johanna Drucker, referring to a more general description of the executive nature of algorithmic behavior, notes: "Algorithms are instructions for processes, for performances, whose outcomes may usually be predictable, but of course, are as open to error and random uncertainties in their execution as they are to uncertain outcomes in their use at the higher level of their operation and use". [52]

The repetitive nature of algorithms is linked to a second property, the ability to inductive reasoning. The algorithm modifies its actions each time it is executed. Having said this, in every new execution of itself, the algorithm operates in a different way avoiding to repeat the same mistake, thus ensuring its internal coherence. The ability of the algorithm to achieve the same result or to correct or improve a previous result is identified with the recall of appropriate past experiences from its memory, a process which depends heavily on closed internal loops. As McCulloch argued in 1952, referring to the Turing machine's feedback capability, what is important and allows the machine to develop the capacity for inductive reasoning and real-world learning is the ability to receive the input of a new execution, the output data of its previously performed executions. According to McCulloch:

"It is a beauty of the Turing machine to be open to contingent facts from an external agent conceived as able, like the machine itself, to print symbols on its tape. These marks which the machine and the world may make and erase, serve both as signals for operations and for operands, sometimes subserving both functions simultaneously". [53]

Conclusions

*If a lion could speak,
we could not understand him
— Ludwig Wittgenstein*

In the prospect of the existence of fully autonomous, non-human systems of art production in the following years, this paper attempts to question the explanation of artificial creativity through anthropocentric analysis. As Moura notes: "Art produced by autonomous robots cannot be seen as a mere tool or device for human pre-determined aesthetic purpose, although it may constitute a singular aesthetic

experience. The unnamed characteristic of such a kind of art must be translated in the definitive overcoming of the anthropocentric prejudice that still dominates Western thought. In short, a true robotic art must be the matter of robots themselves". [54] In this context, the first part of the work sheds light on examples of collaboration between human and artificial entities in the creation of art. Observing the nature of the interaction of artists/programmers with nonhuman systems of art production, leads to a fruitful and less discriminatory understanding of the living and the non-living creative agents as two ontological partners who converse, jointly aiming for new artistic explorations.

The second part provides definitions for generative art along with a different reading of the ontology of algorithms. It then investigates whether the rigidity that characterizes algorithms is mitigated by highlighting the lesser-known aspects of their behavior. The analysis contends that overcoming the limitations of a creative artificial system, occurs from within the system itself and is intertwined with the very structure of the algorithms that constitute them. Lastly, from a methodological stance this analysis underscores the necessity of a theoretical framework which will allow a fresh understanding of the way nonhuman agents create art. I consider such an understanding as crucial for generative art to move away from a technophobic frontier and integrate with the ongoing evolution of art history.

The main problem in the future acceptance of a creative system as an artist *per se* lies in the fact that throughout the spectrum of historical narratives of art, the creative process has been identified with human nature itself. The human species has so far progressed with an almost undisputed confidence against the machine, believing that it possessed some features that no algorithmic system would be able to emulate: Imagination and creativity, an *ipso facto* human "code" that no programmer could "break". [55] [56] However, the transition of art production to the digital realm and the wider convergence of the fields of art and machine learning, raises concerns about the way we perceive the creativity not only of the machine but also of human beings. The shift that generative art brings to the traditional scene of artistic production is understood as the formation and emergence of a new *otherness*. The acceptance of *other* agents to be creative, requires awareness and self-knowledge of our own creativity, a quality that we think of as a *conditio humana*, defining us as human beings, but which still remains essentially unknown to us.

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Living Biotechnical Lives: Noise, Parasites, and Relational Practices

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Abstract

Life in the era of biotechnology opens up opportunities but also brings challenges related to our values and questions on how we want to see coexistence on our planet inhabited by many species. The parasite is our case study and an interesting concept that we inherit from biology, but which is also addressed in humanism and philosophy. As humans, we commonly understand a parasite as a negative concept that suggests that someone or something benefits at our expense. However, French philosopher Michel Serres has thought differently about the parasite. According to him, the parasite is based on relations between different entities and that there is often noise in these relationships. Michel Serres refers to biologist Henri Atlan, who has argued that noise forces the system to reorganize in a way that incorporates noise as a part of the complex system. The idea of noise included as a part of the system is quite far from today's thought-processes with the development of bio/technology that typically aims at noiseless, error-free and aesthetically attractive results.

Therefore, although parasites are often associated with terms such as inhospitable, undesirable and disgusting, and they are seen to be located outside of art and technology, in this paper we argue that the concept of parasitical is tightly intertwined into our contemporary biotechnical lives. The article relates the parasitic thinking by Michel Serres to an artistic mediation of the biological parasite, a tick.



Figure 1. Questing tick. ©Laura Beloff

Keywords

Parasite, Serres, biology, technology, noise, ticks, relations, biotechnology, science, evolution.

Introduction

Scholar and ecofeminist Vandana Shiva proposes in a published interview that the reductionist approach, typically present in the sciences, symbolizes violence in the level of the mind. This violence begins in the way we are brought up and learn how to think about the world. According to Shiva “the connection between reduction and science, its violence, the technology that it shapes, and a profit center of capitalist structure of limitless resource exploitation is all connected because when you declare that nature is dead, then you exploit her”. [1] This in mind, it is definitely interesting to investigate what we commonly regard as the darker aspects of biology, such as parasites - organisms that we consider unpleasant, and which might be harmful for our health. Similar darkness can also be seen in our practices with biotechnology on manipulating diverse organisms’ faculties, abilities, and their evolutionary trajectories.

However, this article is not specifically a critique of technoscience nor its development, but in what follows, we will conduct practice-based readings of Michel Serres’ text *The Parasite* (1982) in an attempt to formulate a non-reductionist position which include reflections on noisy evolution, parasites and practices relating to the biotechnological lives we are leading. [2]

Parasites

Stephen Crocker reminds us that the term parasite in French refers to three very different things, which however share the common principle of interference. [3] Thus, parasite may refer to a biological organism that lives off a host; a social organism who feeds on the charity of others

without giving anything in return; and static/white noise in a communication circuit.

One of the major humanities perspectives on the concept of parasite is written by the French philosopher Michel Serres. In his text *The Parasite* Serres proposes that the parasite is key to evolution and our relation to our surrounding world. The parasite, Serres argues, can lead us to an image of our world in which relations are enabling further mutation and *parasitism*.

“We parasite each other and live amidst parasites. Which is more or less a way of saying that they constitute our environment.” [4]

The parasite leads us to relations otherwise invisible or inaudible to us. In other words, the parasite according to Michel Serres reveals a relation to relations.



Figure 2. Ticks in the Tick Terrarium 2020. ©Laura Beloff

Biological Parasites

An example of a biological parasite, a tick, is a focus of an artistic research project by Laura Beloff (conducted

partwise in collaboration with Kira O’Reilly under the title #tickact). The biological, social and communicative circuits raise questions about the parasitical relations in humans’ evolutionary trajectory, biological organisms, technology and art. In this article, the tick is used as a case study from biology (and as well as it is the focus of the mentioned art project) representing a world of transforming relations.

Tick is an arachnid and a member of arthropod group together with spiders and mites. Today, we encounter increasing amounts of ticks in our environment; in the natural environment, but also in the borders of urban parks. Tick is becoming one of the frequent parasitic guests in our lives.

Ticks are considered as *vectors* in environmental sciences – this means that ticks carry pathogens, bacteria and viruses, which they transfer from one host to another. Some of these pathogens can cause serious diseases in humans, such as the Lyme disease that is a result of a transfer of the *Borrelia burgdorferi* bacteria to humans. This transforms a tick into a feared and unwanted visitor in our lives. But one can also see that as a vector, a tick creates horizontal connections, or relations, between the different hosts that the tick utilizes for its necessary blood meal. The blood meal is what we humans can offer for the tick, but commonly it is an involuntary act from us. In our minds the parasite is a feared concept that references that someone or something would benefit at the cost of us, which does not easily fit with the individualistic mindset we have been brought up with.

Noise

Interestingly, Michel Serres perceives the parasite and parasitic relation through the concept of noise. Serres’ reevaluation of *parasitic* noise builds on a basic principle of information theory. In Claude Shannon’s pioneering work in which he laid the foundation of information theory, he was researching an efficient way of encoding information and how to deal with the problem of noise. Shannon understood noise as elements of the signal that are not part of the actual message being transmitted [5] [6]. In Shannon’s work noise is recognized as a necessary consequence of transmission. Michel Serres compares noise to parasitism by proposing the following - “Theorem: noise gives rise to a new system, an order that is more complex than the simple chain. The parasite interrupts it, is vaccinated, becomes immune.” [7] Noise becomes as an integral part of the system.

When noise appears in every-day media such as static in a radio transmission, the presence of the medium is registered in what would, seemingly, otherwise be a clear transmission. As Crocker explains, Claude Shannon recognized that whether or not a certain effect is considered noise depends on one’s position in the listening chain. Noise is interference only from the sender’s point of view. From

the point of view of the receiver it may be considered a part of the information packet that is transmitted along a channel. [8]

According to Michel Serres, noise does not indicate a fault, a mistake, or an information-gap; rather, it indicates a surplus of information. To continue further considering the development and impact of technology; Marshall McLuhan famously argued, “The medium is the message”, which means that the user becomes the content of the message. [9] Also, in the early 1970’s art historian Jack Burnham pointed out about technology and artists’ role within the changing milieu: “With increasing aggressiveness, one of the artist’s functions, I believe, is to specify how technology uses us.” [10] More recently, scholar Benjamin Bratton has pointed out about proto-sentience and surfaces in urban environments. He writes how technology and clothing form a type of artificial skin for us, but also the city’s’ surfaces have begun sensing the environment. According to him – “the city also wears us.” [11] We have become an essential part of the system. It becomes clear that a medium/milieu affects, or acts upon, the signal. The active intention to transmit a signal requires that we open ourselves to the passive reception of the medium in which it can occur.

Relational Practices

Serres transposes the parasite to something which should be understood as a critique of common knowledge and especially of the self-understanding of sciences (including the humanities and the arts). This means that technology is already there as part of the relationality of practices. Technology may in fact not be the transcendental link to the framing of human culture as Heidegger, McLuhan, and Kittler have proposed since, according to Serres, there is no such intentional congruence between technology and culture. There is no intentional relationality between technology and humans, but there is a relationality of practices, causes and effects from what is done, while and after it is done.

Michel Serres introduces the principle of the productive force. He follows the French biologist Henri Atlan in arguing that noise in a system should not be seen as a positive force that does something. Rather, Atlan argues, noise prompts a system to reorganize in a more complex form that incorporates the disturbance. [13] [14] Here we really find the heart of Serres’ theory of the parasite.

“In each case, the parasite interferes in, and ultimately upsets, some existing set of relations and pattern of movement. It compels us either to expel it, or to readjust our internal workings so that we can accommodate the needs of the parasite. Noise, in other words, is to communication what a virus is to an organism, or a scapegoat is to a community. It is not simply an

obstacle, but rather a productive force around the exclusion of which the system is organized.” [12]



Figure 3. Tick Terrarium 2020; a wearable bioweapon. ©Laura Beloff

The parasite acts on existing communication, be it biological, informational or social. It instates itself in the circuit between a point of transmission and reception. The parasite does not act directly either on the sender or the receiver. It acts on the relation that joins, for example, an enzyme and the protein it breaks down or a tick performing the relation between different hosts by being the vector for trespassing bacteria or virus. Serres defines quite precisely that the parasite always acts on relations. He writes that while atoms lead us to ontology, the parasite leads us to relations. [15]

The property of the parasite of joining diverse entities enables new constellations and human thought processes, which are based on the relational practices, which inherently include noise as a component of it.



Figure 4. Tick Garden experiment 2021; artificial habitat for ticks. ©Laura Beloff

Noisy relations

The formed network of diverse relations and general interests in the contemporary feared parasite, a tick, form the backdrop for the work *Tick Terrarium 2020* by Beloff. The artefact, the *Tick Terrarium 2020*, is a wearable device for humans, which is made of several glass vessels. Inside the glass vessels are habitats made for living ticks with grass, moss and natural rubbish. This device resembles a suicide bomber's vest by its shape, but instead of carrying explosives the wearer is carrying fragile glass vessels with parasites living inside them. The work directly references through its shape and wearability the biotechnology research and development on ticks that was conducted in the U.S. between 1950's-70's with an aim of using ticks as

bioweapons - which is well described in the popular science book by Kris Newby. [16]

Serres sees the parasite as a key to evolution and similar understanding is also advocated by evolutionary biologists. Scientist Tuomas Avelo writes about human evolution and inherited parasites: "Whilst there was plenty of plant-based food in Africa throughout the year, in the harsher conditions in Europe, they [Neanderthals] only hunted meat on which to live during the winter. Meat, in turn, predisposes more to parasites, and therefore Neanderthals probably had a more effective immune defense than our own ancestors. [...] By moving to the Neanderthalian habitat and consuming the same diet, modern humans also inherited the Neanderthals' parasites. Neanderthals became extinct, but still their genes helped modern humans to adapt to the new environment in the most intimate of ways. [...] We have inherited from Neanderthals not only their parasites, but also their immune genes. While these genes were beneficial to modern humans as they spread around the world, now that there are no longer so many parasites in our environment, they have become harmful" [17]. By stating this Avelo defines that we (humans) would not have evolved to what we are today if there would not have been parasites and parasitic relations on the way. In a sense one can think of parasites as a kind of noise in the system that challenges and potentially reorganizes our minds and bodies - as well as forces us to cope with old and new relations and unexpected noise in them.

The notion of the performativity of facts is useful in approaching the artistic activity with Ticks. Those practices are in fact comparable to *experiments* carried out by practitioners who, according to Isabelle Stengers, raise the question of how to 'struggle against the role assigned to their practice?' She continues by connecting experimental practices to an existential struggle against the growing exposure of practitioners to a destructive pattern of a dominating neo rationalist umbrella-culture cancelling out any noisy images (and thereby the identity of the experimental practitioner as well) generated by experimental practices:

"Under the guise of the (capitalist) "knowledge economy", what is happening is no longer only the intoxication but the destruction of the social fabric which empowers researchers to think and feel, imagine and object. Soon those practices will indeed confirm the critical diagnosis that there was never anything special about them, that they were reducible to power interests. How to connect with those scientists who complain about their increasing subjection?" [18]

One can claim that many experimental art practitioners working with technology and biology create new kinds of

noisy images, which are in a way parasitical of the conventional scientific understanding of *nature* and humans perceiving it.

Artist Paul Vanouse's work *Labor* (2019), can be seen as conducting *experiments* with the hidden biotechnological lifeforms existing in our bodies and perforating through our skin when we sweat. Vanouse shows that microbes vastly outnumber the human cells in and on the human body concluding that: "Our microbiota is integral to who and what we are and complicates any simplistic sense of self. Likewise, the smell of the perspiring body is not just a human scent, unless we are willing to redefine what we mean by human." [19]

The dominating rational scientific culture seems to shy away from the parasite outside its micro-biological 'habitat', and from everything *noisy* when concerning the idea and borders of what is human, and what is not. Similarly, one can critically ask what are the criteria we base our choices on when we e.g., modify organisms or decide which non-humans are accepted and which are not? Parasites would presumably belong to the latter group. The criteria-in-use appear to be influenced by the prevailing technoscientific perspectives and the expected use value for humans. The made decisions, their embedded values and connected aesthetics are also trickling down visibly to art practices. For example, one could say that in digital and biotechnological arts certain types of aesthetics are dominating, which typically one could describe as aiming for clean, smooth and perfection. This is an obvious influence of technological development and biotechnological practices, which drive for better, more efficient systems and idealize continuous progress often with expected profit. It seems that the mainstream technological mediation (as well as development e.g. in synthetic biology) favors a perfect version of the world editing out the bad, the ugly and the unpleasant, such as parasites, noise and errors.

In the case of the tick-project and the work *Tick Terrarium 2020*, as well as the work *Tick Garden experiment*, the opposite is true; these parasites are brought to our vicinity to critically challenge the limits of our anthropocentric worldview and affection towards the non-humans. It is hard to deny that ticks would not evoke, on some level, feelings of hatred and disgust in us. But how can we go further from this beyond the desire for the perfect and control over life?

Vandana Shiva says about (reductionist) science that "it assumes that only things that can be measured exist. You cannot measure a relationship; a relationship can only be experienced." [20]

Biotechnical lives and noisy evolution

We began by stating that this article is not a critique of technoscience: rather, it is an attempt to establish a different relational understanding of practices in art and science. Through a practice-based reading of Michel Serres' text *The Parasite* we have investigated the noisy evolution, parasites and practices relating to what now appears to be a struggle against 'ourselves' and the social, as well as scientific, norms we so keenly construct. Increasingly, scientific culture and practitioners on diverse fields have been subjected to growing expectations of cancelling out noise and the parasitical. These are the darker sides of the biotechnological lives we are leading - and which we need to be questioning.

In this paper we are underlining the importance of Michel Serres' ideas about the parasite as the key player in the noisy evolution of the invisible relational practices that structure the way we live our biotechnical lives.



Figure 5. Tick Terrarium 2019 and 2020. ©Laura Beloff

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Authors' Biographies

Laura Beloff (PhD) is an internationally acclaimed artist and a researcher in the cross section of art, technology and science. The research is in a form of installations, wearable artifacts, and experiments with scientific methods that deal with the merger of the technological and biological matter. The research engages with human enhancement, biosemiotics, AI, AL, robotics affiliated with art, humans, natural environment and society. She is Associate Professor and Head of Doctoral Education in the Department of Art & Media at Aalto University, Finland.

Morten Søndergaard (PhD) is an internationally acclaimed curator and researcher in the histories, theories and cultures of transdisciplinary practices merging technology, media, art and societal trajectories. From the master thesis on the method of Michel Serres in-between poetry, art and science (1995) to the Phd on unheard avant-gardes in Denmark (Show-bix and the Danish media poet Per Højholt) (2007) the line of inquiry draws the analysis of transdisciplinary practices into epistemological questionings regarding the complexities of human and non-human relations, as well as a general study of the overarching question regarding experiencing and evidencing posthumanity. He is Associate Professor and Academic Director of the Erasmus Media Art Cultures Master Program at Aalborg University, Denmark.

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Internet vernacular creativity. Vaporwave, counterculture and copyright.

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Abstract

This article stems from ethnographic fieldwork I carried out in 2019 on the virtual platforms where vaporwave, an Internet countercultural phenomenon between a musical genre and a meme, is developed. In this text I show how copyright laws and technologies operating in the context of vaporwave's creation traverse and affect its creative forms and processes. Based on this case study of vernacular Internet creativity, I encourage an approach to digital countercultural or folkloric movements by putting into dialogue their symbolic dimension and the sociological, technological and legal bases on which they develop.

Keywords

Digital Culture, Creativity, Post-Internet, Copyright, Electronic Music, Memes, Internet Culture.

Introduction

Vaporwave is a digital aesthetic between a musical genre and a meme. It has developed entirely on the Internet since 2010 and its ambivalent nostalgic and ironic position, underground and pop, has given rise to numerous reflections and drifts. This aesthetic takes up and transforms the futuristic visions of the 70s, 80s and 90s, the popularisation of new technologies, the corporate culture of globalisation, the big shopping malls and techno-optimism from a critical nostalgia. Often described as music for abandoned malls, it performs an aesthetic of the disenchantment of 90s techno-utopianism, an ironic renewal of futures that were imagined but never arrived.

Theorists and critics such as Adam Harper, Mark Fisher or Simon Reynolds, among others, have laid the foundations to understand this digital countercultural movement, from *hauntology*, *retromania* or *accelerationism*. [1] [2] [3] Vaporwave has generally been understood as a counterculture that criticises and embraces capitalism, reclaiming corporate and commercial culture.

Numerous reviews and analyses of vaporwave in specialised magazines, books and scientific publications have linked it to *hauntological* electronic music. [4] [5] [6] [7] [8] This concept popularised by Mark Fisher derives from Derrida's *hauntologie*, "described as the way in which everything that exists does so on the basis of a series of absences that precede it and envelop it, while at the same time giving it consistency and intelligibility" and is used to describe a type of electronic music that deals with nostalgia, memory and the absence of a future. [9] Ambiguous and ghostly music linked to the crisis of capitalist society and postmodern distrust in the future that we can find in artists such as The Caretaker, William Basinsky, Philip Jeck or Burial.

At the same time, Adam Harper, in his article "Comment: Vaporwave and the pop-art of the virtual plaza" formulates a widely extended way of understanding vaporwave. The music critic describes vaporwave as an ambiguous critique of capitalism, a critique that is at the same time a recapitulation and an admiration. Vaporwave is understood as an art form linked to accelerationism.

Accelerationism is the notion that the dissolution of civilisation wrought by capitalism should not and cannot be resisted, but rather must be pushed faster and further towards the insanity and anarchically fluid violence that is its ultimate conclusion, either because this is liberating, because it causes a revolution, or because destruction is the only logical answer. [10]

Thus the samples of pop songs and television commercials are read as a critique of capitalism "from the inside", showing its paradoxes and participating in them until they collapse. Vaporwave would represent a strange and ambivalent critical celebration of capitalist consumerism. At the same time, vaporwave speaks about itself and its position within that capitalist machinery, configuring itself

as a metatextual discourse.

vaporwave can be heard as ambivalently dramatizing the decline of contemporary society as if accelerating it. It is a certain take on "the way things are." Floating somewhere between satire, nostalgia and envy, it bathes in capitalist luxury and gloss, huffing the fumes of advertising, and through the prevalence of signifiers of the early internet suggests a fond yet alienated self-image of the very virtual world it finds itself occupying-kitsch, well-meaning, but inhuman, aimed at someone else, too sublime. Its medium and its message indistinguishable, vaporwave is the online underground looking in the historical mirror. [11]

This microgenre has been the subject of great hermeneutics made from music criticism and cultural studies. In this article, however, we show how an ethnographic approach to this post-digital aesthetic is useful in revealing the creative and social processes that construct vaporwave. By focusing on vernacular Internet creativity, [12] [13] we will be able to analyse this countercultural movement without the hermeneutic violence that many researchers exert on our objects of study, whether in painstaking formal analyses or in grand sociological assessments. In this short article I will show concretely how the copyright laws and technologies that traverse the Internet articulate and dialogue with the creative processes of vaporwave.

Vernacular creativity

Within vaporwave we find multiple visual and musical expressions. The latter are mainly based on the appropriation (and in some cases production) of *muzak* or elevator music. This kind of lounge jazz, mood music, easy listening or background music is appropriated and compiled in albums under strange names, sometimes unaltered and other times mixed with ambient sound, teleoperator voices, echo or reverb, generating an ambiguous sensation of artificial calm or comfortable restlessness. Likewise, within vaporwave we can find musical productions based on sampling and remixing pop music from the 70s and 80s, very often slowing them down, making endless loops or creating chaotic mash-ups. Many of these mash-ups and remixes often use audio from antique commercials or TV shows, sampling slogans, background music and catchy melodies. However, what might be the main formal characteristic of vaporwave is the slowing down of popular songs from the 70s, 80s and 90s to turn them into strange, *unheimlich*, familiar and distorted artefacts. Many vaporwave productions are based on modifying a well-known song by drastically reducing

its beats per minute (bpm) and pitch (making it lower) and adding echo and reverb effects. This modification creates a feeling of something broken, of a memory damaged by the passage of time, of strange nostalgia or of an opiate high.



4 cover-arts of vaporwave albums. From left to right and from top to bottom: Floral Shoppe by Macintosh Plus, Chuck Person's EccoJams Vol. 1 by Chuck Person's, B L I Z Z A R D 9 6 by B L I Z Z A R D 9 6 and SANDRA WAVE by 猫 ∩ Corp.

But vaporwave, the genre, the meme, the aesthetic or the movement is not exclusively composed of musical productions, cover-arts, collages and screensavers, but encompasses all aspects of online mediation. It is a paradigmatic example to understand the idea of "vernacular creativity" on the Internet. This concept encompasses those creative practices that arise from highly particular and non-elitist ("ordinary" or "popular") social contexts and communicative conventions. [14] These creative practices, not necessarily linked to a commodification or exhibition, adopt multiple forms beyond those that we can understand within the idea of cultural goods such as books, videos, songs, visual creations, etc. All the practices of online mediation are susceptible to being traversed (and in fact, they are) by this vernacular creativity, from comments or likes to the creation of profiles, file names, tags, hyperlinks, typographic sources or the very platforms through which they are distributed.

In the digital ecosystem of vaporwave, these forms of creativity cross all these aspects mainly with ironic, joking or absurd dyes. The names of the songs and producers are incomprehensible pieces of text that mix numbers with bad

translations from Japanese, such as “MACINTOSH PLUS - FLORAL SHOPPE - 02 リサブランク420 - 現代のコンピュータ” or “2814 - 新しい日の誕生/Birth of a New Day”. These artist or song names are usually written with a space after each letter, something that has now become a sign inextricably linked to vaporwave, to the point that many refer to the genre as "A E S T H E T I C S" instead of vaporwave. This way of writing can also be found in forums, chats, social networks and comments as an implicit way of referring to vaporwave.



Screenshot from <https://mexicanwave.bandcamp.com/>

Instagram, Bandcamp, Tumblr or Soundcloud tags, designed to categorise productions and mostly used to gain visibility, are also another avenue for creativity within vaporwave. Within vaporwave productions, sub-genres such as *pizzawave*, *italianwave*, *brzl wave*, *vaporlevante*, *cutrewave*, *jesusgilwave*, *perreowave* or *favela de vapor* are constantly created without commercial or archivist intention. Genres and categories are constantly invented without seeking to be consolidated or known. This creativity shapes the ways of being on the Internet, whatever forms of expression one has access to, playing with jokes and disorientation.

At the level of production, we cannot separate creations such as songs or collages from other dimensions such as the creation of profiles or tags. As popular culture, in the online underground where vaporwave develops, musical practices make sense in the multimedia context in which they unfold.

Digital folklore and copyright technologies

An ethnographic approach that attends to the social space of production, and understands context, productions and mediations as an indivisible whole, allows us to find the articulations between the different forms of creativity and the technological and social media that generate and host

them. Thus, we can rescue the concept of folklore but not to invent a tradition or imagine an "ordinary people", but to unite context and form in a notion. By understanding vaporwave as part of *digital folklore* [15] [16] we can analyse how the dynamics of the Internet and the characteristics of the digital platforms from which vaporwave is developed intervene in the creation of the genre and in the creativity that is experienced.

From this point of view, I will show how copyright laws and technologies that affect the circulation of cultural products on the Internet traverse and affect the forms that vaporwave productions and creative processes take.

The role of the "content filters" of social networks and platforms such as Youtube, technologies that detect copyright violations of certain content to remove them, have a key place in the generation of countercultural digital currents and aesthetics such as *vaporwave*. In the pirate circuits of the Internet, these technologies have been subverted with 'hacks' such as 'mirroring' images (turning them upside down), modifying file names or altering the sound (modifying the *pitch* or *tempo* of audios or songs).

Wang, creator of the algorithm used by *Shazam*, an app that identifies songs by audio, explains how this technology works. [17] Broadly speaking, each audio file is associated with its "*fingerprint*" (*audio fingerprinting*), composed of data on the sound frequencies of the song, its position on a timeline and the relationship between them. Thus, through these song data, the algorithm is able to quickly identify sounds with their fingerprint, that is, with the specific song in the database. Storing not only the frequencies and their position on the timeline, but also the relationships between them, achieved fast and reliable accuracy. But the devil is in the detail. A simple hack can bypass this detection technology to circumvent copyright-based restrictions. If the algorithm takes into account the temporal relationships between the different frequencies, you just need to modify these relationships so that it can't work. This is the main feature of vaporwave, lowering the *pitch* and slowing down the *tempo* of existing songs to turn them into strange creations somewhere between the familiar and the bizarre. On the other hand, the way of writing used to name songs, producers or simply to talk about vaporwave (automatic translations into Japanese and placing a space between each letter) are related to a hack used by many Internet users to circumvent complaints of copyright infringement. In addition to these automatic detections by platforms like YouTube, the "Google Alerts" tool is widely used to find unauthorised use of songs. This tool communicates an "alert" to an account every time certain words enter its indexing field. Thus, a production company can track verbatim when one of its songs is used. The hack is clear.

Changing the text (for example, by adding a space between characters) can circumvent this technology.

These characteristics of the songs produce a disturbing effect, listening to songs that you recognize in an altered, broken version; a nostalgic sensation, configuring a distorted memory; an ambivalent critique, turning mass culture songs into *unmarketable* sound pieces; and a suspicion of ironic joking by publishing songs under incomprehensible titles in Japanese, created simply by slightly modifying a well-known song. This nostalgic critique and disturbing joke has been analysed by numerous music theorists and critics, but few relate this symbolic world to its more material aspects.

Beyond this link to hacking practices, the exploration of muzak and easy-listening music also suggests a connection to the Internet archive and copyright laws. The idea of 'stock', derived from photos that can be found in image banks such as *shutterstock* or stock audio and royalty-free music, is recurrent and takes on diverse meanings in the *milieu* of memes and digital folklore. These images and songs are used in many memes and works of digital folklore, as well as other aspects of 'stock' such as watermarking, to refer to the *normie*, the familiar/unsettling, the standardised, the capitalist and so on. From the well-known meme named 'Hide the pain Harold', referring to the use of photos of the Hungarian stock photo model András Arató, to the Instagram account @listillas, dedicated to making memes combining stock models with *normie* phrases, or the use of watermarking in certain ironic designs, the 'stock' has become part of the Internet.



Photograph/Meme of Harold found in the web *Know your meme*. [18]



Meme uploaded by @Listillas in her Instagram account.

These watermarked (a copyright technology that prevents illegal use of the images) stock photographs is equivalent to vaporwave's use of elevator music and "royalty-free" music. The ironic exploration into these free music archives, full of boring and cold music, is a creative practice that takes the copyright restrictions on music and acts on them, subverting or exploiting them. These songs are taken from the archive, appropriated and recontextualised on other music sharing platforms such as Bandcamp, Soundcloud or Youtube, or in forums and chats under incomprehensible names that suggest orientalism and complexity.

As we saw in the previous section, the creative acts involved in these forms of creation cross many forms of digital mediation and, in turn, are traversed by the technical and legal contexts in which they are developed. These creative forms are built on the immense archive of the Internet, playing with the meanings associated with the different platforms, the forms of presentation, selection, curatorship and the combination of elements from copying, plagiarism, falsification or appropriation.

As a conclusion

It is necessary to look at the material, technical and legal conditions of the musical space of the Internet in order to analyse its interrelation with the symbols and meanings associated with vaporwave. Understanding the critical and ironic character of vaporwave linked to the existence of the Internet in relation to the technical-legal restrictions of copyright laws allows us to broaden our gaze in the analysis of the cultural phenomena of digital folklore. By focusing on the relationship of vaporwave to hacking and stock platforms, I do not mean to argue that this aesthetic has a practical character nor that it is a direct cause of the application of hacks to bypass copyright technologies.

Likewise, I do not mean to prioritise this material dimension over the symbolic one. Ideas and debates about late capitalism, accelerationist logics or commercialization are an intrinsic part of vaporwave and constitute it as a genre. My intention in showing this concrete example is to encourage the understanding of countercultural movements by putting in dialogue their symbolic dimension and the sociological, technological and legal bases in which they develop.

Many analyses of vaporwave made by musical and cultural critics are guided by a logocentric approach, focusing on the philosophical basis of the productions or their deep meaning for our contemporaneity, leaving aside the creative forms and processes. With this small case I want to give rise to an understanding of a creativity that is experienced in a context, following Ingold's proposal. [19] To deal with the articulation, symbiosis or inseparability of creative processes with the material bases on (and with which) they are developed (in this case the Internet, but also computers, content filters, databases and archives, jpg files, timeline visualisation in audio editing software etc.). Rather than focusing on the philosophical reasons of creations or their deeper meanings, I prefer to look at their conditions of possibility, thinking about a kind of everyday creativity that links creators, materials and mediations.

The creative processes in vaporwave take place on the Internet, with computers, files, filters, algorithms, forums, networks of collaborations etc. and show how these technologies are not exclusively tools for transposing or constructing ideas. In vaporwave, as in all folkloric and artistic expressions, the creative and design work is constructed between the producer and the *machine*, that is, the material and social technologies, forcing us to change our way of understanding and valuing creativity, to leave aside the centrality of innovation and originality and to include copying, archival selection, recontextualization, falsification or plagiarism as creative forms.

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Made you look: crossing visual attention with computational design to create motion-based visual distractions

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Abstract

The Information Age has brought up new contexts and challenges to the way we produce and consume digital content — from personal digital devices to digital billboards in urban spaces. The latter are usually characterized by a high amount of visual stimuli, demanding a considerable amount of attention of the passers-by.

Crossing visual attention studies with computational design we develop a set of interactive prototypes to assess the digital capacity to capture individuals' attention and distract them from a main task.

As part of an ongoing research that aims to develop a system that is able to adapt its visual composition and create its own communication strategy according to its audience and environment, in this paper we focus on the development of computational artifacts to create stimulus-driven distractions. We analyze how these concepts and cross-knowledge may affect the attention of the audience towards these unexpected targets. The preliminary results suggest a set of promising stimuli that can be applied in the design of visual communication objects for this specific purpose. They also establish a basis for further research regarding other visual stimuli and open possibilities for explorations on the application of this visual communication strategy in more complex environments.

Keywords

Visual attention, computational design, context-aware systems, adaptive systems

Introduction

Urban spaces are rich in environmental stimuli [4], often comprehending visual stimuli. These can be found in several sources: from traffic signs, to advertisement boards, to animals, cars, etc, all these demand the attention of the passers-by. This high amount of stimuli represents a challenge when creating visual communication objects that should address the public's attention in these environments. However, when combined with the presence of digital screens, it can turn into an opportunity to explore new resources for the creation of visual strategies and address the contemporary context of urban spaces.

Since attention is a limited resource, each person has to be selective when deciding which targets to focus on. This selection involves attend to determined stimuli while rejecting others. [6] To address this issue, “a deeper understanding of

human attention skills is important.” [1]. As a result, we focus on the study of digital graphic objects towards effective visual communication strategies on visually competitive environments and therefore challenge the public's attention.

In our research we have identified two important approaches. The first, concerns the public's visual attention, i.e., understand how the brain processes visual stimuli and chooses where to focus its attention as much as creating visual stimuli that activates these brain functions. The second, concerns the public's engagement towards a graphical object, i.e., create visual strategies to maintain the public's interest in the object and to guide its eye gaze towards specific elements of the visual composition. In this paper, we draw a set of prototypes and experiments to explore the first.

We cross findings areas such as Cognition and Computational Design to support our research and the development of prototypes that explore the dynamic triggering of a selected set of visual stimuli in a visual composition. On the one side, the findings regarding Visual Stimuli guided the collection of promising visual stimuli to use, either individually or in combination, in the situation we are addressing — contexts where the audience is goal-oriented to other tasks and does not intend to consciously drive attention to graphic communication objects. On the other side, the knowledge of Computational Design allows not only the creation of motion-based graphic compositions but also the development of dynamic and adaptive systems, which application can be particularly interesting in less predictive and evolving environments such as urban public spaces.

In the present research we demonstrate the potential of this approach in addressing the issue raised. Through preliminary results we assign levels of efficiency to a collection of visual stimuli. Additionally, we propose a set of solutions for address the less efficient approaches while identifying new needs that shall be further tested. In sum, we aim to establish a research basis for the development of dynamic systems and consequent generation of graphic stimuli in visually competitive environments.

Visual Attention

To understand how we can address the competition for the individual's visual attention it is important that we first understand how the brain works regarding the reception of visual stimuli. We can do that through the study of Visual Atten-

tion, which “describes a set of mechanisms that limit some processing to a subset of incoming stimuli.” [8] These mechanisms are important because attention is a limited resource [6]. When exposed to a diversity of stimuli, there is a process of filter and selection where some are considered relevant while others are filtered out. After that we distribute our attention resources among the selected activities, either in the center or in the periphery of our attention [1]. This process of filtering and resource distribution “allows us to be aware of what’s going on around us without specifically attending to it” [1].

One common way to explain how our attention works, namely spatial attention, is the Spotlight metaphor, that explains that visual attention acts like “a flashlight that illuminates a region of interest, which allows for increased sensitivity and a more precise encoding of information from this spatial location.” [22] Our spotlight can be guided by our intentions and goals. This goal-driven attention is highly influenced by the perceiver’s goals, motivations and context [1][5][7]. That’s why humans are better at directing attention to targets when they have preliminary information about their features [7]. For example, it is easier to find your friend in a crowded scene when you know he is tall and wearing an orange shirt. This top-down process allows us to focus our attention in performing intended activities.

But how can we drive attention to targets that are not intended by the public? For instance, we can draw an individual’s non-voluntary attention towards a particular object, this is, without its prior desire [13] by using stimulus-driven attention. For example, when searching for a black shirt in a wardrobe full of dark clothing, your attention spotlight can be involuntary diverted if you unexpectedly encounter a bright pink shirt. The bright color was the stimulus responsible for the attention shift and not a conscious intention to find it. This type of processing, called Bottom-up, can be defined as “sensory analysis that begins at the entry-level—with what our senses can detect” [3]. It is “data driven” [3], “takes place in real time” [3], and is driven by “external stimulus event that automatically draws attention to a particular location” [8]. These stimuli are characterised by their saliency from the environment. Highly stimuli such as a car alarm, “a sudden flash of light” [1] or a bright pink shirt in a mostly dark wardrobe, can be easily attended.

In the process of selecting the set of stimuli to address in this paper, we focused on our main goal of capturing the passers-by’s attention in an urban space, which can be focused on performing tasks unrelated to the graphic digital objects we are addressing. Considering that the individuals may not be physically facing these objects, we refined our selection to stimuli to which peripheral vision is more sensitive. Among those stimuli we selected ones that create saliency based on motion and luminance.

Our peripheral vision is motion and light-sensitive which allows objects’ detection even in less favourable lighting conditions [2][20]. Changes in more complex environments can be easier detected if they contain luminance or motion cues, otherwise change blindness can occur and even dramatic changes can go unnoticed [19]. Considering these we developed our experiments applying combinations of the fol-

lowing stimuli: unexpected changes [21], abrupt onset motion [16][17], looming motion [23][10], abrupt and rapid light changes (blinking) and gradual light changes.

Context-aware Systems

In complex, dynamic and unpredictable environments such as urban public spaces it becomes a challenge to design visual communication for a specific target audience or environment conditions. Motion-based graphics may help to capture attention, but may be ignored if the visual stimuli are triggered in determined combinations of environment characteristics. To address this issue, we propose the use context-aware systems. These systems “have some awareness of the tasks users are performing and some understanding of the knowledge background of individual users as well as their location in the world” [9] and can generate outputs adapted to that knowledge.

We can find applications of adaptive systems in areas such as web-development, recommendation systems, ambient intelligence, etc. All adapt their outputs to external inputs from the environment and understanding of the user’s needs in a more or less intrusive way. A recommendation system, which may “recommend an item to a user based upon a description of the item and a profile of the user’s interests” [18] can retrieve, for example, custom advertising in order to attract attention and ultimately generate monetary profit. On the other hand, Ambient Intelligence and Intelligent Environments, in general, “are capable of recognizing and proactively responding to the presence of different individuals in a seamless, unobtrusive and invisible way.” [15].

In this paper we based our knowledge regarding these systems and use computational design and computer vision to detect human presence and adapt our visual output and stimuli behaviour to the the participants’ presence and displacement. By adapting to these characteristics in real time we aim to reinforce the participants’ awareness towards the digital graphic object and enhance the participants’ engagement and experience.

Prototype Development

In this section we describe the process of the prototype’s development. Based on the knowledge acquired in previous sections, we hereby detail the following: (i) experiment main goals, (ii) stimuli selection, (iii) prototypes development, (iv) and user tests.

Description

Based on the study described above we developed a series of prototypes to explore the application of several combinations of our selected stimuli in dynamic and interactive visual compositions. The main goal of this experiment was to understand and observe its efficiency in creating stimulus driven distractions to the participants’ attention to whom was asked to perform a specific task. The prototypes were developed in the software Processing [11], using the the OpenCV [14] library for background subtraction and face detection.

We based our stimuli selection in the knowledge that: abrupt onset — the beginning of movement — can highly

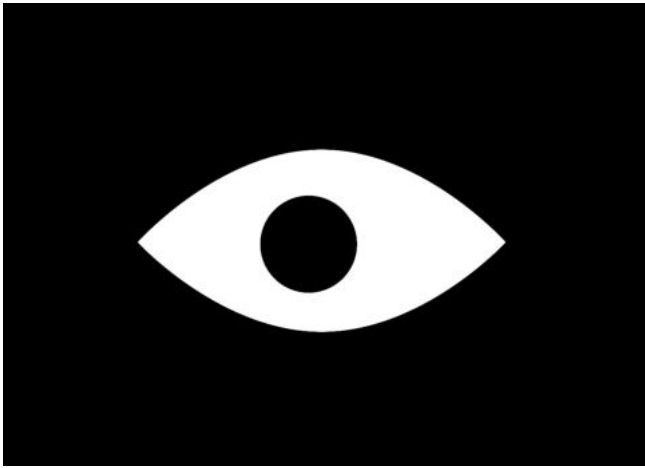


Figure 1: Prototype One

enhance the detection of a target [16][17]; looming motion — dynamic increase in the object size — makes them behaviourally urgent objects, which contribute to its capacity to attract attention. [23][10]; unexpected and abrupt changes captures attention [21][7]; luminance changes has “shown to capture as strongly as an abrupt onset” [10]; and finally that contrast is one of “the most general saliency factor” [22].

The prototypes were motion based and used computer vision to trigger the stimulus whenever motion and a participant was detected. This aspect was implemented to enhance unexpectedness but also to create a direct relation to the participant by reacting to its presence.

Prototypes Implementation

We will now describe each prototype and the stimuli computational expression. It is important to point out that the stimuli in every prototype is triggered by the detection of the participant. Once it stops detecting the participant the stimuli is cancelled and the visual composition returns to the original shape.

Prototype One (Fig.1)

Visual description: shape similar to the human eye (eyeball and iris);

Stimulus: onset motion;

Behavior when activated: the iris moves in the y axis towards the participants’ positions.

Prototype Two (Fig.2)

Visual description: similar to Prototype One. The difference was the use of abstract shapes to represent the eyeball and iris. This was developed to test if there was a difference in the result when showing a human-like eye form compared to showing an abstract eye form.

Stimulus: same as Prototype One

Behavior when activated: same as Prototype One

Prototype Three (Fig.3)

Visual description: grid of squares equally distributed over the width and height of the screen

Stimulus description: abrupt onset and looming motion;

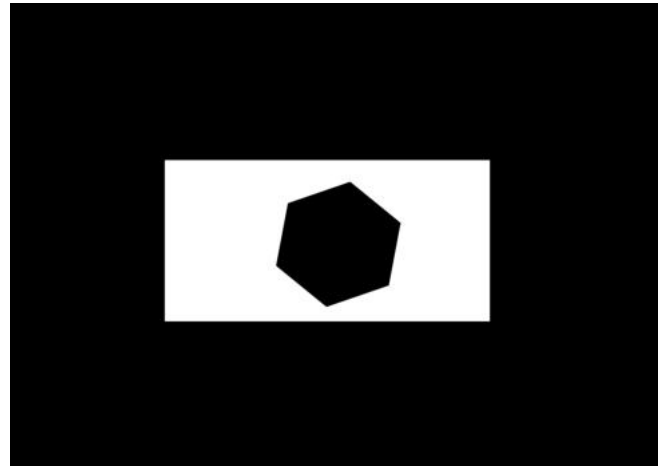


Figure 2: Prototype Two

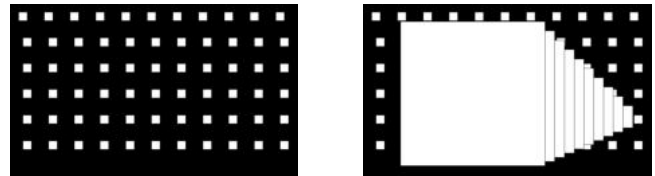


Figure 3: Prototype Three — Original form (left) and motion activated form (right)

Behavior: when activated, a previous selected square pops-up by increasing its size; a series of squares with incremental sizes are drawn between the original square and final one; this new shape moves towards the participants’ position.

Prototype Four (Fig.4)

Visual description: grid of rectangles equally distributed over the width and height of the screen

Stimulus description: onset and looming motion;

Behavior when activated: the rectangles increase shape proportionally to their distance regarding the participant’s position. The result is a circle-shaped blur that follows the participant in continuous motion.

Prototype Five (Fig.5)

Visual description: grid of circles equally distributed over the width and height of the screen

Stimulus description: gradual change in luminance contrast;

Behavior when activated: circle’s color gradually turned brighter as the participant approximated the screen.

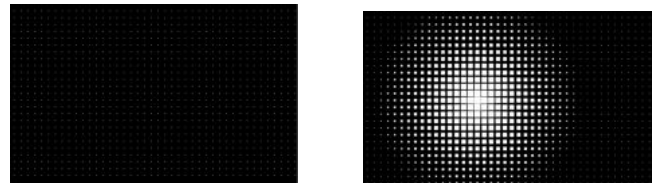


Figure 4: Prototype Four — Original form (left) and motion activated form (right)

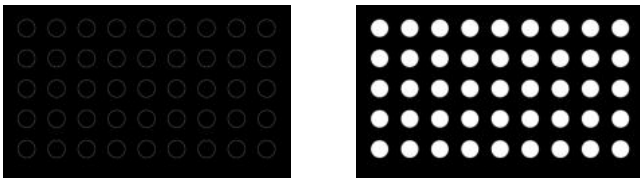


Figure 5: Prototype Five — Original form (left) and motion activated form (right)

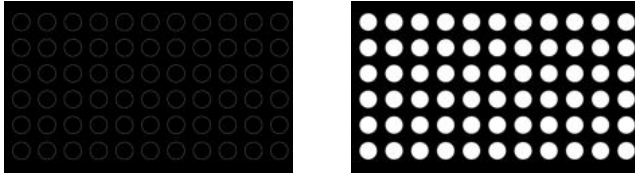


Figure 6: Prototype Six — Original form (left) and motion activated form (right)

Prototype Six (Fig.6)

Visual description: grid of circles equally distributed over the width and height of the screen

Stimulus description: abrupt onset and change in luminance contrast;

Behavior when activated: circle's color gradually turned brighter as the participant approximated the screen.

Experiment Setup

The experiment took place in a room with diverse objects related to a photography studio. There was a white table in the middle of the room with a screen that would display the visual distractions. To test the experiment capability to attract the participant's attention through peripheral vision, the screen was placed in a 90° position in relation to the participant, and in the middle of the path between the participant's initial and final position — the target's location (Fig.7 and Fig.8). The person conducting the experiment was present inside the room and visible to the participant. This presence in combination with the studio photography objects served as complementary visual distractions to replicate a competitive visual environment.

Participants

The experiment was conducted with the individual participation of eleven voluntaries physically present in the experiment room. None of them had prior knowledge of the nature or goal of the experiment. The same task was given to all participants: step to one side of the room and walk a path towards the opposite wall, where a sheet of paper with a small text was placed (Fig.8). After the task was completed, the participants were informed about the scope of the experiment and were asked to describe their experience and perception of the distractor.

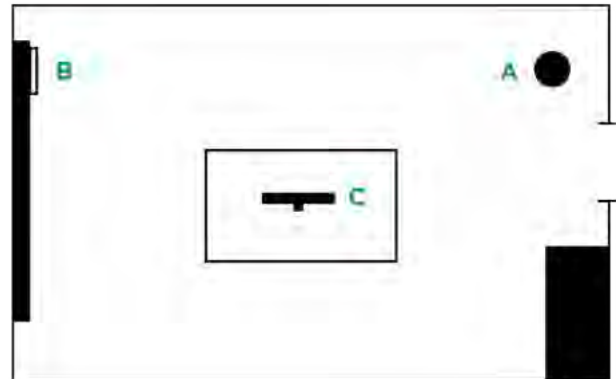


Figure 7: Scheme of the experiment room setup: (A) Participant's original position (B) Sheet of paper with text — Task (C) Screen displaying the prototypes — Distraction



Figure 8: Scheme of the experiment room setup

Results and Discussion

In this subsection we report and discuss the results of the experiments and propose further developments for the investigation. We perform a qualitative analysis of the experiments as the results were registered through observation and the participants' feedback noted.

While performing the requested task, one of the participants clearly moved the head towards the screen once the stimulus from Prototype Six was triggered; six participants reported that they saw the stimuli through their peripheral vision but continued focused in performing the task — this happened with stimuli from Prototype One, Two, Four, Five and Six; three of the participants concluded the task and reported that they could not perceive the existence or the activation of the stimulus — this happened with stimuli from Prototype Three.

Participant's oral feedback allowed to conclude that although most participants did not turn their heads towards the distractor, they have reportedly seen it. They also explained that they had to make a great effort not to turn their head towards the screen, in order to focus on the completion of the task — this was more evident in Prototypes Four, Five and Six. In addition, the text on the paper sheet was in a small body text which made the participants allocate a high amount of attention on that object and on the preoccupation of performing the task correctly. Regarding Prototype One, although the "eye" element is effective in capturing human attention we can argue its lack of efficiency due to the low capacity of the peripheral vision to perceive shape. Regarding the Prototype Three, which did not cause any level of distraction, there was a feedback from the third participant that identified a slight delay in the stimuli activation which may have contributed for its inefficiency. Finally, we also identified that complex visual compositions were less effective than the more minimal ones.

Although "salient items have an intrinsic ability to attract attention (...) the visual system can inhibit these items" [12] depending on the task attentional demand and on the observer's state. The high amount of attention allocated in the task of reading a text inhibited the distractor in different levels, which revealed to be an interesting output from the experiment. This situation is in line with visual attention studies that argue that reading is a controlled task, which requires a conscious control and a high amount attentional resources. This kind of controlled processes makes it harder to perform other task simultaneously or to notice high relevant information [1]. Also, the distance of the paper sheet — where the participants fixated their attention — to the screen, made it harder for the individuals to detect change in the visual composition displayed in the screen [20].

The overall conclusions of this experiment revealed a high distraction efficiency of abrupt onset and change in luminance contrast (Prototype Six), even when competing with a high attention demanding task, such as reading a small size text. A good distraction efficiency of onset and looming motion (Prototype Four) and gradual change in luminance contrast (Prototype Five). A medium distraction efficiency of onset motion combined with eye-like shape (Prototype One). And finally a low distraction efficiency of abrupt onset and loom-

ing motion. Possible reasons for some of these results are suggested in the previous paragraph.

Future Work

The preliminary results and analysis of the developed experiments allowed us to identify a set of important steps for the ongoing research and future improvements. First and foremost, we propose to test alternative explorations of the stimuli identified as less efficient. Then, considering the feedback obtained for the user tests we also intend to analyse the selected stimuli distraction efficiency when applied to visual compositions with different levels of complexity or when applied to competitive tasks with different levels of attention demand. Secondly, we aim to further explore the stimuli identified — either in this paper or in future iterations — as more efficient, and their application in the visual elements of graphic communication objects with an intended and defined message. Afterwards, we will test the computational capacity to read and interpret inputs from more complex environments — e.g., more participants at a time and higher number of environmental stimuli — and test the most appropriate stimuli for these situations. Once we achieve satisfying results in future developments, this is the effective capture of the participants' attention, we will drive our efforts to a study focused on feature-based saliency for maintaining the public's attention and exploration of the public's engagement with the content of the digital graphic object.

Conclusion

In this paper we described public urban spaces as complex environments with a high amount of environmental stimuli and goal-driven tasks. We identified the challenge of creating digital graphic objects that may stand-out from the remaining visual stimuli while addressing to a constantly changing environment. We proposed an approach for this issue by crossing the knowledge from visual attention and computational design in the creation of dynamic and adaptive motion-based graphical objects that trigger selected visual stimuli when detecting a human presence. With these objects we intended to create a distraction from an individual's goal driven task. We developed a series of prototypes and experiments to test their efficiency with a group of participants. The results allowed to identify the most and the less efficient approaches, some issues to be further explored, and established a basis for the next iterations of these adaptive motion-based and stimulus-driven strategies in visual communication objects.

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Ecopornography in Digital Arts

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Abstract

This paper investigates the presence and use of ecopornography in digital arts. Here, “ecopornography” or “ecoporn” is defined as the representation of nature intended to stimulate the viewer into a heightened state of arousal and excitement similar to that when exposed to pornography. There has been an exponential growth in ecopornographic content in contemporary society and culture due to the massive use of digital media and technologies. Ecoporn is now more common, accessible, and persuasive on both personal and societal levels than conventional porn.

This paper calls for an in-depth analysis of nature-related content across digital media and media arts. How can digital arts be more critical in exploring and exposing the effect of ecoporn on society? When does ecoporn’s hyperaestheticization of nature lead to an anaesthetic loss of sensation? A new taxonomy of ecoporn can help us reflect on these questions. Five major subcategories are proposed: a) *Nature Pure*, b) *Nature Rough*, c) *Nature Hurt*, d) *Nature Saved*, and e) *Nature Fake*. Finally, the paper introduces the “Ecoporn Personality Test” – a digital tool that allows users to explore their ecopornographic preferences and tendencies.

Keywords

Ecoporn, ecopornography, digital arts, hyperreality, hyperaestheticization, anaestheticization, contemporary digital society, hypernature.

Introduction

Our encounter with nature can be as passionate as it is cognitive (Rolston, 1979). Within the digital arts, it can also tip into the hyperreal, where layers of media create new associations and experiences that contribute to heightened perceptions and emotions that might be far from the “real nature” outside your door. Such hypostatic, exaggerated, and even fantastical experiences of nature can be defined as ecoporn. Ecoporn is here, therefore, understood as the representation of nature intended to stimulate the viewer into a heightened state of arousal. The intended use can be explicit or naively implicit as in the many examples where new filters such as in Instagram apparently “improve” or deliberately beautify images of nature. Ecoporn’s heightening of arousal might be both cognitive and corporeal. Its intensity is comparable to the

boost in emotional states that is also found in pornography, but ecoporn is not necessarily or explicitly sexual.

Why compare the representation of nature to pornography? In a world increasingly worried about global warming and the onset of ecological catastrophes, we are progressively influenced and sensitized by digital representations of nature. How real are these impressions? And what effect do they have on us? Do they contribute to real-world interventions – or lead us into passivity through media overload?

Hashtag #nature is now one of the most used tags on Instagram with more than 525 million posts and counting (Newberry, 2021). From social media selfies with wild animals to 360° videos of pristine landscapes, and AR filters improving the looks of everything *natural*, contemporary society is oversaturated with more and *better* content about nature than ever. Digital technologies and social media have made ecoporn not just exciting, but its massive presence has also normalized its hyperreal imagery to a point where we hardly recognize it.

Nature has always been an important part of human survival and wellbeing. It is only natural that imagery of nature persuades attention and evokes a strong emotional response. In that sense, overly heightened human desire for nature can be compared to natural addiction, just like the urge for overeating, pathological gambling, or compulsive sexual behavior (Nestler, 2005). This addiction to nature is sensible as it is rooted in our existential dependency on it. Reading and knowing the looks and signs of nature can mean the difference between life and death. Less so in the world of digital aesthetics.

Mediated through electronic media, nature is often objectified, decontextualized, simulated, and presented as a commodity in similar ways to pornography, therefore, such focus on nature can be deemed ecopornographic (D’Amico, 2013, p.149).

In our age of global warming and ecological catastrophes, ecoporn has become a new, legal billion-dollar exploitation industry that is more common, accessible, and potentially even further away from reality than conventional porn. Traditional understanding about presentations of our lived environment is that they will always be one step away from the real thing. Entering the hyperreal dimensions of digital arts we enter a zone where the digital and virtual world becomes the real thing itself, a multidimensional, layered experience with a more

complex, possibly deeper meaning than “real reality”. The reality outside the box still exists, but the actual, perceived meaning is reborn and found inside the new hyperconstruct (Flisfeder, 2017). Immersed in the digitally hyperreal, how does a possibly skewed, misinterpreted, misconceived, or even idealized and adorably exaggerated perception of our environment affect our actions? Given the urgency of the Anthropocene, there is an imperative need to recognize how different representations of nature arise and affect the relationship to nature and the capacity of imagining and building better futures.

How do digital artworks displaying different forms of ecoporn affect the audience’s perception of nature? Can digital art and experimental media projects expose the contemporary society saturated with ecoporn? Or are nature-themed media art just another way to multiply ecopornographic content and simply arouse hypernature-addicted viewers? Hypernature is here understood as a made-up, potentially “better” version of nature that never existed (Next Nature Network, n.d.).

Hyperaestheticization of nature in digital arts

From representations of nature in its supposedly pristine form to exploring emerging global environmental crises, artists use digital technologies to create their own representation of nature and natural processes on the Earth.

Incorporating hyperreal references to nature in digital arts has created many amazing, inspiring, and jaw-dropping pieces. Nature set into the toolbox of digital technologies has also led to an extreme aestheticization of it. Such hyperaestheticization of nature into hypernature is at the core of ecoporn.

The use of nature as a powerful representation and signifier is not unique to the digital arts. Nature has been an artistic focus and element since the Lascaux cave paintings. In the late eighteenth and early nineteenth century, the open-air painting was en-vogue, powerful, and highly popular. Today they might seem like a quaint comparison to, for example, multi-sensory, immersive environments, but not only can traditional paintings be considered a predecessor of modern media, but also in their own time such imagery evoked strong feelings and excitement. Digitally transformed and re-represented they continue to do so in virtual, online galleries such as “True to Nature Virtual Tour” by The National Gallery of Art, USA (2020).

Digital representations of nature are frequently encountered in the digital arts. They are used as the main element in immersive environments, live image filters in social media such as AR makeup (Alpha, 2022), 360 videos, interactive sound environments (Jana Winderen, 2021) and not to forget as digital backdrops. In fact, the probably most viewed image in the world is “Bliss” by Charles O’Rear. Portraying the blue sky above a green and fertile landscape it was used by Microsoft as the default background for its Windows XP operating system (Wikipedia, 2021).

The aesthetic use of nature as iconography in digital arts reportedly has a strong impact on the users. In the “Osmose” installation by Char Davis (1995) users were

immersed in an interactive, virtual-reality environment modeled as a semi-transparent, glowing forest with an archetypal cosmic tree at the center. Users have reported profound after-effects (Davies, 2015). One user purportedly even said, “now I can die”.

Such examples demonstrate how digital art can reconfigure nature. One of the hyperreal aspects of “Osmose” is its representation of a more saturated, possibly even better experience of nature. It is definitively more immersive, intense, and encompassing than an average walk in a real forest. If Char Davis did not intend to create ecoporn, the installation has been a huge inspiration and a predecessor to many digital artworks that did. The immersive “We live in an Ocean of Air” (2019) installation by Marshmallow Laser Feast is one such artwork where: “...as the visual splendour kicks in, and you explore the space, there are gasps of wonder and peals of laughter as visitors explore the possibilities of the artwork. As the world around you begins to fade away at the end of an all-too-brief spell, there is a genuine feeling of loss.” (Jacobson, 2021).

Installations such as the “Osmose” and “We live in an Ocean of Air” harness their users with the power of digital technology that spurs them to imagine the world in other ways. Giving the audience such a radical autonomy far away from physical nature lets them both experience and question what is really real. Simultaneously their experience of loss is also indicative of their wish for a different nature. Or likely, as a consequence of hyperaestheticization, the continuous leveling up of excitement leads to an exhausted state of indifference. Nothing matters anymore and possibly results in a state of anaestheticization leading to an anaesthetic loss of sensation (Welsch, 1997). What was virtually and briefly beautiful is suddenly replaced with the grey weather outside. Will these sudden changes be met with increased engagement? Or a state of disinterest and disengagement? The emancipatory potential of ecoporn has been discussed in many ways.

Redefining Ecoporn

The first definition of ecoporn was introduced by Deep Ecologist Jerry Mander in 1972 in an article titled “EcoPornography: One Year and Nearly one Billion Dollars Later Advertising Owns Ecology” (Măntescu, 2016, p.6). Mander’s interest was to display the inherent power and dangers of corporal “greenwashing”. With a background in advertising, he acknowledged how companies were often misusing nature and ecology to build a more positive and environment-concerned public image (Măntescu, 2016, p.6).

Since the 1970’s researchers and ecocriticism writers have adopted and tried to expand his definition to address the persuasive uses of nature imagery. These contributions have largely remained within the realm of idealized representation of nature.

Several writers, including José Knighton, have criticized ecoporn as using the same production techniques as in pornography, to appeal, seduce and evoke desire

(Măntescu, 2016, p.8; Welling, 2009). Their main concern has been the heavy mediation and distortion of reality through the human viewpoint.

Bart H. Welling similarly analyses the contemporary visual discourse of “idealized and anthropomorphized views of landscapes and non-human animals” (Welling, 2009). However, he also accounts for “hard-core” obsession with explicit sexual and brutal content of wildlife such as mating and violent killing amongst non-human species (Welling, 2009). Further, Welling also recognizes the emerging dualism in ecoporn. For example, the contrasts of representation of nature as dystopia/utopia and destroyer/savior (Welling, 2009).

While the recent studies expand the notion of ecoporn in useful directions, the discussion remains too narrow and short-sighted, neglecting the vast variety and enormous amount of digitized, filtered, and altered nature representations that are mainstream today. A new taxonomy of ecoporn might be helpful in navigating its rocky waters.

A Taxonomy of Ecoporn

The stories and content about nature in digital media and media arts vary greatly. With the onset of the new geological age of the Anthropocene, heightened attention is now paid to Earth’s ecosystem being severely impacted by humans. Much like Jana Winderen’s field recordings, Jacob Kirkegaard traveled to Greenland in 2016 to record “pure nature” sound for his digital artwork “MELT”. The artwork resounds the recorded “different stages of ice melting, moving from violent sounds of ice caps grinding against each other to trickling sequences and flows of water” (Kirkegaard, 2016).

There is also an emerging trend of viewing nature entirely from the augmented viewpoint of machine learning technology. Anna Ridler’s tulips created by an AI algorithm in the work “Tulips from Mosaic Virus” (2018) evoke awe, without existing in the real world.

How does Kirkegaard’s representation of nature differ from that of Ridler’s? Both artworks can evoke strong emotional feedback. Yet the audience’s response to them in relation to nature is likely to vary, and the level of arousal might be different to each individual. How to discuss the potential emotional arousal and impact when digital artworks thematizing nature vary so notably?

Ecoporn serves as a filter to a nature that reveals itself as a cultural construct that is constantly molded, reshaped, and interpreted. To navigate and understand this complexity we introduce five different ecoporn subcategories seen most often: a) *Nature Pure*, b) *Nature Rough*, c) *Nature Hurt*, d) *Nature Saved*, and e) *Nature Fake*.

Nature Pure

Nature Pure represents the romantic, idyllic non-human world untouched by humans. In this category, there is no place for explicit content or even naturally occurring violence. In the age of the Anthropocene *Nature Pure* is the ultimate Disney fantasy. Digital media and in particular

new filter technologies have contributed to a diversity of *naturally*-looking views of nature. As in the case of “Bliss” by Charles O’Rear, a few iconic images are given the power to define the appearance of nature globally and universally.

Emerging projection technologies are used to extend the romantic view of nature conceived in traditional arts. Since 2008, the popularity of immersive 360° projections and VR experiences created based on the work of such painters as Van Gogh and Claude Monet (Exhibitionhub, 2022) have taken over art museums across the world (Cascone, 2021). Here viewers get immersed in 3D, 360 surround projections of idyllic landscapes representing the perfect perceived harmony in the environment. How does this influence the viewer’s relationship to nature when leaving the white cube?

If digitally created nature is not immersive enough, another approach is to use technologies to extend reality itself. What if the romantic, distant image of nature comes alive – breathing, moving, talking? Media artists use sensors, amplifiers, and various outputs to turn the often silent and still impressions of nature into more lively forms.

For example, artist Joakim Blattman’s installation series “Treverk” (“Woodwork”) (2015-) uses surface transducers attached to the trunks of trees, allowing the sound of the artwork to be affected by the electrical conductivity changes in the logs in real-time (Blattman, 2019).

Through curated experiences, including geo-located sound walks, media artists rush to reveal the invisible agency of non-humans. Can mixed-media experiences augmenting the romantic notion of nature change the way actions are taken towards non-human entities? Are people becoming more compassionate and caring towards the natural, analog world by seeing and hearing technologically amplified signals of nature?

Nature Rough

From raging forest fires to the flooded rivers ripping human habitats apart, the *Nature Rough* easily hooks on the viewers as the ultimate apocalypse. On October 14th in 2021, during the writing of this article, 5,497 people were watching a live Youtube stream of the La Palma volcano eruption, in the Canary Islands (afarTV, 2021). Natural disasters and explicit imagery of natural pecking order in the animal and plant world makes for an exciting, popcorn-ready ecoporn.

The ongoing environmental crises have become a major topic in the contemporary media and media art world. What happens to the audience when the power of unforgiving nature is posed and projected through media art?

In the work “Waterlicht” (2015), Studio Roosegaarde created an immersive virtual flood, showing how high the water level could reach in Amsterdam due to climate change (Roosegaarde, 2022). While visually submerging the audience way under the surface of an imagined rise in future water level, the impressive laser show is more than satisfying to the eye. Has the thought of future catastrophes ever been so aesthetically pleasing and stimulating as today?

What if the main output of such hyperaesthetized ecoporn images of rough and powerful nature is to turn the audience emotionally on? Instead of causing the intended reflective changes in behavior as the answer to potential threats to human existence?

Nature Hurt

With the onset of the Anthropocene – the new geological age also known as *The Age of Man*, there is increased attention worldwide to humans’ negative impact on nature and natural processes. This has accelerated the representation of *Nature Hurt* where nature is shown as the suffering entity directly harmed by humans.

The most iconic ecoporn of the 21st century is that of *Nature Hurt*. From plastic-filled seabird corpses and deforestation of the Amazon rainforest to hardcore snuff movies by PETA (PETA, 2012), it is hard to avoid the ecoporn that is supposed to make you feel guilty for troubles in nature.

Media art is often both interdisciplinary and critical of contemporary issues. Media artists are finding ever new ways to expose the pain and suffering that the viewer—as representative of the human species—should reflect on.

An example of *Nature Hurt* is the earlier mentioned sound installation “MELT” by Jacob Kirkegaard. The artist immerses the audience into the painful sounds of melting ice as a result of human-induced climate change.

Nature Saved

Paradoxically, in other cases, humans perceive and represent themselves as the major saviors of nature and wildlife. From selfies of saving animals to sharing and participating in donation campaigns for a good nature cause, social media and the internet are saturated with mixed media content of *Nature Saved*. Such ecoporn can literally even be porn. For example, Pornhub’s creative campaign “Dirtiest Porn Ever” (2019) is an adult film featuring workers picking plastic waste while a couple has sexual intercourse. In exchange for views, Pornhub donated for the cause of cleaner beaches in the world.

Such explicitly ecopornographic content is less common in media arts. However, artists gladly investigate intricate and speculative ways humans could undo or fix their damage to nature.

Artist Rihards Vitols in the project “Woodpecker” (2016) explores if the introduction of artificial birds could contribute to the natural balance of the forest. Commenting on the possible extinction of the woodpecker, he made artificial wood-pecking objects that mechanically pecked on trees (Vitols, 2016). The pecking vibration is supposed to keep the tree-hungry insects at bay.

How are the viewer’s real-life actions affected when seeing the many potential nature-saving scenarios in media

art? Does such ecoporn evoke action or soothe the viewer with the promise of better solutions over the horizon?

Nature Fake

Digital technologies offer endless possibilities to envision the concept of nature. What might look like *Nature Pure* at first glance, can also turn out to be *Nature Fake* and entirely made up by code. One example is the mentioned Anna Ridler’s “Tulips from Mosaic Virus” (2018) that is an algorithmic transformation of tulips according to the price of Bitcoin (Ridler, 2018).

The above discussed categories and examples give an insight into the different ecopornographic subcategories present in digital media and media arts. How do they affect or mirror our personalities?

Ecoporn Personality Test

There might be no way to avoid ecoporn in contemporary digital society. However, a heightened personal awareness of it could potentially improve our relationship with nature. Could a digital tool focused on self-reflection contribute to making better constructive decisions and lead to a real-life impact in the age of ecological catastrophes?

To explore the five subcategories of ecoporn and their different appeal to individuals, we are developing an experimental digital platform. The “Ecoporn Personality Test” will allow users to explore their ecopornographic preferences and tendencies.

Through a series of questions and related visual material, the test aims to analyze how different ecoporn subcategories arouse each user (Figure 1).

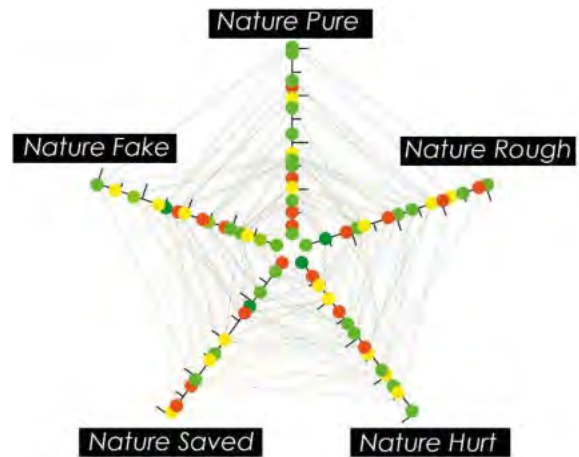


Figure 1. The five ecoporn subcategories in the “Ecoporn Personality Test”.

The first prototype is an online personality test. The platform uses common ecopornographic imagery circulating the internet and social media (Figure 2).

The “Ecoporn Personality Test” will be further developed as user inputs are collected.



Figure 2. The first version of the “Ecoporn Personality Test”.

Outlook onto Ecoporn Future Trends

The “Ecoporn Personality Test” is created as a tool for individual self-reflection. While it exposes the viewer to a large quantity of ecoporn, the project vividly frames the users’ preferences in the process. The massive exposure is intended to be a visible disclosure of their blindness towards ecoporn imagery.

The open question that the “Ecoporn Personality Test” still has not answered is if such an approach can be used to raise awareness of how one is hooked on ecoporn? How can digital arts instead of expanding the already existing volume of ecoporn be more critical in exploring and exposing its effect on society? This is an area in need of future exploration and the focus of the next development phase of the project.

Summary

Contemporary society is exposed to an ever-increasing amount of ecoporn. Ecopornographic content is everywhere from social media to digital arts. Digital technologies have accelerated its spread and creative impact.

Not only are many people unaware of their exposure to ecoporn, but they also seek it and create it themselves. Ecoporn constructs an artificial image of nature and—similar to pornography—connects its viewers to an idealized, hyperaestheticized version of nature.

By introducing five subcategories of ecopornography this paper calls for an in-depth analysis of nature-related content across digital media and media arts.

The examples discussed throughout this paper show the vast diversity of how nature is presented in media artworks. The paper further questions how to recognize and evaluate the potential emotional effects and responses to different subcategories of ecoporn.

The proposed online platform “Ecoporn Personality Test” is created as a self-reflective tool that allows users to reveal their ecopornographic preferences. The platform

gathers user responses to various ecoporn subcategories and playfully speculates on their potential effects. This experiment investigates how the field of media arts can address its involvement in the production and distribution of ecoporn. When is it good? And when is it anaestheticizing us?

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Probing Food and Power with Robotized Spoonfuls of Edible Paste

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Abstract

Food, technology, and humans are entangled in a set of complex relationships that both produce and resist systems of power. The specifics of these dynamics often remain hidden, whether in agrosience, cuisine, mobile apps, or other mediated contexts. In this paper, we present a reflexive analysis of *Orchestrer la perte / Perpetual Demotion*, a food-and-robotic art installation that demonstrates how putting food matter ‘where it doesn’t belong’ can reveal what often remains obscured in our bodies, digital realms, and other relational spaces. Conceived around the theme of domination and nurturing, OLP/PD features a feeding robot that delivers spoonfuls of edible paste to humans’ mouths, using facial-tracking technology. The work probes issues of mutual enslavement, deskilling, the loss of privacy, and the fear-risk-trust within eating. At a broader scale, OLP/PD also troubles food and safety policies, probes culinary authenticity and heritage, and heightens tensions relative to eating and bodily penetration. Drawing on our experiences, we show how digital-material art can illuminate a variety of ways in which dominance and power arise. We propose that this can help surface different and more equitable forms of interaction, whether among food, technology, and humans, or in the more abstract realms of power, culture, and ‘mattering.’

Keywords

Food, technology, robotics, power, nurture, domination, interactivity, performance.

Introduction

Food, technology, and humans are entangled in a set of complex relationships that both produce and resist systems of power. Since the industrialization of food production, this has become ever more evident, yet the entanglements date back to the first time a stick or a stone was used to extend a human being’s reach into the world. At the same time as letting us dig, poke, kill, cut, and cook, our physical tools have blurred the boundaries between what is human and what is technological, what is self and eater, and what is other and eaten.

Today, our hunting and gathering, foraging and culturing, husbandry and horticultural activities often take place in collaboration with digital technologies both visible and hidden. This includes the ways in which we exploit food apps on our

smartphones, the inventory management software of distributors and retailers, and the ever-growing ‘revolutions’ of digital and precision agriculture (Bronson & Knezevic 2016; Lupton 2018; Tian 2017). Numerous forms of non-human agency are now deeply integrated with the ways in which we grow, process, transport, sell, buy, prepare, eat, and even digest our food. In some cases, this web of practices is also dotted with sensing devices—data-capture mechanisms that are in service to both individual well-being and corporate control. Food data is big business, and its use is not agnostic (Carolan 2018; Laurier Centre 2021).

Some food scholars have begun to look at the risks, benefits, and perversions of the blending of food and digital technology. This work suggests that, without critique and pushback, much of the benefit of digitization will be reaped within large-scale agriculture, corporate expansion, and the transnationalization of taste and culture (Barrett & Rose 2020; Klerkx et al. 2019). As in many spaces that are shaped by technocracy, smaller players in the world of food may be becoming disadvantaged in ways that will only become apparent over time.

In parallel to this emerging area of critical scholarship, and as an exploration of certain themes that we (Simon and David) have been exploring some time, we present here a reflexive analysis of *Orchestrer la perte / Perpetual Demotion* (OLP/PD), a food-and-robotic art installation first exhibited in Montreal in 2014. (See Figure 1.)

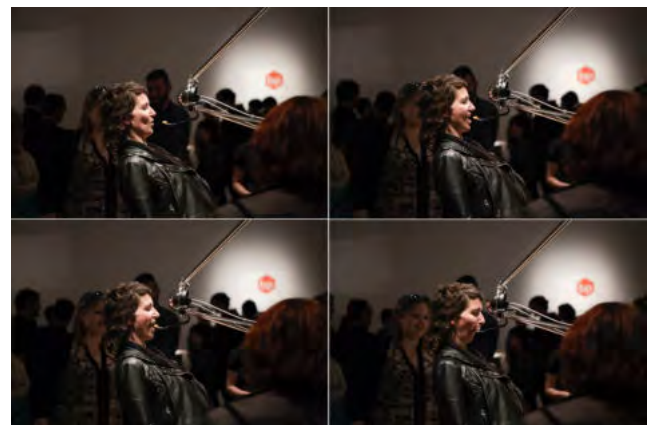


Figure 1: OLP/PD feeding a human in four moments

While not exhaustive, these reflections are intended to surface insights and/or reinforce theorizations about food and power, particularly those related to materiality. Since 2014, our ‘feeding robot’ has been installed at six other events; a seventh installation would have taken place in March 2020 had it not been for the COVID pandemic. In each case, we witnessed our glossy-messy amalgam of material components become a lively and unpredictable social performance. Polished aluminum, brownish-orange edible pastes, a wooden IKEA kitchen table, hexagonal agar-agar gels, electronic circuits, 200 metal spoons, and a human ‘slave’ comprised (most of) the material parts. Taste and disgust, museum regulations, anxiety and enthusiasm, the concepts of art and design, Max/MSP coding, food safety training, human bias, and historically loaded language comprised (some of) the social elements.

Together, these components and the ways in which they performed together produced a series of occasions in which to observe what happens when we put food matter ‘where it doesn’t belong’. Many things that remain obscured in our societies, bodies, digital realms, and other relational spaces became evident, just as other questions about art and materiality remained hidden. With this text, we aim to unpack and reflect on some of those occasions, drawing out the material-social implications of food, technologic, and human relations.

Genesis of a Robot-Feeding Installation

We first met in 2012, introduced by a mutual friend and fellow artist-researcher, to develop an exhibition and colloquium around the themes of food and technological hacking. Although the larger project did not ultimately come about, a smaller iteration comprising three food-tech installations was eventually presented at the Musée d’art contemporain de Montréal (MACM) during the 2014 International Digital Art Biennial (BIAN), itself a part of arts organization Elektra Montréal’s programming. We had therefore been talking about and exploring themes related to our overlapping areas of research-creation—robotics/digital arts and food design/gastronomy—for some time. Notably, both of us shared a common interest in ‘looking under the hood’ of our fields of exploration in order to question and/or invert some of the norms they both present. Through the development of a robotic performance, we wanted to create an opportunity that “simultaneously reinstates the status of automata as counterparts to ‘humans’ and invites biological bodies to reassess their place in a world” (Dimitrova 2017, 162).

We were both interested in themes related to power and destabilization when it comes to human relationships with food and technology. More specifically, we wondered about the ways in which humans are both in control of and controlled by those tools/edibles we take for granted in the day-to-day. We found ourselves speaking the same language about our ostensibly different subjects, eventually realizing how similar many of our questions were. Does buying in to so-called convenience, access, simplification, and information exchange empower humans? Is a smartphone a

helper, a spy, a prosthesis? Do supermarkets and recipe boxes free humans from domestic labour or enslave us to systems that slurp up our preferences so as to sell us more product and deskill us yet further? Are we dominated by food and technology, nurtured by them, or both?

Eventually, this last theme became central to our ongoing discussions: domination and nurturing are implicit in the relationships that humans have with food and digital technology, and yet this simultaneity is not always so perceivable in the day-to-day. As we developed the concept further, we realized that the food-technology relationship is also one of domination and nurturing, and that part of this dynamic relates to microbial life forms—yet another player in the cycles of control that humans imagine themselves to be in charge of. We decided to therefore build a feeding robot, one that would deliver spoonfuls of partially fermented, partially deadened edible paste to human mouths, all using facial-tracking technology. We would use language (the duo-lingual title of the piece and the word *slave*) to destabilize discursive standards. We would install it in a space that is conventionally used for hands-off artworks. We would display the other systems of domination and nurturing that such an installation depends on—an apparatus of humans and refrigerators and food-safety guidelines and scheduling rosters. We would then step back and watch what happened.

And things did happen. Because the world of food art is relatively new, particularly in more-conventional spaces such as galleries and museums, we found ourselves bumping up against procedural norms with each iteration of the robotic installation. Some of these frictions were more predictable, such as questions of whether a waiver would need to be signed by gallery-goers before they opened their mouths. Others related to artistic specificity, as when one curator asked us to change the word *slave* to assistant, or when another told us she’d prefer that the mini-fridge that held the food supply be hidden behind a curtain. On one notable occasion, David found himself on a wind-swept Montreal street having a cell-phone conversation with the Maricopa County (Arizona) food-safety manager, who simply couldn’t understand why we weren’t going to have the robot food made in advance by a licensed caterer.

In each of these situations, the material-discursive entanglements that comprise food kept interfering with the conceptual-processual expectations of digital art. In what follows, we first consider the tensions between material objects and spectacular processes. We then probe moments from our experiences in mounting the piece at seven different art festivals, contexts that show how digital-material art can illuminate forms of dominance and power. Over a longer timeframe, we believe that these learnings can help surface different and more equitable forms of interaction, whether among food, technology, and humans, or in the more abstract realms of power, culture, and ‘mattering.’

Material Objects, Spectacular Processes

One way to conceive performance/art installations that involve interactive and digital technology is through the

design of its functional capabilities. That is, rather than initially concerning ourselves with the visual aesthetics, we first chose to address the behavioural cues of the piece—its “communication aesthetics” (Forest 1984). This meant devising a context in which humans come into contact with a synthesized agent, whether food, human, or material accessories. What might eventually happen among these elements would then be determined (in part) by the ‘open script’ that we would write. This script included the computer coding in the machine, which would enable it to act and react, as well as the instructions given to the slave. But it would also—in fact, mostly—be determined by the physical properties of the material elements we mobilized, as well as the unwritten ‘social scripts’ that tend to guide human behaviour in contexts like art festivals.

The result of this scripting was that the robot was able to ‘see’ visitors, grab spoons, and move here and there. As it slowly brought a spoonful of edible paste towards a visitor’s face, the human would (usually) open their mouth and adopt a submissive posture, ready to be nurtured and/or cede control. Further, because it is taller than most humans, the robot’s physical presence carried an additional quality of domination. The eventual rapport created was thus reminiscent of a parent or a caretaker feeding their child or charge. For us, the symbolic meaning of the experience derived from the interaction between those bodies and their physical-spatial properties, rather than being strictly attached to the conceptual meaning that the installation represents. To read about and imagine being fed by a machine is one thing, but the actual blend of awkwardness, loss of control, and subjugation brought on by performing the act is what gave the work its substantiality (see Boisclair 2019).

The food design followed a similar process. We had a very clear idea about what it would not be, that is, easily recognizable in either form or taste. We wanted the edible pastes to exist as matter infused with potentiality, distanced (as much as possible) from objective gastronomic referents. At the same time, their ‘recipes’ were as scripted as the materiality of the rest of the piece. Culinary histories of the places we visited were considered, particularly histories involving domination and power, such as fermentation techniques, the colonial shaping of Québec, the experience of Italian immigrants in Belgium, and the omnipresence of potatoes in Polish cuisine. So too were the ingredients themselves critical: agar-agar, invoking bacterial culturing; sugar and glucose, touching on slavery and industrialization; mustard seed and powdered ‘wasabi’, generating mild oral and ventral discomfort. In this way, the pastes were both material agent as well as abstract art, acting on bodies and minds simultaneously. They elicited reactions in the eyes, nose, and the mouth through its sensorial properties, while also adding to less site-specific feelings of uneasiness and renunciation.

Established in these ways for each installation, the robot was set in place and activated. We knew it was a multi-material object that would activate many forms of both spectacle and embodiment, but we had no sense of the range of performances that would unfurl, nor that they would be so

different in each context. We now understand it as both material and spectacular object, a set of processes involving matter and discourse, and a thing that is embedded in larger agencies beyond our own. While this is a much-explored theme in art and performance studies (Bourriaud 2002; Kirshenblatt-Gimblett 2012; Spielman 2013), as well as such fields as science and technology studies (STS) and new materialism (Bennett 2009; Law and Singleton 2000; Miller 2005), it was reinforced in ways that continue to bear reflection.

Stories of Materiality

Orchestrer la perte / Perpetual Demotion is an interactive art installation, a feeding machine, and an aesthetic and communicative object. For both of us in our respective practices, however, it is the narratives surrounding its exhibition that have become most interesting. These stories are now fully entwined with polished aluminum and circuit boards and cooking notes, and form an ever-widening envelope of ‘art’ around our formal structure. Embedded in this package are a series of questions that trigger our understanding of the ways that OLP/PD operates as a probe into the materiality of food and technology.

Where Is the Art?

This question first arose in 2014, when OLP/PD was part of the Hedonistika/BIAN/Elektra exhibition at the MACM in Montreal. Upon arriving at the loading dock of the museum, David was met by an administrator with a form to be filled out, identifying all materials comprising the food components of the art piece. Photographs were to be taken of the fridge, packing crate, tools, and other pieces of the apparatus. (Simon, having arrived separately, also went through this process with the table and robot.) Upon our departure, additional photographs would be taken and the original form consulted, in order to ensure that what came in was also what went out.

For standard museum installations, this makes sense—quite reasonably, the MACM would want to be sure that visiting artists weren’t popping a Riopelle or Kandinsky into their packing crates before exiting the building. But for the food—the three edible pastes labelled *lab whiz*, *plum vs. apricot*, and *cheesecake factorial*—were photographs necessary? As David expressed to the administrator, these elements of the artwork would be coming into the museum in chilled plastic containers, but they would be going out in the bellies of the visitors (or down the pipes of the museum’s bathrooms). This meant that making comprehensive documentation of what left the museum would be more than challenging, but it also raised the question, once again, of where art ‘resides’. For OLP/PD, the art is distributed across the material elements of the installation, the bodies of the MACM visitors, and the performance enacted between them. But as David and the administrator engaged in their own envelope of pre-vernissage performance, we also came to understand that the art of the work had implicated

bureaucracies and paperwork, not to mention plumbing systems both architectural and digestive.

Another happy discovery of the multi-sited (and multimedia) project came in the form of notes and comments and drawings that our slaves captured on the task list and roster sheets we had provided them. Intended as a bit of pseudo-bureaucracy attached to the slave's role, the paper and pen eventually became tools of distraction and even resistance. Following the installation at the MACM, as well as several other locations (notably in Wrocław, Poland), we found that the slaves had been exchanging messages, doodling, critiquing visitors, and amusing themselves otherwise with the task list sheets. (See Figure 2.) These informal representations of the tedium of being an OLP/PD slave were documentation of a performance we never anticipated triggering. Invisible to the gallery goers, as well as to us, the artists, the repurposed papers became an icon of the performative nature of the robot, not to mention a powerful symbol of how art-world laborers are often even more enslaved than we normatively imagine.



Figure 2: The slaves' task list sheets at the MACM installations

Is it Art...?

...or is this robot a great new way to feed people with disabilities, freeing up support staff from spooning three meals a day into the mouths of those in their care? That our critical artwork was sometimes viewed as a prototype for an applied piece of technology shows less about its own material presence and more about the other material things that certain contexts implicated. The question at first may seem out of left field: Why would an eight-foot-tall Delta robot—a

model used for industrial, pick-and-place operations on manufacturing production lines—have been our choice for a care-home design? On reflection, however, we realized that it was not the robot 'itself' that gave rise to the question, but rather its integration within other material ecologies.

We first heard it at the 2015 Maker Faire in Ottawa, Ontario, an aggregation of hackers, tech innovators, and artists who came together to experiment with robots and other digital technologies. We had been invited, through media-art contacts of Simon, to present OLP/PD during the run of the event. Some of the Faire's attendees are solution-oriented, some are more exploratory. Nonetheless, because of the nature of the gathering—largely angled towards practicality and action—it was a context in which hearing this question was not surprising. Robot-as-spectacle, robot-as-critique, robot-as-probe: these were not the ways that OLP/PD would have been standardly perceived by the Maker Faire participants. Robot-as-solution, robot-as-worker, robot-as-prototype: much more so.

At a broader scale, it is also unsurprising that a feeding robot would be thought of in practical terms. Robotic labour is increasingly supplanting that of humans, and even in pre-COVID times, there was growing consciousness around care-home labour shortages, as well as the dreariness of many aspects of such work, feeding included. To free up humans from this slow and not always pleasant activity could well be seen as the goal of OLP/PD. The link between industrial robots and ours was also present in the Delta design, and that material connection likely reinforced the 'incorrect' perception of our intent. In parallel, we also realized that the materiality of the food that was being served up—an easy-to-swallow, semi-solid, not-very-identifiable paste—had served as a prompt for the question. The edibles that the robot pushed at people were much like the puréed and mashed foods that are often provided in care homes. We eventually learned to accept and even invite such inquiries, rather than resist them as contrary or simplistic.

Is it Food?

"This tastes like my grandmother's fishy pâté!" said one visitor at the MACM exhibition, just as another (an artist familiar with David's work) said, "I'm not eating any more of your weird shit." The pale orange paste we had coyly named *lab whiz* was made from three naturally fermented and cultured ingredients (labneh, sourdough rye bread, and *nuróc măm*), along with those ingredients' industrially stabilized analogs (Cheez Whiz, Wonderbread, and Lea & Perrins Worcestershire sauce). David called it a "battle royale" between the power of microbes and the power of pasteurization, and imagined it playing out in the stomachs of gallery goers. For him, it was an experiment in conceptual food art. It was comestible—we all ate it, some with pleasure, others with doubt, but none (to our knowledge) with digestive distress. It was comparable to familiar foods (salmon mousse, processed cheese spread), and it needed refrigeration to maintain texture and palatability. Simultaneously, it was also distressing and unrecognizable to some (*fishy pâté*,

weird shit), and a few who tasted and tried to swallow eventually had to spit it out.

Somewhere between our *lab whiz* going into one of the robot's spoons and being expectorated into a visitor's hand, the paste may have ceased to be food. But had it been food before that? Certainly it had existed as such in its lifetime—as a set of ingredients bought at a grocery store, combined and processed in a kitchen, sealed into plastic-wrapped cylinders and kept 'safe' in a fridge at an appropriate 3–4°C. But when it went into the cake-decorator syringes and from there was pumped into metal spoons by the slave, then laid out on hexagonal agar-agar pads on an IKEA table anchored to a shiny robot, did it remain in a state of foodishness? What about even earlier, when we conferred about the effect we wanted it to produce in visitors' bellies, or the symbolic meaning we were aiming at—dominations of technologies, nurturing matter for humans, spaces of microbial control? Did our use of the materiality of food, when taken out of the cooking/eating/digesting context, turn it into not-food? Probably not fully, but the tensions between *pâté* and paste remained.

How Stable Is this Art?

Immaterial concepts and discursive ideas can traverse long trajectories through time without too much erosion or damage. But art that is made with things that move, sense, and ferment can be more fragile. As we packed and unpacked the robot, blended ingredients in somewhat unsanitized spaces, and kept pushing back on curators' demands, elements of OLP/PD began to fail. Moreover, in Mons, Belgium, when we placed the robot in the care of some less artistically engaged slaves (festival volunteers), pieces of it actually broke, and we're not entirely sure that the food safety procedures were followed.

This is one of the problems of giving body to concepts, and of asking less committed bodies to maintain already tenuous concepts: they tend to eventually come apart. Because of the fragility of matter (edible, technologic, human), we became aware that our rather conceptual work was decaying through use. Repairs and retraining (of both the robot and the slaves) had to take place between and before each exhibition. Every time we evaded food poisoning (real or imagined), we felt like we had gotten away with something, postponing judgment day to the next iteration. We ourselves felt somewhat fragile each time we were asked to mount the piece: did our psyches really want to go through the effort and risk? Did we have it in us to argue for the visibility of the mini-fridge, to precision drill the robot's mounting hole, to train up on new safety regulations, or to find clean kitchen areas to prep pastes and wash 200 metal spoons? Each time, the answer was yes, but each time it came out of our mouths more hesitantly. Our own material (and social) resiliencies were eroding, much like the robot itself.

Now, having had a hiatus due to a global pandemic, we look back at the artwork as a relative—and temporal—stabilization of different technological, food, and human matters. Like all performance processes, OLP/PD is constantly being made, unmade, and remade—a set of homeostatic

relationships between it, its contexts of exposure, its creators, and its audiences.

How Stable Is this Concept?

Even as we state that concepts travel better through time than matter, we have come to realize that the concept of the robot is powerfully linked to material realities over which we have little control. (This in itself is amusingly in keeping with the core theme of the piece.)

In 2018 in Lyon, France, for example—a self-proclaimed European capital of gastronomy—our choice of ingredients for one of the pastes brought concerns from parents about whether it would be "safe" for their offspring to eat. Made with a combination of fresh bread crumbs, panko, cultured butter, margarine, smoked paprika and liquid smoke, the *feu fumée* became a point of friction with some festival organizers and visitors. *But what about the children?* one concerned parent asked. *What if they burn their mouths? What if it's too strong for them?* This sentiment foreshadowed a similar moment in 2019, when David was in a classroom in Squamish, British Columbia, teaching about food and performance and using OLP/PD as an illustration. Again, pushback (this time from a student not facing the robot's glistening visage) came about consent and permission, and whether it was fair and equitable to serve food to people who hadn't adequately been informed of its ingredients. Another student raised the issue of allergies and intolerances, and whether our 'hidden' recipes were creating contexts of exclusion. Both of these moments displayed, once again, the ways in which food art now intersects with the trigger warnings and pre-admission disclaimers that have begun to haunt other forms of art and performance. Just as paintings and sculptures, music and dance implicate sensorial absorption, food brings affective, emotional, and physical impacts.

A perhaps more useful insight relates to the ways in which the matter of food art differs from that of more conventional forms, such as sculpture, ceramics, or painting. That is, because much food art relies on using normative media in non-normative ways, it often aligns with contemporary, avant-garde practices that eschew the beautiful (*l'idée du beau*) and the agreeable, and instead presents itself as a radical, sensory experiment. Our pastes were not aimed at producing pleasure, at least not in a conventional, gustatory sense. They were, instead, conveyors of experience, devices we used to challenge expectations regarding the ingestion of matter. The minimal intensity of *feu fumée*—slightly spicy, fatted bread, extruded onto a magnetized teaspoon in a darkened, spotlighted corner of a contemporary art space—showed how material edibility transects many norms of eating and art. (See Figure 3.)

Similarly, in the lead-up to the ill-fated Emerge 2020 festival in Mesa, Arizona, our use of *slave* in the promotional documentation became a point of contention. The organizers understood our intention, and even appreciated it, but felt that the impacts of American slavery (particularly in the then-Trumpean era of highly fraught race relations) created a context in which this term would act too powerfully. We acquiesced, changing the wording to "attendant" in the

advance materials, while nonetheless agreeing that we could utter the word *slave* on-site. This would allow visitors, and the slaves themselves, to engage in a conversation about the impact of the term, while keeping the un-contextualized website text a little less fraught. Because Emerge was cancelled a few days before we were to travel, we never got to test our deployment of the word in the United States. As awareness of historic enslavement practices in Canada grows (of both Black and Indigenous people), we will continue to remain attentive to the fragility of our discursive choices.



Figure 3: Material elements of the ‘food’ in Lyon, France.

Reflection, Conclusion

OLP/PD probes issues of mutual enslavement, deskilling, the loss of privacy, the permeation of intimacy and the fear-risk-trust complex within eating. At a broader scale, it also troubles food and safety policies, probes culinary authenticity and heritage, and heightens tensions relative to eating, bodily penetration, and the presentation of self. That it is at once a spectacular object and a material process means that identifying its ‘true nature’ is moot. Like other food performances and digital creations, the robot exists as a whole, yet one that is only entire when implanted in a context and interacted with by others. This is where its value lies, we believe. Through integration into the socio-material world, it also intervenes and produces effects. Through analysis of these effects, we (the artists, the critics, the gallery goers, the other witnesses) can discern the subtle and not-so-subtle power relations around us, leading to questions about where and how domination is established.

Our role as artists was to prepare ingredients, to assign potentiality to bodies both artifactual and organic (as well as

some that were in between), and to loosely establish a set of scripts. In order for effects to be projected and for affect to travel among the various bodies, we then set a table and invited visitors to assemble around it. By establishing and engaging with these contexts and environments, we and those that the robot fed entered into a lived experience that was both materially familiar and socially strange. The resulting semblance—an abstraction of power dynamics among food, technology, and humans—produced novel affects that we hope will lead to ongoing reflection about other modes of existence, ones that might hint at new recipes for the re-creation of human/non-human relations.

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Artificial Life within a frame of metacreation on stage

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Abstract

In order to investigate the possibilities of co-creation between performer and interactive virtual system, we have developed a scenic installation composed of two parts: the virtual environment and the interaction interface. We offer an analysis of our creative experience from the point of view of the artist researchers in the field of real-time generative synthetic image. Our results show that the creation depends on how the performer perceives the virtual system as well as how he perceives its influence on this system. The creative potential of the system depends on the mechanisms generated and implemented by the artist in a metacreation context and his interpretation of the interaction data. Our perspectives point towards the conception of a *scenography-character*.

Keywords

Metacreation, performance, interactive digital art, artificial life, scenography, scenography-character, interfaces

Introduction

Artistic context

The process that produces artistic experiences or artifacts is no longer a secret enclosed in the artist's studio, but a system of creation set in motion by the artist and continued when confronted with the materiality of collective participation, of the spaces of exhibition or of everyday urban spaces. [1], [2]

The digital arts have been developed thanks to the advent and popularization of technological tools. They emerge as a transdisciplinary approach between design, computer science, complexity sciences, biology, and artificial life. The creative processes have become technological. [3]

In the context of participatory works, the viewer becomes an actor in the work and potentially a performer, who can even interact remotely. [4] The type of interaction is no longer responsive but can be adaptive, conversational, and creative, between machines and participants. [5]

The literature gives examples that an evolving virtual ecosystem can be creative or that this type of self-organizing system can demonstrate an emerging potential allowing it to improvise with a performer. [6], [7] Some developer-artists seize the computational capabilities of the graphics card in

an alternative way to create complex systems and use artificial life algorithms, giving rise to emerging behaviors and impressive endogenous interaction phenomena. [8], [9]

Other developer-artists create or hack interfaces using electronic sensors or mobile devices to establish a tangible, intimate and active relationship within the technological social context and connected networks. [10] Through such interfaces, artists seek an adaptive and dialogic, conversational engagement between the participant and the virtual system, in order to investigate possible relationships with the machine and to express the uncertainty of existence through the uncertainty in the work of art.

For Whitelaw, the conception of a generative, evolving, interactive system is one of the characteristics of an artwork that can be described as autonomous. He refers to this method of creating digital works by the term *metacreation*. [11] Such a system contains parameters of appearance and behavior which can be modified according to the interaction with the external environment to the virtual, what Bret calls the sources of exogenous interaction that complements the endogenous interactions which occur between the components of the virtual system. [12] This dynamic diverges from the initial instructions given by the artist-developer and may result in unpredictable behavior occurring during the processes. It is regarding this meta creative process that we will assess the creative potential of the virtual part of our scenographic proposal.

Project *Co-évolution, Co-cr ation et Improvisation Homme-Machine* (CECCI-H2M)

The research-creation process described in this article is part of the *Co-évolution, Co-cr ation et Improvisation Homme-Machine* project, led by Chu-Yin Chen: that investigates ways of sustainable behavioral coevolution with emerging human-machine co-creation. The project proposal merges two research-creation approaches through practice. That of the artist-researcher Silvia C rcu, who studies the choreographic interactions between performers and robots. And that of Isadora Teles, which aims to establish a dynamic of improvised co-evolution between performer and evolving virtual system. This article traces and analyzes the experiments carried out by the two researchers during two

artistic studio residencies, from the point of view of the artist developing the virtual system and its interfaces with the scene.

During their experiments, the artist-researchers compared their artistic proposals to find convergences and clarify their intentions and ideas. The common goal was the conception of a co-created performance on stage between the performer, an HRP-4 humanoid robot and an interactive evolving virtual ecosystem. It was also a question of characterizing what the possibilities of co-creation between the performer and two types of artificial entities would be, when those artificial entities are either embodied or not embodied on stage.

The project also aimed to question the design of autonomous and evolving creative tools for performance with the intention of staging an improvisation for the performer and his alter-ego taking the form of an evolving virtual ecosystem. Our hypothesis to establish a dynamic of creative collaboration was that the development of an autonomous and evolving ecosystem would be embodied and therefore would assume a physical form on stage, being able to influence the performer's gestures (**Fig. 1**).

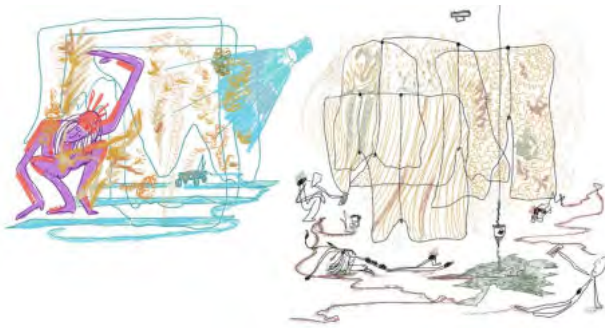


Figure 1. Two different sketches representing our conception of the three elements of the stage together: performer, interface, and scenography. ©Isadora Teles de Castro e Costa, 2021

Experimentations

Experimental Plan

The experimental plan to set up a creative and improvised interaction between performer and artificial entities consist of:

- Developing, separately, three prototypes of "species" for the virtual ecosystem as well as their mode of intra-species interactions.
- Developing three interface prototypes for interacting with elements on stage and embodying the same virtual system in the form of objects that can be manipulated, played, and penetrated by the gestures of the performer.
- To study the possible co-creative and adaptive interaction relationships between each "species" of the virtual system and the performer.

The aim of the proposal was to use metaphors of emotional states to imagine the shape and behavior of the different species that would inhabit the virtual world. The technical goal was to find ways of expressing and giving the sensation that, by their form and by their behavior, each species is possessed by or acts according to one of the emotions mentioned. Once the shapes and corresponding behaviors were clarified, the next step was to create and test the algorithms that could correspond to such sensitive expressions.

Creating a graphical simulation of a complex system must consider the technical challenge of animating and making many autonomous elements interact. This requires considerable computing power, which increases exponentially with the number of individuals. Therefore, the development of the virtual universe was carried out using mainly the technique of image synthesis by shaders.

The shaders enable the programming of the graphics card to generate images by calculations performed in parallel. [13] We have experimented with fragment shaders and then with compute shaders. Compute shaders allow us to get complex image and behavioral animation qualities which are difficult to achieve by other techniques, because they exploit the computing power optimized by the graphics card.

An important reason in the choice of technical tool was the existence of examples of simulation of common biological phenomena with the subjects treated by artificial life using such technique.

Compute shaders are used for scientific simulation as well as for bioinformatics and simulation of complex dynamical systems. [14] However, such references in the artistic field are rare and steps of taming and technical adaptation are required.

Virtual environment

Particle system with fragment shaders

The first prototype was designed to express the "dream" or the state of reverie. To do this, we have conceived a type of behavior which shows wandering flight, expresses a lightness in the movements and would be contrasted with another species which would represent "fear". This behavior leads us to think of the imaginary flight of fairies, a dance of birds or leaves heaving in the wind.

To set up this system of "imaginary fairies", we started by programming a particle system using fragment shaders, within the touchdesigner software. Fragment shaders make it possible to deal with many dynamic pixel data, but there can be no interaction between them, nor exchange of information.

The components of the particle system have basic properties of physical simulation, such as mass, velocity, and lifetime. They are influenced by forces external to the system, which can attract and guide them. An interesting aspect of the behavior of this particle system is that, if we

increase the particles' scale and the force of attraction, the collective behavior becomes an organic mass concentrated on a flow of force. This shape, green on a red background, is reminiscent of a pulsating organ (**Fig. 2**).

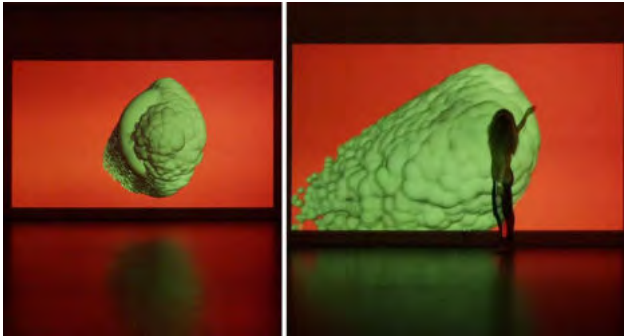


Figure 2. Recurring shapes during our experiments. Organ-like mass of fragment shader particles are depicted in green. ©Isadora Teles de Castro e Costa, 2021

This particle system behavior was not inspired by cell behavior, but it has emergent collective properties vastly used to model dynamic natural phenomena. [15] In our case it behaved like a pulsating organism or animal organ thanks to specific behavioral parameters explored through the process of improvisational interactional and “tweaking” on stage.

The void in the background of the virtual environment suggested an organ in preservation in a jar, isolated, but still “alive” (**Fig. 2**). The sensation of a living organ was due to the unstable movement of the system and therefore of the emerging collective form. This instability of the shape was caused by the data obtained from the capture of the performer by the Kinect, which controlled parameters inherent to the particles such as their maximum speed, their mass, and the constants of attraction towards the attractors. This phenomenon of data instability was the positive cause of the pulsating impression of the particle system organic form.

Particle system with compute shaders

Our second experiment was the modeling of a particle system whose position information was calculated by a compute shader. The change in technique was aimed at establishing an endogenous interaction among the particles and with the virtual environment. For studio residences, the particles could not be perceived among themselves.

The difference between compute shaders and other types of shaders (vertex, geometry, and fragment shaders) is that they do not fit into the render pipeline. The compute and the fragment shader have similarities, but they were designed for different purposes.

The compute shader allows us to use the GPU to perform calculations that are not necessarily related to 3D or image processing. This is the so-called GPGPU technology for General-Purpose computing on Graphics Processing Units.

In our case, we used it to calculate the position and velocity of a particle system guided by a mathematical function that generates organic flow, which can be used to simulate fluids.

We were inspired by the systems of particles moving in a Curl Noise. The technique is often used for dynamic non-autonomous systems such as fluid simulation or the displacement of the sand. In our case, we used it as a wind force to guide the particle movement. The wave variations and their organicity helped us get a prototype of the aimed behavior : an impression of a self-organized multi-agent system [14], [16] (**Fig. 3**)



Figure 3. Choreographic exploration in interaction with compute shader particles. The performer modified the parameters of a curl noise function. The noise guided the movement of the particles. ©Isadora Teles de Castro e Costa, 2021

We tested the interaction between the performer’s motion capture data and the second prototype of the “Dream” species. Two joints of the performer were linked to two behavior parameters of the particle system. The elbow position controlled the direction of the Curl noise that guided the movement of the system, and the knee position influenced the direction of the noise and the friction, that is, the damping of particle velocity.

These interaction links allowed an interesting synchronization between the movement of the particles and the performer’s gestures. This occurred because we were able to identify a notion of rhythm in the intervention in the friction of the particles and the fact that the movement of the arms influenced their direction, giving the impression of a dance master to the performer.

Cellular automata with compute shaders

The second species that would integrate the virtual ecosystem represents “fear”. Our main issue was to find a way to create a type of virtual agent that leaves patterns and traces on a surface by its growth or by its displacement to represent fear as something that spreads out on surfaces and that leaves traces. Traces of infectious and unhealthy appearance, and whose appearance is reminiscent of mold.

We were inspired by the modeling of the behavior of *Physarum polycephalum*, a single-cell organism that can exhibit the formation of complex and emerging growth

patterns. [17] The first step in modeling such behavior was first to set up a cellular automaton system to establish the basis of an optimized algorithm for endogenous perception and interaction between virtual individuals. This method is suggested by Arsiliath in his *Psychobiotik* workshop¹ where the goal is to build a complex system of autonomous agents with compute shaders. Two variations of the cellular automata were tested. One based on the concept of cyclic cellular automata and the second based on Langton's Edge of Chaos article. [18], [19]

The peculiarity of the cellular automata algorithm is that, depending on the combination of parameters of interaction behavior with neighboring cells, it can generate a large amount of different emerging patterns in a complex way and therefore difficult to predict by the artist. One would have to manually test a wide variety of different rule combinations to visualize the possibilities and choose a specific type of behavior corresponding to an intention, in our case, the internal emotional state of the performer.

The plethora of pattern possibilities emerging from several interacting entities is one of the issues studied by genetic algorithms (exploration of "landscapes" or "landscapes" of possibilities), especially when they are used as an aesthetic evaluation technique in interactive generative processes. [20] However, during the interactive experience, the performer explored this landscape of possibilities through his gestures, in a negotiation between the intention of his movement and the projected pattern that formed in response to the behavior generated by automata's evolutionary rules, conditioned by the position of the joints (elbow and knees) of the performer (Fig. 4).

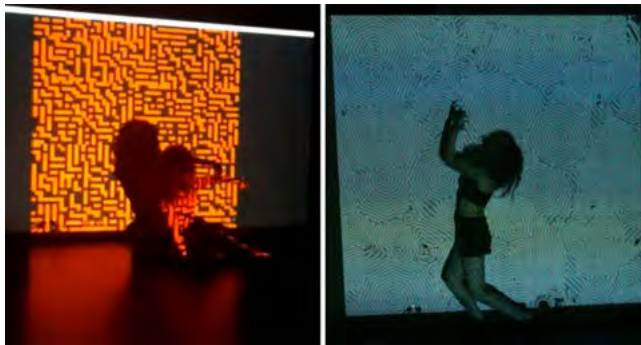


Figure 4. Choreographic exploration in interaction with compute shader cellular automata. The performer's movements modified the parameters of the systems' behavioral rules ©Isadora Teles de Castro e Costa, 2021

Conclusions about the virtual environment

The development of a particle system through fragment shaders was a stage of learning and appropriation of the technique. The system was used during the experimentation

with the performer and opened aesthetic perspectives for further development of autonomous agents.

Once the technique for calculating particle behavior with the fragment shader had been entered, the use of texture buffers and separately rendered geometry instances allowed us to switch to the compute shaders to perform the calculation of virtual environment elements behavior.

The cellular automata algorithm was used as an intermediate step in the appropriation of the technique of building a base algorithm optimized for the creation of endogenous interactions. However, in view of the interesting patterns that emerge dynamically according to the exploratory exogenous interaction modifying endogenous interaction rules, this algorithm will be used as a component of the virtual ecosystem.

This will require an assessment of the expressive and poetic function of the patterns and an assessment of the interaction in the context of the artistic intention to express the internal state of the performer. The discussion is ongoing, but it should be noted the possible addition of a new kind of emotion to the virtual ecosystem following the experiments in the studio.

In the case of the prototype which aims to represent the state of "dreaming", the intermediate stage of development has also instigated thoughts. The particles produced with the fragment shader showed us the plastic potential of such a technique for building systems. We may use distinct levels of autonomy in qualifying different types of virtual individuals. However, a physical simulation operation without collision limitations and a degree of autonomy, can also prove to be a rich source of raw material for the creation of geometric shapes and masses in interaction with the performer. The variation in autonomy levels among the types of virtual elements was important to have a more malleable species, such as a kind of digital clay or a raw material that could be turned, like a vase on a potter's wheel. For the potter, although clay is not an autonomous or living material, it nevertheless presents physical properties and possibilities of plastic derivation rich in creative potential when it is modeled and glazed.

Likewise, the potential for plasticity of the particles' behavior, that were attracted and recalled by the symbolic representation of the performer in virtual space, made us question the condition of the autonomy of a virtual material conducive to creation. How exactly is a virtual simulation of clay matter, for example, more or less fruitful to co-creation than the simulation of a collective of ants or cells, when manipulated or influenced by a performer?

¹ "arsiliath (@arsiliath) / Twitter," *Twitter*.
<https://twitter.com/arsiliath> (accessed Oct. 22, 2021).

Interaction interface

Tested hypothesis

First, we designed an electronic collar that captured the acceleration data of the perforator and transformed it into a rhythm of luminosity by means of two strips of LEDs.

Nonetheless, the interaction with the collar was not perceptible by the performer and this fragile structure did not adapt well to the performer's movements (**Fig. 5**). Given the priority of connecting his gestures to the virtual system, we conducted interaction tests by capturing movement with the camera of a Kinect. This allowed us to have fruitful interactions and gave us some leads about the links that the gestures could have with the virtual system. The interaction with the Kinect provided us clues on the plastic potential of virtual forms and their ability for enjoyment by the performer (**Fig. 5**).

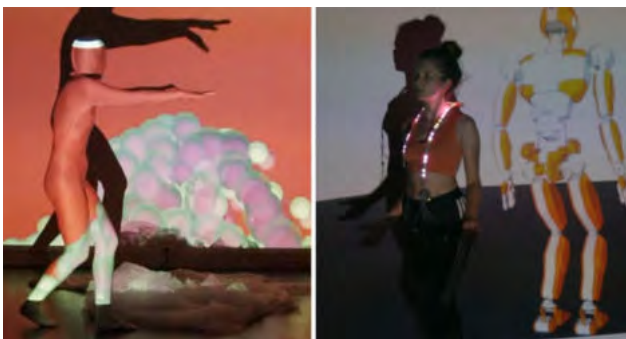


Figure 5. Two moments of experimentation with the Kinect (left) and with the electrical-interactive necklace (right) ©Isadora Teles de Castro e Costa, 2021

Despite interesting interaction experiments with the Kinect, we wanted to keep the possibility of allowing the performer and director to improvise with sensitive interfaces. To explore the creative possibilities of the incarnation of the virtual on stage, the creation of sensitive stage objects that can be manipulated and played was important as a hypothesis to allow us to have a margin of movement in terms of layout in the stage and on the performer's body (**Fig. 6**).

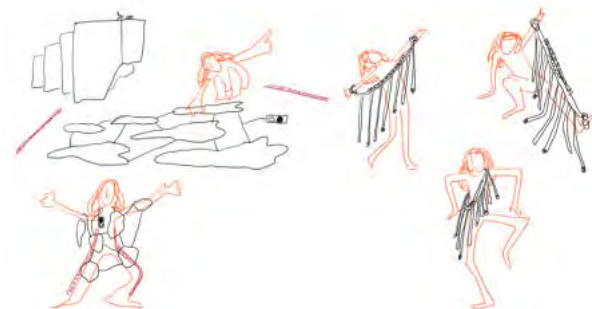


Figure 6. Two different sketches representing how we imagined the interactive interfaces being manipulated by the performer ©Isadora Teles de Castro e Costa, 2021

Prototype 3: Communication between connected mobile devices and virtual system

To test our hypothesis of a modular, fragmented, and sensitive scenography, we needed connected devices allowing reliable communication and resistance to the movements and gestures of the performer. We therefore considered devices linked to mobile technologies as a hypothesis to solve this problem.

We have tested the portable device interaction hypothesis during the second studio residency (**Fig. 7**). During our experiments, the performer had to hold the devices limiting his movements. For the on-screen drawing interaction, the performer had to look at the screen of the portable smartphone. We do not yet know if this constraint of movement limitation is an interesting creative path, but, although this limitation seems unconstructive to the dancer, it reflects quite faithfully our daily use of portable devices.

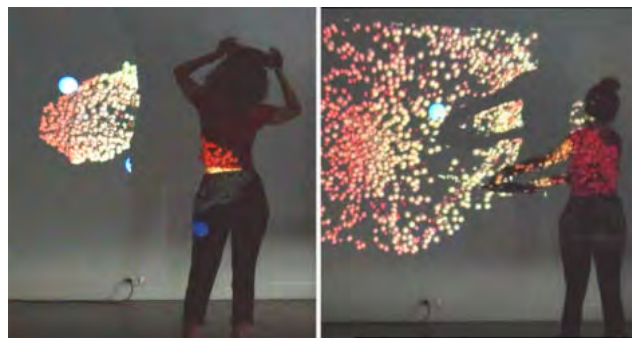


Figure 7. Experiments of choreographic interactions with fragment shader particle system through the manipulation of a tablet. ©Isadora Teles de Castro e Costa, 2021

Conclusions about interface interaction

The use of this portable device by the dancer on stage led to the following observations:

On the one hand, the public or anyone connected to the web server could act as an attractor to the behavior of the virtual environment, partially controlling it from their smartphone. This is part of a process of active participation of the spectator in the performance. On the other hand, we could use multiple cell phones, which are more easily accessible to create connected objects or costumes. The function or the appearance of these smartphones would thus eventually be "recycled".

In our co-creation context, the exploration of the creative possibilities and the potential gestures that these portable devices allow remain to be deepened during a next residency together with an evaluation of the theoretical issues that their use gives rise to. For example, if we fix them on parts of the performer's body, what type of movement can the sensors of the portables acquire and make usable by the virtual system? The interaction by their sensor motivates an original use of cellphones or would daily gestures persist?

Results

For Whitelaw, metacreation as an artistic technique is theorized as a creator method itself, because the artist creates a creative process: "Familiar tropes of endless novelty and metacreation reappear; often the works are somehow autonomous; once made, they make themselves". [11] This creativity is developed in a different timeframe than the one we planned to study. Prior to the establishment of a co-creation between the virtual system and the performer, there is a co-creation stage between the artist-developer and his generative system that must be considered. In order to be able to characterize the emerging aesthetic phenomena that result from the functioning of the virtual system in interaction, the creation of a vocabulary specific to the generative system and to the performance.

The ability to describe a moment of creation and adaptation between the performer, the artist-developer and the generative system turned out to be necessary in our case study.

Although we have developed several types of virtual systems, they took on new meanings and those new issues arose during the studio experience. Prior to the establishment of a potentially autonomous and emerging system, the question of the perception of virtual autonomy by the performer as well as the physical characteristics and conditions of communication by the interface are important aspects that must be tested in situ. These are variables that can promote or jeopardize performance, and therefore, co-creation.

The hypothesis of creating an interface began with the idea of having a means of exchanging data between the stage and the virtual environment. Its appearance and operation have been designed to respond to artistic intentions and to the metaphor of the representation of emotions. Very early on during our experiments in the studio, we realized that their presence on stage fell within a broader framework than that of communication with the virtual ecosystem. We were confronted with the staging intentions and with the construction of the meaning of performance in general (in contrast with the sense of the virtual in isolation). The projected virtual environment and the interface became the scenography of the performance and therefore had to be considered together with the means of perception of the scene by the performer.

We developed some of the interfaces during the studio experience and tested them in the initial phase. This experience allowed us to direct our expectations and assumptions based on the materiality of the stage and the performer's body; the creation was therefore more applied and more suited to the desired artistic situation. The constructive or ineffective constraints of movement, induced by interfaces, were identified from interaction observations made in the studio. They allowed us to consider the performer's movement in a precise way

according to emerging hypotheses about the interface and embodiment of the virtual on the stage.

Through conversations and an interview with the performer, we noticed that the perception of co-creation (expressed by the performer as a perception of the autonomy of the virtual during interactions with autonomous entities) was more present when the interaction was simpler, clearer, and more responsive by the performer. This impression might be explained by the stage layout which was not very ergonomic or not very consistent with the idea of an exploratory and improvised creation with the virtual system. Indeed, the image of the virtual ecosystem was projected on a screen located behind the dancer and by which he was implicitly attracted. This generated a form of confusion or conflict of attention linked to the sharing of focus between the bodily creation of the moment and the follow-up of the exploratory interaction with the virtual. For the performer, the dynamic lived between that of being a spectator of an interactive installation and that of a dancer who focuses on his presence and his expressive gesture on stage.

This shared attention between the real and virtual environments turned out to be unconstructive and therefore uncreative. This observation made us consider the possibility of spatializing the projection on the stage, by means of a projection on the fabric of the performer's costume (**Fig 8**).



Figure 8. Experimentations with the projection of particle simulations over white and translucent fabric ported by the performer ©Isadora Teles de Castro e Costa, 2021

The first impressions of this ongoing test are already promising. They outline a path towards the resolution of the problematic of the interaction by the perception of the scenography. This scenography attracts the performer's commitment to the co-creation. The problematic of the perception of the scenography by the performer lead to the hypothesis of creating a scenography-character incorporated into the scene as a staged element. Such a hypothesis is as important a condition for co-creation as the construction of an autonomous evolving virtual ecosystem. Moreover, if the virtual system is not perceived as autonomous or if it is not perceived at all, how can it be in creative dialogue with the performer?

Discussion

Our experimentation in the studio gave us clues to understand the conditions conducive to co-creation in three key aspects of the scenic environment conception: the scenography (how the performer and the audience perceive the virtual), the interface (how the virtual perceives the "real") and the programming of the virtual system (creation of the behavior of virtual entities and of its endogenous and exogenous interaction modalities).

In view of the prototype state of species and interfaces, at several times the artist developer intervened to calibrate the interactions, test new relationships between the collected data and the parameters to improve the configurations of the virtual system. The presence of the artist-developer as an operator or mediator in the relationship between the performer and the generative system was studied within the INREV team and represents a concept and a model in its own right, within the dynamic of co-creation between the participant and the interactive device. [21], [22] The sensitivity and perception of the mediator enter as a variable in the evolution of performance.

The concept of performance co-created between mediator, performer and generative system gives us indications on how to incorporate a virtual system on the stage. Can or should this type of hybrid scenography have a mediator? Can he participate in the performance while being on stage? The operator's mediation on the perception of the performer's data by the virtual system could be used in the design of an evaluation function (fitness function) aiming to characterize the adaptability of the virtual system and its species as part of the implementation of an evolutionary step by genetic algorithm.

The studio development experience allowed us to consider the performer's expectations and needs and helped us build an emotional bridge between him and the virtual system. An added step in the interaction experience plan was the familiarization with the functioning of the system, during which the artist-developer explained to the performer how the system worked, how it was developed, what were his inspirations and what were the links that united the simulations or algorithms of artificial life described in many publications and the digital art systems created on these principles. After this introduction, the performer was able to forge subjective links with the virtual and led the interactions based on his new knowledge.

The learning and exploration phase have been shortened and new clues for co-creation have emerged, which Edmonds calls the adaptation and dialogue phase. [5]

A need of the performer was to perceive his influence on the rhythm of the particles. She felt that this influence existed at times and waned at others. The moments when she rediscovered this interaction became moments of creative awakening, driving new gestures. This need expressed by the performer motivated the start of the creation of a common vocabulary, mentioned in the **Results** section of

this article, which served as a bridge between the programming of the virtual environment behavior and the scenic vocabulary of dance. This need manifested by experience suggested the idea of introducing parameters into the behavior of virtual entities that could be identified as the "rhythm" of the virtual by the performer. How to identify dance phenomena in the language of virtual autonomy simulations to make the interaction clearer and more constructive with a view to co-creation? Other concepts from the vocabularies of the modeling of complex systems and of performance were exchanged such as: autonomy, incarnation, form, flow, among others, for which links will be built and discussed during the next studio experiments.

At the end of the first residency, we presented an excerpt from our experiments and received constructive feedback from the *Centre des Arts d'Enghien-les-Bains* and INREV teams. As spectators, they problematized the surface of the projection as well as the way in which we staged this projection. During a team discussion, we realized that this problem was also perceived by the performer and could thus be formalized from the angle of the perception of the virtual environment by the performer: how a specialized and fragmented scenography in space, not only at the level of the interfaces, but also at the level of the projections, can it contribute to a better perception of the scene and therefore encourage a dialogic / adaptive improvisation on the part of the performer?

This feedback was considered for the second round of studio experiments, when we tested projections on fabric in space and on the performer's costume. The new environmental specialization tests have been promising and are in line with our goal of building co-creation conditions.

Conclusion and Perspectives

The goal of designing a scalable virtual ecosystem quickly shifted to creating the virtual environment and building some form of onstage incarnation to support the performer's adaptive engagement. Our new research-creation hypothesis is to develop the evolving virtual environment so that its incarnation on stage allows spatialized perception and interactions with the performer. If we want the scenography to be played, touched, and manipulated by the performer, but also to be autonomous, acting and reacting to the stage environment, that supposes that it becomes an actor on stage. We call this conformation a scenography-character.

The dialogue will be established not only by the attention that the performer pays to the virtual environment projected on a screen or on himself, but also because in inhabiting the stage, the virtual induces constraints but also the suggested possibilities, which are as many attempts to confront these two elements.

The expression of emotions was initially implemented by following a process of metaphoric and analogical description of emotional sensation, and by transcribing it

through virtual movement from the point of view of the artist-developer. But these descriptions were changed during the studio experience thanks to observations and exchanges of ideas with the performer in an improvised situation. In this case, the expression of emotions by the entities is co-created at the level of the initial programming of the behavior of the virtual entities, within the limits of the emotion-behavior metaphor set up by the artist-developer. The scenography intends to express the alter-ego of the performer during an evolutionary transformation; its implementation will be our next work step.

The studio experience also caused the adaptation of goals and methods development of the virtual system and of the interaction interfaces, considering the limitations of the initial proposals through the materiality of the experience, the expressive needs and intentions of the performer / director and discovering the weak points and new potentials of the creation when it is put in a situation.

The characteristics of the hybrid scenography described in the article make us think of the possibility of interpreting the design of the scenography in a way integrated with the conception of the staging, by improvisation and by experimentation in the studio, in the form of a *scenography-character*.

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THE MULTICULTURAL AND TRANSDISCIPLINARY CONSTRUCTION OF ANTI-CONSUMERIST CRITICAL THOUGHTS – THE MULTISENSORY DIVERSITY OF THE ARTISTIC INSTALLATION SERIES “THE WISHING TREE” (2012 – 2019)

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Abstract

“The Wishing Tree” is a sort of multimedia sensorial installations made in artistic workshops that have proposed anti-consumerism thought and practice by a mix of recycling assemblage, handcraft, visual art, interactive music and technological artistic experiences. They are initially aimed at art educators and elementary and high school students and promote, from the integration of different means of expression, the integration between the visual arts, the audiovisual and digital/sensorial systems. This article evidences some aspects of these procedural art series, such as critical protagonism, agency, pro-activism and other ethical and cognitive additions in the courses of these international workshops-installations held between 2012 and 2019.

Keywords

Education Through Art, Art and Technology, Transdisciplinary Arts, Multiculturalism, Sensory Aesthetics.

Introduction

The pathological consumerism that plagues humanity today has been one of the main vectors of destruction of nature and civilization itself in the Anthropocene era (ISSMEMER & LÉNA, 2018), [1]. Reflecting and debating on this theme is necessary in all public and private instances, especially in the educational sphere.

From our background in the fields of communication technologies and Technological Art, we decided to provoke and reflect the above concern through the possibility of interactive and participatory integration between the arts, science and technology, in order to awaken, together with people involved, a critical anti-consumerist conscience through transdisciplinary artistic productions. Thus, we developed and carried out a series of multidisciplinary workshops that addressed, in their own ways, the artistic, technological and media fields, initially in elementary and intermediate schools, bringing together elements of recycling, drawings, sculptures, handicrafts, video,

animation, interactive music and interactive sensory mapping with approximation digital interfaces.

The foundations established for such achievements were based on an artistic and critical reinterpretation of the "Tanabata": a piece of traditional Japanese folklore constituted in a "tree" with written and hanging powers to fulfill wishes. However, the "trees" built in these workshops were derived from object waste and discarded industrialized product packaging. This leads to a reflection on realizing that such construction takes place from "realized desires" and, with this, a critical provocation to consumption practices led by desires and impulses (by necessity or will).

Twelve “trees” were built through workshops in schools, cultural centers, villages and indigenous villages in nine different countries, between March 2012 and July 2019. They took place in schools in Brazil (Campinas and Chapada dos Guimarães), Portugal (Guimarães), Germany (Kehl), Greece (Thessaloniki), New Zealand (Auckland), Nigeria (Osogbo), Nepal (Sikles), Namibia (Walvis Bay) and India (Annaikatti and Kochi). Some of these works were even exhibited at later art museums and cultural events.

We know how much visceral relationships, which nowadays tend to be established between art, science and technology, provide us with opportunities to explore unusual relationships between individuals and artificial structures of expression. As with all other areas of human knowledge, the evolving dynamics of this symbiosis have constantly led us to rethink procedural bases in the fields of technological art and emerging media.

Although, initially aligned with perspectives that take into account the fluidity of the constant material and behavioral transformation (JENSEN, 2001) [2] caused by the resulting informational actions-reactions between the work, the performer and the audience as well, in each place where they were carried out, provoked distinct and unique experiences and spontaneous actions as the final result, within the scope of human-machine interactions, from their diverse cultural, art-educational, motor and affective contexts. In this way, as the experiences took place, new concerns were attached to the ongoing investigations, caused by occurrences of a multi and transcultural nature (SANTOS, 2013) [3]. This has led

us to constant bibliographical, conceptual and conjunctural reviews, constantly promoting epistemological revisions and additions to this set of actions and resulting works, as well as their impacts on different and diverse audiences.

This manuscript brings the set of actions, results, past and former reflections that gave rise to and that derived from these local and transcontinental experiences. The dorsal thematic construction of these events starts this work, externalizing the diagnostic (JAGODZINSKI, 2020) [4] and tactical (FREIRE, 1970; BARBOSA, 1989) [5] [6] approaches, regarding the argumentative structure that anchors the development of these works. The productions and subsequent exhibitions of these works are discussed here from ontological and procedural conjunctions in their interactive and participatory aspects in all stages of their realization. The resulting expressions and concerns are finally debated in the light of a critical though changing "supra-relational" aesthetic, anchored in "ecosystem" (GIANNETTI, 2006; TELES, 2009; VEIGA, 2018) [7] [8] [9], multiversal and rhizomatic arguments (GUATTARI, 1992) [10].

Symptomatological radiography: the construction of an anti-consumer critical thinking through Art

"As art and media teachers, we have no choice but become symptomologists of our current crisis that penetrates so deeply how we live in the environment that we are modifying". this way, art-educator Jan Jagodzinski (2020, p. 266) defines the role of one who, at the same time, produces, teaches and researches in the field of Art, based on experiences, acquired knowledge and, mainly, an expressive diagnosis of situations and conditions experienced.

Even before the European aesthetic ruptures at the end of the 19th century and beginning of the 20th century (HAUSER, 1953 [11]; LITTLE, 2004 [12]), artists, in general, already sought to illustrate the materiality of their surroundings and formatted in his imagination, although he also sought subjectivities of an emotional nature and states of mind. Greek and Roman sculptures, as well as practically most of European art from the Renaissance to pre-impressionism, evidence this search as well as, with the acceptance and consecration of increasingly abstract arts from that *avant garde* period onwards, the supra-material diagnosis expressed has become more evident.

Among critical and affective apprehensions and consonances, the art educator also uses to encourage his students to become protagonists in order to provide, through expressiveness, not only their "soul state", but also to build, individually and/or collectively, their own knowledge. The symptomatology proposed by Jagodzinski acquires power and robustness when it is experienced in a dialogical and critical way, such as that already observed by Paulo Freire

(1970), for which "the dialogical man, who is critical, knows that, if the power to do, to create, to transform is a power of men, it also knows that they can, in a concrete situation, alienated, have this power harmed." (FREIRE, 1970, p. 46)

We will be critics, true, if we live the fullness of praxis. That is, if our action involves a critical reflection that, by organizing thinking more and more, leads us to overcome a strictly naive knowledge of reality. (Idem, p. 73).

Ana Mae Barbosa (1989), art-educator and former student of Freire, also provides subsidies for this supra-conjunctural look in the construction of critical knowledge through an artistic perspective. She argues that "despite being a product of fantasy and imagination, Art is not separate from the economy, politics and social patterns that operate in society. Ideas, emotions, languages differ from time to time and from place to place and not there is an uninfluenced and isolated view." (BARBOSA, 1989, p. 178)

We build History from each work of art examined by the children, establishing connections and relationships between other works of art and other cultural manifestations. (Idem)

More than a vector of consolidation of our Anthropocene era (ISSMEMER & LÉNA, 2018), consumerism, as an individual and collective social practice, became the main source of the system that produces and regulates our livelihood and performance in our world. At the same time that it produces everything we consume, it is, in fact, an inevitable destructive drain on matter, energy, information, as well as a producer of unprecedented waste and pollution. Its mainspring is the constant change that occurs in the forms, features and validations of products, whose terms and obsolescence have been predetermined in increasingly compressed time intervals. Stimulated by affective seductions, repetitions, viral media and machinic customization, consumers become hostages of this mantric spiral that prevents them from reflecting on effective alternatives that lead to a less destructive socio-environmental harmony than we currently experience.

The challenge posed here to this question originated from the encouragement expressed by the US-based Indian art educator, Dr. Mousumi De, to this author, in the sense of integrating artistic-technological productions to art education. This theme erupted in a dialogue between us in which she reported a work she did with teacher, artist and curator Roberta Altman with children from New York and New Delhi, based on the folklore of the "Tree of Desires" (Tanabata). In them, children expressed their desires through drawings and collages with recyclable material.

When designing this work, we decided to design a workshop that, initially, should reach Art teachers and

elementary school students (elemental, junior and secondary school), preferably aged between 09 and 14 years. They would be encouraged to express their desires through drawings, paintings, writings and video testimonials. Also, a three-dimensional sculpture in the shape of a tree should be built from used and discarded objects and packaging, with the knowledge that they are building a tree with fulfilled and consumed desires.

Interactive art + participatory art: ontological and procedural conjunctions

The touchless interactive aesthetic has since 2005 permeated our concerns about using the gestural actions of people in the empty state as part of a multimedia artwork. In our PhD thesis (TELES, 2009) we took this issue to a more robust understanding regarding the cultural and temporal diversification of interactive processes and interactional actions, anchored by theorists from different eras and scientific, philosophical and artistic currents. From Heraclitus' processualism to Giannetti's endo-aesthetics and the Guattaryan rhizome, passing through Hegelian dialectics, Einsteinian relativity and several other comparative references between ontological and systemic currents of thought.

Likewise, our experience in teaching in the fields of media studies led us to promote courses aimed at the audiovisual training of elementary and high school teachers in municipal and state public schools, from educative constructivist perspectives anchored in Paulo Freire, Ana Mae Tavares, Mario Kaplun, Jesus Martin-Barbero, Ismar Soares, among others (TELES and DE, 2017) [13]. In this way, the established challenge that emerged from that dialogue with De, came to merge this set of actions and epistemological baggage, developed that occurred in parallel throughout the first decade of the 21st century.

Touchless interactive works from lab to world: development, experimentation and mixed-media collectivization in art-educational workshops.

The search for the development of a touch-free sensory interface started in 2005 with the beginning of research into electronic and digital components that would transform the signals for capturing body movements into algorithms capable of producing and manipulating sounds, images and others machinic animations.

During this period, technologies that would promote DIY practice made it possible to actively connect a rich set of possibilities for action and sensory communication of the most diverse. Low-cost controllers such as the "Arduino" brand and derivatives, as well as nano computers such as the "Raspberry Pie" brand and the like, have opened the door to the imagination of garages, electronic and digital artists.

Presence, proximity, touch, heat, sound, color, mechanical pressure, speed sensors, among others, have become outstanding channels of artistic interactivity whose resulting works have become popular in the most diverse museums, events and cultural centers.

In addition to the Hegelian dialogical subjectivity (HEGEL, 2002) [14], the audience became a mechanical and bodily part in the "completion of the work" (MURRAY, 1997 [15]; WILSON, 2002 [16]; SHAW and WEIBEL, 2003 [17]; PAUL, 2003 [18]; HANSEN 2003 e 2006 [19] [20]; among others). Triggering and transformations of sounds, lights and images without touching or touching anything were for us a procedural consecration and a break with the cyborgism of material connection.

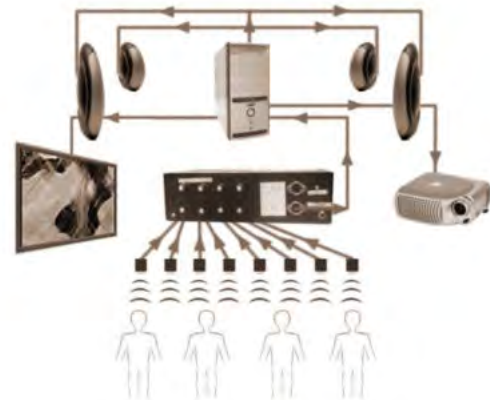


Figure 1. Sensory original structure scheme (XXXXXXXX,XXXX) ©Author's Copyright.

The option to establish the linear sensory capture of distance and approximation as a procedural basis for the triggering of interactive expressions in the works, from then onwards, was due to the possibility of "slicing" the total distance captured by the component for the execution of multiple commands algorithms and also the possibility of using several of these sensors in the same controller.

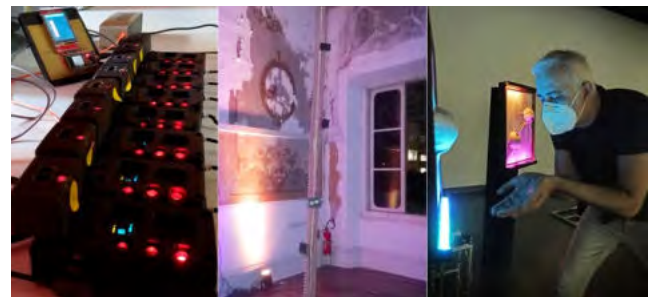


Figure 2. Photo montage: latest proximity sensorial interface controller, developed by Juliano Prado (left), the interactive installation "Pontos G – Um auto sem Natal", exibida no Museu da Imagem e do Som, Campinas, 2015 (center) and the interactive installation (in progress) "Antigenous 2.021 – current Resistances" (right)

The scripting of events to be triggered and transformed took the linearity of narrative time and replaced it with

spatiality. Thus, for those people used to script linear pieces, it would be as if minutes and seconds were transformed into centimeters.

Since then, the artistic pieces produced since then under this interfacial structure have not only become fundamental objects in our research, but also, on the other hand, got expressive results of fragments of one view of the world and of the moment, as well as of the interactive process framework itself.

Interactive and participatory processes as a “meta-endo-aesthetics” way.

The workshops that result in the interactive installations "The Wishing Tree" feature a pre-established plan between the author, the welcoming institution and the participants. A reference agenda with the proposed events is presented in advance to the future participants and then adapted before or during the event, according to the characteristics of the place, the participants and the total time available.



Figure 3. Photo montage: scholars building assemblage 3D sculpture from rubbish at Annapurna Secondary School in Annaikatti, Nepal, 2017 (left), the same job at Kingdom Kids School, in Osogbo, Nigeria, 2016 (center) and drawing their wishes at Agrupamento Escolar 2/3 João Meira, in Guimarães, Portugal, 2012.

In general, the list of activities for this workshop consists of:

- Initial lecturing to the participants: presentation of the project, debate about the theme and discussion of the work plan;
- Collection and recycling: non-organic objects are collected, cleaned and selected to be used in the sculpture - it is at this point that the previous usefulness of the object or packaging is observed, as well as the "leftover" which, when thrown back in the trash, they already do so by reflecting on the volume of consumption observed - in some places, especially in the indigenous villages of Silkes (Nepal, 2017) and Aldeia Milagrosa Pataxó Hahahae (Brazil, 2018) organic materials (tree branches and pieces) and local clay too were used;
- The construction of the sculpture: on the first day of the event (in certain places even before the event) a certain local tree is chosen by the participants to inspire the construction of the sculpture - the planning and

construction process, in which the separated garbage is transformed into a sculpture artistic is performed jointly by the author and the participants;

- Drawings and writing: students between the ages of nine and fourteen are invited to draw and/or write their wishes;
- Video interviews: a group among them selected by the responsible teacher reports their wishes on video recording - photos of their faces are taken for the final composition;
- Digital animation: some of the drawings produced are selected, digitized and animated - the rest are displayed along with the installation on the days of the exhibitions;
- Recording of interactive music tracks: musicians are invited to record a song to compose the installation under construction - with a laptop, a smartphone and a pair of headphones, participants record the theme composed or chosen together and then separately - the individual material is "recomposed" in the final composition of the work;
- Diagramming and editing of interactive reactions: through the "Isadora" software, images, sounds and animations are diagrammed and distributed on the display screen and their triggering are mapped in the linear space of the sensors (the number of approximation sensors has varied from one to three according to the size of the displayed place and the number of attendees at the event).

During the exhibition, participants and guests were encouraged to approach the sensors attached to the trunk or branches of the sculpture. Such movements made the animated images, the photos of the interviewed participants' faces, the interviews and the soundtrack (with the addition of each instrument or participant voice as they approached) to appear and become audible. those who participated in the construction, whether in assembly, drawings, sculpture or music, began to have an unusual contact with a strange and familiar work at the same time because of their co-authorship.



Figure 4. Photo montage: video collecting of wishes testimonials at Tulla Realschulle, Kehl, Germany, 2014 (left), recording of the interactive music's track at Vidya Vanan School, at Annaikatti India, 2019 (center), and digital editing process at !Nara Primary School in Walvis Bay, Namibia, 2018.

In turn, the mixed media interagency of waste from industrial products consumed with manuals and touch-free digital technology highlighted the pedagogical potential of expanding creative and multidisciplinary perspectives. The idea is not to teach a technique or a practical artistic craft, but, through the application of different techniques and skills already developed in each of the people involved, to build an expressive work that promotes at the same time unusual experiences in the field of art, and also to promote critical reflections on consumption, ethics and collectivity through the interactional and interactive environments established during the making and display of the artwork.



Figure 5. Photo montage: Assemblages tree sculptures at School of Oreokastro, Tessalonik, Greece, 2014, and at Thermoizina Siqueira Primary School, at Chapada dos Guimarães, Brazil, 2015.

Multicultural Impacts - Multiversal Results

Almost all installations resulting from these experiences were exhibited in the places where they were produced.

These are the cases of those that occurred at the Sesi Santos Dumont School, in Campinas, Brazil; at Agrupamento Escolar João Meira 2/3, in Guimarães, Portugal; at Tulla Realschulle, in Kehl, Germany, at the Secondary School of Oreokastro, in Thessalonik, Greece; at Somerville Secondary School, Auckland, New Zealand, at Shree Annapurna Secondary School, in Sikles, Nepal, at Aldeia Milagrosa Pataxo Hahahae, in Pau Brasil - Bahia, at !Nara Primary School, in Walvis Bay, Namibia, and at the Indian schools of Vidya Vanam, in Anaikatti, Tamil Nadu, and Tattwa Center of Learning, in Cochi, Kerala. The exhibition venue of the installation made at the Thermoizina Siqueira School, in Chapada dos Guimarães occurred in a local restaurant. In Osogbo, Nigeria, because the tree production was made in two secondary schools - Kingdom Kids and Excellent School - the grand finale took place in a city hotel capable of accommodating students, teachers and guests from both schools.

Some of these installations were later re-displayed in other locations, cities and countries. The installation produced in Nigeria crossed the Atlantic Ocean towards Brazil with the artists Olaniyi Sunday and Babalola Mahmood, who also brought some of their works painted in oil on canvas, and was exhibited in the lobby of the Mário de Andrade Library, in the city of São Paulo and at the

Museu da Cidade and Museu da Imagem e do Som, in the city of Campinas.

The installation, which was carried out with the Pataxó Hãhãhãe indigenous people - through an artistic residency promoted by the project "Indigenous Electronic Art" (AEI) led by the NGO Thydewa - was also exhibited at the Pankararu-Paraguassu Indigenous School, in the city of Pau-Brasil and at the Museum of Modern Art in the city of Salvador (Figure 4). It also became one of the reference works of the award that obtained the "Honorable Mention" in the "Start Prize 2019" awarded to the AEI by "The European Commission honoring Innovation in Technology, Industry and Society stimulated by the Arts" (CIBERARTS, 2019) [21].

The Brazilian curator and researcher Alessandra Simões (2019), who visited the exhibitions of the project "Indigenous Electronic Art", analyzes "The Hãhãhãe Wishing Tree" from the perspective of aesthetic results based on common shares between contemporary and ancestral poetics. She understands that they "cannot be understood as opposing expressions, but practices and knowledge that interrelate in unstable and syncretic spaces, whose ultimate goal is the junction of "art-life"" (SIMÕES, 2019) [22]. The installation was considered by her as "a true relational web".

The "tree sculpture" was made from the recycling of garbage found in the village, with digital proximity sensors and interactive audiovisual expressions based on the movement of people around. (...) the "ritual dimension" was unveiled with artists who incorporated ritualism in their work, such as the Tree of Wishes Hãhãhãe, whose parts were composed by collecting waste in the village, desirous of being transformed into art from a ritual of collective choices. (Idem)

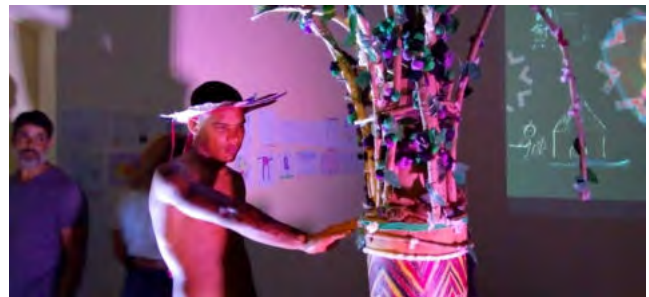


Figure 6. The Hahahae Wishing tree at Museu de Arte Moderna, Salvador, Brazil, 2018.

The!Nara Primary School installation workshop, in Walvis Bay, Namibia, was also exhibited at the InSEA

International Seminar 2018¹, which took place in that same city the week following the event. I invited some students and the key-teacher, among those who participated in the workshop, to present this job together with me to an audience of artists and art educators from more than twenty countries. Event guests were also encouraged to interact with the wishes expressed by those children.

Altogether, among participants, staff and audience, more than two thousand people have already visited and interacted with these works on five continents (we still do not hold workshops of this series in North America). Some of those installations were re-displayed in art schools and museums. These were the cases of the workshops that took place in Osogbo, Nigeria, and in Aldeia Milagrosa, Brazil.

Some of the events received around eight hundred people, as in Osogbo and Auckland (in this school we held several daily exhibitions over three days, serving an average of sixty students each), while those with the least participants and visitors occurred in Chapada dos Guimarães and Sikles, with approximately forty people in each of them.

In addition, other installations were produced by us from the materials collected in those previous workshops and from the first "tree" produced, donated (back) by the Sesi Santos Dumont School and kept until today. The concatenation of these materials produced "world tour" versions of this work, which were exhibited at the University of São Paulo (ABCiber 2017)² and at the gallery of the cultural space "Casa do Lago". In these cases, we realized that they played the role of "interactive multimedia documentary". In those exhibitions, a set of photographs and a video documentation were added in order to provide the audiences (without any previous connection with the work) of information about the procedures and results emerged from those related experiences.



Figure 7. Photo montage: "The Wishing Tree World Tour" 2012 – 2019 exhibition at Casa do Lago, 2019.

1 The InSEA SEMINAR was hosted by the Society for Arts Education in Namibia (SAEN) at Walvis Bay, Namibia in October 29 to November 02, 2018.

Universal consciousness, spontaneous interactive polysemy and the constitution of a rhizomatic ecosystem multiverse

A brief analysis is needed here regarding the diversity of those who interacted with these experiences in relation to the impacts caused to them. For a more accurate understanding, we must distinguish those who acted in the construction of the installations from those who acted in the form of an agency audience (MURRAY, 1997), despite the fact that, in the exhibitions at the venues, the people were the same.

In this case, even though the productions have taken place in a vastly different way in the social, cultural, pedagogical and technological spheres, the concerns generated around garbage pollution were quite similar. The transformation of waste into an interactive multimedia work had a "universal" impact on the workshop participants by giving them a solid sense of belonging and attachment to that whose composition derives from the connection of the expressions of their aspirations with the metaphor expression of "once fulfilled desires" contained in the rubbish.

Actually, we never expected that the workshops would promote an immediate anti-consumerist conversion among the participants, but rather provide them with a dynamic opportunity for the issue to be reflected in a critical and creative way. Our awareness of space-time-cultural differences is in line with the reflections of Appadurai (1996) [21] regarding the reception and implementation of "external" paradigms and the care that this demands from all involved ones.

With regard to consumption, long-term change is not everywhere equally rapid, although it seems increasingly foolish to contrast static with changing societies. The question seems to be the pace and intensity of change, as well as the alacrity with which it is invited. (APPARDURAI, 1996, P. 71)

Anyway, in almost all the exhibitions that took place where the externalization of desires on the screen and on the posters was produced, they caused a lot of commotion among those present. At the Somerville School in Auckland, all students and many guests were also able to draw their wishes on posters, which resulted in the display of over twelve hundred wishes pasted on the walls of the venue. Several of them moved schoolmates, some teachers and relatives to tears.

2 The X ABCiber National Symposium took place in December 14 – 16, 2017 at Universidade of São Paulo in Sao Paulo, Brasil.



Figure 8. Photo montage: shot from the commotion of the audience with the wishes displayed on the wall at the Somerville Secondary School, 2015.

Other event to be pointed occurred at the indigenous Brazilian school Caramuru-Paraquassu during the “Árvore dos Desejos Hãhãhãe exhibition. Due to there was just one sensor attached on the assemblage sculpture, the participants have organized a collective circular walking around that piece in order to provide that all the audiovisual expression available can be triggered by everyone. It brought to light how collective actions made coordinately, even the singular ones, can bring access results to all (Fig. 9).



Figure 9. Collective circular walking around the Tree. Pau Brazil, Brazil, 2018.

On the other hand, in some of the experiences, unusual interactive strategies surfaced spontaneously from some of the participants. Students from Campinas invented a game of "hunting" the images of certain colleagues, which appeared and disappeared by approaching the sensors and entered ecstasy when they managed to fix the image on a particular face. The same "face hunting" took place with participants from Sikles and Walvis Bay. Due to the small size of the venue, image projections took place on their clothes and faces.

Thus, the spontaneous "gamification" created in the three cases was one of the people "finding" in the space mapped by the sensors, whose filling would lead to the appearance of a certain face. In the last two cases, one person stood in front of the projector to get the image of the installation projected on his clothes, while another positioned himself in front of the sensors, in order to "set" the proper face image and another one took shots the person, whose own face was being projected on their clothes, with his smartphone.

As for the external exhibitions, we can also discriminate the set of different audiences found in the events into: workshop participants, guests, and casual visitors (onlookers, art fans, scholars). Within the scope of the fortuitous audience, it is worth mentioning the occurrence observed in the Exhibition of the Nigerian Wishing Tree at the Mário de Andrade Library. A group of visitors, one by one, began to interact with the sculpture, entering and leaving the sensory zones abruptly, activating the sound and images projected to the rhythm of the music made available in the installation (playing in a loop) whose volume increased and decreased in accordance with their positions.

We can also observe that each experience carried out and shared in each of these collectives formed, in fact, a small "universe" with ontological and procedural elements that very much refers to the communicational scheme of Jakobson (apud COELHO, 1980) [24], Teles (2009) or even to Veiga's "ecosystemic view" (2018) that propose, each in its own context, symbiosis between beings, machines, actions and information systems. However, when we look at the set of all these small "systems", we realize how much their connections reveal a frankly rhizomatic "multiverse" (GUATTARY, 1992) when we realize that the connections between them are not limited only to the form of the project used in all of them, but it also covers the lessons learned in each one of them that were, in some way, used in the following ones.



Figure 10. Photo montage. Sesi Santos Dumont School's students interacting in the space for an specific image exhibition in Campinas, Brazil, 2012 (left), interactive image is projected on student's shirt at !Nara Primary School, Walvis Bay, Namibia, 2019 (center), Mário de Andrade Library Hall's visitors making a rhythmical interaction with the installation in São Paulo, Brazil, 2016.

Conclusion

Although garage technology is nowadays quite popular, especially in developed countries (Germany, Portugal, Greece and New Zealand), the "sensory magic" of making sounds and images appear and disappear only with the movement of the body without touch, it proved to be as "innovative" to the participants as in those countries with more restricted access to it (the cases of Brazil, Nigeria, Nepal, Namibia and India). In turn, although the experience of artistically recycling waste, focusing on desired and

fulfilled desires, induces waste to be more observed by people, we know that the absence of a continuous praxis tends to dissolve, in a short time, concepts and awareness constructed mainly by critical biases.

In any case, this trajectory used by experimental technological art for an effective educational application through critical, militant and expressive biases through it - also highlighted for us how different skills, competences, technological resources and cultural bases - can coexist and generate unique and common expressive universes among all parties involved. The participant people commotion occurred the Auckland's school, as well as the collective interactive process established in the Pau Brazil school as well, brought us some of how the critical thought can be triggered by technological, multimedia and handcraft in a single artistic experience.

Therefore, more than a multidisciplinary militancy and "mixed media", this series of artistic, pedagogical and sociocultural experiences was (and is) to show present, critics, artists and scholars in related and related areas a possible way of acting in an artistic and pedagogical way while at the same time inspiring other themes lacking in action, training and expansion of knowledge, as well as transformative artistic expression.

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A Networked Multi-channel Audio and Video Authoring and Display System for Immersive Recombinatory Media Installations

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Abstract

Waterways Past, Present and Future is an informative interactive media exhibition aimed at increasing awareness of the fragile relationship between people and water in the Okanagan Valley and catalyzing sustainable water practices among residents. The exhibition draws on the power of multi-channel sound and video media immerse, provoke, destabilize, transform and move participants to act responsibly and sustainability. We describe the system design toward a networked multi-channel audio visual system capable of generating sequences of environmental recordings and interview footage over an arbitrary number of modules in an installation.

Keywords

Environmental Science Communication, Indigenous Methodologies, Recombinatory Media, Immersive Installation, Multi-Agent Systems

Introduction

The Waterways exhibition represents a four-year collaborative undertaking between the University of British Columbia Okanagan (UBCO), Elders and Knowledge Keepers of the Syilx Okanagan community, Kelowna Museums Society, Okanagan Basin Water Board, and the Okanagan Collaborative Conservation Program. Waterways was led by Dr. Aleksandra Dulic, Principal Investigator, and Coinvestigators Drs Jeanette Armstrong, John Wagner, Lael Parrott and Miles Thorogood from UBCO with other essential partners, including the Eno'owkin Centre whose input was vital in ensuring a rich cross-cultural Indigenous perspective on water. The exhibit features Syilx Indigenous-led best practices in water management and ecological resilience, including the return of the salmon to the Okanagan waterways and flood bank restoration along Shingle Creek and Okanagan River. These restoration initiatives demonstrate how Traditional Ecological Knowledge is applied along with Western science and show how Indigenous institutions have worked effectively with provincial and federal government agencies to co-manage and co-lead these restoration efforts. To communicate these stories, we recorded audio and video documentation of the environmental and cultural detail of the Okanagan landscape, soundscape, and community events, along with interviews toward designing an immersive installation.

The installation comprises two main spaces:

- The outer panels of the exhibit highlight Indigenous Syilx teachings and wisdom related to human-water relations and the value of water (Figure 1.). Visitors will also find screens of virtual worlds of the Kelowna landscape pre-colonialism. These screens are interactive and depict the diversity of life in the Okanagan, including plant, animal and insect species indigenous to the region. Visitors can experience the virtual world through touch-screen interfaces and explore what Okanagan landscapes and waterways looked like before development.
- The inner walls of the panels (Figure 2.) comprise five video screens where visitors experience recordings of the Okanagan landscape (b-roll footage). The recordings in b-roll sections impress the beauty and sensitivity of a diverse range of environments throughout the Okanagan region (see figure 3.). Accompanying a-roll includes stories of knowledge keepers from the Syilx indigenous community (Okanagan, and Colville Confederated Tribe) and Western science trained experts discuss the meaning of water, innovations in water ecosystems management and sustainability, new co-management arrangements for caring for our water and ecosystems, and lessons from these practices for the future.

A-roll interview clips discuss the following themes:

- **The value of water**, with a focus on what we can learn from Syilx Indigenous values that equate water with life, and consider water the most important natural asset.
- **Traditional Ecological Knowledge (TEK)**, with a focus on what this knowledge-practice-belief system comprises, its contemporary significance for understanding how ecosystems work, and how TEK and Western science can complement one another in dealing with the critical environmental and natural resources issues we face today.
- **The successful return of Sockeye salmon** to the Okanagan waterways after the canalization and damming of the Okanagan River and its tributaries and the near disappearance of Sockeye. This 20+ year endeavor was spearheaded by Syilx leaders and involved a co-management arrangement with the Okanagan Nation Alliance and provincial and federal authorities.

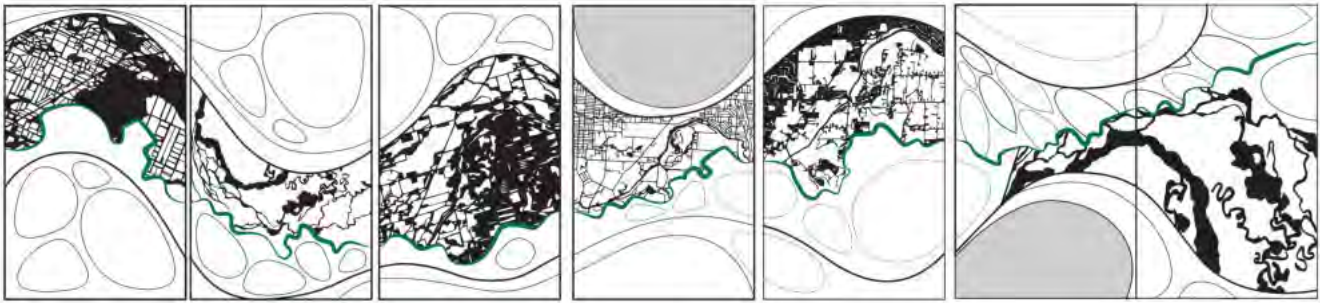


Figure 1: Design of the rear side of the Waterways modules.

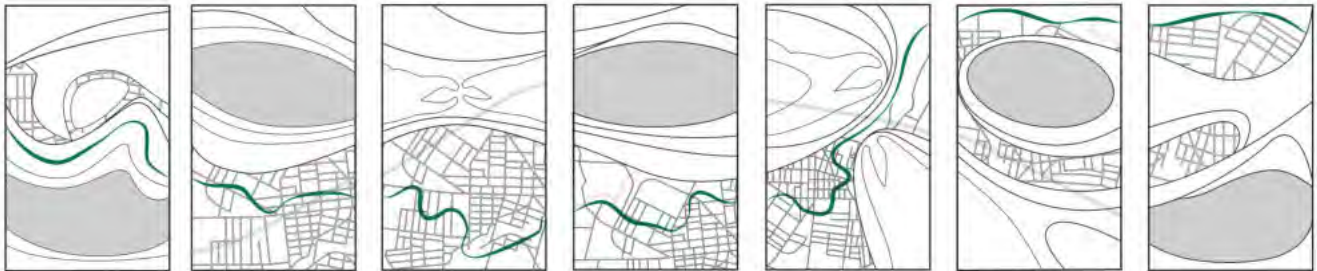


Figure 2: Design of the front side of the Waterways modules.

- **Adaptive co-management** of environment and natural resources, a power-sharing arrangement between governments and local resource actors and stewards, that brings structured learning by doing and adaptation to environmental and natural resource practices.
- **The Columbia River Basin** of which the Okanagan is a part, including the status of the all-important Columbia Basin Water treaty currently being re-negotiated between Canada and the US and stories of change and destruction of water and land habitats from elders who have lived through the changes.
- **The restoration of habitats in the Okanagan**, including cottonwoods and riparian systems, the Yellow-Breasted Chat at the ECOMMUNITY Place on Shingle Creek in Penticton.
- **Injustice and racism** endured and experienced by the Syilx Indigenous community in their efforts to restore their traditional lands and water, and the demonstration of the resilience of the Syilx nation in the face of this mistreatment and injustice.

Related Work

For the past four years (2017-2021), the authors have documented the environment landscape and community voices from the Okanagan region in Canada with the vision of creating a multimedia installation named Waterways [4]. During this time, we developed media to express the place and voices through multi-channel visual music performance Aeon [10], and the multi-channel video and audio installation Journey of a Pod [3]. While travelling through Sydney, Australia,

in 2019, we were inspired by the installation *Sydney Elders: Continuing Aboriginal Stories* [6] at the New South Wales State Library that used screens installed in objects distributed around the gallery to display a synchronized montage of the urban and natural landscape, integrated with interview stories with Australian Aboriginal elders.

In designing the Waterways visual and sonic experience, we aim to create a multi-channel audio and video display of the local environments and voices in the Okanagan. A sound design complements the visual display by modulating location recordings of background sound, such as water from the creek, and foreground sounds, including bird sounds of the region. Interview footage fades into the scene to highlight the speaker, then fades back out to the landscape footage with the speakers' voice remaining. The aesthetic choice of the Waterways exhibit design is loosely based on Jim Bizzochi's [1] concept of Ambient Video, which he describes as privileging the use of nature sequences, slow motion, gradual transitions that are "pleasant, visually interesting and capable of supporting occasional close viewing. It should change, but not too quickly, and the details of any particular change should not be critical over a limited time frame".

Pan [8] demonstrates how immersive installations create illusions of time and space by applying multi-sensory display methods to envelop visitors in the experience. Pan calls attention to managing the physical space by using nonlinear thematic frameworks and dynamic displays and identifying multi-sensory stimulation as immersive exhibitions' critical attribute. Otondo demonstrates an example of such an installation, and Rabello-Mestre [7], who use a procedure of mounting field recordings over a multi-channel sound installa-

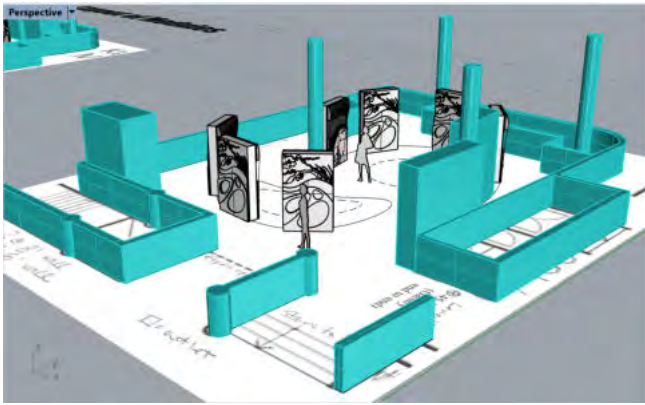


Figure 4: Screenshot of Waterways exhibit floor plan

tal elements. The picture plane is divided vertically between these two alternatives. This compositional and spatial framework has been at the core of Chinese landscape paintings.

The three distance concepts help us understand the process of positioning objects with each other and composing space itself with multiple and dynamic points of view. The deliberate representation of multiple points of view in the scroll painting allows for an abstract impression of the space, similar to music. It allows viewers to engage in rhythmic elements, such as points, lines, planes, sequences, and harmonies. Lines do not function as guiding elements that direct our attention from a particular point of view centred on the meaning of the work. The actual substance of the painting is in the sensation of multiple voices of counterpoints through linear melodies within the work. The journey through the painting is achieved by shifting the points of view and synchronizing pictorial elements within each sequence. The observer must participate in the experiential synchronization and linking of the different elements, sequences, contexts and content in time. This is a dominant method of conveying information within scroll painting [9].

System Design

The combinatorial use of media creates a continuous variation for viewers to experience the space of concepts the media represents. We designed the Waterways system to facilitate the composition and display of stochastic video and audio sequences from discrete media segments over a distributed network of modules. Each module includes a computer, an LCD screen, and two-channel audio embedded in a constructed display - with one speaker at the front of the box and another on the rear side to spatialize sound in installation contexts (Figure 6.).

The Waterways system can manage an arbitrary number of modules, with each video and audio channel addressed independently. A system management computer is assigned the role of the conductor that serves file requests to the modules that take on the role of players in the audio-video orchestra. A local WIFI network provides the infrastructure for communication between the conductor and players.

The conductor keeps a list of active players to orchestrate

and addresses these over Open Sound Control (OSC) by sending names of audio and video files sequenced from a generative software program. Modules can be added and taken away from the orchestra, which, in turn, the conductor adapts to the new network topology. Each module, plus the conductor, is then only tethered by a power cable to operate as a plug-and-play system.

At its core, the Waterways system includes a database of video and audio clips indexed by tags representing a particular concept. The system chooses a topic from the database, plays a sequence of a-roll clips, and selects accompanying b-roll footage and audio recordings to disperse across the screens and speakers in the system. The system conductor analyzes the database and, at run-time, moves between concepts based on a specified interval to remain within a concept and a list of transition probabilities to go to the next concept.

A remote player program receives commands from the conductor to play video and audio assets. When a video approaches its duration, the player requests another video from the conductor, who serves up the request based upon the current concept being explored. The player then crossfades the audio or video files to create a smooth progression. Accompanying audio tracks sequenced by the conductor include background sounds to engender the ambiance and foreground sounds to gain the listeners' attention.

Database

The composition approach taken by the Waterways system is building a database. The artist creates video clips of a-roll and b-roll footage and places these in a folder named with the concept. Audio files accompanying the b-roll footage are placed in a sub-folder named audio, with subsequent sub-folders for foreground and background sound. Additional concepts are added to the media space by repeating this process of populating folders. Populating named folders affords the artist a familiar means of managing and grouping media files.

After the database is populated, a Python script analyzes the directory structure and generates an index of the video files with the corresponding concept determined by the directory name. Similarly, an index of the audio files is produced that indexes the name, the concept, and if the sound is background or foreground. In addition, the script generates a $n \times n$ transition probability matrix of the concept names with weights for switching system-level exploration of the conceptual space at run-time. The script also generates a matrix for the weighted selection of accompanying b-roll footage given a concept; if the artist modifies the database, simply re-running the script updates the index.

Conductor

We designed the conductor program to generate sequences of audio and video file recommendations from the database. The Conductor references the matrix of a-roll transition probabilities to navigate the relationships between semantic concepts represented in the database of video clips. Starting from a random concept, the Conductor selects a parameterized number of shuffled a-roll clips from the video list, tagged with the concept and weighted by the number of times played, preferring clips selected the least.



Figure 5: Example of a system generated b-roll video composition.

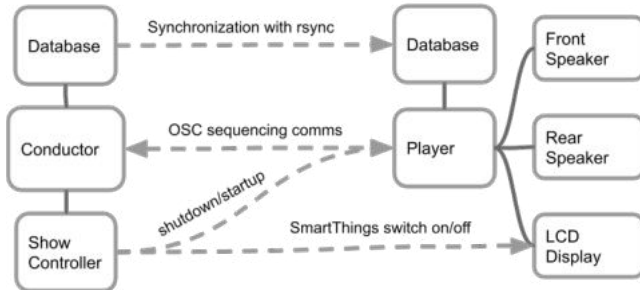


Figure 6: Waterways system diagram

The Conductor then selects a b-roll section based on the weights supplied in the probability matrix. When requested, the b-roll video and audio files are scrambled and served sequentially to the players. When all recommendations from the list are served, the Conductor will either scramble the list again or reference the table to select a new b-roll collection. Concurrently, the Conductor pushes foreground sounds requests for the concepts to modules in a stochastic fashion - constrained by specifying the minimum and maximum time an interval to trigger the push again.

To manage this, a timer initializes when a new section begins, and the Conductor starts serving up b-roll clips to the players when requested. The Conductor sequences the a-roll clips based on the duration since the completion of the last a-roll. When the timer duration reaches its end, the Conductor then serves an a-roll clip to the next requesting player. The player notifies the Conductor when the clip finishes, the timer then resets, and the following a-roll clip lines up for serving at the next interval.

After all a-roll clips are served from the section and complete playing, the Conductor goes into a refrain section of sequencing only b-roll footage and audio for a set amount of time. After that time, the Conductor refers to the transition matrix to switch into a new section.

In a nutshell, the Waterways Conductor behaviour is summarized as:

- At system initialization, send a ping to log active players.
- * Choose an a-roll concept from the transition probability table.
- Choose a b-roll concept based on the a-roll concept selection.
- Select n a-roll clips from the video list for the concept.
- Select and shuffle all b-roll clips from the video list for the concept.

- Select and shuffle background sounds from the audio list for the concept.
- Select and shuffle foreground sounds from the audio list for the concept.
- Start a-roll timer.
- Push new b-roll and background audio request to all players.
- Serve b-roll media when requested from a player.
- Serve a-roll media when timer interval triggers.
- Reset a-roll time when Player notifies completion of last a-roll.
- Switch to refrain after a-roll list is exhausted.
- Repeat from *.

Player

A Waterways Player is responsible for making requests to the Conductor for new media to display and receive section change commands. Developed in OpenFrameworks, the software contains three video planes. A Player uses the first two planes for cross-fading b-roll video clips, while the third plane manages transitions of interview footage. On start-up, the program sends a ping over OSC notifying the Conductor that it is available to join the orchestra. If there is no response from the Conductor, the ping is resent at 1-minute intervals until notification from the Conductor that it is registered to perform.

A summary of the program behaviour is as follows:

- Send a ping at regular intervals to alert the conductor it has joined the orchestra.
- Receives video and audio file requests to play.
- When b-roll video is coming to completion, send a request for next video.
- after receiving new b-roll video request, cross-fade into the new clip.
- If conductor serves an a-roll request, fade a-roll in on top of b-roll.
- After a duration, the a-roll video is faded out to b-roll with audio from a-roll remaining.
- Alert the conductor when a-roll is complete.

System Management

Database

When working across multiple networked computers, there is the challenge of updating each machine's video and audio



Figure 7: Waterways installation view.

database. Copying the database to a hard drive and replacing the directory on each machine is one cumbersome solution - especially when there are many machines and repeated changes over a brief time. We use the rsync command-line utility to address this challenge for transferring and synchronizing files across networked computers. When the artist is ready to synchronize the database to all the machines, they run a script with the rsync utility that points from the local database to the directory to synchronize on each machine. To circumvent the need to enter the password for each machine when synchronizing the database through SSH, we generate and install public/private keys on the local and remote machines.

Installation Control

To make it straightforward for the gallery staff to turn on and off the installation, we developed an Android App to control the system using Processing with Android mode enabled. The App interface displays buttons for switching the system on and off and levels to attenuate the loudness of the audio space. The App communicates with the conductor machine by sending OSC commands for these particular operations. A program on the conductor machine receives these commands and forwards the volume level request to the conductor that tweaks the player level at each of the modules. The on/off commands are handled by executing scripts on the conductor machine that tells the player machines to open the player program and power up the LCD or close the player program and power down the display. The power-up and down of the displays were managed using the Samsung Smart Things API as this was the available functionality. In the future, we recommend using display devices enabled with LAN control over a direct Ethernet connection.

Remote Management

A risk assessment for the relatively complex public art installation of Waterways included accounting for unexpected fluctuations in the system's stability. We deemed it unsustainable to maintain the installation on-site with the anticipation of touring across Canada. As such, we deployed a remote management software to allow observation and debugging of the system and update the programs and database.

Conclusion

Altogether, the Waterways system facilitates authoring and display of a multi-channel recombinatory audio/video installation that autonomously explores the space of concepts detailed in the media. The gradual, relational, and ever-changing transitions between and within concepts provide a gentle cognitive engagement for the viewer. Further, distributed over multiple screens and speakers, the sonic and visual modulation of environments and voices further immerses the viewer in the spatial and temporal movements of the media design.

The exhibition features Okanagan environments and insights of Elders and Knowledge Keepers of the Okanagan community, scientists and conservationists. Although out of the scope of this paper, there is also a highly realistic virtual world where visitors can explore what the Okanagan waterways were like before development via a touch-screen interface. Waterways explores the nature of our relationship with water - from the impact of development and climate change on the environment to the importance of Traditional Ecological Knowledge in ensuring all living things have clean water, now and in the future. In keeping with Syilx environmental ethics, the Okanagan Waterways Project reminds us that we all have a responsibility to work towards building and upholding the sustainability of water for healthy ecosystems and future generations.

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Waterways is a collaborative undertaking between the University of British Columbia Okanagan, Elders and Knowledge Keepers of the syilx Okanagan community, Kelowna Museums Society, Okanagan Basin Water Board, and the Okanagan Collaborative Conservation Program.

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Amanda Snyder, curation
Carla Mather, 3D project manager
Dalmarr Hussein, 3D interface design
Emerald Holt, content development
Jeannette Armstrong, Indigenous leadership and knowledge
John Wagner, content development
Jordan Pike, 3D visualization and production
Lael Parrott, content development
Linda Digby, project proponent
Maria Correia, project production
Marlowe Sam, Indigenous knowledge and research
Miles Thorogood, sound composition, systems design and development
A. Michael Bezener, content development
Rylan Broadband, module design and development
Sarah Alexis, Indigenous content development
Scott Boswell, content development
Sepideh Saffari, exhibition design

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Aleksandra Dulic is an artist-scholar with expertise in interactive art, climate change communication, and media for social change. She is the Director of the Centre for Culture and Technology (CCT) at The University of British Columbia. She leads an interdisciplinary research team that engages multiple forms of art, media and information technologies as vehicles for the expression of community, culture, and identity.

kin_ – An AR Dance Performance with Believable Avatars

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Abstract

Reflecting on the challenges and potentials that Mixed Reality (MR) media present for the production of digital performance art, we present the concept of the Augmented Reality (AR) artwork *kin_*. The piece is opening the question on how to transfer a real live performative experience into AR, as well as the question of owning and maintaining agency within an artistic fabric. This is explored with a focus on the interaction of different types of agents, using artistic research at the intersection of art, dance and technology.

Keywords

performance art, believable avatars, augmented reality, digital art, agency

Introduction

How can performance art be transferred into a digital context? What happens when the audience meets performers in digital form? How can believable avatars be created and staged? How can agency be designed within a digital performance? There are many questions that unfold from the initial one, bringing into conversation the rich theoretical background of performance art on the one hand and the theory of digital media, especially MR, on the other.



Figure 1. Mobile Augmented Reality dance performance *kin_* © Jochen Müller

As an umbrella term coined in the 1970s to capture all art forms that escaped other categorizations [1], performance art might be the only art form that is being defined as the undefinable within the art. In her attempt to delineate its development throughout the 20th century and up until the end of 1970s, RoseLee Goldberg asserts that it is in the very nature of performance to “defy precise or easy definition beyond the simple declaration that it is live art by artists”, adding that any strict definition would actually “negate the possibility of performance itself”. [2]

With all due acknowledgment of this uneasy and flexible terrain, for the argumentation purposes of this paper we agree to the definition of performance art as “practice that involves a person or persons undertaking an action or actions within a particular time frame in a particular space (...)”, central to its execution being “the live presence of the artist and the real actions of his/her body to create and present an ephemeral art experience for an audience”. [3] The creation in the moment of performing has been crucial to performance art itself since its beginnings.

Liveness plays an important role in the experience of the piece for the viewer. As an art form that traditionally relies on its physical immediacy, bound to its mediums of body, time and space, performance art seems to be multiply challenged when coupled with MR, which blends the physical and digital world into a new form of interaction and co-existence. AR is defined as a particular form of MR that runs interactively and in real time. The digital content of an AR experience is registered in real space.

The mentioned live presence or real actions are challenged in this context or, more precisely, we are challenged to reconsider the meaning of performance art in the medium that possibly disintegrates its very foundations, molding it into a new digital form that is yet to be defined.

While our first question – *How can performance art be transferred into a digital context?* tackles the aspects of technological possibilities and practical choices, the second one – *What happens when the audience meets performers in digital form?* invites for a more philosophical discussion on the experience of human-avatar encounters within a digital medium and its meaning in performance creation. The question – *How can believable avatars be created and staged?* addresses the production process of suitable AR avatars for the performing arts. Finally, the piece itself tackles the question on – *How (...) agency (can) be designed within a digital performance.* We argue that with AR it might be possible to attempt liveness within a digitized dance piece without losing the artistic and bodily quality to technology.

The discussion on these questions and notions is being built upon the example of the interactive performative art piece *kin_* (2021), created by artist Charlotte Triebus and an interdisciplinary team of developers of MIREVI Lab at University of Applied Sciences Düsseldorf.

The work *kin_* was realized in 2020/2021 and premiered with Erholungshaus Leverkusen and Kunstverein Leverkusen at City C from August till October 2021.

Installation Description

The interactive dance performance *kin_* is a dance piece with one up to three moving avatars and audience, developed for AR and freely accessible to download from the AppStore. The performance runs as an app on a personal device. (Figure 1)



Figure 2. *kin_* setup at City C Leverkusen 2021, © Charlotte Triebus

AR merges a real life setting with digital content and enables its usage almost everywhere due to its markerless design. Aside from being independent of specific locations, this possibility offers other advantages for developing and experiencing digital artworks that are not site-specific, such as free choice of viewing time and company or lower travel expenses. Although technically playable on any location, *kin_* is designed with an intention of use in spacious museum environments or private surroundings that offer enough space to the dance and the audience experience.

To run the AR experience at its fullest potential, a bright, quiet, and empty space should be chosen and permissions to access microphone and camera need to be given. The use of headphones is highly recommended for appreciating the connected, multidirectional sound experience.

kin_ is divided up into three dramaturgical parts that give structure to the piece. At starting the application an introduction is given, leading through the process of requirements and recommendations such as the placing of the content. The first part of the piece invites the user to get to know three avatars, their space, functionality and behaviors, by introducing choreographic material and setting the scene to slowly immersing the user into an AR setting. The second part consists of a fast choreographed trio of all three avatars dancing on relations and postures. Meanwhile the avatars do not take notice of the user in the second part, they fuse into one avatar at the beginning of the third part and start following the user in an intrusive manner. During the piece, the avatar(s) move closer to the user: the last part is staged as an interactive, following close up, that adds another layer of reality decomposition by introducing distorted facial expressions of the avatar. The piece ends with the avatar closing its eyes to disappear.

In the design of MR scenarios, a distinction is made between global and local agency:



when global agency is assigned to a user, their decisions cause permanent changes to the entire piece, while assigned local agency gives the possibility to influence individual factors that do not affect the overall event. [4]

For the sake of the dramaturgy within the dance performance, local agency competences of different sizes were assigned to the spectator in order to achieve a balance, so that despite influence, the piece remains perceptible in its entirety.

Making use of their local agency competences it is possible for the user to directly influence the piece through own movement and interaction, as the avatar dancers respond to proximity and distance, direction and angle of movement. The interaction of the user with the avatars is designed to be „indirect“ – triggered either by moving, inclining or tilting the device physically towards or away from the avatar, causing a dodging behavior. Direct touch is not encouraged and does not trigger any interaction with the avatar, but offers access to the menu structure of the app.

Each of the three compositional parts begins with a set constellation of the avatars. During the evolution of each part, the avatar corresponds to each user interaction in real-time, using different patterns of reactions, depending on input, angle and intensity of the approach. After dodging, the avatar continues to follow the choreography at a restored, reasonable distance at the new chosen place in virtual space until the end of that part. Each subsequent part continues, after the dodged avatars have restored the needed constellation for that following part. As the piece evolves, the avatar actively follows the visitor and comes very close to the camera for the final scene.

All reactions by the avatars to intended and unintended interactions of the visitor manifest in a uniquely arranged, non-repeatable performance each time the piece is screened. This way, the resulting performances represent a temporally and spatially non-repeatable version of the digital dance piece *kin_* in the chosen exhibition space.

For the likewise interactive soundtrack as well as a reactive costume, the artist collaborated with a composer, as well as a digital makeup artist. Three layers of sound are offered: the stereo ambient composition, split for the three different parts, samples, bound to a certain radius of each avatar, and different sound elements for dodging movements. The sound composition is arranged in 360 degrees and adapts to the orientation of the user.

The costume design includes asymmetrical fins reacting with a secondary animation to movements of the corresponding bone that each fin is attached to. The secondary animations of the fins are designed to physically imitate movement in water. Lighting estimation is included in order to adapt the lighting of the virtual scene to the real environment.

For the setup of the installation in a museum, the piece includes three large-scale banners showing high-resolution texture parts of the avatars: eyeballs, facial skin, and the normal map of the scanned dancer's hands and feet. The banners serve as a physical representation and contextual enhancement of the piece. (Figure 2)

Related Work

AR avatars can be reflected on different, mutually related levels - artistic, design-oriented, user-centered, technical, targeting social or ethical implications. Mixed media performance artworks offer an approach for separating the screening of a dance event from its live production tied to a specific time and place. Moreover, artistic experiments with AR can be understood as explorations of interactivity through technological means.

MR applications that revolve around movement related arts can be differentiated according to their two or three-dimensionality. For example, the work *Whiteout* uses videos of performers for displaying several pre-produced performances in virtual reality. [5] In this case, the three dimensionalities of the experience is based only on the 3D surrounding of the VR medium in which the videos are embedded and the perceived effect of depth at a certain distance from the video. The piece *kin_* is an example of staging three-dimensional avatar dancers which are approachable from every angle.

The approach of a three-dimensional avatar is also the main topic of Julie Curtiss' work *Lune* featuring a nude body which is interactively turning away and hiding its face from the user. [6] A similar approach is used in *kin_* with the avatar's evasive behavior as the user is coming too close. *Lune* and *kin_* though differ in integrating the interaction: *Lunes* evasive body movement forms the movement itself, whereas in order to avoid a rupture of the choreography of *kin_* the dodging behavior had to be integrated seamlessly into the performative fabric, which was not to be disturbed by the interaction.

Martina Menegons work *It feels like home* also features nude avatars in a performative virtual sculpture to be accessed through a webpage. [7] Other than in *kin_* the avatars are to be moved by drag and drop, imitating certain gravitational settings.

The design of movement of the avatars within the work can be understood as a second layer for differentiation - unlike projects that use movement loops (such as the

artwork *Dance Trail* by Cie Gilles Jobin), [8] the choreography of the project presented in this paper is continuous.

The introduction of an interactive element is adding a third layer to the performance, as shown in the dancing AR Playmoji Stickers of *Google Pixel's Playground* which enables facial reactions of the avatars to the user in real time. [9] Whereas the interaction of the dancing AR character is limited to reactions to certain mimics, the interaction with *kin_* is designed to be a full body interaction in virtual space.

The design of avatars is also closely related to the discourse revolving around the uncanny valley effect, showing that the representation of human-like avatars above a certain degree of similarity or realism is perceived as creepy and the interaction with the avatar tends to be unpleasant. [10] An internal research project on efficient avatar production facilitated meeting the objectives of realistic avatar design in *kin_*. [11]

Following Photiadis et al., "user experience arises from the integration of perception, action, motivation and cognition in an inseparable meaningful ensemble". [12] Also Law et al. compare user experience to a dialogue with the user's world through action being determined before, during and after the interaction with the experienced object. [13] Using diverse communication channels has been shown to be crucial for presence and interaction attractiveness. [14] Since an enhanced feeling of presence for the user was determined to be crucial for the art experience of *kin_*, an emphasis was put on the animation of expression abilities of the 3D characters, such as facial expressions, a full-body animation and full animations down to the fingertips to support different layers of believable, realistic movement at every moment in the performance.

The *technical perspective* focuses on the efficient production of believable avatars. Tools like Epic MetaHuman Creator can efficiently produce high quality, believable avatars. [15] However, the design of a fully animated realistic avatar of the dancer herself was not realizable due to the restrictive presets provided by the software. There are several tools for creating virtual characters based on photos [16], hand-held video input [17] or 3D scans [18]. Many approaches also use AI-based methods to generate the avatar structures. Motion capture systems provide an efficient solution for extracting information related to a human skeleton, which is often exploited to animate virtual characters. When the character cannot be assimilated to an anthropometric shape, the task to map motion capture data onto the armature to be animated can be challenging. [16] In [19] the authors addressed the problem to estimate accurate and natural motion sequences and proposes "Video Inference for Body Pose and Shape Estimation" (VIBE), which makes use of an existing large-scale motion capture dataset together with unpaired, in-the-wild, 2D keypoint annotations. In *kin_* we created animations using a tool-set of motion capturing systems and manual fine-tuning for the recorded animations. As to *social and ethical implications* revolving around believable avatars we have developed a mediation format targeting this issue, described later in this paper.

Artistic Background

What about mechanically, digitally, or biologically reproduced replicants or clones? It may be that a film or a digitized performance art piece will be the same at each showing. But the context of every reception makes each instance different. Even though every “thing” is exactly the same, each event in which the “thing” participates is different. The uniqueness of an event does not depend on its materiality solely but also on its interactivity – and the interactivity is always in flux. If this is so with regard to film and digitized media, how much more so for live performance, where both production and reception vary from instance to instance. Or in daily life, where context cannot be perfectly controlled. Thus, ironically, performances resist that which produces them. [1]

kin_ is an explorative dance piece about both human corporeality and body-based art through and with digital technology. It is considering several philosophical and sociological discourses, among them the transfer of performativity into the digital, reality entanglements and the dichotomy of surveillance and intimacy.

In the piece, one up to three avatars perform in augmented space and can be approached, influenced and experienced through the user's personal handheld device. To perceive the piece *kin_* in its entirety, the viewer must actively move around the dancers and through the piece.

With the post-digital assumption that humans are so intertwined with surrounding technology that these parts are not separable anymore [20], a cyborg can be understood as a term for certain forms of relationships between body and technology in which the organic and the technical combine in a hybrid life form. [21] In Materialist and Gender Studies the concept of the cyborg stands for the negotiations of traditional dualisms – questioning the distinction between the analogue and the digital, the overcome dichotomy of culture and nature, the social and the technological, sex and gender, and with it the body itself. The cyborg is a material-semiotic creature, entangling the formerly opposed binary opposites. [22]

Following this argumentation, *kin_* can also be understood as a playful statement that abandons anthropocentrism and the dancing agents that serve as surrogates for human dancers, and instead, follows the idea of an own techno-organic hybrid lifeform, as dancing cyborg, transferring organic contemporary dance movement onto digital avatars by digitizing a real dancer.

As choreographic material the artist decided to explore the techno-organic aspect by developing tightly choreographed, geometrical body and trio constellations with organic movement qualities, alternating between machine-like and humanly distanced observing poses. As a contrast, system-inherent tracking poses served as input for the choreographic material, to allude to the communication process between human and machine (in this case: the tracking-system). Poses, constellations and forms refer to loops and repetition, alluding to digital reproduction, without actually being repeated. As the dance evolves the poses get slightly shifted and twisted – giving space to the reflection on approximations to an ideal to the piece.

Performance art is happening in the very moment of the creation by the agents themselves. [23] Stating that agency is no distinct human quality but can be assigned to other-than-humans, constellations or inanimate objects, [24] *kin_* appeals to the shift of agency between performer and recipient in moments of interaction. *kin_* is labeled as an interactive performance with up to three avatars and spectator, and according to the definition of agency as “a potential to act” [25], inviting the user to also take part as an agent in the piece. (see also: [26]) Object-ontological theories argue that the connection between multiple actors itself accounts for its own agency. Derived from this, the fusion of a digital being with analogue features leads, at least theoretically, to a new form of being for the performative arts with a possible agency.

Since *kin_* is experienced with a handheld device, the physicality of the device is creating an inevitable frame through which the piece is being observed. The surveillant aspects of the window for the scene puts the visitor into a surveilling position. (see also: [27])

Through the potential to act and to move around the avatar within AR, the possible engagement is staged as a moment of empowerment for the user, to influence the events of the piece with their own actions. (see also: [28])

The abbreviation *kin_* in the title is short for kinship. The underscore is suggested for languages with a generic masculine grammar (such as the German language) as a symbol for a gender-equitable spelling that leaves room for a variety of forms and expressions of gender, in this case including digital ones.

The title gives a clue as to how the piece can be read: In order to survive on earth, we need other forms of kinship, following Donna Haraway's train of thought, making kin, both with other humans and non-humans. [29] She argues for a non-anthropological view and questions often propagated human exceptionalism, that we can only survive by „co-becoming“ with other ontologies.

Holding up this argumentation, the title *kin_* refers to the respectful exploration of the relationships between human and other-than-human, from the body of the dancer, to the body of the avatar, to the body of the viewer, interweaving different types of agents and agencies (once again.)

Following this idea, it was decided that the design of the AR interaction should take into consideration that avatars can be understood either as other entities, or as a representation of humans, suggesting the audience to interact with the avatars as one would treat another human. Slater et al. refers to the Golden Rule of Reciprocity as a guideline on how to interact in Virtual Reality. [30] This thought lead to uncommon UI decisions for the piece *kin_* such as indirect interaction or an uncommon placing-procedure – at placing the content after starting the application, the avatars would appear outside the frame of view– in order for the avatars not to be touched – as touching without consent is considered disrespectful towards other entities (Figure 3).



Figure 3. Avatar and user in respectful distance © MIREVI

Technical Implementation

The technical implementation of the piece is developed as a mobile AR project available for iOS. The user can download a mobile app in the AppStore [31], which contains the piece including all media assets. For efficient scanning and detection of the environment and the placement of the avatar dancers, an appropriate context recognition is necessary to position the avatars correctly in the real environment and register the virtual elements in 3D space.

In addition to the classic RGB camera of the mobile device, *kin_* provides significantly improved detection for devices using LIDAR scanners (e.g. with an iPad Pro). The technical implementation is done using a suitable workflow with the following steps:

- advanced avatar modeling,
- facial expression design,
- interactive costume development,
- dance motion tracking, and
- AR framework integration.

The development of a believable avatar that is not located in the uncanny valley is particularly challenging because a copy of the human performer that is as close to reality as possible had to be created. While it is possible to produce a realistic copy for a high-end character for non-realtime display as a movie clip, there are currently no comparable options for interactive rendering in a 3D engine such as Unity3D. A workflow and tool chain was developed to create, edit, and deploy the female dancer model. [11] The steps follow a pipeline for designing believable avatars in the film domain and are then manually reworked for deployment as an interactive AR app.

The costumes are produced as textured 3D models and combined with the uncostumed avatars by partially binding the models directly to the skeletal structure. This makes it possible to realize the reactivity of the costume in the final AR app, e.g. the movement of the fins when the arm is moved.

The recording of suitable facial expressions of the digital dancers is particularly important for credibility. For this

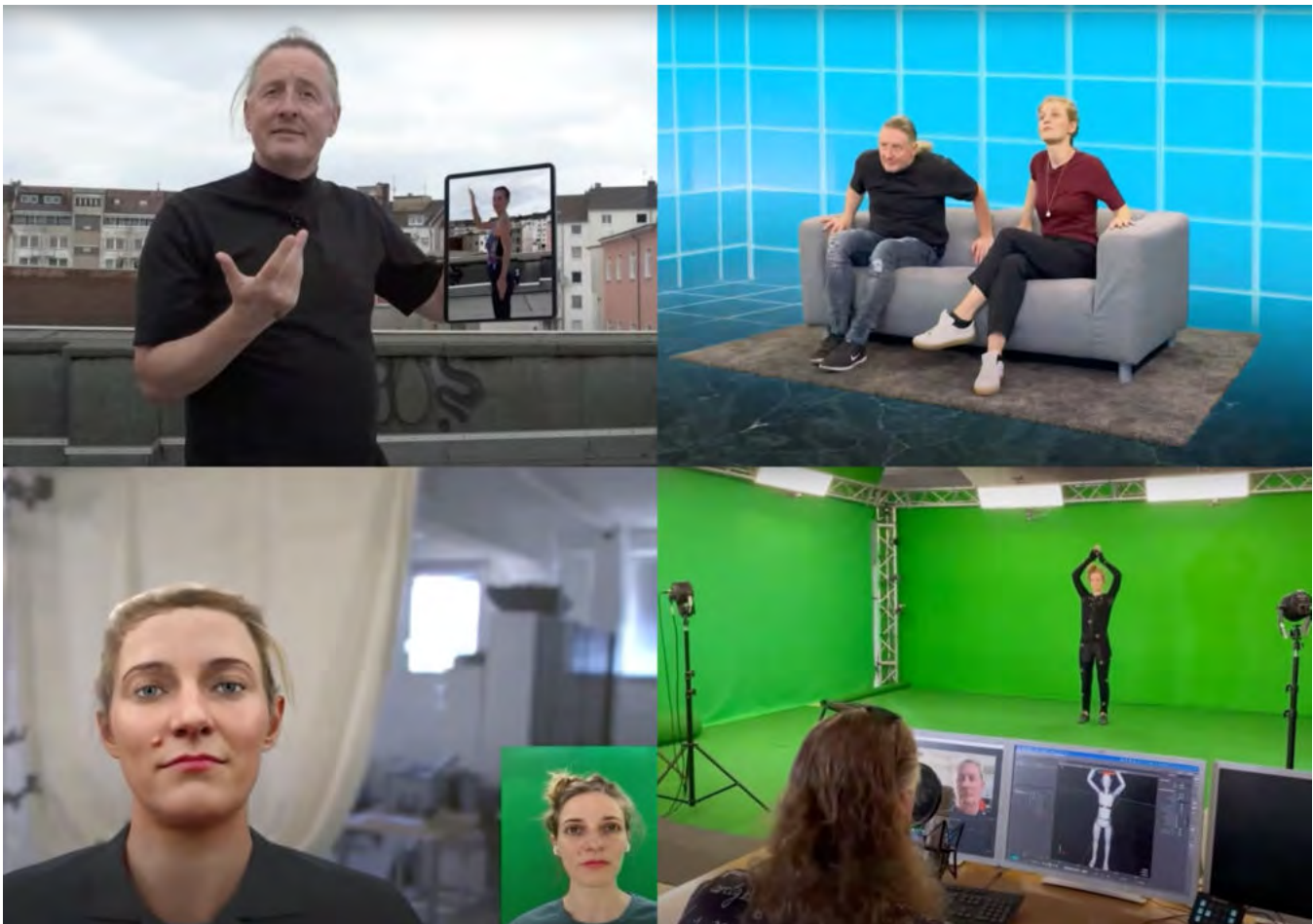


Figure 4. TEDx video talk on Mixed Reality avatars © MIREVI

purpose, the professional face tracking system dynamixyz was used and all facial animations of the performer were recorded and processed for integration into the AR application. The choreographed motions were recorded as individual sequences with a hybrid tracking approach, using Optitrack and Perception Neuron systems to fuse the results. The integration of the 3D models, textures and animation files was done in Unity 3D, AR Foundation was used for AR functionalities.

Extensive tests for a comparison of Unreal and Unity3D showed clear advantages for Unity3D. Although the production of realistic 3D avatars is easier in the Unreal engine and the rendering is qualitatively better, tracking support and presentation quality in the AR space in Unity3D is more powerful and allows for expressive representations. Additional interaction modules were used to ensure the reactivity of the avatars. A collision detection in the first part of the choreography notices when the user approaches too close to the avatar and starts an evasive movement before continuing with the choreography. In the last part the avatar follows the user in relation to her movements.

Mediation

Although *kin_* is impregnated with several layers of meaning, there is no further explanation of the piece nor context within the performance. In order to expose these aspects and bring the peculiarities of MR avatar design and post-digital reality entanglement closer to a broader user group, the piece has been used as a reference point in an alternative mediation format on avatar design and ethics. Instead of a classical artist talk, which discusses the background of *kin_* or our development perspective on MR avatars, we developed a format of dialogues between art and technology where we debate on design, production, and use of MR avatars in the post-digital age by combining different levels of narratives.

We are technically able to produce MR avatars, which are difficult to distinguish from humans or can even be manipulated by one, as well as to manipulate or create human images with Deepfakes. Thus, the question continuously arises whether the perceived reality is real, virtual or a blend. We decided to use these intertwined realities not only as a topic for our discussion but its very narrative structure. Using the artistic work of *kin_* as a starting point, different aspects of MR avatars, e.g. user experience, critical distance, ethics and technical production are addressed and made conscious by a dedicated intervention (a medial break) in the representation. The format begins with a somewhat too euphoric presentation of *kin_* in which the protagonist emphasizes the credibility and fascination with MR avatars. At the first media break, one realizes that the presentation is only a video on a mobile device, which is being critically examined by two people. A conversation develops about challenges and opportunities in production and the need for an ethical imperative when interacting with avatars. In the next media break, avatar production is presented on a very technical level including a motion shot, which arrives at the start sequence as a ring closure in the last media break. A final media break is used after the credits to comment on the entire production of the clip from the point of view of the avatars involved.

The production was done as a video shoot using green screen technology and screencasts from the AR app *kin_*. The digital effects were added in post-production. During the broadcast of the format at TEDx Koenigsallee, [32] a live Q&A session was additionally streamed, in which the two protagonists answered questions and presented some technologies in the same digital studio featured in the production.

Conclusion

The interactive dance performance *kin_* shows a way to experience dance qualities with virtual means taking into consideration both artistic bodily as well as digital possibilities. It challenges the visitors to question expected formats of performances and proposes to take part in the piece. The research can thus offer a form of empowerment that participates in the discourse around the contemporary, performative body, both in times of social and travel restrictions and virtual art formats, as well as giving a hint with regard to the increasingly urgent ethical questions in dealing with virtual bodies.

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Sparking Emotion in Mexican Electronic Art

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Abstract

This paper deals with the methodological and cognitive processes involved in how innovative ideas evolve in the human mind. It also addresses the principles and foundations of creating new ideas and the different phases of creative processes: participation, tendency, incubation, intuition, evaluation, actualization, communication, and participation. Also significant are the reactive, interactive, and emotional facets of the participation phase of the creation process. Hence, these aspects are analyzed in order to produce an in-depth reflection on the elicitation of emotions during the production processes of electronic artworks. Finally, the paper examines a number of techniques and resources used to elicit emotions in electronic artworks.

Keywords

Electronic Art, Production Processes, Creation, Elicitation, Emotion, Innovation.

Introduction

In Mexico, Electronic Art is a branch of Contemporary Art and part of the global phenomenon called Art & Technology, in which artists may use both cutting-edge and obsolete technology. An essential characteristic of many works of Electronic Art is that they require the participation of the viewer.

Over the last three decades, Electronic Art in Mexico has produced fascinating artworks and renowned artists. Prior to this period, pioneers like Manuel Felguerez or Pedro Meyer had already explored the artistic possibilities of new technologies, Felguerez with his work *Aesthetic Machine* (1979) and Meyer with *I Photograph to Remember* (1990).

However, due to the lack of information on Mexican Electronic artworks and their emotional content, it is in the realm of public interaction with the artwork that this investigation identified its area of research. Additionally, according to modern psychology emotions to be behavioral and visible; they manifest. The question that emerged from these considerations was, is it possible for artists or art students to deliberately plan to elicit specific emotions in public?

Aim and Scope

Hypothetically, the answer to the foregoing question can be inferred: as a result of advances in modern psychology in the detection and development of emotions, it is possible to create a model to elicit emotions in electronic artworks. Consequently, this chapter involves the analysis of diverse Mexican electronic art developments related to emotions. However, the model does not predict viewers' emotional response. As Jonathan Frome says, the emotional response to any given work depends on a "variety of contexts of viewing the artwork, and the varied individual histories and cultural backgrounds [that] make this impossible. [There is an] enormous influence of historical and cultural factors in emotional response." (Frome, 2007, p.831).

Then there is the fact that emotional response relies on the term "emotion," which in itself is highly ambiguous, since there are multifarious ways to classify emotions. According to Frome (2007), Ekman's basic emotion types are joy, sadness, disgust, fear, anger, surprise, interest, and contempt. On the other hand, others, such as Ortory, Clore, and Collins classify emotions as either positive or negative, while for Damasio, emotions are "vast". (Frome, 2007, p.831). It should be said that emotions, in general, function to our benefit, even the negative ones. Regardless of whether these may sometimes lead us to perform nonpositive actions, emotion arises for our well-being. Although space precludes a deeper discussion, it is my belief that emotions respond to stimuli by means a phenomenological 'feeling' that is associated with them and is designed to promote an organism's well-being. (Frome, 2007, p.832). Finally, for cognitive psychology, emotions are a product of thought which create behaviors essential to an awareness of the diverse topics that some electronic artists pursue.

Public Participation in Mexican Electronic Art

The use of technology in the arts gives rise to new artforms before which the viewing public is no longer made up of viewers, but of participants, in such a way that may be completing or even creating the artwork. There are multiple ways or levels of participation in Electronic Art:

- a) Using particular devices such as VR lenses, tablets, joysticks, keyboards, microphones, apps, and cell-phones, among others, (see, for example, "Escrituras" by Gilberto Esparza; "Kauyumari, The Blue Deer" by Arnold Abadie; or the works in the series of "Relational Architecture" by Rafael Lozano-Hemmer).
- b) Performing body movements, facial gestures, or particular actions ("Multiple Vortex Tornado" by Ivan Abreu, "Body movies" or "Level of Confidence" by Rafael Lozano-Hemmer, among others by the same artist).
- c) Speaking in a certain way or through special devices ("Voice Array" or "Less than Three" by Rafael Lozano-Hemmer).
- d) Typing on a keyboard, (the Arcangel Constantini Net Art pieces "Anima" and "Unosunosunosceros").
- e) Wearing specially designed garments ("Wearable Soundscape" by Amor Muñoz).
- f) Interaction on social media ("Arma Sonora Telematica" by Leslie Garcia).
- g) Interaction with another being ("Pulsu(m) Plantae" by Leslie Garcia).
- h) Musical compositions ("Meridian" by Ivan Abreu).

As Fakhrhosseini and Myounghoon observe, the experience of physiological change leads to feelings, and it is reasonable to believe that the public can use bodily movements to evoke emotions. (2017, p.245).

Themes and Emotions in Mexican Electronic Artworks

It is necessary to say most Mexican electronic Art elicits emotions in part due to the subjects they tackle, such as those relating to Mexico's politics or environmental problems.

A) Politics. Historical truths, social expression, and racism, among others. Depending on the artist's observations, these works can raise concerns among viewers.

Artistic works like "Taxonomic-comparative study between the Castes of New Spain and those of Contemporary Mexico" (2010) by Erick Meyenberg, about a million-dollar government investment in sequencing the Mexican genome. From an artistic point of view, this initiative actually heightens the differences that already exist between Mexicans such as skin color, or their cultural, social, or economic levels, to name a few. According to the artist, the first impression of the viewers is amazement at the bright colors and the light of the rings floating around it; then some of them will read about what the work is about (Villagomez, 2014).

Another example of a political art piece is "Loud Voice" (2008) by Rafael Lozano-Hemmer, a commemoration of the 40th anniversary of the 1968 massacre of students in Mexico City's *Plaza de las Tres Culturas Tlatelolco*. (Lozano, 2008). Witnesses of that deadly night speak sadly into a megaphone about what they experienced that year while brightness of several searchlights alters automatically. Also, by tuning to a radio station, thousands of people could listen to the testimonials.

The same artist's "Border Tuner" (2019) also addresses this topic, consisting of powerful searchlights located on both sides of the Mexico-US border in such a way that a "bridge of light" can be seen crossing the sky. (Lozano, 2019). The piece requires visitors who can interact by speaking into microphones situated at six interactive stations on both sides of the US-Mexico border. Participants produce a wide range of different emotions ranging from joy to sadness and beyond due to this interaction between people in El Paso, Texas, and Juarez. This artwork questions President Trump's immigration policies and his intentions to build a wall between both countries during his administration.

I first knew this piece as *The 43 of Ayotzinapa*, but the actual title of this work by Rafael Lozano-Hemmer is "Level of Confidence" (2015). This artwork recalls the mass kidnapping of 43 students from the Ayotzinapa teachers' college in Iguala, Guerrero, in 2014. The artist explains that the project consists of a face recognition camera trained to look for the faces of the disappeared students. As you stand in front of the camera, the system uses algorithms to find which student's facial features look most like yours and gives a "level of confidence", expressed as a percentage, as to how accurate the match is. The biometric surveillance algorithms used (Eigen, Fisher, and LBPH), are familiar in the military and police forces, where they are used to look for suspicious individuals. In this project, they are instead used to search for victims. The piece will always fail to make a positive match, as the artist has based it on the assumption that the students were likely murdered and burnt in a massacre in which the local government the police, and drug cartels were all involved. Despite, the commemorative side of the project deals with the relentless search for the students and the superimposition of their images on the public's facial features. (Lozano, 2015). I saw this artwork at the Guanajuato University gallery during the 2019 *Cervantino Festival* before the global covid pandemic. Without a doubt, the evolving mix of emotion it engenders is sadness, anger, and resentment.

Other worthy members of this category are Arcangel Constantini's "Anima, 3:00 am" (2002) and "Unosunosunosceros" and "El auténtico chilango" (2000), "Displaced Emperors" (1997) by Rafael Lozano-Hemmer; "Escrituras" (2008) by Gilberto Esparza; and "Arma Sonora Telematica" (2013) by Astrovandalistas and Leslie Garcia, among others.

B) Environmentalism. Many Mexican electronic artists are deeply committed to the environment, and so pieces have emerged dealing with water pollution, trash, obsolete technology, devices that interact with whales or plants, and so on. Depending on what the artists have observed, these works can elicit astonishment, concern, and, in some people, awareness.

One example in this category is Leslie Garcia's "Pulsu(m) Plantae" (2014), a work that analyzes the way plants communicate through biological communication process that are invisible to humans. The piece consists of a "sound prosthesis" derived from biofeedback, a technique based on plants' physiological functions and the instruments used to collect

information about the plants (García, 2014). The prosthesis translates these data on sounds as if the plant had a voice, so that, if the public touches the plant, speak, or turn on a nearby light, they will obtain a sound in exchange. When they see the plants react to stimuli, people's reactions are generally surprise and increased awareness of other beings' lives.

"Nomad Plants" (2014) by Gilberto Esparza reflects on the environmental and social impact humans have through such things as the exploitation of natural resources, resistance to the energy transition, lack of awareness, in order to find better, more empathetic ways of interacting with nature. An artist's "words technology" has a vast potential to make significant transformations in order to achieve this goal. The "Nomad Plant" is a living organism made up of a robotic system, an organic plant species, and a set of microbial and photovoltaic fuel cells. It is about the union of different forms of intelligence so as to constitute a more robust species with the potential to restore damage to the environment on a small scale. This robot takes polluted water and processes it in its fuel cells through a colony of bacteria native to these waters, which feed by transforming nutrients into electricity to be stored by its energy harvesting system. In this biodegradation process, the water quality improves and provides the plant species that also produces electricity with its metabolism. This energy cycle concludes with the release of its byproduct, oxygen. Therefore, it is not only a species adapted to the modified environment, but it also restores the energy available to the earth (Esparza, 2013). The robot was put to work on the river Lerma in Salamanca, Mexico. People's curiosity was aroused, which provided the artist with an opportunity to speak with people about the possibility of technology restoring a polluted environment.

"Nanodrizas" (2009) by Arcangel Constantini is a series of 13 robots capable of detecting polluted water in rivers and lakes. They also provide solutions to local environmental problems through wireless communication. The "nanodrizas" collect and send data to a station and respond to the conditions with chemical interventions, consisting of releasing bacterial and enzymatic remedies and sounds.

Another piece falling into this category is "Auto-Photosynthetic Plants" (2013) by Gilberto Esparza, which uses microbial fuel cells to create sound and energy from polluted water samples collected from urban spaces. The artist creates a symphony using microscopic bacteria as an orchestra. (UQAM, 2017), thereby raising awareness of highly contaminated water in cities produced by human activity and the consequences for the environment. The piece involves plants that amazingly transform polluted water into energy that enables them to survive.

Leslie Garcia's "Spherical Memory" (2019) is an installation that releases odors and edible spheres from damp earth. The piece first synthesizes the smell of the dry soil after a rainy day; then, a bioprinter makes the aforementioned edible spheres out of this phenomenon using plant oils released from the earth. The artist says these spheres melt in your mouth, liberating the aroma that flows from the pharynx to the olfactory bulb. As a consequence, brain connections

strongly link to emotions and memory. Finally, the project has a collection of more than a thousand testimonies of people who share the memories evoked by this experience. (García, 2014).

Further works in this category include Ariel Guzik's works on plants and whales.

How to Spark Emotions Through Mexican Electronic Art

At this point, we can infer that Mexican electronic artists are able to elicit diverse emotions through their work. However, creating a model to produce an emotion may be useful to both beginners and artists experienced in experimenting with the possibilities of obtaining a specific range of emotions, positive or negative.

To create a model to elicit emotions in electronic artworks, we will review and connect with different approaches to appraising emotions in order to contribute to Mexican Electronic Art. In what follows here, I will develop some ideas about emotion elicitation methods based on the studies of diverse authors.

For Seyedeh Maryam Fakhrhosseini and Myounghoon Jeon (2017) of Michigan Technological University: *Imagination, Films, Sound, Music, Images, Reading passages, Writing passages, Embodiment, Virtual Reality, Feedback, Self-Referent-Statement, Social Interaction, Physiological Manipulations, Motivated Performance Tasks, Combined Techniques* are ways in which emotions are induced. Below is a discussion of some of these techniques that may be appropriate to the realm of Electronic Art.

The same authors consider *autobiographical recall* as one of the most powerful tools for invoking emotions. No doubt recalling emotions in groups brings about reflection and awareness. Consequently, past events in the back of our minds emerge and, by doing so, can heal some individuals (groups like *Alcoholic Anonymous* or *Adult Children of Alcoholics* use this principle too). In Rafael Lozano-Hemmer's "Loud Voice" (Voz Alta, 2008) residents of the Plaza de las Tres Culturas in Tlatelolco recall the massacre of student protesters in 1968, which took place where they live. The result is an intense and moving work made by viewers' memories and emotions [1].

Historically, art has consisted primarily of *images*. For Fakhrhosseini and Myounghoon (2017), in daily life, people seek out evocative imagery in magazines, on the internet, or in various forms of social media. Although images are unimodal visual stimuli, they are capable of expressing and evoking emotions (2017, p.242). The authors mention that researchers use images to induce emotions, and that one of the most commonly used tools is the *International Affective Picture System*, with more than 1000 systematized images. In Electronic Art, artists do use images but frequently in combination with movement, interaction, or projection in specific spaces. Rafael Lozano-Hemmer uses this technique masterfully in "Level of Confidence" (2015) by using black and white photos of the 43 students murdered by narco-traffickers, police, and the Ayotzinapa [2] army unit. A small

town with significant production of the poppies that the *narcos* use to make drugs. Nevertheless, the crime remains unsolved by the Mexican government. The photos the artist uses were the ones the students' school made public and are typical in Mexican schools: 2.5x3 cm, black and white, facing the camera, etc.

Another technique to elicit emotions that Fakhrhosseini and Myounghoon (2017) mention is *embodiment*. The concept is related to a theory by William James, who suggested that the experience of physiological changes leads to emotional feelings. (2017, p.245). In many electronic artworks, participants move, strike postures, make facial gestures, or speak. Examples of embodiment in Mexican Electronic Art can be subtle or very clear. One example is "Multiple Vortex Tornado" (2013) by Ivan Abreu, which encourages members of the public to leaf through books, which they are doing when the sound of a tornado is heard [3] and the public is then enveloped by a soundscape. Another example of embodiment is "Body Movies" (2001) by Rafael Lozano-Hemmer, which consists of interactive projections where thousands of photographic portraits taken on the streets of the cities presenting the project are displayed by robotically controlled projectors. The portraits appear inside the shadows of the people passing the installation, so that many of them began to move, or dance, stretched in front of the projectors [4], where they are able to see both themselves and the photos.

Fakhrhosseini and Myounghoon also cite Virtual Reality as a further technique for eliciting emotions, pointing out that, "it has been shown that a computer can replicate an environment, real or imagined, that allows the user to interact with it. With virtual realities, participants can artificially experience some situations just as interacting with real-world people, objects, scenes, and events." (2017, p.246). VR opens the possibility for artists and scientists of recreating real or imagined environments to open up a new world, the virtual one, which can seem as genuine as the real one. One example of a VR artwork is "Kauyumari, The Blue Deer" (2016) by Mexican artist Arnold Abadie. Abadie won the Eco Film Festival in 2013 and decided to make a VR version of his winning entry. The short film shows a Huichol god who guides his people on a pilgrimage through the desert in order for them to recognize the mysteries of existence and the balance of the planet.

Films combine images and sound; viewers can empathize or identify with characters. Through cinema, the public "lives" real-life emotional situations, making the use of films one of the most ecologically valid emotion invoking techniques. (Fakhrhosseini and Myounghoon, 2017, p. 236). However, there is another way to classify how emotions evolve in a given artwork. For Jonathan Frome, film, literature, in fact all narrative art can generate *narrative emotions*, which are the most commonly felt when engaging with works of art. (2007, p.832). Electronic Art goes beyond narrative. But pioneering artworks like CD ROM "I photograph to remember"[5] (1990) by Pedro Meyer do explore narrative. The piece is about the life and death of the artists' parents and a family album about the body, old age, and illness.

For Jonathan Frome, another emotional category is that of *artifact emotion*, which is generated by our response to work as an artifact or crafted art object. However, an artwork prompts every kind of emotional response. Artifact emotions relate to the artwork as an artwork; they come from how the artistic work represents its content. In other words, artifact emotions are emotions of aesthetic evaluation. As Frome (2007) says, we tend to think of Artifact emotions as artistic judgments or preferences. They do not have the same intensity as other types of emotions. But they are nonetheless emotions; aesthetic evaluations can cause frustration, amusement, surprise, and other emotions in much the same way that narrative can. (Frome, 2007, p.833). Examples are the colors, the textures, the forms, or the images in the artwork that provoke admiration.

The final category of emotion Frome identifies is *ecological emotions*, which are generated when a participant responds to a given stimulus. The author focuses on video games, but these emotions fit the sphere of Electronic Art as a response to any interactive installation. Frome says that "Whereas an artifact emotion responds to a videogame at the level of representation, an ecological emotion responds to what the videogame represents, and responds to it as if it were real." (2007, p.833).

The table below shows some of the inputs of emotion related to Electronic Art.

THEME	EMOTION ELICITATION METHOD	TYPE OF INTERACTION	ELECTRONIC ARTWORK
a) Politics b) Environmentalism	a) Embodiment / Ecological emotion b) Virtual Reality / Ecological emotion	Use of special devices, i.e., VR lenses, tablets, joysticks, keyboards, microphones, app, cellphones, etc.	a) "Escrituras" by Gilberto Esparza. b) "Kauyumari, The Blue Deer" by Arnold Abadie.
a) Environmentalism b) Politics c) Politics	a) Embodiment / Ecological emotion b) Embodiment / Ecological emotion c) Images / Ecological emotion	Body movements, facial gestures, or certain actions.	a) "Multiple Vortex Tornado" by Ivan Abreu. b) "Body movies" by R. Lozano-Hemmer. c) "Level of Confidence" by R. Lozano-Hemmer.
a) Soundscape b) Soundscape c) Politics	a) Embodiment / Ecological emotion b) Embodiment / Ecological emotion c) Autobiographical Recall / Narrative / Ecological emotion.	Speaking in a certain way or through special devices.	a) "Voice Array" by R. Lozano-Hemmer. b) "Less than Three", by R. Lozano-Hemmer. c) "Loud Voice", by R. Lozano-Hemmer.
a) Environmentalism b) Politics	a, b, c) Artifact emotion / Ecological emotion	Clicking on a keyboard.	a) Net Art: "Bakterias", by Arcangel Constantini. c) "Unos unos y unos ceros", by Arcangel Constantini.

Soundscape	Embodiment	Wearing certain garments.	• "Wearable Soundscape" by Amor Muñoz.
Politics	Ecological emotion	Interacting on social media.	• "Arma Sonora Telematica" by Leslie Garcia.
Environmentalism	Embodiment	Touching another being.	• "Pulsu(m) Plantae" by Leslie Garcia.
Soundscape	Ecological Emotion	Making music.	• "Meridian" by Ivan Abreu.
Environmentalism	Ecological emotion	Eating	• "Spherical Memory" by Leslie Garcia
Personal memories	Film / Narrative emotion / Image / Autobiographical Recall	Clicking on a CD ROM	• "I Photograph to Remember", by Pedro Meyer
Politics	Artifact emotion	Reading	"Taxonomic-comparative study between the Castes of New Spain and those of Contemporary Mexico" by Erick Meyenberg

Table 1. Emotion Inputs. ©The Author.

Conclusions

The development of the knowledge on emotional content and its assessment is innovative in Mexican Electronic Arts. The influence of Mexican electronic artists could be extended through application of the theory and concepts of the behavioral sciences.

It would be possible for artists or art students to plan works based on the range of emotions they want to elicit. This is not to say that they do not already try, but it does mean that the result could be more accurate. In Mexican, Electronic Art it is necessary to develop methods for emotion evocation, because our environmental, economic, social, and political situation requires it; we as a society need more influential artists to bring about an ecological and political change. And our electronic artists had proved that they have an enormous interest in changing our social landscape for the better.

Even though emotions are vast and depend on historical and cultural factors, scientists have performed a significant amount of research related to emotions and behavior. In this chapter, our efforts have focused on linking this research with the sphere of Mexican Electronic Art. It should be noted that the connection between Electronic Art and the Behavioral Sciences is a new topic of study.

Electronic artworks offer different forms of interaction; the artists believe that it is the public that finishes off their work, and that each person gives every one a new ending. Interaction makes this possible by asking the public to use a particular device, move their bodies, speak in a low voice or shout loudly, click on a keyboard, wear special garments, write or publish on social media, etc. That is why Electronic Art offers an extraordinary medium for awakening new ways of thinking.

The design of the model to elicit emotions that was created was based on an analysis of existing methods of stimulating emotions and those electronic artworks that use a particular form to communicate their artistic statements. It also involves different examples of research that examine the subject through autobiographical recall, images, embodiment, Virtual Reality, films and narrative, artifact, and ecological emotions.

Finally, more research should be done in both spheres so as to develop, for example, a database able to detect the specific emotions generated by particular electronic artworks. The truth is worth the effort; we have invaluable resources of new information on the behavioral sciences waiting to be explored to the benefit of Mexican Electronic Art, and artists and society as a whole.

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Supra-dimensional Cinema: VR Case Study *TesserIce*

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Abstract

The combined three-dimensional, stereoscopic space and embodied navigability of virtual reality foster a supra-dimensional perceptive space. They provide an opportunity to experience a four-dimensional, shifting landscape and acoustic, cinematic environment from within the fourth dimension. VR is uniquely positioned to visualize hyper-space as a mathematical construct in which the participant can experience four dimensions.

TesserIce is a four-dimensional, VR mediascape that utilizes these features, allowing one to enter the 4D space-time of glacial ice. The mediascape constructs a tesseract as an embodied cine-poem – a hyperspace of spatialized meaning and navigable time, examining the effects of climate change on polar ice. Within a crystalline, cinematic tesseract, a four-dimensional architecture composed of different scales, forms, sounds, and speeds of ice enacts the meta-dimensions of our contemporary data-world in manifold perspectives. Participants propel themselves through the hyper dimensions of this tesseract, unfolding uncharted vistas, juxtapositions, and timeframes - the space-time of Earth's polar ice. The stark iconography of ice serves as a distinct access point into the overwhelming complexity of climate change and its ramifications, creating an embodied experience of the time, scale, causes, and effects of climate change.

Keywords

Cinema, Virtual Reality, Tesseract, Climate Change, Hyper-space, Fourth Dimension, Somatic Montage, Space-Time.

Introduction

Physical reality may be a hyper-volume of past and future matter extending along the limitless axis of time into a higher dimension of space, beyond our sensory perception. *This* present moment is a continually shifting, metamorphosing shadow of this hyper-solid as it passes through our three-dimensional space. Visible evidence of this space-time hypervolume is our perception of changing states of matter over time: rusting objects, geological strata, coral reefs, melting icecaps...

The Earth's cryosphere, the frozen poles, is a four-dimensional space-time container of atmospheric history. Ice cores drilled from glaciers in Greenland and Antarctica provide a physical timeline 800,000 years back into the history of Earth's climate. Glaciers encapsulate a hyperspace of environmental time.

A Brief History of Hyperspace

Reality as observed in common experience has three directions in it: up-down, side-to-side, and forward-

back. This world consists of three orthogonal dimensions, laid out along the construct known as the Cartesian coordinate system (x,y,z). The necessity for three dimensions of space can be traced back to Aristotle where there is already a notion of three-space, the same Euclidean space used by Rene Descartes and the great 17th-century physicist of classical mechanics Isaac Newton to represent the familiar three-dimensional, macroscopic world we are accustomed to from daily observation.

The dawn of the twentieth century was accompanied by invisible dimensions of space and a curved universe in which the familiar rules of geometry no-longer applied. Non-Euclidean geometry was discovered in the early 19th-century by Carl Friedrich Gauss and solidified in the 1870s, introducing a new notion of hyperbolic geometry accompanied by a variable, curved perspective. Late 19th-century, Western culture was furthermore fascinated with the concept of *n*-dimensional geometry, hyperspace, and the idea of a fourth dimension. The four-dimensional cube, the hypercube or tesseract, was introduced at this time.

The profound mathematical discovery of non-Euclidean geometry resonated with creative artists and intellectuals, influencing the arts, literature, and the cultural psyche, in particular, the avant-garde. The new ideas ushered in new conceptual approaches to the depiction of visible reality that rippled through the artworld, such as dispensing with the linear perspective of the Renaissance and, for a time, the visible altogether. Turn of the century scientific discoveries instigated a break with the classical logic of Euclidean/Newtonian space and time that resulted in a cultural embrace of relativistic ambiguity and indeterminacy. The lingering aesthetic constructs invented by the artistic movements that evolved from this shift share critical concerns with the supra-dimensional approach to immersive cinema discussed in this paper. We endeavor to conjure a post-Newtonian space-time by breaking with cinematic linearity, single-point perspective, and spatiotemporal continuity.

Visualizing the Tesseract

Two strands of interpreting the fourth dimension developed at the turn of the twentieth century. One defined the fourth dimension as an additional dimension of space perpendicular to our own three, unimaginable to us yet encompassing our three-dimensional scope as the cube encompasses the square. The other defined the fourth dimension as time, imagining space-time as a continuous, four-dimensional volume of past and future

spread along a linear time axis, all moments existing simultaneously. This present moment constitutes a continually shifting, three-dimensional slice of this hyper solid cast through our lower-dimensional space.

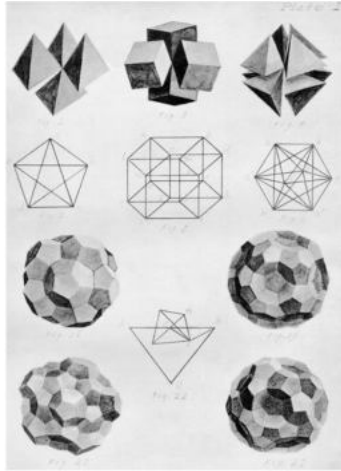


Figure 1. W.I. Stringham, *Hypercube sections from Regular Figures in n-Dimensional Space* (1880) [1].

Mathematician W.I. Stringham attempted the first drawings of supra-dimensional hyper-solid sections in 1880 by calculating perspective projections from four-space into three. His drawings are shaded shadows of shadows, two true dimensions of spatial information lost in rendering (Figure 1).

In 1903, the mathematician Esprit Jouffret described the method for projecting a geometric configuration of n -dimensions onto a space of $(n-1)$ dimensions, giving us the possibility of visualizing a four-dimensional object from the confines of our three-dimensions (Figure 2).

Architect and designer Claude Fayette Bragdon played a key role in popularizing the fourth dimension at the turn of the twentieth century. Bragdon was intrigued by the notion of a supra-dimensional object that is only perceivable as shadows cast into our familiar three-space, and then only partially. Bragdon proposed that our ability to perceive the fourth-dimension manifests as time. Time appears as changes of state to immobile objects as the four-dimensional space-time form moves progressively through the three-space sliver that is the object's present. Space is transposed into time.

It was Charles Howard Hinton who coined the term "tesseract" in 1904 to describe a four-dimensional cube or hypercube. In his endeavors to visualize hyper-solids, Hinton used color to represent an additional dimension of information in his illustrations of hyper-cubes.

Hinton, like Bragdon, placed great emphasis on the need for a time-based experience, on motion, as

requisite for comprehending an object of an $(n+1)$ dimensions from within the limitations of an n -dimensional space. The invention of cinema has made it possible to aid in the perception of space – the ability to see around the object – using time. Time-based, animated rotation of a two-dimensional projection of a three object overcomes the perceptual limitations of a single, two-dimensional view by portraying three dimensions of information, (x,y,t) . The rotation over time reveals faces hidden in the depth, or z -dimension.

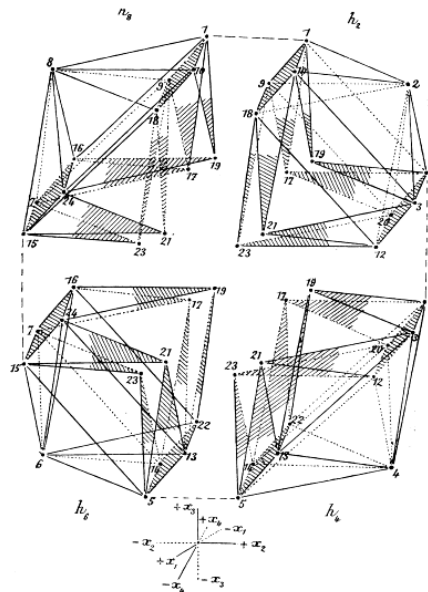


Fig. 41. — Perspective cavalier des seize octaèdres fondamentaux.

Figure 2. Jouffret's octahedroid or hypercube (1903) [2].

In 1962, computer scientist Michael Noll at Bell Labs was able to realize the dream of a tesseract viewable in motion, creating the first stereoscopic computer animated film of a rotating hypercube (Figure 3). Noll had the computer plot out images of the intersections of the hyper-form in motion with three-space, projected onto two-dimensional coordinates.

Noll adds an additional pseudo-third dimension, using stereoscopy and the very real extra dimension of time to portray the four-dimensional object on the two-dimensional image plane of the screen. Noll's stereoscopic, time-based rendering can display four dimensions of information on the two-dimensional image plane. – three-space and time, (x,y,z,t) .

Visualizing four-dimensional structures from the confines of our three-dimensional space is a question that continually challenges mathematicians and artists. Most "solutions" have envisioned these structures from a distance, looking *at* them rather than experiencing

them from within. These visualizations are shadows of shadows – the two-dimensional screen renderings of the three-dimensional shadow projections of the four-dimensional object.

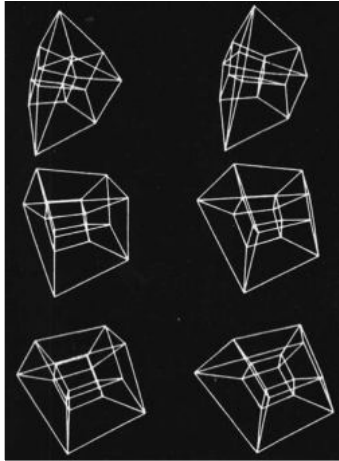


Figure 3. Successive, stereoscopic frames of a rotating tesseract from the film *Hypercube* (1962) - the first stereoscopic, 3D computer animation of a tesseract by A. Michael Noll, Bell Telephone Laboratories.[3]

The three-dimensional space and navigability of virtual reality presents an expanded information space uniquely positioned to visualize four dimensions. It allows an opportunity to mathematically construct a space in which the participant can experience the shifting space-time shadows of four-dimensional space from within the tesseract. The three-dimensional space and navigability of VR provide an opportunity to fully experience the shifting landscape and acoustic environment of four-dimensional polar ice from within.

4D Cinema

Contemporary Western culture exists in the meta-dimensions of a redefined world, full of strange data vistas that surround us in manifold, crystalline perspectives. Supra-dimensional composition, grounded in geometry, is an unfolding, enfolding, evolving continuum that affords an artistic expression of reality more closely aligned to the mechanics of the post-Newtonian universe as we currently understand it.

Cinema, because it is both a spatial and a time-based medium, has a unique capacity to assimilate new, evolving spatiotemporal relationships in the arts and sciences, and to structure narrative according to a non-

Classical notion of causality. The history of cinema has challenged the representation of the irreversible and unidirectional relationship between cause and effect, the calling card of classical, Newtonian physics, nearly since its inception.

Three-dimensional film space is a closed system. The passage through narrative space is strictly ocular, linear, and virtual. The four-dimensional film space described here is hyperspatial, relativistic, ambiguous, and non-deterministic. Within this space, perspective is a function of the viewer's point of view. Narrative, too, is dependent on the orientation of the viewer. The narrative axis is non-linear and non-causal. Sequential linearity is replaced by spatial simultaneity. Navigation through narrative space engages multiple aspects of physical perception and occupies a liminal space between the real and the virtual. Somatic montage¹ is a spatial narrative approach to immersive cinema constructed according to a non-classical notion of space-time.

Supra-dimensional Navigation: Somatic Montage

The notion of an object that is only perceivable in time, an object containing time within its own space, is what makes the tesseract so intriguing. The tesseract as perceived from three-space has an inherently cinematic nature.

The sentient viewer of immersive cinema navigates a somatic montage of different patterns of juxtapositions and associations within the cinematic space. The spectator moves freely amid a multiplex geography of audio-visual fragments, building interpretations and decoding the poetic cipher.

Motion is essential for comprehending a four-dimensional object from three-dimensional space. We use the notion of the cinematic tesseract to formally explore immersive cinema in hyperspace. We create a spatiotemporal flow structure that explodes the screen into an architectonic, immersive cinema. A hyper-mediascape is formed whose poly-perspectival space is deciphered by the somatic perambulations of the beholder, guided by the syntax of a somatic montage.

Visualizing and navigating immersive environments using somatic montage involves portraying reality as time and space faceted into simultaneous streams, distributed in the space. The spectator is placed in a supra-dimensional position relative to the geometry of the *mise-en-scène*, creating alternative spatio-narrative perspectives. No narrative hierarchy, no explicit viewing direction or pathway dominates the flow. The narrative of immersive cinema must be composed as an open

¹ The nomenclature “somatic montage” was first introduced by this author in “The Cine-poetics of Full-dome Cinema” [4].

work, a prepared field of possibilities for an unpredictable viewer.

Poetry and montage are manifestations of the same idiom of fragmentation, juxtaposition, and association. The poetic language of supra-dimensional cinema is an unfolding, enfolding, evolving continuum that affords an expression of reality more closely aligned to the mechanics of the universe as we currently understand it. With somatic montage, we aim to reinstate an explicit connection to a poetic space, an enfolding of embodiment and participation within the spatiotemporal experience of the cinematic.

TesserIce: The Poetics of Hyperspace

The geological provides a glimpse of deep-time as a supra-dimensional force – a four-dimensional perspective that subsumes both past and future and whose scope far exceeds human perception.

The *Ice-Time* [5] series is a document of our unique moment in glacial space-time. This series of works realizes hyper-dimensional, cinematic spaces that transform the audience's subjective perception of time. The works present non-human scales of time, in particular the time scales of glacial ice, as an experience of the temporal reality of climate change.

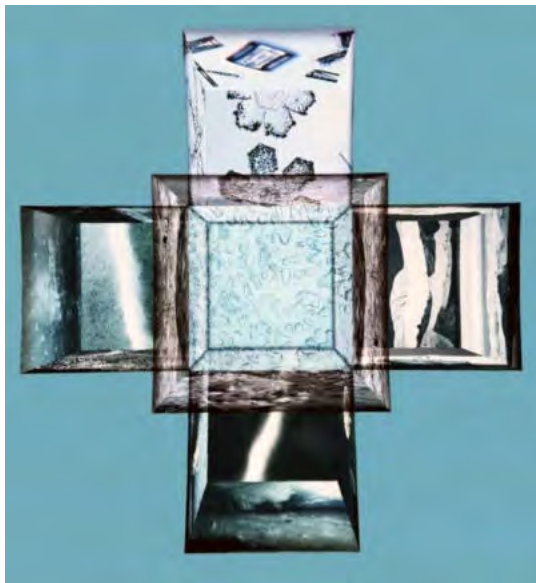


Figure 4. External VR view of *TesserIce* (2021), a crystalline, tesseract architecture, shown unfolded. © Clea T. Waite 2021.

TesserIce [6], part of the *Ice-Time* series, is a four-dimensional, virtual reality mediascape that allows one to enter the space-time of glacial ice. It is a hyper-documentary poem within a crystal tesseract, a 4D hypercube, revealing the space-time effects of climate change

on the ice as individual experience (Figure 5). *TesserIce* brings human perception into the space-time of glaciers, creating an immersive, embodied experience of the time, scale, causes, and effects of climate change on the ice.

In the artwork, the participant enters a crystalline tesseract architecture (Figure 4). Within this architecture, different scales, forms, speeds, and sounds of ice filmed in the cryosphere compose the space. The participant's movements propel them along the four spatial axes of this tesseract, (x,y,z,w), between different cube-rooms, unfolding uncharted vistas, juxtapositions, and timeframes that reveal the 4D space-time of Earth's polar ice.

Filmed during an expedition to Western Greenland in 2016, the images of *TesserIce* present hyper-realistic, magnified views of ice taken at all scales, from the microscopic to the planetary. Movements of ice in the film are perceived as the effect of time on matter. The scales of time expand and contract. Movement often occurs at speeds beyond human perception – until the timescale of the ice is transposed to meet the perceptual time frame of the viewer. Time then reverts, drawing the sensate viewer back into the perceptual time of ice. The body of the beholder is enfolding, collapsing its sensory distance to the ice.

In *TesserIce*, the viewer is free to walk through walls, floors, ceilings, and time within the four-dimensional space. The navigation is inspired by Robert A. Heinlein's "Crooked House," [7] a four-dimensional architecture that continually wraps back on itself, infinitely. Viewing back into the third dimension from the four-space of the tesseract, the head and the tail of an object are coextensive. Neither inside and outside, nor top and bottom as we know them are distinguishable, and linear perspective is fractured into crystalline, poly-perspectival facets or curved into a space of relativistic proximities. Within this cinematic space, the action is as pervasive as sound.

In any technological variant of immersive cinema, immersive sound plays an increasingly critical role as a key sensory component of defining space. The acoustic soundscape plays an essential role in the sensory environment of the *TesserIce* experience. For *TesserIce*, we have recreated a physical 9.1 surround-sound mix in the Unity VR environment, experimenting with how this immersive soundscape "behaves" in a four-dimensional, navigable space.

Conclusion

The *TesserIce* VR experience constructs the tesseract as an embodied cine-poem, a hyperspace of spatialized meaning and navigable time, enacting the strange data vistas that surround us in manifold perspectives – the meta-dimensions of our contemporary, disembodied

data-world. *TesserIce* constructs a tesseract of polar ice in time as an spatial poetics. The artwork examines our culture’s altering perceptions of space and time, the deep time of Earth’s environment, by using polar ice to

create a unique experience of climate change.

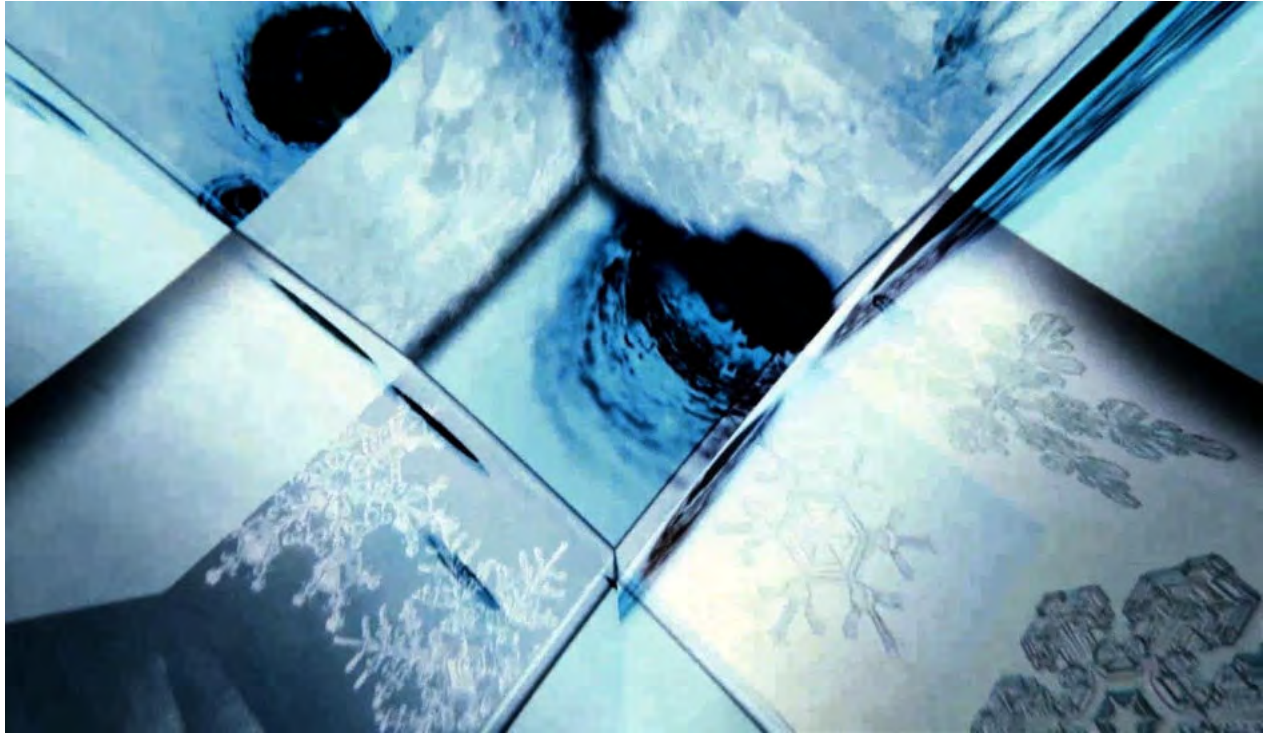


Figure 5. Stillframe from *TesserIce* (2021), a four-dimensional, VR mediascape allowing one to enter the four-dimensional space-time of glacial ice. © Clea T. Waite 2021.

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Author Biography

Clea T. Waite, Ph.D. is an intermedia artist, scholar, engineer, and experimental filmmaker whose artworks investigate the material poetics that emerge at the intersection of art, science, and technology. She creates immersive, cinematic works engaging embodied perception, dynamic composition, and sensual interfaces – as well as one inter-species collaboration with several hundred tropical spiders. Her themes examine climate change, astronomy, particle physics, history, feminism, and popular culture. Waite received her Ph.D. at the University of Southern California in interdisciplinary Media Arts + Practice, combining a background in physics and computer graphics from the MIT Media Lab with her current research in cinema, media art, and critical theory. She brings a unique blend of expertise to her projects from which cross-disciplinary synergies emerge.

Cultivating the possible: using design methodologies for artistic research

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Abstract

Artistic research and art residencies allow artists to cultivate the possible, to capture a contemporary moment and to look towards the future. This seems to be their prerogative and a requirement for reflecting critically on ‘the now’. The digital medium demands this. In order for a new possible way of working to be imagined – artists and researchers need to look outside of their own contexts, towards other ways of working to ensure sustainability, longevity and relevance.

The covid-19 pandemic demands that artists, curators and researchers re-imagine their practice for a technology orientated future. As digital product design or interaction design has progressed, so have the research methods which aid in the realisation of digital products and systems. This field of human computer interaction (HCI), leverages design thinking as an iterative, agile approach. This paper will present //2Weeks special edition, the TMRW residency programme and the Floating Reverie website as case studies indirectly and directly been inspired by this way of working applied to an artistic research practice, curatorial projects and collaborative working within the digital medium.

Through the use of different methodologies and approaches to artistic research and art residencies, within the context of the digital medium, a reinforced connection between arts and technology has the potential to occur.

Keywords

Preservation
Documentation
Art residencies
Design methodologies
Artistic research
Cultivating the possible

Introduction

Artistic research and art residencies have the potential to cultivate the possible, to capture a contemporary moment and to look towards the future. The past two years have brought with it the COVID-19 pandemic and have demanded that we, that artists, curators and researchers re-imagine their practice for a technology orientated future. Positioning artist research within a digital context seems inevitable. The digital medium demands that we rethink what creative practice is, that we re-think processes and research within a practical context. One of the possible new ways of working is to look to the medium itself to ensure sustainability, longevity and relevance.

The different research methods and pieces of documentation required for digital product design or interaction design have evolved as the complexity of contexts and products have increased which result in the realisation of digital products and systems. This field of human computer interaction (HCI), leverages design thinking as an iterative, agile approach – focusing on the user. This approach, which places people, the user of the product, at the centre of the research,

guides all actions, solutions and ideas back to this point isn’t a new approach.

This paper will start with exploring the different methods that can occur within this scope of research and project realisation – focusing on how they have manifested in different artistic and curatorial projects. These projects directly and indirectly have been influenced by this way of working within the digital medium. *Residencies as artistic research* explores how artistic residencies can leverage the online digital medium in different ways in order to cultivate unique artistic research through action research. This section focuses on location, or context, as a motivation for practice. This will be showcased using Floating Reverie’s //2Weeks special edition which was held in April 2020, The Mixed Reality Workshop’s (TMRW) proposed hybrid residency programme and the redesign of Floating Reveries website as case studies.

Residencies as artistic research

The residency exists as an artistic space for practice to develop and emerge as a result of a dedicated time, context and location. Residencies can often act as educational spaces, where learning and growth occur for artists as individuals and for a broader community within the space – within an online space this too is the case - challenge existing methods of education and artistic research.

Miriam La Rosa explores the history of a residencies and defines them from a Western perspective, a residency can be identified by components such as “studio space, opportunity to exhibit and living accommodation” (Rosa 2). The author suggests that the residency can be seen as a “crucial step in the career of artists and, more recently, also curators”, in addition it is an “opportunity for visibility” and in some cases a “status symbol... to raise their own public profile, improving their reputation and enriching their CV” (Rosa 2). Allowing a safe space for making along with “seclusion and isolation” seem to be crucial to the residency as defined in this context. This “seclusion and isolation”(Rosa 3) comes with great privilege and access to both funding and mobility. The residency is often framed as this utopian space where making and existing are all possible within the constraints of the space. La Rosa goes on to suggest that the defining characteristics of our contemporary moment for residencies, is the ability for them to extend both artists and curators networks and allow for collaboration (Rosa 4).

In ‘Transnational, Collaborative Artists in Residency Programmes’ the authors describe the residency actively, as intangible, existing through “a structure of times, discussion, thought, action and proclamation” (Dekker et al. 33). The following are identified as inherent characteristics; “time and space for artist(s) ... to research and develop a new work, a modest artist fee, production budget”, regular critiques with communities, “online documentation of project process, testing opportunities, [and] public presentation of research” (Dekker et al. 33). This adds nicely to the definition of a residency; however the context, format and

capacity to determine how many of these criteria can be applied and implemented. Often it is up to the organisation running the residency to determine the intention or aim of the residency programme and the subsequent objectives. What does stand out in their description and criteria is the requirements of communication, for feedback, critique and dialogue to occur around the practice of the artist or curator. Enabling this space to occur, this support within a studio or practice context is what seems to provide further focus and vision for specific residencies. Regular and focused sessions (formal or informal) as it “strengthens connections, opens unforeseen exchanges and builds confidence” in the artists with the organisation” (Dekker et al. 35). Another important criterion is the documentation of the process of both the organisation and the artist. This does speak to a more technical focus of a residency, maybe to something more structural that exists in the background; however, documentation of the practice and process is crucial when evaluating and assessing the outcomes of the residency and the validity of the space of organisation. This documentation can assist in “valuable reflection and evaluation” (Dekker et al. 36) of impact of the residency, the organisation and the outcomes of the practice. These “moments for discussion and reflection” (Dekker et al. 36) or “dialogical relationship between all the parties involved” (Rosa 5) could be in the form of “organised presentations, workshops and test sessions.. [or] ad hoc in response to the needs of the project” (Dekker et al. 36) can provide support and enable documentation to occur. Dekker et al. also refers to the residency life-cycle, specifically within a collaborative space (Dekker et al. 38).

Tatsuhiko Murata, co-director of Youkobo Art Space in Tokyo, Japan, in a report from 2012, describes three general categories or models of residencies; “the ‘academic model’ (facilitated as academic bases of artistic research and creative production), the ‘community art model’ (taking the form of a community art centre designed to contribute to local development) and the ‘event-based model’ (organized as part of international festivals/exhibitions etc.)” (Murata 2). He goes on to describe another category or model, one which operates “solely for the support of the autonomous activities of the artist in a new creative environment” and suggests the term for this model: ‘microresidencies’. This model was identified and discussed as La Rosa points out through many roundtable discussions, workshops and a proposed way of understanding this model was established and represented in the referenced report. Many of these findings were based on Youkobo’s own context. La Rosa describes the model, which she applies to Largo das Artes in Rio de Janeiro, Brazil too, as “flexible, translocal and [opting for an] artist driven approach, seem to look at the residency as an opportunity especially thought of for artists and afterwards curated” (Rosa 5). She states that this is preferred over the “prospect for a horizontal collaboration between artists and curators”. Acknowledging the power relations that exist between artist, curators and the space they occupy together and separately further adds to the complex understanding of where the artist practice emerges.

The question of physical location or space has also been a requirement and for many artists or curators is a necessity as is the mobility of the artists. This takes us back to the romanticised notion of a residency and an artistic practice. It is crucial to acknowledge that this is not the case for many artists, nor is it possible La Rosa acknowledges that a “residency used to be about going ‘somewhere else’, usually beyond one’s own country”, but now it “can take artists directly into their own environment, their own cities or towns” (Rosa 6). The artists or curators could “experience difference there, but the challenges come not from working far away but from being in totally different contexts, professionally, scientifically, politically” (Rosa 6).

La Rosa identifies a fifth model, the ‘secular residencies’ which she states “stretches the limits and borders of what

residencies have been traditionally recognised with, for a very long time; almost becoming a metaphorical point of encounter, rather than a place of individual learning” (Rosa 6). This leads her to analyse three components; networks, collaboration and studio space.

This method of generating knowledge, of reflecting on one’s own practice in a residency context, starts to resemble and draw parallels with HCD and action research. Action research is a research methodology which stems from Lewin’s initial process which consists of the steps ‘observe-reflect-plan-act-evaluate’ (1952). According to McNiff and Whitehead (2006), action research is “a form of enquiry that enables practitioners everywhere to investigate and evaluate their work” (7). The process followed in action research is reflective as described by Schön in his book “The Reflective Practitioner” (1983), he describes reflection-in-action for practitioners - “not only that we can think about doing but that we can think about doing something while doing it” (54). This act results in “constantly [modifying] ongoing practice in such a way that learning takes place” (Leitch and Day 180). This is an intrinsic part of where knowledge and insight is generated during action research for the practitioner and for the participants. Leitch and Day (2000) go on to explain that reflection-on-action is the “retrospective analysis of [the practitioner’s] performance in order to gain knowledge from experience” (180). This process is not too dissimilar to that of UCD or IXD.

//2Weeks special edition

Floating Reverie is a digital residency programme that was started in early 2014 by its curator Carly Whitaker. It consists of two components – an online residency programme which once a month for two weeks, where artists are invited to iterate a concept on a daily basis over the duration of the two weeks. Floating Reverie is an ongoing annual experiment. Each residency, and artist, brings a new dynamic to the process and each has added insight to the framework. The residency has naturally shifted towards a process-oriented, research residency as opposed to a conventional residency focused on the art object or an exhibition. Artists use varying methods during their residency, but ultimately an action research methodology emerges, which cultivates an iterative outcome over the duration of the residency. The artistic process is often removed from the final showing of a work. It can be treated as mystical, as being for the artist’s eyes alone. It is not often that the audience or viewer is involved, or necessary, in the process. The //2Weeks residency breaks with these conventions, enabling the artist to reveal their process, reveal their research.

The Post-Digital instance occurs at the end of the residency year when artists are invited back to respond to their residency and process. It acts as a space for the artist to perform a re-imagining and to re-engage with the residency. Artists are encouraged to interrogate their own experience of the residency, their process, research, and how they produced work, while maintaining the essence of the digital residency during //2Weeks. This enables artists to take their digital residency, re-locating it to a physical, ‘real’ space.

In early 2020 the world started to embark on a collective change and our entire understanding of existing in the world shifted as a result of the global pandemic. This change was collective yet brought with it nuanced individual changes on a micro and individual scale, many of which we are still in 2021, yet to be able to identify. Towards the end of March in 2020 South Africa embarked on an initial three week national lockdown and we entered a State of Emergency. This was then extended for an additional two weeks, which Floating Reverie decided to engage with.

The //2Weeks special edition of 2020 took place at the end of April deliberately coinciding with the initial first extension of the hard lockdown, Level 5 in South Africa. The idea

was inspired by conversations with the artist 1001_1001. Our current context and way of working online resonates with Floating Reverie as a framework for artistic practice. The special edition was an open invitation to all previous residency artists and an opportunity for them to re-imagine their past residency on a new or similar platform. It was still focussed on process, practice and research, positioned as an opportunity to develop an idea - no matter how incomplete or complete. Daily iterations and outputs. The poignancy of this moment has not been lost on these artists.

Post-Digital 2019/2020 special edition is a re-imagining of the //2Weeks online digital residencies that took place in 2019 and the *special edition* in 2020. It is a reflection, a re-imagining and re-engagement of an experience, process and practice, and an interrogation of the residency. This *Post-Digital* presents creative practice emerging from, and because, of two pivotal moments in our contemporary context – before and during the pandemic. The artists who participated in //2Weeks during 2019 are engaging with their practice from before the pandemic, reflecting and re-imagining now in the heart of the pandemic in 2021. The artists who participated in the //2Weeks special edition are engaging with their practice from the beginning of the pandemic, also reflecting and re-imagining now in the heart of the pandemic in 2021.

As part of the *Post-Digital 2019/2020 special edition* there is an online component which was developed using the Art Curator Grid tool which allows you to plot and map out content (Whitaker). Each artist and artwork has corresponding Artist Notes and Curatorial Notes which have been compiled from interviews which are also accessible from the Art Curator Grid. This information was compiled progressively as throughout the duration of the exhibition, so the audience or viewers or users, could interact with different components at different points in the exhibition. These notes and documentation of artworks have also been compiled into digital publications.

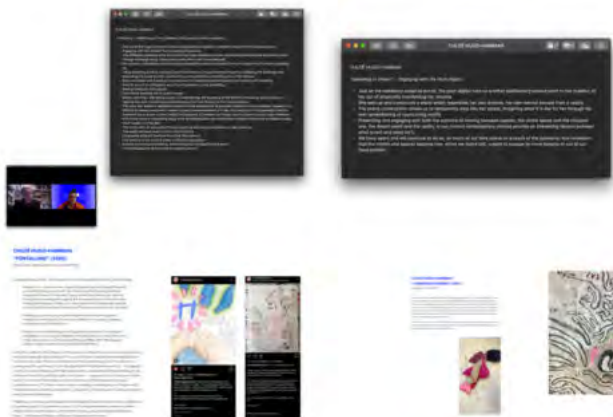


Figure 1: *Post-Digital 2019/2020 special edition, Curatorial Notes, Chloë Hugo-Hamman*



Figure 2: *Post-Digital 2019/2020 special edition, Curatorial Notes, Neil Badenhorst and Luke Turk*

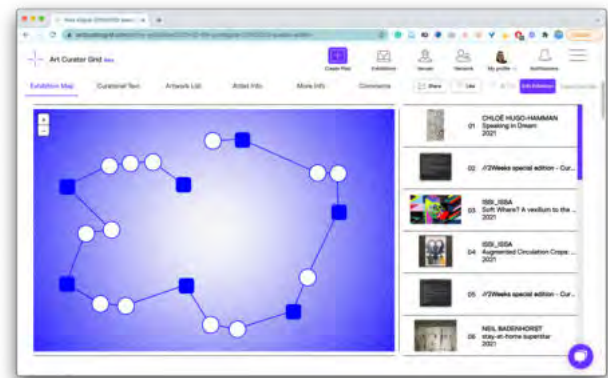


Figure 3: Screenshot of *Post-Digital 2019/2020 special edition* digital version on Art Curator Grid.

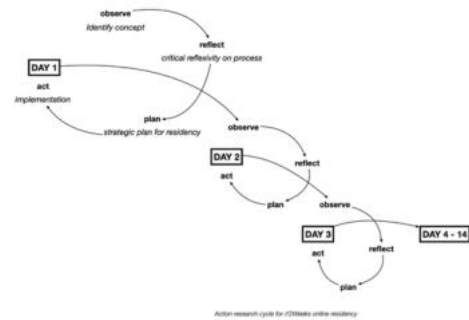


Figure 4: Diagram of //2Weeks as action research

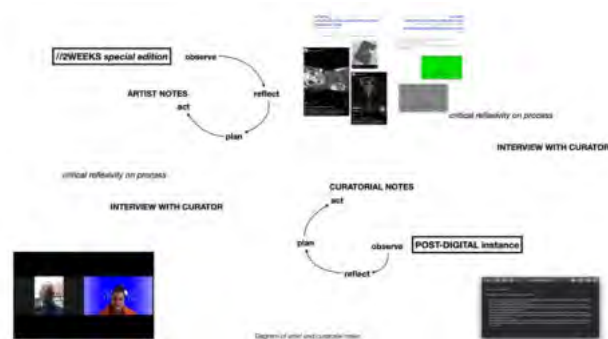


Figure 5: Diagram of relationship between artist notes and curatorial notes during the process of *Post-Digital 2019/2020 special edition*

TMRW residency programme

"Our World to Come", is a residency programme and publication developed by The Mixed Reality Workshop (TMRW), a gallery in Johannesburg, which will be held from March 2022 – October 2022. This programme will create opportunities for artists to develop their creative practice both in a space and remotely (hybrid context), exhibiting their final collaborative creative outcomes in the gallery space. Ensuring that there are spaces for artists to practice

ing, to exhibit in and have their work be engaged with and establishing a discourse is crucial for a sustainable creative practice and to ensure that their skills are developed, financially they can sustain themselves. The proposed project exists in a physical space, in the gallery that TMRW occupies and the online space - enabling artists the flexibility to work both remotely and in a dedicated space. This is heavily influenced by new creative practices which have emerged as a result of the COVID-19 pandemic. This programme will facilitate a sustainable development of creative and digital technological practices in South Africa and beyond. It will cultivate and contribute to the discourse on a digital, technology based practice - amplified over the past two years due to COVID-19 pandemic - many more artists are turning to digital mediums to explore their artistic practice.

The residency program offers a chance for six artists to participate, through an open call, and collaborate in the TMRW space over six months, each residency lasting for 2 months. One month will act as a studio/practice space and One month for exhibiting/showcase the work produced during the residency. There will be Two artists per residency - one based in Johannesburg and one working remotely in the Global South - working collaboratively. This format is influenced by the consequences of the pandemic and allows artists to embrace their location and leverage the online digital medium. The process of making between the two artists in each residency will be documented and engaged critically - contributing to the publication. TMRW's mandate is to cultivate space for artists to grow and develop ideas in relationship technology which is why a residency programme is integral to the sustainability of the space. Artists would receive a stipend, enabling a sustainable practice and capacity for themselves in a business context. Through the use of technology artists will be able to reflect iteratively using a variation of action research.

COVID-19 has been devastating to practicing artists financially, and the industry has lost much of its financial support from funders due to funding being rerouted to more immediately demanding areas in CSR budgets and NGO or government grants. The demand is far higher than the availability of funding and support in the current fiscal climate, leaving artists vulnerable to exclusion from the cultural spaces to which they previously had access and relied on.

TMRW has similarly seen a deep impact on its artists, and its own ability to run at the same capacity considering the different lockdown levels has impacted TMRW's curatorial planning drastically. Formerly the gallery has been able to have major Virtual Reality exhibitions, and with COVID-19 we cannot have interactive exhibits that require many people to touch the technology to their hands, heads or faces. This has had a knock on effect on the practice of artists. The different components - space to practice, to exhibit, to learn for both the artists and galleries is crucial for creating a healthy ecosystem. TMRW is passionate about positioning the space, not just as a gallery, but as a space to learn and grow with.

"Our World To Come" asks artists to respond to these impacts on their world, lives, artistic practices, and audience reach, asking them to reimagine the use of technology in a world where we cannot share devices, and where we rely increasingly on the digital realm as the gallery outside of the physical white cube.

Figure 6: Diagram of the relationship between the art making process and hybrid contexts.

Redesigning an archive

The Floating Reverie website has the opportunity to be filled with complexity and nuances revealing and capturing the archive of residencies, Post-digital exhibitions and discourse that has been created and generated around the programme. The archive consists of digital artworks, process, images representing different artists and what Floating Reverie represents.

The website has acted as a preliminary, literal archive of the work that has been done by different artists, but has the potential to be far more than that. When briefing the redesign in, the following was requested:

- The website should articulate the connections between the different artists within a networked curatorial methodology and the different themes that each residency explores, and each residencies post-digital artwork.
- The challenge is in represented an iterative, performative residency which has occurred over the two weeks, after the residency has occurred. This documentation becomes an artefact within itself.
- There is a lot of discourse (curatorial notes and articles) written on Floating Reverie

Based off of this, an information architecture, user flows, wireframes and design guidelines were developed and are in development. This process of approaching the archive from a mapping perspective, leveraging the concept of networks through the functionality is crucial. Below are some pieces of documentation which will seek to challenge the archive, its representation and ultimately the process of capturing the residency, artistic research though a reflective and reflexive manner.

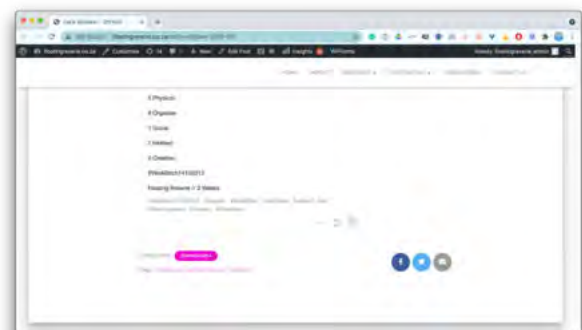
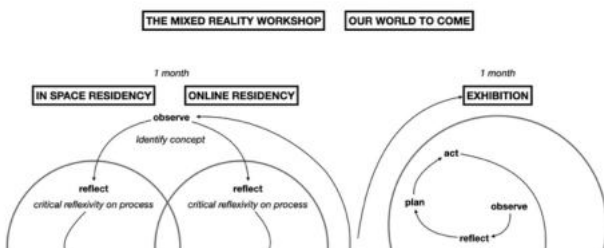


Figure 7: screenshot of previous Floating Reverie website.

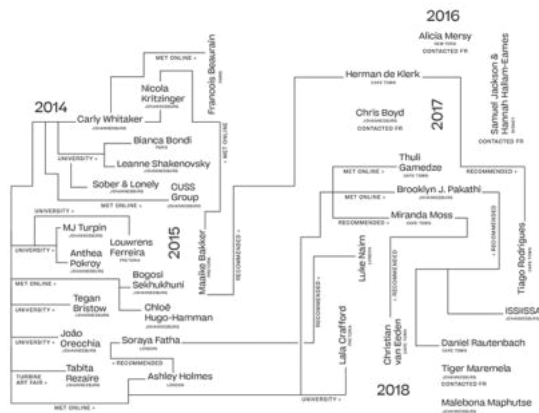


Figure 8: diagram of potential information architecture that will be used to guide the website structure.

Conclusion

Being aware of these research methodologies and experiences from art and design production and research context enables an artistic practice to emerge in a different way, through the consideration of technology.

Through the use of different methodologies and approaches to artistic research and art residencies, within the context of the digital medium, a reinforced connection between arts and technology has the potential to occur.

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SHORT PAPERS

Extended Listening:

Towards non-humans interpretation of the sound environment through AI systems

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Abstract

Technology has allowed extended human capabilities, amplifying the sense of hearing toward the sonic perception of different physical layers of our environment, such as electromagnetic fields, ultrasonic/subsonic sounds, underwater sounds, long-distance sounds, animal spectrum, etc., generating as a consequence new symbols, new languages and new cultures.

In this sense, the main question in this paper is related to how can we transcend the current use of AI as a methodology to recreate or even create sounds, images, music, texts and move toward the development of models that could spawn a language created by machines.

Questions like that, provide the philosophical context to move forward to generate models that could lead the processing of sound towards complex and unpredictable results, allowing the development of methodologies to create non-human language involved in a technological ecosystem.

Keywords

Machine listening, Sound Art, Extended Listening, Non-human Language, Technological Ecosystem, Ontology of machines.

Introduction

In 1996, the artist Stelarc implanted in his forearm an ear made of human cartilage. This 'third' ear could connect through Bluetooth and transmit what it hears. In light of what technology will be able to do, what are the limits of the human body? How can we interpret the world from a sound perspective through technological listening devices? The human body is an interesting field of study in which technologies have had a significant influence. Technological advances in human history have allowed us to improve our life, providing solutions to medical problems, but also, technologies have allowed us to extend the human limits, giving a new context to reflect on the meaning of the body.

The relationship between the human and machine, in which technologies and devices act as an interface that extends our human abilities, allows for the amplification of the human perception, transforming, changing, and degrading the information from the environment. This could provide different and new interpretations or meanings of the world, and also creates new scenarios, symbols, and realities mediated by the technology itself.

Human Sound listening

New technologies provide new human physical characteristics, extending the natural capacities of our senses, allowing us to amplify the perception of the world.

Barry Truax states that the senses are our physiological mechanism to understand the information that surrounds us. It provides us with a system that allows us to perceive the threat and the characteristics of the environment, giving us resources to survive and build our thinking, ideas and concepts of the world. Despite these abilities, like all living things, human senses have their limitations with respect to their biological capabilities. Human vision, for example, has a specific range with respect to frequency, distance, and visual fields. The ear can hear a certain frequency range (between 20 cycles per second and 20,000 cycles per second), delimiting the possibility of listening to certain types of sound in certain distances and in some places, generating a long quantity of life, events, and situations out of our perception.

Furthermore, the human brain filters the data observed, smelled, or heard converting it into valuable information that depends on our interests, experiences, and circumstances. This generates a vision and perception of the world contingent upon our own biological and psychological limitations: "Whereby the senses employed are always already ideologically and aesthetically determined, bringing their own influence to perception, the perceptual object, and the perceptual subject". [1]

In this sense, the human ear has a physiological inability to block its function. Unlike the function of the eyes, where it is possible to stop seeing something by closing the eyelids, the ear, biologically, is always working. It is only possible to stop hearing if the brain decides to pay attention to something else. That means, listening is not automatic, potentially it is a conscious act to understand the world:

"In this sense listening is not a receptive mode but a method of exploration, a mode of 'walking' through the soundscape/the sound work. What I hear is discovered not received, and this discovery is generative a fantasy: always different and subjective and continually, presently now". [2]

In the mid-1960s, American artist Pauline Oliveros began to develop the concept of "deep listening." In essence, this idea refers to an attitude. To experience conscious listening is to act actively with the body, memories, and feelings; it is listening taking a position on how, and why to use the ear.

Pauline Oliveros (2003) states that the idea of "deep" refers to those things that are difficult or impossible to understand or something that has unknown and different parts. "To listen or listen deeply for me is to learn to expand the perception of sounds to include the entire space/time continuum of sound, finding the immensity and complexity as much as possible". [3] Oliveros states that the concept of listening requires an exploratory attitude towards the perception of sound in physical space. In this sense, listening is an active, unstable, untouchable, ephemeral,

and conscious sensory process toward approaching the world. It is confusing, filtered, and subjective; as Salomes Vogeling states, listening is a practice about doubt.

Extended body

As a consequence of that exploratory attitude, in the sound field, from science to contemporary art, different experiments and projects have crossed the idea about how to amplify the sense of hearing, resulting in the extension of acoustic listening practice, toward the development of technologies around sound listening devices. The purposes of this extension include reaching unreachable worlds, creating interfaces between the human and inaudible layers of sound environments, amplifying the limitations and abilities of the body, and incorporating new sound dimensions to understand the physical world that surrounds us.

One of the pioneer examples in developing sound listening technologies is Acoustic Mirrors. After the first World War, between 1915 and 1935, Great Britain created a military architectural structure based on a concrete, concave and parabolic design. Its shape allowed it to hear sounds at long distances and detect possible aircraft threats. During those years tens of acoustic location devices were developed for the passive detection of aircraft by picking up the noise of the engines. From devices such as horns that worked like ear prosthesis and body extension, to big concrete structures that gave both acoustic gain and directionality, increasing the observer's ability to localize the direction of a sound.

Extended listening

Thereafter, with the advent of electronic sound technologies, and the arrival of sound experimentation, this field moved from its scientific purpose to an artistic point of view, becoming one of the fields of study in the sound art aesthetic.

During the 1970s, German sound artist Christina Kubisch started to develop an interest in the sound of electromagnetic fields generated by human activity, and more specifically generated through the electronic devices around us. The performative experience of walks around the city was captured by sensitive wireless headphones, by which the acoustic qualities of aboveground and underground electromagnetic fields become amplified and audible. Since 2003, Christina Kubisch has been developing what she calls "Electrical Walks", all over the world. Searching each city for inaudible phenomena that human biology is incapable of perceiving, in order to reach to impossible layers of the physical world, amplifies not only the human abilities, but also amplifies the unknown places of the sound dimensions in the world, therefore expanding our perception of the world. In the words of Kubisch, "The perception of everyday reality changes when one listens to the electromagnetic fields; what is accustomed appears in a different context. Nothing looks the way it sounds. And nothing sounds the way it looks". [4]

Machine Ontology

Evaluating further the consequences of these devices in terms of human perception, meaning the flow of information: the environment, the human biology, the technology devices, and the human interpretation of the environment, and also understanding that the focus of discussion here is the relationship between human and machines, it is appropriate to ask what is the role of the machines and technology in that information flow: Is technology only a bridge between the world and humans? That question implies that machines or technology are only tools to achieve some purpose. However, observing how technology has changed everything around us, how it has evolved and is involved in probably all of the parts of

human life, it is possible to understand technology beyond its usefulness. In this sense, technology could be understood as a complex language; a culture that has its own codes, procedures, and meanings that converge with the environment. Therefore, it would be possible to state that technology is a complex system of interaction with the social system that generates new symbologies, objects, and codes of communication. Consequently, the relationship between humans and machines is not just morphological, it could be ontological as well. In this sense, the philosopher Guattari in his book *Chaomose*, reformulates the idea of machine extending it further the field technological, going beyond the signifier of the machines, and the limits that represent technological devices:

"Through these positions, we will attempt to discern various levels of ontological intensity and envisage machinism in its totality, in its technological, social, semiotic and axiological avatars. And this will involve a reconstruction of the concept of a machine that goes far beyond the technical machine. For each type of machine, we will pose a question, not about its vital autonomy - it's not an animal - but about its singular power of enunciation" [5]

In this sense, in the information flow mentioned above a bifurcation can appear: in one sense, the human interpretation mediated by technology, and in the other, an interpretation model mediated by the machine's own language, thus advancing to the hybridization: human/machine, and also toward an ontology of machines. In 1985, Donna Haraway presented the Cyborg manifesto, stating the concept of the cyborg as a refutation of the boundaries between humans and machines. This proposes a hybridization as a cybernetic organism that emerges from a given context, and social relationships. For Haraway the concept of cyborg goes further:

"The cyborg age is here and now, everywhere there's a car or a phone or a VCR. Being a cyborg isn't about how many bits of silicon you have under your skin, or how many prosthetics your body contains. It's about Donna Haraway going to her gym, looking at a shelf of carb-loading bodybuilders' foods, checking out the Nautilus machines, and realizing she's in a place that wouldn't exist without the idea of the body as a high-performance machine. It's about trainers. "Think about the technology of sports footwear," she says. "Before the Civil War, right and left feet weren't even differentiated in shoe manufacture. Now we have a shoe for every activity." [6]

The concept of the cyborg has generated a culture around the idea of the human machine, expanding the idea of the body, by using technology in our lives and using the body as material for experimentation. This transforms the body into something different from its nature, introducing the posthuman culture.

Machine Listening: towards Non-human languages

There have been years of the ongoing discussion about human hybridization by technologies, cyborgs, posthumans, and transhumanism. Considering this discussion and the current artificial intelligence research, it is possible to ask: could the technology go further and create its own existence beyond human beings? Is it possible to create systems that could give way to the ontology of machines mediated by A.I?

It is necessary to say that current A.I. is an ongoing technology that is much closer to an utopian philosophy than having real analogies between human intelligence and artificial ones. In this sense, Johana Zylinska states about the current AI generation that:

"The renewed interest in AI research has been accompanied by a change of tack: from what became known as Artificial General Intelligence, whose goal was

to replicate the human's mental functioning as such, to specialized, or 'narrow' AI, focused on performing particular tasks and solving singular problems. The new approach involves developing artificial neural networks, which at a rudimentary level imitate the way neurons in the brain work". [7]

This new direction transformed the utopia of thinking machines from speculative analogy with human complexity, into powerful computer skills that can resolve specific problems. This allowed for incredible advances in information processing, affording machines the skill of precise decision making, and performing certain and specific tasks based on the training of a large set of data. This new perspective is beyond the idea promised and speculated about historically, nevertheless AI technology is still a field that provides deep questions about the future of humanity and machines, giving the context to continue speculating on the question of what will come next.

In the sound field, different technological advances related to AI have happened in the last few years, generating both artistic, scientific, and commercial applications. Going back to the information flow mentioned above, it is especially relevant to mention the highly advanced sound recognition systems like speech to text, and also the new possibilities in sound recognition of more complex sounds, like every day and natural sounds, through signal processing and machine listening.

Machine listening is a branch of the AI field that amplifies the results of the advancements in speech recognition researched in the last 70 years. Therefore, if it is possible to process the voice and take linguist information, recognize words, gender, and even the speech emotion, is it also possible to recognize more complex sounds like music, or sounds from complex sounds environments? Izotope, for example, is a commercial tool for studio recording, that analyzes the audio signal and through machine learning techniques suggest custom presets that are tailored to the sound you're trying to achieve. Also, Andrew Owens of MIT, created an algorithm to insert sounds in silent videos. Through the image analysis and the training of thousands of movie scenes and sound effects, a neural network predicts which sound to synchronize with the image. Other advances in Machine Listening have allowed for the recognition and description of sound environments, which will determine if the ambient sound is an airport, stadium, library, park or coffee shop. There is also an algorithm that allows for the recognition of short sounds, like "sound objects" and also describing its characteristics.

These examples clearly provide extremely interesting tools to process audio signals and to gather valuable information that will allow machines to make decisions. but this model is still under the paradigm of usefulness and not under the question of how to get senses and deeper meanings from the information obtained.

From this perspective a question emerges, how can a machine listen to sounds and then process it to make an unexpected decision? That process may not be necessarily useful, but it could be challenging, confusing, provocative, or generate results in an imminent state. That means, in other words, it seems necessary to ask how this intelligent process can create art, but art pieces that are different from pieces that humans can create. It is necessary to find reasons to use this high technology in the art field, therefore, the artistic challenge is how to pass from the utilization of AI as a methodology that can recreate or even create art using known and human parameters, and move toward a model that can create an artistic language itself; a language potentially non-human.

AI from a critical perspective

The question fits about how this current powerful technology serves a complex purpose, and can also create systems in which machines observe and listen to the environment, not only makes decisions, although contradictory, can also create models where machines open

unpredictable paths. If this is the case, it is also taking an aesthetical position that is not human, creating devices and models that extend the listening towards autonomous "machinic" interpretations through AI systems.

In this sense, it seems necessary to have a critical position on AI and to observe this technology from a certain distance in order to explore conceptually at the same time that this technology is going forward. This attitude establishes a reflective context and opens a counterpoint to what the mainstream wants to state about what this technology is. Therefore, generating questions about: what really those results, predictions, and conjectures are? And How AI can provide a new way to create Art? But understanding this technology beyond being only a tool: How does AI provide an artistic language itself? Can this technology open up new or different aesthetics that could be named non-human aesthetics?

These questions and reflections, regarding the relationship between humans and machines, the interpretation of reality through listening, and as well as the question about how technological devices and AI create new contexts and scenarios, thrust the idea of the possibilities of experimental processes which could create complex interpretation models about the physical environment, that could give way to new symbols, senses, and meanings through sound experiences

The Ear and Imaginary Machinescapes

In the beginning of 2020, inspired from the philosopher Byung Chul-Han ideas related to how western and eastern countries were facing the pandemic, putting on the table concepts such as surveillance systems and individual freedom, I developed an artistic work called The Ear.

The ear is a listening, surveillance, and Artificial Intelligence project. It is a device that collects human voices, transcribes them into text, and with that information create new texts.



Figure 1. The Ear, University of Washington, Seattle, US

This Machine uses the collected texts as a data set, accumulating day by day more information from the environment where it is installed. The data set is trained constantly, creating AI texts based on the specific situation where this machine has been involved, transforming this piece also into a cultural apparatus. The AI texts generated are shown in small parabolic speakers using a computer voice, returning the data to the acoustic world. The experience with the piece shows how the human voice is transformed into a digital object and that can be analyzed, recorded, transformed, stored, and used, questioning the concept, sense and value of the information, privacy and freedom in our contemporary society, questioning also the relevance of the information collected in surveillance systems, and the ethical and political limits in this type of devices.

The aesthetic experience of The Ear emerges from the mistakes that this machine produces:

Speech to Text in real time makes several mistakes, transforming the coherence into a degraded text, transforming the data in absurd texts, and also bringing invented words. Furthermore, considering that the data set is based on the texts collected, the AI texts are even more absurd and therefore a weird kind of digital poetry

emerges, generating a listening experience based on AI experimental narrative created under the series of mistakes that this machine does, putting on evidence the imprecise and cracks of this kind of systems.

To further explore these interesting spaces of error that this kind of system leaves, In the beginning of 2022 I started a new project related to machine listening.



Figure 2. 3D Design, Imaginary Machinescapes device

Imaginary Machinescapes is a robotic intelligent listening device that senses and collects sounds from different sonic layers of the environment. Using the AudioSet Ontology (a large data set based on youtube videos with more than 2 million sounds and 527 labels) the system processes and classifies audio signals in order to recognize what kind of sounds the machine is listening to. This process will generate complex descriptions of the sound environment, allowing for interpretations yielding experimental sound narratives. This process also spawned new procedures that could generate more complex results; creating sound experiences through the exploration, expansion, and creation of linguistic models, and extending listening towards non-human interpretations through AI systems.

The system relocates sounds in a foreign landscape, recategorizes the information of the real time environment,

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and plays sounds from other territories and ontologies, questioning the conflict of local and global, and also questioning the territorial identity in counterpoint with landscapes created by machines.

The sounds are displayed acoustically in a new natural territory, based on how the system understands the environment, thus reinterpreting the reality of the site, generating a machinic ecosystem produced by the dialog between the situational soundscape and the intelligent machine interpretation of the environment.

As in *The Ear*, the aesthetic of this system comes from the mistakes. In ideal conditions, machine listening can be very effective, recognizing and therefore categorizing the sound from the environment. But situating this system in a real environment, that means, several layers of sounds, and also a complex and diverse data, the system fails, bringing erroneous categorization. Also, considering that this system is using these categories in order to calls sound from an uncontrolled sound repository as freesound.org, both because the erroneous categories and also the juxtaposition of labels, the system open up unexpected results, creating a new soundscapes created by interpretation of the machine.

Taking both projects, one possible clue to going forward in the idea of non-human interpretation is asking where the holes, cracks, and gaps of this kind of system are. It seems like those spaces open up paths to the surprising, uncontrolled and unexpected, allowing us to ask about creativity and the sense of the use of AI in the art field. Under that perspective, perhaps, hacking, intervention and transformation through the navigation in the errors could be an aesthetic strategy that would allow us to re-appropriate, re-imagine and re-define the purposes and behaviors of the A.I systems in the art context.

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He is a sound artist and electronic media artist. He has a degree in music from the University of Valparaíso, Chile and a Master in Electronic Arts from the National University of Tres de Febrero, Buenos Aires, Argentina. He is currently pursuing his doctorate at DXARTS, University of Washington, Seattle, United States (Digital Arts and Experimental media). His research has been orientated on the relationship between the human and machine, and how technologies and devices act as an interface that extends our human abilities, allowing the amplification of human perception, transforming, changing, or degrading the information that comes from the environment, providing new interpretations or meaning of the world. The last two years his work has been focused on machine learning, NLP, and machine listening applied to robotic and sound installations

Bridging traditional and digital crafts: Digital Dynamic Ornaments

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Abstract

This study draws parallels between the work of traditional craftsmen and the workflows of digital artists, and acknowledges both of them as cultural actuators and generators of ornamentation. Moreover, the elements of play and visual complexity are considered in the exploration of ornamental forms, as integral practices in both the analogue and digital realm. Play is a natural function, connecting intuition to actions, and specifically in the digital arts, it helps shape different notational systems bound to individual imagination. Visual complexity is explored as an ornamental quality that was forsaken in favor of minimalism and functional design, but nowadays is returning as an integral and desired quality in both traditional and digital ornamentation. It is, as well, a common feature of generative art, a field of digital art, which is interpreted as the augmented continuator of the intellectual and procedural heritage of traditional handcrafting.

Keywords

Play, Complexity, Ornamentation, Digital Art, Craftsmanship, Generative Art.

Introduction

“Culture arises in the form of play, it is played from the very beginning.” Johann Huizinga [1]

A first thing to consider is the relationship of the function of “play” to ornament. In particular, play has a close relationship to the traditional handcrafted ornament. Craftsmanship excellence often started from physical play and experimentation. The traditional handcrafted ornament was a result of workflows of repetition with the material, pushing the craftsman’s skills a bit further every time. This created an intense mind-hands connection similar to all skills that are “played”, such as music and sports.

The handcrafted object of beauty carried the individuality of the craftsman blended with his infused perception of society and reality.

“Its production involves some play, some waste, and above all a kind of communion. [...] As an object it represents and serves its culture; its daily handling is a

humble act of participation in that culture.” Malcolm McCullough [2]

The process is manifesting in a visceral, intuitive way; from his mind to his hands. Traditional craftsmen were admired for their skills; for each new intricate level of detail implied a lifetime of consistent practice on connecting the body to the mind.

The psychological action of play, which is based on intuition, led to the conceptual formation of symbolic worlds and notations, which were channelled in the traditional handcrafted ornament. So, the ornament was an expression of the culture, while play can be considered a cultural actuator. Personal and communal rituals, skills and operations are practiced and learnt through the fundamental action of play.

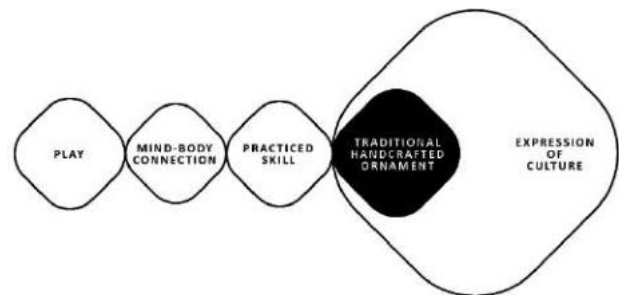


Figure 1. From play to traditional handcrafted ornament, to culture

The fall and comeback of the Ornament

Ornamentation was essential to experience culture; whether it was through the architectural ornamentation in churches and sacred spaces or intricate patterns on the clothing of priests in communal ceremonies. However, in the post-industrial revolution era, ornamentation was discarded.

“Revolutionary developments in the fields of industrialization, transportation, communication and production have led to heavy criticisms about social functionality being replaced by the figural-meaningless repetition of the visual-fanciful.” Hakan Sağlam [3]

A deep separation was introduced between objects that served functionally and those that did not. In this context,

ornamentation fell in the category of art which "...concentrates objects that have no other function than to be." [4]

Specifically, in architecture, "it is largely accepted that Modern architecture (1900-1968) abided by the call to eliminate ornament from architecture in lieu of augmenting the true spatial experience produced by architectural surface, form and space." [5]

"Eugene Emmanuel Viollet-Le-Duc [...] emphasises that architecture should tell the truth as an ethical and constructional obligation by saying that "the primary function of columns is to carry loads, and if they do not do that, they should not be placed on the facades of buildings like arabesque ornaments which are useless" [6]

"English architect George Aitchison has emphasised the point that in order to establish an architectural style of our own era, stylistic beauty should be taken into consideration more than ornament and he has expressed this though the following statement: that "pure, elegant and unornamented plain style should be applied everywhere from buildings to our tea-spoons." [7]

"The evolution of culture is synonymous with the removal of ornament from utilitarian objects." Adolf Loos [8]

The combination of such ideological inclinations with the new faster and cheaper building technologies of that era resulted in creating urban landscapes as we know them today; rectangularly organized, with utility-driven forms and minimal ornamentation.

"For Huizinga, the rigors of the Industrial Revolution caused adults to put away their toys; [...] He argued that, thereby, when utility rules, adults lose something essential in the capacity to think; they lose the free curiosity that occurs in the open, felt-fingering space of play." Richard Sennet [9]

With the rise of automation and mass production, the craftsmen were replaced. However, criticism arose and mass industrial reproduction was eventually accused of producing disposable form, devoid of personal or communal meaning.

"For it is not the material but the absence of the human labor, which makes the thing worthless ". Malcolm McCullough [10]

The absence of human touch implied a lack of the essential body-mind connection described in traditional craft excellency. This suspicion is wide spread till today, when handcrafted items are sold as rare and unique, while products of computation are replaceable and of less value. In the comeback of ornamentation in its digital form, creative computing has this reputation to overcome.

However, digital craft has capacities that can reshape the way in which human experience is channelled in creativity. Today, we could say that computation can approximate human thinking closely, particularly when it comes to abstraction. Computational abstraction can describe human conceptions of reality such as symbols, notations, information structures and processes. It can also describe natural pattern formations through algorithms.

"In much the same way as a recursive script may call itself, and perform a series of steps in a loop, until some condition is met, so can material systems." Santiago R. Perez [11]

The digital tools and interfaces go deep into the symbolic mind, by approximating the "abstractive power of human thinking" and expanding "our capacity to visualize abstract symbolic structures as physical images." Malcolm McCullough [12]

Not only this, but according to Mario Carpo, the mind-body connection can be restored; "...digital design and fabrication tools are creating a curiously high-tech analog of preindustrial artisanal practices." [13] Digital arts can be an intuitive medium, through which culture is abstracted and re-expressed. The automation is there but the human decision is there as well; It is important because computational systems are unaware of their context and "...have the unfortunate disadvantage of containing no information about when their contents are appropriate." [14]

Digital Dynamic Ornaments

Returning to the concept of play in traditional ornament, we can see that play can similarly create symbolic worlds through creative computing and digital notational systems, leading to our idea of a new digital ornament. However, traditionally ornaments were usually physical and static. Digital craftsmanship can manage not just inanimate but also animated forms. Animated forms can describe ornamental geometry that moves and digitally augments a space, potentially a minimally designed space. A digital dynamic ornament, or an ornamentation that is not based on physicality, that is dynamic and that serves the old purpose of cultural expression. Practices like projection mapping or video jamming or screens in public spaces are culturally meaningful, dynamic, interactive ornaments. Today a lot of these practices are often driven from advertising and it is important to connect to the bigger perspective of what they represent in the space and their cultural impact.

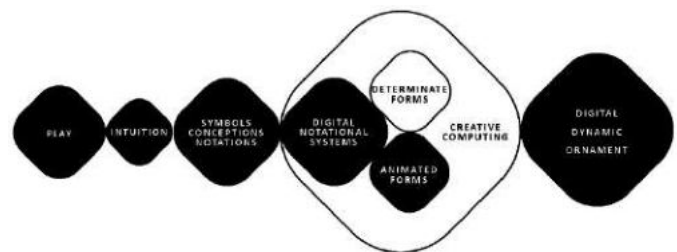


Figure 2. From play to digital dynamic ornament

Complexity in Generative Design and Traditional Crafts

After assessing the relationship of the social function of play to ornamentation, where ornamentation was redefined as something not necessarily physical or static, we will explore the role of visual complexity in this equation.

In particular we will examine visual complexity as a possible symptom of generativity. Generativity is the quality that characterizes generative design and art. Generative design is a method that is capable of producing limitless and unpredictable answers to a question, within specific constraints. And even though, the term generative design refers to digital practices, the concept of generativity stems from natural processes; nature could be seen as the absolute master of generating “unique designs”. No leaf is exactly the same as any other, yet they all fit in the constraints of the term “leaf”. However, creative computing is following closely.

Generative algorithms are saturated with the language of complexity theory, because “[...] it is integral to current understandings of the generation of pattern and structure in inorganic, organic and cultural dynamic systems.” [15] So, generative art can be seen as an effort to imitate nature, not just its form but its logic. This is very fitting to the long history of traditional ornamental culture. Upon a closer look, for example, ornaments in religious buildings always got inspiration from nature. So, traditional ornamental complexity was often derived from mimicking plants or natural geometrical patterns. Complexity was also obtained from exceptional craftsmanship and layered work. The human as a natural “generator” can produce complexity and endless answers for a single question, based on layers of personal skill, experience, physical constraints, luck.

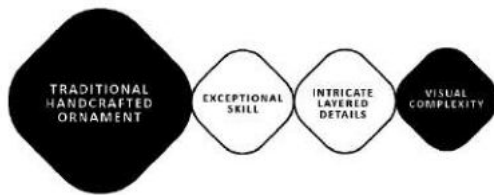


Figure 3. Complexity in traditional handcrafted ornament

Complexity was put aside by utility-driven ideologies, as an unwanted feature. But it is not only a by-product of referencing nature; it can be a desirable aesthetic despite the various intellectual and artistic movements that supported a strict functional minimalism. There are a lot of references explaining how the right kind of complexity is more appealing to people than no complexity. Moreover, a lot of observant conclusions could be exported from the popularity of architectural masterpieces with complex geometries such as the Taj Mahal or St. Vitus Cathedral in Prague.

“Many studies have observed a relationship between visual complexity and affect (pleasantness). This relationship has been observed dating back to the early 1970s¹ and this idea has re-emerged more recently². Importantly, these studies suggest that more complex pictures are perceived as more pleasant than less complex pic-

¹ Examples of references from the original paper: Kaplan et al., 1972; Aitken, 1974; Aitken and Hutt, 1974

² Examples of references from the original paper: Stamps, 2002; Marin and Leder, 2013, 2016; Schlochtermeier et al., 2013; Machado et al., 2015; Marin et al., 2016

tures, a hypothesis supported by earlier work where pleasantness and physiological arousal have been found to be higher for more complex abstract shapes³. At particularly high levels of complexity, pleasantness decreases, however, following an inverted-U shaped function⁴.” [16]

Generative design can be a continuator of intricate traditional ornamentation, filling the gaps that decades of minimal aesthetics left in the cities and objects of daily or ritualistic use.

In essence, generative systems in digital art provide new visual syntax for the communal experience, as “a natural extension of intellectual development that can be expressed in terms of our knowledge of notations.” [17] They are alike traditional craftsmanship in more ways; in the book “the Language of Ornament”, James Trilling [18] states that “ornament comes from ornament”. Historically, styles and ornament were catalogued, and these were used as the basis for generating most other new ornamented works. [19] Generative systems are also consuming cultural knowledge about, for example, Islamic or Chladni patterns and they are building on them. Throughout the process, the artist’s involvement is important and he is not outsourcing his intuition to a mechanistic process:

“ [...] (generative structures’) power will be realized through the complementary role of personal sensibility [...] Explorations of generative structure obtain power from hand, eye, and tools. They arise from personal knowledge, practice, and commitment of the sort found in traditional handcrafts, now applied to symbolic systems.” Malcolm McCullough [20]

Complexity and Play

Coming back to the concept of play, we can close the mental circle by establishing the relationship of complexity and play. Play in natural and social systems is basically an essential generative factor in creating complexity in nature.

“Evolutionary Biologist Brian Goodwin has introduced the role of play as an essential component of the “generative field” constituting complex adaptive systems. Complex patterns of behavior or play in animals, is compared with goal-directed behavior, which tends to have strong elements of repetition that give it a somewhat stereotyped, even mechanical, quality, play is extraordinarily fluid” [21]

In nature play accounts for generating unpredictability or complexity, and so it does in the formation of traditional handcrafted ornaments or digital dynamic ornaments.

“Play, or play-like behavior, is like a high-temperature or excited state, in which participants have reached a condition of highly unconstrained movement, a state like chaos. As they cool down again, order reemerges from this chaotic condition... One consequence of this repeti-

³ Examples of references from the original paper: Berlyne et al., 1963, 1968; Vitz, 1964; Day, 1967

⁴ In the paper this is referenced as “Wundt curve,” Berlyne, 1970

tion is that out of the high symmetry of play, new patterns of order can emerge as the symmetries break again” Brian Goodwin. [22]

Conclusions

The notions of play in culture, handcraft and generative design expand to characterize digital practices on the whole.

“As all of us learn about this promising new domain, a chain of developments should be clear: play shapes learning; learning shapes the mind; mental structures shape software; and software data structures afford work and play.” Malcolm McCullough [23]

The idea together with the computational capacities can elevate the symbolic power of ornament in different dimensions; because now movement, sound or light can be “crafted” allowing for more intense manifestation of cultural experiences. Dynamic interactive ornamentation is taking the concept of creation-through-playing on a different level; now the receiver of the ornamentation is also a contributor. Vocal expression and dance were in the past natural ways for an audience to respond creatively in a cultural happening, but now the possibilities of interaction are endless.

This project is aspiring to contribute to the transmutation and resurgence of ornamentation in terms of workflow and associated values. The idea behind this study is to identify digital arts as a continuation of the cultural heritage of the past, and, in part, connect it to the architectural ornament. Ornamentation, an essential actuator in communal experiences, has now been redeemed of the accusations of the past and it is coming back augmented in a new digital reality. Generative design, digital notations, experimentation and complexity build on the tradition of the mimesis of natural inherent rules, iterations, symbols, intuition and play. The difference is that while not everyone could build the occasional cathedral, now anyone with a computer can start his way to altering virtual or even physical landscapes.

“Poiisis is in fact a play-function. It proceeds within the playground of the mind, in a world of its own, which the mind creates for it.” Johann Huizinga [24]

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Author Biography

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***eCO₂system*: exploring the environmental and social impact of the internet's materiality through a data-driven media art installation**

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Abstract

The internet's materiality often lacks attention in recent controversies surrounding the environmental footprint of physical versus online activity. The operation of the internet presupposes a physical infrastructure that consumes natural resources and generates pollution. The obfuscation of the materiality of the internet conceals power asymmetries produced by the uneven access to the control of the internet's material infrastructure.

This paper investigates the social and environmental impact of the internet's materiality through the data-driven, media art installation *eCO₂system*. The installation consists of an aquarium which is connected to the Internet of Things and contains a small-scale ecosystem of fish. The technologically augmented aquarium retrieves data from a social media platform and detects digital activity promoting climate change awareness. The living conditions of the ecosystem deteriorate according to the number of awareness-promoting posts, highlighting the divergence between digital actions and physical consequences.

A complex network of more-than-human agents is articulated around the aquarium, including things, animals, humans, technologies, cultural structures, and other material and immaterial entities. The dynamics of this network impel us to rethink technology as part of a symbiotic whole of heterogeneous agents and to adopt less technocratic and more ethic criteria to redesign, reprogram, (re)use and recycle technologies.

Keywords

internet's materiality, Internet of Things (IoT), media art installation, data-driven, social media platforms, climate change, ecosystem, more-than-human networks, opensource, DIY.

Introduction

The internet's materiality refers to the physical infrastructure required for the operation of the internet. This infrastructure is often overlooked by internet users who tend to

conceive the internet as a totally immaterial entity. The obfuscation of the internet's materiality obscures the social and environmental impact of the internet's operation and the asymmetric political relationships produced by the uneven access to the internet's material infrastructure.

The digital medium is largely perceived as immaterial [1, 2], namely as a "mere collection of 1s and 0s" in the void of immateriality. [2] However, this collection of digital bits cannot exist independently from the physical infrastructure (the physical memory of a material device) where it resides. Software cannot exist without a hardware which stores and executes it [3], or as Friedrich Kittler states: "There is no software." [4] Meanwhile, during the last decade, the number of objects connected to the Internet of Things (IoT) has exceeded the number of people on earth [5, 6]. Despite of a gradual "shift in the way engineers talk about the Internet" focusing on the physical aspect of interconnected devices [7], the internet is still largely conceived as immaterial.

Material infrastructures are systematically overlooked in order to obfuscate power relationships, hide them from perception and prevent potential will for change. The immaterial metaphors used to describe the internet -such as the terms Cloud and cyberspace- are deliberately misleading [3, 7, 8]. The Cloud is nothing more than "buildings with servers in them" [7]. This deliberate disorientation conceals the fact that infrastructures of power are material things [7] owned and controlled by human beings. By hiding the internet's physical infrastructure from view and access, users are excluded from open and wide participation to the control of such infrastructure. Additionally, the occultation of the internet's materiality contributes to the concealment of the vulnerability of data networks, which depend on material components -often precarious and exposed to extreme natural conditions-, such as the underwater internet cables. [7] This way, the seamless functioning of the internet, that users take for granted, can be limited or suspended due to physical disasters or due to deliberate actions by the authorities managing these components.

Additionally to the previously described social and political implications related to the control of the internet's

physical infrastructure, the operation of this computational equipment has a significant environmental footprint. Servers and other networked devices depend on fossil fuel power and their operation generate large quantities of CO₂ emissions. Indicatively, a cryptocurrency mining network was estimated to consume the same amount of electricity as an entire country of the size of Ireland. [9, 10] Especially social media platforms are among the most visited sites [11] significantly contributing to air pollution.

Apart from the operation of the internet's infrastructure, the processes of manufacturing, as well as the disposal of the devices that constitute this infrastructure further imperil the current precarious ecological balance. The manufacturing of electronic devices depends on the extraction of non-renewable natural resources, and unsustainable practices of transformation and distribution of the extracted minerals. [8] Moreover, the discarded parts of the infrastructure contribute to the accumulation of toxic electronic waste. The corporate strategy of planned obsolescence accelerates the substitution of electronic equipment even before it becomes dysfunctional, further increasing the production of e-waste. [12] Indicatively, approximately 250 million functioning devices are discarded each year in the United States. [12]

All phases of the lifecycle of internet's infrastructure and IoT devices -from birth to death- accelerate environmental deterioration, due to exhaustive and highly polluting mining processes, depletion of non-renewable reserves, extensive fossil fuel power consumption, vast emissions of air pollutants, and uncontrollable disposition of toxic electronic waste in dumps. The natural environment "bears the weight of media culture", from the manufacturing to the disposal of electronic material equipment. [13]

Related Works

Media artists address the aforementioned issues related to the social and environmental impact of the internet's materiality. Trevor Paglen, in his project *Deep Web Dive* (2016), photographs NSA-tapped undersea internet cables, while deep diving in the Atlantic Ocean. [14, 15] The photographs reveal the material infrastructure of the internet and the mechanisms of mass surveillance exercised on users' data travelling through the undersea cables. Paglen's work draws attention on the precarious nature of the internet and the limited access users have to the control of the internet's infrastructure which is owned by economic and political elites.

Inspired by *Deep Web Dive*, César Escudero Andaluz presents a dystopic future scenario, according to which the authorities that control the internet's infrastructure deprive users of internet access completely. In this scenario, he proposes the destruction of the internet's physical infrastructure and designs a device to achieve it. His artistic project *Free Universal Cut Kit for Internet Dissidence*

[*FUCK-ID*] (2017) consists of an autonomous device able to cut undersea internet cables. The digital files required to 3D print the device are available for free downloading through the artist's website. [16]

Joana Moll investigates the air pollution generated by the operation of internet servers. Her work *CO2GLE* (2014) is a net-based installation that displays in real-time the amount of CO₂ emissions per second generated due to the global visits to Coogole's search engine. [17] In her subsequent net-based piece *DEFOOOOOOOOOOOOOOOOOOOOOOOOOOREST* (2016), Moll visualizes the number of trees needed to absorb Coogole's CO₂ emissions, by dynamically depicting an equivalent number of tree icons on a website. [18] The artist conducts further research on the energy cost of online services and the free labor assumed by the internet's users, in her project *The Hidden Life of an Amazon User* (2019). The project aims to shedding light on business strategies adopted by companies, such as Amazon, which include "endless pages of indecipherable code, [...] activated by user labor". [19] According to the artist, "these strategies have a significant energy cost, part of which is involuntarily assumed by the user." [19]

Kate Crawford and Vladan Joler investigate the entire lifecycle of an AI device connected to the Internet of Things. In their project *Anatomy of an AI System* (2018), they create a map of the human labor, data and planetary resources consumed for the manufacturing, operation and disposal of the IoT device Amazon Echo. [20] This complex map reveals an extensive and dense network of interconnected entities including human agents, minerals, corporations, digital technologies, data, and other more-than-human entities.

The *Social Things* Trilogy and the *eCO₂system* Artwork

The artworks previously discussed explore the materiality of the internet infrastructure and of IoT devices, focusing on various issues related to the environmental footprint of their manufacturing, operation and disposal, as well as the hidden power relations related to the ownership and control of these devices and infrastructure.

eCO₂system (2019-2020) is an artwork that increases the visibility of the environmental impact of the internet's operation by directing its effects towards a real small-scale ecosystem of living organisms. More concretely, the *eCO₂system* installation consists of an aquarium containing a micro-scale ecosystem of fish (Figure 1). Parameters of the ecosystem change dynamically according to real-time data retrieved from the social media platform Twitter. Tweets tagged with the hashtag #stopClimateChange deteriorate the conditions of the ecosystem, by gradually decreasing the amount of water inside the aquarium. The artist's intention is to highlight the divergence between digital activity and its impact on the physical world.

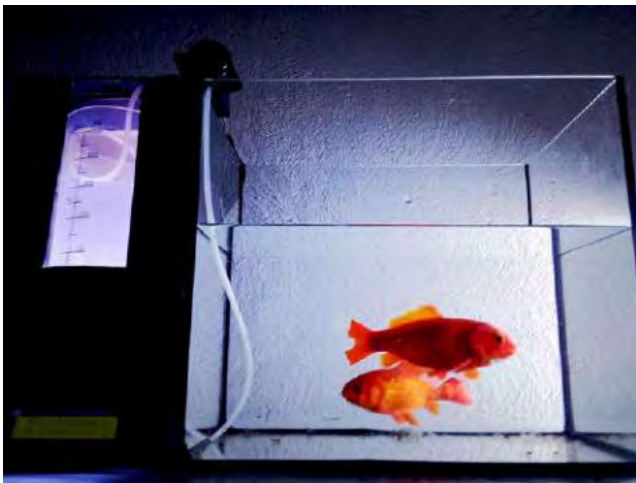


Figure 1. The *eCO₂system* installation

eCO₂system is one of the three artworks of the *Social Things* trilogy. The trilogy consists of the media art installations: *inflated_ego*, *#freePrometheus* and *eCO₂system*. The three artworks critically reflect on the technological mediation of everyday life and highlight asymmetries of power and pathological behaviors related to the extensive use of social media. Each installation consists of a technologically augmented common object, connected to the IoT. The augmented objects dynamically change parameters of their functionality and appearance according to real-time data retrieved from wide-used social media platforms, such as Facebook and Twitter. The installation *inflated_ego* consists of an augmented balloon and addresses the narcissism of social media users and the rift between their digital and physical identities. The installation *#freePrometheus* consists of an augmented lamp and reflects on dataveillance by authorities and the phenomenon of digital listening. [21] Finally, the artwork *eCO₂system* consists of an augmented aquarium and reflects on the environmental impact of the materiality of the internet and the physical consequences of digital actions.

The creator of the *eCO₂system* used opensource software and hardware to technologically augment the aquarium. Through the embedded technologies the object acquired capabilities of sensing, actuating, data-processing and decision-making, as well as internet connectivity. The artist created a custom DIY electronic circuit, containing a peristaltic pump, a liquid level sensor, and an LCD screen. An Arduino microcontroller was used for triggering the peristaltic pump, receiving the input data from the liquid level sensor and controlling the LCD screen. The artist built the custom software with the Processing programming language and used the *simpletweet* and the *Arduino* libraries. The software runs on a Raspberry Pi 3+ board which is connected to the internet (Figure 2).

Through the embedded software the augmented aquarium establishes a connection to Twitter's API in order to

retrieve data from the social media platform. The connection requires user authentication according to the open-standard authorization protocol OAuth (Open Authentication). As soon as the connection is established, the algorithm starts querying the API periodically in order to detect new tweets tagged with the hashtag *#stopClimateChange*. Whenever a new tweet is posted, the software sends the information to the microcontroller. The microcontroller activates the peristaltic pump for a few seconds, which pumps a small amount of water from the aquarium to an auxiliary vessel. The LCD screen displays the username of the social media user that posted the most recent tweet.

The data received from the liquid level sensor guarantee that the volume of water will not decrease under a certain minimum level to ensure that the ecosystem will not be put in danger. If the liquid level sensor indicates low water level inside the aquarium the pumping process stops immediately, until the aquarium is refilled with water.

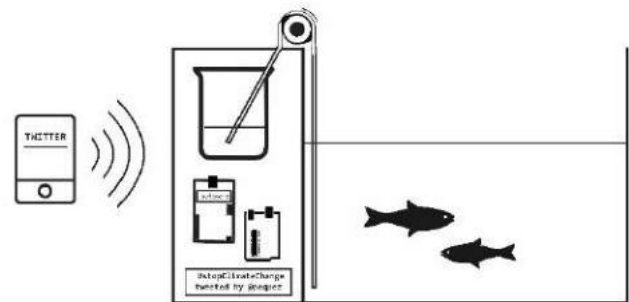


Figure 2. Schematic diagram of the *eCO₂system* installation

Thoughts and Reflections

The work *eCO₂system* increases the visibility of processes that usually remain invisible or hidden. Digital entities (tweets) acquire a physical dimension and are mapped to material entities (water) with physical qualities (volume). The consequences of digital activity have an immediate impact on a small-scale ecosystem, in real-time, before the eyes of the viewers, and thus they become easily observable and perceptible.

The unexpected and semi-automatic functionality of a familiar object (aquarium) draws attention to a dense network of interconnected entities that interact and produce this complex action. This network includes human entities (social media users, the artist, the audience, etc.), heterogeneous technologies (platforms, protocols, sensors, actuators, microcontrollers, servers, routers, and more), corporations (Twitter), laws and regulations (policy agreement to access Twitter's API, etc.), other cultural immaterial structures (language, ideologies, etc.), non-human living organisms (fish), physical objects (aquarium, vessel), other material entities (water) and more. A deeper analysis of each node of the network reveals further connections and inter-

Learning non-human. Can participatory practices change an institution?

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Abstract

This paper shares learning from an artwork ‘Learning Nonhuman’ produced by a learning team working at FACT an art institution/production centre in Liverpool. [1] Artist Jack Tan worked with an intergenerational group of participants to develop a game that allows people to roleplay as nonhumans and propose policy changes on their behalf. The game was then played by FACT staff members, to inform the writing of a new environmental policy. In this paper, we are presenting our reflections on institutional learning coming from applying arts based learning experiences to the art organisation’s culture.

Keywords

Epistemological Pluralism, Pedagogy as Artistic Practice, Art and Design production centres, Cultivating the Possible.

Introduction

The learning project and artwork ‘Learning Nonhuman’ emerged through the design and application of an online game.

The game allowed people to play as nonhumans and to identify conflicts or issues that nonhumans experience and then to propose legal or policy changes. Within the framework of this project, we understood nonhumans as beings that we might share spaces with in our everyday lives, such as plants, insects, animals, birds and natural features, such as hills or streams. As Donna Haraway would say, our kin. [3] *“Those who have an enduring mutual, obligatory, non-optional, you-can’t just cast that away when it gets inconvenient, enduring relatedness that carries consequences.”*

Over 12 weeks, the Artist worked collaboratively with an intergenerational group of participants and the arts organisation’s learning team to create a prototype game. The game was tested by participants and also within the organisation as a governance tool for environmental planning and decision making.

The participants were a group of 3 adults over 60 and 3 young people between 11 and 14 yrs. During four months, they worked together with the artist, a game developer and had sessions with a trustee of a local residents committee and an Animal Computer Interaction Researcher. They worked together for a total of 12 sessions.

Thinking non-human

In his work, Jack Tan uses social relations and cultural norms as artistic material. They create performances, sculpture, video and participatory projects that highlight the rules — customs, rituals, habits and theories — that guide human behaviour. Tan was commissioned to produce this artwork in response to FACT’s ongoing annual theme, ‘The Living Planet’ a programme of exhibitions, artworks

and events presented online and in real life that explored our relationship with the natural world.

The Artist proposed a project to participants that promoted empathy with nonhumans and experimented with artistic ways to bring their voices and experiences into human policy and planning discussions. [2].

Their objective was to shift power and representation in decision making processes. They aimed to challenge the assumption that human beings are supposed to make all the decisions, based only on their particular experience. *“All I can do is to try and understand where I as a human end and where my fuzzy edges touch and intermingle with where the more-than-human begins.”* [5]

For this paper, we would like to focus on what FACT learned from this art commission.

Designing nonhumans of Liverpool

For three months during 2020, the group used different digital tools to transform a collaborative creative writing practice into an interactive gamified experience. Players that access this “game” would be rewarded for writing from the point of view of a non-human in their home city. The participants also designed a reward system based on how appealing the story was to convince humans to change human law or policy on their behalf.

This stage of the project culminated in participants playing a test version of the game. Their family and friends played as different nonhuman ‘folks’ (e.g. insects, plants, or birds). To win points, players left written ‘incident report markers’ detailing imagined injustices against nonhumans in locations on a digital map of the city. The grand finale of the game was played as a LARP (Live Action Roleplay) set in a fictional near-distant future in which Liverpool City Council recognised the rights of nonhumans as citizens. Participants performed as nonhumans in a meeting with the Liverpool City Council Committee for Nonhuman Relations. The committee was played by a senior manager, the CEO and a board member of FACT. Participants represented each folk’s cases in an attempt to convince the committee to make changes to council policy. The committee awarded the players points depending on how evocative their case was.

At that point, we thought that the next stage of the game would be for audiences across the city to play it and to invite actual Liverpool city councillors to play the role of judges in the live finale.

A taste of our own medicine

Was asking a few City Council representatives to be judges in a game tournament the best opportunity to test a decision-making model?

Was opening out an (early stage prototype) game to potentially 1000's of players to discuss environmental issues across the entire city the best focus for a second test?

This project was based on the Artist's parameters of "what if...?" What if we could see, hear, smell, touch, see and speak as nonhumans? What if we could find a way for that to impact how we think about the world around us? What if instead of predefining every outcome of the art project, we decided to cultivate the possible?

We decided then, to follow the learning [1], and take it to the most impactful place we could; we were going to apply the same process to our institution.

Like most other arts organisations in the country, ours was about to start writing a new environmental policy. It was in a conversation about policies and governance with the Artist, when we decided to approach our Senior Management. The Artist suggested "using the game" to start conversations about sustainability; and to turn the learning journey toward ourselves and explore how this might have an impact on our policies.

We invited colleagues to test a version of the game. They role played as nonhumans in and around FACT, writing incident reports addressed to the people responsible for new Environmental Policy. The reports described imagined injustices caused by FACT (from a non-human point of view) and made suggestions for changes to the new environmental policy.

The game was played over a week and culminated in a virtual town hall event online. The members of the staff writing the environmental policy performed as themselves in the role of judges, asking questions and awarding points. At the beginning of the event, the judges were introduced to the non-human players. It was explained that they were there to listen to and learn from non-human voices, to inform policy writing. Playing the game raised environmental issues in ways that we had never imagined before, including: pigeons in fear of becoming roadkill, trees complaining of being cleared to make space for public art and the water in pipes worried that they might leak away.

According to the Artist, the learning team and the senior manager who had performed as a judge at the virtual town hall, the main outcomes of playing the game had been:

1. how listening to colleagues speaking as nonhumans had helped them to look at the policy from lots of different angles.
2. how the institution could embed the practice of using role play to advocate for nonhumans in policy meetings.
3. how the organisation can represent its ongoing learning around environmental sustainability.

The Artist decided to present this process as the artwork: *"Rather than present just the participants' learning, I wanted the presentation to highlight the institution's learning of environmental and non-human issues itself as the artwork."*

Curatorially, the Artist thought representing the learning process in a conventionally 'finished' artwork would misrepresent the open ended, dialogical nature of the practice we had explored. *"For our project, I realised that learning about the nonhumans couldn't be confined to a time-limited project because learning and refining our relationship to nonhumans and to the environment has to be central if we are at all interested in understanding the*

climate crisis." [5] He worked with us to curate a selection of documentation, game prototypes and reflective writing to present as a digital assemblage on our institutional website.

The Duty of Care. What did this project bring to our practice?

For the past few years, we have been trying to articulate our experience of bringing participants into the production of artworks that are shared as part of our Artistic Programme.

The Duty of Care is a shared approach towards understanding our mutual responsibility to produce the best artwork, while providing the best learning experience for participants.

1. It sets the basic working principles. These principles evolve from different projects: it is influenced by educators and thinkers, but mainly from our learning from the artists' practices and ways of working with participants:

- Participants are experts that share their unique voice and experience.
- The role of the artist is to convey different strands of that knowledge and lead on the artistic vision.
- Participants are made aware of how and when the artwork is going to be criticised by values associated with aesthetic art experiences.

2. It builds on FACT's Safeguarding Policy. In our experience, safeguarding procedures, participant recruitment and workshop facilitation go hand by hand in a participatory project:

- Guidelines for both artists and stakeholders that explain expectations and responsibilities throughout collaborations.
- Risk assessments that respond to different social dynamics, technologies and spaces.

3. It helps to articulate FACT's Learning programme and the importance of the ethical responsibility in the curatorial work with artists. We invite artists to make an artwork which makes the journey of everyone involved evident to the viewer, without the need to watch yet another "documentation video".

4. It creates a space to advocate for the interest of the artist & participants, within the institution. As we work more closely with other teams, we learn how to bring curatorial thinking to learning activities. In the process, our colleagues become more sensitive to the nuance that participants and artists bring to learning projects.

We repeat the same assertions that generations of people in our shoes have made about what it takes to create high quality arts-based learning experiences; the time, quality and effort needed to make it happen, the care needed to represent the artwork in the same curatorial space as others in the program, without flattening the layers.

This curatorial dialogue has an impact on the overall artistic programme. Most of the projects we produce as part of the Learning Programme are presented in the gallery space or virtually on our website.

5. It is a space for reflection. The Duty of Care is developed from inside the practice while we are producing the learning program. We collaborate with external curators and researchers to help us reflect on what we do. This happens through a combination of informal chats, formal discussions and by writing documents together.

The most unexpected (for us, at least) conclusions from our Duty of Care has been that our work is as much about supporting institutional learning as it is about exploring participatory art practices. This project took this responsibility a little further. Is it possible for the institution to learn from the knowledge that artists and participants produce together?

When participatory art practice changes the institution

From conversations with the Artist, we realised how much this commission had brought the learning programme and team's practice to the centre of the artistic programme. Not by advocating for the representation of participants or by "fighting" for learning to have a place in the artistic programme. It did so by bringing the approach developed by the Artist and participants to the organisation's governance.

The work in the Learning programme was now in the spine of the institution, where power lies, where policies are written and applied. The participatory artistic practice designed a way to bring the different structural levels of the organisation together.

As the Artist explained: *"It's about how you create body memory in an institution. How an organisation embeds 'lifelong learning' is through its structure and policy. If the learning team leaves for example, and none of your knowledge is in the DNA of the organisation, it all disappears. The whole organisation has to be a learning, listening organisation and has body memory. I think that's the museum of the future."*

Learning team art commissions are easily absorbed by the art organisations when the outcome is curated as an art object and presented in exhibitions. In this project, the outcome is the whole process of producing knowledge. Because of this shift, our colleagues had the experience of testing the learning process and not just the final object.

On this occasion, our colleagues turned into participants themselves, they had a meaningful experience playing the game.

This is our Marketing Manager talking about their experience playing the game: *"Playing the game really made me think about the wider impact that our organisation has in the city. Thinking beyond our human audiences and focusing on the ecosystem in which we exist, the game pushes you to consider your personal and professional actions, whilst enabling important conversations through the powerful action of play."*

This is a huge flip in perspective towards learning in an arts organisation - not just benevolent giving to 'the community' but really finding out what we can learn from what the artist & participants create.

As the artist puts it: *"How do you design a museum as an organism that is constantly in conversation with its communities and its environment and remembers it? One of the key ways is to make boundaries between gallery and education, artwork and policy, contracts and creativity, board and staff, etc., more porous and to put this approach into policy and to practise that policy."*

What's left

This project shows how participatory art approaches and knowledge produced with participants can be replicated in

other contexts, including institutional decision making. Not every project has to work at this level, but it proves the potential for art to shift arts organisations and the system from within.

The potential long-term learning of institutions lies in its approaches, policies, procedures and governance. The Artist helped us to reflect on our role as a team in the organisation and on a practical level, they have worked with us to redesign our Artist contracts to better reflect our vision, objectives and ethics.

Since last April 2021, Jack Tan is the first artist to have a residency on the FACT Board of trustees. Throughout a year-long residency he will develop the work he started in this project, exploring themes of institutional trust and transparency.

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Complex acquisitions: understanding the infrastructural properties of born-digital objects in museum collections

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Abstract

Whilst born-digital collections continue to be developed in several museums internationally, this paper contributes to debates as to how we conceptualise born-digital objects. Many complex artifacts of digital culture, in fact, elude the behavior of traditional collected objects. Here, we concentrate on three examples to illustrate different degrees to which born-digital museum acquisitions can be understood as infrastructures. By examining an immersive reality piece, a procedurally generated film, and a digital platform, this paper addresses hybridity, fluid relationships across the main and auxiliary parts of an acquisition, and the lack of clear boundaries to define what the collected object is. It concludes that developing deeper understandings of the infrastructural properties of born-digital museum acquisitions could support changes in institutional practice and thinking to better accommodate this emergent area of collecting.

Keywords

Born-digital collections; digital design; infrastructure; digital preservation; platforms; contemporary collecting.

Introduction

Our cultural and creative production is increasingly digital, based on digital tools, distributed through digital channels and frequently engages critically with the impact of digital technologies on society. For a few decades now, archive and museum professionals have explored and developed means to preserve digital files [1][2], digital time-based media, digital art, videogames, and architectural design records [3][4][5]. Some museums are also collecting complex born-digital objects such as immersive reality works, mobile applications, and social media [6][7]. Scholars and professionals are increasingly becoming aware of the challenges of collecting and preserving digital culture, some of which are associated with the way born-digital objects elude the traditional, self-contained objecthood typical of museum objects [8]. The field of videogame preservation, for instance, has shown how collecting institutions face the question of defining the boundaries of artifacts which come to life in online environments, incorporating user-generated content, and encompassing a range of components from source code, to hardware and controllers, from patches to packaging and marketing materials [9]. The documentation of user or visitor interactions also has an increasingly important role alongside the preservation of digital art [10][11][12], and it is already a typical feature of videogame heritage, where walkthroughs and gameplay videos constitute an invaluable testimony of games of the past [13]. The scholarship has also considered the significance of born-digital records of the creative process in the fields of architecture [14] and videogame production [15], especially valuable for pedagogic and research purposes.

This paper explores three case studies to emphasise how complex born-digital objects rely on multiple infrastructures

and present infrastructural properties which have an impact on the way they are accommodated within the collection. This concept refers to understandings of the digital infrastructure ‘as the computing and networking resources that allow multiple stakeholders to orchestrate their service and content needs’ [16]. Complex born-digital objects in fact, are frequently characterised by an expansion of their socio-technical and structural ecosystem, so that the organising logic of the museum acquisition reflects the layered architecture of digital technology.

This understanding will help to emphasise both the recurrence of multipart acquisitions and the way born-digital-objects are embedded in multiple infrastructures (comprising the internet, open standards, servers, datacentres and hardware devices). The concept of infrastructurality is proposed within the specific context of museum collections, to support curators and conservators in addressing the process of decontextualisation and recontextualisation of the object from its original online environment to the museum’s own infrastructure. More specifically, the three examples address the co-presence of physical and digital components (hybridity); the flexible relationships across main and collateral components, such as materials illustrating the making process; and the boundless, irreducible dimension of digital platforms.

The case studies

Our methodology is based on the investigation of three different types of born-digital objects two of which, at the time of writing, are in the process of being acquired by two UK-based institutions, whilst the third one is a speculative example. The analysis is based on conversations between the authors and the curators responsible for these acquisitions, combined with insights from a range of experts (curators, conservators, designers, museum professionals, archivists) invited to take part to three workshops looking at these objects under the perspective of collection management, preservation and access [17]. The interviews with the curators and the workshops focused on understanding challenges and examined the ways in which these acquisitions push institutional boundaries.

The first case study, *In the Eyes of the Animals* (henceforth *IEOTA*), is a virtual reality piece by Marshmallow Laser Feast (MLF), launched in 2015 and now part of a pilot acquisition scheme at the British Film Institute. The work enables users to experience a forest from the perspective of three animals (dragonfly, frog and owl), and is rendered by computer generated graphics based on footage captured with laser scan and 360 drone cameras. The work has been presented in different versions for different settings, outdoor and indoor, and the institution is exploring the acquisition of digital files comprehensively covering all these different iterations. MLF has also crafted bespoke ‘mossy’ headsets and vibrating backpacks synchronised with the sound design, to deliver an especially immersive and haptic experience. These have been used in some but not all of the versions.

The second object is *geist.xyz*, a procedurally generated digital film by design collective ZEITGUISSED. The Victoria and Albert Museum (V&A) has recently completed the acquisition of the film and a set of digital materials illustrating the creative process behind the piece, including a dedicated microsite; research & development clips in .mov, .gif and .png formats from the studio archive that depict the process through which procedural animation is made; the ‘Parametric Animated’ patterns pre-rendered, in .mov and .gif form; work in progress 3D data, which includes a series of alembics and .obj files of the virtual textiles represented in the film; and the soundtrack.

The third object is Instagram, which was identified by the research team as a speculative case study to explore the challenges an art and design museum would face in collecting the platform as a piece of interaction design. This meant addressing the social media not just as an aggregator of user-generated content and testimonies of the present, but more holistically including its architecture, modules and interactions.

Hybridity

Like many born-digital objects, IEOTA presents both entirely digital components (such as executable files, source code, software packages) and physical ones: in this case, the headset and backpack, that, with their own unique design differ from replaceable playback equipment. In the context of this short paper, we want to concentrate on one of the many challenges to collect and preserve this work, which pertains specifically to our proposed understanding of the object. This concerns the barriers to acquiring the hardware components alongside the digital ones, due to a combination of policy constraints and lack of resources in the institution (BFI). In fact, the BFI National Archive Collection Policy (2011) formally concentrates on the acquisition of moving image artefacts only, leaving out physical objects. As a consequence, the institution lacks suitable storage space, financial and staffing resources (such as skilled conservators) to effectively care for the hardware. The barriers to collecting the hardware threaten the integrity of the piece as they put this particular version and user experience at a higher risk of being lost. In fact, the particular version, and user-experience associated with using headset and pack is at a higher risk of loss. Additionally, the presence of multiple versions shows how the infrastructural dimension of IEOTA goes beyond hybridity, and poses the question of which version(s) should be prioritised or considered more suitable for preservation. Further, it challenges the BFI National Archive preservation strategy which is based on the application of standard procedures to a variety of analog and digital film formats. The novelty of interactive virtual reality technologies and the complexity of an acquisition comprising multiple versions and a considerable bundle of files, by contrast, demand the development of specific workflows, monitoring and preservation solutions.

Within its experimental framework, aimed at understanding needs and requirements for a type of object which has never been collected by the institution before, the BFI is not prepared to commit to its preservation in the fullest sense. Instead, IEOTA is becoming part of the BFI National Archive but not formally accessioned to the collection. This enables the institution to work outside normal policy constraints and concentrate on the bit storage of the digital files. Although this approach does not guarantee future public accessibility, it constitutes an initial step towards exploring more comprehensive preservation strategies, and might enable future conservators to bring the piece back to life, once it has become obsolete.

Process

When collecting the present, and especially the digital present, there is a limited window of time where a wealth of materials is available before they become unavailable. Born-digital records of the creative process, for instance, are subject to individual or industry-wise archival approaches that can be inconsistent, non-standardised, and rarely conceived as a step towards long-term preservation, but rather as a back-up strategy directed at ensuring short-term interventions on the project. Some museums, including the V&A, have a tradition of keeping evidence of the process, especially for research purposes and to inspire further creative work. At the V&A, in particular, there is an established practice of acquiring process-related items associated with design and architectural objects, and to keep them separately from the main object, in a collection called Designs.

The experimental attitude of ZEITGUISSED’s aesthetic practice, directed at pushing the boundaries of the technologies used for their creations (especially 3D software suites such as Cinema4D and Marvellous Designer), leads to a different understanding of the process material, which they describe in an interview as ‘smaller fragments of finished work’ [18]. In fact, *geist.xyz* depicts a range of inorganic textiles, floating in a space which subverts the rules of gravity and shows ZEITGUISSED’s mastery of digital software. The process-related items are part of an ecosystem of digital experiments in textiles that exist in a space of fantasy and speculation but that could potentially become real.



Figure 1 ZEITGUISSED, *geist.xyz* (2016). ©ZEITGUISSED and Victoria & Albert Museum

By recognising these materials as networked but independent items with their own inherent value, the curatorial section opted for an approach to managing the acquisition which breaks with the museum’s traditional separation between core and auxiliary objects. In fact, film and process materials are in this case kept together with no particular hierarchies established across the institution’s information system. This also reflects an awareness that the preservation strategy for *geist.xyz* will consider the same understanding of the acquisition as a complex ecology of parts.

The autonomy of the process is reflected by the way these items depend on their own production tools to remain accessible. Differently from the film, which presents itself as a standard output suitable for most players, the 3D data files in alembics format can only be accessed through the proprietary systems used to create them. Open-source alternatives are under investigation, but they are unlikely to represent the work as the author intended, because they will use different software libraries which will alter the original custom set-up used by the designers.

Boundlessness

Digital platforms [19][20] are distributed, shared, manifested through performances which are unique to each user, programmable with multiple features, evolving from one version to the other, and embedded into an extensive infrastructure of digital and physical systems. Social media platforms have been examined by digital preservationists and

museum professionals as a source of important testimonies of the present, and hence used as tools to gather resources for future historians [21][22]. However, no institution has yet embarked on the enterprise of collecting social media or other kinds of platforms (streaming services, e-commerce, search engines...) holistically as objects of interaction design with their own architecture, modules and interactions. The research team and the workshop participants identified a number of challenges to collecting Instagram, including its cloud-based (not downloadable) nature, the privacy and proprietary systems hiding its networked interactions, privacy and broadly legal issues associated with the presence of user generated content and specific terms of use.

Further, platforms like Instagram embody more strikingly than other objects the interstructurality that we are discussing in this paper. Asked to attempt to identify what a comprehensive acquisition of Instagram would entail, the participants' list included: the mobile app files for different operating systems and for different versions of the platform across time, the interface design, the source code, relevant databases, dedicated hardware, contextual items such as interviews, documentation of user-experience, social history content, curated captures of exemplary interactions and so forth. Participants felt that the decision-making process to identify priorities across such a heterogeneous set of items could be daunting, and that it might be determined by a combination of curatorial intention, institutional mission and scope, and pragmatic choices (what is desirable? what is effectively available?). Consequently, in the case of Instagram, the identification of what is the core object and what is collateral proves difficult and ultimately meaningless, showing how new understandings of the object are needed to guide practical approaches to collection management such as acquiring, accessioning and distributing within the institution's asset management system.

Shifting practices: between sustainability and future-proofing

The three case studies illustrate how born-digital acquisitions behave as infrastructures, demanding for careful processes of decontextualisation from the networked systems where they are embedded, reconfiguration of the relationship across the multiple items composing the object, and recontextualisation within the museum's own infrastructure.

The hybridity of many born-digital objects means that part of the object might fall outside collection policies and that institutions are not fully prepared to deal with the different needs of digital and physical components. The example of *IEOTA* shows that institutions used to caring for discrete objects need to reconsider both policies and practices to accommodate the infrastructurality of born-digital objects and their emergent characteristics.

The case of *geist.xyz*, signals a change in institutional practice motivated by the specific rationale of ZEITGUISSED's experimental approach. This results in reconfiguring traditional hierarchies between main and auxiliary objects, which are reflected in the way items are distributed across the museum management system. Within the limits of this short paper, there is no space to delve into the connections across the procedural nature of this strand of

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digital artistic practice, the role of process, and the opportunities for collecting and safeguarding the making-process afforded by the circumstances of collecting contemporary objects. However, it is important to recognise that process and auxiliary items in general can acquire new relevance due to the uncertainties surrounding the long-term preservation of complex born-digital objects. Process and auxiliary items, in fact, can become integral to the public access and future understanding of the object.

Finally, the example of Instagram shows that for some objects there is no a-priori distinction between main and auxiliary items, and that the object can overlap with the infrastructure. The spillage of the collected object beyond its traditional boundaries and the presence of multiple items suitable for acquisition requires a thinking of collection management and preservation approaches. Further, it marks the existence of a potentially fruitful conflict between sustainability and futureproofing. On one side collecting multiple items can put a strain on an institution's limited resources; on the other side, the availability of a range of contextual and process-related materials, can ensure that curators and conservators will have more than one option in terms of preservation and display solution, and will be able to reconstruct or reinterpret the object, once obsolete, thanks to the rich documentation collected.

Conclusion

The aim of this paper was to broaden the ways through which to interrogate the notion of a collected object in the context of born-digital museum collections. This is informed by the idea of infrastructure, to respond both to the multiplicity of items that could be acquired, and the embeddedness of these objects into networked systems. Whilst we anticipate that this will help museums developing new approaches to care for these objects, we are conscious that more research is needed to refine this conceptualisation and examine its implications for institutional practice. What this paper does not do is also to problematise the notion of the infrastructure within the context of digital culture. For instance, there is a need to disentangle more thoroughly the infrastructurality of the collected object from the broader contemporary tendency to integrate services and social behaviours within digital infrastructures and platforms [23]. Nevertheless, the concrete examples discussed in this paper provide the first steps towards a reconceptualisation of born-digital objects that will benefit both scholarly reflection and professional practice.

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Online collaborative design with students for autobiographical VR stories about Covid-19

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Abstract

This research examines opportunities for using virtual reality (VR) as an autobiographical storytelling tool for students during the COVID-19 pandemic. Collaborating remotely with eight university undergraduate students in Canada, we created eight individual 3D nonfiction VR pieces that express the students' own pandemic experiences. Through a collaborative design process, our findings highlight how VR was used as a meaningful device for telling students' autobiographical stories about the COVID-19 pandemic: delivering the storyteller's own feelings, creating a sense of confinement and disconnection, showing environmental details, and expressing inner worlds.

Keywords

Autobiographical VR Storytelling, Virtual Reality, Immersive Journalism, VR nonfiction, Collaborative Design

Introduction and Background

Many artists and filmmakers have attempted to create VR works that provoke emotional engagement in nonfiction stories [1]. These attempts have predominantly focused on the notion of empathy; most exaggeratedly in the case of the empathy machine – a term first used by Chris Milk at the TED conference in 2015 [2]. Another example is an immersive journalism model created by Nonny de la Peña, which refers to news that is recreated virtually in 3D to allow viewers to experience events from the first-person perspective as though they are actually present [3].

Although many VR documentaries and immersive journalism pieces have been created to elicit empathy or identification with protagonists or people in real-world situations, it can be unclear whether the work actually delivered the protagonists' perspectives and emotions if the work is not created by or with the protagonists themselves. Although VR gives viewers the freedom to look around and interact with the environment [4], VR creators determine the position of virtual cameras and aspects of the environmental design or setup, which might reflect the creator's perspectives about the work more than it reflects the protagonists' actual perceptions of their lived experience.

Therefore, it is important for people to be able to use VR to create their own autobiographical stories and share their perspectives and experiences with others. However, there have been few attempts to create autobiographical VR stories, or those in which the creator relates their own lived experiences [5]. In this context, our research is to explore the democratization of VR storytelling and support storytellers of various skill levels in creating and representing their autobiographical stories in VR. We conducted a practice-based study to design autobiographical stories collaboratively with students who lack experience and skills in creating VR stories. We ran individual collaborative design [6] meetings with eight undergraduate students in Canada and created eight individual 3D-based VR short videos about their stories regarding their COVID-19 pandemic experiences.

Research shows that teachers who collaborate with their students empower them to enhance their self-determination, problem-solving, decision making, goal setting, self-knowledge and self-regulation [7]. Collaboration with students to make VR projects can be an effective pedagogical method that allows students to learn and explore VR storytelling more actively. Based on these perspectives, students were assigned the role of director and were supported by a member of the research team throughout the VR design process. Following their feedback, we translated their ideas into VR short films. This method allowed us to understand how they approach VR design as novices, how their mental model of VR evolves over time, as well as the challenges and opportunities they encounter when creating an autobiographical VR story.

This project also represented a unique opportunity to help our students create and share their own COVID-19 experiences, leveraging the storytelling affordances of VR. The COVID-19 pandemic has had significant impacts on mental health issues in North American university students, including increased levels of stress, anxiety, and depression [8]. Creating their autobiographical stories about the COVID-19 pandemic could allow people to indirectly experience undergraduate students' experiences of COVID-19 and the effects of isolation on their daily lives. The resultant works can serve as a historical archive that contains personal feelings and ideas related to the pandemic experiences of university students.

In summary, this research demonstrates how 3D VR can be used as a meaningful tool to create personal storytelling about the COVID-19 pandemic for students and provides insight into the democratization of VR autobiographical storytelling in practice, which could allow many people to create their own VR stories in collaboration with VR experts.

Collaborative Design Meetings

Student participants in this study had been previously enrolled in and completed an online course about immersive storytelling taught by the first author in the winter of 2021. Following the conclusion of the course, students were invited to participate in the study over the spring of 2021. A total of eight students from that cohort participated in this study. We refer to the student participants as S1-S8 throughout the following sections.

In the course, students were asked to create a rough prototype of a two- to four-minute VR autobiographical short film about their pandemic experience. The collaborative design meetings were conducted using the prototype they created for the course as a starting point for the study. Due to pandemic restrictions, both the course and the study had to be conducted online. As such, the students were not able to gain physical access to the VR lab and VR prototyping software. Instead, they only created their work in the course for 2D screens using a first-person controller in the Unity game engine that simulates VR experiences such as walking around the environment and looking around using a keyboard and mouse.

The student participants had no previous experience with 3D modelling, animation, interaction design or VR before taking the course. In the course, they learned how to import free 3D models into the Unity game engine and set up the environment. They did not learn 3D modelling but learned basic texturing techniques in Maya. Using the Unity timeline, they learned how to create a simple animation and insert spatial audio.

We conducted one-on-one design meetings via Zoom to translate students' final projects into the 360° video VR format while also helping them refine or change their projects' audiovisual aesthetics. Prior to the first meeting, students sent the Unity project folders that they had created for the final assignment to the lead researcher, and the researcher connected the VR headset (Oculus Quest 2) to their project. At the first design meeting, the lead researcher showed how their work could be viewed through the VR headset by demonstrating her usage of the VR headset in real-time.

Based on that demonstration, we discussed how to refine and develop each participant's final assignment for VR with them, specifically for a 360° video. Using their input, we helped them to transfer their projects to the 360° video format. We then worked collaboratively with students to complete technical and aesthetic refinements. Students were assigned the role of director, and the lead researcher assisted with VR design and technical implementation based on their direction and discussions. We collected their ideas, comments, and feedback on the collaborative design process in the first and second meetings.

Based on the results of the first and second design meetings, we exported their work as a 360° video using VR panorama software from the Unity asset store. We used a 360° video instead of other real-time VR formats because 360° video is most accessible to students. Students received a cardboard head-mounted displays (HMD) in the mail along with a \$30 Amazon gift card for remuneration. In the third meeting, they viewed their projects, discussed what they felt and thought when they experienced their work using the HMD, and reflected on the collaborative design process.

Design Outcomes

VR Projects

Based on our one-on-one collaborative design meetings, we created eight individual 3D 360° VR pieces featuring the students' autobiographical stories about their experiences during the COVID-19 pandemic. All eight students expressed their pandemic experiences in creatively different ways and provided the narration in their own voices. They represented how their daily lives during the pandemic became repetitive, lonely, inescapable, confined, or surreal. Audiovisual aesthetics in each of the projects are diverse and depend on students' expression, including realistic scenes, low-poly cartoony aesthetics and fantastic or surreal environment construction. Each work's running time is 2 to 5 minutes in length.

Greenhouse by S1 represents her yearning to connect to the world and the loneliness arising from her disconnection during the pandemic in a poetic way. In *Confusion & Life*, S2 describes his repetitive and lonely routine in his studio apartment as a Chinese international student. *Pandemic Dream* is based on S3's bizarre dreams during the pandemic, presenting various surreal moments and perspectives such as lucid dreamlike experiences. *Loop* by S4 portrays her isolated life during the pandemic through replication of her room to

allow the viewer to feel as if they are actually in her room. *COVID Confinement* demonstrates S5's pandemic experience as if he is in a prison cell; the door disappears, the ceiling descends, and the light becomes red. *The City of Dawn* by S6 represents the Wuhan lockdown. She believes the Wuhan lockdown might have directly influenced her life and many other people's lives. *Sinkhole* is based on S7's inner experience of the pandemic. He metaphorically expresses his status as a sick person in a motel room by using surreal and abstract aesthetics. *Solitary Confinement FT COVID-19 Pandemic* by P8 shows many different rooms that gradually become smaller to represent his sense of confinement and feelings of entrapment.

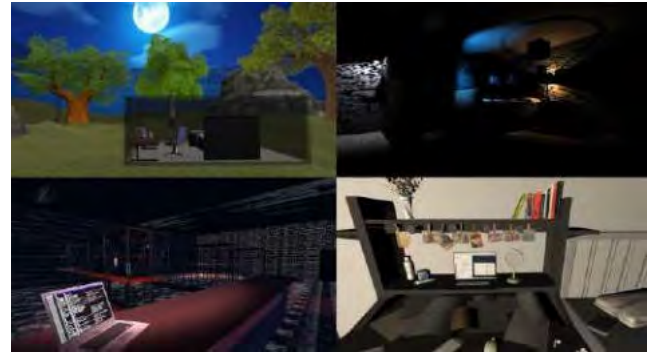


Figure 1. Still images from a collection of 3D VR autobiographical stories about the COVID-19 pandemic from university undergraduate students in Canada. Clockwise from top-left: *Greenhouse*, *Sinkhole*, *Loop*, and *Pandemic Dream*.

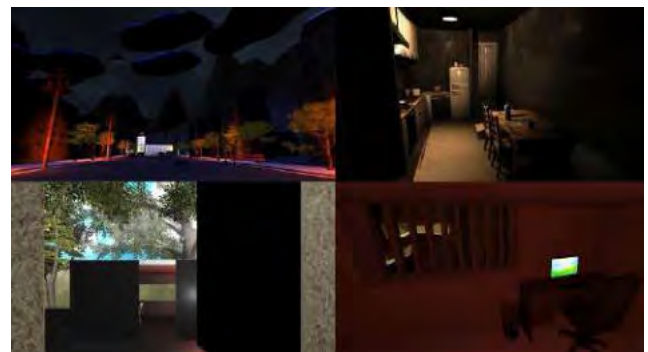


Figure 2. Clockwise from top-left: *The City of Dawn*, *Confusion & Life*, *COVID Confinement*, and *Solitary Confinement FT COVID-19 Pandemic*.

Collaborative Design Process

During the design meetings, we showed the students how to view their projects with a VR headset in real-time. Based on this demonstration, we discussed how we could refine and change their projects for VR design.

Aesthetic consistency: Most students constructed their environments using existing assets without changing the textures, so they did not consider aesthetic consistency. Therefore, some visual elements did not match. We discussed how we could help them with their project's visual aesthetics. For example, we discussed changing of colors, model shapes, textures and other elements to increase the project's aesthetic consistency. Collaborative design discussions during the sessions were used to finalize decisions about the students' desired aesthetic and how they would like it to be represented in VR. Based on this, we changed the visual aesthetics and showed the students these changes in the second meeting.

3D environment reconstruction: some students created environments without considering the perspectives afforded by VR, in which the environment can be seen by the viewer

from all directions. For example, one student designed an outdoor scene only for a 2D screen, so outside of a specific view, there was a lot of empty space. Based on the lead researcher's discussions with the student, we created the surrounding terrain by adding more buildings and a mountain. Due to technical limitations, one student only used a 2D texture to create land and grass. Following the student's direction, we created 3D terrain and grass to replace the flat 2D texture.

Visual details: we refined many small visual details based on the design meeting. For example, we created a reflection texture for a mirror image that looks like a real mirror, and we inserted video texture on a computer monitor to simulate the character playing a video game. We also added more objects to certain scenes, and we changed the light to intensify the atmosphere the students wanted to express.

Camera position and movement: We showed students how their work can be seen through a virtual camera setup in real-time and discussed the position and movement of the camera with them. When the students created their final assignment, they used the Unity FPS (First-Person Shooter) controller to simulate their first-person perspective VR experience. They could navigate in the environment they created using a keyboard and mouse to look around the virtual environment. However, for the 360° video format, the viewer is in a seated position, so they can only experience different 3D perspectives in the scene by changing the perspective of camera. We discussed with the students which camera positions and movements could deliver their stories most effectively. The camera movement was adjusted carefully due to the dangers causing motion sickness. Five students used slow camera movements to represent their movement in the environment, and two students used cut scenes rather than moving cameras to reduce the danger of motion sickness and intentionally show sudden changes and disorientation. Three students used an extremely low or high camera position to exaggerate the surreal components of the scene or to make the viewer feel overwhelmed.

Audio design: The most important part of the audio design was the students' voice narration. Taking the camera position and movement for the 360° VR format into account, the narrative structure of four projects needed to be changed. The students re-recorded the audio narration and sent it to us, and we combined the new audio narration with the new virtual camera. Furthermore, many students did not use audio elements effectively and did not consider features such as spatial audio. We discussed how spatial audio can be used impactfully based on camera position and movement. Based on this, students sent us more audio effects and we added sounds that came from specific directions in the virtual environment, such as a knocking sound behind a wall, the sound of a toilet flushing in the bathroom, and television sounds coming from the position of a television located in the 3D scene. We also discussed the impact of music in creating emotion or setting the mood in film.

Findings and Discussion

We collected and analyzed participants' responses to the collaborative VR design process and each individual VR piece that we created based on the design meetings. We recorded the online meetings using the record function in Zoom. The average length of each session is approximately 45 minutes, and the duration of the recorded videos totals approximately 20 hours. We collected students' ideas, comments, and feedback about VR design in the first and second meetings. In the final meeting, we conducted semi-structured interviews with the students and focused on their

responses to their experience viewing their individual revised VR pieces using the cardboard HMDs we sent to them. We transcribed all the recorded video sessions and then analyzed the data using an inductive thematic analysis following Braun and Clarke's six phase approach [9].

We found that VR allowed the students to deliver their feelings as the central characters or protagonists. All eight students said that they actually felt as though they were in their rooms or the environments they created and re-experienced the feelings they had felt during the pandemic. This may be not a surprising finding, as VR brings a sense of presence and the first-person point of view. However, this finding is important because our students felt as though their feelings were accurately represented in the resultant VR shorts through our collaborative process. There is always a risk that narrative elements that are important to the storyteller can be incorrectly re-imagined or omitted in the final project. In the context of this study, our method effectively sidestepped this issue, resulting in an effective representation of the students' own feelings and lived stories.

We also found that camera position and movement were important to allow viewers to experience the character's feelings. As storytellers, how to position and move the virtual camera is related to the identities and activities of the subject in the stories themselves. For example, if the camera is on the bed, the viewer may feel like they are on the bed. If the camera is positioned in front of the desk, the viewer could feel that they are sitting in front of the desk. When the camera moves forward, the viewer may feel that they are walking forward. The extreme camera angles, such as a very low angle, could also make people feel like they are small entities in the virtual world. If the camera position is very high, they may think that they can observe events as they unfold from a distance.

In traditional film and screen fields, camera angles and movements are considered very important factors when creating the moods of work and conveying the feelings of the story's characters [10]. However, in VR, the camera position and movements are considered less important because most research focuses on the sense of presence in the environment itself [1,3]. Although there is no frame in the virtual environment, the camera position and movement can be experienced more physically in VR, so the virtual camera should be carefully adjusted to tell a VR story. Especially in the context of autobiographical storytelling, the camera position can be directly related to the subject's perspectives and feelings in the stories.

We discovered that 3D VR can be used as a meaningful storytelling tool to create stories that accurately reflect our sense of confinement and disconnection during COVID-19. Seven of our participants used VR storytelling to express the sense of loneliness, isolation and disconnection encountered during the COVID-19 pandemic in different ways. This may suggest the students' experiences in dealing with their feelings of isolation during the pandemic are somewhat similar; however, this finding shows that VR can be used to deliver people's personal stories specifically related to feelings of helplessness, frustration, and isolation. Many people use VR to create a fantasy and escape from the real world, freely exploring other worlds; however, it is important to be aware that current VR technologies cannot deliver a complete, fully immersive experience due to the limitations of interactivity and immersive technology. There are always hardware and software constraints that limit our interactions in VR. Due to this, ironically, VR can be a powerful tool to explore stories that focus on the loss of movement or agency [11].

Conclusion

We found that the students perceived 3D VR as a way to effectively express their inner worlds and perspectives, such as feelings of being in a dreamlike state, subconscious desires or even fantasy elements. Five students mentioned that 3D VR was particularly helpful to express their personal pandemic experiences in more creative or surreal ways. Two participants intentionally used surreal aesthetics to express their inner worlds and perspectives. The findings may have been different if we had used 360° cameras rather than 3D VR. However, 3D VR can give storytellers more artistic freedom to create their story environments, adjusting the virtual camera position and movement in dramatic ways. This media affordance allows the creator to express their inner world and perspectives rather than mimicking the realistic environment and situations.

Furthermore, we also discovered that the disorienting features of VR bring many more surreal or unrealistic experiences than 2D-based traditional media. As viewers in VR experiences, we often feel as if we are in the virtual environment, but we cannot see our own bodies in VR, which can make the experience surreal, disorienting, dreamlike and imaginary. This can sometimes be an unintentional side-effect of the affordances of VR. However, sometimes this can be leveraged by VR storytellers as a powerful tool for conveying feelings associated with surrealism or a dreamlike state. Many VR creators try to use VR to represent reality accurately and mimic real-world situations as if people are in reality; however, VR can be used meaningfully to deliver subconscious, fantastic and dreamy worlds that cannot be easily expressed in the real world.

We found that the environmental detail in the virtual environment helped our student participants convey a personal story. All eight students were surprised by how well VR revealed many details of the virtual environments they had created, and how much these details added to a strong sense of presence and gave more information about the stories. The advantages of showing environmental details in VR storytelling do not simply mean providing a lot of visual information is best. Environmental details and objects can be used as main storytelling components because the viewer has the opportunity to look around and explore the environments to understand someone else's personal life during the pandemic. However, it has been noted that too much simultaneous spatial and temporal information can increase the mental effort required by the viewer [12]. Because the VR shows a lot of environmental detail, viewers can miss the temporal or important narrative-related information or other parts of the stories. Therefore, adding detail to the environment is not necessarily good; intentional deliveries of visual information using the environmental details will be the key to storytelling.

In addition, all student participants mentioned that the collaborative design process gave them opportunities to learn and explore complex VR design processes in depth. Although they could not work with VR technical implementations, they mentioned that discussion with a VR expert allowed them to become more aware of their ideas, defining them more clearly and finding design issues by themselves. Six students said that they could clearly understand what is possible and not possible using VR through communications, which also helps them understand the specificities and affordances of VR. Five students noted that what they had learned from collaborative design gave them decision making abilities with technical assistance, allowing them to express their opinions and ideas freely, while understanding technical limits and possibilities simultaneously.

This paper presented an online collaborative design approach for autobiographical VR storytelling by students during the COVID-19 pandemic. For practical examination, we created eight autobiographical VR pieces about COVID-19 collaborating with undergraduate university students. We conducted one-to-one online collaborative design meetings with eight students to explore how VR can be a useful and meaningful tool for creating stories about the COVID-19 pandemic. The discussions and interviews from the meetings revealed four elements—delivering the character's feelings, creating a sense of confinement and disconnection, showing environmental details, and expressing inner worlds—that were used by students as methods of autobiographical VR storytelling. This study highlights the democratization of VR as an autobiographical storytelling tool and the significance of online collaboration as a pedagogical method in VR storytelling during the pandemic.

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TeleWindow: A Flexible System for Exploring 3D Immersive Telepresence Using Commodity Depth Cameras

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Abstract

Video conferencing has become an essential part of everyday life for many people. However, traditional 2D video calls leave much to be desired. Eye-contact, multiple viewpoints, and 3D spatial awareness all make video conferencing much more immersive. We present TeleWindow: a frame with mountable volumetric cameras that attaches to a display for immersive 3D video conferencing. The full system consists of a 3D display and a frame with up to four volumetric cameras. Our system was flexible conceptually as well as physically. We intended our research to be “unfettered” rather than focus and directed, e.g., for anything directly entrepreneurial and commercial: “art as unsupervised research” [1]. In contrast to similar work, our focus was on making an accessible system for exploring immersive teleconferencing so cost of materials and required technical knowledge is kept to a minimum. We present a technical baseline for immersive, easily replicable 3D teleconferencing.

Keywords

display technologies, telepresence / tele-existence, human computer interaction, mixed/augmented reality

Introduction

If the COVID-19 pandemic has shown us anything, it’s the need for effective video communication tools in the

contemporary world. Remote telepresence systems provide benefits across many use cases, from education to healthcare to everyday conversation. However, traditional video conferencing still has many barriers to an immersive experience, including a lack of eye contact, a static viewpoint, and no three-dimensional spatial awareness. Aside from the highest-end solutions, current commercial systems are sufficient for communication, but fail to provide the immersive experience of a face-to-face conversation. Accurate 3D spatial representation may be necessary in industry and healthcare use-cases, and immersive communication makes a huge difference in educational and everyday instances.

Much work has already been done implementing software and hardware methods for real-time 3D teleconferencing. However, most of these systems require significant resources, technical experience, and equipment to function. To achieve widespread immersive teleconferencing, these systems must be accessible to individuals and organizations without access to cutting edge expensive technology.

While existing hardware and software for 3D remains prohibitively complex or expensive, much will rapidly become more accessible as computing systems continue to develop. Volumetric capture cameras and workflows are also becoming increasingly more ubiquitous as they can be found on a multitude of mid and high-end mobile devices.

As such, we focus on creating an easily replicable physical system to demonstrate the feasibility of widely available immersive video communication. We present a modular system built with commodity depth cameras that can be replicated and installed by an end-user on a home system. Our work establishes a baseline for easily replicable 3D teleconferencing implementations.

Motivation and Related Work

Thomas Sheridan identified three main operational components of virtual “presence:” accurate sensory information, the viewer’s ability to change their viewpoint, and their ability to manipulate objects remotely [2]. Since we focus on video communication, we do not consider remote manipulation a crucial function of our system and instead focus on the first two requirements identified by Sheridan. To tackle these problems, we require accurate, real-time capture and display of three-dimensional data with a dynamically updating rendering perspective.

Many systems have since been developed that meet some or all of these requirements for virtual telepresence, as described in “Immersive 3D Telepresence” [3]. An early effort from UNC reconstructed a 3D view using a “sea” of two-dimensional cameras [4]. Carnegie Mellon used a dome of 51 cameras to reconstruct a three-dimensional screen [5]. Schreer et al. presented a system concept for a real-time 3D teleconferencing system [6]. Finally, blue-c was perhaps the first actual implementation that represented real telepresence; it reconstructed two 3D scenes and shared the data between two systems [7].

With the advent of commercially available depth cameras, contemporary systems have been able to capture and display 3D scenes in real-time. UNC developed one such system using multiple Kinect cameras placed around a room [8]. Most recently, Google announced “Project Starline”, a massive and expensive system for 3D teleconferencing [9]. Other similar attempts have been made to also provide physical presence in a remote space, such as the Telehuman [10]. While these systems clearly demonstrate the possibility of remote telepresence systems, they rely on significant setup, including multiple cameras spread throughout the room, expensive equipment, and significant technical experience. Our system implements similar methods with out-of-the box technology and a simple frame around the display for a more flexible and modular system.

Most current depth cameras use a combination of point cloud data for depth representation and 2D video for texture information to achieve accurate 3D RGB video data. Many commercial systems are available for volumetric data capture, including the ZED stereo cameras, Kinect from Microsoft [11], and the RealSense cameras from Intel [12]. These cameras use some combination of infrared, RGB, and lidar data to generate 3D visual point clouds. We

settled on the RealSense camera for our system, as discussed in the System Description section.

To process volumetric data and register point clouds we turned to the Point Cloud Library [13]. PCL is a comprehensive C++ library for the intake and manipulation of point cloud data, and capable of interfacing with most current commercial depth cameras.

System Description



Figure 1. A CGI rendering of the frame around a display. The final system included four cameras.

Hardware

The physical implementation of our system consists of an eye-tracked stereo lenticular display from SeeFront 3D Technology with a simple frame built around the display to hold four Intel RealSense D415 volumetric capture cameras and attached lighting. The frame and cameras can be seen in Figure 1. We decided to use RealSense D415s as they proved to be a good balance of form factor, cost, performance, and accuracy; a good fit for our goals of accessibility, especially when compared to other popular depth cameras such as the Kinect. Four cameras were used in the initial build of our system with configurations available for simpler setups using fewer volumetric cameras. Lights were added to provide even illumination of the scene and increase depth camera accuracy. The physical system itself was designed to eliminate the need for required wearables such as headsets or tracking modules.

Capture Pipeline

The capture pipeline begins with a non-real-time point cloud registration sequence to roughly align the RealSense cameras using an ICP algorithm [14]. A quick and rough initial alignment is all that is needed after the volumetric cameras are locked into the frame. The multitude of cameras are used to overlay point clouds on top of each other to minimize typical occlusions on a human figure (i.e., beneath the chin or behind the arms) from lack of depth data. Point cloud data is culled so that depth data is constrained to the subject within the capture zone. In contrast, previous

work focused on room-sized teleconferencing and required cameras distributed around the room. For a one-to-one use case like ours, the view is restricted to the movement typical of a face-to-face conversation and does not require angles of view that extend past the frame. An example of the point cloud merge can be seen below in Figure 3.



Figure 2. An example of the merged point clouds. On the left, the different colors each represent a view from one of the cameras.

It's worth noting that much of the research with 3D video capture and display uses the Microsoft Kinect rather than RealSense cameras. We found that images and point clouds were generally more accurate with a Kinect, but multiple cameras caused interference between infrared screens used for depth-mapping, and their bulky nature made mounting difficult. The accuracy of RealSense cameras is more than sufficient to exhibit an accessible 3D teleconferencing setup, and has improved considerably since we acquired them for this project.

Rendering and Display

First, the RealSense cameras return RGB texture data and a grayscale depth map. Next, the point cloud is extracted from the depth map and colored with the RGB texture using RealSense software. The transformation matrix from the registration step is used to align the point clouds within virtual space. Eye-tracking data is received from the See-Front display's eye-tracker, which is used in an off-axis projection algorithm to present a head-tracked multiscopic view of the captured volume [15]. Eye tracking can also be performed on the RGB texture data with existing open-source computer vision software such as OpenCV.

Discussion and Future Work

The system itself runs in real-time with a resolution of 3840 x 2160 at 30 frames per second with all four cameras running. Point cloud registration can also be manually fine-tuned to more closely align point clouds given errors during ICP alignment. To save cost and avoid volumetric

streaming issues, we worked with a single standalone system, to explore both real-time properties (as a "Telemirror") and record/playback opportunities (as a "Telerecorder"). This allowed us to focus on issues of immersion rather than bandwidth.

Our results may be described as "noisy and inaccurate" yet "cinematic and authentic." We wanted to minimize the cartoonishness of smoothed, highly interpolated avatars in favor of a "raw" look. We often used Star Wars' Princess Leia hologram as exemplar: even though it was completely fictive and made for a sci-fi film, it consciously included vertical raster lines and noise spikes. This intentional representation of noise and unfiltered data minimizes any "uncanny valley" effect, and our test users appreciated this alternative-to-avatar approach.

Test users also recognized glasses-free 3D as a necessary component. There is a certain magic, sitting in front of a 2D display, when the eye tracker locks on the users' eyes and the image instantly becomes stereoscopic. It is a unique media experience.

Given a single system, we could only explore multiscopic, "multi-view" perspective via pre-recording. For example, a single volumetric frame can be grabbed which allows a user to look around their own face, something impossible to do with a mirror. We find a multiscopic perspective is a key feature for maintaining immersion in future TeleWindows.

Future work may involve exploring the middle ground between a "low-tech" solution, our solution presented with the TeleWindow system, and high-end teleconferencing setups like Google's Project Starline. General improvements can be made to our system such as refinement and streamlining of the current capture and rendering pipeline. Since the initial development, new cameras have become available, and volumetric capture technology has already become more accurate with cleaner captures. Implementation of real-time deep learning based rendering helpers may also minimize occlusions and clean up depth data for better representations of human beings. But our exploration also has a twist.

As summer 2020 approached, the COVID pandemic had engulfed the world. We were in our third year of TeleWindow exploration, with the bulk of our work taking place during the summer with recent Media Arts and Computer Science graduates. Our flexible, "unsupervised" approach gave us a well-informed view of both the big picture of immersive teleconferencing and the in-the-trenches experience of what works, what doesn't, challenges, and opportunities. We decided to spend summer 2020 applying what we learned to something focused and practical.

We focused on how we could help college students as millions went online for the first time. Students were the perfect subject for our research because a) they were regular users of teleconferencing software and b) we could safely assume that nearly all of them had a laptop and smartphone.

The result was a “cheap simple hack” of separating the speaker view from the presentation or seminar view by moving it to a smartphone above the laptop’s camera and screen [16]. It’s not where we expected to go. We began by considering predictable solutions like computational view interpolation, relighting, and more spatial sound. But once we tried our hack, it worked much better than we expected. We produced several hundred and freely distributed them around our campus. Other universities participated as well. We don’t think we would have discovered this solution without the “unfettered” “unsupervised” TeleWindow exploration behind us.

We anticipate moving forward in both directions: continued exploration of the original TeleWindow and further development of “cheap hacks,” along with various versions in between.



Figure 3. Our cheap simple hack for telepresence.

Conclusion

The system outlined here was designed as a jumping-off point to explore what was possible in the field of immersive teleconferencing given increasingly accessible tools and technology for volumetric capture and display. The system and variations can be easily replicated. Our “simple hack” was one variation, an extreme scaled-down version. An immersive middle ground could contain a 2D, but still head-tracked multiscopic version, using a single clip-on volumetric camera. Our own exploration into telepresence demonstrated the feasibility of a widespread, low-cost immersive teleconferencing experience.

As is often the case exploring emerging media, unanticipated results occur. While some are not so good (but always increase knowledge), others can be magical. We encourage further exploration of more such uncharted territories.

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Debunking the quantified self through artistic data portraits

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Abstract

Today the “quantified self” is a technical reality that structures datasets of all kinds of interfaces. These interfaces are created with the goal to establish, develop and transform the relationship with the self, the data and the society. In a “datified” world, data visualization challenges traditional representation systems by opening up a wide world of analytical and graphical opportunities. As user interfaces, data visualizations are artificial devices that carry cultural messages in a wide variety of forms and media. Additionally, data visualizations are never neutral mechanisms of data transmission since they affect the messages, providing a model of the world itself, a logical and ideological scheme. The fascination related with big data and the creation of increasingly sophisticated user interfaces pave the way for the proliferation of diverse mutations in the perception of the world and of ourselves. The false neutrality and transparency of quantitative representation of one's own self is built on the assumption of a closed and measurable self that perceives itself as an entity that can be calibrated, compared and evaluated using numerical parameters. In this context, our research is focused around the implications and mechanisms of the quantified self and its visualization and also about the role that artworks based on data can play.

Keywords

Quantified self, qualified self, artistic data visualization, big data, interface criticism

Introduction: data portraits, subjectivity and metaphor

Erik Kessels 2011 installation “24 HRs in photos” (Figure 1) is a sea of printed photographs uploaded to Flickr in a 24-hour period. Through that work, we realize the banalization of the image itself, the loss of value implied by its massification, the datification of a mountain of selfies, faces without faces and bodies without bodies that are lost in the vastness of big data.

Photography has been, and still is, a very powerful tool for representing the self. However, since the big data explosion, today the self is also represented by the data that comes from our digital trails.



Figure 1. 24 HRs in photos. © Gunnar Knechtel Photography, 2014

During the late 1990s, years before the term of the quantified self appeared in 2007, Donath [1], Xiong [2] and Viégas [3] began to build and discuss about data portraits [4]. A term applied to the first portraits with data that were created as artistic experiments to explore the possibility of portraying people from their data.

“Unlike photo-realistic portraits, which show physical features such as gender, age, or race; data portraits are abstract representations of users’ interaction history” [2].

Some of these early projects exploring the aesthetic qualities of data for representing people should be mentioned such as VisualWho [1], Chat Circles [3], PeopleGarden [2], Newsgroups Crowds and Authorlines [5], The Anthropomorphic Visualization [6], or Lexigraphs [7].

Lexigraphs [7] (Figure 3), for example, is an experimental tool that produces portraits from Twitter usage data. Each user is shown as a silhouette created from the words derived from their updates, the portrait that moves to the rhythm of their updates. This work tries to obtain graphics with an artistic value and, in turn, obtain patterns of personal representation in the results [4].

Data portraits are intended to make visible and convey to the naked eye aspects of the social interface and allow, at the same time, the user to explore a subjective, mutable and complex image. Each aspect of the visualization has a function and reference is made to the metaphor (abstract forms, a flower, a humanoid body or a bust, for example) as a key aspect for its functionality but also for its poetic evocation. The interesting thing about this proposal is not

it could be. Individuals are reclassified in terms of their associations and links with others, and then included or excluded based on the attributes of the data groups to which they belong. The knowledge generated is used to support predictive systems, calculate the future behaviors of an individual and act preventively.

Today, big data is a technical reality that structures data sets of all kinds but does so in an opaque and silent way, without revealing its mechanisms or strategies. In the data sets of the different companies are "quantified selves" that they want to attribute them as a true revelation of our pre-selected years. With Foucault [19] we can say that these data sets, rather than building new relationships with an essentialist self, directly produce a self in practice. The quantified self is a technology of the self that responds to a truth inscribed in self-care, in pure individual governance [19].

The qualities of a quantified self

But what qualities do these quantified selves have? Authors such as Davis [20] or Lupton [16], [21] begin to raise the most qualitative dimensions of the quantified self playing with the term qualified self [13]. This qualitative component is present from the beginning in the decisions about what to measure and how to do it. In turn, it is also present in subjective narratives and interpretations, mechanisms by which data is transformed into stories that self-trackers tell about themselves. They are the bits with which they give meaning to their atoms [20].

In turn, the quantified self is also becoming a qualified self by applying tracking methods to qualitative phenomena such as mood, emotion, happiness or productivity [17]. However, although it manages to measure emotions, feelings and bodily responses to a certain degree, it does not have access to the field of affections in the strict sense: the social, psycho-structural, or other factors that cause affective responses or interpersonal interactions. Worker tracking technologies, for example, can tell us which working conditions or interactions seem to cause a particular set of emotions or behaviors, not how or why. They claim that they show us what a body can do, but in reality they only show us what certain bodies have been seen they can do from a particular point of view. This is characteristic of a change from "truth" to empty functionalism, from deductive science to a coarse and inductive orientation of "this works" [22]. And so, the fallacy emerges based on the fact that the self can be quantified, that the identity and the self is something that can be measured, represented and perceived numerically. This simple assumption implies the idea that there is an objective self, an essence to be discovered that can be captured and reduced to quantitative data, in favor of a renewed extreme positivist illusion.

On the other hand, the intensely individualistic approach of quantifying the self is also noteworthy. When the notions of health, well-being and productivity are presented through data extracted from self-control, the social determinants of these attributes are hidden. Illness, emotional distress, lack of happiness or lack of productivity in the workplace are mainly represented as failures of self-control or individual efficiency and, therefore, require greater or more effective efforts, including perhaps greater intensity of automatic tracking regimes, to produce a "better self" [16]. Therefore, the quantified self approach can be considered as one of the

many heterogeneous strategies and discourses that position the neoliberal self as a responsible citizen, willing and able to take care of their own interest and well-being. Foucault's writings on the practices and technologies of the self in neoliberalism are pertinent to understand the quantified self as a particular way of governing the self [16]. The quantified self technologies introduce a micro and self-surveillance, with more psychological and emotional implications that affects power, body, knowledge and space dimensions. Some individuals do not make self-determined decisions but delegate the power to make decisions and to determine what is beneficial for them to the technologies. [23]

Also, repairing in what we are shown and how it does it, Moore & Robinson [22] point to the ontological premise of Cartesian dualism with the dominant mind over the body, where the data provided by a body without authority is interpreted by a rational mind that takes command and makes decisions about his subordinate body. Lupton [16] points to a vision of the body / self as an entity similar to a machine that provides inputs and outputs.

Of the representation and perception of the self

The era of data and quantification entail the development of new forms of data management and analytical techniques that are based on machine learning and new visualization modes. In a "datified" world and in the middle of the quantified self era, data visualization challenges traditional representation systems by opening up an immense world of analytical and graphic opportunities. These representations also affect the perceptions of the self, impacting one's feelings for oneself.

As we saw above, the data portraits, first artistic experiments on the representation of the self through the data we generate, put subjectivity and metaphor in the foreground. With the arrival of big data there is a naturalization and neutralization of an infallible and omnipotent data that erases the traces of subjectivity. The quantified self, governed under the capitalist and data market logic, hides the mechanisms and metaphors that produce the representations of a self that is supposed to exist and that the data is capable of revealing. It is an individual self, which can be measured in numerical terms and can be calibrated based on the same parameters as other selves. It compares and competes with the data of others or with their own, building a statistical self that controls itself and self-regulates. The self is perceived as a subordinate machine body that provides data to a mind that dominates and domesticates it.

Thus, in the face of the illusion and positivist impulse to capture the quantified self reduced to fully objective data and devoid of all subjectivity, it is possible to oppose the constructivist vision not only of the data and its visualizations but also of the same processes of subjectivation and of one's own self as a practice, that escapes all omniscient truth. Are we going to approve the given and hidden metaphors as the only true representations possible? Are we willing to limit our subjective perception to what the logic of quantification dictates? How can we question these logics? How can we break the hegemony of what is shown to us and gut what is hidden?

From the first artistic explorations of data visualization such as data portraits until today there have been many

more approaches from art to data. As we can see in the brief survey of projects in the field of artistic information visualization of Viegas and Wattenberg [24], artistic data visualization uses the same sophisticated visualizations techniques of academia or commercial, but in a very different style and for different purposes. Data oriented artworks expose a particular point of view and actively guide analytical reasoning and encourage a contextualized reading of their subject matter. What role can art play to highlight the subjective dimension behind any visualization

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of data? Are we able to build new subjectivities and metaphors that give space to other, more complex, risky and more sensitive selves? How can it be claimed from there that data are always portraits? In this research we propose a review of the terms in which we relate to data visualizations. The data portrait concept is the starting point to rethink the subjective and ideological dimensions of data visualizations and the logics of quantified self and big data.

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Codex Endogenous: Designing Interactive Self Data Visualization Tool for Trauma Impacted Individuals

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Abstract

The Quantified Self is best described by Gary Wolf as “self-knowledge through numbers.” William James’ theory of the consciousness of the self and the study of coping inspires drawings that retell personal narratives. *Codex Endogenous* is a project that reveals and visualizes the beauty and morphology of a “self” and its environment. Here, “codex” refers to a collection of pages stitched together, and “endogenous” is a term in cognitive neuroscience used to describe phenomena that is spontaneously generated from an individual’s internal state. Every day, quantifiable information about the self is produced and collected like pages in a book. Daily data drawing is a method of journaling with naturally emitted data from the self, creating an oracle into an individual’s brain body connection. This paper evaluates the characteristics of what daily data drawings are, methods of collecting data, and the possibilities of using data collection and visualization as a mindful-ness practice for people who are diagnosed with post-traumatic stress disorder.

Keywords

Data Visualization, Mental Health, Journaling, Therapy, Tools, Generative Art,

Introduction

There is simply too much information to keep track of the complex narrative that makes up your own self-hood. When you look in the mirror and see yourself, you can point out the physical appearance, but it is often a much harder task to recall accurate self knowledge. Self knowledge can be difficult to unravel and recall because of the complexity of themes within our psyche. There is not a mapped out visualization with a detailed legend for navigating, but rather a novel with sequences of interconnecting events that have themes and story lines [13]. A common symptom of Post-traumatic Stress Disorder is a sense of losing one’s body and mind connection. There is a part of the brain responsible for sensing the self called the “default state network” (DNS). It’s how we know we are alive. Patients with PTSD show a startling lack of activation in the self-sensing parts of the brain [10]. Neurofeedback is used as a treatment that uses visualization of the “electrical symphony” of a patient’s brain waves to cause emotional arousal and in return enhances the sense of identity [9]. In effort to build a similar mirroring effect, *Codex Endogenous* provides a reflection of the self each

day. Generated from naturally emitted data, daily entries have the ability to be recorded through a network of devices.

Codex Endogenous aims to construct a narrative about the self by examining drawings produced from devices that collect biometric, environmental, and self-reported information. A daily representation of data is translated into patterns that make up a visual language mapped on a canvas. A user may collect pages that adds to their own narrative, positively reinforcing identity and relation to one’s own environment.

The inspiration for this project came from the practice of meditational drawing. The process involves sketching a simple mark on the paper repetitively in a meditative state and watching the pattern build and grow into a larger complex form. Then the creation of a new pattern begins, builds complexity and exists against all the previous patterns on the page. With the ability to create graphics with creative coding and integrating devices that are best described as the *Internet of Bodies*, a term described by Giorgia Lupi as technology that captures and stores information about a person’s location, bodily functions, audio and visual perception and even self recorded information that would reflect an individual’s thoughts [4].

Background

This project is situated heavily in generative design as an art form. Imagery is created by constraints defined by the data that is streaming through a program. The art form originated in cybernetics and general systems theory in the late 1960’s. Roy Ascott coined the term “cybernetic vision”, referring to concepts drawn from computer science. Methods of computing to mathematically display graphics using algorithms derived from artificial intelligence or artificial life [1].

Codex Endogenous utilizes self-tracking, otherwise known as The Quantified Self. Dating back to the first cave paintings, humanity has been compelled to record themselves for thousands of years. When this complex human tendency to preserve themselves combines with the power of computation, the conversion of human bodies and minds into data flows are figuratively reassembled for the purpose of self-reflection and interaction [8]. The quantified self is defined by using “invisible technology” in order to collect data that reflects the daily lives of people, like a data double. Motivation to collect such data comes from a desire to change or improve.

According to Ksenia Fedorova, technologies that utilize

biosensing to gain an accurate “picture” of one’s mental and bodily state would help create balance with more “informed” behavior [2]. This project attempts a snapshot for a person to distinguish and identify their mental and bodily state, while grounding themselves in the environment. Data is taken from streams of data that is left by the self during the span of 24 hours. Later the data is recalled in a one-time journal-like task.

James divided the history of self into three parts – its constituents, the feelings and emotions they arouse, the actions to which they prompt. When we use sensors to automatically track ourselves, we are reminded that our ordinary behavior carries more obscure signals that can be used to inform our behavior [12]. The collection of the data for this work aims to seek information that makes up the empirical self. William James grouped all of the components of the empirical self into three subcategories: (1) the material self, (2) the social self, and (3) the spiritual self. In this work, items of data that include bio-metric, sleep, and environmental information can be classified as the material self as it pertains to the tangible objects, people or places that carry the designation *my* or *mine*. Data collected about who people interact with each day is classified as the social self. In effort to support the spiritual self, thought and emotional data through daily survey is collected.

The way in which personal narratives are recalled from memory inspired the modality, origin, and meaning of data that was used in developing drawings each day. The philosophy behind the method of data collection is heavily informed by the concept of “Data Humanism”, coined by Giorgia Lupi. The idea addresses the issue that as a result of the rise of Big Data, attempts at complex infographics become merely eye-candy and leave us with copious amounts of unreadable and cheap graphs and pie charts. In actuality, the conventional nature of these visualization lacks depth and exploration in possibilities of what *could* represent more meaningful data to the viewer [7].

Self Data Visualization and Trauma

Semiotic explorations within personal data have been used as a tool for simulating and representing the inner experiences of individuals using data trails [3], but there is an absence in work regarding tools for individuals who are prone to experience lack of self, such as patients diagnosed with Post Traumatic Stress Disorder. The combination of using self data as visual feedback integrated as an artistic representation is designed to act as an intervention to promote self-healing. *Codex Endogenous* was developed as a tool for an individual to acquire information to act as scaffolding to one’s own self-concept, a collection of beliefs and thoughts that make up an individual’s perception of the self. A negative self-concept is commonly reported amongst patients diagnosed with Post Traumatic Stress Disorder [6]. The page like structure of *Codex Endogenous* provides a narrative based experience similar to collecting pages in a journal. It is a procedure of data collection that is then translated into markings on a page through the means of generative art and data visualization. The form of the markings are completely determined

by variables that change based the data collected for graphical output onto a page. This means that the graphical form of the artistic daily data drawing is completely unique upon the self, metaphorically acting as a mirror and acting on an individual’s inner experience. For trauma-impacted individuals whose inner experience also includes the lack of sense of self [11], this intervention is designed to stand in as scaffolding that otherwise is hindered or disabled.

We can imagine a simple scenario for the use of daily data drawings. A person is diagnosed with PTSD and starts to receive outpatient care. Their treatment plan includes establishing care with a psychiatrist and regularly seeing a counselor for talk therapy. While they are receiving care on their own, they start to think about journaling as a form of self-care. *Codex Endogenous* provides them with a free form interface to draw out their own daily data trails which provides them with feedback about their self-information generated from factual data. Their idea of self is now more enhanced than purely what they would originally write in a journal.

Methods

The thought process behind the format and visual representation in this project is informed by an understanding of human memory. The term *implicit memory* refers to when a participant does not deliberately attempt to collect information from the past, yet memory is still expressed in the performance of a task (e.g. walking or playing a learned song on the piano). *Explicit memory* is exhibited when participants consciously and deliberately attempt to recollect information from the past, such as life events that are primarily sensory experiences (e.g. recounting a childhood memory of having dinner at their grandparents house) [5]. Self Knowledge requires both implicit and explicit memory to form a personal narrative. The following describes the ways in which data collection parallels memory and functions as the data that makes up the self to be used for daily data drawings.

Given this information, *Codex Endogenous* proposes that there is a connection between data as personal narrative from memory and the modality in which data from devices are collected. When translated into the visual output, the journal-like output for personal use is a form of Data Humanism. This is because visually representing self-data in respect of self psychology, such as the empirical self or what makes up a person’s self-concept and human memory, we can approach the design of a visualization with more meaning and thoughtfulness. Iterating on Lupi’s words – “We are ready to question the impersonality of a merely technical approach to data and to begin designing ways to connect numbers to what they really stand for: knowledge, behaviors, people [7].”, this work takes into consideration a humanistic approach with respect to the physical and mental experience of whom interacts with their self data.

A survey of data collection was conducted to deepen the understanding between the usage of a device and how the output of data is internalized. A myriad of devices was tested, such as a Fitbit tracker, web API’s, an eye tracker, cameras, and sensors to detect the external environment. The selection of data collection methods had to satisfy the following criteria:

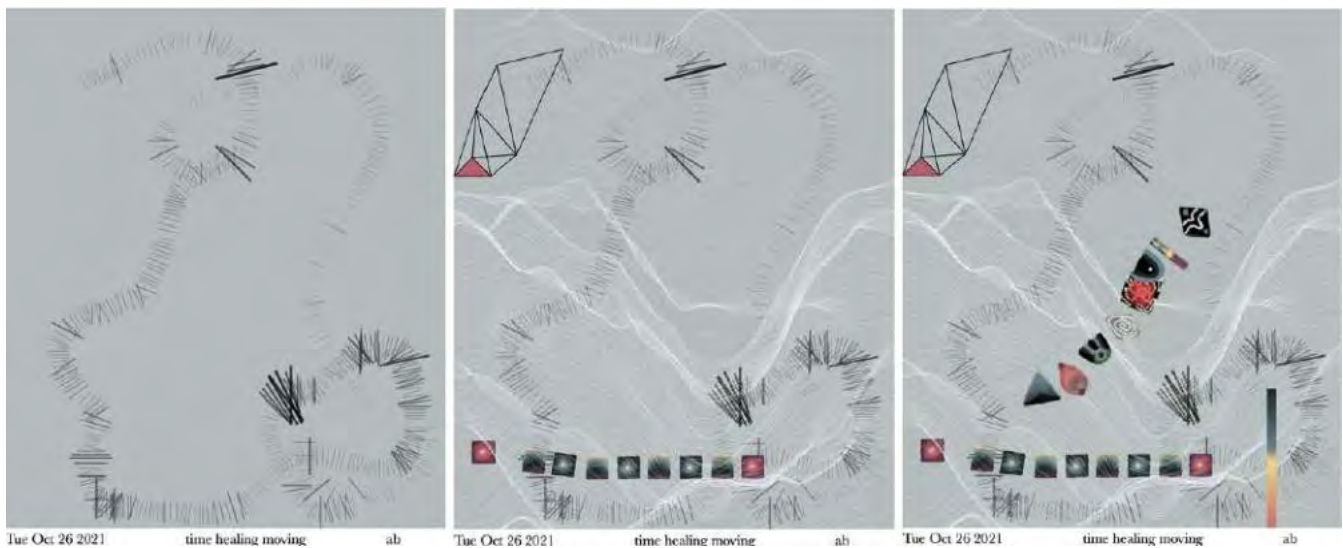


Figure 1: Example of beginning, middle and end using a mouse-drag interaction to draw out patterns for a daily data drawing.

- There is a direct and strong connection oneself narrativeto the data that is output.
- A wearable device functions symbiotically with the self with minimal disruption during the day.
- There is a low sense of surveillance
- The data can be retrieved on the web via API.

The Fitbit tracker and Web API's fit the criteria the best. For information that requires a conscious recall, a screen-based visual interface that includes input for emotional, social, and thought data that is then collected and stored in a database. If you can imagine yourself living out each day, think about what information your body and mind "outputs". The chosen modalities of data collection were designed to carry out a composed way of getting self feedback to an individual. This includes heart rate or sleep patterns – the type of data that is retrieved automatically through the use of our devices. In a sense, they are an extension of ourselves when it comes to the data it is capable of generating. In this model, the data that is collected through automatic means like the Fitbit and data from Web API's is considered implicit. The data that is collected from the visual interface is considered explicit. The collection process combined with the content being self information is metaphorically represented as retrieving memory about the self.

In this project, the method of collection the implicit memory data is straightforward. This is because implementation is based on setting up the stream of data and making it available to be used when it comes time to create a daily drawing. This was done using JavaScript. On the other hand, it was a more involved design process to achieve an accessible and meaningful web interface that collects emotions, social information and thoughts.

Because of the lack of assessing a full range of emotional experiences in previous surveys to measure emotion, Harmon et al. developed a questionnaire to assess situationally

induced emotions that expand the range of mood states seen previously that assess only specific ranges of emotions such as anxiety, pride, and shame and guilt. The importance of a tool that assesses emotion comprehensively is because the same event occurring in two different individuals' life may evoke two different emotional states between the two. Another reason of importance is the possibility of an event evoking mixed emotions. The Discrete Emotions Questionnaire developed by Harmon et al. includes "basic by prominent emotion theories" that allows individuals to distinguish emotions and determine a level of which they are feeling them. The questionnaire declares eight different broader categories of discrete emotions: Anger, Disgust, Fear, Anxiety, Sadness, Desire, Happiness, and Relaxation. Amongst these larger categories, subcategories consisting of more specific emotions.

Codex Endogenous takes this list of emotions to be checked off each day. To be completed in a way that imposes less burden on the user, there is no scale like there is in the original questionnaire. While there is worth in denoting the intensity of emotions each day and reflecting it in a visualization can be achieved easily, the focus was on minimizing burden in completion of the form while maximizing the sense of being able to identify personal mood states, bring it forth to attention and opening the door for reflection. It is intended that every day the form would be completed. The submitted data goes to a database for later retrieval and visual encoding during the data drawing stage.

The social and thoughts form works the same way as emotion and is submitted to a database. The user recounts their day and notes memorable names of those who they interacted with during the day. The thoughts form prompts the user to describe their day in 3 simple words. This answer is used to title the drawing. The purpose of the minimalist nature of only writing 3 words is because it creates a task to pull the most important elements remembered from the day and in turn creates less cognitive load when going back into the

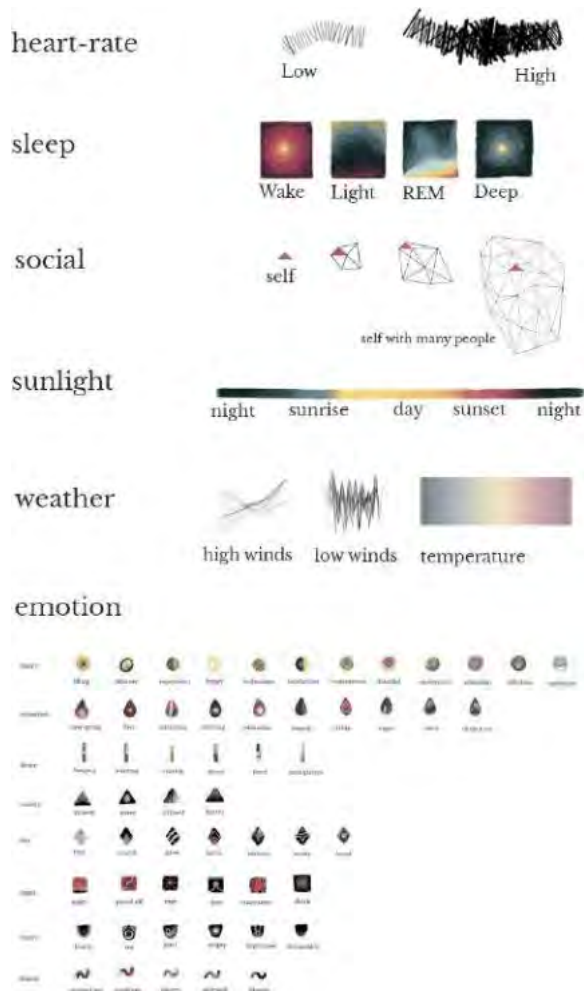


Figure 2: Legend to each pattern correlating to heart rate, sleep, social, environmental and emotional data ©Respect Copyright.

archive of daily drawings. This feature contradicts the conventional function of keeping a journal where meandering thoughts get written down.

Conclusion

Codex Endogenous seeks to provide groundwork for a procedure to concurrently collect personal data pertaining to aspects of the self. Two main processes make up the procedure: observation of self data trails, including biometric and environmental data produced by our network of devices and an intervention for collecting emotional, social, and thought data. The journal-like collection of daily data drawings aimsto provide an accessible and non invasive way for individualsto receive a *semblance* of neuro-feedback, as a complimentary tool to be combined with professional psychiatric treatment and counselling for PTSD patients.

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Live Data in Live Performance

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Abstract

Real-time data feeds offer a new kind of liveness in the performing arts, and an opportunity for natural phenomena like wind, tides and air pollution to join in live performance as dynamic, unpredictable forces. By heightening the presence and agency of living systems, real-time data can contribute to a less anthropocentric portrayal of the world.

Keywords

Data art, liveness, digital performance, data theatre, Gaia

Live Data in Live Performance

We live in an age of unprecedented data accessibility and data malleability. Data is not only available, it is available in digital form; easily analysed, easily transmitted through networks, easily converted into visual and sonic displays. In the visual and performing arts, experiments in the 1960s used electronic systems to create interactions between different elements of a performance. Pioneers include Merce Cunningham and John Cage, who used proximity and light sensors to enable the positions of the dancers to influence the sound in their performance *Variations V* (1965). This kind of transformation - movement to sound, sound to image, input to output - is characteristic of art and performance made using data feeds. The following year saw a key event in the history of art-science collaboration: *9 Evenings: Theatre and Engineering*, a set of performances detailed by Clarisse Bardiou in “Un Exemple Fondateur De Collaboration Interdisciplinaire”, where she observes that “the transformation from one medium to another is a dimension explored by Robert Rauschenberg (the sound of tennis rackets controlling lights), Lucinda Childs (movement into sound, sound into image) and David Tudor (sound into lighting variations and image)”.¹ [1]

Nowadays, digital technologies facilitate the capture of various types of data, while Bluetooth and Wi-Fi enable us to transmit it rapidly and wirelessly, and a host of software

is available to transform it and present it in different forms. The rapidity of this process means that raw data can be converted into palatable visual, audio and text formats and presented to an audience almost at the same moment as it is produced. This is a kind of liveness, and as such it carries immense value for the performing arts.

Liveness

Liveness is a key concept in performance studies, and one that evolves. As Philip Auslander has observed, “[t]he default definition of live performance is that it is the kind of performance in which the performers and the audience are both physically and temporally co-present to one another. But over time, we have come to use the word “live” to describe performance situations that do not meet these basic conditions.” [2] Radio, recording technologies and the internet have challenged our cultural understanding of what a live experience is, so that we now listen to recordings of artists “live in concert”, live-stream events that take place elsewhere, and live-chat with friends and customer service chatbots online. This last example touches on the other aspect of liveness that is now called into question: the *alive-ness* of the participants.

In the performing arts, a coincidence in space and time between audience and performer is still often considered to carry a higher value than, for example, online performances where audience and performer inhabit separate spaces, or pre-recorded performances which audience members view later. Even in the case of performances that don’t conform to the ideal of spatial and temporal co-presence, an instinctive preference for liveness prevails. Theatre-makers and audiences alike favour real-time interactions between real and virtual worlds and between audience members, even when these interactions occur in the digital realm. In episode 43 of the performance studies podcast *On TAP*, Sarah Bay-Cheng² notes that engagement and enjoyment are enhanced by connecting to other audience members on Twitter while watching an online performance. [3]

¹ Translated by the author.

² Dean of the School of the Arts, Media, Performance and Design at York University.

The urge to maximise liveness is apparent in examples of text, music and image generators in performance. Theatre-makers frequently opt to run their algorithms during the performance so that generation occurs live, despite the risk of technical hiccups, even when the audience wouldn't be able to tell if it had taken place in advance. In 1997, Jean-Pierre Balpe created *Trois Mythologies et un Poète Aveugle*, a performance that relies on a text generator and a music generator. During the show, the two programmes produce the text and the score, which are then performed by human readers and musicians. [4] In the United States, Annie Dorsen's experiments with text-generating algorithms started with *Hello Hi There* (2010)³, shown in figure 1, where two chatbots generate a conversation from a database composed of several texts about human nature, creativity, language and power. [5] This piece for two computers also raises the question of whether or not a human performer is still an essential part of the evolving definition of live performance. She followed up with *A Piece of Work* (2013), a show in five acts, each of which applies a different algorithm to the text of *Hamlet*. In addition, the sound and lighting, also managed by algorithms, adapt according to the words chosen by the text generator. In all of these examples, the algorithms perform live – in real-time in the same room as the audience – and this liveness is treated as a selling point in promotion and descriptions of the performances.



Figure 1. Two computers on stage conducting a live algorithm-generated conversation, in Annie Dorsen's *Hello Hi There*. ©W. Silveri.

Data feeds

A data feed, or data stream, passes up-to-date data from a source to a user. It provides an evolving sequence that reflects real-time changes. This is pertinent where whatever is being measured is in a state of flux, and the user wishes to view the changes as they happen.

³ Further information about Dorsen's work is available on her website <https://anniedorsen.com/>

In theatre and dance, data feeds tend to be taken from within the performance itself. A common example is the use of wearable sensors to gather motion and biometric data from performers or spectators. This data is relayed to a server, converted into visual or sonic form, and incorporated into the performance. Examples include:

- *Boiling Mind* (2020), produced by a team at Keio University and Darmstadt Technical University. Audience members wore electrodermal and cardiac sensors. The data from the sensors was converted into data visualisations and also affected video, sound and lighting parameters. [6] See figure 2 below.
- *Noor: A Brain Opera* (2016), produced by Ellen Pearlman, used an electroencephalogram (EEG) headset to measure a performer's brain activity. The data was used to choose between banks of video and sound files, so that the projected images and soundscape corresponded to the emotional state of the performer. [7]



Figure 2. Infographics displayed behind the performers show each audience member's electrodermal and cardiac activity in *Boiling Mind*. ©Moe Sugawa

Examples from the visual arts, such as the work of Andrea Polli and David Bowen, demonstrate the artistic potential of live data feeds sourced in the natural world. Polli is a digital media artist and a professor at the University of New Mexico. She has been creating art installations based on sonorisation and visualisation of digital information since the 1990s. Her recent work centres on using lights to present ecological data.⁴

- Exhibited in cities across the United States and Europe, *Particle Falls* (2008-) is a large-scale projection installation displayed on the side of a building. A nephelometer measures the level of PM2.5 particles in the air every 15 seconds. This data is translated into bursts of colour in the projected image. [8]

⁴ For photographs and videos of Polli's work, visit her Flickr page <https://www.flickr.com/photos/andreapolli/>

- *Energy Flow* (2016-17) is a light installation on the Rachel Carson Bridge in Pittsburgh. It uses LEDs to show the energetic potential of the wind in real time.

David Bowen is a digital artist specialising in converting data into movement, primarily using data from natural systems connected to dynamic sculptures.⁵

- *Cloud Piano* (2014) videos the sky, processes the data and transmits it to a mechanical system that presses the keys of a piano, producing music that responds to the movement of the clouds.
- *tele-present water* (2011) is a sculpture that hangs in a gallery and moves in response to water currents in the Pacific Ocean, using real-time data from a data buoy.
- *tele-present wind* (2010), uses an accelerometric sensor attached to a dry plant stalk to capture its movements as it sways in the wind. The data is transmitted to mechanisms attached to a group of similar stalks inside the gallery, which reproduce the movement. See Figure 3.



Figure 3. *tele-present wind*. The stalks move in unison, replicating the movements of a stalk positioned outside in the wind, sometimes many miles away. ©David Bowen

Artworks created using data feeds drawn from nature offer us new insights and new ways of perceiving our world; as something in flux, as something alive, spontaneous and constantly evolving.

Gaia

Coinciding with rising alarm over the impact of human activity on our planet is rising interest in changing our understanding of the Earth and our place in it. Anthropologists and philosophers like Bruno Latour and Anna Louenhapt Tsing are exploring and espousing an ideology wherein we are part of a multispecies network of living things. In this network, all animals, plants and natural processes have their own kind of agency, and man is no longer the star player.

⁵ For more about David Bowen's work, visit his website <https://www.dwbowen.com/>

Gaia is the name suggested by environmentalists James Lovelock and Lynn Margulis and adopted by Bruno Latour to designate this conceptualisation of our ecosystem. *Gaia* in this context is "neither the Greek goddess, nor nature in the sense of landscape, nor the Earth as a planet, but a personification of this fully living system that evolves with us and confronts us."⁶ [9]

With their trilogy of conference-performances, *Théâtre de la Terre*,⁷ Frédérique Aït-Touati and Bruno Latour promote this more integrated, less anthropocentric understanding of the world. They liken this re-evaluation of our place in nature to the change that came about with the scientific revolution in the 17th century, when the belief that the Earth was at the centre of the universe was challenged by heliocentrism. [10]

Conclusion: Live data on stage

Experiments with live data on stage have demonstrated its potential, often using biometric data generated during the performance. This type of data reinforces the centrality of the human performer. However, as evidenced by the work of Andrea Polli and David Bowen, it is equally possible to use data feeds drawn from meteorology, oceanography, and other non-human sources. Using real-time data from such sources enables natural systems to engage in art and performance with a degree of unpredictability and agency. It enables *Gaia* to be present and active; discernibly alive. The use of this kind of data on stage could contribute to an ideological shift that situates humanity within a network of natural systems and living things.

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Author Biography

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‘Taman Tugu: Interference/Resistance’: Addressing Urban Rewilding with a Musical Augmented Reality Experience

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Abstract

‘Taman Tugu: Interference/Resistance’ is an immersive, interactive musical work that has been mapped onto the pathways of the Taman Tugu jungle park in Kuala Lumpur, Malaysia. Taman Tugu is an unusual place – a large rewilded space teeming with wildlife in the centre of a modern metropolis. ‘Taman Tugu: Interference/Resistance’ uses Audio Augmented Reality and placed sound to raise questions about the importance of urban green spaces in general and rewilded urban spaces in particular. This paper explains how the work asks these questions of its audience through the mapping of electronic sound over the unique geography of Taman Tugu.

Keywords

Placed sound, locative media, site specific art, rewilding, augmented reality, immersive music.

Taman Tugu

Taman Tugu is a jungle park in the centre of Kuala Lumpur, Malaysia. Opening in 2018, the 50 acre park lies on the site of a former city neighbourhood, some signs of which can still be seen in the concrete ruins that poke through the foliage. The park contains more than 4000 trees, including over 1000 categorised as ‘endangered’ or ‘critically endangered’ by the International Union for Conservation of Nature. More than 230 indigenous Malaysian rainforest tree species have been planted, many of these species being selected due to the wide range of fauna they will attract; the overall aim being to encourage biodiversity. [1]

Taman Tugu is an unusual place; a reclaimed green space teeming with wildlife in the middle of a modern metropolis. It provides an excellent example of how we can do much more than simply preserving existing urban green spaces, demonstrating that we can be proactive in the creation of rewilded areas in our urban centres. It therefore also

provides a suitable location for an artistic work that examines the importance of such spaces.

Taman Tugu: Interference/Resistance

Performed through a GPS-enabled Smartphone and headphones, ‘Taman Tugu: Interference/Resistance’ (henceforth referred to as ‘TTIR’) is an Augmented Reality (AR) musical work created in response to this unique location. The bulk of the music created for the project uses field recordings gathered in the park as its raw material. AR is often perceived to be in the visual domain; users can view digital content overlaid onto the real world by looking through a phone screen or Smartglasses. However, AR experiences can be created for the other senses as well; *Audio AR* (AAR) takes place when a real-world soundscape is overlaid with digital sound. [2]

GPS technology allows for the mapping of a composition over a landscape so that the music (or non-musical sound) is experienced within the context of a very specific geography. It is possible to achieve a fine alignment of sound with space that enables the structuring of a musical work around specific landmarks. Behrendt has termed this type of work *placed sound*: “Here, artists or designers curate the distribution of sounds in (outdoor) spaces, often – but not exclusively – by using GPS. The audience typically experiences these sounds via headphones and sometimes via mobile phone speakers or other mobile speakers. The audience does not contribute their own sounds or determine the location of sounds[...] but each member of the audience creates their own version or remix of a ‘placed sound’ piece, depending on their trajectory”. [3]

A placed sound work is tied to a specific location by definition, and this offers the artist an opportunity to tap into deeper layers of meaning associated with that location. Indeed, in their Brief Bibliography and Taxonomy of GPS-

Enabled Locative Media, Bleecker and Knowlton show the greatest interest in “experiences that take into account the geographic locale of interest, typically by elevating that geographic locale beyond its instrumentalised status as a ‘latitude longitude coordinated point on earth’ to the level of existential, inhabited, experienced and lived place”. [4] In creating a work that is closely linked to its performance location, numerous opportunities are opened up to the artist. It is possible to create an interplay between the real-world soundscape of the location and the recorded sounds played back through headphones or speakers. Furthermore, the recorded sounds can be related to the historical and/or cultural context of the location. It is also possible to very closely align real physical objects with virtual *sound objects*, creating *audio-visual congruence*; a concept that will be explored in more depth further on.

Pieces that are inseparable from their performance locations therefore allow for a deep layering of meaning, as well as for intriguing opportunities for creating audio-visual congruence. In ‘TTIR’, the audience hear a musical piece that has been mapped on to the environment while also experiencing the sounds of the surrounding ambiance in real time; a soundscape that has formed the basis for the musical composition itself.

In his writing on Kudsk Steensen’s AR work ‘The Deep Listener’, Obrist proposes that “digital world building can in fact entangle us with the natural world rather than separate us, training our attention on the details of how our actions create irreversible change to those environments and the biodiversity it plays host to – a necessity in light of our current environmental emergency.” [5]

‘TTIR’ layers a digital sound layer on to Taman Tugu in order to celebrate the park and its soundscape while exploring themes that resonate strongly within the Natures and Worlds track of the ISEA2022 conference. The work warns of the fragility of urban green spaces while also acting as a call to arms; the transformation of urban areas into places where nature is allowed to flourish is a small but immensely worthwhile step in the fight against climate change. This paper explores the methodology behind the creation of the work, explaining how the piece was conceived and structured to deliver its message.

It is hoped that the work will encourage new visitors to come to Taman Tugu, while offering regular visitors an opportunity to explore the park in a new way. The work premiered on September 4, 2019 as part of the international Soundwalk Sunday festival. The first public presentation of the piece occurred at a fully-booked event at the park on

December 1, 2019, and was covered on Malaysian national TV news channel Berita RTM.

Methodology

Field Recordings as Raw Materials for AR Music

‘TTIR’ is created largely from field recordings, both processed and unprocessed. In places these field recordings are augmented by synthesised tones that have been designed to sympathise with the timbre of the Taman Tugu soundscape. The recordings were gathered at various locations within the park over a period of several weeks in 2019.

The park has a rich soundscape; bird and monkey calls, the sounds of animals moving through the undergrowth, wind rustling the foliage, water dripping and running in small streams. In certain places the sounds of the city encroach too; motorbikes, trucks, construction work. However, the ever-present sound that underpins it all is a veritable roar of insect noise. It is the sound of insects therefore, that forms the base layer of the composition; recordings of this noise were manipulated in the studio to create drones that retain the shifting timbres of the jungle soundscape. The intention is that these drones appear to be embedded in the soundscape of the location, rising out of it and creating moments of interplay with the sounds of the real world. The drones are augmented by melodic parts played on instruments that were constructed using samples of bird and monkey calls, or other distinctive jungle sounds.

Delivering a Message Through Mapping

The recordings were mapped onto Taman Tugu as 22 overlapping audio zones using an app named Echoes. [6] Participants can download the Echoes app for free from the Apple App Store or Google Play Store and use it to stream ‘TTIR’. The audio zones are triggered by a participant’s phone GPS when the zone is entered, while the behaviour of the audio itself is dependent on various settings determined by the artist. The audio can start abruptly, or can fade in gradually as the participant approaches the centre of the zone. The audio can be looped until the participant leaves the zone, or can play once from start to finish before ending. ‘TTIR’ makes use of all of these audio behaviours.

In the weeks the artist spent exploring Taman Tugu gathering field recordings, it was noted that a striking feature of the park was the way in which the city of Kuala Lumpur felt entirely absent in certain places, while being extremely conspicuous in others. In the depths of the park, the foliage masks the city both visually and aurally, immersing the visitor in nature. In other places, a path can rise onto a ridge where the skyline of the city can clearly be seen, and the sounds of the city can plainly be heard.

These liminal zones – in which one finds oneself between nature and the city - became key areas in ‘TTIR’ and were mapped by the artist as can be seen in Figure 1 below. In the places where the sounds of the city infiltrate the park, this shift in the soundscape is exaggerated by the music. Digitally distorted layers of jungle soundscape and field recordings of urban sounds are layered into the music at these points; a jarring reminder that the city is not far away and could in certain circumstances swallow Taman Tugu once again.

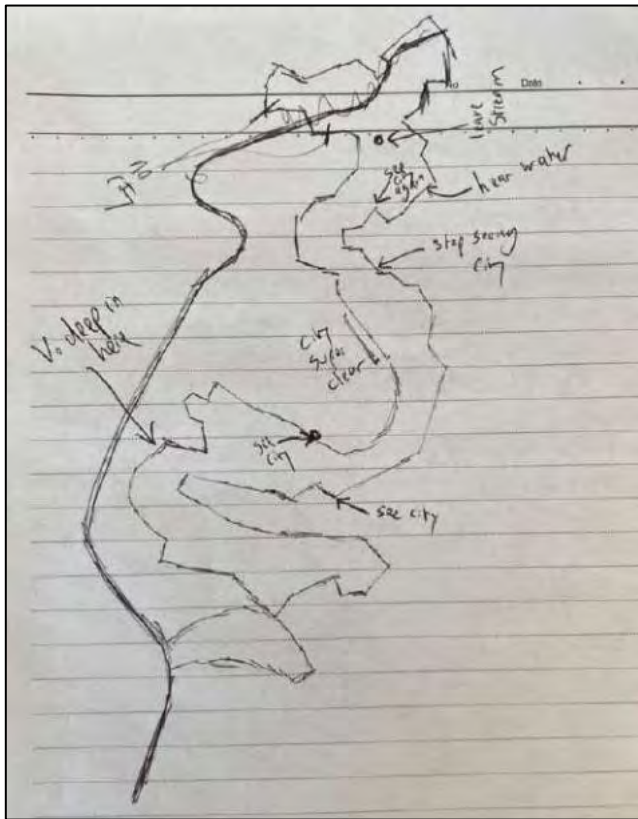


Figure 1. Artist’s map, hand drawn in the jungle, showing the points on the Taman Tugu trails at which the city becomes visible.

These are moments of audio-visual congruence, and they are central to the success of the work for two reasons. [7] Firstly, they heighten the level of immersion experienced by the audience and secondly, they help to reinforce the themes explored by the work. In his introduction to AAR, ‘Sounding Out Aural Augmented Reality’, Green explains that one requirement of such experiences is that virtual and real objects are aligned in space. In addition, he suggests that “the contextual alignment of an augmentation with reality is of equal or greater importance than spatial alignment. For

contextual alignment, a conceptual link between the virtual and real realms is needed.” [8]

Reid & Fleuriot describe the physical-virtual collisions of audio-visual congruence as an example of *magic moments*; “those moments which are deemed to be both moving and memorable and thus are those that people really value.” They deemed these moments to be of such importance to ‘situated mediascapes’ that they identified a “need to design for coincidence; that is creating events which we know will happen synchronously in the real and virtual worlds.” [9] Hazzard holds that there “is strong consensus that music shapes and drives an audiences referential and emotional interpretation of imagery” while Stevens demonstrates the impact of music on the interpretation of images, explaining that “when watching images and hearing music the viewer will form mental associations between the two, bringing the connotations of the music to bear on their understanding of a scene.” [7] [10] ‘TTIR’ makes use of the inclination of audiences to forge links between what they are seeing and

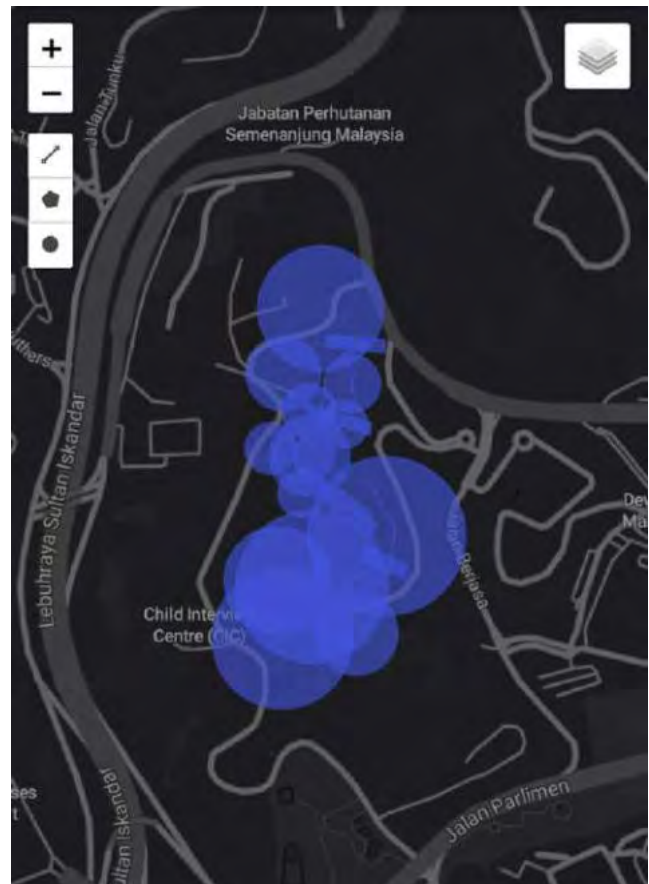


Figure 2. The 22 overlapping audio zones as they were mapped to Taman Tugu in the Echoes app.

the music that they are hearing in order to encourage engagement with the themes the work seeks to address. The final mapping of audio to Taman Tugu in the Echoes app can be seen in Figure 2, above.

Participants in ‘TTIR’ do not have to walk a set route through the park. The audio zones are arranged in such a way that the park trails can be navigated in any way the walker wishes. The message of the work is unaffected by the trajectory of travel and relies only on the participant’s willingness to explore the park. The work was designed in this way in order to encourage an approach to place that was known as *Topos* to the Ancient Greeks. In his paper on the subject, Parmar defines *Topos* as being “less concerned with directed travel than peripatetic wanderings and the experiential nature of the journey.” [11] By dispensing with a map or prescribed route, it is hoped that ‘TTIR’ foregrounds the experiential nature of a walk through the jungle and its accompanying sights and sounds, while leaving room for the themes of the work to emerge gradually as the walk progresses.

In summary, ‘TTIR’ provides a physical alignment of real and virtual objects (when the city is visible, the soundscape reflects this) that is also a contextual alignment that drives the message of the work (this green space provides a fragile refuge from the city and this requires consideration).

Conclusion

Musical composition that is strongly rooted in a specific location can help us to a greater understanding of landscape and our relationship to it. [12] ‘TTIR’ is an AAR musical experience that acts as site-specific discourse; using Taman Tugu as a refraction point for a series of broader intersecting themes, it acts as a stark reminder of the climate crisis but also invites participants to reflect on the benefits of rewilding urban spaces.

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Author Biography

Yoni Collier is currently working towards a practice-based PhD; an examination of how location-based recording, musical performance and production can be used as tools for examining artistic practice, landscape and history. Alongside a written thesis, Yoni is composing and producing immersive, interactive musical pieces that are laid over specific landscapes and ‘performed’ through location-aware Smartphone apps. Yoni holds a BA in Popular and World Musics from Leeds University and an MSc in Sound Design from Leeds Beckett University. Alongside his research, he continues to work as a freelance producer, composer and performer. His experience in composition for visual media includes work for dramatic film, corporate clients and video games. His music has featured on TV shows on ABC Family, ITV and Sky Sports, and he has scored films that have been exhibited at numerous international film festivals including the BFI London Film Festival and The ECU European Independent Film Festival.

RESILIENT TERRA

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Abstract

RESILIENT TERRA is a proposal for a collective curatorial research project looking for alliances. It aims at politicizing the notion of geoengineering by bringing together a variety of artistic practices and interdisciplinary approaches that explore geoengineering within and beyond the neoliberal context. Through a relational methodology, RESILIENT TERRA's objective is that of engaging the wider audience with concepts of geoengineering and climate justice, in order to create a space for socio-political debate that encourages transformation and speculative thinking on multiple 'larger' futures.

Keywords

Curatorial research, relationality, archipelagic thinking, intra-action, terraforming, geoengineering, new narratives, artistic research, art and technology, futures.

RESILIENT TERRA

This paper outlines the initial stages of RESILIENT TERRA, a curatorial research project that begins with explorations of the shift in meaning from terraforming to geoengineering within the global climate crisis and the "neoliberalization of the Anthropocene". [1] Benjamin Bratton defines terraforming as the process of transformation of an ecosystem of alien planets or moons into environments that are able to support Earth-like life. [2] However, he continues, the term has gained new connotations: it can now be associated with the technological interventions necessary to mitigate the effects of climate change in the Anthropocene. [3] RESILIENT TERRA aims to foster a discussion within and beyond academia and institutional contexts to engage various kinds of audiences into the current debate on geoengineering. McKenzie Wark argues that there is in fact an urgency to engage the wider public into this highly political discussion as the elites cannot be left to handle the "state of advanced metabolic rift" which themselves have caused. [4] This is a project proposal that aims to facilitate the coming together of different practices and forms of knowledge and that questions the apparent artificiality of AI and planetary technology-generated-data in order to speculate on alternative futures.

In this context, planetary scale is to be understood as the "big-world condition of co-existential nth dimensionality". [5] Patricia Reed's definition calls for relational modes of worldbuilding to move away from the neoliberal conditions which are the roots of the term's own existence. [6] In addition, the concept of contemporaneity – a "present constituted by the bringing together of a multitude of different temporalities on different scales" [7] – grounds the research at the intersect of temporalities against the linear histories of neoliberalism. It also fosters the articulation of critical thought as one of the means to escape the no-alternative scenarios precipitated by the current economic system, already well articulated by Mark Fisher in *Capitalist Realism: Is There No Alternative?* [8] The starting point of RESILIENT TERRA is to critically problematize visions of geoengineering ventures that may market the ecocide as a planetary investment opportunity, thus hindering the realization of alternative solutions which take into account climate justice.

How can the concept of geoengineering be questioned through a political lens that contrasts an understanding of the climate crisis as an opportunity for the accumulation of capital? Can we still conceive of ways in which planetary scale technology can be deployed to support practices of climate justice? These are some of the questions on which RESILIENT TERRA's methods have been built on. The methodology is inspired by Édouard Glissant's archipelagic thinking [9] and is built on the ideas of mondialité [10] and Karen Barad's intra-action [11]. These concepts support the relational nature of the project at multiple levels and allow RESILIENT TERRA to emphasize climate justice issues within a politicization of geoengineering practices. Archipelagic thinking allows me to envision a model for curatorial practice that enables the coexistence of fragments, agents and narratives through processes of "broken comprehension, ambivalent competence, unhinged knowledge". [12] This rogue knowledge connects to Glissant's proposition for a mondialité (or globality) that does not "homogenise culture but produces a difference from which new things can emerge." [13] The image of the archipelago outlined by Glissant visualizes a particular mode of exploring contemporaneity, one which encourages diversity and

multiplicity and that opposes global homogenizing and alienating practices. [14] The aim is to address each enquiry through curatorial, artistic and discursive methods that allow a diversity of viewpoints to come together and multiple perspectives to emerge.

The intertwined plurality of the agents involved in the curatorial project is articulated through the idea of intra-action. [15] In intra-action, responsibilities are distributed and human and non-human agents intra-act in a co-constitutive manner. [16] Incorporating this idea into the methodology allows me to think of the curatorial as evolving sets of relationships which have the ability to inspire the development of political ways of worldbuilding and strategies of resilience. Within these parameters it is also crucial to consider what Reed refers to as “situational insistence.” [17] This is an approach that preserves the particular in the context of the planetary, much like Glissant’s understanding of the local within mondialité. It is through a methodology built on practices of relationality and non-hierarchical configurations that RESILIENT TERRA aims to form an interdisciplinary think tank that encourages research, artistic explorations and knowledge production that focuses on what making geoengineering political means on a planetary scale as well as on a local and situational level.

RESILIENT TERRA looks to contribute to the urgent debate on viable and reliable responses to climate change effects with a relational and intersectional methodology that enables a discussion on geoengineered futures which includes what techno-positivist approaches tends to disregard: “social in/justice concerns.” [18] In recent years, the work of Holly Jean Buck and Benjamin Bratton has produced invaluable research. By exploring the dichotomy between connotations of geoengineering with ecomodernism and politics of inequality and the link between sustainable technology for climate justice, Buck speculates on how a geoengineered future may look, giving us an intervention on climate realism (or the eco-planetary crisis). [19] Planetaryity is also a key concept in the Terraforming research program at the Strelka Institute, which explores, among other themes, a comprehensive notion of terraforming (from urbanization to planetary design for life survival) as a tool for keeping our planet safe for Earth-like life. This planetary perspective, formulated with data collected by the stack of planetary technologies, [20] allows us to shift the anthropocentric focus of terraforming and open up the geoengineering project beyond human survival to other species.

Within this framework, RESILIENT TERRA fosters research on imaginative spaces and resilient narratives

linked with terraforming and geoengineering in the socio-political and environmental realms affected by the metabolic rift. One of the concerns that motivated this research emerged from the existence of initiatives such as the Breakthrough Institute. J.D. Demos criticizes Ecomodernism and references Michael Shellenberger and Ted Nordhaus’ essay *The Death of Environmentalism: Global Warming Politics in a Post-Environmental World* (2004). Demos explains how Shellenberger and Nordhaus, founders of the Breakthrough Institute, “sought to dispatch what they termed the “politics of limits” – the kind based in the regulatory environmentalism of the 1970s emphasizing Earth’s finite carrying capacity – and replace it with a “politics of possibility” dedicated to technologically-driven economic growth.” [21] He continues by highlighting the growing bond between Big Tech and Green Economics, which would turn geoengineering into a neoliberalist strategy for saving the planet. [22]

Inherited from Science Fiction literature is an idea of terraforming as “the utopian moment par excellence”. [23] It represents a process of transformation of an alien planet (often Mars) into an environment safe to inhabit for humans. Although, the immediate question that arises is: Utopia for whom? The connection between utopia and terraforming and by default geoengineering is one of the narratives that RESILIENT TERRA contests in order to make manifest in accessible ways the white supremacist, colonial and neoliberal biases intrinsic to the trope of terraforming. One of the challenges is to distance geoengineering from these traits and from Ecomodernism while investigating possibilities that may arise from reframing it within the context of climate justice. What can we learn from Afrofuturism’s space settlements that can help us reimagine a habitable future for all on our planet? Another question that arises here is if utopian speculations can help us experiment with imaginary and self-enclosed models for alternative futures that fight what China Miéville summarizes as the threat of lucroforming: “In neoliberalism, we see the quickening logic of “lucroforming”, a politico-geo-transformative agenda to make our entire planet ... the most fecund biome possible for capital.” [24] It is in this context that RESILIENT TERRA values personal utopian speculations but requires us to consider these intersectionally, as local agents on a planetary dialogue that values situational knowledge, histories and futures.

To avoid lucroforming and ecomodernism from becoming the new normal, artists, thinkers and practitioners from all fields are required to envision alternative futures. At her acceptance speech for the

National Book Foundation Medal for Distinguished Contribution to American Letters (2012), Ursula Le Guin called for artists to envision exactly these alternatives in order to avoid being stuck in this not at all promising present:

“Hard times are coming, when we’ll be wanting the voices of writers who can see alternatives to how we live now, can see through our fear-stricken society and its obsessive technologies to other ways of being, and even imagine real grounds for hope. We’ll need writers who can remember freedom — poets, visionaries — realists of a larger reality.” [25]

In real-life geoengineering projects, the presence of artists and creative thinkers is rare. Two examples come to mind: the Biosphere 2 experiment (1991-1993) and a NASA experiment in which a team of scientists, architects, urban planners and artists were employed to design speculative space habitats for millions of people (1975). The book *Space Settlements* (2019) by Fred Scharmen offers an account of this particular event. The Biosphere 2 project, recently popularized by the documentary *Spaceship Earth* (2020) directed by Matt Wolf, was a utopian experiment that attempted to replicate Earth’s atmosphere in an enclosed ecosystem should humans, due to ecological disaster, have to vacate the planet. The latter example is especially relevant due to Steve Bannon’s involvement and influence in turning 1993’s failed experiment into an opportunity to experiment on and with climate change effects on Earth.

RESILIENT TERRA’s investigation has begun with the work of artists, researchers, writers and collectives who have explored aspects of terraforming and geoengineering in their work through a variety of lenses and approaches. DESIGN EARTH (founded by Rania Ghosn and El Hadi Jazairy in 2010) is a research initiative working with design and architecture to reveal aspects of the eco-crisis. Their project *Cosmorama* (2018) speculates on planetary narratives in space and raises the ever-relevant questions of space sovereignty, terraforming practices and space pollution. In *Geostories: Another Architecture for the Environment* (2018) they present us with a “manifesto for environmental imagination” that through geographic fiction asks us to rethink our relations and understandings of planetary scale systems. [26] The more recent *The Planet After Geoengineering* (2021) is a multimedia speculative work which complexifies geoengineering as a form of management beyond the popular good vs evil dichotomy. The project, which was presented at the Venice Architecture Biennale 2021 also included Holly Jean Buck, Benjamin Bratton and Kathryn Yusoff as contributors. [27]

Kim Stanley Robinson’s science fiction novels allow us to imagine different future scenarios that are all very much embedded in the present. *Mars Trilogy* (Red Mars, Green Mars and Blue Mars, 1992-1996) is a key literary exploration of terraforming in climate fiction. The subject is the transformation of Mars into a habitable planet for human beings but, in classic sci-fi fashion, the author uses the terraforming trope as a means to reflect on the current status of Earth’s various infrastructures (organizational, economic, socio-political, ecological, etc.). [28]

Sun Ra and Parliament’s Afrofuturist space-age narratives contribute to the process of decolonization of the idea of geoengineering itself. Outer space represents a public and free space where speculations on better futures are still possible to imagine. Sun Ra’s work in the 70s (*Space is the Place*, 1974, for instance) frames outer space as a utopian possibility for people of color to escape Earth-bound racism, injustices and colonial histories of oppression. [29] Parliament’s *Mothership Connection* (1975) presents funk as a state of being, an attitude toward living holistically in the world; with George Clinton envisioning a futuristic space age in which the main protagonists are black people. [30]

Back on Earth, Superflux’s *Mitigation of Shock Singapore* (2020) speculates on the living conditions of an apartment in Singapore towards the end of the 21st century. The context is an ecosystem falling apart due to the effects of climate change. Human and non-human forms of co-operations in the post-Anthropocene era together with strategies of resistance and adaptation are the subject of a variety of works by Superflux, funded by Anab Jain and Jon Arderin in 2009, such as *Invitation for Hope* (2021) and *Refuge for Resurgence* (2021). [31]

Of interest are also two further initiatives. Geocinema: a project of artistic research exploring future cinema: a cinema in which the “big-data infrastructure combining information from thousands of sensors and satellites might be considered as a “lens” for planetary-scale drama and storytelling.” [32]; and Natasha Myers’ *How to grow livable worlds: Ten (not-so-easy) steps for life in the Planthropocene*, a 10-point manifesto for decolonizing the Anthropocene through a plant-centered approach. [33]

These are some of the works that, together with the key references appearing throughout the text, have inspired the formulation of RESILIENT TERRA as a speculative curatorial research project proposal. This is a project in its initial stages that needs alliances with interested researchers, artists and creative practitioners from different fields to take its best form in real life as a collaborative and

relational initiative aimed at politicizing the concept of geoeengineering beyond the framework of the neoliberal Anthropocene and within the context of climate justice.

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Biography

Patrizia Costantin (PhD) is a lecturer and researcher in curating whose work investigates the curatorial as a site for knowledge production and political worldbuilding. She is particularly interested in exploring the role of curating as a relational practice for negotiating with reality, contemporaneity and the technological realm. Costantin holds a PhD in Curatorial Practice (Manchester Metropolitan University, 2019). Her thesis, *machines will watch us die: a curatorial study on the contemporaneity of digital decay* explored digital decay after the material turn in media studies through a postmedium approach. The project emphasized the multiple materialities and temporalities of digital technology and experimented with curatorial strategies with the aim of making visible digital decay and its contemporaneity within the context of a research exhibition. She is currently Head of Visual Cultures, Curating and Contemporary Art – ViCCA major – and Lecturer in Curating at the School of Arts, Design and Architecture at Aalto University.

FORM AND TIME / DECENTERING SITES OF ART STUDIO PEDAGOGY

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Abstract

From the art school's studio-based format, the authors situate *Form and Time* as a *Studio Presentation* course. Scheduled to launch on campus in Fall 2020, the course pivoted to fully remote. Thematic units of Space, Form and Time were explored in synchronous meetings and asynchronous video lectures and micro-workshops.

Studio Presentation courses can engage art students in dispersed, interdisciplinary research-creation networks, through strategies including a diversity of fabrication options, DIY and place-based knowledge and accessibility as approaches to meaning through making.

The authors ask: how can hands-on fabrication skills and health and safety instruction be incorporated into large format studio courses? When is face-to-face, hands-on learning crucial and for whom? How can virtual studios be used for community collaboration and exhibition opportunities, online and in-person?

Form and Time and its collaborators in WebXR foreshadow new modes of art school studio delivery that decenter and critically intersect with studio precedents suddenly disrupted by remote learning during COVID-19.

Keywords

course-based research, studio-based pedagogy, research-creation, art as research, WebXR

Background

Before Fall 2020, *Time-Based Media* and *Form and Structure* were required first-year studio courses at OCAD University in Toronto, introducing media and sculpture-installation practices. Classes met weekly in fabrication studios, computer labs or studio/seminar rooms, where safety, basic techniques, and studio critique were

introduced. These gateway courses fed into specialized programs that culminated in studio thesis work. This approach to teaching studio art foundations has gone largely unchanged since the late-twentieth century in the Faculty of Art at OCAD University (OCADU).

Fault lines in this model emerged before the COVID-19 disruption. Inequities of access are disproportionately experienced by racialized and international students, learners from northern communities and First Nations, the financially precarious and those who cannot or choose not to relocate to downtown Toronto. This includes students facing accessibility challenges of physical and mental health, and those encountering systemic discrimination within the art school. OCADU's 2017-2022 Academic Plan¹ frames accessibility alongside decolonization. Renewal of pedagogy and BIPOC cluster hires are amongst initiatives implemented by OCADU to support accessibility, sustainability, representation, inter-disciplinary, relational and place-based knowledge and practices, and decolonization including training in anti-racism. Curriculum is also being reconfigured to implement the Truth and Reconciliation Commission of Canada's Calls to Action², including educating teachers in how to integrate Indigenous knowledge and teaching methods in post-secondary classrooms. Finally, large-format cross-disciplinary courses including *Form and Time* are designed to offset the costs of small studio classes.

Remote Delivery During Pandemic

Cross-disciplinary and thematic, *Form and Time* was designed by Doyle, Jones and participating teaching faculty to combine delivery approaches: large scale auditorium faculty presentations alongside smaller faculty-led studio-seminars and micro-workshop makerspaces with

¹ (OCADU's) Academic Plan 2017-2022 devotes Priorities 6 and 7 to interdisciplinarity and changes in studio delivery and the teaching and learning environment, in the context of an institutional call to decolonization.

² The Truth and Reconciliation Commission of Canada's Calls to Action – Education and Reconciliation, 62.ii (TRC Calls to Action, 7)

technicians and teaching assistants. Students conduct weekly creative experiments from thematic units: Space, Form, and Time.

In Fall 2020, the new course pivoted to fully remote delivery for three consecutive semesters with enrolments of between 150 and 240 students each semester. The COVID-19 response called for quick improvisation, with the creation of a suite of instructional videos for weekly release, and a reworking of prompts for creative experiments that could be undertaken without access to campus.

Each week, an instructional video was released on Space, Form and Time subthemes. Students posted weekly experiments and comments to Discussion Boards, with bi-weekly synchronous online meetups on Teams. *Form and Time* launched online with the *Space: Site Specificity* module, acknowledging the worldwide emergency conditions of physical distancing, border closures, police brutality and anti-racist protest. Creative activities included walking, observation, documentation and experimentation.

Students produced creative experiments that referenced their specific sites (local, regional and international) including personal aspects of the disparate places they occupied.

Decolonizing Site, the week two module, included the option of an experimental Land Acknowledgement: Emilia Nahdee layered images of herself in Oakville Ontario, and Walpole Island Unceded Territory. Nahdee writes, “Indigenous culture, land and history is still alive, vibrant and dynamic. Those who choose to look closer will find details in the layers, but the constant in the image (and this land as well) is the experiences of the Anishinaabe Indigenous person. I intend through the blurred appearance and saturated layering of images for my audience to reflect, looking closer at their own communities and actively acknowledging the land and its first peoples”³. (Figure 1).

Basic techniques normally introduced on campus in the first-year shops, translated to experiments with non-traditional materials and processes that were available to students in situ and encouraged documentation of experimentation and process work, DIY techniques, and fabrication using everyday materials close to hand. Faculty and teaching assistants shared their diverse skills and practices, contributing to a growing library of video micro-workshops with specific technical instruction. Students were assessed on a rubric of criticality, ideation, experimentation, observation and thoroughness of the documentation. An atmosphere of collegiality, community and peer-to-peer learning and exchange of ideas emerged

and was critical to the success of the online studio learning environment.



Figure 1. Emilia Nahdee, *Land Acknowledgement*, digital compilation photograph, 2020. © Emilia Nahdee.

To highlight weekly student experiments, several student projects were featured in weekly Artist Spotlights on the course home pages, motivating students by example and encouraging risk-taking and experimentalism. Students shared their work in weekly, synchronous meetups and in-depth ‘Crit Club’ presentations that they could opt into. Faculty observed that these synchronous critique sessions were popular; although not all chose to share their work, many participated as observers, providing feedback, engaging with ideas and sharing their individual responses to the course themes. These discussions were intensely interdisciplinary, with students executing their ideas using a variety of media and approaches. Many students shared that they came from a traditional drawing background but were now interested in 3D and digital explorations in relation to their 2D practices. Building on these initiatives, Doyle and Jones identified a need in *Form and Time* to develop a more ambitious community exhibition space.

WebXR Exhibition and Critique Studio

At OCADU, WebXR experimentation began in the Unreal Club based in the Social Media and Collaboration Lab (SMACLab) led by Doyle, who used volumetric capture in her workshops conducted at the Athens School of Fine Arts in 2019 and at ISEA 2019 Gwanju: *Tangible, Embedded, and Embodied Interaction*.⁴ Dr. Graham Wakefield at the

³ Emilia Nahdee, “Artist Spotlight”, Form and Time Canvas Homepage, September 2020, cited October 12, 2021.

⁴ These workshops received support from the Ontario Arts Council in 2019.

Alice Lab at Toronto’s York University (York U) explored WebXR with his advanced students. The researchers at OCADU and York U secured funding to develop an open-source open-access WebXR Exhibition and Critique Studio for undergraduate and graduate students, focusing on project creation, curation and critique, supported by the Government of Ontario’s eCampus program.⁵ The project aimed to develop WebXR to support local and community-based pedagogy by developing accessible technology, using research-creation and course-based research methods.⁶ The collaborators included Dr. Graham Wakefield and his researchers including Nick Fox-Gieg, and Doyle, Jones, Elizabeth Lopez and Dr. Haru Ji at OCADU, who during Summer 2021 designed, prototyped and tested WebXR approaches. Prototype artworks were created by Joaquim (Juka) Almeida and Paulina Aviles to identify and stress-test WebXR features, and as inspiration for students. Participating remotely from Mexico as an undergraduate Intern, Aviles’ work engaged with museum practices of collection by creating volumetric collages from photogrammetric captures from the collection in a local cultural archive. Almeida, an OCADU graduate student, created an experimental fusion including archival Brazilian Cinema Novo film, performance, sound and mask in a VR space. He writes “...This mask represents a *Cangaceiro*, a folkloric Brazilian entity... captured through photogrammetry (and) stored as a point cloud. (Figure 2). The films (included in the WebXR gallery) were designed to offer a virtual reality experience, composed by layering personal diving footage from Brazilian seas with extracts from a 1937 anthropological documentary about the Cangaceiro movement...”⁷



Figure 2. Screenshot of WebXR, work by Joaquim Almeida, *Cangaceiro*. ©Joaquim Almeida.

⁵ WebXR Exhibition and Critique Studio, funded by the Government of Ontario and through eCampusOntario’s support of the Virtual Learning Strategy, 2021.

Collaborative Sites

Each course-based team created templates, resulting in three toolkits for exhibition and creation in WebXR. The *Form and Time* team at OCADU developed an A-Frame WebXR interface and user manual (Nick Alexander) with quick use entry-level programming templates (Tyson Moll). The Project Manager (Lopez) and Virtual Studio Manager (Ernesto Rodriguez) directly supported students in their creation of photogrammetry and its installation in WebXR, working with students in group synchronous sessions or over email and file sharing.

Design and prototyping by undergraduate and graduate students in the Creative Computation class based in the Alice Lab at York U led by Dr. Wakefield included course work on WebXR features for real-time collaboration and generative art, including design to best support distributed creative experimentation.

Dr. Ji piloted WebXR as part of OCADU’s Digital Futures Atelier 1, in the 'Endless Forms Most Beautiful' unit. For this project, Ji and her researchers developed a prototype framework for generative art. Students forked the template and edited it to add their own generative artworks. Tim Chou, a second year Digital Futures student wrote, “I want to use this space to display my process of this generative experiment. Each side of the wall shows a new and different result produced by manipulating or changing the fundamental rules”. Looking forward, OCADU faculty are investigating potential spaces where generative and pre-configured artworks and assets intersect and overlap.

Reflections and Observations

Launched in an emergency, *Form and Time* defamiliarizes and troubles dichotomies between studio delivery modes—online or in-person, synchronous versus asynchronous. Employing a multi-modal, flexible, responsive format, the course engages different modes of delivery and group sizes, embracing experimentation and interdisciplinary approaches to artmaking and research-creation. Building community for students in their first year of university is an important component of the course. Student participation in synchronous and asynchronous opportunities for information sharing and exchange of ideas fostered an inclusive environment that was dynamic, respectful and highly rewarding.

⁶ “...art with an activist impulse... offers speculative frames through which to *defamiliarize* and *reorganize* the local. (Loveless, 301)

⁷ Joaquim Almeida, Artist Statement, October 2021.

The authors observe that direct teacher-to-student feedback including marking poses challenges in large-format studios; individual feedback is time-consuming and not scalable. Student peer-feedback, including group work, is key to managing class size and motivating students. Studio Presentation is a form of blended delivery, combining online and in-person, and smaller and larger scale encounters. Optional sign-up activities—field trips, gallery visits and micro-workshops—provide in-person possibilities introducing first-year students to their peers, the campus and local art communities. Differing faculty expertise and preferences for teaching modes (online, partially remote) can combine and complement each other through shared online resources and scheduling innovations. Online resources, including WebXR, can facilitate collaboration with other courses, faculties, universities and community-based networks, developing an archive of open-source, open-access assets, including the studio WebXR platform alongside micro-workshops, video tutorials, student examples and creative computation toolkits.

As access to campus and fabrication studios reopen, we can seize the opportunity to reconfigure studio pathways for creative experimentation, materials handling and technical instruction. Importantly, online exhibition and display of student work can expand beyond the confines of the institution, to build relationships between communities (institutional and non-institutional), localities and student groups.

WebXR enables blended modes of studio art delivery. The authors explored generative art, photogrammetric capture, and creative, collaborative coding in this project. Cinematic capture from virtual environments for video installation also benefits from open-source access to WebXR. INTERPLACE—a video installation featuring screen captured moving images from WebXR of the *Form and Time Fall 2021* class—was exhibited at the Ada Slight Student Gallery and the Great Hall at OCADU in Winter 2022. The exhibition included multiscreen monitors, projection, surround-sound and live sonic art performance by Paul Geldart. The video installation merged online and physical places, featuring student photogrammetry produced in their home studios across dispersed localities during COVID-19. (Figure 3: detail, *Yellow Staircase* in WebXR)

INTERPLACE marked the occasion of return to in-person exhibition on campus following pandemic restrictions; it was a powerful encounter. This back-and-forth between WebXR and local in-person exhibition and performance is a fertile option for hybrid, online and blended teaching pedagogy. Expanded and mixed reality exhibitions, collaborations and events foster community-based engagement and extend the potential to decenter studio art pedagogy by supporting community-based networks.

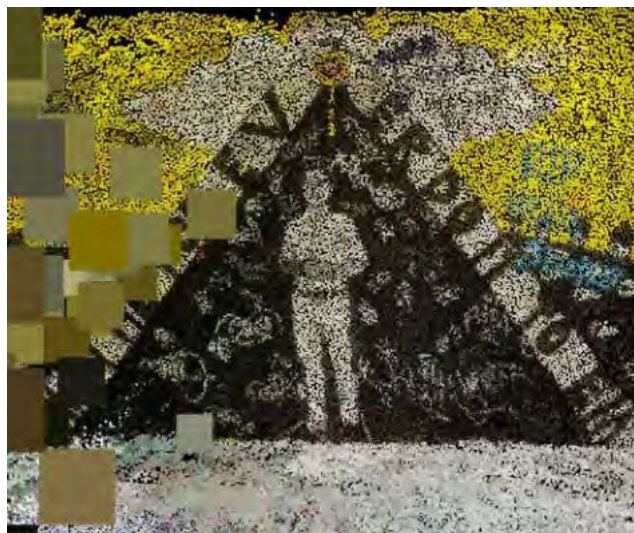


Figure 3. Screenshot of WebXR, work by Unreal Club (Nick Alexander, Judith Doyle, Lillian Leung), *Yellow Staircase*. ©Simone Jones.

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Authors Biographies

Judith Doyle is an artist practicing in cinema and expanded reality. An Associate Professor at OCADU, they are Chair First-Year Art and co-direct the OCADU SMACLab.

Simone Jones is an artist whose works are shown internationally. They are a Professor at OCADU.

Elizabeth Lopez is an interdisciplinary artist and researcher whose works are shown in Canada and the US.

Memory's death... or the desire of immortality

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Abstract

Who tells history? We can find multiple versions about the electronic art history, most of them with subtle differences, but it has been unusual -until a few years ago- to find references pointing to countries out of a small group from Europe and North America. Several projects have been developed to change that situation. The Latin American Electroacoustic Music Collection, hosted by The Daniel Langlois Foundation for Art, Science and Technology, represents an example of the relevant role and the impact that the archival of electronic artworks and its public access can play in having another perspective about history.

Keywords

Archiving, electronic art preservation, electroacoustic music history, cultural decentralization, Latin America.

Introduction

The journey from the cultural memory and the ethical concerns to the practical strategies on preservation and the impact of disseminating knowledge generated by computer art has been navigating a sinuous road.

Memory's death could benefit some as much as the desire for immortality could block the way to innovation open naturally to new generations. Computer art memory has been partially dead, or perhaps deaf or blind or simply looking to the other side, maybe to avoid the perception that the so-called digital revolution has reached most of the known world and that history does not happen only in a few "central" countries. The desire of immortality and for being a cultural lighthouse as much as the guardian of the right values and the significant art should not take us all to mislead that intelligence and sensibility belongs to a few.

Who tells history? Who knows about it or who has the opportunity to do it? We can find multiple versions about the computer art history, most of them with subtle differences, but it has been unusual -until recently- to find references pointing to countries out of a small group from Europe and North America. Inequalities have always existed and if we want to see a change, probably we will need to work hard ourselves to produce new results. There are many lost and hidden stories about computer art that probably should be part of the official history and not just left aside. There have been people, ideas and concepts, artworks, discoveries and inventions, and we expect someone will take care of keeping the memory of all that for us but sometimes it simply doesn't happen and when we look around after a while, it seems that the history has not been the one we thought it was and we remember, but a different one that is being told by others.

Between the obsession for archiving everything and the difficulty and strong responsibility of deciding what to preserve, the opportunity to archive computer art makes us face a challenge involving from technical issues to political, social, cultural and economic aspects.

How many histories can be told about the same subject? To who their narrative is directed? I have heard some educated young people saying that "if something is not on the Internet, does not exist". Then, today the digital divide could be not linked to who has access to the web but to who dominates the inclusion of content or develop the strategies to keep our attention on certain places and not others. It looks like we are bombarded with cues guiding us to consider that the art conceived by some cultures are the only ones to be recognized as valid.

The Daniel Langlois Foundation for Art, Science and Technology [1] in Montreal has been a leading organization heavily focused on studying theoretical aspects related to preserving electronic and computer art and actually archiving it. A number of major projects have been developed or hosted there since the late 90s, including the Latin American Electroacoustic Music Collection [2], among many others.

Music & technology innovation in Latin America

The political and economic instability in most Latin American countries has been deeply affecting the life of its inhabitants for decades. Support for artistic activities has usually been postponed to solve urgent social problems. In spite of that, the development in the region of the electronic arts in general and the electroacoustic music in particular, is really astounding. To name but a few examples: Mauricio Kagel (Argentina, 1931 - Germany, 2008) composed eight electroacoustic studies in Argentina between 1950 and 1953, according to Hugh Davies' International Electronic Music Catalog published in 1968 [3]. Kagel was one the pioneer composers that were laying the foundations of a rich history of experimentation and creation in the region. Reginaldo Carvalho and Jorge Antunes in Brazil, León Schidlowsky and Juan Amenabar in Chile, Joaquín Orellana in Guatemala and Horacio Vaggione in Argentina are only some of the many names in the ocean of electroacoustic music creativity that has always been Latin America.

José Vicente Asuar composed between 1958 and 1959 in Chile his piece *Variaciones Espectrales* using only electronic sound sources. The Estudio de Fonología Musical was created in the University of Buenos Aires of Argentina by Francisco Kröpfl and Fausto Maranca at the end of 1958. During those same years and also in Argentina, César Franchisena was also experimenting with electronic sound sources at the National University of Córdoba radio station and composed *Numancia*, a ballet music on tape, in 1960. A landmark in the electronic music history of Latin America was the lab created in Buenos Aires during 1963 at the Centro Latinoamericano de Altos Estudios Musicales - CLAEM of the Instituto Torcuato Di Tella (the Electronic Music Laboratory was part of the Latin American Higher Studies Musical Center of the Torcuato Di Tella Institute). Peruvian composer César Bolaños created *Intensidad y Altura*, the first piece for tape produced at that lab, in 1964.



Figure 1. Latin American composers at CLAEM's Electronic Music Lab.

In Cuba, Juan Blanco composed *Música para danza* for tape in 1961 and *Texturas* for orchestra and tape between 1963 and 1964. Blanco composed around a hundred works using electroacoustic media, including music for mass public events and large venues, like the five-tracks 1968 tape piece *Ambientación Sonora*, played during 30 nights along La Rampa Avenue in Havana. Carlos Jiménez Mabarak composed in Mexico *El paraíso de los ahogados*, a piece on tape, in 1960.

Also in 1960, engineer Raúl Pavón built the prototype of a small electronic musical instrument featuring an oscillator with multiple waveform outputs, a white noise generator, a variety of filters, an envelope generator and a keyboard. Named *Omnifón* by Pavón, his creation was among the first voltage-controlled electronic sound synthesizers. Well before that, in the early 40s, the aforementioned composer Juan Blanco designed an innovative electronic instrument similar in concept to the Mellotron. His *Multiorgan* was based on 12 loops using magnetophonic wires. It predated the Mellotron -that is considered the predecessor of the digital sampler, the instrument that changed the way of doing music- by several years. Fernando von Reichenbach invented in Argentina the *Analog Graphic Converter* in the 60s (also known as: *Catalina*). It was used to transform graphic scores -from pencil drawings done on a paper roll- into electronic control signals adapted to work with analog sound equipment. José Vicente Asuar produced in Chile a hybrid analog-digital computer system in the mid 70s, exclusively devoted to create music.

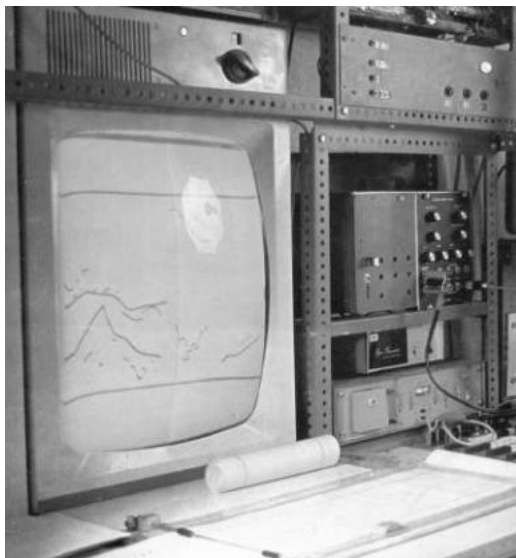


Figure 2. The Analog Graphic Converter developed by Fernando von Reichenbach at CLAEM during the late 60s.

Reichenbach redesigned CLAEM's Electronic Music Lab and invented several devices, such as the keyboard-controlled polyphonic third/octave and octave filter and a touch-controlled patch-bay that helped composers to simplify some cumbersome processes in the studio. Today, Reichenbach's inventions are starting to be internationally recognized.

Latin American Electroacoustic Music Collection

Unavailability of musical recordings, bibliography and almost any basic reference to the electroacoustic music activities that were developed since the early 1950s in several Latin American countries was commonplace when I started to work on the field around the mid-1970s. That situation did not change much during several decades.

In various Latin American countries, universities, state organizations and major private foundations have taken initiatives to support art research and the use of new media already in the early 60s, but most have stopped before developing the resources to document their processes and preserve the results. Many early tape compositions, for example, have been lost or the master recordings damaged.

The Latin American Electroacoustic Music Collection, with over 1,700 digital recordings [4] of compositions by almost 400 composers, and accompanied by photographs, scores, interviews, a trilingual historical essay [5] and over 200,000 words in its database, represents an example of the relevant role that the archival of artworks and its public access can play in having another perspective about history. This is today a key resource in the field, being consulted extensively by people from around the world each month (e.g., researchers, composers, performers, musicologists, historians, artists and the general public) and helping to transform the usual perception of "ownership" that exists related to some countries with respect to the computer art history.

The archive it includes compositions for fixed media (tape, DAT, CD, HD or similar) as well as mixed works for acoustic instruments or voices and fixed media or live electronics/interactive systems. There are also some multimedia works in the database. In the case of pieces for fixed media and other sound sources (e.g., mixed works), full recordings as well as "tape only" parts (i.e., fixed media) are preserved and catalogued. The archive also includes audio and audiovisual recordings of interviews [6] to composers and technical innovators (e.g., Alberto Villalpando from Bolivia, Manuel Enriquez from Mexico, Alfredo del Mónaco from Venezuela) as well as photographs, videos and some scores (e.g., by Alcides Lanza from Argentina, Javier Alvarez from Mexico, Milton Estevez from Ecuador).

From a technical perspective, the archiving of audio material went through a myriad of problems: recovering from massive hard disk crashes, finding analog tape recorders with old track formats, re-digitizing material to correct severe DC offsets in brand-new equipment, computer operating systems and FireWire conflicts, etc. Defining how best to work with very noisy old recordings was another challenge (a few pieces were processed using an advanced de-noise system to moderate hiss, always preserving the original recording and following the composer's advice). The bulk of the process was done between 2003 and 2005 at the Langlois Foundation, working with three different computers and nine hard disks to manage the audio and visual files, the database and the large amount of info as well as the daily international communications.

Worth mentioning that while the recording quality of some music stored on old analog tape could have suffered through the years, digital technologies for recording storage were the ones presenting the most difficult challenges. For example, some DATs (Digital Audio Tapes) lost part of their recordings and only a loud digital noise was in place of the music. In those cases, the problem was not only a poor quality (e.g., because of hiss or the loss of high frequencies) but a complete lack of the recorded signal, without any possibility to recover the original materials.

There are 1,723 compositions preserved as digital audio -with CD quality- in the database. While all is available for listening to researchers who ask for an access code (to avoid copyright infringement) contacting the Langlois Foundation, 558 works from those are freely available and can be listened to by the general public online. The database has also over 200,000 words in information, and there are multiple ways to find the information in there. The digital audio recording of a composition can be found by its title, the name of the composer, the country linked to that composer, the year or decade when the work was composed, etc. In addition, there are two playlists to access and listen to the compositions: one sorted alphabetically by the last name of the composer [7], the other sorted chronologically, following the year the piece was composed [8]. Instrumentation, program notes, production studio, version, composer's bio and more have been also included for each work when the information was available. Part of that comes from two previous reports I wrote commissioned by UNESCO, between 2002 and 2003: *Historical Aspects of Electroacoustic Music in Latin America: From Pioneering to Present Days* [9] and *La música electroacústica en América Latina* [10]. They were published online and are available through the UNESCO's Digi-Arts knowledge portal. These texts include references to hundreds of composers who were born or pursued a portion of their professional careers in Latin America: 191 from Argentina; 14 from Bolivia; 90 from Brazil; 39 from Chile; 39 from Colombia; 5 from Costa Rica; 44 from Cuba; 3 from the Dominican Republic; 11 from Ecuador; 5 from El Salvador; 6 from Guatemala; 73 from Mexico; 3 from Panama; 4 from Paraguay; 15 from Peru; 12 from Puerto Rico; 27 from Uruguay; and 35 from Venezuela.

This is one of the most visited and consulted collections of the Daniel Langlois Foundation.

Final words

The Latin American Electroacoustic Music Collection has recovered and made visible (and listenable) the creative work of many electronic artists otherwise almost forgotten. It has defied the wish of immortality and the hegemony of the electronic art history narrative, breaking one of the memory's death roads and slowly shifting and widening the way the history of electroacoustic music is been understood.

Archiving and disseminating electronic and computer art history findings is crucial to comprehend the present and to build our future.

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Visualizing the Unpredictable Behavior of Wildfire Using an Artificially Intelligent Aesthetic

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Abstract

The 21st century sees the rise of wildfires, which radically destabilize the anthropocentric paradigm that places the human at its centre, by manifesting what theorists like Bruno Latour term ‘terrestrial agency’. As a manifold process that encompasses Earth’s ecological systems, we have been co-evolving within these processes, harnessing them for our civilizational progress. Yet, our concomitant refusal to acknowledge nature as an independent agent in which we exist has exacerbated climate change, leading us into what scholar Rick McRae terms the ‘age of violent pyroconvection’ [10] – an age in which life on Earth will be shaped by wildfires and their complex dynamics. It amplifies the autonomous nature of terrestrial agency whose behavior defies human assumptions [8]. These evolving dynamics between the human and the planetary require new aesthetic contexts in which two autonomous yet interrelated agencies mutually transform and disrupt each other. Existing creative visualization paradigms have struggled to aesthetically engage this relationship, falling short of providing compelling sensorial points of engagement. The paper briefly analyzes exemplary artistic works and proposes a novel aesthetic framework premised on integrating immersive visualization systems and Artificial Intelligence (AI) programming. It experimentally explores this architecture in relation to the *iFire* research project currently in development at The University of New South Wales.

Keywords

Aesthetics, Artificial Intelligence, Bruno Latour, Climate Change, Creative Visualization, Installation Art, J.M.W. Turner, Michel Serres, Real-Time Interaction, Terrestrial, Virtual Reality, Wildfire

Introduction

As the world has warmed over the past two decades as a result of dynamic terrestrial and atmospheric processes, so have fires increased in their incidence and scale [4]. Examples are the ferocious wildfires that most recently tore through North America and Argentina in 2022, the Mediterranean, Northern America and Russia in 2021, and Australia in 2019 and 2020 [8]. Most wildfires are characterized by mega-scale, unprecedented speed, generation of their own weather systems and their unpredictable dynamics [9]. Over the past two decades, they have caused devastating loss of human lives, fauna, habitat and property, in turn further warming the planet [14]. As

climate systems change across the globe, we are entering an age scholar Rick McRae refers to as the ‘age of violent pyroconvection’, in which our lifeworlds will be predominantly shaped by fire, with more communities than ever affected by its manifold forces [10]. Theorists such as Manuel DeLanda, Bruno Latour and Michel Serres analyze such developments as expressions of a terrestrial system whose independent yet symbiotic agency is perpetually evolving in a non-linear way as it interacts with the human world [6]. Its forceful amplification requires us to comprehensively address our position within this planetary system, learning to adapt to forces that act according to their own logic [10]. Wildfires represent a concentrated manifestation of such destabilizing agency, giving rise to uncontrollable forces. Yet, engagement and resilience to their complex dynamics will be necessary to secure human habitation into the future.

Research into the complex interplay of the many variables that determine wildfire dynamics currently spans a vast range of disciplines, interweaving, for example, creative visualization, atmospheric sciences, mathematical modelling, geological studies and historical enquiry. The resultant multi-layered data adds to the knowledge base about wildfire activity in different parts of the world, revealing a complex interplay of factors that influence evolution and progression of fire fronts. These include, for example, fluctuating wind directions and strength, the degree of moisture as well as fuel type, terrain particularities and accessibility for firefighting resources on the flanks of megablazes. Studying these variables in the field allows creative and scientific researchers, along with fire personnel, to model wildfire events to gain insight into the forces at play and to embody possible future scenarios and their likely evolution.

The aesthetic capture and visualization of this interrelated information, however, is challenging. In sensorial ways, immediate access to wildfires is experientially hazardous due to severe temperatures that eliminate oxygen and melt matter within split seconds, as well as prohibiting detailed documentation via cameras or sensors. This means that despite its massive volume, the available data on fire activity is to some degree always incomplete and requires careful and reflected interpretation [2]. In terms of visualization, captured data formats and volumes pose hurdles to seamless assimilation, entrenching the gap that exists between scientific representation of fire variables (conventionally ren-

dered in schematic maps on the basis of multidimensional netCDF files) and their on-the-ground experience. Representing, communicating and gauging the complex nature and vast scale of wildfires is therefore difficult for expert and general audiences alike. Consequently, despite its increasingly central role to planetary ecologies, wildfires currently remain abstract to the human imagination, primarily represented visually through remotely captured imagery, graphic models, news feeds and secondary effects such as smoke and scorched flora and fauna. This constrains effective engagement with the terrestrial forces that are shaping our lifeworlds and hampers our preparedness. This is especially the case in an age in which personalized engagement with visual information has become the expected norm [5].

As wildfires change our life-worlds, interactive art provides an opportunity to engage with this autonomous yet symbiotic terrestrial agency by creating virtual environments that challenge our assumptions and help us shape our dynamic relationship with its ongoing evolution.

Engagement of the Terrestrial in Current Artistic Paradigms

Art has played a key role in shaping our experience and application of fire, providing a conduit for the exploration and development of human and terrestrial relations. A pivotal figure within Modern Art has been Joseph Mallord William Turner (1775-1851) who conceived fire as a dynamic thermodynamic process, dissolving all matter and representational forms through its fiery energy [1]. For Turner, fire presented as an all-encompassing phenomenon, fueled by the birth of the Carbon Age through the Industrial Revolution. Aesthetically, he explores a terrestrial agency that is leveraged in a feedback loop with the human and makes the unleashing of matter's thermodynamic potential the focus of representation [13]. These representations leap beyond the frame of the canvas, challenging its material underpinnings. At other times, they implode, demolishing conventional optical perspectives. Turner's painting *The Burning of the Houses of Parliament* (1834/35) shows London's center of political power ablaze, an uncontrollable agent in its own right, at war with the fabric of human society, generating a moment of radical uncertainty in which human agency is confronted with an entirely autonomous and alien planetary agent. The scene is captured from a distant perspective, allowing viewers to take in the scenario in its expansive breadth – with flames erasing the built structures, engulfing their surrounds and welding river, streets and sky into an indistinguishable whole whose blazing energy radiates outward and draws all focus into the fiery maelstrom at the image's center. Turner's 'pyrotechnical canvases' [12] shifted terrestrial agency centre stage. While laying the foundation for the modernist aesthetic that disintegrated figuration into an atmospheric flux, he simultaneously initiated an entirely new aesthetic cosmology that prioritized terrestrial agency and its disruptive turbulence [3]. His work changed the aesthetic paradigm by taking us inside the destabilizing dynamics of this agency, rather than picturing it from the outside.

More recently, contemporary art has made powerful ad-

vances in the depiction of fire-laden landscapes. Installations like David Claerbout's evocative *Wildfire (meditation on fire)* (2019/20) immerse viewers within an all-encompassing visual field. This computer-generated video projection reconstructs a fiery forest landscape across large-scale screens. Using slow-paced panning across images of a blazing fire ground, it reorganizes spatial perceptions of the firescape. Positioning viewers in a 3D-modelled landscape of a fictional wildfire, it enables deep contemplation of the spectacle through a reconstructed scenario, amplifying the concept of a fluid materiality despite its adherence to a hyper-realist representational approach. The friction between the rendering that embraces recomposition as aesthetic principle and the passive visual articulation of the firescape, constrains the terrestrial as a stable and mute object. Viewers here partake in an expanded experience of terrestrial energy through immersion within a space that sensorially invites contemplation of an optically mastered fire [7].

The meditative qualities that stem from the artwork's large scale and durational composition, contrast markedly with the frantic energy conveyed through on-the-ground visual documentations of wildfires, as for example evident in the award-winning work of Matthew Abbott for the Australian photographer collective Oculi. Captured at the flanks of megablazes such as the Currowan Fire near Lake Conjola (NSW), Abbott's iconic coverage of the 2019/20 Australian Black Summer documents firefighting efforts at close range. It provides affectively moving accounts of devastation through detail-rich compositions and stark contrasts that visually transport the viewer into the unfolding crisis. Terrestrial agency here is documented as a ferocious impact, made accessible to human contemplation as a visual spectacle. This aesthetics limits the terrestrial to being a static observational object, affirming the supremacy of the human gaze.

While the works of Turner foreshadowed an entirely new understanding of fire as a destabilizing actor, Claerbout and Abbott tend to depict fire as a dynamic event able to be mastered by the human gaze and its technologies. While imbuing fire with force, they render it passive and immobile rather than an unfolding and unanticipated force. As such, their capability to aesthetically express the non-linear autonomy and unpredictable agency of terrestrial phenomena is inherently constrained, capturing as they do a mute tableau of interacting forces whose combustion is frozen in time and space. The centrality of human agency remains the dominant framework through which the planetary lifeworld is conceived and experienced.

Proposal for Terrestrial Aesthetic Framework

Representing wildfire agency as more than an inverted imprint of our human gaze requires an aesthetic framework that can respect and embody its autonomy. It demands the modelling of kinetic and multidimensional terrestrial spatial processes, which cannot be understood by human cognition alone, requiring an AI system able to visualize the complex processes involved. This would integrate the speed and scale of AI in establishing patterns and predicting behaviors with the subtlety and adaptability of human situational understanding and decision making. It would provide autonomy to the

fiery landscapes, so they can follow their own logic and behave as independent agents. This would provide the means to embody compelling scenarios that enable viewers to sensorially engage with dynamic wildfire events. By enfolding and scaling a section of this fiery turbulence, such an aesthetic framework would enable researchers and users to imagine spaces where they can collectively experiment with this disruptive planetary agency.

Under the direction of Australian Research Council Laureate Fellow Dennis Del Favero, a research team at The University of New South Wales's iCinema Research Centre is currently collaborating with artists, AI and fire scientists, designers, programmers and social psychologists, firefighters and planners across a range of organizations. These include the Australian and New Zealand National Council for Fire and Emergency Services, Data61 of the Commonwealth Scientific and Industrial Research Organisation, San José State University's Wildfire Interdisciplinary Research Center, The University of Melbourne and the Spanish Pau Costa Foundation. The aim is to develop an immersive visualization environment capable of rendering complex wildfire dynamics in real time. Titled *iFire*, it uses a virtual setting consisting of an AI fire-laden landscape that evolves interactively with users and translates these interactions into changes to its appearance and behavior. The team has scripted a database architecture that automatically extracts netCDF file input from the fire modelling software *SPARK* and *WRF-SFIRE*, using field data from recent mega-blazes across the USA and Australia, translating these into dynamic scenarios simulated through the *Unity* game engine. This historical data will be used as a training ground for an Artificial Intelligence and Machine Learning Framework which will analyze patterns among documented fire variables, using these to model a library of wildfire behaviors from which an infinitude of new possible scenarios can be algorithmically sampled. These will be played out in a high-fidelity custom 3D environment, displayed across a range of networked immersive systems, from 360° cinemas, wall screens, head-mounted displays to laptops (Figure 1). The 360° 3D cinemas on their own will enable full-body and full-circumference interaction between multiple users and the intelligent fire-laden setting, where the setting interprets a user's corporeal and kinetic behavior and translates this into visual changes in its behavior. It will enable users and 3D setting to interact with one another by rendering users as avatars and the setting as a landscape. Motion tracking of user actions and the translation of AI decisions will create dynamic and responsive interactive scenarios which incorporate behavioral changes by the users and setting as they interact.

This architecture will provide the means to experimentally prototype a co-evolving and open-ended aesthetic between human agents (represented through the user) and a simulated terrestrial agency (articulated through the AI landscape). Co-evolution means that the two agencies are engaged in a reciprocal feedback loop, mutually transforming each other through intelligent and adaptive response to one another's input [11]. The intelligent fire landscape system will be programmed to generate unpredictable scenarios that confront the users with ever new developments, allowing users to en-



Figure 1: The *AVIE* 360-Degree Cinema ©iCinema Centre

gage with an unfolding wildfire that morphs under varying climatic conditions. The full-body immersion enabled by the *AVIE* cinema will allow for deep sensory immersion within the digitally reconstructed image field, leveraging the advantages of the fluid materialities afforded by the digital that can dynamically generate terrain in real time. Through animation and non-linear progression, in which both human and AI agencies act and respond according to their own goals — rather than through a simplistic immediate binary cause-and-effect structure — autonomy and co-evolution are engaged, enabling users to expand their situational awareness and decision-making capability. Just as human actions have accrued cumulative effects on terrestrial systems, for example, by burning fossil fuels, the *iFire* visualization system will incrementally reflect the impacts of a multitude of user interactions. As in the physical world, the AI visualization will do so in a non-linear way, executing actions according to their own logic and factoring in user response. By interactively exploring and transforming the dynamic range of possibilities involved, it will offer a new genre of collaborative human and machine co-creativity through which they will be able to compose a wide spectrum of previously unanticipated and mutating fire landscape encounters. In these encounters, both agencies are autonomously framed, engaged with the uncertain tension generated by their mutually indeterminate yet independent behavior.

Conclusion

By deploying immersive and intelligent technologies within a terrestrial aesthetic, the *iFire* project generates an opportunity to prototype an open-ended exchange between human, machine and terrestrial agencies. While building on advances in art to engage the non-linear aesthetic potential of pyro-

convective processes, it utilizes an advanced human-machine partnership as a way of exploring the larger terrestrial systems in which they are embedded. Its novelty resides in integrating scientific data and sensorially compelling experiences to enhance insight into and engagement with highly complex pyroconvective processes [7]. Imbuing the fiery topography with its own intelligence enables the experiential exploration of unforeseen pyroconvective impacts whose constantly evolving processes defy human-centered logic. *iFire* enables us to reimagine such extreme scenarios to prepare us for the Possibles to come.

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Setting limits in preservation strategies from the stage of acquisition: a feasibility approach for Media Art Installations.

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Abstract

Over the past decades, the development of technological equipment and the arrival of the *Digital Era* have generated numerous artistic products that integrate technological devices and that have lesser durability than other traditional cultural objects, such as Media Art Installations. The field of Art Preservation, responsible for safeguarding the collective knowledge heritage artefacts contain, is facing new challenges, and the solution lies in applying innovative strategies all the way through the life of the artwork, starting in the acquisition stages. What should we as art conservators consider when performing feasibility analyses in the acquisition of technological artwork? This paper analyzes the fragility of this art-science intersection with the aim of establishing preservation strategies that ensure the viability of this type of artworks in an institutional environment.

Keywords

Media Art Installations; Obsolescence; Change; Preservation; Feasibility

Introduction

Media Art Installations are groups of elements -in this case, related to technological objects like computers, cathodic-ray TVs and such- that work together as one with the space they are displayed in and have the purpose of introducing spectators to a particular experience. The traditional idea of the one-of-a-kind object is expanded in this type of artworks [1] since they exist somewhere between performance and sculpture [2].

Regarding its preservation, we need to think about technology, which in this scenario is no longer a tool but a medium [3]. Therefore the devices may convey the intention of the artists and be an essential part of the artwork's materialization, which means that conservators will have to take care of their inherent fragility and obsolescence [4]; in other cases, these elements will be considered as consumable or replaceable [5]. On the other hand, we also need to take care of intangible aspects and figure out if the environment where we display the installation is adequate and how will we enable users to interact with it¹

The nature of these artworks, where some elements are fungible based on their relationship with the immaterial values of the installation, allows for a reflection on changeability and variability, a complex conceptual tool that can give conservators an interesting advantage in the race against time and heritage loss.

Change as value: possibilities against obsolescence

The conversation around change is commonplace in the discipline of art conservation, and therefore there are several theoretical positions on the subject.

Historically, we identify good change with *patina* [6] and bad change with decay; in the first scenario, the item acquires new values -usually related to the ideas of aura and historicity-; in the second one, the item loses originality, integrity and subsequently authenticity [7]. But what happens when change is a part of the artworks essence or can be applied to some of its elements?

In her 2017 book *Paik's Virtual Archive: Time, Change, and Materiality in Media Art*, Hannah Hölling shares a reflection on this topic. From her point of view, one we also share, multimedia installations have the potential to transform their appearance and constitution, depending on the space they are settled and the degree of spectator's participation. This change could even mean that the work of art is no longer what it was but has acquired a new ontological condition, as it happens, for example, with Nam June Paik's installation *Zen for Film* (1965), which is now a relic and a static artefact [8]; that is what she calls *changeability*. Additionally, we should also speak in these installations about *variability*, the degree of applicable change within a particular range that sets the artwork's identity and integrity outside of which the item is no longer the same. This type of change could then be considered valuable for the work of art if made inside a reasonable range of action rather than a risk [9].

To apply preservation strategies related to variability, every media art installation should, of course, be evaluated individually. In the last few decades, some ideas around art conservation have clearly shifted, we have overcome the relationship between matter and identity, and now the work's essential properties lie in the relation between material and immaterial elements and their link with conceptual values -such as artist's intention or social context representation- that should be defined and documented thoroughly and will be the basis of our practice [10]. As David Garetta states: *being able to understand a piece of information is meant that one can do something useful with it* [11].

Once we have a clear idea and score of these essential parameters, we can apply different strategies, ranging from the smallest degree of variability -with storage or data migration- to a medium degree -emulation of an old appearance made with new materials- and even a full re-interpretation and reconstruction of the work [12].

Possibilities seem endless, but where do we draw the limit, and perhaps most importantly, when do we have the ideal degree of knowledge to make an informed decision?

¹ It is to be noted that with interaction we don't always mean physical interaction, but a participatory observation; as the media artist Antoni Muntadas states: *perception requires involvement*.

Feasibility of Best Media Art Installations: the start of preservation

To ensure the survival of this type of heritage, documentation should be performed throughout the entire existence of the artwork, ideally starting in the ideation and production of the installation. This is why collaboration between artists and conservators has been advocated as a fundamental for good praxis [13], either through consulting in the development of the piece or via subsequent interviews [14]; however, this is not always possible.

The second-best scenario would then be the acquisition stage, which differs from one institution to another, although it would perhaps be beneficial to develop some standard procedures for media art installations [15]. In this phase, conservators must work collectively with other stakeholders, such as engineers, curators and even lawyers, in a multidisciplinary team since we are also dealing with an interdisciplinary item. They will have to reflect on the physicality of the installation, both software and hardware, in order to maintain its functionality [16]; provisions should be made for the need for technical equipment, physical and virtual storage space and others. It is also to be considered some other collateral aspects to the artwork, such as property rights or the overall cost of maintenance or auxiliary equipment for viewing and checking the state of preservation of the works

The feasibility of the work inside the institution will also rely on musealisation, the level of adaptation of a work of art to the demands and policies of the institution [17]. Before a media art installation enters the museum, stakeholders should set the limits on its variability, taking into consideration not only the decay of its technical elements and the safeguarding of its immaterial aspects but also the adequacy of the exhibition space and the access we will be able to provide. This information should be reviewed every time the installation is settled, strengthening our knowledge of the artwork and pointing out the possible interpretation errors; ideally, the process should be carried out by a stable team that is familiar with the artwork.

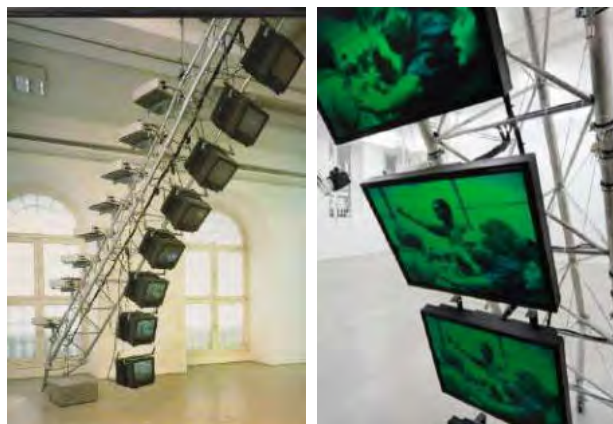
In this scenario, it may be possible to apply variability to the maximum degree, re-interpreting the installation; a commonly known example would be *TV Garden* (1974), by Nam June Paik, a single-channel video installation that consists of a number of TVs scattered in a space filled with plants. This work was exhibited in Paik's life numerous times; therefore, it has a clear corpus of instructions that set limits for its variability, it can be executed with a new set of plants and TV, always a minimum of thirty, and if it increases to forty or more, a second video channel may be added [18]; with the agreement of the artist, *TV Garden* has always been re-installed with CRT TVs, sometimes with emulation techniques by inserting flat screens in the CRT frames [19]. Another interesting example would be *Transmission Tower: Sentinel* (1992) by Dara Birnbaum, which underwent a more visible transformation as CRTs were replaced by flat screens, also with the artist's permission [Fig. 1 & 2]. Although they look like similar installations, both have been re-installed and have gone through a similar degree of variation; conceptually, both changes have had a different effect. In the first case, Paik's garden reflects on the naturalization of technology, which dies and is replaced like the plants that surround it in a never-ending cycle. Since technology surely develops continually and rapidly, conservators could -hypothetically speaking- substitute TVs with new elements of our technological second nature like mobile phones or tablets. Contrarily, Birnbaum's statement is a critique against TV broadcast as a mass media, a situation that no longer occurs in our society with the everydayness of the Internet. Even with the au-

thorization of the artist, media art conservators should be careful, and reflect on the consequences of variability in the future knowledge of the artwork, if it suffers too much change, we could be damaging its immaterial values, recasting the installation into a caricature of what it once was [20].

Fig. 1. ©The Arcillect, *Transmission Tower: Sentinel*, 1992, <https://twitter.com/archillect/status/1005469591701803008>.

Fig. 2. ©Marian Goodman Gallery, *Transmission Tower: Sentinel*, 1992, <https://www.mariangoodman.com/artists/32-dara-birnbaum/works/40252/>

A third scenario is also a common situation in the preservation and exhibition of media art installations: removing the artwork from storage without access to the artist's opinion and without documentation analyzing its variability; in this case, we should apply a historical perspective and limit changes to those that maintain the functionality of the work, unless we have a clear set of instructions with different directions.



Conclusions

As we reflect on the context and effect of Media Art Installations and accept its variability, we are also shifting the point of view from a so-called *freeze-frame* paradigm -that pursues to secure the object in an illusion of eternal steadiness- to an awareness of future possibilities and evolving identities [21].

The limits to this variability and changeability of the artwork should be decided as soon as possible, taking into consideration not only physical elements but also immaterial values. It will be impossible for the conservator to completely recognize the threats to the piece's future presentation or to comprehend which features of the piece may alter and to what extent, if he or she does not thoroughly comprehend its key attributes.

This is decisions should be taken in the present, especially in the acquisition process -when we are able to communicate with more ease with the artists and comprehend better their intentions- in order to ensure the feasibility of the installation in the institution, but also be reviewed every time the piece is settled if there are new possibilities to apply.

Acknowledgements

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KÖDOS: multiple investigations through art, science, and technology

Abstract

The artistic poetics produced related to science and nature increased prominence as they incorporated political, technological, and social changes into their discourse aware of the environmental crises and their connection with the capitalist economic program. Hitherto, the union between artists and scientists has inspired works that, in general, incorporate new forms of organization between organic systems, technologies, and symbolic processes. Many contemporary artists conduct their projects through multispecies collaborations and work with a high potential for questioning and formulating non-hegemonic knowledges. This paper focuses on the recent KÖDOS experiments, a Brazilian art collective, which aims to investigate the visual poetics in relations with non-human organisms (living and non-living) and technologies to provide alternative and speculative models to inhabit the Earth. KÖDOS is composed by Claudio Filho and Fernanda Oliveira both members of ACTlab - laboratory for arts, science, and deviant technologies hosted at Universidade de Campinas (UNICAMP), Brazil.

Keywords

Anthropocene; Art; Science; Technology; Ecosystemic Intelligence.

Introduction

The New Climate Regime and the transformations that outcomes with the concept of Anthropocene had instigated several research in the arts, science, economy, and philosophy areas. The term broadly stands for analyses and practices, which question the boundaries between men, culture, and their own environment of centuries of European-centralized thinking. The Anthropocene easily assumes a broad scope with the potential to include multiple and complex postulations; However, assorted nomenclatures diverge to its main features: Anthropocene – from the fossil fuels industry [1]; Plantationocene – with the exponential commercialization of agro commodities [2]; Capitalocene – delimited by the capital era [3]; Cthulocene – as a process that integrate the humans and non-humans' dynamics [4], and so on. The Italian scholar Rosi Braidotti highlights the “post-Anthropocene” as a critical process about these various definitions. By including the prefix “post”, according to her, we are delimiting alliances with living beings, science, sociability, power dynamics and technologies [5]. In similar circumstances, Ulrich Beck points out in *Risk Society: towards a new modernity* the prefix “post” used as a key word of our times:

“It hints at a 'beyond' which it cannot name, and in the substantive elements that it names and negates it remains tied to the familiar. Past plus post - that is the basic recipe with which we confront a reality that is out of joint” [6].

Both uses can guide our perceptions about the Anthropocene: a political place that can only succeed through some no-holds-barred wrestling against the old theories and conventional ways of thinking, whose life has been artificially prolonged by the word 'post', and at the same time delimiting new forms of relationship with the Earth.

Taking the “post-Anthropocene” as a guideline, this paper proposes a discussion about some ideas that surround the human, non-human, other-human intelligences in the art field. The study of artworks allows us to imagine other possible relationships with the systems of nature, technology, and society nowadays. The aim is to articulate these notions with other non/other-European perspectives between pre and post Anthropocene intelligences that operates in the merge with Ancestral knowledge expressed by Amerindian thinkers as Davi Kopenawa, Ailton Krenak, Viveiros de Castro, and the new media technologies, which directs us to an operative way to understand the poetic processes that act in these intersections.

Art, Anthropocene, and Nature

Art and Nature are topics that remain a challenge until now. However, the discussion has one of your embryos in the 1980s with the Art Ecology movement, furthermore, with a global economic crisis, artists have been becoming aware of the seriousness of environmental problems and their connection with the economic program [7]. This broadens the political-environmental engagement artistic actions related to nature. Joseph Beuys, Agnes Denes, Hans Haacke, and Jackie Brookner were some of the many artists who have engaged works between art and nature, expressing the inability of many government policies to measure the consequences of climate change for the biosphere. Recently, the focus on the manipulation of Nature and living organisms through art can be conducted towards collaborative action between human, non-human, living, non-living organisms, and technological networks. Roy Ascott's enthusiasm for wet media is updated by contemporary artists from the second decade of the 21st century. Collaborations among artists, biologists and scientists allowed others to speculate senses of life systems organizations, biological, synthetic, and symbiotic processes manipulated in the most varied scales. Artists team up with researchers and computer scientists intending to expand the boundaries of the artistic object. Some works of art “directly relate the artist to other beings and techniques, which made symbiosis its product” [8]. We can observe

these relations between art, technology, science, and nature in the works of Guto Nóbrega, Paul Vanouse, Oron Catts and specially in CESAR&LOIS collective by Cesar Baio and Lucy HG Solomon. These, among other artists, conduct provocations with a high potential for questioning and formulating deviant knowledge.

Towards to ecosystemic intelligence.

The concepts briefly explored here intend to make a poetic and speculative provocation of other operating systems that support society, ecosystems, and the Earth. In this perspective, the formulation of "non-correlational thinking" by Whitehead is significant, which, through a review by Steven Shaviro on *Discognition* (2016) was defined as a proposal or sentence for the assembling of knowledge that is not intentionally constructed from the Anthropocene dialectic: Which remains "on knowledge" when we consider the world-without-us or the autonomous reality of beings outside of human thought? According to Shaviro, speculative models of thought are manners to understand and occupy the Anthropocene's Earth:

"Speculation – fictions and fabulations – about sentience. There is something oddly recursive about this, since sentience itself is arguably a matter of generating (or being able to generate) fictions and fabulations" [9].

By speculating the organizational arrangements of non-humans with technology, we can expand the possibilities of creating operational dynamics that help us to face the obstacles of the Anthropocene. In short, the use of the presented concepts leads us to advance towards the relationship between non-human organisms, such as fungi and bacteria, with the recent digital informational systems in the contemporary art.

To exemplify what is stated above, the collective CESAR&LOIS, composed by artist-researchers Cesar Baio (UNICAMP) and Lucy H.G. Solomon (California State University San Marcos) probes the evolution of humanity's relationship with nature by advancing intersections between the parallel networks of technological, biological and societal systems. By arranging alternative conceptual models for thinking across networks, reframing the artist's and potentially viewer's understanding of what motivates and shapes society, set off important triggers. In the context of computation scale the artists criticize the intellectual and economic production systems in the form of artistic poetics.

For them, ecosystem intelligence [10] is the awareness of performative image forms in relation with hybrid systems and artificial intelligence. The ecosystem intelligence inquires the centrality of the human being as a unique model for the Nature's organization. This involves properties and dynamics that sustain life in non-human organisms, a quote almost incomprehensible or insignificant in the capitalist way of making knowledge. Ecosystem intelligence is the union of pre and post-anthropogenic intelligence that when combined can result in innovative proposals aimed at the well-being of the world [10]. Ecosystem intelligence can explore collective dynamics in a world of emergencies through the arts, organisms, technologies and life sciences:

"(...) We acknowledge the importance of the balance of biomes and microbiomes, both within and outside our bodies, and the biological linkages which connect species and creates nested relationships among whole sets of species: ecosystemic connections. These connections, if replicated within technological systems, constitute an ecosystemic intelligence, an AI that engages with a broad planetary community and which operates according to broad principles of community well-being" [10]



Figure 1 - Degenerative Cultures ©CESAR&LOIS Copyright.

CESAR&LOIS potentially see in art the possibility of producing experiments that reflect the aforementioned characteristics. The work *Degenerative Cultures* [Figure 1] operates from a collaborative model between entities that were previously understood as disconnected from or opposing their conventional logic. The work is a biohybrid agent that blurs the lines between biological and artificial intelligences. In the composite microbiological and digital knowledge network, prehuman and posthuman intelligences work together to probe the centuries-old dichotomy between humanity and nature [11]. The collaborative union of these systems makes them operate under a new perspective, engaged with nature and problematizing the Anthropocene. With the collaboration of non-human organisms active in their projects, artists, researchers and scientists become strategic mediators to elaborate forms of knowledge that challenge the Anthropocene project.

“By advocating for ecosystemic artificial intelligences (EAI), we align ourselves with the movement to decolonize knowledge, a movement that can also inform and reshape society and technology, such as those social structures and embedded technologies that for the most part still adhere to the archaic principles of a dying world. In response to this movement and its underlying broadening perspectives, we ask: how do we move forward and away from centuries of progressive thinking, in anticipation of AIs that embrace new possibilities for connected thought?” [10]

KÖDOS

The investigative approach that Art, Science and Technology studies take is against most descriptive scientific accounts of nature. In addition, the Brazilian art collective KÖDOS acts at these intersections. Conceived by Claudio Filho and Fernanda Oliveira, both multimedia artists members of ACTlab - laboratory for arts, science, and deviant technologies, hosted at Universidade de Campinas (UNICAMP), Brazil – KÖDOS often draws conversations and collaborations with other artists, scientists and researchers.

For KÖDOS, the Art, Science and Technology highlights the complex and often contradictory paths of knowledge, valuing and living with a common interest in the different forms of life in collaborative relationships. Unexpected collaborations between non-human living organisms and technology can promote a model that guides us in readings between art, nature, science and technology in the face of new impasses of the environmental crisis, information and communication theories, and the de-colonial and multispecies studies. At this point, I ask: how can the artist make it work the questions concerning the Anthropocene with the technological environment of daily life?

Technological art refers to the technical tools that artists seek, use, and create to solve problems of different kinds. These tools progress over the decades, and this makes each period have a different meaning of the use of technology [12]. Thereby, is necessary to analyze works that use technological devices, such as computers and databases, given heed to their historical, geographic, and political context as part of the post-Anthropocene perspective. The use and manipulation of data have been a topic of wide discussion nowadays, as the increase of data with social networks that we continuously produce at each digital interaction through sharing, accessing websites, messages, posts, likes, research, etc.

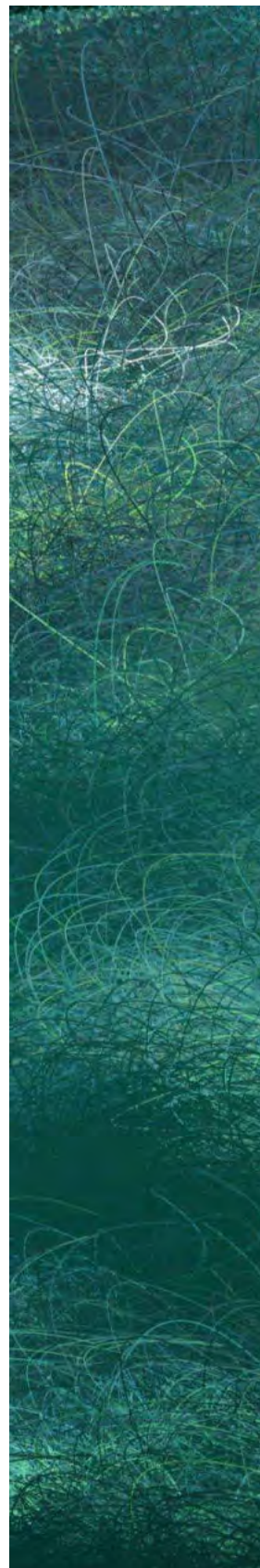


Figure 2- Data-River, ©Kōdos
Copywrite.

In this scenario, the exploration of databases become a place for artistic exploration.

Technological devices participate as agents to give visibility to what is not visible, or difficult to see. The work *Data-river* [Figure 2] by KŌDOS proposes an environment that is built across multiple interactions. *Data-river* tries to unlimit the gesture imposed by technological mediations and its implications on the body as collective regime and in the processes of co-learning between humans and non-humans. The work seeks to re-signify human-data-landscape relations, intervening in the code of operation of digital images. What the artists propose was a resumption of attention to these invisible images operations. The method was to subvert the geolocation logics (real coordinates in physical space) of rivers' photographs presented in databases and include them as decentralization vectors on the programming of a digital image (virtual space code lines) through the software P5.js. The entire layer that makes up the images is understood by codes, and the results are abstract images in which the disruption of pixels programmed from the numerical data of geographic coordinates reveals their movement and disruption in the automatic processing logic of digital images. The work is presented in a format that highlights the hybridity of the image located on the boundaries between photography and landscape. The paradox of the presence

of technology in the environment is the information overload, based on the increased reach of technological products, which creates an illusion of democratic access related to the evolution of the acquisition of digital communication devices.

Conclusion

How does the artist act in the field of multispecies studies and what articulations does he provoke by involving non-human entities in his poetics, procedures, and discourses? The artworks briefly narrated here acts with the force of contestation and to reconfigure our thought of technologies, beings, and environment in the 'post-Anthropocene'. Therefore, contemporary artists articulate current notions of nature, Anthropocene, and multispecies studies, often integrating living organisms and technological systems, to update the production of previous decades through poetics and criticism based on multidisciplinary collaborations. The exploratory link between the activities of CESAR&LOIS and KŌDOS collectives are carried out through collaborative strength, manifestations that propose to fable multispecies landscapes together, which conflict with scales, disciplines, perceptions and affectations on Earth.

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Polyphonic Materiality in Extended Reality

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Abstract

Much human-computer interaction design (HCI) research on materiality investigates the ways in which computational qualities become embedded within physical materials, often under the banner of ‘the material turn’. With the development of extended reality (XR) and the emerging metaverse, how might we understand and articulate the qualities and agencies of digital materials as they overlay, embed and replace the physical world? This paper advocates for an ontology of digital materials to understand how they actualise in the world without being tangible, providing a way for XR designers and artists to critically work with them as part of an assemblage. It will introduce an idea of polyphonic materiality, drawing on Anna Lowenhaupt-Tsing’s concept of polyphonic assemblage. It will locate digital materiality within Giles Deleuze’s idea of the virtual and actual, and Karen Barad’s concept of agential realism. This provides a conceptual underpinning to the proposition of polyphonic materiality as a typology for doing XR design, where material properties emerge as various physical and digital processes coalesce or intersect.

Keywords

Extended Reality, Materiality, Polyphony, Assemblage.

Introduction

Contemporary computing is increasingly entwined with physical materials through the Internet of Things and smart materials. Much human-computer interaction design (HCI) research on materiality investigates the ways in which computational qualities become embedded within physical materials, often under the banner of ‘the material turn’. [1], [2], [3], [4] With the development of extended reality (XR) and the emerging metaverse, how might we understand and articulate the qualities and agencies of digital materials as they overlay, embed and replace the physical world? Our ongoing tangible experience with the physical world platforms a generally well-developed appreciation of the forces, affects and properties of physical things. The sensorial qualities of physical things

mingle with practical, cultural and aesthetic considerations. We attune to the supply chains of physical materials to understand how sustainable and ethical they are. Yet digital things foremost appear to us as mediated representations. Coupled with metaphors that tend toward the immaterial, it becomes difficult to position their affective capacities and qualities. So how might we begin to describe and discuss digital materiality in HCI design? Speculative films can do well to critically illustrate the atmospheric, lived experience of the digital materials in XR such as Keiichi Matsuda’s 2016 ‘Hyperreality’. [5] Such films help to visualise the nascent relations between digital and physical materials as experienced by humans. Science and Technology Studies provide precedents for materialising the intangible relations of people, actions and systems through Practice Theory and Actor Network Theory. Mikael Wiberg proposes interaction itself as a material, one which transcends categories of the digital and physical. [6] In these propositions, any materiality of the digital is folded into human-computer assemblages. It manifests *as* a relation; a critical concept, but one which does not specifically address what digital materiality itself may be within that relation. We have language to describe the social, the physical - even the atmospheric. Yet with the increasing incidence of mixed reality and immersive virtual environments, it seems timely to wonder specifically about the affective capacities and qualities of digital materials like 3D objects, images, posts, and videos as well as the interface elements, code and design patterns that present them. This paper advocates for an ontology of digital materials to understand how they actualise in the world without being tangible, providing a way for XR designers and artists to critically work with them as part of an assemblage. It will introduce an idea of polyphonic materiality, drawing on Lowenhaupt-Tsing’s concept of polyphonic assemblage. It will locate digital materiality within Deleuze’s idea of the virtual and actual, and Barad’s concept of agential realism. This provides a conceptual

underpinning to polyphonic materiality as a typology for doing XR design, where material properties emerge as various physical and digital processes coalesce or intersect.

Polyphonic materiality

Extended Reality (XR) encompasses a nascent suite of technologies and devices that enable augmented, mixed and virtual reality. Each of these extended realities intersects the digital and the physical in different ways. In this paper, digital materials are considered as the projected and presented media that manifest during an interaction with technology. A non-exhaustive list includes images, 3D objects, posts, videos and interface elements, and these naturally are connected to the design patterns and code that manifest them. As XR technologies continue to develop into physical space, working from a material perspective might assist to understand what atmospheres and effects may emerge when the digital entangles with the physical world as mixed reality, or immerses us within virtual worlds. Polyphony provides an interesting metaphor to both assemble and appraise this materiality. A musical term, it speaks to both the collective and the individual. Multiple rhythms, melodies or tones operate as independent voices that together produce a unity. Polyphony can suggest harmony, but it is different structurally and conceptually to a purely harmonic pattern. A homophonic harmony sees all of the voices in the collective operate in service of a single, key melody as in Figure 1. Polyphony lets multiple voices collect together as a single texture: maintaining their independence while still suggesting connection and interplay. You can listen to these voices separately or collectively, and importantly you can keep moving between these listenings. [7] Interaction design has spent much time in tune to what might be seen as a homophonic harmony, where the digital is forever in service to the ‘real’ or physical world. Yet with such an entangled or imbricated [8] play of digital and physical materials in contemporary culture, it no longer makes sense to separate the two [9] or to place one above or in service to the other.

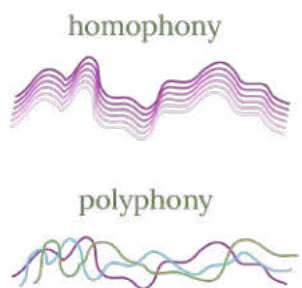


Figure 1. Homophony and polyphony as 2 examples of Musical Textures (Kate Geck, 2021).

The material turn in interaction design has seen a greater attunement to the physical properties of interactive objects, as well as a greater understanding of the complex ecologies they exist in. Tending to physical materiality allows us to examine how sustainable a material may be in terms of its life cycle, its supply chains and the labour practices entangled with its production. Working from a position of materiality thus allows designers and artists to relationally position things, people, time, and space within an assemblage. Drawing the digital into this assemblage might further enable designers to understand the ecologies within which digital materials sit: we can think about the aesthetic and sustainable aspects of digital materials such as the atmospheres that emerge and the resources involved in their manifestation. Tsing conceives of assemblages as ‘open-ended gatherings’ noting that they ‘allow us to ask about communal effects without assuming them’. [10] She sketches the diffractive conceptual usages of assemblage, before offering polyphony as her divergence. Relevant to interaction design, her concept of assemblage is centred in a notion of encounter. ‘Ways of being are emergent effects of encounters’, gesturing to the net effects that may exceed the sum of parts within an assemblage and asking ‘how do gatherings sometimes become happenings?’. [11] Bennett further discusses the emergence of effects within an assemblage. Working through the lens of a ‘vibrant’ materiality enables her to flatten the hierarchy of actors, parts or things within the assemblage, advocating for its collective agency:

“Assemblages are not governed by any central head: no one materiality or type of material has sufficient competence to determine consistently the trajectory or impact of the group. The effects generated by an assemblage are, rather, emergent properties, emergent in that their ability to make something happen (...a blackout, a hurricane, a war) is distinct from the sum of the vital force of each materiality considered alone. Each member and protomember of the assemblage has a certain vital force, but there is an effectivity proper to the grouping as such: an agency of the assemblage”. [12]

XR can be seen as an assemblage where our encounters with digital and physical materials is polyphonic: we interact between physical objects and digital interfaces. Materiality itself in these encounters is polyphonic: the sensation of the screen or projection connecting with the form, colour and composition of the digital interface; the pattern of an endless scroll connects with the form factor of the phone in the hand and the compositional qualities of the digital materials on the screen. Polyphony provides a useful metaphor for thinking about our engagement with materialities in interactive experiences. Situating XR

design thinking within a polyphonic assemblage of materiality allows us to attend to different rhythms, tempos and voices, attuning to the conditions and effects of their manifestation without preferencing either the digital or physical.

Furthering an ontology of digital materiality to uncover agency of the intangible

Yet still, the materiality of the digital is difficult to grasp. It cannot be touched by human skin, and so, a binary emerges: the physical world is ‘real’ and here, while the digital is ‘not-real’ over there. We work within nebulous webs, nets, clouds, and ethers; while in everyday vernacular the virtual itself describes the almost. [13] These barely-there metaphors shape networked spaces in the periphery as shadows, making it hard to understand their material effects in the world. But, like shadows, network ethers are atmospheric; they obscure, cloak and cast affect on the bodies that entangle with them. Acknowledging the digital as a material with qualities and capacities could help to better understand its atmospheric effects on humans and non-humans alike; particularly in light of mounting evidence on the psycho-social effects of interface culture. In talking about materiality in HCI, Wiberg remarks that ‘despite growing interest in smart materials and increasing capacity to treat computers materially, we have yet to transform our thinking about the ontology of atoms and bits’. [14] Fundamentally, this concern applies to the nature of the digital, to understanding or even conceptualising its materiality in the face of its intangible nature. How then might we conceive an ontology of the digital to enable it to find an active position within the polyphonic assemblage?

First of all, dismantling the conflation between real/physical and not-real/digital is necessary. Arguably, this conflation occurs due to differences in tangibility of the physical and the digital. Because the digital has no ‘tangible matter’ its ontological status is greatly reduced. Deleuze’s concepts of the virtual and the actual are useful here, where despite their differences in tangibility both are conceived of as ‘real’. The virtual is as real as the actual, existing as a suite of intensities that manifest within all materialities. [15], [16] This concept removes tangibility from the condition of realness. Importantly, it provides a way to consider the materiality of the algorithm. An algorithm may represent many virtualities, and through its meeting with users and data, it actualises particular conditions, qualities and events. This idea connects with Karen Barad’s agential realism. Drawing on the slit experiment in quantum mechanics, where the appearance of matter changes depending on the way in which it is measured, agential realism posits that an apparatus

produces ‘cuts’ in reality as it intra-acts with particular materials [17]. Algorithmic material futures thus emerge when the agency of the algorithm actualizes particular realities [18]. In this way, Deleuze and Barad provide a conceptual underpinning to position digital materiality as an agential force that transcends tangibility.

Relations, encounters and atmospheres forming through the digital

We can suggest an ontology for the digital, agreeing that it is ‘real’ and in many cases, agential and we can situate it as material within an assemblage, conceiving that materiality itself is polyphonic and discursive. How then might we describe, categorise or address the qualities of materialities that are digital so that we can design with them? In this paper, digital materials refer to images, videos, posts, interface elements, code, and design patterns. This is an initial scope, and should be further interrogated through ethnographic investigation and the development of a taxonomy of digital materials. From this initial scope, digital materials can already be seen as always part of an assemblage. This is a critical way to conceptualise them: images/video/posts manifest through interfaces and code in their production, presentation and consumption. Therefore, digital materials emerge through design patterns, and these design patterns entangle directly with algorithms and data. Typically, these materials are located within an attention-extraction paradigm for doing design, creating design patterns that hook users in and use their data traces in exchange for profit. This is the paradigm on which the metaverse is being built. We can presume many digital materials will continue to exist in a highly relational way to the user, as part of a personal assemblage: images from people we know, people we follow or from things we have searched. A differential force emerges in the digital - these images are both parsed and produced in relation to ourselves. Particularly in the case of targeted ads, digital images appear because of traces of ourselves in data patterns and reinforce certain moments of previous interaction. The nature of encounter with these digital images is fundamentally different to the ways we would encounter equivalent moments or vignettes in the physical world. This is coupled with the infinite nature of their emergence and their capacity for real time modulation. Digital encounters can be stored, they can produce atmospheres that can be ongoingly modulated by information, and they can be highly relational, even targeted. The forces of emergence that produce digital materials are different to those that produce physical materials. As such, one way to draw out the qualities of digital materials might be with reference to attention, allowing us to understand how they are algorithmically attentive to us. Some qualities of digital materials might

include the way they are ‘targeted’. This might be with reference to the self: digital materials might offer ‘improvement’, ‘distraction’, ‘belonging’ or ‘difference’. Under this attentiveness, some qualities might reference ‘temporality’: ‘rhythm’, ‘duration’, ‘tempo’ with respect to the cadence of the digital manifestation and individual schedules. Digital materials could be considered through their formal material properties like transparency, saturation and blending. Their motion or animation could also factor in here. Digital materials have uniquely emergent properties such as generative forces of modulation as well as degrees of malleability/customisation. These are only speculative ideas, but offer opportunities for further investigation for HCI researchers, artists and designers to better understand what qualities might exist in digital materials that make them different to physical materials beyond tangibility, and help to identify and design with their affective force.

Conclusion

There are many calls at present to address the targeted algorithmic appearance of ads and news feeds. The

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MEDIA ART AND FACE RECOGNITION: CRITICAL LINE OF WORKS

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Abstract

In recent years, Media Art practices related to facial recognition reflect present concerns about AI in general and facial biometrics in particular. The ambiguities, biases and lack of ethics present in the development and implementation of facial recognition techniques is present in pieces and essays by creators determined to reveal the lack of ethics and transparency of these mechanisms of classification and control. Artistic spaces and festivals are beginning to support and make these kinds of issues more widely visible.

At present, we distinguish three lines of critical work: those that attempt to "annul" the effects of technology, those that show how detection algorithms work, and a small group, more experimental and less fruitful so far, made up of works that propose to reinterpret the uses of technology more in line with social needs.

Keywords

Media Art, facial recognition, biometric art, critic, technology, privacy, surveillance, control, biometry, IA

Media Art and face recognition: lines of work artistic practices

Facial recognition technologies (FRT) make it possible to verify the identity of individuals through the still or moving image of their face. Its popularisation in recent years, associated with a worldwide pandemic that has led to remote contact, began to develop in the 1960s led by Woodrow W. Bledsoe. The project, although somewhat rudimentary, leads to further research to train machines to recognise human faces (Hao 2021). Today, experts around the world are warning us that what appeared to be a great and beneficial investment in the short term may generate social problems due to the biases detected in many of the algorithms, and with ethical risks that have not been studied in depth (Goffi 2021). Research such as *About Face: A Survey of Facial Recognition Evaluation studio*, which studies over a hundred facial recognition datasets created between 1976 and 2019, concludes that the data collected is biased by political evolution, technological capacity, and revision in standards (Raji and Fried 2021). The rapid evolution of the systems in recent decades has obviated their restricted practice for very specific uses, resulting in an excessive application that is very difficult to control. Debate has been eliminated and energies have been devoted to the implementation of these systems without assessing their limitations, their scope or the importance of using historical information to predict the future of any citizen (O'Neil 2017) to communicate any evaluation process. Other wide-ranging research such as Gender Shades assesses the (in)accuracy of AI-driven gender classification products, revealing the need "for

greater transparency in the performance of any AI products and services that focus on human subjects" (Buolamwini and Program in Media Arts and Sciences (Massachusetts Institute of Technology) 2017) [1] Gradually, such fundamental issues as privacy and ethics have been overlooked.

Both governments and companies have entered a globalised market in which neither the rules nor the interpretations of the tool are made according to the same scale of values. The use of facial recognition techniques differs between countries such as the United Kingdom, the United States and the European Union. Faced with this lack of definition, in 2020 the European Parliament approved three proposals to regulate AI "in order to promote innovation, ethics and trust in technology" (European Parliament 2020) [2]

Media Art Criticism: lines of work.

Media art criticism of facial recognition technologies (FRT) is not emerging at present. Practices that question their use form a specific group within biometric art proposals focused on denouncing the limits of Artificial Intelligence. All of them are the result of the evolution of prevailing methodologies and tools in the last decade of the 21st century. They include, among other basic issues:

- How governments have had to manoeuvre along with large companies to perpetuate their power (Zuboff 2020) [3]
- Changing perceptions of ourselves, as well as our environment, as a consequence of the accelerating digital transformation - accelerated during the pandemic - have devalued our sensitive capacities. (Sadin 2018, 278) [4] This change in perception takes its toll on our privacy.
- Adapting to such a context of uncertainty, with such marked patterns, means that critical voices become blurred in a world overwhelmed by incessant digital inputs.

Multidisciplinary creators such as Trevor Plagen, Adam Harvey, Joy Buolamwini and Paolo Cirio denounce this situation both in their artistic practices and in essays. Current exhibitions such as *Paolo Cirio. Monitoring Control* at the FMAV, which presents different pieces by the artist aimed at sabotaging security and surveillance systems (FMAV 2021) [5]; or *Training Humans* at the Prada Foundation in Milan, which reveals the evolution of sets of training images from the 1960s to the present day are examples of how art centres are committed to reflecting on the subject (Crawford, Plagen, and Fondazione Prada 2019) [6]. The Ars Electronica Festival also includes a new

section *Artificial Intelligence & Life Art* which includes projects from our field of study. Paradoxically, some of their denunciations have had a greater impact on the general public through documentaries broadcast on large platforms: *The Social Dilemma* (2019) (Orlowski 2020) [7] or *Coded Bias* (2020) (Kantayya 2020) (Kantayya 2020) [8] denounce the discriminatory failures of the algorithms that intervene in facial recognition technology. It brings together the testimonies of specialists in the study of race and gender biases reported in various articles and reports. The denunciation of the social prejudices related to AI, and the data collection systems studied by Joy Buolamwini, researcher at the MIT Media Lab and founder of the Algorithmic Justice League.

Media Art's interest in the use of facial identification is beginning to intensify and renew itself, offering differentiated lines of work that sometimes complement each other:

1. Counter-surveillance works that teach spectators/interactors how to annul the effects of facial recognition technology. The work of Paolo Cirio is a good example, but there are also works by Zach Blas or Sterling Crispin, whose proposals seemed in their presentation to be closer to science fiction than to reality. In the case of Blas: *Facial Weaponization Suite* (2011-2014) and *Face Cages* (2013-2016) are also two good examples of criticism against the standardisation and expansion of RTFs under neoliberal practices. In both cases, unrecognisable masks are generated for the logarithms. The first constitutes a collective representation of all the features of the participants in a workshop, and the second is materialised in "facial cages" that oppress the face and adapt to the specific biases of their wearers (Blas 2015) [9], with the aim of denouncing "computer opacity in the service of the state" (Lee-Morrison 2019) [10]. Crispin's *Data Mask* series (2013-2015) also reverse-engineers a tangible response based on invisible data.

2. Those that focus on revealing how it all works tend to adapt facial recognition technologies. A good example is Trevor Paglen's *They Took the Faces from the Accused and the Dead* (2019), in which black and white photographs of convicts from the database of the American National Standards Institute, used without their permission, have served as a privileged source of visual training for facial recognition systems. Their proposal attempts to change our mental schema. They show the world how algorithmic identification systems have been trained (de Young Museum 2020) [11]. Adam Harvey and Jules LaPlace's *Exposing.ai* is another good example of disclosure practice: it tells any user whether their Flickr images have been used in surveillance and artificial intelligence research projects ((Harvey and LaPlace, Jules 2021) [12]. In *Humans of AI* (2009/2021), artist Philip Schmitt acknowledges authorship of the 34,248 Flickr images that make up the COCO Image Dataset and offers a certificate for the collaboration. This group also includes simpler proposals such as *The Flemish Scrollers*, 2021, by Dries Depoorter, in which the faces of Belgian politicians who use their mobile phones while attending parliamentary sessions are automatically tagged.

3. A small group, more experimental and less

fruitful so far, is made up of works that propose to reinterpret the uses of technology that contribute to social welfare. Let's not forget that facial recognition systems are actually neutral. It would be interesting if digital creation were to make a commitment to investigate this aspect in depth. Rafael Lozano-Hemmer's *Level of Confidence* (2015) is perhaps one of the few examples in which an algorithmic project proposes a new line of work using a facial recognition camera. The interactive piece has been trained with the images of the 43 students abducted in 2014 from the Normal Rural School of Ayotzinapa in Iguala (Mexico). Their disappearance remains a mystery to this day. So Lozano-Hemmer's proposal becomes a constant search for the protagonists among the facial features of the audience. An act that merely intends to maintain their story in our collective memory. (Lozano-Hemmer 2021) [13] These kinds of practices help to empower both creators and spectators about other functions of a technology that continues to maintain its essence as a tool of control, but which can undoubtedly address new challenges of global transformation.

Conclusions

Critical media art with regard to facial recognition systems, as Devon Schiller points out, can be considered an intellectual and ethical activity (Schiller 2020)[14]. These practices provide new ways of seeing how people are classified, labelled and even controlled on the basis of their face.

In times of pandemic, it is more necessary than ever to establish more robust solidarities in order to focus on combating "monotechnological culture, and to produce a technodiversity through alternative technologies and their corresponding ways of life and ways of inhabiting the planet" (Hui 2020)[15]. Undoubtedly, more information must be made available and more spaces for debate must be created. Creators cannot be the sole drivers of this change, but they can help to drive it. Multidisciplinary proposals that offer better use and results in fields yet to be explored should be encouraged without ever lowering the level of criticism regarding the lack of transparency and ethics.

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The Sonic Body: creating embodied sonic performances within an extended reality context

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Abstract

This paper presents “The Sonic Body”, a research-creation project conducted between May-September 2021 that studied methods of creating embodied sonic performances and installations within an extended reality (XR) context. I explain two prototypes created for the project, outline the strategies I used and rationale behind the design choices, and summarize the results of my research. The prototypes explore contrasting methods of engaging with sound in an embodied way: one employing the use of head-mounted augmented reality (AR) and the other muscle sensors and material interaction. As my methodology relied on a self-reflexive approach, I focus on my personal experience as an artist designing these prototypes. Two research questions guided this project and inform this paper: How can new types of interactive audio affected and enhanced by bodily movement and gesture affect the experience of listening and connection to the environment? How can such interactive listening systems be designed to better encourage this sense of connectedness? Ultimately, this paper showcases “The Sonic Body” project, conveys the findings of the research questions from the research results and offers insight into how AR and muscle sensing technology might be used to create a real-time, embodied sound art installation and performance.

Keywords

Augmented reality, sound art, muscle sensors, interactive music performance, sound

Introduction

While there is a history of audio focused AR applications there is little research in sound focused AR applications that emphasize embodied interaction for the purpose of creating a real-time sound-artwork. Furthermore, there is little research into how the affordances of mainstream AR headsets effect sonic design and interaction for embodied performance and installation.

Recent projects [1] [2] similar to “The Sonic Body” using head-mounted AR have not prioritized designing user interaction with sound from a perspective of embodiment. This project took up this design challenge and situates itself within a larger program of developing research in the area of sensory experience design for extended reality. I explored

how we could further what researcher Steph Ceraso calls “multi-modal” listening, “Multimodal listening is a bodily practice that approaches sound as a holistic experience” [3]. There is a tendency to view sound as solely to do with the act of hearing with our ears, but as explained by Ceraso, “sound is not experienced exclusively through a single sense; other parts of the body can be engaged during a sonic encounter” [4].

Preliminary findings from this project are that AR technology as it exists today is limiting for sound art performances and installations. This is not to say that the technology is devoid of interesting and novel experiences that lend themselves to meaningful sound interaction, but more research into areas such as the size and shape of the ‘playable’ AR environment could yield important results. In both performance and installation, it would be useful to further research using speaker set-ups instead of the built-in headphones in AR headsets to allow for more accessibility to the audience and non-participants. Also, bringing in bodily sensors like EMG sensors, as well as interactive tangible objects could allow for the development of more nuanced and meaningful gestures in AR sounding environments.

Research Prototypes

Experiment 01: A modular sounding environment

The first prototype was an experiment in using a person’s entire body to trigger sounds based on collision detection and proximity sensing. It was created using a Magic Leap 1 AR headset and developed in Unity using the Magic Leap Toolkit for Unity. I used Cycling’74’s Max for sound processing as well as for routing collision, proximity, and positional data using OSC from Unity. I used IRCAM’s spat5.pan~ module to pan sound sources. The resulting sound was outputted from Max on a 4-channel set up.

Description

A user wearing a Magic Leap headset moves within a pre-defined sounding environment and as they move, their body collides with and triggers various types of sounds. These sounds appear visually to the user as simple shapes and are

placed on top of the real world. Three types of sound sources are available for the user to interact with:

- 1) Stationary sound with proximity sensor (colored red in Figure 1)
- 2) Moving sound without proximity sensor (colored blue in Figure 1)
- 3) Stationary sound without proximity sensor (colored green in Figure 1)

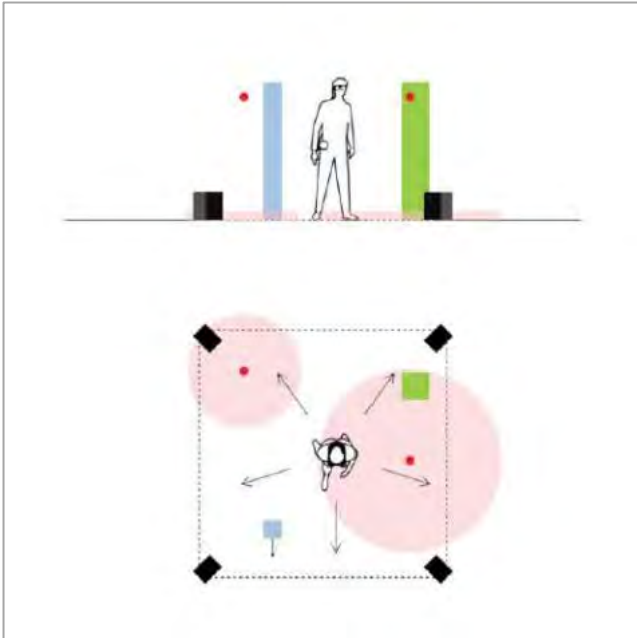


Figure 1. Diagram of a user in Experiment 01. The user moves around the space and sound is triggered based on when user walks towards (collision) or through (proximity) a sound source.

Infinite combinations of sound positions and sound movement paths are possible, and they are set up and uploaded to the Magic Leap headset before the interaction with the prototype begins. The position of each sound source is reflected in a Max patch utilizing IRCAM's Spat KNN panning algorithm. A sound will thus sound where it is physically in the virtual space (mapped to real space) which reinforces the spatiality of the sounding environments for the user and audience.

Headphones vs. speakers

I made the design choice to not use the built-in headphones found in the Magic Leap 1 headset but instead stream collision and proximity data over OSC from Unity into Max and play sound on a 4-channel sound set up. The reason for this choice was twofold: I wanted to be able to easily allow potential audience members to hear the sound produced in a way that did not require them to have headsets, and I wanted to program the gesture/sound interactions within Max as it offers more sophisticated sound processing capabilities than Unity. Most AR applications are built for solitary audio experiences – I wanted to subvert this with my project to allow for a collective audio experience for people not wearing a headset. This makes the experience more

accessible to a greater number of people as well as allowing for a more traditional performance of a sound piece.

Observations

In Experiment 01 there are two main modes of bodily interaction with sounds that depend on the virtual sensor applied to the sound source. For a proximity sensor the sound source's volume slowly rises or falls depending on how close to the center of the sound source sensor the user is. For a collision sensor, a brief or prolonged collision with the sound source plays the sound at the same volume and the sound loops for the duration the user is in contact with it.

With a proximity sound source the user can play with the sensing area of a sound. Running quickly in and out of the sensor bounds creates a very different sonic effect than slowly edging one's body towards the sensor's centre. I found that feeling and hearing the effect of moving my entire body towards/in/through proximity sound sources at different speeds to be engaging and gratifying. Changing the "sensitivity" of the sensor by either increasing or decreasing the size of its sensing area and thus creating a sharper rise or fall in volume had an interesting effect on my movement and I found that learning the differences between the properties and sensitivity of each sound source became a full body act that I felt could be learned and remembered.

The sound sources based on collision detection were quite simple to use and did not have the depth of experience that the proximity sensors had. More interesting results came from having the sound sources move on motion paths. Adjusting where the sound sources were in the environment and how fast they moved around the environment greatly affected how I would move around the space. Sometimes choosing to stand in one area and letting various sounds simply collide with me could produce a nice rhythm to the sound output. Quickly stepping out of a sound source's path would disrupt this rhythmic sound.

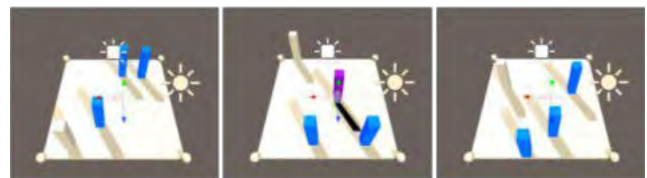


Figure 2. Unity project with four collision sound sources moving on predefined motion paths. The scene is 1:1 scale with the real world and mapped on top of a real-world location. A user triggers sound output by moving their body to collide with each of the sound sources.

Experiment 02: Sonic string

The second prototype was in response to my experiences interacting with the first prototype. In designing Experiment 01, I found it difficult to create meaningful gestures for both performer and audience. Typical head-mounted AR interactions rely on someone viewing virtual 3D objects placed in the real world and then interacting with these 3D objects through either the use of a remote or through hand tracking. The hand tracking technology in the Magic Leap 1 is quite impressive with initial testing but using the tracking

for an embodied interaction leaves something to be desired. This is because the field of view [5] of the headset is quite small, so you must be looking directly at your hands for the tracking to work, which doesn't allow for full bodied or varied movements. I decided against hand tracking for Experiment 01 because it was simply too cumbersome and brought me out of the embodied immersive experience I wanted to create. Also, while the hand tracking technology can allow for some meaningful gestures for the individual user, it is hard to make these gestures seem meaningful for an audience member who has no access to what the user sees behind the screen. With Experiment 02, I was interested in how to create meaningful gestures for sound interaction for both user and audience.

Following the research of Frédéric Bevilacqua et al. I attempted to "associate objects and actions, motion and sound" [6] through physically tangible means to increase a sense of meaning with my gestures. I also follow the work of Karmen Franinovic who explored "perceived affordances of an everyday object" [7] in the *Flo)(ps* project. My experiment examined the affordances inherent to materials from a sonic perspective and so the range of my motion/expression was limited to what I can do to/do with a given material. The material thus provides an artistic limitation as well as a starting point to understand and explore gesture. Experiment 02 involves a Thalmic Labs Myo armband and string to create an embodied sonic performance.

Description

A performer wearing a Myo armband pulls on, unravels, and ravel a length of string attached to the ceiling. As the performer performs the necessary bodily movements to do these tasks a soundscape is heard on a 4-channel set up. EMG signals and motion data read by the Myo armband are translated into sound in Max in real-time using the Gestural Sound Toolkit [8].



Figure 3. The performer wearing a Myo armband interacting with string to create sound output based on EMG signals.

Observations

In Experiment 02 having the tangible feedback of the string in the environment immediately made me feel connected to the gestures I was performing. Choosing to use the Myo armband instead of sensors on the string itself allowed me to focus on how my own body was affecting the sound and material. Programming the sound such that a stronger grip on the string provoked different more intense sounds vs. a lighter grasp and more delicate sounds made for interesting spontaneous gestures as well as range of gestures over a

period of time. From these preliminary results using muscle sensing on the body in combination with external tangible materials I was encouraged to bring EMG sensing as well as materials into the head-mounted AR environment. This however fell outside of the scope of this project and thus will continue in my future work.

Conclusions and Future Work

From my research I discovered ways in which AR technologies can hinder but also promote connectedness to our sounding environment. Since AR technology is just in its infancy, the Magic Leap 1 has many notable limitations: the glasses are cumbersome, very difficult to use with prescription glasses and the field of view is small. I found I could not ignore these limitations, as they highly impeded the sense of immersion that I wished to feel in tests I created.

While the technology is lacking in its immersive qualities it is still quite a novel experience to be able to see floating holographic-like objects juxtaposed with the real world – let alone be able to hear an observable effect when interacting with these objects. I found myself able to enjoy the interaction with these objects and notably the aspect of physical scale was one of interest. In Experiment 01 I had to put my body in the path of moving sound sources, as well as move around to hear different sounds/triggers. While this movement was perhaps not very elegant, the feeling of using my whole body across a large area and the speed at which I had to run around felt satisfying and immersive. I believe that more study into the size and shape of the 'playable' AR environment could yield interesting results, as would adding in 'real' objects into the environment. While it was interesting to use my body to trigger sounds I felt that it would be interesting to explore actually physically touching objects to have more of a tactile feedback. This led to the creation of Experiment 02 which was quite theatrical in nature, almost as if I was creating a performance for the string.

In my further research I plan to combine the findings from both Experiment 01 and 02 to create an embodied sonic performance utilizing AR, muscle sensors and tangible objects that is accessible to both performer and audience.

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Maxime Gordon is a Canadian sound and new media artist. In her work Gordon is interested in exploring the boundaries of sound, architectural space, and the human body. Through sound art, performance, and installations or a combination of these media she creates immersive art works that offer a looking glass into various intersections of humanity and technology. Gordon’s work has been shown at Monom in Berlin (Germany), the Spatial Sound Institute in Budapest (Hungary), and the OutsideInsideOut residency in Stadt Wehlen (Germany).

Artistic Research in European Extended Reality Laboratories

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Abstract

This paper analyses the use of Immersive Experiences (IX) within artistic research, as an interdisciplinary environment between artistic, practice based research, visual pedagogies, social and cognitive sciences. This paper discusses IX in the context of social shared spaces. It presents the Immersion Lab University of Malta (ILUM) interdisciplinary research project. ILUM has a dedicated, specific room, located at the Department of Digital Arts, Faculty of Media & Knowledge Sciences, at University of Malta, appropriately set-up with life size surround projection and surround sound so as to provide a number of viewers (located within the set-up) with an IX virtual reality environment. The set-up is scalable, portable and provide easy to use navigation and allow the user to move around within the virtual environment. The paper discusses how ILUM combines and integrates three research strands that are part of a major, sustained artistic or scientific focus of the partnering academic institutions, namely the Visual Narratives Laboratory (VNLAB at the Centre for Interdisciplinary Research, Filmschool Lodz), the Instytut Kultury at Jagiellonian University, Krakow, Poland, and the Spatial Media Research Group (SMRG) at the National and Kapodistrian University of Athens, Greece. In those labs researchers, artists, film-makers investigate and create different kinds of IX. ILUM provides the opportunity to situate artistic research in the context of scientific. The thematic backgrounds of these research strands and the infrastructure of ILUM serve as starting points from which the partners collaboratively create new communication content, exhibition settings and research as well as teaching materials.

Keywords

Immersive Experiences, Social Shared Spaces, Virtual/Augmented Reality Exhibitions, Media Arts, Cognitive Sciences, Social Sciences

Immersive Experiences in Social Shared Spaces

This paper discusses the use of Immersive Experiences (IX) within artistic research, as an interdisciplinary environment between artistic, practice based research, visual pedagogies, social and cognitive sciences. This paper examines IX in the context of social shared spaces. It presents the Immersion Lab University of Malta (ILUM) interdisciplinary research project. ILUM has a dedicated, specific room, located at the Department of Digital Arts, Faculty of Media & Knowledge Sciences, at University of Malta, appropriately set-up with life size surround projection and surround sound so as to provide a number of viewers (located within the set-up) with an IX virtual reality environment. Throughout the project, scientists collaborate to transfer scientific experimentation settings into the Immersion Lab that enable visitors to actively engage with and learn about these topics and methods of investigation. The paper discusses how ILUM combines and integrates three research strands that are part of a

major, sustained artistic or scientific focus of the partnering academic institutions:

- 1) The development of the ILUM as being oriented towards practice-based research in Media Arts: Interdisciplinary Immersive Experiences within Media Arts.
- 2) The second scenario and field of expertise is established through collaborative work with the Department of Cognitive Science, Faculty of Media and Knowledge Sciences, University of Malta, on Interdisciplinary Immersive Experiences within Cognitive Sciences.
- 3) The third scenario is the application of techniques, tools, and processes of ILUM in Interdisciplinary Immersive Experiences within Social Sciences, such as Heritage Dissemination activities and finally an outlook on envisaged IX productions within migration studies.

1) Interdisciplinary Immersive Experiences within Media Arts

In *Genius Loci* [1], Towards a Phenomenology of Architecture, Norwegian architect and theorist Christian Norbert-Schultz re-interpreted the ancient notion of Genius loci advocating a more sensitive approach to architecture in the direction of the symbolic understanding of places. Going back to taking into consideration the value of the 'character of place', and understating it in terms of heritage, would – Norbert-Schultz suggested – offer insights to a more sensitive and dialectic relationship between society, the environment and the forms of human living. In *Computers as Theatre* Laurel [2] introduced a totally new perspective on the then rather new domain of human-computer interaction [3], by combining drama studies with video-game design at the Atari corporation. Laurel's work brought a refreshing perspective to the emerging field of interface design. Laurel advocated to look for advice in formulas from the classic world noting how "designers of human-computer activities can borrow concepts and techniques from drama in order to visualize and orchestrate the structural patterns of experience" [2]. From a different perspective, interesting insights in this area can also be found in Char Davies' early experiments in Virtual Reality [4], like in Davies' *Osmose* [5] immersive VR installation. In a general context in which technology radically modifies the relationships between the visible boundaries – that we, at large, consider as a "screens" – and the moving image artifacts they are meant to display, the idea behind the traditional immersive VR setup is being questioned. A key area of investigation is, on the grounds of a long-established history of orchestration between spatial, visual components and storytelling, hence that of the possible contaminations between the diegetic space [6] of the audiovisual field and the narrative power of an expository medium. Furthermore, the very practice of sharing and creating information on social media, so characteristic of our times, tends to introduce a new space in which the real and virtual dimension overlap, interacting in new and unexpected ways.

2) Interdisciplinary Immersive Experiences within Cognitive Sciences

or the researchers, the key element is that the subjective experience [7] can be challenged using new technologies and IX that induce perceptual bodily illusions. Such illusions are interesting to study for cognitive neuro-scientific research of self-consciousness and provide an excellent way for communicating and explaining our scientific questions. Work in ILUM implements the experimental conditions for visitors to experience these bodily illusions and provides the public with a better understanding of the fundamental mechanisms of self-consciousness [8]. The main goal of the science communication project is to showcase exemplary research at the intersection of art and science. An example for such a field of expertise is established through collaborative work with Cognitive Sciences. The design of the User Experience [9], through cognitive analysis, is the first fundamental step to create an immersive experience. The cognitive science potential for researchers of the ILUM project are in researching and implementing content production pipelines at ILUM, concentrating on the creative aspects of IX research through (serious) game-like experiences using ILUM, disrupting dominant narratives, often unwittingly, promoting – by embedding stories, perspectives and artefacts representing cultures and communities that were previously hidden, or indeed (due to past prejudice in what might constitute legitimate historical narratives) altogether missing. Those stories, perspectives and artefacts will be positioned in juxtaposition to the most popular narratives. The new connections, meanings and nuances that will emerge from those juxtapositions will help demonstrate novel uses of IX technologies. ILUM develops a method in prototyping an experience for the inclusion of cultural perspectives and artefacts, which represent communities and groups that are currently missing or under-represented in the collections of cultural institutions.

3) Interdisciplinary Immersive Experiences within Social Sciences

One major aspect for ILUM is the engagement with Maltese cultural and historical sites. Museums are sites of knowledge and memory, heritage and culture. Museums and historical sites in the Malta also are publicly funded institutions that have a social responsibility to reach out to a wide range of demographics. However, participation in culture is often significantly lower among those from a lower socio-economic background [10]. There is strong evidence of arts and culture's intrinsic, social and economic value. The government expects that all publicly-funded arts organisations must increase access for people from disadvantaged backgrounds and open up arts and culture for all. Furthermore, even when visiting museums and sites of cultural heritage, many visitors only engage with the 'star' exhibits, missing out on other, equally important if less celebrated or spectacular elements of the exhibition, either because they do not have an incentive to visit certain parts of the exhibition or because items are hidden in the storage. This can lead to educationally limited visits of cultural and heritage sites. Therefore ILUM focuses on learning to set up IX solutions to counter key challenges faced by Maltese cultural institutions today:

1. Diversity of audiences and narratives displayed. The diversity of audiences does not currently reflect the demographics of Malta as a whole. A contributing factor to this challenge is a widely-held perception that the story of the past, as the dominant narrative currently presented by mainstream cultural institutions, is primarily that of wealthy, heterosexual, white males. As a result, audiences from different ethnic and religious communities, or with particular protected characteristics, can feel disconnected from this cultural narrative. Maltese heritage sites, museums and galleries are urgently seeking to address this through examining how cultural sites can better contribute to cultural and social developments by encouraging and facilitating diverse communities to contribute to culture within Malta.

2. Visitors only engage with 'star' exhibits, resulting to educationally limited experiences. According to Walzl "the process of establishing museums for the many goes hand in hand with transformation of museums which (...) 'change from being product-led to audience-centred'" [11]. Cultural institutions today seek to offer more engaging, enriching and relevant experiences to visitors, encouraging them to extend and diversify their visits. They want visitors to engage with the wider collection beyond the star exhibits, which would enrich the visitors' experience, offering a broader contextual understanding and instigating 'surprise encounters' with objects or ideas they might have not previously encountered, thus audiences would learn more and deepen their enjoyment of visits.

3. Physical space and resources limit the range of collections and archives that can be displayed. Cultural institutions tend to only display a proportion of their collection to visitors at any time. A great deal of it remains 'hidden' either because of a lack of space or because of the fragility of the artefacts. However, the 'hidden' artefacts [12] are often those which are most pertinent to the under-represented communities [13]. ILUM enables immediate accessibility and provides direct experiences for general audiences that range from school-age children to adults. The ILUM researchers have the opportunity to retrace the process with a possible adaptation to the Maltese context [14]. Crucial is that by bringing together images, sounds, and movement through interaction, an embodied relationship arises from reconstructed shapes of palaeolithic art [15], [16] and their synthesised movements. Critical points of development are the translation of heritage content [17], [18] into digital interaction modules, providing uninhibited access via animated media scenarios.

Another Social Sciences research project which benefits from the ILUM project is the Platform for Migration [19] at the University of Malta. In an increasingly integrated world, migration presents opportunities and challenges to communities, institutions and individuals alike. The mission of the University of Malta Platform for Migration is to offer a dialogical space in which researchers from different academic disciplines can work towards understanding all the evolving aspects of international migration, including that of belonging across generations. The long-term goal is to thereby contribute to an equitable, more sustainable and more inclusive society that brings benefits to migrants and their families, communities of origin, destination and transit, as well as their sending and receiving countries. Today the migration crisis renders the Mediterranean an opaque space, removed from the public eye, where the key founding values of the European Union (as per Art 2 TEU) are put under strain, making the Platform for Migration initiative all the more necessary.

The Platform for Migration can help to shed light and raise awareness among stakeholders, policy makers, and the general public about the unfolding crisis at the common maritime borders of the Member States. ILUM supports the Platform for Migration in data visualisation within immersive space for awareness raising purposes.

ILUM, considering the above discussed case studies, serves as a vehicle for the exploration of new narratives for spatial media-arts work, combining the modalities of musical and visual surround presentation with a full-scale interaction surface. A core idea is to provide a platform for a wide variety of researchers and artists to experiment in and develop artistic works specific to this multi-modal configuration. The installation system intended for a variety of research scenarios that include researching in the domains of social and cognitive sciences, and media arts, such as creative coding, interactive media, as well as computer music and algorithmic composition. Furthermore ILUM allows for experimentation in the artistic research domain, as well for generating experiences to be investigated from the point of view of composition, systems theory, and above all interaction and social behaviour within media environments.

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Animated Cadavre Exquis: A locked-down experience of collaborative filmmaking in education

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Abstract

The COVID-19 pandemic poses challenges for students and faculty in educational contexts that focus on collaborative and creative practice. Courses that involve working in large teams and interacting in the field require new approaches to cope with limitations on in-person instruction. Building on the concept of *chained animation*, the case study *The Invention of Numbers* (2021) will be used to discuss how the concept can be adapted for hybrid teaching. In *chained animation*, students develop a common concept, realize individual parts in small groups, and assemble them into a short film, rather like an omnibus film. The core element is on-location exchange, especially in the animation studio. Covid-19 regulations have placed limits on these kinds of meetings and exchanges. To deal with those limitations, the creative method of *cadavre exquis* has been applied to the concept of *chained animation*. *Animated cadavre exquis* features a systematic form of collaborative filmmaking that requires little or no coordination between teams, making it particularly well-suited to the new classroom situation. This analysis demonstrates how to set up creative processes for large collaborative groups in distance and hybrid teaching and how the concept of *chained animation* can be adapted using the *cadavre exquis* method.

Keywords

animation, collaborative conception, participatory art, collaborative art practices, co-creation, crowdsourcing.

Introduction

The Covid-19 pandemic urgently requires us to rethink higher education; it poses particular challenges for both students and teachers in courses with a practical element. New concepts for collaborative projects are needed for courses that promote social and creative skills in addition to the acquisition of practical skills. This raises the question of how best to handle creative work in large teams within a framework of distance and hybrid teaching. An answer is offered here based on the example of an animation course in the Department of Digital Media at the University of Applied Sciences Upper Austria.

In the course *Analog Animation*, an elective in the 5th semester of the *Media Technology and Design* bachelor's program, the didactic focus has been on collaborative projects for several years. Building on previously acquired knowledge in photography and animation, so-called *chained animations* [6] have been created on various topics since 2015. This

form of animation is a method in which jointly conceived and produced individual parts are “chained” into a film. In contrast to conventional film productions, here all contributors are equally involved in the conceptual and creative process as well as the implementation. In 2016, the first *chained animation* was realized with 48 students working on the animated short film *Home* (2016), an animated poem about the wave of migration caused by the Syrian war. Additional short film projects with different didactic concepts of collaborative filmmaking followed: *Utopia Now* (AT 2017), *Draft One* (AT 2018), *Golden Cage* (AT 2019) and *Think Twice* (AT 2020). The *chained animation* concept requires in-person instruction in small groups and cross-group collaboration on location. The students develop the storyboard together in a workshop setting and realize the individual parts in small groups in the animation studio, which serves as a hub for exchange between those groups. Because in-person classes were strictly limited due to the pandemic, the *chained animation* process had to be realigned. The challenge was to maintain the collaborative form of conception and production despite limited opportunities for interaction. The creative method developed in surrealism, *cadavre exquis*, a playful way of producing images and texts in a group, was used and adapted for *chained animation*.

Collaborative Forms in Animation

Participatory Art Practice

The first forms of participatory art can be seen in the work of such artists as Marcel Duchamps and László Moholy-Nagy, who delegated works of art to others by telephone or through written instructions. Central components of participatory art practice include playing with instructions, communication (by speech, letter, telephone, social media, etc.), open-ended experimentation, appropriation or instrumentalization, various forms of intervention, and politically or socially motivated activism [4, 10]. Brown et al. [3, pp. 16–19] distinguish three forms of participatory art practice in the museum context. In *crowd-sourcing*, the audience is invited to contribute to an artistic product; in *co-creation*, the audience is directly involved in an artistic experience; and in *audience-as-artist*, the audience essentially takes control of the artistic experience. A stronger form of participation, in the sense of active involvement in the design process, is found in the creative method of *cadavre exquis*. In that method, images or

texts are created by several people passing the artifacts from one to another for further editing, without the later contributors knowing about the previous work. This playful collaborative method can fall somewhere between *co-creation* and *audience-as-artist*, depending on the procedural instructions.

Chained Animation

In contrast to traditional forms of animated film production [5, 9], in *chained animations* many or even all participants take on the role of director, which is similar to omnibus films, also called anthology or episodic films [11, 8]. This type of feature film is made up of several stories or films, usually by several directors, although there may be only one. One of the first films in this genre is Disney's third animated feature *Fantasia* (US 1940), a string of eight visualizations of classical music pieces based on the *Silly Symphonies* concept [7]. Collaborative experiments are especially prevalent in artistic animated film, borrowing from various participatory art forms. An important basic requirement for this kind of project is a simple and direct exchange of data and information. This is facilitated by a shared animation studio, as for example in the early collaborative animation projects at what is now the University of Applied Arts Vienna. For the animated film *Life Show* (AT 1990), for example, a dedicated animation studio was created that served as a hub for the entire production. Similar processes can be seen in "animation jams," where participants usually work together in small groups to create an animated film on predetermined themes in a short period of time. The various short films are usually assembled during production and "chained" together to form a coherent overall work. Working at the same time and in the same place allows for a lively exchange, insights into the productions and consultation on transitions between the individual parts.

Animated Cadavre Exquis

The creative method *cadavre exquis*, developed in Surrealism, was defined by André Breton as a game with folded paper in which pictorial and textual works are created collectively by several people [2, pp. 143–144]. The crucial characteristic is that what has already been created is passed on to the next person or group of people without them seeing what has been done so far. *Cadavre exquis* is a form of collaboration that requires little or no exchange of information between the individual participants. Its synergistic appeal comes from the deliberate disinformation involved. In a classic version of this creativity-promoting method, a sheet of paper is folded into sections, a participant fills in the first section, folds it over, and the following participants build on it and continue the work. Participants can discern some indication of what the preceding artist has drawn at the edge of the fold; the information handed over is reduced to a minimum and yet produces a result that can be highly cooperative. For animated film, digital communication and film production have made this game particularly convenient, whereas the hand-off used to be very time-consuming, costly, and limited. An early example of an animated *cadavre exquis* is the computer-animated film *Kettenanimation* (AT 1993), a production created by 45 Austrian artists according to the principle of this creative method with the following instructions: The first

filmmaker was given an image on a floppy disc that was used as the starting point for an animation sequence of up to two minutes. A production time of one week was allotted for this. After that, the last image was given to another person on a diskette, and after 45 weeks a 21-minute video had been created. The computer-animated short narrative film *Animation Tag Attack* (DK et al. 2012) was also created according to this principle, but with different rules. The current production step was visible to all participants so that each subsequent animator could decide on the basis of the current status of the film how and in what form the story should be continued. All participants had four weeks to produce a film of at least five seconds. Then the clip was uploaded to the blog and the next person in line could continue working on the film. The result is a ten-minute film, a diverse mix of techniques, styles and narrative strategies: "This movie is a celebration of the art of collaboration and of creative process" [1]. Animation director Matt Taylor took a similar approach with 22 animators in the promotional film *Rick and Morty Exquisite Corpse* (US 2017).

In summary, *animated cadavre exquis* can be categorized as a special form of *chained animation*. Both are extremely diverse in terms of their form, aesthetics, method, unifying elements, and techniques, and have similar essential characteristics to participatory art practices (playing with instructions, communication, structure, open-ended experimentation, playing with chance).

Chained Animation in Education

Between 2016 and 2021 we developed, organized, and initiated various *chained animation* projects in the course *Analog Animation* at the University of Applied Sciences Upper Austria, Hagenberg Campus, Department of Digital Media. For each course, we chose different approaches and distinctive requirements. All projects consisted of a fairly large number of participants (30–51) who worked on their concepts while attending a theoretical class and receiving professional coaching in production, editing, direction, and sound design. All of these departments were distributed among the students and only used to the necessary extent. Various topics were offered to the whole group and the students also offered some topics of their own. Final decisions were made democratically and broadly discussed, either in person during classes, or online on specially created social media channels or communication tools. Decision-making tools and communication channels varied depending on the needs of each project. Theoretical classes, literature, or inspirational reference materials were adopted accordingly. After this stage, each team or group worked on the storyboards which were again discussed and feedbacked in small groups or with all class members, then modified to fit the overall concept of the *chained animation*. The priorities were to avoid redundant similarities, find common themes and/or discover links across the narration. A head of communication was needed to keep the process well organized; this role was taken on by the lecturers or by a student volunteer. Either way, final decisions were always made by the students themselves. Interestingly, this was often done immediately before the beginning of the production or even "on the table" where concepts and materials were already fi-

	HOME (2016)	UTOPIA NOW (2017)	DRAFT ONE (2018)	THE INVENTION OF NUMBERS (2021)
JOINING ELEMENT	Theme, voice over (poem)	Topic	Object & theme	Theme, cadavre exquis
EDITING	Predefined (voice-over)	Post-production	Influenced by production	Predetermined by rules
MOTIVATION	High: current events	Average: socio-political	Average: Auto-reflexive theme can be abstract	High: on-site despite Covid-19
RULES	Strict: Predefined length but visual freedom	Average: conceptual freedom in interchange with departments	Very free: overall theme gives broad scope for creativity	Average: cadavre exquis
STRUCTURE	Lectures: direction & sound, Students: editing & post-production	Determined after production by artist	Departments for direction, co-direction, editing & sound	Direction, editing & sound: Coaching and students
PRO (+)	Common research, strict rules	Independent conception, socio-critical topic	Departments establish security	Collaborative processes during Covid-19
CON (-)	Strongly influenced by lecturer	Common vision suffers due to limited time for research	Critical identification due to abstract topic	Limited on-site interaction

Figure 1: Comparison of *chained animations* with different didactic concepts of collaborative filmmaking.

nalized and ready for animation. At all times, the production process happened in the presence of at least one lecturer to guarantee technical and theoretical support during the two days in the studios. Hence this kind of “last-minute” decision making had several benefits for the students: they were able to experience the effects of “trial and error” on a practical level and were challenged to deal with the limitations of their materials of choice, which gave them valuable insights into real-life production processes.

The first *chained animation* is *Home*, an animated poem about the different meanings of the term “home,” contextualizing the refugee movement sparked by the Syrian war in 2015. 48 students created associative images based on semantically corresponding verses of the poem. The second case study, *Utopia Now*, is an animated dialogue of two thinkers striving for a vision of a “better tomorrow”. There was one big difference with regard to the prior project: the conscious absence of an audio layer or voice-over. The concepts were created freely and involved sketching a voice-over template to inspire the final wording of the dialogue. For the third *chained animation*, *Draft One*, we chose a self-reflexive approach to illustrate the creation process itself using one of the most profound MacGuffins of all-time, the “bouncing ball.” One of the biggest challenges in the collaborative process this time was to find the joining elements between the scenes while maintaining the overall structure (see figure number 1).

The Invention of Numbers

In the case study *The Invention of Numbers*, 30 students were divided into 9 groups. There were 3 sessions at the animation studio, each attended by 3 of the 9 groups so they could work on their parts of the animation project while complying with Covid-19 regulations. Based on an introductory session, the leitmotif “The Invention of Numbers” was presented as a conceptual framework and unanimously agreed upon. The assignment called for reflection on the “idea of

the number” itself and its scientific, mathematical, or political consequences or dependencies in private or public action. The ideas presented in preproduction demonstrated a high degree of identification with the topic and, despite a relatively isolated way of working, sparked intrinsic motivation. The communication platform Discord was used to coordinate all the participants, although in keeping with the *cadavre exquis* method, the individual groups were not aware of the way others had elaborated on the concepts. The order and assembly of the individual sequences was determined by the course instructors (see figure number 2) and presented to the students. As an additional task, each team had to select an object from their animated film as a transition to the next clip, which was passed on to the following team. The teams were given the transitional object immediately before production and had to adjust their concept based on it at the animation studio (see figure number 3). Flexibility, improvisation and spontaneity were particularly called for here.

The *chained animation* translated the method of *cadavre exquis* into film by having each production team pass a physical object from their animated sequence on to the next team, with the last two frames of the previous sequence serving as a reference point for a seamless transition. After the technical introduction and revision of the storyboards, the chronological order of the concepts was determined on the basis of narrative, technical or logistical aspects. Communication between the participants was handled entirely via the Discord communication platform. This is also where any voting or polling took place. After central collection and assembly of all contributions, the final film was presented via video conference. The decisive advantage of running a *chained animation* with 30 students, even with very little in-person work and limited consultation, was the deliberately broad conceptual approach and the *cadavre exquis* method, which allows for decentralized creative work on a collaborative product without physical contact. From the point of view of the collabora-

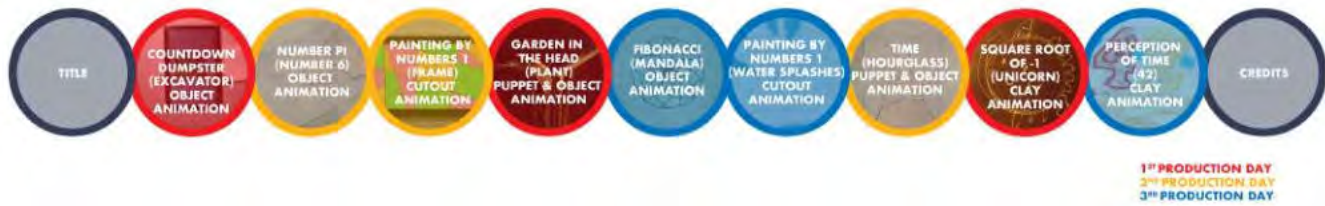


Figure 2: After the concept presentation, the course instructors determined the order of the individual animation sequences. Students selected an object from their sequence as a transition, which was passed on to the next team.

tive approach of *chained animation*, it was observed that there were more constraints than in previous case studies due to hybrid teaching and the limitations of online communication. The *animated cadavre exquis* nevertheless proved to be a very suitable form of collaborative animation that features the essential factors of *chained animation* (rules and certainty, communication and structure, identification and shared vision).



Figure 3: On two production days, teams of three to four students implemented their concepts for the animated film *The Invention of Numbers* in the animation studio.

Conclusion

The nature of the rules of *cadavre exquis* and their adaptation for use in *chained animations* made a thoroughly positive impression. In addition to successfully completing the collaborative film project, the majority of the participating students found this form particularly exciting and conducive to creativity, and rated the course a very successful example of hybrid teaching. The essential challenges were playing with chance, engaging with the unknown, and having the flexibility required to connect the individual pieces. Things that are subject to logical order in conventional production pipelines are here deliberately jumbled up in a creative method that requires all participants to think in new ways. Independence, limitations and spontaneity create conditions that are highly compatible with Covid-19 regulations, such as distance learning or limited in-person teaching. Various factors for spark-

ing intrinsic motivation can be observed or even classified in the collaborative processes. As the previous case studies have shown, a comparison of these factors or the applied rules can be quite instructive (see figure number 1). In contrast to previous collaborative approaches, the *cadavre exquis* method almost seems paradoxical. Whereas disinformation that is spread deliberately can cause limitations and obstacles, here it becomes a creative stylistic device that provides fertile ground for the creative or collaborative process.

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Xenoactivism and Impious Machines: Digital Art as Aesthetic Model of More-Than-Human Politics

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Abstract

Effective activism is predicated on its ability to summon strong emotions and desires, yet its affective palette appears depleted. Next to a fear for destruction of the planet, other emotional and affective programs seem to fade rapidly. Is it possible to develop an eros for a future dominated by hyperobjects like climate change, characterised by unravelling of traditional political structure, and populated by new technological monsters in the form of AIs and lifelike robotics? What kind of desires can provide cohesion to activist collectives? Digital art presents unique opportunities for practicing negotiations and desires within collectives to come. Within this paper we are proposing the notion of *Xenoactivism* as a conceptual ally to activists and digital artists alike. To this end the notion of xenoactivism seeks to productively hijack new materialist discourse around machines. Art practices are discussed as germinal agents for these unborn, nascent, and as of yet unproduced desires. These are desires for novel formalisms and abstractions that span anthropic, vegetal, faunal, and machinic phyla.

Keywords

Activism, Post-Humanism, New Materialism, Anarchive

Introduction

The future presents itself as a daunting place. Hyperobjects such as climate change challenge our notions of objecthood and temporality while existing political structures appear unable to cope with these challenges. Consequently, effective activist practice, conceived as political processes unfolding outside instituted political protocols, is a more crucial force than ever. However, a resurgence of activist energies seems paired with a crushing sense of futility. A sense of urgency is complemented by the insight that it already is too late. The overpowering need for an appeal finds itself confronted with the feeling that there are no political bodies worth appealing to. Resultingly, activists often find themselves curating emotions such as fear and hopelessness, or burn out within fields of aimless intensity.

This poses the question of how to craft a desire to live through the coming series of disasters while embracing the monstrous objects lurking in our common future.

The Trouble with Machines

Activism already is an activity not exclusively practiced by humans¹. Facebook algorithms, search engines, virtual assistants, and twitter bots, help us to incite hatred, protest state power, spread misinformation, or save the planet.

The degree to which non-human elements partake or even steer activist action seems poised to only increase. This raises the specter of a political process in which the grass-roots level is dominated by machines.

At the same time, political practice appears to be overwhelmed by this non-human element: As symptoms of an overwhelming ecological crisis become ever harder to deny, displace, explain away, and ignore, non-humans appear to dictate the terms within which human politics can unfold.

On the part of well meaning humans this is often framed as injunction not to “hurt the planet”, to “respect the environment” or similarly cater to the needs of a non-human entity.

At the same time, these alterous interests and demands are notoriously hard for human bodies to accept and address as part of their political processes. What do non-humans really want? They do not join a protest, submit petitions to parliament, or vote a government out of office. Should there be a section of politics dedicated to machines? Should the political process become more inclusive towards the desires of non-humans?

What kind of social structures would be able to allow us to translate non-human desire into intelligible demand in the first place? How to practice politics and activism in a way that recognises non-humans as friends, that conducts politics not only for non-humans but with them?

Activism and its Aesthetic Textures

Activism has always found itself as enmeshed with aesthetic practice. Separate from instituted protocols of power, its influence derives from its capacity to be seen, for its pains to be felt. However, at this moment, existing concatenations of aesthetic machines and activist practice often seem unproductive and redundant. They present themselves as factories of narcissistic desires in perfect alignment with a capitalist machine based on the control of platforms [8].

¹<https://superflux.in/index.php/calling-for-a-more-than-human-politics/>

Just as art practices can be reduced to a stream of Instagrammable events, activist practice can serve as producer of visual elements consumed by social media feeds. This trajectory has been set in motion through development of visual mass media. It has fundamentally shifted through proliferation of smartphones and social media, as activists themselves seek to produce these images and further their circulation.

Perhaps no image embodies this phenomenon better than the infamous “Riot Hipster”: Shot during the G20 protests in Hamburg 2017 it shows a male protester in front of pittoresquely burning barricades posing for a selfie with a recent generation iPhone.

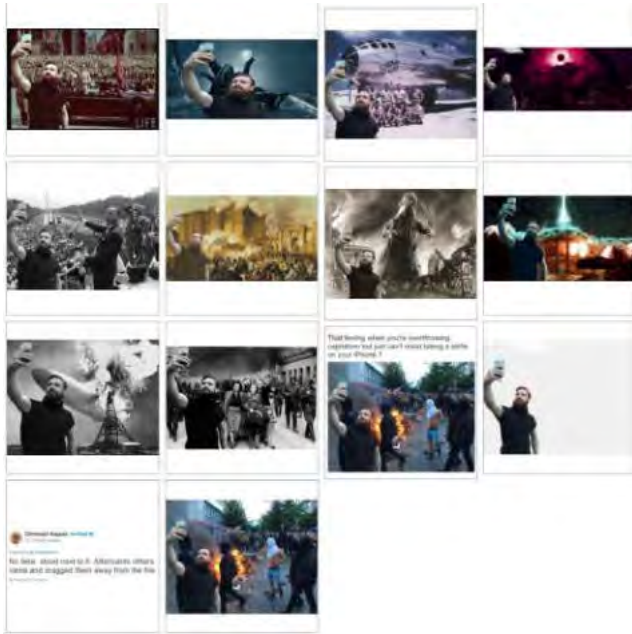


Figure 1: Riot hipster meme, knowyourmeme.com

Posted on twitter, the image quickly went viral, attracting ridicule and speculation concerning the protestor’s and image producer’s intentions. A powerful symbol for the paradox of narcissistic performance of radical identities through corporate platforms and devices, the “Riot Hipster” quickly became a meme in its own right, multiplying and modifying itself through the help of meme-generators and social networks (Fig. 1). Paradoxically, through its failure the riot hipster’s act ensured a degree of circulation of his image which far exceeded the effect expected of a ‘successful’ insurrectionary gesture.

Digital art documenting activism always finds itself situated in this uncomfortable position: Enmeshed with the digital structures it has to critique, witnessing and documenting the voyeurism and narcissisms of others while relying on these very same psychological predicaments in order to circulate itself within social networks. The level of the aesthetic thus emerges as a necessary yet at the same time, deeply unsettling base of effective activist practice.

In order to account for the status of technological and platform elements, two readings immediately present themselves

in the context of the above scenario: The riot hipster enlists the help of the phone in order to circulate his own image. At the same time he draws upon an environment created by activist practice, burning barricades and a crowd of protesters. The image is his effect, installing him as creator.

Conversely, platform elements can be cast in a more active role. Within this scenario, it is the platform which enlisted the riot hipster as its agent, feeding images to its algorithms, serving corporate interests, contributing to ad revenue, balance sheet, and business objectives. In this instance, the process of enlistment happened indirectly: The unnamed shooter of the riot hipster’s image comes in as a crucial mediator.

Following Massumi, it is possible to frame the aesthetic not as situated at the surface level but as an essential dimension within political processes of becoming [1]. The already constituted power of the platform, of aesthetic codes, and modes of identity performance make themselves known. They structure and penetrate into the spontaneously constructed space depicted while striating the mode of depiction.

What we are seeing is not a function of individual narcissism, or the mere effect of platform logic, but the workings of an aesthetic apparatus kept in motion by constituted power in the form of striated codes of self-performance.

As a result, the collective actually assembled is quite different from what its immediate human participants might proclaim. Facebook marches as part of the black bloc, the Apple corporate logo features as prominently as the extinction symbol and peace signs, iPhones make friends with burning trash cans and makeshift barricades.

If activist situations here appear as expectable ruptures of everyday life which are projected on the thin aesthetic layer of an Instagram feed, how could we move past this deadlock? Is it an overabundance of technological elements and corporate machinery that subverts activist intentions?

Learning to Love Machines

The perspective proposed here is not to oppose elements of the capitalist machine with those of activism but to ask for possible future strategies of rearranging structural components which are already effective today. As conceptual element allowing for a productive rearrangement of components we propose an appropriation of the term of the *machine*.

Coined by Deleuze and Guattari in their *Capitalism and Schizophrenia* [2, 3] book series and further developed through Guattari’s *Chaosmosis* [4], the concept of the machine allows for a productive dissolution of dichotomies between human and technology. Here, we draw on Gerald Raunig’s reactualization of the concept, specifically through *A Thousand Machines* [7] and *Art and Revolution* [6].

Raunig employs the concept in order to frame activism in the context of Euromayday protests. Through his discussion of “Mayday Machines” [7, pp. 75] Raunig demonstrates how the machine concept can be used to subvert entrenched forms of activism, prevent repetition of unproductive discursive rituals and negotiate novel forms of assembling collectives.

Raunig’s discussion here centers on precarization: Unproductive differences between calls for “full employment” or celebration of joblessness are productively subverted through

the Mayday machine. This allows for contradictions to become manifest, to be experienced, questioned, and mobilised.

Raunig describes a “revolutionary machine” which he analyses into components of insurrection, resistance, and *constituent power* [6, pp. 26]. Resistance as the necessary correlate of power, allows for insurrection to manifest and ultimately to upset ossified structures of already *constituted power*. Constituents through these structurally necessary ruptures within power structures become able to negotiate and constitute novel patterns of political structuring. These necessarily also always already operate with and against resistances from beyond and within.

Crucially, the machine is utterly ineffective, if one of its components is absent. Insurrection+resistance do not amount to an effective strategy if there is no constituent power to channel intensities, give rise to patterns, and produce new desires.

Code Machines

The work the machine concept is able to do in relationship to code (as in source code) is in fact similar: It allows coding bodies to experience the inherent conflicts and contradictions implied by the practice of coding. In so doing it wants to pave the way for novel forms of experiencing and aestheticising the work of assembling collectives of coders, thus exceeding the received paradigm of “hacking”.

Thus, I propose to frame elements of digital art with the conceptual prosthesis of the *Code Machine*: Elements of digital art contain elements of source code and data. Their function is to reconstitute these formal materials in a way that allows us to desire them, or desire them differently than before.

The concept of *Code Machines* thus seeks to productively hijack discursive formations surrounding the machine concept as developed by Raunig. It draws on connections and relationships made between political practice and the notion of machine, while playing with the (quantum)mechanical overtones implied by the choice of signifier.

Algorithms are not mere embodiment of human knowledge or goals. An algorithm is always more than or less than what its human masters want it to be. As any programmer knows, algorithmic materials quickly take on a life of their own, subverting their creators’ will, unexpectedly complicating processes of making while occasionally offering serendipitous solutions without prior elicitation.

Inhering within formalization thus is the potential for an unruly element, allowing for unexpected consequences and requiring for continuous intervention in order to uphold a certain order.

While the connection between digital art, activism, political processes, and future modes of constituting collectives might at times appear spurious, it is indeed substantial: When creating digital art collectively, we negotiate a set of rules, of formal procedures which become part of the collective. These are known, questioned, become subject to processes of collective examination and self-perception. Thinking in the direction of formal structure infects the reflection and negotiation process itself. While it does not become formal and technical, it begins to lend itself to (negative) concatenations, temporal overlap with code machines.

By doing digital art in the context of activism we thus experiment with models of interrelating formal material and code systems in a way that exceeds the bland aestheticism effected by the constituted power of platform capitalist regimes.

Constituent power is in need of these experimental-constructive modes of action if it wants to productively subvert constituted power in the form of a static concatenation of platform and state apparatuses. Ultimately, these practices challenge the distinction between activism and codified political process.

Xenoactivism

Using conceptual components tentatively developed above, it becomes possible to experiment with reframings of activist practice. To that end, the authors have tried on the concept of *Xenoactivism* in order to frame their own intertwinements of digital art and activist practices:

Xenoactivism is a practice concerned with the construction of machines. Machine here refers less to the notion of a mechanical apparatus and more to the new materialist notion of *abstract machines*.

In the context of xenoactivism this manifests as desire for future machines which create different flows of affect, materials, resources, information. Hopefully, these will be machines able to mitigate looming planetary disasters.

Constituents negotiate these repeatable patterns of organizing affective and material flows. Crucially, non-human constituents such as members of vegetal and faunal communities are conceived as equitable partners in these discussions.

A model for these processes of negotiation can be found in Soon & Tzu-Tung’s *Forkonomy*²: Digital materials such as open-source software are employed in situations of collective negotiation of economic systems. Constituent power is symbolically mobilised to negotiate the protocols used and constraints imposed by economic systems.

Movements such as horti-counterculture stretch into the realm of the vegetal [5]. Projects such as the *Economic Space Agency* describe ways of measuring value that include the Biosphere³.

This equitable nature is rooted in a realisation of mutual alterity. Balance sheets within a capitalist corporate apparatus are no more able to understand or react to the needs of indigenous communities than an animal keeper is able to express the interests and desires of the bodies she finds herself entrusted with. Since we are never able to fully account for our own desires, we have to make the effort to at least partially account for those of others. We cannot lay a claim of exclusivity on our desires, they never belong only to ourselves.

Vegetal and faunal soul, human unconscious, and calculating intellect entangle, embrace, and penetrate each other.

Xenoactivism: Towards a Future Constituency

Should activism be conceived as “convulsive beauty” creating something new? Is it forerunner to instituted political process? Tasked with breaking the predominance of humans before they ruin this planet?

²<https://siusoon.net/forkonomy/>

³<https://economicspace.agency/>

Aesthetics is always already present within practices of activism. This can unfold in the mode of stagnant narcissism or be forerunner to new and unexpected practices. By introducing and experimenting with the notions of code-machines and xenoactivism we hope to construct aesthetic models for future collectives.

In that sense, xenoactivism is about assembling a collective receptive to the strange desires of vegetal and animal communities. It thus seeks to effect and respond to mutual infringements of the realms of vegetal, faunal, and anthropic life. Just as theories of successive ensoulment modelled a connection of human and animal souls, xenoactivism tries to construct a productive relationship between these entities.

Working with digital structures, reflecting on their formal and material properties allowed participants to arrive at a new conceptualization of activist practice: Constituent power expresses itself through construction of formal rulesets which learn to materially respond to non-human bodies. Future constituencies thus comprise human and non-human citizens, spanning across human, animal, and machinic phyla.

The effectiveness of activism itself hinges on its capacity to create and (negatively) concatenate machines: The value of digital art lies in its capacity to analyze, problematize, disassemble and reassemble digital machines which modulate streams of affect and attention.

Crucially, there is a necessity to constitute economic machines. To organize flows of energies, nutrients, drain waste, circulate goods in a way that subverts the horrors of existing capitalist machines, while allowing for constituent power to manifest and modify itself.

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Authors' Biographies

Michael Heidt likes to situate his practice at the intersection of poietic code creation and critical-reflective theory produc-

tion. He has conducted practice-based research endeavours informed by fields such as philosophy, media art, and electronic writing. Project foci range from software-based inquiry into microbiological populations to speculative inquiry into the potentials of distributed ledger technologies to foster post-scarcity economies. An ongoing focus of Michael's research is complexity, which he has applied as intellectual lens motivating research engagements with biological systems, interaction systems, and distributed systems. Michael was a visiting scholar at Simon Fraser University's School of Interactive Arts and Technology, is an alumnus of German Academic Scholarship Foundation, of DFG's research training group crossWorlds, and of Andrea von Braun Foundation. Currently, he is conducting the project CoGS at Anhalt University while being an affiliated researcher at University of Kassel's Gender/Diversity in Informatics Systems group.

Victoria Moulder is an artist, researcher, and imaginative advocate for a better world. She is a pioneer in the field of social art practice and has co-produced events with not-for-profit organizations since 1988 in Europe, Canada, the United States and Asia. Moulder's research explores narrative design in the context of everyday activism (i.e., the habit of working socially conscious choices into our everyday lives). She draws on human-computer interaction design theory, as well as fine art practice to investigate how (or if) mobile and social computing can support the exploration of real-world places, histories and collaborative problem solving platforms. Moulder holds a PhD, School of Interactive Art + Technology, Simon Fraser University, as well as a BFA, Emily Carr University in British Columbia, Canada.

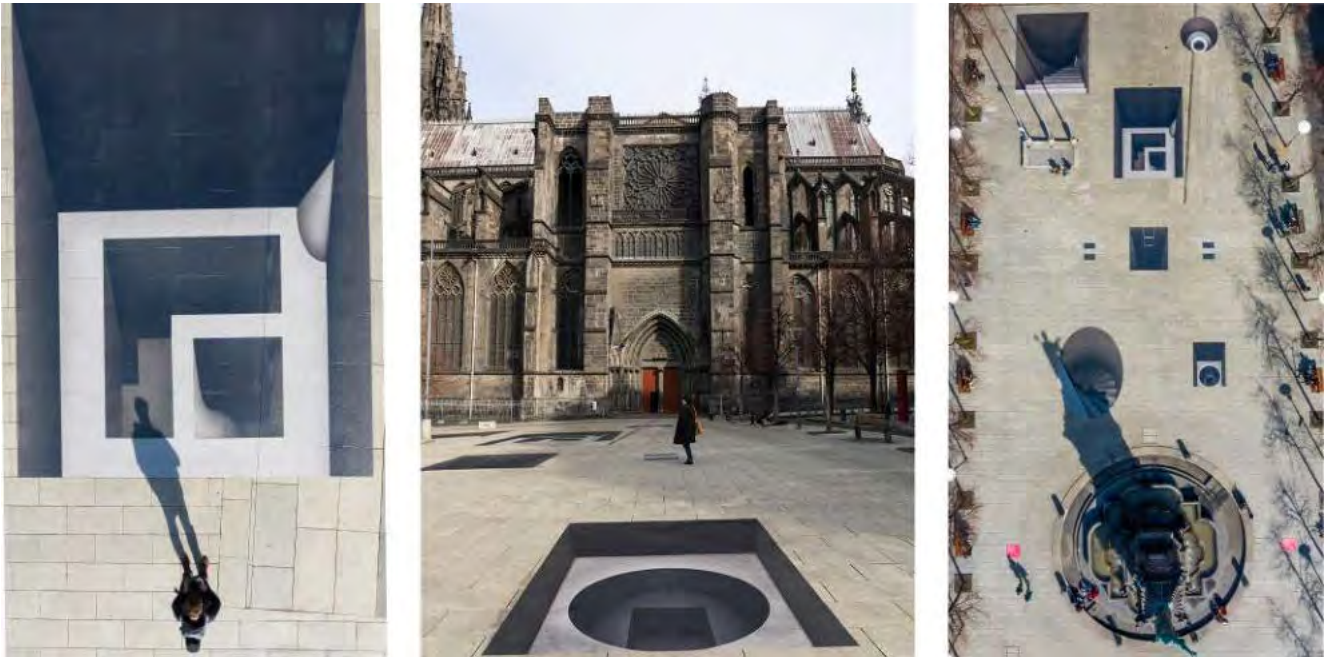


Figure 1: Three Images From *Below Victory: Trompe L'Oeil In Situ* © Copyright Scott Hessels 2021

Below Victory: Revealing a Buried Past and Present

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Abstract

During the height of the COVID-19 pandemic, a creative and technical team used an emerging geological sensor technology to scan the subterranean landscape under a historic plaza in central France, originally the site of a Roman temple buried since Antiquity. This paper will present the resulting trans-disciplinary project that included artists, programmers, designers, archaeologists, geologists, academics, historians, cultural leaders and government agencies all working together to create a series of media works based on what has been hidden in the heart of Clermont-Ferrand for 2,000 years. Ground Penetrating Radar reveals through echo and its haunting visualizations were core to the foundational data used in the artworks but also its theme and metaphor. With the collected data, the team created a site-specific collage of trompe l'oeil anti-sculpture, virtual experiences, films, prints and performances. Place de la Victoire, a cultural heritage landmark, became the source and site of an inverted public experience for inverted times.

Keywords

Data Visualization, Art/Science, Art Tech, Site-Specific Art, Public Art, Archaeology, Digital Heritage, Scanning, 3D Modelling, Sensors

Introduction

"The ends of things and their beginnings are impregnably concealed from him in an impenetrable secret."

Blaise Pascal [1]

The 17th Century mathematician and philosopher Pascal wrote those words pondering the 'great hidden' in Place de la Victoire, the cultural heritage core of Clermont-Ferrand, France. By his time, a jet-black Gothic cathedral overlooked the Plaza, built from volcanic lava rock in the 13th Century. Both are still standing today, however the plaza itself rests on the ruins of a Gallo-Roman temple complex, specifically the inner 'cella', that dates back 2,000 years.

The commissioned artwork began with a Ground Penetrating Radar scan of the Plaza, revealing the structures below the surface. The public space artwork presented large-format optical illusions that used the forms of an archaeological dig to metaphorically represent the ruins and broken homes that lie below every victory [Fig. 1]. A series of Augmented Reality prints, lightboxes, films and visual experiments also resulted from the data.

Background

Two recent archaeological discoveries triggered the thematic direction for the project. In the past few years, a highly detailed Roman town and a 1,000-year-old Viking ship in Norway were both revealed without moving any soil. Both findings credited advances in Ground Penetrating Radar or Georadar. A humble engineering tool to find underground pipes for decades, recent improvements have led to an increased interest by archaeology as the apparatus now makes it possible to reveal buried objects in high resolution. Safe and non-invasive, GPR has evolved from manually waving a single antenna over the ground to towing multi-antenna arrays from all-terrain vehicles, pairing the measurements with satellite GPS. A crude technology has recently evolved and been appropriated for an entirely new purpose.

Victory Square is located next to the Cathedral of Our Lady of the Assumption in the historic heart of Clermont-Ferrand since its foundation in Gallo-Roman times. Over the centuries, different underground structures have revealed various phases of occupation, but the stones under the artwork hide the original temple complex, part of the larger forum. For this project, the site was GPR scanned in December 2020 at two different frequencies with archaeologists consulting on areas of suspected Gallo-Roman remains.

The Scan Technology

Archaeology's previous sole methodology—excavations—were time-consuming, expensive, and risked damaging the findings, if indeed there were findings at all. It is easy to understand why a non-destructive tool would be so quickly embraced by the field. Ground Penetrating Radar offered a way to map the underground without opening it.

Most important was the technology's newfound ability to produce three-dimensional displays. Identifying pipes, cables or structures in soil or concrete is much easier when represented as continuous lines in a 3D model. This is especially important in increasingly complex urban contexts where below could be multiple intersecting, dipping, or layered targets (pipes, rebar, *etc.*). The 3D modelling ability of the technology suddenly made the detection and classification of multi-layered targets much easier, particularly subtle features that were previously easily missed or misidentified. For this reason, the technology quickly jumped from military and subsurface construction to archaeology.

Electromagnetic pulses—radio waves—are transmitted into the soil and bounce off materials with varying dielectric properties. Different soil horizons, groundwater surfaces, man-made objects, and rock formations all 'echo' the signal

back differently to the antenna. The depth positions of these varied interfaces are calculated from the return time of the signals. Larger dielectric differences between adjacent layers result in larger amplitude of the returning signal waves. This contrast is recorded and transposed into imagery.

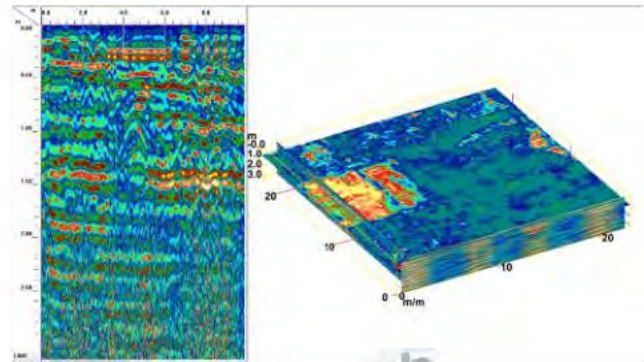


Figure 2: Raw Colorized Time Slice and Block GPR Data © Copyright Scott Hessels 2021

The radar pulses are set for distinct depths and result in 'depth slices' or 'time slices' that are fractions of the total data collected by the GPR. A 'slice' is an extract of the dataset with all the datapoints with equal depth (z), or width/height (x/y). The reflected waves are collected from different points of width (x) and height (y) on the surface and matched to the reflected waves' return time/depth (z) and amplitude. When a 3D display is generated, the computer examines each profile and fills in the gap between it and its neighbor with generated data. This interpolation produces a rectangular block of data that formed the core of the artworks produced [Fig. 2]

On-site Methodology and Resulting Dataset

The research was conducted using a 400 MHz receiver antenna with an SIR-3000 GPR system. The sensor recorded 100 scans per second, each scan was sampled 512 times with each sample condensed out of 16 bits. The instrument travelled in a zig-zag mode across a 23x23m surface, recording 92 narrow line scans. Nine depth slices were recorded to 4 meters deep in increments of .5 meters.

Each data point of a time series is ascribed to a position x, y, z and echo amplitude. The result was 307 675x677px images or 140,000,000 vertices, each coordinate with an xyz position that was partnered with a color to indicate amplitude. The z coordinate is calculated from the two-way travel time in nanoseconds measured by the radar and the dielectric constant: wave propagation velocity in ground equals light speed/sqrt (dielectric) and depth equals half the two-way travel time times the propagation velocity. This produced a point cloud with a 1cm distance between each point vertically and 3cm between points horizontally.

It took six months of failed attempts to convert the data into a format that could be used within design software. The project was the first to attempt this leap from scientific data to creative potential and therefore was both literal and figurative 'uncharted territory'.



Figure 3: Design exploration from a GPR layer © Copyright Scott Hessels 2022

The Public Art Experience: Trompe L’Oeil

“Science is to the visual arts what mathematics is to music; it is an underlying structure that informs the potential for aesthetic expression, an expression that in turn enhances and enriches our understanding.” Jeffrey Shaw [2]

The resulting data images were poetic and haunting, abstract to anyone unfamiliar with reading geoscans. To an artist, scientific data can be released from its usual requirement to inform and simply be intrinsically beautiful. Even the limitations with the technology itself translated into metaphor. For example, in the dataset, the surface layers are very distinct but become blurry as the radar attenuates as it propagates through the medium; once below 3m, the signal to noise ratio is not enough to image anything. The deeper the history, the hazier the memory.

A more literal visualization of the dataset was determined to be best presented as prints in an exhibition where the entire process could be clearly detailed for the public. The outdoor experience in the plaza was uniquely tailored for COVID times. The site’s significance meant that the artwork needed to be constructed with materials that would not damage the place and were safe for public interaction. The artist and festival agreed that an open work, with no need for guards nor security, was preferable. The simplicity and endurance of an emerging technology of large-format ground adhesives was selected. Large ‘stickers’ were suddenly becoming ubiquitous, increasingly used as both indoor and outdoor ground markers to separate people in queues and other spaces during the pandemic. The strong, waterproof adhesives could be custom cut to the images and removed at the end of the festival with no damage to the surface of the plaza. The layout meant that the public could be safely distanced, contact-free, out in the open, and have both a physical and virtual experience. It could also produce the 21st century requirement of a selfie.

The artist began conceiving of illusionary portals placed on the plaza surface that would reveal the ruins of an abandoned mansion. Enormous trompe l’oeil prints of disappearing staircases, rooms, wells, and shafts referenced the geometry of archaeological digs. Developed with a graphic

designer based in Budapest, six anamorphic entrances into an imagined world below were created. With a globally distributed team to realize this work, the coordination of the local arts festival helped the project pass through many filters including governments, commercial interests, environmentalists, educators, scientists, art historians, preservationists and more. In April 2021, over 180 square meters of optical illusions were laid over Place de Victoire and opened to the public. The site quickly became widely photographed and attended, with impromptu dance performances, group stagings, children playing, and multiple types of interaction, all within France’s very strict social distancing laws enacted at the time. The project remained in place until total lockdown was reinstated in France, a few weeks later. The site-specific work occurred in a very small and very opportune moment in the pandemic timeline.

The Museum Experience: Augmented Reality Prints and Lightboxes



Figure 4: Detail of *Below Victory: Light* © Copyright Scott Hessels 2022

Following the site-specific event, the artist then studied the data itself for the best areas to be highlighted through creative visualizations. Each depth slice had a unique topography and was meshed with various color schemes and textures applied; the information was so rich that nearly 50 different designs resulted from readings of echoes at varying depths. One layer slice even became the branding design for the upcoming 2022 festival, its strange mix of data waveforms and geological phenomena making for a unique art/science image [Fig. 3].

Combining all the vertical slices and their interpolation revealed the actual structures below the surface. 3D models of the temple’s cella and courtyard, directly formed from the GPR data, were hidden in fantastical natural settings. An augmented reality overlay revealed thin lines of 17th century text from philosopher Blaise Pascal intersecting and running parallel with technological data about the site [Fig. 5].

Lightboxes of models from the data were also created. The connected datapoints glow in the images, as if discovered gold underground, and act as a metaphor for the knowledge and partnerships that have been generated by the project [Fig. 4].



Figure 5: One of 4 Augmented Reality Prints from *Below Victory: Memoria Hospitis* © Copyright Scott Hessels 2022

Conclusion

The collected artworks, including blended physical and virtual elements, considers how loss is deeply integrated, and quickly forgotten, with each success. The bricolage of conceptual, scientific, aesthetic, and historical sources created a moment to consider what is silently buried below our triumphs. The GPR science provided a new point-of-view and led the site-specific artwork to become an inversion of a public sculpture, not an object nor a statue but a sealed urban memory below the surface, literally revealed through an echo.

The result is Place de la Victoire as a spatial conjunction; now but also then, here but also below, real but also virtual. Art often reveals a new perspective, and this project achieved this both metaphorically and literally. An intersection of art, science, heritage, and emerging technologies allowed visitors to look directly down and see a parallel world visible through the echo of the hidden ruins.

This promising new scanning technology also reinforced larger themes of appreciation of cultural heritage, adaptation of science for innovative creative ideas, interactive public experiences that span social media, and a deeper responsibility to understand complex history. Collectively, the project became a unique shared encounter for socially distanced times.

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Trompe l'oeil Design with Zita Barber
Print and Augmented Reality Art Direction with Thomas Leung
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Algorithmic Vision and the Dialectic of Visibility

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Abstract

This article proposes to analyze the definition of the human being through the 'eyes' of machine learning models dedicated to the recognition and classification of people. For this, the image of a dialectic of surveillance and social control is offered based on the constant visibility of those affected and the invisibility of those who benefit from this system. The algorithmic vision emerges here as a privileged place to exercise this power, but at the same time as the place of vulnerability, from where it is possible to transform this dialectic and the power relations that it determines. The article then proposes a reflection on the different counter-surveillance strategies that take advantage of creativity and aesthetic experience to think about other power relations, that is, about other possibilities to think about what a human being is today.

Keywords

surveillance, control, algorithm, visibility, invisibility, adversarial examples, human, non-human

Algorithmic Vision and the Dialectic of Visibility

In the West, not only because of the predominance of an 'ocularcentrism' (Jay, 2007: 26) but also because of the cloak of objectivity that has been assumed, vision is the meaning par excellence to know the world. This preeminence is adopted in the research and development of Artificial Intelligence (AI), which partly explains the current popularity of functional applications aimed at image classification or object recognition and detection (WIPO, 2019).

This epistemological preponderance was recognized by the military interests that animated cyber and AI research. Before the first conference sponsored by the Macy Foundation in 1946, computer vision was already considered "one of the most important military instruments that the armed forces possess." (Edwards, 1997: 199). With the development of current systems that take advantage of the potential of algorithmic vision, we should also add to the appointment the police forces and the techno-corporate market forces. Indeed, functional applications with greater resources for research and development are today destined to the fulfilment of surveillance and social control tasks [1], thanks mainly to the effectiveness of algorithmic vision in the recognition, classification and categorization of people, things and situations.

Machine learning (ML), based on artificial neural networks (ANN) and deep learning (DL), is inspired in classification and 'pattern recognition, developed by Oliver Selfridge in his Pandemonium and later applied by Frank Rosenblatt on the Perceptron. ML, DL, and convolutional neural networks would definitely achieve their fame when, in 2006, Geoffrey Hinton took up the ideas of Rosenblatt's Perceptron and Yann LeCun's research. As a result, "in just seven years, the accuracy of classifying objects in the data

set increased from 71.8% to 97.3%, exceeding human capabilities." (Gershgorn, 2017).

The effectiveness of these automatic vision machines (Virilio, 1999: 26) is indebted to another aspect that links AI with other practices of surveillance and social control. Today it is claimed that the DL is a "statistic on steroids." (Press, 2020). And this is because statistics "is eminently a science of classification." (Farr, 1985: 252, cited in Bechmann and Bowker, 2019: 4). Foucault asserts that statistics were established "through the police (...). The police make statistics necessary, but they also make them possible", since the police exist to monitor and control "the activity of men." (2006: 370). Nowadays, thanks to complex statistical calculations, ML and DL have become "omnipresent techniques that constitute new forms of surveillance and governance" (Joler and Pasquinelli, 2020).

So what, then, is the reality for this automatic vision so closely linked to surveillance and control tasks? And, in that context, what, then, is a human being for the algorithmic vision?

The human being and its algorithmic recognition

The operation of the algorithmic vision is based on complex statistical calculations inside neural networks, trained with millions of images in order to carry out the correct classification of the input data. During your training, the parameters of the network are gradually adjusted so that the weight of the 'bias' tilts the classifier towards the desired response. In this way, the machine can identify a person on the basis of his statistically emerging characteristics; that is to say: a human being is for the algorithmic vision a mathematical abstraction of the patterns that emerge with each training image. This automatic vision is thus characterized by what Hito Steyerl (2016) has called "automated apophenia": the machinic perception of patterns within a set of random data.

In the 'eyes' of the machine, human beings cease to be recognizable by observable biological characteristics to become the numerical materialization of a statistical hyper-abstraction, initiated in visually perceptible data, later converted by the deep neural network into a humanly unrecognizable numerical entity. The similarity of visual patterns, which was always for the human being a matter of relations between figurative characteristics, stops working in favour of an automatic perception that already has nothing familiar to our sensitivity: "not seeing anything intelligible is the new normality." (Steyerl, 2016)

Visibility and Invisibility: The Dialectic of Surveillance

What can be seen can be controlled. This statement is increasingly present in the algorithmic vision. On the contrary, the invisible departs from this power. On the one hand, our current 'computational regime' has become a system "practically invisible to our eyes" (Bridle, 2020). What should be presented under the reflections of an actively vigilant society is, on the contrary, beyond our

visual reach. Despite its incarnation on screens of all kinds, on mobile devices or gadgets familiar with our closest environment, the true functioning of AI appears to us as something invisible and unintelligible.

On the other hand, there is a permanent demand to make the human being, his life and his image, something immediate, constantly accessible to automatic perception. Cyber absence is now suspicious, just as disconnection becomes a punishable act of rebellion. As in "1984", we are required to have a constant cybernetic exposure and connection, in such a way that it is always possible to trace the path of our movements, decisions and desires. We are faced with a system in which the people under surveillance have little or no control over the technological system that watches over them.

This is the dialectic of visibility and invisibility in the context of an actively vigilant synthetic gaze: while the vast majority of the population is required constant exposure to the 'eyes' of the machine, the surveillance and control systems, as well as the people, institutions and, in general, the interests that animate this entire network, remain completely invisible before the 'eyes' of the public. A power based on coloniality and gender, race or class discrimination is articulated on this dialectic, which reinforces the hierarchies and historical discriminations that millions of people have suffered. Algorithmic insight extends this tradition with statistical precision that promises to keep everything under control.

According to Byung-Chul Han: "You cannot see differently without exposing yourself to a violation. Seeing presupposes vulnerability". (2015: 27). If all technology produces its own accident (Virilio, 2010), that characteristic of the algorithmic vision is its vulnerability (Carlini and Wagner, 2017) to recognize and classify correctly.

What strategies are possible to hack that hyper-abstraction that today defines us as humans for algorithmic vision? How do we become non-human to the machine? How to give face and body to that which has escaped from our gaze and, thus, from our vigilance?

Visibility and invisibility strategies

What is at stake is not only the underpinning of a totalitarian and discriminating surveillance and control system but also an ontological proposal related to the ability of the machine to recognize what is presented to it. In the eyes of the machine, we are recognized and classified based on certain bodily characteristics, in such a way that the transcoding of these computationally calculated features has the potential to change algorithmic reality. The Adversarial Examples (AE) are erected in this sense as a fundamental part of the possible strategies for the invisibility of those people forced to their visibility.

First identified, defined, and named in the field of computer vision in Szegedy, et al. (2014), the investigation of EAs began with the discovery of a "counter-intuitive" characteristic of ANNs, namely, their possible instability with respect to the introduction of small disturbances within the images of the dataset. By changing or attacking certain pixels, for example, it is possible to incite visual

agnosia and deactivate the recognition and classification mechanisms.

According to Goodfellow, et al., (2015), both linear and non-linear RNAs are susceptible to being deceived by AE. "Adversarial vulnerability is a direct result of the sensitivity of our models to well-generalized characteristics in the data." (Ilyas et al. 2019: 1). This means that the AE are not errors, but indeed accidents, that is, characteristics intrinsic to the training of the classification models. The AE will thus become a possibility to imagine the "rebellious subject or the anomalous event that escapes classification and control". (Joler and Pasquinelli, 2020).

From the first attacks with physical objects (Kurakin et al., 2017; Sharif et al., 2016, Brown et al., 2018) in real scenarios (Papernot et al., 2016; Papernot et al., 2017, Eykholt et al., 2018); with objects printed in three dimensions (Athalye et al., 2018); or with images of other users (Smith et al., 2015), today these strategies have been expanded and refined. Guetta et al., (2021) have implemented an even more effective attack on facial recognition models, employing common makeup. Others (Su, et al., 2019), have discovered that single-pixel data completely transforms the reality of the algorithm. And, although different in its methods but similar in its purposes, the VFRAME collective [2] has created the Dface application to make any face in an image invisible, making it impossible to use it for surveillance and control purposes.

On the other hand, and to complete the repositioning of power relations within the visible/invisible dialectic, recent years have witnessed a wide and diverse movement of aesthetic and political practices that question the operation, location and secrecy algorithmic control and surveillance systems.

In tune with the work of Trevor Paglen in *Limit Telephotography* (2006)[3] and *The Other Night Sky* (2010)[4], where he tries to reveal the material places of surveillance and social control; or with that of Harun Farocki in the film essay *Gefängnisbilder* (2003)[5], where he shows the dialectic of the "watchful eye" (Farocki, 2008), nowadays other strategies have forced the hidden powers to incarnate in subjects, groups or institutions, legally responsible for the surveillance and exclusion system from which they benefit. Levendowsky (2021) has proposed a legal strategy, based on copyright infringement, - which is what companies do when they create datasets without the authorization of people whose faces are used for training facial recognition models. The most interesting thing about this strategy is the obligation of companies hidden behind a complex legal apparatus, to respond publicly. An initiative with similar claims is *Reclaim your Face*, by Paolo Cirio (2020)[6], which seeks not only a ban on these recognition technologies but also the legal responsibility of those who benefit from them.

What is the proposal?

The transformation of the dialectic and the repositioning of power relations within it is closely linked to strategies that take advantage of creativity and aesthetic experience. The artistic proposals reviewed here are a clear example of how the totalitarian look of the algorithmic vision can be deceived, evidencing its vulnerability.

This accident typical of ANNs puts the ontology of the human being in suspense as a recognizable entity through statistical inferences that identify its "patterns" in a dataset. The series of numbers that allows the machine to know exactly what a human being is or is not, is the numerical chain that today ties millions of people to incessant vigilance. However, a simple change in this chain allows us to think about the political potential of invisibility.

The effectiveness of surveillance, then, depends on this algorithmic definition of the human. The core of the question is located in this numerical definition: its transformation becomes the possibility of altering the algorithmic reality and the positions within these power relations. The place that completes this dialectic is shaped by the unveiling of what remains invisibility.

Conclusions

The algorithmic vision has brought with it a new definition of what a human being is. Today, in the "eyes" of machine learning algorithms, the human being is a completely different entity from what he has been before. Regardless of the possible benefits of this new definition, this article

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historically discriminated people and groups.

The dialectic between visibility and invisibility proposed by the algorithmic vision at the service of technocorporations and security agencies determines the positions of the subjects within the power relations that crystallize there. Faced with this, this article has wanted to highlight the importance of those creative proposals, which take advantage of the possibilities of the aesthetic experience to think about strategies of counter-power and counter-surveillance from technological activism, approaching the possibilities of the algorithmic vision to imagine and perceive other realities.

Finally, the possibility of thinking about the human and the non-human necessarily passes through the places from which these definitions are produced. In this case, the entire system that allows the algorithmic vision to function. Likewise, the possibility of thinking about other relationships not only between humans, but also between humans and non-humans, goes through creative strategies that dare to question, and at the same time understand, the mechanisms of algorithmic power. Today, what is possible is a reconfiguration of power relations, within which the very idea of who we are is at stake.

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Umwelten: Shifting agencies among the human, the non-human, and a machine learning algorithm

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Abstract

This work is a research-creation project that invites a human, a non-human (a touch-me-not plant), and a machine-learning (ML) algorithm to question and re-formulate the relationship among themselves using the concept of ‘umwelt’ given by the German biologist Jacob Johann Von Uexküll. Through this project, the human and the non-human are brought in the same physical space (with different umwelts) to interact with one another and an ML algorithm, each having an agency to change others’ environment and hence, their umwelts. Such interactions are manifested on the screen (using a text writing platform developed as a part of this project) where the typography of the text dynamically changes over time based on such interactions, encapsulating a space where a non-linear and confusing typography symbolizes the overlapping, collision, and entanglement of the umwelts of these organisms - depicting the shifting of agencies among the human, the non-human and the machine learning algorithm over time.

Keywords

umwelt, senses, perception, human, non-human, machine-learning

Introduction

The concept of Umwelt (meaning “surrounding world” or “environment” in English) was given by a German biologist, Jacob Johann Von Uexküll. According to Uexküll, an organism should not only be treated as a objective entity or physio-chemical being (as per biology) but as a being whose existence is established based on the behavior in the environments it inhabits. Therefore, according to Uexküll, an animal together with its environment forms an ‘umwelt’ - a sensory bubble that is shaped by the sense-perception of the organism in that particular environment. For example, according to Uexküll, something as simple as a flower can be a sign of aesthetic to a human, a pipe full of liquid for an insect, a place to navigate for an ant, and a home for a bee [10] - the same flower yet perceived differently depending on the umwelt of the organism. Therefore, this sensory bubble not only limits the perception of an environment for a particular organism but also shields the organism from our observation. In other words, Uexküll strongly criticized the existence of a reality outside one’s own subjective experience (or beyond the sensory bubble or umwelt).

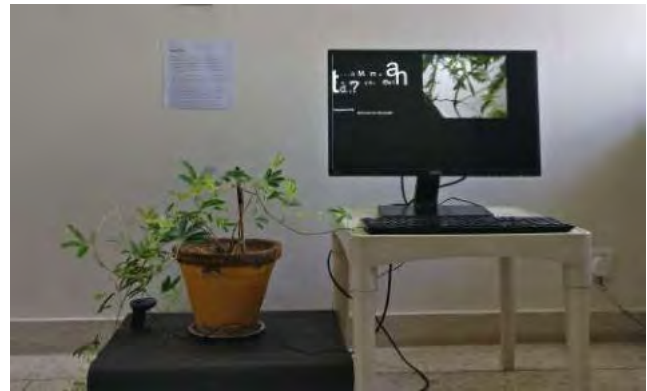


Figure 1: The set of the project, Umwelten

In contrast, natural sciences like physics have strongly believed in an objective reality and hence anthropomorphize the non-humans as ecosystems or as habitats. Such a viewpoint as claimed by the Feminist scholar Donna Haraway leads to a profound belief in human exceptionalism and bounded individualism [3]. Furthermore, as Environmental scientist Haydn Washington puts it - “It [Anthropocentrism] removes almost all moral standing from the non-human world, seeing it purely as a resource” - amplifying a troubling idea of philosophical ownership of humans over the non-humans [12].

Umwelten, as a research-creation project thus playfully provokes this ideology by inviting a human, a non-human, and a machine learning algorithm to interact with each other in the same physical space (with different umwelts) to re-formulate their relationship with one another through a shift of agency over time. While Uexküll limits the concept of umwelt to animals and humans, this project expands it further to the sense-perception of a machine-learning classification algorithm as well, an algorithm that senses images and classifies them into categories. Through a text writing platform developed as a part of this project, the interaction between the human, non-human, and the machine learning algorithm is visualized in the form of a dynamically changing, confusing, and non-linear typography over time on a screen - a typography emerging from the shifting and sharing of agency

among the three entities. In the sections that proceed, a brief related work is described which is followed by the set up of the project, reflections from the audience interaction with the installation of the work, and the conclusion.



Figure 2: A static shot of the dynamically morphing typography displayed along with classification probabilities from the machine learning algorithm and typing speed as visual outputs on the screen

Related Work

Engineers and artists have built a plethora of interfaces to communicate with non-humans through multiple modalities such as sound and touch. The Plantron [2] by Dogane is a bio-electric interface that analyses values of electrical changes measured from plants and converts them into audible sound, reflecting how humans affect an environment and ecosystems through bodily interaction or artificial intervention. Project Florence, a plant-human interface [8], uses human language (though restricted to English) as a medium to initiate a communication between the plants and humans. Wahby [11] has presented a bio-hybrid approach of using autonomous distributed mechatronics to shape the growth of natural climbing plants. Cyborg botany have also been studied recently by Sareen et al. [7] that uses biological processes of plants to act as sensing mechanism for human-non-human interactions.

While there is always an ambiguity of expectations when interacting with the non human (also explored by Triebus et al. in a recent installation [9]) most of these projects do not escape the anthropocentric view and in fact use it at their resource for a deliberate communication with the non-human. Vanessa Watts [13] claims such a thought process to fall under a hegemonic Euro-Western epistemological-ontological framework, contrary to Indigenous (Haudenosaunee and Anishnaabe) cosmologies according to which land, humans, non-humans cannot be separated from each other - each existing by circulating an agency among one another. With a dominant culture of amplifying political economy and productivity, scientifically oriented 'objective' pursuits of

communicating with the non-human portray a falsified belief of ascertaining truth [6]. Tim Ingold [4] has defined such a feature of production as a "subjection of an extractive process to intentional control".

Umwelten (while fully aware of the incapability of escaping the objectification of the non-human) opens a dialogue between the human, the non-human, and the machine learning algorithm by pushing the human to adjust to the spatio-temporal scales of the non-human. Hence, questioning the hegemony of agency between the human and the non-human. The text writing platform developed as a part of this project allows the human to type while the plant and the machine learning algorithm have the agency to alter the typography (spacing between letters, color of the text, font size of individual letters) over time, a time different from the clock time for a human to perceive - the computational time of the machine learning algorithm and the time-scale of the touch-me-not plant.

Set Up

The set up consists of a *Mimosa-pudica* plant, a machine learning algorithm, a human, a camera along with a custom-made text writing platform where a dynamically changing typography on the screen symbolizes the interaction between the aforementioned entities. The plant, a camera facing the plant, a monitor (to see the typed text), and a physical keyboard (for the human to type) were all placed in the same physical space in close proximity to each other as shown in Figure 1. Furthermore, each one of them are described in detail below:

Mimosa-Pudica (touch-me-not plant)

The non-human chosen for this project is a touch sensitive plant, *Mimosa Pudica*. Also known as a touch-me-not plant, the leaves of the plant fold inward (close) or droop when acted upon by an external stimuli (wind, a poke by a human hand etc.) and re-open in approximately 8-10 minutes of human clock-time. Moreover, the leaves of the plant are also susceptible to droop in the absence of sunlight (during night) and re-open in the presence of sunlight.

Machine learning algorithm

Assuming the touch-me-not plant has two specific states of existence with leaves open and with leaves closed, 150 images of the plant were captured in those two specific states in different lightning conditions (during the course of a day). Hence, two image data sets were created each having 150 images and labelled with two categories - *Mimosa Open* (images which have leaves open) and *Mimosa Closed* (images which have leaves closed).

Using Google Teachable Machine [1], a machine learning classification algorithm was trained using the aforementioned image data sets. The image data set was used as an input to a machine learning algorithm to learn the states of the plant, using which a mathematical model (or a machine learning model) was trained. After the model was trained, any new

image of the plant as an input to the model would predict the state of the plant with respective probabilities. The state (Mimosa open or Mimosa Closed) with a higher probability output was assumed to be final prediction by the trained model. In order to test the trained model with new images of the plant, the plant was placed in different settings and light conditions and additional images were added to either of the data sets (and re-trained) to improve the machine learning model and achieve a testing accuracy beyond 99 percent. The model trained was later exported as an open source link and used in a p5js script (the script that runs the text-writing platform).

Camera

A Logitech camera (720p, 30fps) was set facing the plant to capture images of the plant frame by frame and send it to the machine learning algorithm in real time. The camera was glued to the same table (as shown in Figure 1) where the plant was placed and was free to rotate on one of the horizontal axis. The degree of freedom along the one of the axis enabled participants to play with the camera and its placement to capture images of the plant at different angles and thus observe dynamic changes in the typography on the screen.

Human

The audience members (the human) were invited to type through a physical keyboard and doing so one could observe the text appear on the screen in real time (See Figure 2). The appearance of the text, however, was not homogeneous, static or linear on the screen as it depended on several factors described in the later section. One of the factors which the human could control was the typing speed which had a direct correlation with the color of the text, font size, and spacing between the letters - resulting into a dynamically morphing typography on the screen even when the user has stopped the typing.

Text Writing Platform

A text writing platform was created using an open source javascript library (p5js) so that the work can be accessed and replicated easily by anyone as it is hosted on the internet publicly. The p5js library provided inbuilt functions to modify the background color, color of the text, the size of the font, and positioning of the letters typed by the user in real time.

Factors influencing the typography on the screen

The typography on the screen depended on several parameters (or factors) and would even change even when the audience has left the installation space. The factors are described in detail below:

Typing speed of the human

As the audience members typed through the keyboard, the typing speed was calculated in words per frame (the frame rate here refers to the time duration between the consecutive images clicked by the camera). The typing speed was then

mapped through an exponential function to the spacing between individual letters, color of the text (from 0 [black] to 255 [white]), and font size of the text. The typing speed was one of the factors which gave the human an agency to alter the typography on the screen.

The images captured by the camera

Although not a direct influence, the images of the plant clicked by the camera had an indirect influence on the typography on the screen as these images would be an input to the machine learning algorithm (also called the machine learning model) thus having the agency to alter the typography on the screen in real time. Since the classification algorithm detects pattern in the neighboring pixels in the image internally, the placement of the camera, the angle of the camera pointing towards the leaves of the plant, the lighting conditions in the room (which would affect the quality of the image) were all implicit factors which would result in a dynamic change in the typography of the text.

Predictive probabilities by the machine learning algorithm

The images captured by the camera act as an input data for the trained classification algorithm. Internally, the algorithm uses convolutional neural networks [5] to classify the images into categories. In our case, the machine learning algorithm will be called a binary classifier as any input image to the algorithm outputs two probabilities for the respective labels (that is, Mimosa Open or Mimosa Closed) denoting whether the algorithm detects the leaves of the plant to be open or closed based on the images captured by the camera in real time. One should note that the algorithm internally does not understand the images by context, but detects pattern in the pixels of the image to map it to the respective categories, thus outputting the probabilities as a measure of confidence in detecting whether the leaves are open or closed. For example, an input image of the plant might give an output as 0.8 for the category 'Mimosa Open' and 0.2 for 'Mimosa Closed', depicting that the algorithm is 80 percent sure that the leaves of the plant are not folded but open. These probabilities are also displayed on the screen in real time for the audience members.

These probabilities are again mapped using a mathematical function to dynamically influence the typography on the screen thus giving an agency to the machine learning algorithm along with the human and the non-human. One should also note that even when the camera is not pointing to the plant, the algorithm still outputs a prediction, further explaining that the algorithm does not understand the context but have an ability to sense (a sense to recognize pattern in a pixelated image) the environment through images, hence, having a different *umwelt* than a human.

Interaction with Audience and Observations

This work was exhibited at Ars Electronica Festival in Austria in September, 2021 under the theme EMERGENCE/Y. However, due to COVID-19 travel restrictions the work was both



Figure 3: Two participants interacting with the installation

physically manifested in India, exhibited at authors home for the local audience to interact and also showcased at Ars Electronica in the form of a video installation. For the local exhibition in India, due to COVID-19 restrictions only two participants (age 11 and 13) were invited and the set up and working of the installation was explained beforehand. Both the participants had freedom to type and play with the plant (poke the leaves etc.) and observe the changes in the typography of the text on the screen. Since the participants were filmed but not interrupted during the interaction, following observations were made:

- Both the participants divided their task during the course of the interaction. One of the participants typed while the other played with the plant.
- Although not intended as a method of interaction, one of the participants changed the orientation of the camera to forcefully see variations in the typography.
- The influence of the typing speed on the text acted as a gamifying factor, since the participants tried typing faster to influence the typography more dynamically in real time.

Conclusion

A customized text writing platform is developed as a research-creation project to bring a human, a non-human (touch-me-not plant) and a machine learning algorithm into the same physical space but with different umwelts - to question the agencies they have over each other. While the human influences the typography on the screen by varying typing speed on the text writing platform, the agency is also circulated among the touch-me-not plant and the machine learning algorithm as they dynamically alter the typography along with the human but at different time-scales (the computational time of the algorithm and time-scale of the plant). Hence, borrowing the concept of umwelt by the German biologist Jacob Johann Von Uexküll, this project manifests the overlap and entanglement of the umwelten of the three organisms through the text writing platform - depicting a shift of agencies among the human, the non-human and the machine learning algorithm.

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AI Art and the “Transparent Author”

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Abstract

Artificial intelligence (AI) technologies seem novel in an artistic context yet, by exploring certain proposed new terms, I aim to demonstrate that the practice of ‘relinquishment’ of creative activity has its roots in art history. The following questions will be addressed in the paper: can such a ‘relinquishment-technique’ be considered a universal mechanism for artistic inspiration? Can we find something similar in surrealist techniques? Is the author disappearing or becoming ‘transparent’ when abandonment of creative activity occurs? Does AI-based art assume the transparency of the author and is it possible that artworks can be created by other artworks? The terms ‘linear’, ‘circular’ and ‘closed-loop’ concept transfer will be analysed with regard to interactive artworks.

Keywords

Artificial Intelligence Art, Surrealist Techniques, Transparency of the Author, Interactive Art, Linear Concept Transfer, Closed-loop Concept Transfer.

Introduction

There has been much discussion about how artificial intelligence (AI) revolutionises everything, ranging from day-to-day situations to mass production, including creative practice, and the automatising of users’ online behaviour: “It recommends what we should see, listen to, read, and buy” was noted by Lev Manovich in 2018 [1]. AI technologies exert an influence over our everyday choices, the ways in which we represent ourselves and how we perceive others. Another quote from Manovich [2] that should be kept in mind as a backdrop to this article is: “What defines whether something is “AI” is not a method but the amount and type of control we exercise over algorithmic process.” In the subsequent discussion I would like to use the term ‘intermediary technologies’ to describe the various methods, tools, mechanisms, software and technologies that humans utilise to obtain information from the external world and to carry out their creative practice. These intermediary technologies are situated between humans and the external world and serve to vary or enhance human behaviour allowing it to be more effective, rapid and informed. To a certain extent all previous technologies—beginning with writing—were enhancement technologies which influenced humans to better understand the world and communicate with each other. These are well-known McLuhanesque concepts, relating to how the means of transmission of a message influence the message itself.

The paper will discuss the various mediating technologies which function as support systems for intelligent artistic behaviour. Several creative technologies, exemplified below, illustrate ways of externalising mental and creative activity. These techniques of externalisation, relinquishment and automatising of creative activity are common denominators in the various analogue methods used historically in art practice and intellectual entertainment to uncover new creative opportunities. In the examples below we can recognise similarities with AI in the manner in which the responsibility and authorship is ‘given away’ or ‘relinquished’ and the author becomes ‘transparent’ as the mechanisms and techniques take responsibility over the final outcome.

Material and Conceptual Intermediaries

The phenomenon of authorship is a relationship between an author and their work. The authorship, when represented in terms of a ‘concept transfer’, could be depicted as a *vector*, an imaginary arrow, which connects the author and the artwork and represents a variety of **material and**

conceptual intermediaries (tools, materials, technology; rules, methods, algorithms). As a rule the author is understood here as a biological person, a human being. The artwork can be a physical object which has emerged due to the unique activity of the author, or could be a sort of immaterial artefact such as a digital artwork or a performative or processual ‘object’.

On the *vector* from author to artwork we could ‘mount’ different tools, technologies, processes and intermediary events and the resultant artwork could be considered to vary in its ‘distance’ from the author. For instance, drawing refers to the use of manual tools to leave traces on the surface of that which is called the artwork. In this transformative process there are not many elements: author, pencil, paper and time (drawing could, of course, involve a variety of other tools and surfaces). In more complex creative practices this *vector* refers to a computer, software programme and/or other technologies. The software could function with different degrees of autonomy and if AI-based then it could actually replace the author. The various means of AI-based creation involve different degrees of artistic participation, ranging from providing an authorial support function (as is typical with photo editing software) to the total replacement and imitation of the author. In extreme situations the author is little more than an instigator of the process of creation which is not dependent on his or her decisions. In this case a prerequisite is the transfer of the creativity principles and rules to the autonomous system, and that it is capable of learning them.

Technologies of Creation as Technologies of Transformation

From drawing tools to artificial intelligence the methods and media used in art practice have evolved. This can be exemplified by a variety of intermediate forms, but the underlying point is that every mediating technology situated between author and artwork that changes creative practice also changes something in the author and the artwork. The artist creates and changes the work, but this work itself changes the author: a feedback loop is formed between the technology of creation, the author, and the work, which forms an almost closed system that effects change in all the constituent elements.

The novel and playful possibilities brought about by new technology can inspire a sense of excitement and exaltation in the author, but its importance lies in its function as a **transformation technology**, not simply as a **transmitter technology** to turn an idea into materiality, because it changes the transmitter and transforms both the creator and the creation. Most authors have experienced—and are eager to repeat—the effect of **self-transformation through creative activity** which takes place with the assistance of technology.

The Externalisation of Authorship

The utilisation of technical methods and autonomous technologies that are capable of imitating an author’s creative activity produces a situation in which we can say that the **author has relinquished the authorship to an external mechanism**, a computer programme, an AI, or in more general terms to an external agent. The authorship is shared between the artist and this external agent. In the context of traditional art this seems problematic, since there is an expectation that the author controls and produces the artwork from beginning to end. This ‘relinquishment’ of creative activity is a rather artificial construction which raises questions about the extent to which it is taking place. For example, we can say that in abstract and action painting the artist has handed over decisions on how the paint and/or objects fall on a surface to chaotic processes if we consider

practices based on gestures and physical acts, such as those performed by Jackson Pollock, Niki de Saint Phalle, Gustav Metzger, Arman, Daniel Spoerri, Hermann Nitsch and others. Nevertheless, Jackson Pollock exercised control over the paint to a certain degree despite his drip-based technique. Pollock stated that there is no accident in his paintings, no beginning and no end [3], but a study of Hans Namuth's film offers the opportunity to disagree with the artist: although the throwing of paint onto the surface was conscious and deliberate it is impossible to claim that each drop's landing was completely controlled by Pollock. The emergence of the image is both controlled and non-controlled at the same time: the artist exercises a general control, but the entire creative activity contains chance-based episodes caused by the inexact trajectory of the falling paint drops onto the surface.

Pollock could be defined as an 'intuitive' artist, who had no experience in systemic art, as was suggested by Philip Galanter [4] in his article "What is Generative Art?".

Surrealist Techniques as a Randomisation of Creative Practice

In the surrealist techniques of *frottage* and *grattage* the control over the making of an image is given over to accidental and random events. In *frottage* the artist attempts to 'print' chaotic visual effects by placing the paper or canvas over rough surfaces and rubbing with charcoal or pencil: the result exhibits an unexpected visuality which is reminiscent of landscape. In *grattage* the visual image is revealed by scratching or scraping into lower surface layers of the canvas. *Decalomania* is also chance-based, in this process the surface is covered with thick paint and then paper, aluminium foil or glass is placed over the top and removed. The result could provide the source for a possible follow-up painting or can be considered a ready-made artwork in its own right. These techniques were practiced actively by **Oscar Dominguez** and **Max Ernst**.



Figure 1. Oscar Dominguez *Untitled* (1936)

Many other techniques and methods exploited by the surrealists are worthy of mention here. *Automatism* is the general term for creative practice in which the creator 'switches off' their reason and control. *Bulletism* is similar to inkblot drawing and painting. *Calligramme* is a writing practice using words. *Cubomania* was invented by Gherasim Luca and involves a painting being cut into squares which are randomly put together. The *Cut-up* technique involved newspaper words being cut out and reassembled into a new story. *Entropic graphomania* was the practice of connecting the words on a page by drawing lines between them so as to 'write' a new story. The *exquisite corpse* has probably inspired the most popular

usage amongst visual artists, and is performed by several participants in a process of collaborative drawing—numerous digital interpretations of this activity have been produced during the last twenty years which allow participants from different locations to contribute to one communal drawing. *Indecipherable writing* can be mentioned here as a peculiar method of nonsensical writing practice which is performed spontaneously, imitating the manner of writing but with visuals devoid of recognisable signs. Many other techniques such as *soufflage*, *paranoiac-critical method*, *étrécissements*, *surautomatism*, *triptography*, *outagraphy*, and *involuntary sculpture* were employed by the surrealists. Most techniques were based on spontaneity, freed from artistic intention and will, allowing things to happen and examining the results afterwards. 'Post-creation' revisions and corrections were frequently applied, particularly in the case of *decalomania*, which was mostly utilised as an inspiration-technique for the generation of randomly-looking landscapes.

The 'Relinquishment-technique' as a Method for New Ideas

In the above examples of surrealist techniques there is a relinquishment of authorship and the episodes of creative activity occur with the assistance of manual visualisation practices: the author/artist gives away control and later takes it back. The author intervenes after the period of relinquishment, reclaims the work and continues from the new situation, but this is no longer the same work and it could appear surprisingly and inspirationally fresh and new. Different kinds of relinquishment of authorship occur in the case of audience participation artworks. Interactive art exemplifies this most clearly: the artwork's existence is defined by the 'collaboration' between the viewer/audience and the physical entity of the artwork. This entity could be called the 'pre-artwork', a term which I use to describe the participation-enabled technical-material entity before the participation actually takes place. Ironically we could argue that a pencil lying on paper is also a type of pre-artwork in the sense of a 'pre-drawing'. This argument can be colourfully advanced by a quote from Michelangelo: "The sculpture is already complete within the marble block, before I start my work. It is already there, I just have to chisel away the superfluous material." [5]. Combining pencil and paper in the activity of drawing results in a drawing, a similar situation to the function of an interactive piece which comes to life because of participation. There is however a marked difference: the drawing activity is not presented as an artwork in its own right unless it is staged as a performance. Experiencing interactive art, however, means being in the territory of the artwork, inside the artwork. Thus the interactive artwork is by nature performative, engaging for participants and performative for spectators.

Certain specific categories of technical and computer-based art such as algorithmic and generative art show this relinquishment act most clearly. Theoreticians have claimed that generative art could be performed manually, but they consider the term in connection with technique-based art practices. Algorithmic art is connected to digital art and could be considered as 'instruction-based' or 'rule-based' art. The instructions for the creative act emanate from the 'external machine' to which the artist relinquishes (totally or episodically) the creative activity, inputting some form of raw material to this 'instruction machine' and obtaining a result. This 'machine' could be metaphorical, or it could be an actual machine. It could be a written list of instructions or rules about how to make something (rather like a cooking recipe) but could equally take the form of programming code which runs on computer hardware. A classical example of algorithmic instruction is Tristan Tzara's *How to Make a Dadaist Poem* (1920) in which he describes, line by line, actions which should be performed in order to create a chance-based poem. In the same manner Sol LeWitt's [6] sentence "The idea becomes a machine that makes the art" is a metaphorical description of conceptual art. The idea could take the form of instructions, a sequential order of

proposed actions, which result in a final work that could be different each time the instructions are carried out.

POUR FAIRE UN POÈME DADAÏSTE :

Prenez un journal.
Prenez des ciseaux.
Choisissez dans ce journal un article ayant la longueur que vous comptez donner à votre poème.
Découpez l'article.
Découpez ensuite avec soin chacun des mots qui forment cet article et mettez-les dans un sac.
Agitez doucement.
Sortez ensuite chaque coupure l'une après l'autre dans l'ordre où elles ont quitté le sac.
Copiez consciencieusement.
Le poème vous ressemblera.
Et vous voilà "un écrivain infiniment original et d'une sensibilité charmante, encore qu'incomprise du vulgaire."

AA L'ANTI-PHILOSOPHIE ET TRISTAN TZARA.

Littérature 15, juillet-août 1920

Figure 2. Tristan Tzara's *How to Make a Dadaist Poem* (1920)

The Relinquishment of Combinatorial Activity

Computer programmes are the most complex form of representing instructions, consisting of a successive chain of actions which the computer is tasked to perform. Artists also sometimes think in terms of rules, acting almost machine-like and algorithmically, deriving each new action from the previous step whilst relying frequently on intuition and the impulses of non-rational and accidental actions. By episodic relinquishment of the creative activity and handing over the decision-making to the machine, the machine/computer/AI acts, or a line of instruction is executed, without interference from the artist.

Understandably, relinquishing combinatorial activity to an external mechanism or allowing combinations to happen by chance are well discussed themes in the field of art history. There exist a significant number of chance-based artworks and even artistic trends in which the non-planned action of the artist is intentional, is documented and performed (examples being Marcel Duchamp's '3 Standard Stoppages' of 1913-14, Niki de Saint Phalle's 'shooting paintings', Viennese actionism actions and paintings, and Daniel Spoerri's 'snare paintings'). In addition, there are plenty of interactive and multimedia works which allow multiple 'endings' whereby the audience can complete the artwork in a different way each time. In Bill Seaman's 'The Exquisite Mechanism of Shivers' (1991), which was converted to multimedia CD-ROM in 1994, the user can combine discrete video clips into short video sequences which are complemented by a combinatorial sentence of text. In Ken Rinaldo's 'Augmented Fish Reality' (2004) the audience is 'viewed' by fishes in rolling fish-bowls which can be physically moved according to the swimming motions of the fish themselves. Numerous artworks reflect this open structure which becomes the basis for continual variations of the work, yet at the same time these works are able to function as closed self-referential loops, as is evident in Ken Rinaldo's piece in which the 'data' that the artwork processes is an integral part of the artwork itself—the movement of the fishes. A similarity exists with certain AI artworks such as Mario Klingemann's 'Memories of Passersby I'. Based on classical portraiture, this work is "... an autonomous machine that uses a system of neural networks to generate a never-ending, never-repeating stream of portraits of non existing people." [7] There is no input to this work from outside the piece itself, hence it is essentially a closed work, it is not open.

Here I wish to return to my earlier proposal of an imaginary vector representing the 'concept transfer' from the author to the artwork, in which the term 'intermediary technologies' is used to describe the conceptual, material and technological transformations 'between' the artist and the final work. This process results in a consistent artwork. We can distinguish between the different forms in which this 'transfer' of ideas from author to artwork can take place. The most primitive form could be called the 'linear' concept transfer, typically occurring in the traditional art-making

process: the work is made by the artist and it remains as such forever.

"Linear concept transfer"



Figure 3. "Linear concept transfer".

In interactive art the work exists as a series of transformations. Theoretically, each interaction with the work is a different realisation of the concept which is reflected back upon the author or audience. We can call this a 'closed-loop concept transfer' since each realisation is able to feed back modifications to the concept produced by the software and hardware of the work.

"Closed-loop concept transfer"

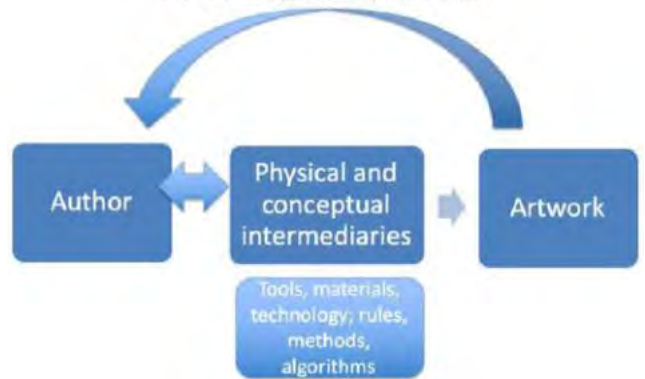


Figure 4. "Closed-loop concept transfer".

In these artworks the interaction takes place by means of 'intermediaries' assembled by the author, and the author may even become part of the installation and be involved in the interaction, becoming one of the many variables with which the user interacts. This is typical in artworks that contain performative elements and the artist's physical presence. Examples include Stelarc's performative and interactive works and Sonia Cillari's interactive work 'Se mi sei vicino/ If you are close to me' (2006) in which the performer's presence is part of the installation and therefore the concept—audience members can move the performer or move themselves around the performer, creating real-time animations on screen.

Interactive art



Figure 5. Interactive art "closed-loop concept transfer".

In interactive and AI-based art the author's position could be described as 'transparent'. The author in these artworks seems irrelevant due to the fact that the artwork produces creative combinations autonomously, without interference nor the need for any initial input from the author. This latter case is hard to imagine because even in AI-based art the responsible person or initiator of the input maintains a

presence. The aforementioned work by Mario Klingemann, for example, was conceptualised, designed and programmed by the artist. In the introductory video for this work Klingemann presents an analogous example: “If you hear somebody is playing a piano, would you say that piano is the artist? No.” [7] The same applies to works made using AI. Even if such works generate constant variations of visuality which are not pre-determined by the author, it is still the author who has instigated the process which could theoretically maintain its transformative existence forever. In that sense the ‘transparency’ of the author does not imply complete absence but rather the absence of the author’s influence over the content of the work. The situation in which an artwork is designed by another artwork is a somewhat theoretical case. Although Klingemann’s project ‘plays’ its transformations via a closed framework of dataset portraits and neural networks, it is possible to imagine a more open work which compiles its dataset autonomously by retrieving information from a network in real time. In this case the unpredictability of the result is again increased and the author’s role shifts even further, becoming more transparent.

AI art and the “transparent author”



Figure 6. AI art and the "transparent author".

Conclusion

The aim of this paper has been to discuss the relinquishment of authorship in traditional art practices, by analysing how this has been exploited in earlier creative practices and to question whether the situation is different with AI-based art. The answer turns out to be both yes and no. The technology used in such artworks is certainly new, and the cultural context in which the results are presented is different. The types of transformation produced using AI techniques can be surprising, for example the generation of imaginary faces and non-existent people, but even this is not impossible for traditional artists to accomplish by using their own techniques to ‘synthesise’ and visualise non-existent faces. In that sense it is hard to consider such types of work as a specific achievement of AI, although AI is incomparable in its productivity and the variation in the visual artefacts it can generate. An interesting case could arise where the artwork is designed by another artwork, such that the creative activity is instigated and maintained without any help from a human artist.

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Biography

Raivo Kelomees, PhD (art history), is an artist, critic and new media researcher. He studied psychology, art history and design in Tartu University and the Academy of Arts in Tallinn. He is senior researcher at the Fine Arts Faculty at the Estonian Academy of Arts and professor at the Pallas University of Applied Sciences. Kelomees is author of *Surrealism* (Kunst Publishers, 1993) and article collections *Screen as a Membrane* (Tartu Art College proceedings, 2007) and *Social Games in Art Space* (EAA, 2013). His doctoral thesis is *Postmateriality in Art. Indeterministic Art Practices and Non-Material Art* (Dissertationes Academiae Artium Estoniae 3, 2009). Together with Chris Hales he edited the collection of articles *Constructing Narrative in Interactive Documentaries* (Cambridge Scholars Publishing, 2014).

Perlin Noise and Sovereign Land: *Minecraft*'s World Generation Algorithm and Colonialism

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Abstract

This paper explores the connection between procedural generation technologies, specifically those used in world generation in 2011's *Minecraft*, and colonialism. Specifically, it examines the ways that the Perlin noise generation algorithm generates a world that exists specifically for the player's extraction of resources, and provides control mechanisms so that the world is never too wild or untameable. The paper concludes with reflection on some methods by which these colonial ideas might be subverted in games that use procedural generation technology.

Keywords

Procedural Generation, *Minecraft*, Colonialism

Introduction

One of the things that digital technologies do more than ever is create worlds for people to inhabit. Sometimes these are worlds of work and production, sometimes they are of community and socializing, and sometimes they are of play and leisure. In no application is this more literal than in video games, where often there is an attempt to replicate the exact materiality of the world. Historically this has often been done in an authorial way, with artists individually placing every stone and every tree. However, with the increasing scope and scale of many contemporary games this approach is becoming fast outdated and procedural models have taken precedence, where terrain is generated algorithmically.

The many different methods by which different games approach terrain generation span such a broad range that addressing them all is outside the scope of this paper. Instead, I would like to focus on some of the revealing aspects of the terrain generation of one specific game, 2011's *Minecraft* (Mojang 2011), which remains a prominent example of procedural terrain generation. As Sabine Harrer, Daniel Dooghan, and many other scholars have pointed out, *Minecraft* is also a clear example of the colonialist ideas embedded in modern game design. [1][2] Harrer points out the procedural slavery enabled by the game systems, and Dooghan similarly points out the extractivist models that underpin the game design. It should be no surprise, then, that these ideas also extend to the procedural generation of the terrain itself — the very world of *Minecraft*, in a literal sense, is built with colonialism in mind.

Generation

Arguably, the generation of a world in *Minecraft* begins with the seed, a string of characters and numbers that determine the output of every random factor in the creation of the world. Normally, it's hard to predict the output of a random number generator, but a seeded random number generator will always produce the same results, given the same seed. This reproducibility has a number of effects: in

development, buggy or broken worlds can be easily reproduced and debugged. After release, players can share seeds of interesting worlds so that their friends can generate the same ones. This encoding of the world into a finite string is a way of keeping these worlds controlled and in many ways, owned by giving them a pseudo-name that can be possessed. As Harrer writes, this naming can be an act of colonial control, as the unknown world is brought into existing knowledge systems, in this case, brought into a Perlin noise generation framework. [3]

This name/seed is unique in that it is both intelligible to a human reader, in that it uses the Latin alphabet and Arabic numerals, and also intelligible to the procedural generation algorithm which uses it as a seed. The primary aspect of the *Minecraft* world generation is the Perlin noise function which creates the majority of the topography of the world. *Minecraft* is already a grid-based world, where 3D cubes make up just about everything about the terrain. Perlin noise applies another lattice over this grid, and at different points in this grid, randomly determines the slope of the terrain. [4] Then, these slopes are interpolated between to create smooth connections, creating the hills, valleys, and other terrain components.

There's no real limitation to the size of the world created by the process, only that of computational storage and memory. In *Minecraft*'s case, generation corruption begins at about 12 million blocks from the origin point of the generation, but terrain is still generated much further. At this point of generation, the world is entirely made of stone and water, which will later be converted into other kinds of materials in a later stage of the generation process. At this point, it's an infinite empty world awaiting content, nearly only existing as a mathematical representation of curves and height. Crucially, despite its pseudo-infinity, it is still controlled — by the seed, and by the generation algorithm thus far. This control is essential, as we'll see in the next step of generation.

Population

The world is then filled with quite a lot of content — first, different regions of the world are assigned different biomes, which impose restrictions on the generated world and also convert different blocks to materials corresponding to that biome: snow in the tundra, sand in the desert, etc. Under the ground, caves are dug using one of a set of different cave carving configurations. On top of the ground, features like villages are constructed using other sets of generation rules which are semi-biome independent.

Importantly, this is when resources are allocated in the caves, and on the surface. Placing these resources after world generation is a deliberate choice, it means what's in the world is dependent on the shape of the generated world, as opposed to the world's shape being altered by the things that are in it. This subordinate relationship between resources and the world further drives home the fact that these resources exist only for extraction by the player —

the world doesn't care about or need them at all. The act of extracting these resources thus bestows a great benefit to the player while having no negative effects on the world, justifying it as both the right thing to do and something the player is entitled to do.

The only time that entities, monsters, animals, etc., are placed in the world is during play, with a player already in the world. In this way, while the game may depict them as having houses or "living", they're truly as much strangers to the world as the player. This further reinforces the player's right to the resources of the world, these monsters and creatures don't use them, and in fact aren't even responsive to their existence (except in the one exception of the Piglin's desire for gold). The riches of the world are only accessible to the player.

Conclusion

A named, controllable world yet with infinite resources that can be harmlessly extracted. These are the worlds generated by *Minecraft*'s procedural generation algorithm. They reflect the colonial drive to control the unknown and extract resources from it. Games need to take a more thoughtful use of procedural generation technologies to avoid replicating these colonial ideas.

Elizabeth LaPensée, Outi Lati and Maize Longboat suggest the notion of sovereign games as one method to avoid these shortcomings, involving Indigenous designers in various capacities and emphasizing self-determination as a core aspect of development. [5] *Minecraft*, developed in Sweden with a lead developer who holds beliefs so toxic that he was disinvited from his own game's 10th anniversary¹ certainly does not meet the criteria of a sovereign game.

What other paradigms are possible for procedural generation in games? Could the resources come first, with a world generated to do justice to the complicated ecosystems that generate around them? Could worlds generated provide histories, like those in the generated worlds of *Dwarf Fortress* (Bay 12 Games, 2006), that provide complicated ground for the player to traverse, instead of empty? Could world generation begin from something other than a shape or seed, and could they be freer to develop in uncontrolled ways?

We can only hope the future of game development leads us to answers to these questions and to more sovereign games.

¹ <https://arstechnica.com/gaming/2019/04/online-conduct-leaves-markus-notch-persson-out-of-minecraft-10th-anniversary/>

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Reinventing the Colonial Gaze Employing AI: a Case Study

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Abstract

This short paper accounts for a case study of artistic research revolving around Cyprus' colonial past and inspired by present day decolonial affairs. The endeavour pivots on a hybrid AI system, trained on text from colonial handbooks of Cyprus (originally published when Cyprus was still part of the British Empire) and employing a custom image dataset meant to reflect this colonial view of the island. AI then generates new colonial 'gazes' of Cyprus upon demand. Output text and imagery is used in a number of physical and digital artefacts and events that are presented herein.

Keywords

Digital Colonialism, Decolonisation, GAN, Text to Image Synthesis, Text Synthesis.

Introduction and Background

Affairs of digital colonialism have been well fleshed out in a number of resources and AI-driven systems have been shown to be biased, racist, or sexist on many occasions. More, they generally fail to account for non-Western realities and cultural perspectives. Such affairs are currently researched in a number of contexts, *e.g.* related to economic and political neo-imperialist practices [5], the impact of information and communication technologies on non-western knowledge systems [8], or third-world user-data exploitation [3]. It has been then suggested that a very real opposition is in place: one between increasing control and freedom and concerning persons, populations, and entire geographic regions [1]. This confrontation is simultaneously relevant at many different levels of cultural and political organisation and manifests itself by means of controlling digital assets, data, computational power, and a variety of other means. Such concerns are very relevant to AI-related research that has been repeatedly shown to proclaim western symbolical, ethical, and ideological values. Benjamin [2] shows succinctly that AI algorithms are a very contemporary manifestation of a discriminatory architecture wherein racist assumptions are made intrinsic to the world's technological infrastructure.

'CY as AI Saw it: Reinventing the Colonial Gaze' artistic project by the author and Alexia Achilleos is part of 'Cyprus as AI Saw it' wider thematic concerned with decolonial re-interpretations of the Cyprus history, see also [4]. This endeavour employs a modified AttnGAN text-to-image genera-

tion model based on [7] and the RNN text generator pipeline introduced in [6]. The latter is trained on text from colonial handbooks of Cyprus, originally published when Cyprus was still part of the British Empire and reflecting an overly orientalist gaze of the then newly annexed British colony. Cyprus is presented therein as a degenerate country whose people are in urgent need of salvation. Trained on such a corpus, the model generates new colonial descriptions of Cyprus that become the input of the subsequent GAN-driven text-to-image pipeline. This subsystem relies on a bespoke dataset that is meant to reflect the local reality since, not surprisingly, the readily available image databases largely fail to account for Eastern Mediterranean landscapes/culture (they generally produce images that are more reminiscent of the Western cities that host the big tech companies that distribute them)—also see [4]. The resulting AI hybrid is then left iterate, generating original colonial views of Cyprus upon demand.

The output text and imagery are used in a number of related artistic outputs, exhibitions, events and artefacts that are detailed herein. The deeper motivation behind such a project is to creatively interrogate affairs of post-colonialism in a local context as well as to comment on the aforementioned concerns of digital colonialism concerns in an empirical and critical fashion. The artists intend to contribute to this broader discourse as well as to give agency to a rather idiosyncratic geographic region that only exceptionally (if at all) appears in present day AI research. It should be noted that they do not approach the local (post-)colonial reality as neutral outsiders; they are not speaking on behalf of some oppressed other in some other part of the world. Rather, they are themselves based in the region under scrutiny and, thus, they are themselves subjected to relevant ongoing post-colonial concerns and questions of local identity.

A (de)colonial book

Figure 2 illustrates the 'CY as AI Saw it' book that comprises AI-generated text and imagery. The book is partly intended as a conceptual statement, fulfilling a circle starting with a series of 19th century books published by Cyprus colonisers and concluding with this publication featuring imagery and text generated by an AI trained on the former. In this fashion, the book interrogates how the dominant colonial views of Cyprus resonate contemporary AI-driven techno-scientific



Figure 1: Installation at Tetramatyka festival, Lviv UA.



Figure 2: CY as AI Saw it book.

culture to produce contemporary (de)colonial narratives. The book comprises 57 A5-sized pages inside a hardcover case. The pages can be shuffled in arbitrary fashions so that readers may intuitively explore this material and the different kinds of (de)colonial narratives it may set out.

Installation

Figure 1 above illustrates the ‘CY as AI Saw It: Reinventing the Colonial Gaze’ installation exhibited at the Tetramatyka festival in Lviv (Ukraine). The installation comprises a wall with numerous 3x3 inch prints of AI-generated photos (in photo paper) and text (in heavy white paper), some of the colonial handbooks used to train the AI pipeline, the ‘CY as AI Saw it’ book, QR codes to download smartphone applications (to be discussed below), as well as small craft envelopes, photos, and text printouts for the audience to interact with — as explained below. Figures 3–4 demonstrate examples of printed media.

Assembling own (de)colonial narratives

Having surveyed a ‘CY as AI Saw it: Reinventing the Colonial Gaze’ exhibition, audiences are encouraged to take a few (de)colonial ‘gazes’ with them as mementos. Craft envelopes, spare photos and text printouts are available so that each individual may assemble *in situ* their own tiny (de)colonial narrative—see also Figure 5. Engaging audiences in such a fashion draws, of course, on relational aesthetics, doing-it-with-others, and participatory approaches to art. In this context, nevertheless, and alongside the book, they should be also understand as an articulation of post-digital objecthood: a cybernetic AI system produces digital artefacts that are then transformed into actual objects audiences may physically engage with, holding them into their hands, shuffling



Figure 3: Sample imagery.

them around, and even creating their own micro versions of the work as a memorabilia.

(De)colonial gazes on the go

Further hybridizing the project with more exhibition modalities, the artists also distribute a smartphone version of the project: an Android and an iOS app. This mobile app iteration serves users with new colonial text/image upon demand. On touching the screen they are presented a new AI-generated image alongside its generating text or just a piece of AI-generated text. Figure 6 illustrates a screenshot from the iOS version.

Conclusions

As briefly outlined in this short paper, ‘CY as AI Saw it: Reinventing the Colonial Gaze’ revolves around Cyprus’ colonial past and pivots on a hybrid AI system, trained on text from colonial handbooks of Cyprus to generate new colonial ‘gazes’ of Cyprus upon demand. Resulting imagery and text have pollinated a number of artefacts and presentation media so that in its totality the project becomes a multimodal aesthetic experience inviting audiences to engage with smartphone apps, books, printed matter, and an installation in space. In this manner audiences are given multiple opportunities to engage with the generated material as well as with *ad-hoc* narratives thereof—either assembled by the artists (the installation wall), random processes (shuffling the pages of the book, mobile app), or by audiences themselves (selecting printed matter and assembling narratives on the fly). That is to say, that employing a variety of physical, digital and hybrid media, audiences are encouraged to interact with the system, producing unique (and often individuated) (de)colonial gazes of Cyprus.

The women are generally about two and a half feet southwood, was a favourable position, the actual advantage of extensive space.

Figure 4: Sample text.

Eventually, the project attempts to re-examine the historical relationship between coloniser and colonised. It touches affairs of (digital) colonialism, and brings forth an alternative (de)colonial narrative as a tactic to regain agency from a local point of reference. Then, ‘CY as AI Saw It: Reinventing the Colonial Gaze’ becomes a concrete attempt to critically engage with the possibility of alternative realities and research paradigms within AI-programming (and through a Cypriot lenses). That is, this work extends the body of research discussed in [4] and proceeds into the direction for future work announced therein: further raising concerns of digital colonialism in AI research.

Acknowledgments

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Figure 5: Assembling individuated decolonial narratives *in-situ*.

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Author(s) Biography

Marinos Koutsomichalis is an artist, scholar, and creative technologist. He is broadly interested in the materiality of self-generative systems, (post-)digital objecthood, sound, image, data, electronic circuitry, perception, selfhood, landscapes/environments, and the media/ technologies we rely upon to mediate, probe, interact, or otherwise engage with the former. He has exhibited or performed his work extensively and internationally and has held research or teaching positions in Greece, Italy, Norway, and the U.K. He is a Lecturer in Creative Multimedia at the Cyprus University of Technology (Limassol, CY) where he co-directs the Media Arts and Design Research Lab.



Figure 6: iOS App screenshot.

Cymatics as a tool to create visual cartographies with the ecoacoustics from Delta del Llobregat Natural Park.

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Abstract

This artistic research project approaches the environmental transformations suffered by the Llobregat Delta natural park from the soundscape, using the acoustic science of cymatics¹ as a tool with the aim of generating visual cartographies on the water of the Llobregat River itself, which show the creation of wave patterns, making visible the transformation of the environmental sound heritage, and the changes due to the systems of economic growth.

Keywords

Cymatics, sound art, cymatic cartographies, acoustic-ecologies, visual sound.

Introduction

Barcelona, like other large metropolises in the world, has grown by developing unsustainable economic, urban and industrial models that have expanded its borders to the natural spaces that surround it. The enormous growth of the port and airport of Barcelona in the last 20 years has delimited and modified the physical space of Llobregat Delta, transforming its ecosystems and modifying the acoustics of one of the richest environmental zones in southern Europe, declared a ZEPA area by the European Union.



Figure 1. Delta of Llobregat Natural Park, with the Port in the background and a plane in the final landing.

The research presented sheds light on the concept of economic power and the relationship that individuals as part of society develop with nature through attentive listening. This artistic research project uses the acoustic heritage of the Llobregat Delta space as an oasis between two industrial giants. Using acoustic ecology and the transfor-

mation of soundscape records in cymatic cartographies, photographic images are presented as unique traces of the place through the visualization of wave patterns that by their shape, composition and structure, will determine the origin of the sound.

The images obtained in this process are analogous to sound spectrograms, focusing on the visual structure of sounds through the propagation of wave patterns on the materials themselves, generating sonic traces or imprints through the sound of the ecosystem, on the water of the Llobregat River. It is very important for the construction of these cartographies the use of the river water, since through the deposition of sediments, it is the main cause of the formation of the Delta and its ecosystems of Mediterranean walls, pine forests and wetlands. Schafer states: "The rivers of the world speak their own language. The gentle murmur of the Merrimack River, 'Whirling, swirling, and falling downward, kissing the shore in its wake,' was a sleeping balm to Thoreau. For James Fenimore Cooper, the rivers of upstate New York often flowed slowly into rocky caverns "producing a slack sound, resembling the firing of a distant gun." [1].

Art referents

As we approach an artistic research project attempting to develop a visual mapping based on the acoustic ecology of river ecosystems, it becomes crucial to define some artistic antecedents as origin elements.

Schafer affirms: "Acoustic ecology is the study of the relationships between living things and the environment. Acoustic ecology is therefore the study of the effects of the acoustic environment or soundscape on the physical responses or behavioural characteristics of the creatures that live in it. Its particular aim is to draw attention to imbalances that may have harmful or adverse effects on health. [2].

In the contemporary artistic context, we found various examples of artists who work directly with soundscapes and different aquatic ecosystems, with the aim of mapping and creating artworks in which listening to environment and the surroundings become the constructive axes of his plastic discourse. The artwork by Ursulla Biemann [3] *Acoustic Ocean* (2018) uses a hydrophone positioned between the ocean and the land, to focus on the sound ecology of the marine and underwater environment from a scientific perspective. Other sound artists such as Annea Lockwood [4] and her projects *The sound map of the Danube* (2005) and *A sound map of the Housatonic river* (2010), or Chris Watson [5] with his work *The Ice Mountain* (2020), shows the need to address environmental challenges, complementing the listening process with visual maps of different places.

¹ The science of cymatics studies the visual representation of sound waves on matter.

Metodology

In the field of soundscape as an artistic practice, we regularly find projects focused on listening processes that also generate visual cartographies as a documentary of the space where the recordings have been made. These cartographies are usually materialized in the form of drawings, maps, videos, the relocation of objects, photographic documentation of the place and descriptions, intended to help guide the viewer's listening. This act proposes an exhibition focused on the artist's point of view, which influences the viewer's imagination.

In this way, the perception of the listening sound environment is altered, which has been objectified during the recording process by the choice of location and the orientation of the recording equipment. Acosta affirms; almost certainly because of this added impossibility of evoking the unknown and in the absence of other sensory stimuli, records or CDs are often accompanied by texts that are descriptive of the situation or simply poetical. The images also help because, with that generosity for illusion that is so much our own, we can imagine ourselves in that place that sounds like that [6].

Through the sound recordings generated in the same locations but in different temporal stages (during the Covid-19 pandemic in which massive confinement took place and in periods of economic activation without lockdown), the aim is to show the effect of environmental noise as a phenomenon that directly affects the non-human ecosystems inside the natural spaces at Delta of Llobregat. Espinosa states: "A bit by a bit, the differential sound features that, as in maps, gave us clear profiles of the different regions and places on the planet, have been disappearing" [7].

Using scientific laboratory equipment, the recorded soundscapes have been transformed into vibrations. Using a Pasco mechanical wave oscillator coupled to an oscillation bath containing the water of the Llobregat River, the different soundscapes are projected, making resonance. With zenital photos taken in a dark room and the use of an LED ring flash, nodes and wave patterns on the water surface can be seen, showing how different sound sources can produce differential wave formation.

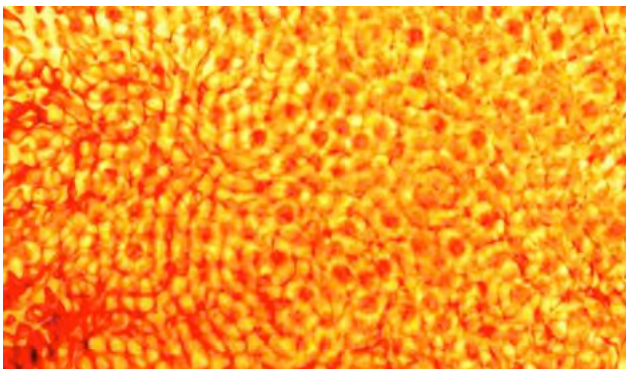


Figure 2. This image shows the experimental procedure in the Acoustics Lab, where the soundscape is converted into a wave-form.

These cartographies take the form of abstract photographs showing wave patterns, which do not provide contextual information about the place of recording and differ from traditional visual supports, only allowing the viewer to imagine the recording spaces without offering a preconceived idea of the space. The sound of the environment is then incorporated into contemporary sound aesthetics and an experience ensues through mental abstraction, contravening the usual rule, we encounter, in which the experience of the soundscape is enhanced through contextual information.

In this way, my goal is to induce the exact opposite experience through abstraction, making it impossible to imagine exactly what the acoustic reflections are about. The images I obtained are conceptually reminiscent of a spectrogram; however, unlike a spectrogram, which can contain a long period of sound in a single image, these images provide precise fractions of a few seconds duration snapshot.

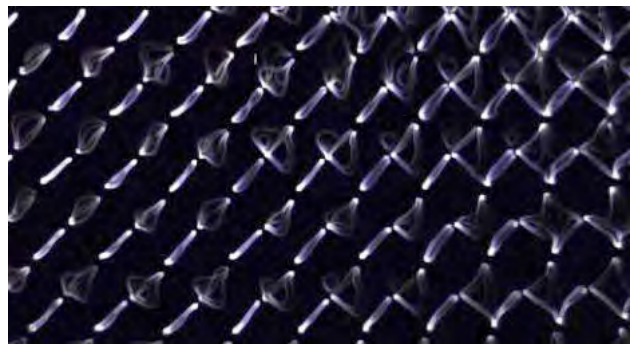


Figure 3. Industrial soundscapes create geometrical forms on water.

Conclusions

One of the most important conclusions obtained during this research has been to verify that human action has acoustically cohered many of the sound spaces of the environment, making it increasingly difficult to locate the unique traces that determine these ecosystems.

I have observed that in soundscapes dominated by a natural sound environment, the sound registers are usually formally quite uniform. The predominant frequencies in these systems generate soft and constant ambient sounds. Thus, when water undergoes the oscillation process with these sounds, it enters into resonance quickly and durably over time. Therefore, they tend to adopt an organic visual structure, in which we observe many entangled nodal lines (see Figure 2).

In contrast, when industrial soundscapes predominate (sounds of airplanes, ships, automobiles, industry), the structure of the recorded artificial sounds tends to be much more intense, interrupted and less continuous over time. When oscillation begins, the fluid takes much longer to resonate and form stable patterns. The shape of the waves varies intensely and produces peaks of high amplitude and moments of low intensity due to the variety of frequencies. Visually, this results in very intense but short-lived resonance processes, leading to the formation of geometrically patterned structures that fade away very quickly (see Figure 3).

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Author(s) Biography(ies)

Ferran Lega has a PhD Cum Laude and received the extraordinary doctorate award from the University of Fine Arts of Barcelona, specializing in sound art and the use of acoustic science of cymatics as a tool for artistic expression. Since 2009, he has combining his artistic practice with teaching. In 2019 he started his full-time career as a professor of digital design and creative technologies at the University of Lleida. His artistic works have been exhibited at Botín Foundation, Santander (2009), ATM contemporary, Gijón (2009, 2013), Art Eka, Madrid (2012), Colorida gallery, Lisbon (2013), Tàpies foundation, Barcelona (2013), Tortosa Museum (2016), Lo Pati art centre, Amposta (2016), Arts Santa Mònica, Barcelona (2017), CMMAS Mexico (2017), IEL, Lleida (2017, 2019, 2021), Roca Umbert, Granollers (2017), MEM, Bilbao (2019), Bideodromo Bilbaoarte (2020), Sant Andreu Contemporani, Barcelona (2020), CCCB (2021), La Capella Arts center, Barcelona (2022), Leucade Gallery, Murcia (2022), among others.

The vanishing of remix concept in machine-driven text

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Abstract

In this paper, the process of remixing is analysed through the evolution of machine-driven text transformation approaches. Starting from semi-random early techniques for the composition of poetic or experimental literature, the process of associating and composing preestablished pieces of text, sourced from analog and then digital repositories, will be investigated. A continuity emerges from the combinatorial experiments realised by the *Ouvroir de littérature potentielle* (OuLiPo) group in the 1960s to the later software that has advanced remix possibilities up to the contemporary attempts to establish an almost autonomous “automatic publisher.” The increased sophistication of the algorithms and the growth of available sources have affected the plausibility of the produced texts, including a technical analysis of style, laying the foundation for its simulation. More recent tests, using unusual or different technologies to produce texts, will be included. In the essay, I will analyse the remixes of text’s evolving structure since the early experiments in the 1960s, the role of machines in effectively emulating a writer’s style and their essential support to generate credible fakes, particularly deepfakes.

Keywords

remix, publishing, deepfake, experimental literature, generative text, generative poetry, software art, electronic literature.

Can machine-driven texts be defined as a “remix” of content?

Machine-driven texts, or texts produced by some degree of automation, have been around for a long time. The idea of automatically elaborating texts and generating new texts through an algorithm, albeit a very simple one, was attempted as early as the fourth century AD.[1] Throughout history, the application of mathematics to literature has produced a wide range of experiments, from the application of rules and the permutation of elements, such as Nanni Balestrini’s historical combinatorial poetry *TAPE MARK 1*, discussed later, to the current sophisticated elaborations of

large amounts of data by machine learning algorithms, such as the heralded “AI-based text generator Generative Pre-trained Transformer-2 (GPT-2)”. But only a few of them can be described as possible “remixes”, i.e. as processes in which samples are extracted from pre-existing material and combined into new forms according to personal taste. [2] These remixes have different structures and purposes, while recent developments run the concrete risk that the difference between the remix and the pre-existing material disappears in the immediacy of digital machines. My main question is therefore: can machine-driven be defined as a “remix” of content?

The shift of focus: from code to database

Beginning in the 1950s, early experiments with programming code to generate texts in various forms and styles mostly focused on a combinatorial approach. They produced a collection of texts that had a distinctly uncertain or redundant style, depending on the nature of the randomness implemented. They were usually based on a set of fixed rules that were applied each time the code was executed. “Chance” shaped these experiments by associating words with what was essentially a given literary structure, such as a single sentence, a poem, or a letter.

Tristan Tzara’s 1924 Dadaist poetry manifesto, for example, encourages Dadaist poets to cut words out of a newspaper, put them in a bag and take them out one by one. In his cut-and-choose process, he uses a combinatorial method in which all possible combinations of words are reduced to one.[3] He also creates a “database of patterns” in the bag and algorithmically, albeit in a very straightforward and random process, produces a text that is often nonsensical. The patterns are merely functional, filling in a carefully laid out scheme as if they were “shuffling” in a fixed matrix. But in this process, the “sampling” is so minimal, reduced to single elements, that any perceptible reference to the pre-existing work (the remix component of the “spectacular aura” [4]) is irrevocably lost, except for the structure. These are thus “permuted new works” rather than remixes, as they retain a reassuring and consolidated, but at the same time quite rigid structure.

The turning point in this strategy was the availability of larger databases of samples and the development of hardware and software that allowed the use of longer samples and thus the creation of more complex compositions. An example of this is Stéphanie Vilayphiou's "La carte ou le territoire", where she finds all the sentences (or fragments thereof) of Michel Houellebecq's plagiarised "La carte et le territoire" in other books in a kind of conceptual combinatorial remix (same samples from different sources/history), which would have been impossible without a database like Google Books. Over a few decades, the mechanisms have remained largely the same, even with modern machine-learning techniques that use more sophisticated algorithms.

Sampling in 1961

In the 1960s, texts were increasingly combined in more sophisticated ways, in proportion to developments in hardware and software. It seems rather coincidental that in the same year, 1961, two different works that could possibly be called "machine-driven remixes," were released in two different ways.

The first is the iconic Raymond Queneau's "Cent Mille Millions de Poèmes" (One Hundred Thousand Billion Poems). It is an experimental book consisting of ten sonnets where each page is divided into horizontal strips with a single line that can be turned over independently, offering the reader 1014 possible unique poems. Each time a strip (or series of strips) is turned, the reader can read a slightly or completely different poem in turn. Queneau calculated that it would take 190,258,751 years to read all the possible combinations.[5] He co-founded the avant-garde literary movement OuLiPo (Ouvroir de littérature potentielle) and used mathematics as a source of inspiration for literature. The content of this unique book is generated by a calculated, software-like process that shuffles the different strips/lines. Yet it is the reader, not a machine, who chooses. It goes beyond the combinatorial aspect of most late Oulipian works, which faced the challenge of writing according to strict rules, such as "lipograms" (excluding one or more letters) or applying the S+7 rule (replacing each noun with the seventh noun listed after it in a dictionary). Technically, "Cent Mille Millions de Poèmes" is a combination of samples (the stripes/lines) that can be recombined by the reader at will and never exhaustively. The mixing can then go on indefinitely, always with a plausible and different result. The peculiarity of this work, however, is that its structure remains fixed and each result formally collides with the "original", as do all possible elaborations. Although the work could easily be transformed into some software programmes, its strength lies in the implementation of these ideas and mechanisms in a slightly modified printed book. The book itself acts as a machine, and the reader actively uses it to select and produce the content.

In 1961, there was another literary experiment that attempted to use the possibilities of computer programming to create a credible literary work: "TAPE MARK 1", developed by the Italian writer and artist Nanni Balestrini. For

this work, Balestrini, together with engineer Alberto Nobis, developed a computer programme for the IBM 7070 that would have combined three different poems by Michihito Hachiya, Paul Godwin and Lao Tse into a new "original poem". There was a meeting in Milan, in a bank office where the computer was housed, attended by the semiologist Umberto Eco and the avant-garde musician Luciano Berio. The computer produced more than three thousand remixed variations of the three poems, but Balestrini decided to select only one of them as a representative result to be written about in articles and art catalogues. He also intervened minimally to select the computer edition and correct some grammatical errors. Technically, the poem should have consisted of six verses, each composed of four metrical units. TAPE MARK 1 was remarkably on display in the historic exhibition Cybernetic Serendipity at the ICA London in 1968, and here Balestrini imagined computer processes as tools to open up the space of composition to another, more sophisticated and partially automated level. He put together a proof-of-concept that conceptually echoed the Open Work theorised by Eco, a publication in which he asserts that for this type of work "the possibilities which the work's openness makes available always work within a given field of relations." [6].

This work was reconstructed in 2017 by three Italian hackers, Emiliano Russo, Gabriele Zaverio and Vittorio Bellanich. They reprogrammed the original algorithm in Python on a Raspberry Pi hidden in a wooden box that contained a small monochromatic CRT monitor that visualised the output. They gave it to Balestrini, who liked it so much that he wanted to include it in his solo exhibition at the ZKM in Karlsruhe [7]. The reconstruction with modern technologies makes the "remix" process inherent in the algorithm even clearer. The team technically and aesthetically "remixed" Balestrini's work fifty-six years later by combining its principles and references, such as the monitor and the wood for the box, with contemporary technologies, such as the electronics inside and the chosen programming language. It is significant that the author not only acknowledges the remix, but symbolically re-appropriates it by including it in his official solo exhibition, while retaining the full name of the recreators.

Remixing author's style

These early experiments show two different methodologies of remixing: one is based on the potentially infinite interchangeability of samples once they are compatible with each other and within the stable environment in which they reside. The other is based on creating a solid but fluid structure that can accommodate more complex samples so that they create a more dynamic result. Both are based on a structure that guarantees combinations and gives mixed results. In the following decades, the focus has shifted primarily to producing trustworthy output that can be recognised as human-like. Computer-generated output has often sought other human's trust as their final validation of quality. And trust in literature essentially means a projection of what is written

onto a person, the author, and onto his or her perceptible 'style'. To discuss this particular aspect, it is worth looking at one particular work: *The Death of The Authors*, 1941 Edition, by Femke Snelting and An Mertens (part of the Belgian Constant collective) from 2012. This work undeniably refers to Roland Barthes' "The Death of the Author", on the level that it seems to technically embody its main argument to the extreme.[8] It is a generative software that produces a freely downloadable novel based on various texts by Virginia Woolf, James Joyce, Rabindranath Tagore, Elizabeth Von Arnim, Sherwood Anderson and Henri Bergson. Snelting and Mertens become the ultimate "screenwriters" (in Barthes' definition), building on the programming code that elaborates the final result. The work was published on 1 January 2012 to celebrate the authors' works becoming public domain, as they all died in 1941 and their works were protected by copyright for up to 70 years after their deaths. According to Snelting and Mertens, the aim was to point out that copyright itself blocks much more than unlimited reproduction. [9] To highlight this aspect, they ironically refer to the act of working freely with the work of dead authors as a "macabre form of liberation".

The perceived presence of the author has been analysed at length by Foucault. The "status" we give to an author "when we began our research into authenticity and attribution"[10] is that of a presence closely linked to the author's name and serving as a "means of classification"[11]. The author's name is essential even in the remix process, as it is the main, irreplaceable reference for the texts to which it belongs, or, in other words, to "group together a series of texts and thus distinguish them from others." [12] The author's name "remains at the contours of texts -separating one from the other, defining their form and characterising their mode of existence." [13] Finally, the function of an author is to "characterise the existence, circulation and operation of certain discourses within a society." [14]

The remix of different authors thus has a direct effect on their overall work. Should Balestrini's work (even if it is explicitly derivative) be included in the bibliography of Hachiya, Godwin and Tse? And what about Snelting and Mertens' endless and equally derivative compilations of Woolf, Joyce, Tagore, Von Arnim, Anderson and Bergson? According to the criteria in force, they should not, but from a creative perspective that would seamlessly include "new" works, this very concept of an "author bibliography" could be challenged.

The structural remix of fakes

If the 'trust' we instinctively place in print is one of the crucial elements of publishing, then the sophistication of the output produced and the underlying computational power and access to useful data are essential to remix publishing. A true literary remix needs the pre-existing samples (the data) and possibly the pre-existing structure (the vessel in which the original author's style is embedded) and other compatible data to elaborate.

Eric Drass' *Cut Up* magazine embodies this concept. It was conceived as a printed guide for *The Great Escape*, a music festival held in Brighton that featured 300 (mostly unknown) bands. The festival usually lacked any kind of reference or background information on the bands, so audience members had to reserve judgement on the bands before seeing them perform. His *Cut Up* magazine was distributed free of charge and featured computer-generated band profiles. As he explains, *Cut Up* magazine was a way of "algorithmically filling the 'critical void' [...]. The reviews were created using a mix of historical reviews from the UK music press and data gleaned from Last.fm. Even for an unknown band, there would usually be a few listens logged at Last.fm which helped describe the genre of music and perhaps a few song titles. Using this data, I algorithmically generated music reviews - using text taken from reviews of bands of the same genre to keep the tone consistent [...]. I printed 128 fanzines, each with 16 unique reviews of bands playing at the festival, with details of the performance and a random mark out of 10. In this way, a band could feature in multiple copies of the zine, with wildly differing reviews. I went to the festival and handed them out to the fans. An act of algorithmic de-tournement". [15]

Remix in machine learning-based texts

There is an ecology of literary bots on the internet, especially Twitter bots that incessantly remix content from databases or other online sources. One of the most famous examples, now defunct, is *Pentameton*, a bot that collects tweets in iambic pentameter and arranges them into pairs, with poetic and sometimes surprising results. These bots are an evolved version of the early *Ou-LiPo* experiments. In the 1980s, Italo Calvino, who was an active member of *OuLiPo*, turned against a schematic approach that had already been extensively explored, even with the limited technologies of the time, for a more subversive approach. He praised machines that would produce "disorder", meaning something other than slavishly following the classicist rules. [16]

At the beginning of the 2020s, in a media ecosystem that is increasingly vulnerable to manipulation thanks to the orchestrated or spontaneous spread of "fake news", remixes of textual content play a conceptually important role.

In this context, it is useful to define the term 'deepfake', which was introduced to categorise synthetic content (mainly videos and, to a large extent, audio) in which a person is 'replaced by the image of another person'. [17] The sophistication of the technology here overcomes trust, as these videos and audio recordings look and sound real and can mislead even an attentive audience. An equivalent text product is currently being developed by OpenAI, a non-profit research company. Called *Generative Pre-trained Transformer-2* (*GPT-2*), this machine learning system is capable of generating text based on short prompts and a corpus of forty gigabytes of text sourced from various internet sources. The researchers chose to release a much smaller version to avoid the risk of the software being used to "generate deceptive, biased, or abusive language at

scale".[18] One of the highlights of this software, apparently, is that it did not "lose track of what it was writing about as it generated output keeping everything in context".[19] It perfectly embodies the "new logic of speeded up cultural remixability enabled by computers." [20] At this level, the potential to confuse, mislead and manipulate the reader is greater than ever. Moreover, this technology potentially puts the historical validation of works in a very difficult position. The disorder Calvino mentions is paradoxically enabled by the essential structure of Deepfakes. It is a structural "disorder" that makes the spectacular aura disappear: The final result is indistinguishable from the pre-existing work, so that they only acquire the same status.

To quote Foucault again, "The Author is a certain functional principle by which in our culture, one limits, excludes and chooses,"[21] and then "is therefore the ideological figure by which one marks the manner in which we fear the proliferation of meaning".[22] The uncontrollable dissemination of meaning, possibly triggered by deepfakes, takes on forms that call into question the very notion of the author as well as the entire remix process.

Conclusion

What the deepfakes bring about is the final, true disappearance of the preexisting work concept and the trust we place in it. These kinds of productions affect a relatively small number of people, but they redefine the nature of the material used before and during the remix process. In Deepfakes, the former existence of materials is hidden both technically and through the seamless simulation of elements such as the writing style (or the face in videos or the voice in audios). At the same time, it is conceptually removed by being believable to a mass audience that does not question its authenticity.

The concept of remix has previously been understood to mean the recognition of samples or the recognition of "preexisting" original material, intrinsically validated as "original".

But deepfakes systemically avoid any explicit and verifiable source or reference to what was used in their process. To speak of an "original" then seems simply a challenge, while the concept is deeply shaken: Only sophisticated algorithms can distinguish a credible fake from an authentic production. The acceptance and accumulation of deepfakes in our visual and written culture would mean an increasing layering of fake but recognised pre-existing material that we can no longer verify over time.

These potentially infinite new digital productions of "originals" would seriously challenge any classical remix practise and question the historical attribution of their samples. Paradoxically, the only remaining valid pre-existing originals would increasingly become a thing of the past, with their records of existence and production still authenticated. The machine-driven texts of the post-digital age are thus remixes without references. Their content is created through the sophisticated elaboration of earlier forms and styles that look and feel like a new original. As these new

originals become the norm, they may redefine the categories of work, pattern and authorship that we still use today.

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Laboratorio de luz. More than 30 years of research in art, science and technology in the Spanish panorama.

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Abstract

In 2022, the *Laboratorio de Luz* (UPV) will be 32 years old, and it is a good time to reflect, and to share that reflection, on the contributions and positions of the work carried out by this group of researchers and artistic collective that is considered one of the first university, Art and Science nodes on the Spanish scene. Re-thinking our work in this presentation framed within the “artist talk” format also implies reviewing the conditions of possibility that existed in the Spanish context 30 years ago and those that exist today for art research-science-technology.

Keywords

Laboratorio de luz, Media lab, Media Art, ACTS, STEAM.

Introduction

The *Laboratorio de luz* grew out of an earlier group called the *Laboratorio de luz y Color*, created in 1986 by the artist and professor of painting José María Yturralde, which expanded the approaches that Yturralde himself introduced in his Color-Light Seminar, seminar that he taught in a non-regulated way at the Faculty of Fine Arts of Valencia from 1983 to 1986.

José María Yturralde held a fellowship during 1975 and 1976 at the Center for Advanced Visual Studies at MIT. In 1979 he became a professor at the Faculty of Fine Arts in Valencia and excitedly transmitted an idea of a university to us, understood as a space for connection between art, science and technology, with studies on the environment and energy systems that resonate with us today current sustainability policies.

Clearly interested in this intersection of University, Art and Science, at the beginning we moved as a funambulist between the evolution of art and science, with the determination to open new possible paths in the development of artistic practice as research.

At the university, we linked teaching and research, which in a sense complemented an idea of teachings dislocated between the teaching of art and what art teaches us, from the friction hinge between both sides an important thread arises open to reflection.

Research at the *Laboratorio de luz* has been mainly linked to the development of R&D projects with a clear application in artistic practice, carrying out research in art and for art [1], whose approaches emphasize the role of image and

sound technologies, as well as the questioning of perception and light.

But we were also concerned about the dissemination of knowledge and in 1992 we started the magazine *Arte: proyectos e ideas* [2], in which the idea of university was reviewed, artistic projects presented by their own authors were disseminated, and re-readings of works or ideas that we considered referential at that time. The magazine is still open in its e-magazine version on the group's website [3].

Wish for the future.

In the 1990s, already as *Laboratorio de Luz* (without color), we began to introduce technological devices in the works we made, because we believed that this placed us on a path to the future, while maintaining conceptual winks with historical artists that we liked. As in the work *Proyectante de sombra* (1993) [4], whose title alludes to Marcel Duchamp's *Notas del infraléve* (1914).



Figure 1. *Proyectante de sombra* (1993). ©laboratorio de luz.

In this piece we question the role of light and the difficulty or insufficiency of reading. On a prominent wall of the *Arteleku* exhibition hall (Donosti, Spain, *Iluminaciones profanas: La tarea del arte*) a text made with phosphorescent paint was hidden by the light that occupies its entire extension, the text remained imperceptible due to the strong illumination from a theatrical cut reflector. In this way light desecrates its own function by hiding with its rays the element that in itself is an enlightening agent: the language.

The action of the spectator, voluntarily or by chance, activated the change by means of a pair of sensors, allowing for a few seconds the absence of light to see/read the work, but

the time of clarity was brief and the cyclical structure of the text hinders the continuity of the reading.

Another example of this search for the future, and at the same time a link with works of the historical avant-garde, and which also alludes in a certain way to the vacuum, is the piece *Modulador de Luz 2.0* (2006) [5], whose title refers to the work *Modulador* by László Moholy Nagy (1930) and was presented in the exhibition *Banquete Nodos y redes. Laboral Centro de arte y producción industrial* (Gijón – Spain).



Figure 2. User interacting with *Modulador de Luz 2.0* (2006). ©laboratorio de luz.

The installation was presented as an empty stage space with three microphones hung from the ceiling. When a spectator/user transmits sounds through the microphones, he or she may draw the theatrical light, or perhaps take it away from someone else who is interacting at the time, as a light fight.

But the behavior programmed for the lights, in relation to the sound, favors unforeseen games; different roles and attitudes of light can be given depending on the times that these data of the tone, timbre or intensity of the sound have been recorded throughout the day: sometimes quickly, intensely and sharply, sometimes hesitantly or timidly and with blurred edges, the light is directed towards one microphone or another, simulating a social physics of actions and reactions in which the desired illumination is not always achieved for all the spectator-actors.

Without the interactivity of people with technical devices, these works would remain empty, illuminated white wall, or strange empty stage. Interactivity is fundamental for us.

All perception involves interacting with the stimuli that generate it and the environment in which those stimuli are produced. Through the senses we collect data (inputs), our mind encodes and / or reflects on them (processes them) and as a result they can modify our knowledge, behavior, state of health, mood, etc., (output), is in other words, the cognitive, cultural and psychological is incorporated into perception,

while what is perceived can transform these fields, if the interaction has had a true effect on us.

In the context of digital media, the notion of interactivity grows above all in the technical factors, transforming the spectator, with his interactivity, the process of development of the work. It is to be hoped that this level will be added to the others, so that this experience of human-machine, spectator-piece interactivity is not restricted.

Timeline Art / Computer Science / Art-technology.

The art world carries with it a long, long, history and tradition. Centuries of works of art that are preserved in museums. The field of informatics or computer science, although its origins can be traced back to Sumer with the abacus as the first known calculation tool, as we understand it today digital computing is very, very, young, born in the sixties of the twentieth century approximately. The weight of tradition shapes an artistic discipline that walks slowly, solidly. The youthfulness of computers sciences allows for rapid and much more fluid growth.

Because of this fluidity in the growth of computer technology, digital devices have advanced so fast that the supports of those first works have become obsolete, old and, therefore, out of that idea of the future that motivated them. After more than 30 years of activity, today we are looking for a balance between this desire for the future that runs forward without looking too much to yesterday, and the durability of the works, so we are updating versions of those that have become technically obsolete.

The conservation or preservation of digital art works is an important field in which we will not stop off much in this text, but we invite anyone who may be interested to sound out it because it is growing academically with very interesting criteria. We will only stop at one of our works to point out what was learned in this process of updating the piece.

Entre_Cabanyal

The work *Entre Cabanyal* (2002) [6] is an interactive installation that was originally programmed with Macromedia Director 8.5 software, on a PC with Windows 2000 and a Miro DC30 video recorder, all now obsolete. We had to update it for the 1998-2015 *Cabanyal Portes Obertes* exhibition. *Cultura y Ciudadania* that was held at *Centro de Cultura Contemporánea del Carmen* in Valencia in July 2021.

The work has been reprogrammed with C ++ language, because the use of proprietary software would probably limit its maintenance in the future, and under the Linux operating system, also open source, because both Windows and Mac are increasing the incompatibilities in their new operating

systems. The video files, as they had the proprietary codec of the Miro DC30 capture, we had to export them through FFmpeg, by the terminal, frame by frame, later reconstructing their original format DV PAL 720 x 576, square pixels, without fields, and with the JPEG 2000 codec for having less loss for future adaptations. The rest of the assets were incorporated into the new configuration without modification.



Figure 3. *Entre_Cabanyal* (2021). ©laboratorio de luz.

This updating process allowed us to see the importance of elaborating a detailed documentation of the interactive works in view of possible updates due to obsolescence of the devices. We also wonder if *Entre_Cabanyal* (2021) can consider a new work or as a new version of *Entre_Cabanyal* (2002). When installing the work in the exhibition we understood that any artistic installation that is not site-specific, each time it is installed in another space, is transformed, even if there have been no changes in its software or hardware, it will always be experienced differently by the influence of the qualities of the exhibition space.

Tools for art-technology-interactivity and teaching.

The crossover between teaching and research made us see the need to develop applications or software for the teaching of interactive art and to facilitate its use by students with little knowledge of programming languages. *Gamuza* [7] and *Mosaic* [8] are the 2 softwares developed by Emanuele Mazza that have emerged as a result of research projects subsidized by the Spanish Ministry of Education and Science.

What is *Mosaic*? *Mosaic* [8] is a visual programming environment in real time with objects that are connected with wires, and, among these objects, it inserts some destined to program in Lua, Python, GLSL Shaders and Bash languages. It is intended for creative applications, live performances, interactive installations and, above all, for teaching interactive art.

Interdisciplinarity and commitment.

The *Laboratorio de luz* has also been and is sensitive to social and environmental political commitment.

The project *Bajo la Manga* (2020), is situated between sound composition, mapping and live cinema. It was presented in October 2020 at the exhibition *Reset Mar Menor*:

Laboratorio de Imaginarios para un Paisaje en Crisis, as the result of an interdisciplinary research project about a unique environment of great environmental richness facing a situation of serious deterioration. The project brought together artists, scientists and citizen platforms with the purpose of collaboratively rethinking this territory, understanding the visual arts and their intersection with other disciplines as triggers for thought, critical action and the creation of alternative narratives. One year later we know that the situation of the *Mar Menor* (Murcia- Spain) requires much more attention and care.



Figure 4. *Bajo la manga* (2020). ©laboratorio de luz.

Draw a new idea of the future.

The *Laboratorio de luz* from the UPV, has grown from three members in 1990 to more than 20 researchers today from different departments and their participation varies according to the proposals that are being developed: working between the collective and the individual.

The new drawing of the laboratory follows the same pattern of its foundation, but trying to highlight its interdisciplinary structure.

Since its foundation, it has carried out more than 14 research projects funded by national (Spanish Ministry of Education) and international (European projects) public calls for proposals.

In recent years we have seen the need to direct the capacities of art and technology towards the goals of sustainable development. The potential of technology to build this path is essential and enormous, to imagine devices that are at the service of new social, ecological and economic models.

Art is one of the best vehicles to take science out of the laboratories, to transmit scientific information to the population, and to advance science without forgetting to bring the consequences of this research to the scale of human senses and experiences, citizen science.

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Artistic Residencies as Critical Research: Entangled Methodologies for Future Science.

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Abstract

This paper is an account of *Future Forest Diorama*, an artistic research project and residency taking place at the experimental station of Can Balasc. Written from the artists' point of view, it reflects on the challenges and opportunities that arise from inhabiting scientific environments, and the specific type of situated knowledge such environments afford. It advocates for more systematic accounts of the methods and tools invented on-the-fly by artists during art-science residencies to respond to the growing demand for methods of trans-disciplinary collaboration.

Keywords

Artistic research, art residency, epistemological pluralism, speculative design, complex networks, human and non-human, hypernatural, bio art, collections.

Introduction

Future Forest Diorama is an artistic research project and residency that took place at the Can Balasc experimental station in the Collserola Natural Park near Barcelona between June 2021 and March 2022. Granted through a joint call for projects from scientific and artistic partners (La Escocesa, art center situated in the Poblenou neighbourhood, and CREAM, a major Ecology and Forestry public research center), the goal of the residency was to develop fundamental research required to design and build an interactive artwork, a bio-socio-technological assemblage consisting of a network of three smart terrariums built inside discarded home appliances. Our goal was to study botanical communities present in the Mediterranean forest that surrounds the station, and to populate our terrariums with groups of plants selected to trigger interaction among species. Akin botanical networks, terrariums would be connected to each other, monitor activity in their surroundings and develop survival strategies inspired by cooperation models present in botanical communities. They would monitor their surrounding environment using movement and temperature sensors and communicate with each other through a local machine-to-machine network, triggering light, sound, and humidity effects in response to activity within space. Such responses, in return, would impact the plants' growth and development inside the terrariums, and influence the participants' movements within the exhibition space. All processes are interdependent.

The residency at Can Balasc experimental station offered us the opportunity to observe plants in their natural settings, to access specialized knowledge from scientists, to



grow selected species using different techniques, to build the first prototypes of our future terrariums, and to delineate spaces of knowledge shared by scientists and artists. It also revealed the potential of artistic residencies as critical research within traditional scientific spaces: that of challenging unquestioned assumptions, revealing blind spots and mapping shared zones of inquiry.

As artists-researchers, we are interested in deconstructing the power structures responsible for the ecological crisis humanity is facing today. We seek to challenge the nature/culture divide, to undermine the positivistic scientific principles based on separation and control [1] upon which modern sciences have developed, as well as the classical, representational understandings of art that only reinforce dominant cultural values. We are not interested in producing a new static representation of the forest; nor in accessing data to generate visualizations that only engage with participants at the sensorial level. Building upon botanical knowledge and the potential of entangled bio-technological systems, we aim at exploring the possibility of recreating the conditions of emergence of a forest-like experience.

Instead of representation, we strive for performative understandings of artistic practice and research, “a contestation of the unexamined habits of mind that grant language and other forms of representation more power in

determining our ontologies than they deserve". [2] Against extraction, we seek to trigger and support botanical communities and synergies; to explore potential, speculative, desirable futures, where beauty takes place beyond what centuries of western (human) culture has taught us to admire. Inspired by the marginal streams of thought of early British cybernetics, technofeminism and hacker culture, we will build ontological theatres to explore and expand visions of what more-than-human relationships might be like in post-anthropocentric worlds. [3]

Taking the Forest-Art-Technology triangle as a starting point, and building upon the notions of network, interaction and homeostasis shared across botanical, social and technical realms, we will speculate with future, cyborg-forest scenarios where technology supports and enhances co-evolution across species. The wealth of signals and interactions between plants, terrariums, physical space and human agents will define the relational space of a potential forest beyond anthropocentrism, an intertwining of physical, organic, social and cybernetic processes and subsystems. Such a system produces its own aesthetics [4].

The Forest and the Museum

Forests hold a particular status in modern Western culture; that of idealized places of regeneration, untouched by humanity's destructive power. They play the significant role of Heterotopias, counter-spaces that compensate, in a symmetrical relationship with everyday places, their unwanted qualities. [5] But in their becoming icons of a preserved world, forests also inevitably become the center of attention for scientific inquiry, technological domestication and socio-cultural merchandising. [6]

The principles of segmentation and extraction predominant in scientific models inherited from the Enlightenment are based on the myth of an abstract environment, one that leaves the relational, in-between space of process and evolution unaddressed. Within this dualist value system, the museum plays a significant role. In her influential article "Teddy Bear Patriarchy: Taxidermy in the Garden of Eden, New York City, 1908-1936" [7], Donna Haraway deconstructs the human notion of nature through a historical analysis of the formation of the Museum of Natural History and Carl Akeley's research on taxidermy. Haraway focuses on the way the great dioramas that populate the museum were built, and on how the pursuit for preservation of natural environments led to the hunting of the specimens that would represent animal species. Later, those magnificent works of art, culmination of humankind's representational capacities, were observed through a glass, a prophylactic barrier between spectators and the vivid scene, perhaps also protecting them from a dark discovery.

Hacking the heterotopia

Infrastructures such as Forests and Museums produced categories, taxonomies, non-human mobilities and immobilities that radically altered the dynamics of life. But there is no going back to a pre-modern world - nor do we want to. Instead, we want to hack dominant frameworks of thought, undermine their underlying power structures and reverse their effects, transforming them in mediums of life through the melding of natural and technical ecologies. By revisiting the iconic archetypes of the diorama and the forest, we want to explore alternative futures offered by our cyborg, post-natural world, to develop strategies of defense, care, survival, and restoration.

We do not want to make another pretty picture of the forest as a lost 'natural' world, because if, as artists, we reinforce idealized representations of the forest as 'external environments' separated from places inhabited by humans, we also amplify the threats that put forests' survival at risk. Instead, we want to set up a relational space, create the conditions of inter and intra-actions between beings. [8] The aesthetics of our *Future Forest Diorama* stands at maximum distance from bucolic images of wilderness while remaining loyal to the way forests think, that is, through a wealth of semiotic processes entangling living beings, human-made objects and technology. [9]

We refuse isolation and alienation. Taking encapsulated worlds as a starting point, we want to deploy scientific, technical and aesthetic means to bring about emergent entwined, speculative worlds that dynamically adjust living conditions, cooperate with each other and communicate with their surroundings. Where plants from different times and places can meet and collaborate; where technology supports biodiversity and evolution, rather than competition and human profit. A reverse garden, where the plants are the gardeners. [10]

Creative strategy

Our strategy builds on two critical methodologies, deployed across technical, biological, and aesthetic planes: mutual aid against segmentation and control, and situated knowledge against dualism and the myth of objectivity.

Mutual aid: [11]

The speculative worlds we are building do not reproduce natural settings and conditions. Yet, we will design them with care for natural communities in mind.

- Community building Inside the terrariums. With help from scientists from CREAM, we are designing speculative communities informed by botanical knowledge and models.
- A future forest. A responsive system emerging from the entanglement of physical, organic and cybernetic processes and sub-systems. Such a system, based on an evolutionary, (rather than casual) grasp of time,

does not aim for a pre-defined visual output, nor does it rely on visual syntax.

Situated knowledge: [12]

We want to critique the myth of objectivity, the becoming universal of a position that only reflects a very specific portion of humanity, and the dualism of the inside/outside divide. There is no objectivity because any observing agent is already a subject; no outside, because the limits that separate any being from the rest vanish when observed at the right order of magnitude. Therefore, we are rooting our project in a specific setting -the experimental research station of Can Balasc at the Collserola Natural Park.

Throughout the research phase, we worked with CREAM's team to design viable ecosystems inspired by Can Balasc's past and present conditions. The research station provided us with a concrete grounding and initial conditions (air and soil composition, temperature, humidity, types of plants...), and an active *umwelt* to build upon [13]. We studied the most common species and collected seeds that, after germination and growth, were used as a base for our terrariums' first prototypes.



Figure 2. Research on local species. Photo © Carola Moujan

Networks in science, art and technology

Whilst modern botanical science focused strongly on individual ontologies, pre-modern botanical knowledge was instead more interested in processes, analogies and the space between individuals: relational ontologies. In contemporary ecological sciences, relational concepts such as *botanical community* defined through energy flows rather than taxonomical classification, are essential to study evolutionary and adaptive phenomena within specific spatial settings that could not otherwise be addressed [14]. The concept of community and its underlying values of



Figure 3. Planting process. Photo © Agustín Ortiz Herrera

cooperation and enhanced capabilities are shared across social and botanical worlds. Moreover, network science and theory provide useful models to represent interaction between species and speculate with evolutionary scenarios. Significantly, such models are also at the basis of many technological developments as well as artistic experiments where interaction with the public is paramount.

We do not seek to use technology only from an instrumental standpoint, nor do we rely on collaboration with scientists as a simple way to access specialized knowledge. What we are aiming for, is an entangled methodology where the cultural barriers that separate constructed notions of art and science begin to dissolve. The conceptual tool of the network across different disciplines reveals a shared space where common interests and concerns can meet.

Building the tools for collaboration

Willingness to build common spaces of inquiry is shared today by many artists and scientists around the world. The number of opportunities and initiatives for transdisciplinary collaboration seems to be increasing at an exponential rate, yet several recurrent obstacles need to be overcome before maturity is reached. Beyond the above-mentioned philosophical, disciplinary, and cultural barriers, there are a great number of disparities and misconceptions that stand in the way of continued and productive collaborations. Even though a considerable body of inquiry about artistic research has already been developed, it remains largely unknown beyond a narrow circle of specialists. Many times, excessive focus is put on the foreseeable outcomes of collaborations: what will be produced, who will benefit the most from the process, what each actor is expected to provide... forgetting that research-creation is speculative in nature, “a practice that does not seek to describe, explain, or solve problems [...] an ‘event’ that creates concepts that problematize. Concepts are not pre-given or known in advance”.[15] The major benefit comes from the process, from the questions

Boundaries in networked digital societies: Membranes as a new model of boundaries focusing on nonconscious cognition

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Abstract

Boundaries have provided humans a frame of understanding and foundation for social structures – like hierarchies, classes, and races. Acknowledging the development of technology has brought significant changes in human life, this paper explores a new model of boundaries that fits into a networked digital society and reexamines the idea of boundaries/borders as a solid wall that separates, segregates, isolates, and disconnects. Instead of a concrete wall, this paper suggests considering membranes as a model for boundaries in the technological era because of their semi-permeable and fluid nature, as well as their active engagements in relations/interactions between heterogeneous bodies. This idea of membranes in a technological society is exemplified in political borders, control mechanisms, and human-nonhuman cognition. Katherine Hayles's discussions of cognisphere and nonconsciousness illustrate the semi-permeability of the boundaries between human and technological cognition, highlighting their interdependency and continuous inflows/outflows of information on the nonconscious level. The author introduces the process of creating an interactive art project *Surrogate Being* to demonstrate how the author experienced such a membrane-like boundary between heterogeneous yet interconnected modes of (digital and biological) memories about the same place.

Keywords

Membrane, Boundary, Border, Cognition, Human-Technology Relationship, Autopoiesis, Cognisphere

Introduction

While classifications are pragmatic and inevitable for efficient communication and knowledge organization, the concept of boundaries and borders to set limits and mark areas has been challenged and reexamined across a wide range of fields, including philosophy, humanity, sociology, politics, and science. The linguistic turn in the early twentieth century emphasized representations and languages by continuing the ideological legacy of dualisms that divided objects from matter and meaning from language in the same way that sees mind and body as separated entities. The semiotic

classification has drawn artificial boundaries in natural and fluid phenomena of the world as “a fixed, determining, and inhuman grid imposed upon life, rather than a living force”, and culture is a world mediated by (linguistic) representations – imposed upon and immersed in nature.[1] To overcome the limitation in the traditional conception of boundaries derived from linguistic epistemological structures, this paper looks into a cognitive relationship between humans and technology at the nonconscious level, which support the idea of membranes as a new model of boundaries in a digital society. As opposed to the linguistic turn that imposed languages, significations, and intelligible frames on nature, this approach seeks an insightful reinvestigation of boundaries by imposing nature upon culture.

The word *cell* exemplifies the contrasting conceptions and functions of boundaries in nature and culture. In biology, a cell is the smallest functional structure, enclosed by a membrane, which is a semi-permeable boundary, but a cell in culture and society often refers to a small room to lock up and isolate a prisoner. A prison cell is one of the institutional structures of disciplinary societies as presented in Foucault's panopticon – a paradigmatic architectural model of modern disciplinary power. Considering that the advancement of technology has made control systems invisible, I argue that biological cells with a semi-permeable, fluid boundary better represents technological society than cells for disciplines with an isolating concrete boundary. In societies of control, a body is not disciplined under a closed institutional system but controlled by data. Deleuze notes, “individuals have become ‘dividuals,’ [...] data,” which can be endlessly divided, subdivided, and recombined. These control mechanisms may seem liberating compared to enclosed institutions in disciplinary society; however, a “dividual” as data is interconnected within a complex system and shifting network while unceasingly monitored through advanced technology in an open environment.[2] Boundaries in societies of control became invisible and penetrable while still actively (and more powerfully) engaging in control.

Boundaries as Membranes in the Digital Era

Humberto Maturana and Varela assert that autopoiesis is a common characteristic of organization in all living organisms, which regulate their own systems within their boundaries like a cell membrane. According to Maturana and Varela, autopoietic machines (referring to living organisms) generate themselves through constant change and dynamic interactions in networks of relations among components. Boundaries in autopoiesis emerge from a dynamic process of self-regeneration and self-regulation and simultaneously participate in such systemic mechanisms. The most fundamental example of the autopoietic machine is a cell, which regulates the mechanisms of its entities/molecules and maintains the system within boundaries (membranes). I argue that biological mechanisms (autopoiesis) and structures (cell membranes) are the most suitable and compatible model for our highly networked sociocultural structure and boundaries.

The semipermeable nature of membranes enables their role as “a gate allowing transport into the cell of essential nutrients and movement from the cell of waste products.” [8] A membrane is a natural boundary that organisms build to protect themselves, keep its constituents in, and block unwanted substances from entry. Unlike boundaries in disciplined societies, membranes are dynamic, fluid, and semipermeable. Defining spatial and temporal boundaries is not the only role of a membrane; it also participates in chemical processes such as transporting organic matter and respiration. This integration of cell components and membranes closes the gap between different views on boundaries in intra-action and autopoiesis, as a boundary is seen as an active component rather than an apparatus to disconnect. I claim membranes that maintain and regulate the system as well as engage in the chemical process could demonstrate how boundaries between different individuals, nations, and bodies function in a highly networked global society.

It is worth noting that these biological barriers have various levels of permeability. Membranes let small, soluble, and nonpolar molecules like O₂ and CO₂ permeate, while large or polar molecules are not allowed to pass through the lipid bilayer. The role of membranes is similar to the purpose of political borders in that they inspect and regulate what is allowed to cross the border, and both membranes and borders demarcate and define an entity such as a nation, individual, or cell by holding constituents within the boundary. Goods, animals, and people are scrutinized at international borders to determine their eligibility to cross, but certain constituents can be seamlessly transferred and exchanged across borders, such as digital information and the online community. People around the world send and receive digital data without border control. During the COVID-19 pandemic with the highest level of travel warning, online communication allows people in different nations to stay connected and share their experiences. Human and technological cognition are interconnected and pass through their boundaries – skins in human bodies and inter-

faces in technology. In a networked digital society, boundaries are not an impregnable fortress, but rather fluid, organic, and semipermeable membranes.

Emerging Questions on Ethic and Privacy

Humans and technology compose a cognitive system together in a highly networked society, and N. Katherine Hayles calls such a complex cognitive system made up of unceasing communication between humans and machines the *Cognisphere*. [7] In the cognisphere, the highest level of cognition, which has been considered as humans' exclusive field, is largely influenced by technology, and in fact, “human awareness comprises the tip of a huge pyramid of data flows, most of which occur between machines.” [7] Digital information and communication technology process a great amount of information much faster than human consciousness, analyzing and learning patterns from big data. Furthermore, intelligent machines interact with humans in a natural and flexible way through various interfaces resembling analog/non-digital experiences, and digital interactions have become more intuitive with advanced technologies such as Natural Language Processing (NLP) and Natural User Interface (NUI) to compile human voices and gestures. The interface as a boundary can be an example that fits the membrane model, as it keeps constituents inside (digital media), is selectively permeable (input and output data), and engages in the processes of the system (interpretation of information). While the interaction between humans and technology is mediated through interfaces, cognitive processes between them flow seamlessly in a continuously shifting network.

Digital information, software and apparatuses are integrated in most of contemporary cognitive/information systems, and accordingly, boundaries between human and machine cognition became blurred and unsettled, including decision-making and free will. Humans often make a choice based on their evaluation of interpreted and processed data by networked computers and technological agencies (e.g., digital forensics), and advanced computers like AIs (designed by humans) are capable of analyzing patterns and making decisions themselves (e.g., YouTube algorithms that suggest the next video to play). Hayles also notes that the U.S. surveillance program, which has now become a global issue, demonstrates the shifting boundaries between human and technological cognition, especially the legal and ethical ambiguity of the violation of privacy. The ontological distinction between humans and machines is further complicated as machines study and acquire expertise (e.g., expert systems) or personal memories to respond, act, and make a decision by proxy.

In a networked digital society, the conception of surveillance has also been reshaped along with expanded/shifting boundaries of a self with digital data recorded on mobile devices, credit cards, and emails. During the COVID-19 pandemic, the South Korean government's integration of digital information in epidemiological investigations has been prominent among their methods of slowing the spread of the virus at the early stages of the pandemic. When a person

with COVID-19 provides vague and opaque information as to where he or she has been in a survey for contact tracing, Korean epidemiologists traced the GPS history of their phones and looked into credit card transactions and records of surveillance cameras to obtain more accurate information. It is a complex question to ask if their privacy has been violated or if they initially “agreed” to engage in digital networks and surrender their data by using mobile devices and credit cards. Such personal digital information is mostly a stream of numbers that technology can display instantaneously upon command, but the same data to a person with a much more complex cognitive capacity (such as self-awareness and feelings) can be associated with intimate memories or secrets to hide at the risk of the public good, even during a global health crisis. Technology presents merely a vast set of numerical data, yet it is humans who turn it into a story.

The Distinction between Memory and Data

Pages of numerical data can be personal, precious memories or a secret history when combined with the complex human mind. Therefore, the boundary between human and machine cognition does not separate them, but rather allows them to exchange data and share the cognitive process, simultaneously keeping their distinctive nature in themselves, like membranes. Digital information systems, enmeshed with human cognition in the cognisphere, have made the presence of the boundary fade from our senses, but it is still actively present in the human-technology relationship, not only participating in the cognitive process but also holding unexplored possibilities in it. The project *Surrogate Being* (2019) investigates the cognitive gap between humans and digital technology to mediate the disparity through the process of recreating my hometown of Suwon in Korea. I often recall memories of one specific area in the town where I lived in my childhood, and I believed that the nostalgic image in my mind was intense and concrete. When I decided to recreate the place in a virtual space, however, I realized that the vivid image came from my reminiscence with various sensory experiences such as the mood, smell, and temperature – not merely from the visual. Visual references from online (such as Google Street View) were incompatible with my memories because concrete images provided by the interactive map did not evoke the intensive and profound feelings I had for the place. I created the virtual hometown in a 3D space as a place to mediate this discrepancy by weaving the complex and affective mode of awareness in my imperfect memories with *nonconscious* digital information.

My memories have faded and become distorted over time through consistent and dynamic interaction with the world, but digital images display themselves only through a mechanical interpretation of information – a set of binary digits that represents color data on each pixel rendered into images without deviations. Memories of my hometown must have been influenced by the encounter with the disinterested digital images of the place, which are sharply different from the nostalgic images in my mind. In fact, my mind existing within the shifting boundary never stops interacting with the

world as well as with the parallel memories in digital space. Through the process of recreating my hometown for *Surrogate Being*, I learned to work with technological cognition and to recognize underlying interaction with it on a nonconscious level as a part of a process of contemplating the cognitive coevolution of the network that humans and machines compose together. Such inseparability of human-technology cognition makes the boundary between humans and technology invisible and indistinguishable and dismantles the traditional conception of human morality, free will, and the conscious mind.



Figure 1. *Surrogate Being* (2019), © Su Hyun Nam

Nonconsciousness of Cognizers

The idea of *cognisphere* attests that human cognition is largely influenced by technology as well as other biological life forms and guides us to understand our mind as a part of a multilayered, interconnected, complex ecology of cognition, challenging the binary opposition of human and non-human. In such unceasing interactions, memories of my hometown are not and indeed never were intact. They have been transformed, warped, and faded over time through my interactions with the world, even at the very moments when I navigate the virtual hometown with uncanny feelings. My memories are influenced by my affective and sensory experiences in the physical space as well as indifferent digital landscapes I encountered during the exploration of the virtual world. Since it is dynamically integrated with technological systems in its development, human cognition and behavior are increasingly entrained by digital information and data processing, but humans are not cognizant of these underlying processes because most of them occur at the nonconscious level.

Even though nonconsciousness is intangible and unperceivable on the surface, its role is powerful and extensive,

positioned at the wider middle position under consciousness according to Hayles's tripartite framework, which breaks down cognition into three different layers: mode of awareness, nonconscious, and material process.[5] Nonconsciousness underlies all conscious actions and thoughts without being noticed, but it processes information much faster and deals with much more complex and dense signals than consciousness can handle. Located at the frontier of our bodies in contact with reality, the boundary between the external world and nonconscious human mind is much more sensitive and responsive than the conscious mind. Nonconscious cognition illuminates the fact that our bodily actions, mind, and feelings are not fully under conscious control and extends the idea of cognition far beyond human consciousness. In this way, focusing on nonconscious interactions with nonhumans sheds light on various modes of neural activities in other biological life forms and even technical systems, leading to more comprehensive and inclusive understanding of the complex cognitive networks with nonhumans beyond the boundary imposed by the human's conscious mind.[5]

As the binary distinction of humans and nonhumans not only isolates humans from everything else on the planet [9] but also displays human privilege, Hayles proposes an alternative distinction of cognizers and noncognizers that balances the relationship. Given that cognizers never stop interacting with each other on the nonconscious level, the humans/nonhuman distinction arbitrarily disconnects the continuous flow of cognition. Cognizers, including humans, plants, animals, and technological systems, have the capacity to make decisions to various degrees, and this capacity displays the cognitive properties of *flexibility*, *adaptability*, and *evolvability*, which are not present in material processes.[5] The alternative distinction between cognizers and noncognizers foregrounds cognitive capacities, and thus lets us interrogate the meaning of cognition in the technological era in a way not centering on humans and draw a proper boundary in the networked cognitive system.

Membrane between Human-nonhuman Cognition

Technology is one of the most peculiar nonhuman cognizers as it is a nonliving/nonorganic entity that significantly influences human consciousness. As the term *cognisphere* connotes, the cognitive networks that combine human and machine cognition compose not an entity but an environment, where their unfolded cognitive processes and activities constantly interact and transform. Humans and machines play dual roles for each other, as an environment to be affected and as a dynamic actor to affect. Analogous to the relationship of life and environment on the Earth, their cognition assimilates each other, and their adaptation is multidirectional. Digital systems are often designed based on analogues to human life, and human cognition adapts to the technological mechanisms – e.g., a two-finger operation expecting a zoom-in function on a map or image. Nigel Thrift proposes the term “technological unconscious” to refer to

such habits regulated and shaped by technological environments and to acknowledge human cognition beyond its boundaries stretching into the environment.

Given the limitations of the Freudian notion of unconsciousness as a part of consciousness, especially oppressed and traumatic memories, Hayles suggests modifying the term to *technological nonconscious* and acknowledges the cognitive capacity of technology.[6] Foregrounding nonconscious cognition, which rapidly and unceasingly processes a huge amount of data through interactions with human/nonhuman cognizers, legitimizes the borderless and nonhierarchical network of humans and technology with shifting, fluid, organic, and permeable (membrane-like) boundaries. A long history of human and nonhuman dualism, linguistic representation, and scientific classification has shaped our understanding of the world, which has led to the invention of the most influential cognizer in the cognisphere – technology. Continued reexamination of the frames and boundaries we live within should be one of our duties as conscious humans to maintain sustainable relationships with all cognizers on the planet. I argue that a new concept of boundaries as membranes let all human/nonhuman cognizers breathe as a whole system and live together within a cognitive ecosystem – as cell membranes do.

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WHEN THE OTHERS ARE THE MACHINES: THE CHALLENGE OF RELATING TO THE NEW CRAFTSMAN

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Abstract

This article proposes to reflect on artistic creativity in the artificial dimension, experienced under the dynamics of co-creation, in which a new interactor emerges from cyberspace - we call it the new craftsman. The article will discuss characteristics of a scenario in which the development of artificial works seems to suggest the repositioning of the authorial discourse, articulating changes that allow us to assimilate the metamorphosis that symbolizes both a new generation of techno-images and a new moment for art-science, through a new poetics that manifests itself in a context of expanded hybridization between bodies of different natures: both organic and inorganic. Starting from the time frame that is established in the 1960s, we propose a discourse oriented to reshape the relations between human and non-human beings and suggest ways to think Artificial Intelligence (AI) in an attitude that values the differences between biological and synthetic thinking. We conclude the article by suggesting the reasons why we believe that creation with AI seems to be the greatest revolution since the advent of photography.

Keywords

Authorship; Artificial intelligence; Machine creativity; Computer art; Machine art; Media art; Art criticism

Introduction

In face of the techno-scientific developments in the last decades, whose significant temporal mark gains dimension at the dawn of the 1960s, which glimpse in the computer-based solutions a new partner to make art with instead of making art through, arises the need to reflect upon creativity in the artificial dimension, a virtualized space whose operations are mediated, in a certain sense, by inorganic entities.

The origin of this thought, which finds in generative art and computer art its main exponents, was established between Europe and the United States from the pioneering works of George Nees (University of Stuttgart, January 1965) whose doctoral thesis, defended in 1969 under the supervision of Max Bense, is believed to have been the first

publication on computer art [1] Candy, Linda, Ernest Edmonds, and Fabrizio Poltronieri. *Explorations in Art and Technology* (London: Imprint and Springer, 2018), 5.; Frieder Nake (at Wendelin Niedlich's installations, Stuttgart, April 1965); and A. Michael Noll and Bela Julesz (Howard Wise Gallery, New York, April 1965).

The isolated attitudes observed in this period played a fundamental role in the foundation of machine-art, and resulted, a few years later, in what would become the true landmark of numerical creation – the timeless Cybernetic Serendipity (1968), an exhibition that had among its objectives to present ways in which human beings could use computers and new technologies to enhance their creativity.

As if it had been handpicked, the 1960s would still count with the beginning of Harold Cohen/AARON's (1968) journey as another pioneer enthusiast who, joining (perhaps in a first moment without even being aware of it) the Bavarian hegemony, contributed so that the interest in arts partially generated by numerical systems could gain dimension and scope and thus paved the way to the contemporaneity that today disposes of highly complex entities – intelligent interfaces to support artistic creation, as well as autonomous creation interfaces.

Before we continue, it is appropriate to emphasize that the term “machine” is used figuratively in this paper. The term is used interchangeably to represent both intelligent entities and algorithms, which manifest themselves through machines, which are in turn the interaction terminals that allow HCI (human-computer interaction) relationships to be realized. Machines are the hard dimension (or hardware) that reproduce in physicality the impulses of software, which is the legitimate controller of the process, “the invisible glue that holds everything together”. [2] Lev Manovich, “Estudos do Software (2008)”, in *Teoria digital: dez anos do festival internacional de linguagem eletrônica* (São Paulo: Imprensa Oficial do Estado de São Paulo e FILE, 2010), 182–194. All art that is recognized in the new media framework is software-based, be it robotic art, sensor art, or generative art. The explanation is necessary because it allows the use of a common

expression, "machine art" (even if sensitively imprecise), that can go through all the movements.

Having made this remark, it is observed that since the 1960s, the attitude of anthropomorphizing machines and technifying human beings has revealed itself as an

irreversible trend as virtualized entities become more and more intrinsic and integrated into daily life, operating mutations that lead to a cyborg-like embodiment and allow us to experience what Roy Ascott called cyberception, a perception that can be considered deterritorialized by accentuating and assimilating the “technological amplification”, resulting in the “enrichment of our powers of cognition and perception”. [3] Roy Ascott, “Cultivando o Hipercórtex”, in *A Arte do Século XXI – a humanização das tecnologias*, ed. Diana Domingues (São Paulo: Editora UNESP, 1997), 336-344.

The awareness of cyberception seems to constitute a fundamental element that allows for engagement and approximation with virtualized entities, immaterial elements that present themselves under the generality of Artificial Intelligence (AI) and that regulate and control a vast and growing portion of daily operations.

In this sense, it seems timely for both artists and researchers to think and articulate contemporary strategies capable of promoting new forms of relationships with non-human entities. The scenario that is based on the paradigm we call “new craftsman” – an expression that symbolizes the set of operations that are not only developed in the software-hardware frontier, but also in the flesh-calculus dimension – imposes itself as a central element to discuss the disembodied artistic creation that proliferates in our hyper-connected age.

The symbiotic creation in these terms, which implies a hybridism between human beings and inorganic entities, favors the recognition of bodies of different natures [4] Rachel Zuanon, “Biointerfaces inteligentes: transdisciplinaridade e transversalidade em arte-arquitetura-design-ciência-tecnologia”, in *Transdisciplinaridade nas Ciências e nas Artes* (Santa Maria: Editora PPGART, 2020), 234-247., an avant-garde thought that understands humans and machines as beings with equivalent values in the creative dimension. While assimilating the machine as an entity of distinct nature, the approach also allows us to think of artificial intelligence as something different and, consequently, to hope that from this difference unexpected creations may emerge.

Discussion

What the numerical entities (new technologies) offer - and new technologies are constantly emerging - are potential means by which artists can express themselves. However, and at the same time, the more one perceives the technological evolutions, the more tenuous seems to be the line that delimits the frontiers of creation. As they are not mere extensions of the body, prostheses that allow the execution of tasks in the most tool-like sense of the expression, intelligent entities need to be recognized as partners.

The use of the terms communication and collaboration applied to machines, terms so commonly associated with human relationships, seems to be rapidly becoming more natural as virtual operations become embodied and personalized, and, in equal measure, as bodies are embodied in digitized geographies.

The urgency of repositioning the role of the human being in face of the rise of the new craftsman, a paradigm that presupposes the establishment of a relationship in expanded hybridization, gains traction as we observe the growing number of artistic creations made in tandem with inorganic entities. Important questions appear from this recognition: what is the role of human beings in contemporary artistic development associated with machines?

And “what constitutes the authorship relation an artist bears to a work, when on one reading the artist may have created little of its content”? [5] Sherri Irvin, “Appropriation and Authorship in Contemporary Art”, *The British Journal of Aesthetics*, Vol. 45, No. 02, accessed October 20, 2021, 10.1093/aesthj/ayi015, 127. These are curious questions. Was Harold Cohen the author of his paintings or was AARON the main producer? It is no secret that Cohen said he was surprised by the works of his digital partner: “Clearly the machine is being creative, the program is being creative in that every time it makes a drawing, it makes a drawing that no one has ever seen before, including me”. [6] Harold Cohen, Interview with Ray Kurzweil, *The Age of Intelligent Machines*, The Massachusetts Institute of Technology Press series, 1987. Cohen didn't know what to expect, there was a mysterious element, works in a state of suspension.

When the Parisian collective Obvious allegedly misappropriated from programmer Robbie Barrat a complex algorithm designed for image-making, produced by using that code a series of portraits, and auctioned off the Edmond de Belamy canvas for over \$400,000 in 2018, the question arose as to who produced the work. How to attribute authorship in this case or, more profoundly, how should we position ourselves to deal with the non-human in the face of such questions? It would be very convenient to say that the artist is the one who programs the algorithm, or even to grant both the collective and Cohen the authorship title (reproducing an attitude like the one adopted by the conceptual art movement), but both hypotheses lack depth.

Of course, the results of artistic experiments (the cause or the code) are humanly programmed, but the consequence or “what is claimed to be the work of art - is not done directly by a human being. The algorithm, not the human, is the ‘artistic’ agent”. [7] Mark Coeckelbergh, “Can Machines Create Art?” *Philosophy & Technology*, Vol. 30, No. 03, accessed October 20, 2021, 10.1007/s13347-016-0231-5. One can see that the problem has no immediate solution, and that any attempt to shout certainty seems to prove unstable. Would it not be the case to openly address artificial creation?

Towards a different kind of intelligence

Artists-researchers like Leonel Moura (Portugal, 1948) adopt a position that attributes to machines an important fraction in the creative process by considering valid an “idea of autonomy in which the machine is capable of its own creativity”. [8] Leonel Moura, “Self-made art (n.d.)”, Leonel Moura's website, accessed October 20, 2021,

<http://www.leonelmoura.com/self-made-art/>. This point of view is in line with a preliminary attempt to address the questions presented, which suggests appreciating artificial intelligence as a form of organization of ideas different from those of human beings. It seems obvious, but it is reasonable to stress this aspect.

The character of difference would allow, so we suppose, a way to expand the relationships between humans and machines into a kind of amplified hybridization, in which the character of competition between the different bodies could be replaced by the exercise of collaboration. By understanding AI not as a mimesis of thought, but as an aid in making connections, creation with intelligent entities seems to make more sense. In our case (that of artistic creation), replicating human intelligence in a virtual way and applying this multitude of efforts to the poetics does not seem a very coherent move. If the idea is to replicate in silicon form a human intelligence, wouldn't it be better to remain creating from human-human relations?

On the other hand, if we seek in AI a different, motivating, and unexpected intelligence, perhaps this approach will contribute in a way in which we would act more like humans and less like machines. Faced with the recognition that inorganic intelligence has not reached the perfect simulation of human intelligence and that, therefore, it is not a replica of organic logical operations, it may be possible to infer that human-machine associations seek the unforeseen, that they pursue original forms of creation and go beyond the conventional poetic exercise. In this way, we address a reasonable solution to the problem of authorship and, equally, to the way in which the human being can relate to the non-human.

This stance recognizes that the artificial will always be artificial, but, at the same time, does not exempt the human being from the responsibility of assuming that a creation was made collaboratively. Persisting, the artificial will always be a gathering of all human knowledge (and all ignorance and misinformation), even as we realize that a new wave of AI emerges in leaps and bounds from the computer depths allowing algorithms to be able to formulate creations in an unattended, unsupervised manner, deeply disconnected from the natural dimension and free of anchoring with the human-produced repertoire.

AI can be understood, therefore, as a gathering of all the silliness and wonder extracted from the natural dimension. And it is a very well-made assemblage, one that somehow seems to make sense about the world and that invites us to empathetic reasonings and approaches about its modes of creation.

The point is not to anthropomorphize technology through discourse and understand it as something organic, but to understand that certain inorganic creations can touch us, help us, make us more human, illuminating our own creativity by promoting latent connections and tensions whose connections were, at some point, awakened by an agent outside biological thought. This proposition does not seek to disqualify human creation, but to identify if and how we can be

better when we associate with machines, since this association is irreversible. The argument seeks to reveal symptoms of incoherence that arise from the false conclusion that artistic creation, precisely in the scenario presented here, is independent and based exclusively on synapses and epiphanies.

The necessity of the recognition that, in a certain sense, works of art (or any other creative manifestations) developed with machines are not necessarily the exclusive creation of the artist, "but the product of the generative process - a self-precipitating structure" [9] Henry Clouser, "Towards a Dynamic, Generative Computer Art", *Leonardo*, Vol. 21, No. 2, accessed October 15, 2021, <https://muse.jhu.edu/article/600627/pdf>. is determinant for this theoretical formulation that is organized in opposition to current conventions. It seems in this sense inconceivable not to recognize that creation with machines implies co-authorship and, consequently, that it also implies a new thinking about how relations between humans and non-humans can be organized.

It seems to be shallow to assume that artificial intelligence is merely a translation of human intelligence and that inorganic imagery/textual/sound creations are coded expressions of humankind; no. AI is a different kind of intelligence, which despite having at its core the goal of mimicking human intelligence remains constantly flawed. However, if we shift the interest from the desire for mimicry to a desire for difference, we will begin to walk a prosperous path, especially in art. The flaws themselves may turn out to be delightful and desirable accidents.

We can neither expect nor desire an artificial intelligence to be equal to a human one. For that there are humans, and they are very good at what they do (even when they take questionable or harmful attitudes towards others, they do it efficiently).

Conclusion

We believe, first and foremost, that from these man-machine collaborations it would be more appropriate to hope for novelty, unthinkable associations, silliness. In short, to crave the new. The break of paradigms and a revolution in the artistic dimension cannot be conditioned to a set of operations that repeat the same logical forms of thought.

Artificial poetics should not reproduce organic poetics, it cannot be a pastiche of biological thought. Instead, it must seek a different anthropological condition that approaches a technological symbolism [10] Mario Costa, "Pour une nouvelle esthétique", (paper based on a talk presented at the ISEA2000, Paris, France, December, 2000). *ISEA2000: 10th International Symposium on Electronic Art*, <http://archive.olats.org/livre/etudes/etudes/nouvEsthetique.php>. a new aesthetic that moves from the predominance of subjectivity grounded in man to the openness allowed by instrumentalized collaboration.

AI needs to continue to be developed for a hyper-connected world, and the challenge to artists is to subvert its

original applications so that it can do dumb things down, operating a movement in which the researcher “unveils the essence of technique and allows it to manifest itself in the modes of the aesthetic” [11] Mario Costa, “Corpo e redes” in *A arte no século XXI – a humanização das tecnologias*, ed. Diana Domingues (São Paulo: Editora UNESP, 1997), quoted in Walter Zanini, *A arte de comunicação telemática: a interatividade no ciberespaço*, ARS (São Paulo), 2011, accessed September 22, 2021, <https://doi.org/10.1590/S1678-53202003000100003>.that drains the program of the black box [12] Vilém Flusser, *Filosofia da Caixa preta: ensaios para uma futura filosofia da fotografia* (São Paulo: Annablume, 2011).or even that subverts “continuously the function of the machine or the program that he [the artist] uses”. [13] Arlindo Machado, “Arte e mídia: aproximações e distinções”, *Galáxia*, No. 04, accessed September 27, 2021, <https://revistas.pucsp.br/index.php/galaxia/article/view/1289>.

It is necessary to leave it loose to create, to conceptualize and make sense about things, about beings and about the world differently than we would do. Certainly, a lot of works obtained in such a way will result in digital *Merdes d'Artiste*, and this is the main symptom of its elegance forged under stochastic perspectives.

It is hoped that this discussion will contribute, even if only slightly, to the formulation of paths towards the resolution of several problems associated with artistic creation with artificial entities: how we can relate to non-humans in the creative sphere; how to think systems as bodies of different natures; how to attribute authorship on the man-machine frontier; and how to evaluate the creative process in inorganic systems.

Finally, one must acknowledge the proliferation of a new aesthetic, and it is perhaps safe to conclude that AI applied to artistic creation is, maybe, the greatest revolution in the field since the invention of photography. The main differences and challenges are that now we will probably have an army of Baudelaire’s along the way.

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PhD student in Visual Arts at the Institute of Arts, University of Campinas (Unicamp). Current research interests are focused on the investigation of new technologies and artificial intelligence in image generation, articulating the role of the artist and the role of the machine: human beings and inorganic intelligent entities are here considered bodies of different natures, somewhat equivalent systems. Issues such as machine coauthorship, subversion of technology by the artist, and the problems associated with the standardization of technologies, controlled by oligopolies, are part of the discussion surrounding the paradigm of the “new craftsman”.

Decoupling design from the industrial paradigm

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Abstract

We suggest that a critical examination of computer-human design, as a field developed under industrial requirements, could be helpful at addressing the problems derived by the industrial development of digital technologies. Since it would seem difficult to conduct current problem-solving logic under the unprecedented yet probable conditions derived from industrialization problems -as energetic and material scarcity-, this examination could also aid in tackling their derived emergent (social and environmental) effects by exploring new situated approaches.

Keywords

Human-Computer Interaction, Human-Centered Design, Extractivism, Un-design, Techno-solutionism

Reasons for degrowth

There is almost consensus among the scientific community about the origins of climate change as human-induced phenomena. The increase of global temperature has been caused, among others, by large-scale deforestation and, since the industrial revolution, the massive use of fossil fuels, or the release of huge amounts of fluorinated gases. Its side effects span as increasing unbalancing environmental issues: acidification of oceans, ice melting, sea level rise, disrupting atmospheric anomalies, mass extinction of species, loss of biodiversity, or high human migration flows due to harsher climate conditions, to mention a few. Altogether, conditions that threaten even survival on the planet.

This historic change is rooted in the modern western industrial logic of extraction to accumulate. Colonialism provided European nations with bulk and inexpensive materials and labor, that industrialization transformed to develop technologies, which would in turn allow for larger and more efficient modes of ubiquitous exploitation. Transforming anything on the planet into resources and stimulating consumerism enabled the extraction of surplus value and growth under a competitive logic of wealth accumulation. Thus, this growth has manifested itself very asymmetrically among the different societies and between their citizens. [1]

In the last two centuries, the planet has witnessed an unparalleled use of non-renewable energies and polluted landscapes. The product of such intensification was and is

waste: broken ecosystems, suffering and ecocide among the disenfranchised actants of this finite planet. Information technologies are underpinning global production and are embedded in consumerism in many ways. Though seemingly immaterial and harmless, these have heavy material implications in this ravaging system. Around these technologies new, yet connected to the former, exploitation regimes have emerged. Under the guidelines of industrialized Human-Computer Design (HCD), IT infrastructures - hardware, their interfaces, the algorithms behind them, and the datified information flowing through- have become part of the environmental and social crisis-fueling practices. [2]

In the last decades, there has been increasing concern about the natural reservoirs of energies and materials used to progressively develop industrial growth. Currently, there is research pointing at an impending depletion of most of these. We have crossed the peak of fossil fuels, we are approaching rapidly the peak of uranium used in nuclear plants, and renewable energies, like sun or wind, don't yield by far the same EROI (amount of energy by amount of energy invested, in short). Besides this, the yield of rare minerals, necessary to produce renewable energy technologies, as well as general ubiquitous computing technologies, is also supposed to shrink rapidly. [3]

The infrastructural and energetic crisis we might face, together with the possible threatening environmental conditions explained above, pose a hard to work through scenario.

How new industrially designed regimes contribute to collapse

Colonialism, although still a reality, has evolved into coloniality, to produce extra-territorial forms of exploitation through data. Such outsourcing reproduces again asymmetric flows of wealth and waste. [4] This data is then used for behavioral capture and manipulation. [5] Mainly to foster consumerism, but even to influence institutional power. The psychological consequences that these practices have just recently started to surface. [6]

This digital power is concentrated in a couple of companies that have a bigger impact, in all kinds of spheres, than countries way larger than them. The new paradigm of power revolves around the concept of platform. To extract patterns (for example, to feed the cutting edge of automation: AI) in order to later produce per-user (or archetype)

customized “experiences”, very large datasets need to be extracted and aggregated. This is relayed through careful design of their interfaces and experiences. The more time users spend, the more can be extracted or persuaded. Through massive investments, digital platforms can stay inexpensive (until necessary) or gratis, in attempts to monopolize the market. Moreover, many of these platforms are owned by umbrella corporations, so data is shared between companies. Once they have wiped competition, the monopoly is free to change policies, pricing, etc. [7] Mediated by the platform, new forms of labor have spawned. From the so-called gig economy to crowdwork. Unregulated work, micro-managed automatically through the platform, again to allow lower prices and stimulate consumerism. Within an accelerated growth oriented logic, and rampant effects, blurrier extraction and waste. Still on the same size planet. [8]

As quickly mentioned above, the planet, as a closed, balanced system, doesn't seem to be any longer capable of sustaining this mode of coexistence. Some authors hold that moving towards sustainability implies a shift towards degrowth, at least for the small part of the global population at the top of this trophic chain. In order to extend the current regimes of opulence, some bring up untested technologies for terraforming the atmosphere, achieve CO2 capturing, or just crave for new clean energy technologies to come soon. But as mentioned above, probably there will be not enough energy and resources to carry out such colossal digitally underpinned endeavors, no matter how growth-involved actors try to delay broad acknowledgment and measures. [9]

Alternative approaches at designing within limits

Despite preceding research, there has been, as part of the “third wave” of CHI, a growing interest among the CHI community, to deal with the inherent industrial logic of design.

This research has been trying to understand and circumvent some principles underlying design. Most notably and with overlapping works, we find Information Technologies For Development (ICT4D), Slow Design (SD), Sustainable Human-Computer Interaction (SHCI) and Collapse Informatics (CI).

SD aims at addressing the issue of consumerism by addressing speed of disposal through personal and emotional attachment to products. It approaches critically one of the main principles of industrial development, the necessary obsolescence of products to sustain continuous energy and material digestion-based growth. [10]

ICT4D has been focusing on how to improve living conditions (against monstrous economical and political forces) in “developing” regions. Since normally this is carried by foreign researchers, participatory design is unfolded to avoid cultural assumptions. It tries to enhance poor resource-available populations by using easily available technologies. [11]

SHCI has been mainly theorizing, envisioning and discussing how design should be adapted in order to alleviate the unsustainable environmental conditions, explained in the introduction, by correlating them with new design approaches, methodologies, or metrics. It's research deals mostly about contributing to a more sustainable future. [12]

CI emerges from the hypothesis that sustainability is no longer possible. Foreseeing a hypothetical collapse (of infrastructures over time) CI tries to anticipate design guidelines with the aim of contributing to smoothing increasing scarcity conditions and generating resilience for the transition. [13]

Lastly, we want to mention a heterogeneous collection of work we can call Undesign, that deals with possibilities to design less, design low-tech to remove hi-tech, or stop designing sometimes. [14]

Yet, while the phenomena at stake get worse, these efforts have proven relatively successful, with an increasing sense of frustration due to the scattered conclusions, lack of overall agreement and few disruptive outcomes [this changes sustainable HCI]. These issues have led several authors to suggest HCD should borrow from social sciences and philosophy with the purpose of framing sustainability in a bigger picture. [15] Some of the issues, at least the social ones, could be fixed by almost just by political, legal and economical means as some authors denote. But we still believe there is room to contribute from critical technical practice. [16]

Examining HCD as an industrial discipline

We argue that when referring to HCD, we actually refer to Industrial HCD. However, as in many other areas of design, the industrial connotation is omitted. In the next sections we explore whether it could be helpful to notice how design principles are infused with an industrial logic. Such logic was forged in the rise of the industrialization period.

Design blooms in the transition from crafts to industrialization. This new production system shifted from crafts and incorporated labor division to increase efficiency. This way it could use unskilled workers and machines to mass produce commodities. These products would be acquired by generic people, unlike prior tailored production. The great wars left an immense industrial productive system (specially in the USA unaffected by war) that was put to work quickly. Under a new worldwide peace period, it was adapted to transform resources into commodities (instead of war stuff) for the population, now transformed into consumers. Hence, the position of (industrial) design got more and more weight. As a new discipline required new knowledge, that had to be produced to keep the workforce productive in a competitive market. Thus, design came in to fulfill a productive need.

Industrialization and engineering expanded with time as new technological fields emerged. Among other disciplines, digital engineering disciplines, from electric engineering to software architecture or interaction design. But

we argue, the same industrial constituents persist inside the CHD logic. We find that decoupling environmental-threatening industrial principles from the larger concept of planning/design can be insightful.

Design constituents

“We didn't work on time travel, teleportation, and antigravity. They are not important problems because we do not have an attack. It's not the consequence that makes a problem important, it is that you have a reasonable attack.” [17] In this statement (about designing scientific research) by Hamming, we see clearly how common in (HCI) design is to make problems emerge when there is a foreseeable technical solution to it, like in the popular proverb “if all you have is a hammer, everything looks like a nail”. [18] We argue that HCD inherent logic -of industrial nature- tends to search for new problems that can justify the development of new technologies. The work done around Undesign or around introducing friction delves into alternatives. [19]

As a productive task, design's main goal is to plan and foresee feasible products that get adopted. Ekbia et al refer to marxist argumentation “production creates the consumer” to suggest how, by designing production, actually it is that consumers are designed. [20]

User-Centered Design (UCD), spurred by the influential research of Donald Norman -using behavioral psychology concepts-, is probably the most popular framework in CHI fields to conduct a design process. We find revealing the use of the term user instead of consumer, when actually they are almost exchangeable. In doing so, it obfuscates the economic roots of design in the industrial productive system.

We suggest that the notion of consumer is relevant when addressed as resource exploitation. Centering a design process around the needs of the exploiter seems rather unsustainable. Creating an extractivist consumer/user makes total sense, from an industrial point of view, because the ultimate goal is to generate surplus value from the digestion of resources. Tomlinson proposes a shift towards suffering centered design. [21] Instead of a human (or maybe non-human animal) user, the author asks to design around the different forms of animal suffering. We have used the notion of exploitation to extend (human and non-human) animal suffering to biosphere damage and geological disruption, since they are all interconnected, as stated in the introduction.

Likewise, the notion of resource detaches energy sources, materials, animals and people from their ecological context. Through power relations it reduces these actants to something consumable. In a design that aims to produce sustainable, environmentally respectful outcomes, actants shouldn't be under a power relationship where they could be potentially harmed by being forced into another technological system, but be co-producers with their own interests.

Conclusions

Another way or relationship for digital technologies with the planet is probably necessary to increase sustainability, and even maybe unavoidable because of the effects industrialization had and is having over the very ecological systems it relies upon. Developing these would require a conceptual shift, probably in design principles as well. We have tried to delve into such a shift by examining some of the constituent parts we understand underpin industrial design nowadays. We suggest that further research into these questions from the prism of de-industrialization could be relevant. Furthermore, we find this kind of reframing fundamental if we want to move from a blind and growth development-oriented industrial logic towards a sustainable form of design that does not contribute to systemic disruption and in addition allows us to thrive in a potential scarce-limited scenario.

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The Art of Urgency: Cultural Mediation as a Vehicle for Socio-Ecological Transition

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Abstract

The climate emergency has led to a growing recognition of the need for a socio-ecological transition. This recognition has strong cultural dimensions, shaped by representations and narratives as potential vehicles of change. Cultural mediation is a way of connecting these realms. It can stimulate exchanges between actors (citizens, organizations, policymakers), and ultimately help produce dynamics of change and new solidarities.

ARTENSO, a research centre in art and social engagement, explored the possibilities of these intersections by conducting documentary research on the relationship between artistic and ecological interventions. It illuminated the relationships between art, culture and social-ecological change, both in their conceptual dimensions and through practical considerations. It developed a tripartite typology to map initiatives that bring about transformations in the current social and environmental context.

This study suggests that artists and cultural organizations can become agents of social change by exploring new methods and processes. Often conceived and presented separately, engaged art and ecologically responsible practices are nevertheless dimensions that, when articulated together, can challenge society on environmental issues, question the relationship between populations and the environment, and advance the fight against climate change

Keywords

Cultural mediation, socio-ecological transition, map

Introduction

The climate emergency has led to a growing recognition of the need for a socio-ecological transition. This recognition has strong cultural dimensions, shaped by representations and narratives as potential vehicles of change.

Cultural mediation is a way of connecting the social and the cultural. It can stimulate exchanges between actors (citizens, organizations, policymakers), and ultimately help produce dynamics of change and new solidarities. Is it conceivable to develop a paradigm in which cultural mediation bridges art and science, in which the public interacts sensitively with its environment while appropriating ecological ideas? Is it possible to create a favorable context for a transition that is not only fueled by discourses of loss and deprivation?

ARTENSO, a Montreal-based research center on art and social engagement, explored the possibilities of these intersections by conducting documentary research on the rela-

tionship between artistic and ecological interventions. It illuminated the relationships between art, culture and social-ecological change, both in their conceptual dimensions and through practical considerations.

It mapped initiatives that bring about transformations in the current social and environmental context. It developed a typology to unfold the recurring goals and emerging axes of initiatives that combine artistic and ecological practices.

This study suggests that artists and cultural organizations can become agents of social change by exploring new methods and processes. Often conceived and presented separately, engaged art and environmentally-engaged practices are nevertheless dimensions that, when articulated together, can challenge society on environmental issues, question the relationship between populations and the environment, and advance the fight against climate change

Methods

This research aims to answer these questions: How can we combine arts practices with ecological practices? Who are the actors whose practices combine artistic and ecological dimensions? What are their objectives? What forms do the practices of ecological art movements take?

This research was divided into complementary stages:

- A first literature review on the socio-ecological transition, specifically on the genesis of the concept of transition and on the different dimensions that this movement takes in Quebec;
- A data collection whose objective was to bring to light a maximum of initiatives falling within the "culture and transition" axis;
- A first phase of data analysis to identify recurring objectives from the initiatives listed and to create a typological grid;
- A second literature review, oriented by the intersection of art and ecology, was carried out in order to clarify this axis of research and to make more rich the "culture and transition" nexus;
- Six interviews with actors in the arts and culture sector in Quebec and France. This step made it possible to expand the database and enrich the reflections in the document.

The use of the notion of "socio-ecological transition" was used in this research, as it is embedded in cultural and social practices. Although relevant, the notion of "just transition" is rather anchored in an energy perspective and has therefore not been favoured. Culture is an essential element in the emergence of a community of solidarity, particularly in the creation of shared narratives as a foundation for a strong sense of belonging. It should be noted that creating and strengthening the social fabric is as much an objective of the

cultural sector as of the socio-ecological transition. Moreover, the creation of social links is an indispensable asset for us to adapt to the upheavals we are experiencing and will experience.

The term "socio-ecological transition", although it can be defined in different ways, generally includes the following elements: 'the idea of moving from one state to another', which leads to the need for 'significant systemic change' in order to achieve 'a balance between human needs and the capacity of our planet to meet them' (OVSS, 2019, p. 3). Based on these dimensions, the following definition was adopted: Ecological and social transition is a process that leads to a change in production, consumption and living patterns towards a more equitable sharing of power and wealth. The transition aims at a transformation of the development model by building a more respectful, ecologically sustainable, socially equitable and economically viable society (Round Table organized by TIESS, 2017).

Initially, a rhizome research, without central element and evolving in several directions, was carried out in order to bring to light a maximum of projects, organizations, events and artists whose objectives or work are oriented in the articulation between art and transition.

More than 100 initiatives were identified and divided into three groups (Artists and Collectives, Organizations, Research Centres) Some of these are in the form of organizations, which themselves are working on a variety of projects mentioned earlier. These initiatives are presented in the next section.

Results and Discussion

In this section, we underline the three groups that bridge culture and environmental matters and that we covered in this survey, and illustrate their primary objectives.

Artists and Collectives

Definition

- Artists who explicitly build bridges between their artistic practices and environmental issues. The portrait of artists listed includes artists whose entire artistic process is rooted in reflections on ecology.

Main themes

- To raise awareness of environmental issues and eco-citizenship;
- To denounce realities related to ecological issues through artistic experimentation;
- To draw attention to certain issues through artistic practices of 'upcycling'.

For example, The Nuage Vert project by the HeHe collective consists of projecting a laser image onto the fluctuating contour of a cloud of factory smoke to form a plume of green light. This project was carried out in Helsinki, in 2008, on the emissions of the Salmisaari power plant and, in 2010, on the smoke emitted by the Saint-Ouen incinerator, near Paris.



Figure 1 HeHe, Nuage Vert, 2008. Photo : Antti Aahonen.

Organizations

Definition

- Cultural organizations that created a project related to ecological issues;
- Environmental organization that draw upon art in some fashion;
- An organization created at the intersection of the fields of art and the environment.

Main themes

- To stimulate community interaction through cultural mediation;
- To inspire better ecological practices through artistic practices;
- To support the development of artistic and ecological practices.

For example, Cape Farewell is an international non-profit programme based in the UK that works internationally, bringing together artists, scientists and informants to stimulate a cultural narrative that will engage and inspire a sustainable and vibrant future society. Artist David Buckland created the Cape Farewell project in 2001 to generate a cultural response to the climate challenge.



Figure 2 Rachel Whiteread, Embankment, 2004. Photo : Sjoerd ten Kate.

Research Centres

Definition

- A research-creation centre with an ecological component;

- A research laboratory whose main focus is 'art and science';
- Event or project within the framework of a research centre that deals with art and ecology.

Main themes

- To encourage collaboration between researchers, artists, artist-researchers and cultural mediators in environmental science research;
- To promote the integration of interdisciplinary knowledge in bridging art and science;
- To experiment with the possibilities of transforming territories.

For example, the LAAB research group is located in Saint-Mathieu-de-Trévières, north of Montpellier, and has been active since 2007. Exploring the combined tools and skills of art, science and engineering, LAAB is focused on experimentation and dedicated to creation. The collective's pieces are designed to expose the very expressiveness of the living.



Figure 3 Sabrina Issa, Églantier, LAAB, CRAC Occitanie, 2020.

The documentary research and the interviews reveal that there is currently a favourable conjuncture in the impetus of a socio-ecological transition, in which the arts and culture sectors are involved. All the interviewees agree on the inseparable links between culture and transition, and at the same time stress the importance of pooling knowledge and developing a support network. Three elements emerged from this research and deserve particular attention: the scale of practices, the need for coherence and the centrality of the narrative.

Practices

Urban spaces, territories and neighbourhoods are central to the reflections associated with the transition, particularly in their cultural dimensions. The environment in the sense of territory, living environment or particular context, by already anchoring itself as transversal pillars of doing and living together, encourages social practices combining culture and transition. Consequently, the city appears to be the preferred scale of intervention and will be called upon to play a leading role in the framework of future socio-ecological transformations. The urban space is the theatre of creation and implementation of public policies. It is home to a pool

of human, technical and political resources, which are crucial to the full implementation of the transition. The sustainable city is not possible without a change in the attitude of human societies, in order to take measures for future societies.

The interviews made it possible to identify practices to be developed in order to further link the arts and culture sector with the issues of the transition. Some participants stated that it was necessary to green the cultural sector by supporting the role of culture and creativity in policy-making and participatory governance. Fostering cultural involvement in regeneration and environmentally oriented urban infrastructure in response to environmental challenges is becoming inevitable. The new linkage between transition and culture requires the inclusion of a cultural dimension at every stage, from citizen participation to city infrastructure, emphasizing its essential role as a laboratory for testing and developing new approaches. Some projects will make ethical choices that will lead to criticism, but the ability to make mistakes must be retained. According to one participant, there is an obligation for artists and environmentalists to enter into conversation, as society needs to move towards a stronger cultural sensitivity, while the current models for thinking about transition are outdated. Another participant proposed to encourage the dimension of art as a social tool, since art is an educational tool. Promoting eco-education among the youngest definitely includes raising awareness through art.

Coherence

In England, Julie's Bicycle has been working to develop Creative Green Tools specifically for the arts and culture sector. These tools, which calculate the carbon footprint of cultural organizations, are already widely used in the UK and Europe. Knowing one's ecological footprint is a first step in becoming aware of the problem, in order to take action and change one's practices. These tools enable the cultural sector to create concrete environmental policies and effective, structured and quantifiable action plans. The project aims to change and influence other cultural actors to do things differently and better.

It is clear that the arts and cultural industries sector is currently as much part of the problem as the solution. It is a polluting sector and a major producer of waste, which can no longer ignore its greenhouse gas (GHG) emissions, and consequently its participation in climate issues. Several organizations have emerged in recent years to integrate eco-responsible practices into the arts and culture sector, such as Écoscène in Quebec. They encourage the cultural milieu to question itself, accelerate awareness and stimulate the creation of tools to do things differently. For one participant, the arts and culture sector must become aware of its "unconscious biases". Art is part of the problem and part of the solution; the first step is to become aware of the consequences of one's own practices. Consistency between practices and message is essential: first you become aware of your footprint and biases, and then you can change your practices to raise awareness.

Narrative

The ability to transform our representations and challenge our imaginations is a central element of art. The 2006 report Art in Ecology - A Think Tank on Arts and Sustainability

reminds us that researchers and environmentalists value the skills and techniques of performance and music, visual arts, storytelling and written language, in communicating knowledge. One participant added that it is essential to be able to communicate what you do in order to show your potential. A second participant pointed out that it is not futile to deal with ecology through art, as cultural representations must evolve and change. One participant also noted that artists need to explore how to propose alternative visions, especially in a process of engaging with the public to create new visions or solutions, and thus create powerful experiences that truly help to change our relationship to the world. The power of art lies in its great potential for awakening and its ability to touch the emotions. Without instrumentalizing artistic practices, it is becoming essential in the current context to value art that supports a new vision and questions the status quo.

The notion of story and narrative must be more central as a major power of culture and the arts. We need to revise the way we tell stories and tell ourselves, since the scientific and catastrophist approaches do not work. Furthermore, it is time to diversify the ways of imagining and representing what is happening and where we are going. In this sense, it is essential to turn to those whose job it is to tell the story, and this in all artistic disciplines, as much in visual art as in dance. At the heart of the possibilities of culture, there is a role for artists to play. This capacity to reach out, mobilize and raise awareness must also make it possible to reach those who are traditionally far removed from the discourse on transition. This can be done by stimulating citizen participation, and specifically through cultural mediation. In the report *Culture and Climate Change*, culture is presented as the only way to involve citizens in the challenges posed by climate issues, notably because climate change is a cultural challenge. Cultural because it is embodied in everyday life, in habits and in the way we live together, as well as in the transformation of cultural representations. Once again, narrative is at the heart of the possibilities for change.

Conclusion

In sum, what place can be made for arts and culture in the socio-ecological transition? According to one participant, people need to feel that they are "working" for something better, for a better world. This representation can be created by artists. However, the mandate is ambitious: to transform the imaginary of the end of the world to create a positive representation of a future. A more ecosophical reflection of artistic practices allows us to collectively rethink our environment in its natural, social and psychic dimensions. Finally, it is essential to apprehend all forms of life with wisdom and harmony, and to think more broadly about transition and culture in order to shake up imaginations and create new ways of doing and being that are resilient, sustainable and just.

For the future, it would be relevant to ask to what extent cities and territories can engage in the linking of artistic and ecological practices. How do socio-ecological transition practices, as social and cultural practices, enable the creation of communities? How does art, or any cultural dimension,

contribute to the reduction of social fractures? To what extent does it participate in the construction of a narrative leading to innovations for the development of our societies?

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Crossing Art, Science and Technology for Innovations through Maker Culture and Education

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Abstract

The maker culture, flourishing around the world across the last decade in the form of public, corporate and underground maker-spaces or diverse DIY/DIWO workshop programs presents one of the most important trends in experience-based learning, which often takes place not only informally, but also unconsciously, for example through embodied cognition. Upon this background and along several cases of projects, artworks, institutional alliances and initiatives, the article presents an emerging model for experiencing and learning through interdisciplinary collaborations between art and entrepreneurship. These practices are demonstrating new possibilities for disciplinary crossovers permeated by artistic thinking, such that are particularly fruitful for social, but also for technological innovation, which is confirmed by the current DIVA project as treated in the article. Art Thinking proves to be a key novel approach in the innovation cycle that may be integrated into formal education curricula, business practices and community learning alike, which was proven by the recently finished MAST project as discussed in this contribution. A concrete convergence of the above principles and concepts is finally presented through the concept and process of the current project xMobil as an example of blending maker methodologies with the art-thinking based crossover innovation approach.

Keywords

Cross-innovation, art thinking, making, interdisciplinary, embodiment, art practice, crafting, innovation, art-sci-tech.

Introduction: Maker mentality can radically change the way we do things

The maker culture has been flourishing around the world across the last decade in the form of public, corporate and underground maker-spaces, diverse DIY/DIWO workshop programmes etc. It presents one of the most important trends in experience-based learning that often takes place not only informally, but also unconsciously, for example through embodied cognition. The projects and examples presented in the following, highlight and affirm the concept of the maker mindset and the approach of the artistic kind of thinking (Art Thinking) that has been proven to enhance the resilience and positive disruption of both the social and the business sphere, even more so if expanded onto the novel concept of craft thinking as the quintessence of embodied cognition. [1] If well integrated into the so-called Crossinnovation between art and business, Art Thinking can positively inform a both socially and technically relevant Maker Culture.

All knowledge sharing activities that are based on maker-centered learning teach students or any other learner both hard (discipline-specific) skills and soft skills, such as critical thinking, collaboration, and communication in an interdisciplinary way. The idea of the maker mindset is that learners develop creative confidence and a sense of agency — becoming aware that they have the ability to creatively solve problems on their own and jointly with their peers. These projects and practices seem to be fostering an auto-didactic approach especially among the lifelong learners who are particularly proactive in focusing on what they like and what genuinely interests them without the guidance of

masters (such as teachers and professors) or institutions (such as schools).

On the other hand, crafting practices – which involve a lot more technique, knowledge of material, actual manual practice than design, and craft thinking understood as “embodied creative experience” or “embodied cognition” – emphasize the importance of materiality and tactile perspective aspects in learning, intellectual activity, and meaning-making process. They promote the integration of life and meaningful work, a particular “knowing-in-action” that revolves around how to do something. They also bring about reflexivity because we are thinking about what we are doing (especially when doing it, learning it for the first time) and reshaping the action while doing it. Craftwork is one way to bring people out of isolation, it is turned outward to the community, it is the way that local and international communities can learn together and connect; the way we do certain things, the process itself reveals a lot about ourselves and our communities, including the values involved. [2]

The recent pandemic has brutally hit not only the creative sector and some business realms, but society at large. Nevertheless, in many cases around the world, we see examples of people who have responded with resilience through spontaneous and innate creativity. In a period of ongoing lockdowns and uncertainty, making arts and crafts, tinkering and innovating has started flourishing in unforeseen spaces; from garages to kitchens and living rooms, to studios and backyards, as a pastime or to regain one’s livelihood, from amateur hobbyists to professional artists and makers. A range of actors has been redefining existing practices and the spaces they inhabit. Significantly, acts of making help maintain dignity in times of distress. [3]

During lockdown it became evident how fragmented we are locally, and how broken-apart local communities and institutions have gotten within just a year. It is important to promote and empower the informal arts and crafts practices, as a segment of culture that can be found in every community. It is usually embedded (but thus invisible) in a broader local cultural context of the city or a country, and its history. Metaphorically but also quite physically, the culture that is exercised in the garages, kitchens and backyards or in people’s homes has replaced public and corporate provision: there people spent much more time during lockdown than before. [3] They worked from and at home, solving problems (and creating freely) from what (and in collaboration with whom) they had locally. And these practices seem to be carrying on even after (or between) lockdowns, indicating a fostering of new models of learning and collaboration, of producing and innovating.

Taking a culture of making in the center of our actions promotes active citizenship, shared values, inclusion, and intercultural dialogue. It brings people together, including new target groups like unemployed people and to a certain extent also migrants, and helps us (and them) feel part of a community. The proverbial joy of making and the awareness of the common comfort springing from creative actions both have the potential of different cultures and sectors coming together to overcome the social differences that divide us. Behind the gates of the garages, a lot of knowledge, skills and innovations have accumulated in secret over decades. The cultural and creative industries also

have the power to improve lives by publishing new tools, transforming communities by active citizen-engagement and generating spillover effects in other sectors of the economy. [4] This shall be discussed in the following via two key projects; DIVA that supports the cross-innovation processes between art and business, and MAST that integrates art thinking and the profile of the innovation catalyst into the innovation process:

From problem making to strengthening the European economy (DIVA)

In the following the article explores and presents an emerging model for experiencing and learning through interdisciplinary collaborations between art and entrepreneurship. These are opening new possibilities for art-thinking-based crossovers particularly fruitful for social, but also for technological innovation, which is being confirmed by the *DIVA project*. The project's full name is *Development of Innovation EcoSystems and Value Chains Supporting Cross-Border Innovation through Creative Industries*, with a duration between 2018 and 2022 and budget of 3,5 million Euro this Interreg initiative unites 15 partners from Italy and Slovenia, ranging from creative hubs, intermedia producers, universities and chambers of commerce, to hi-tech companies.

The maker mentality involves a lot of similar approaches to those of artists, since both need a good measure of problem-solving-oriented thinking. While artists are not necessarily geared toward finding solutions, they tend to make problems evident, they tend to rephrase them and shed light at an issue from several (often unconventional) angles. For that reason, Art Thinking can provide an alternative thought process to a more analytical type of thinking. Thus, it is not surprising to find out that artists tend to find solutions for non-existing problems or make problems where there are none. Speculative art takes into consideration what we know now and makes predictions on the future and proposes solutions to problems that have not yet arisen, or might never. At the *Berlin biennale IX* the installation *New Eelam* took inspiration from the startup culture and the real estate market's contemporary problems to create a speculative solution, addressing the audience with an existential ambiguity. [5] On the other hand, we can find artists that highlight the problems of today, which are hard to see. For example, the artist Joana Moll often deals with the invisible in computer technology, her work *CO2GLE* aims at highlighting the vast amount of global warming that is generated from seemingly innocent actions, such as using Google or other search engines to find information. The project aims at showing how much CO2 is being released into the atmosphere while using such engines. [6] Similarly making something virtual physical might help to illustrate the commercialized aspect of social media as can be seen in the work *Quick Fix* taking the form of a vending machine selling followers for social media. [7] On the other hand, we can recognize that even speculative or the exploratory nature of an artist can generate works that are more akin to start-up ventures with clear market goals. This can be seen in the work *Dulltech* which played on a real need in the intermedia art community and responded to it with a Kickstarter campaign, resulting in both an artwork and a true capitalist venture. [8]

In this sense, artists possess a unique approach to problem-solving, since their goal is not necessarily solution-oriented. Art does not need to resolve issues, art can simply make (the actual) problems evident. "Generally speaking, technical research focuses almost exclusively on new technical possibilities: What new things can be done? How can they be done faster or more efficiently? By contrast, artistic and design work tends to focus on the social and cultural meaning of the technology that is under development." [9]

In a world of constant racing against the latest innovations, and keeping ahead of others, Europe seems to have recognized that to achieve a paradigmatic shift in the economic sector, innovation has to take a more prominent role in economic politics. This is why in the last decade the European Union started multiple well-funded initiatives to foster the interaction between the creative and industrial sectors. It is true that artists have ever since and constantly intersected with the working environment and were kept intrigued with technological advancement, but only in the last twenty years policymakers realized the potential behind it. In 2012 the *Cross Innovation* project was funded under the INTERREG IVC scheme. [10] The project made a survey across 11 European countries (Amsterdam, Birmingham, Rome, Berlin, Tallinn, Warsaw, Vilnius, Stockholm, Linz, Lisbon, and Pilsen). It was one of the first organized initiatives that developed a toolkit and manifesto to bolster cross-sector interactions. Unfortunately, the initiative has gradually lost momentum and a fair amount of organization dwindled, shifted, or completely stopped after some time. The *Cross Innovation* website has been recently shut down and the only way to reach the content is through web archives.

The above does not mean the cross-sector approaches are unsuccessful, but it rather shows that due to the nature of business not all endeavors are equally long-lasting. An increasing number of creative hubs and the increasing interest of Universities (Aalto's Design Factory and Fablab, Paris's University CRI Hub, Gothenburg University's Business & Design Lab) to pursue their own inter-sectional hubs shows a big need and will in shattering the boundaries between traditional sector-based practice and research. Furthermore, the EU keeps funding projects aligned with this idea. Thus the *DIVA project* has been designed to create a methodology and implement pilot projects that connect the creative sector with more traditional businesses in a disruptive way, and through shoulder-to-shoulder cooperation between art and entrepreneurship. [11] The aim is to accelerate innovation and bring novel products to the market, finally finding a more resilient model for the European economy. This is further proven to be the European strategy in the latest round of proposed fundings, such as the *Creative Europe 2021-2027* mechanism or the *New European Bauhaus* initiative.

The *DIVA project* is now in its concluding stage, launching fifteen pilot projects, of which one is presented further below in Section 4. So far DIVA was able to identify through its own mapping case studies that clearly show there is a strong benefit in using the creative sector as the driving force behind innovation.

The Innovation Catalyst profile integrating Art Thinking on eye level (MAST)

Art Thinking as a key approach in the innovation cycle that may be even integrated into formal curricula offers a way to prioritize not only the artistic skills and tools, but also the concepts and methods that essentially transform the innovation process. [12] According to Sloterdijk, it is precisely thinking art, science and technology (AST) together that has the potential to generate an expanded knowledge consciousness. While technology is very much about rational knowledge, art is often operating with sensual, bodily knowledge — while science, on its part, is mainly about factual knowledge. A creative process taking place in between them provides the possibility to generate better visions for our future society in need of a more daring approach to innovation, such that entails a complex holistic embodiment that includes non-rational bodily and emotional conditions. To be open to such visions evokes the unforeseen and the unknown, raising more questions than giving answers — which the artistic approach has been always particularly efficient at. While design focuses on products or services that respond to needs, art is a discipline

that often integrates varied kinds of knowledge and experiences, including radical (self-)criticism and questioning of the entire frame of action (or thinking). Thus, and as shown above, artists often seem mischievous or even counter-culture, but in reality, due to their questioning nature, they tend to rethink what seems to be obvious.

Hence, the assumption of the added value of Art in the otherwise predominant Science-Technology blend — which can have a positive impact only if art is considered to have an equal stake at the least — was placed at the core of the *MAST project* idea. [13] It aimed to build a *Master Module in Art, Science and Technology* oriented towards innovations compatible with the Social Europe agenda which is based on the twenty principles of *The European Pillars of Social Rights*. These reflect the current European priorities aspiring to new and more effective work-related rights for citizens, converging in fair working conditions, social protection, and inclusion. [14]

The MAST consortium thus created a trans-disciplinary international Masters-level study module through a two-year-long series of workshops and public events, co-funded by the European Commission. These served as pilot tests for the later on accredited curriculum, where students alongside cutting-edge engineers, scientists, social activists, and artists keep producing both daring prototypes and radical thinking, such that addresses Europe's ambition towards meaningful innovation and social equity. In these pilot course runs sustainable social innovation models were first tested in critical ways, and then accredited within a cross-disciplinary syllabus presented further in the text. MAST promotes a clear interdisciplinary vision and an academic practice that aims to integrate social values into the entire chain of technology creation and social innovation alike.

The Cross Innovation Network (CIN) describes cross innovation “as a collaborative and cross-sectoral innovation process with the cultural and creative industries (CCI), businesses and other actors of the public or private spheres.” [10] In slight contrast with the above mentioned MAST project, the creative industries in this case act as so-called “innovation catalysts” in a collective role, and not as a single personal profile (MAST conceives the Innovation Catalyst as the module's graduate). [15] The CIN puts forward the skills of tackling “an increasingly volatile, uncertain, complex and ambiguous world,” while MAST's definition of an innovation catalyst refers to someone who understands and experiences creative imagination, emotional or corporeal intelligence, and has a deep understanding of aesthetics along with critical thinking; a conception well in line with the core elements of artistic thinking as devised by Buschkühle emphasizing that “sensitive perception, personal imagination, and critical reflection – inspire each other but can also be in conflict with each other;” and pointing to the fact that “the quality of will and manual skills are important factors in developing artistic thinking into creative results.” [16] On an institutional level by contrast, the CIN seeks to connect “public intermediaries, research institutes, study programs, experimental maker spaces, to private Cross Innovation agencies.” [10]

MAST also defocuses from the currently dominant paradigm of design (thinking), and postulates it – within the innovation cycle holistically conceived – as a stage that only comes after Art Thinking, i.e. when the artistic practices and the broad aspects of the humanities have already been considered. It does so not to diminish the importance of technology and design, but rather to embrace the fact that *moving minds* is ultimately more important to the AST nexus (than the actual making practice of technical innovation that may be said to *move matter*). Art thinking provides a series of dilemmas, intuitive observations, questions, paradoxes, etc. that are demanding more conceptual answers which do not necessarily offer a final result, and which do not necessarily lead to a solved challenge. This differentiates Art Thinking from the dominant and recently broadly mainstream Design Thinking that strives for problem-solving and thus (always) offers a

possible scenario or product development — for a known challenge.

The key curricular novum in the MAST module is a consistent introduction of Art Thinking as a core stage in the innovation or catalysis process. The key objective for the student is to become able to apply art-thinking methods and tools, combining them with design thinking to develop (or essentially improve) critical and unconventional breakthrough processes, services, and products. In order to avoid a mercantilist understanding of art-making within the innovation context, the present position supports a description of the artistic production only concerning other practices, which means not looking at the artwork as such but instead discussing the artistic approach towards making or doing things, i.e. as production of meaning. Such an approach involves a conscious, differentiated, and critical treatment of artistic thinking in and by itself.

xMobil, an example of blending maker methodologies with the art-thinking based crossover innovation approach

As a concrete convergence of the above principles of Art Thinking and Cross-Innovation that inform a both socially and technically relevant Maker Culture, the article finally presents the concept and process of *xMobil*. This (DIVA pilot) project aims to produce a working prototype of a solar-powered investigative-art module in the format of a car trailer that empowers creativity and innovation in remote locations. Therein it combines the work of professional artists, designers, architects, and engineers who act as mentors to students and pupils coming from diverse educational programs, and are the actual authors and implementers, the makers of this innovative product (and process as such).

The mobile system is to be derived from a standard car trailer, containing equipment for AV production and playback (DJ, VJ, video, + VR/AR), also designed to support research in Art-Science-Technology projects, including basic natural sciences, field sociology, and visual anthropology. It is geared towards the development of social and technological innovations in limited-access conditions or in (remote rural and natural) locations without electrical supply, thereby also expanding the local outreach of *ISOLabs*, a large-scale (so-called flagship) project of the European Capital of Culture (ECoC) *Go!2025* program that combines several tactical-media artistic approaches such as signal interception and jamming, advanced unmanned aircraft surveillance and environmental vigilance. Contemporary environmental sensing and recording instruments on biological, chemical, physical or visual levels have expanded the human ability to understand the components of what we deem “nature”. Together with *xMobil*, *ISOLabs* thus aims to “completely expand our view on complex biospheres and grasp them as ecosystems, showing that we need to encapsulate cultural, historical, and geological realities alike.” [17]

The art-thinking based design and fab-lab prototype development of *xMobil* will take place in the *Xcenter*, the hub of creative practice opened in September 2021, founded in partnership with the Nova Gorica municipality (*e-hiša* - House of Experiments, Youth Centre), the University of Nova Gorica School of Arts, Kersnikova Institute (both the latter institutions are involved also in MAST and DIVA) and several strong local businesses. *Xcenter* occupies the most central town location (pedestrian zone) in direct context with Nova Gorica's cultural improvement district, a key concept of the *Go!2025* program. It offers an important space for the ECoC activities with different generations engaging in new-tech innovation intertwined with art and design, offering STEAM-based workshops and mentorships, DIY and start-up support as well as a co-curated gallery space. According to regional industry and sponsorship support, several units of *xMobil* shall be

produced through 2023 and 2024 through local cross-sector collaboration.

xMobil thus presents a concrete convergence of all the above-discussed principles and concepts that should bring about a both technologically and socially sound innovation process, and a product (prototype) that will cross-connect artistic, scientific and technological assets in a culturally inclusive and community-sensitive setting.

Even if at the point of writing, MAST is finished while the DIVA project is still ongoing and its pilot *xMobil* is only starting, the above reasoning allows to assume that the maker mindset validating embodied cognition as combined with Art Thinking, within an innovation process, may enhance both individual and community-level resilience. It offers a way to prioritize not only the artistic skills and tools, but also the concepts and methods that essentially transform innovation not only as a process, but also as a concept. Moreover, if strategically aligned in long-term institutional alliances and coded into both educational curricula as well as public strategies or business models, these concepts may bring about a positive disruption of the tech-business spheres, not least by showing that (and how) any innovation should also have a worthwhile social impact.

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CHIME Design Lab: Community-centred, Collaborative Health Innovation partnered with Medical Education

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Abstract

In Canada, healthcare and health professions education, in particular medical education, are grounded in structures of coloniality, oppression, heteropatriarchy and a variety of “-isms” (racism, sexism, ableism, classism). [1,2,3] Like other parts of the world, deep-rooted and enduring health disparities exist for many different groups. Change is needed urgently. CHIME aims to be a physical and social space where a wide range of stakeholders - members of marginalized groups, professionals from a variety of domains in and outside healthcare, as well as students and trainees, and other interested members of the general public - can together creatively and safely explore healthcare problems, test potential solutions and propose equitable, just alternatives to the status quo.

Keywords

Public health, health equity, advocacy, medical education, design in healthcare, innovation, participatory research, collaboration, health humanities, decolonization.

Introduction

Epistemic racism can be described as the “positioning of knowledge of one racialized group as superior to another”. [4] It is a problem that is skewing the educational environment of future physicians. Given this Eurocentric, -ism-riddled brine that trainees, clinicians and patients alike are being pickled in, it is little wonder that deep-rooted and enduring health disparities exist for many different groups across Canada. The list of affected groups is too long: Indigenous peoples; those living in rural, remote and Northern areas; sexually- and gender-diverse groups; those experiencing poverty, homelessness or housing insecurity, mental illness or addictions; racialized and immigrant peoples; and those who are body- and ability-diverse. [5-11] The existence of these widespread health inequities is unsettling and unacceptable. Something needs to change in healthcare delivery and education – urgently and swiftly. While daunting, the need to surmount challenges associated with decolonizing healthcare and medical education is great.

Multi-faceted approaches are needed to achieve the required changes at both the upstream level - training new generations of physicians, as well as mid- and downstream levels - providing equitable access to care and services needed to mitigate negative impacts of disadvantage and alleviate current health burdens faced by marginalized populations. To help address this challenge, we have conceived an approach that combines public and population health, medical education, arts, humanities, and design. Based on a collaborative practice model, the CHIME Design Lab (Community-centred, Collaborative Health Innovation partnered with Medical Education) aims to create a physical and social space that encourages participation from the widest possible range of people – from those identifying as members of marginalized groups, to professionals from a variety of domains (e.g. health, design, humanities), to trainees from these disciplines, as well as policy makers, and other interested members of the public. This way of working creates a community in service of the community. It brings together people with shared concerns but with diverse viewpoints, lived experiences, competencies and knowledge bases. This is a space where, together, people can creatively and safely explore healthcare problems, test potential solutions and propose equitable, just alternatives to the status quo. (Figure 1)

The question may arise: why design? Answer: our entire world is designed. Everything in it, including our health and education systems, has been designed. Design gives us a language to talk about the activities involved in creating intentional change. It can also describe the range of activities, knowledge and skills required to imagine and realize this change. Whenever we create “technologies, organizations, processes, environments, ways of thinking, or systems – we engage in design.” [12] Understood in this way, design is an activity we all do and which concerns us all. It is also up to us to decide whether something has been well-designed, whether it needs to be redesigned, and if the latter is the case, in what form? For what purpose? For

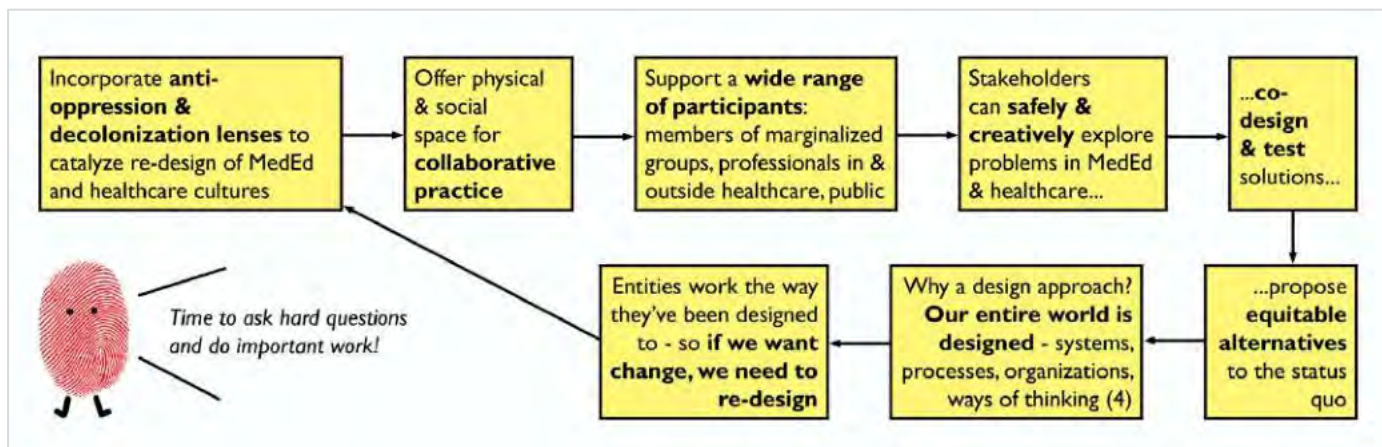


Figure 1. Proposed roadmap for CHIME Design Lab activities.

whose benefit? Why, and how? As Stolterman and Nelson (2014) has cogently observed, design is “at its root, a form of democracy ... the democracy of self-determination ... the kind of democracy that can embrace the growing diversity and complexity of human interests in today’s world. Design provides the possibility that each and every person’s individual good can be considered within the framework of the common good”. [13] This empathetic, collaborative ethos aligns well with the goals of equitable public health and social justice praxis of the CHIME Design Lab.

Methods

The CHIME Design Lab is a large-scale project that aims to engage health professionals, including trainees, as well as members of diverse, marginalized or equity-seeking groups, and other stakeholders to collaborate together in real-world settings to problem-solve complex health-related issues and reduce inequities in health outcomes.

Part 1 - Prototype Development

We are currently conducting a scan of relevant literature to identify high-quality sources describing promising social entrepreneurship models and design approaches directed to addressing health inequities and social justice, relevant to community and public health. This encompasses both peer-reviewed publications and “grey” literature (unpublished, or informally published material). We have cast a wide net to identify a broad range of leading-edge ideas, inclusive of position papers, pilot evaluations, published research findings and reviews, considered along with related perspectives from critical health humanities, social sciences scholarship, arts and health, and research-creation. Through this effort we aim to identify promising directions and opportunities for: 1) creating health equity through a health design lab approach involving community members; 2) engaging health science students in collaborative, participatory methods leading to novel approaches directed

to addressing healthcare inequities and social justice challenges; 3) introducing anti-colonial and anti-oppressive lenses to guide emancipatory design praxis in community and public health.

The broad range of approaches and evidence identified regarding impactful and effective opportunities for addressing social justice at the intersection of community and public health and medical training will be synthesized and shared via a layered knowledge translation approach (e.g. infographic, podcast series, academic publication, project website). The results of this review will also inform the development of a preliminary CHIME Design Lab prototype that will be piloted, evaluated and refined.

Part 2 - Pilot Testing and Refinement

Concrete strategies for designing and evaluating social, change-oriented CHIME Lab Design processes, including clear agenda and accountability structures, will be outlined. A health equity-seeking community group interested in collaborating on testing the CHIME Design Lab process will be identified, along with a cohort of interested medical trainees and practitioners, design colleagues, and community stakeholders. Community-based workshops and focus groups will be held. Project objectives will be refined in response to community issues and concerns. Processes, activities (including capacity-building efforts), and outcomes (planned and unplanned) will be documented and tracked, to ensure a humble, reflexive openness to ongoing learning together. Emergent insights and understandings will inform ongoing refinement of CHIME over time.

Preliminary Findings, Future Imaginings

Early scans of available literature have identified the importance of: openness and commitment, diversity and inclusiveness, empathy and play; processes that support wide-ranging, comprehensive thinking and ongoing

learning; advocacy and community empowerment; sustainability; and ongoing reflexivity regarding issues of power, privilege, access, belonging, and what it means to truly be human. Several programmatic, highly impactful and promising examples are highlighted here as exemplars.

Recognizing the need for progressive practices directed to improving fragile healthcare systems around the world requires an understanding of both local and global, social and political forces that impact health. The “accompaniment” process, referring to long-term relational commitment to listening to people in order to learn what they need to survive and thrive in their communities, has been described as being foundational to the success of “Partners in Health”. Co-founded in 1987 by Paul Farmer and Jim Kim Yong (who were medical students at the time) and a number of their friends, this international healthcare organization follows the lead of the local communities it works with to help bring high-quality healthcare, and dignity, to people in many of the poorest countries in the world. [14] Likewise, medicine's social accountability mandate has challenged medical education programs to introduce dynamic curriculum changes that prepare physicians to provide care that is responsive to the cultural, economic, and psychosocial realities of diverse patient populations. [15] To address this need, an innovative and creative approach to developing relevant and needed curricular content was created by medical educators at the University of Alberta. The DISCuSS model (Diversity, Identify, Search, Create module (with community engagement, Sustainability, Social accountability) provides a community-engaged, iterative approach to curriculum development directed at promoting health equity. Medical educators, community groups, and students work together on socially accountable curriculum modules that have helped medical students feel more prepared to serve marginalized groups. [16] Makerspaces also offer a model for promoting innovation in this area by bringing broad-ranging stakeholders together to explore and expand understanding of a social justice-related problem space, from which new innovative solutions may be explored and fabricated. [17] The catalyzing power of the arts has also been noted in relation to engaging diverse groups in exploring challenging health issues and helping to elevate understanding and ways of moving forward, contributing to advocacy efforts and policy change. Examples include an arts-based research project directed at heightening awareness and understanding of the impact of head and neck cancer, and community responsiveness to the needs of patients and their families, as well as <Immune Nations>, a multi-year, research-creation project completed in 2017 that explored complex views and forces informing vaccine hesitancy (<http://www.immunenations.com>). [18] Relationships between art, advocacy, action and change have been explored with respect to many health issues, including stigmatized conditions such as HIV/AIDS. [19]

Among other aspects yet to be identified, it is anticipated that, as part of the CHIME Design Lab methodology, attention will be given to processes of empowerment, contribution, and recognition. In addition, there will be focus on hands-on, creative processes leading to new ideas, attainment of needed resources, and new partnerships including - when needed - political support, to achieve necessary change and transformation for those who have the most at stake. Recognizing the important role and unique power of the arts and narrative storytelling in expressing complex emotions and experiences in accessible ways, multiple artistic forms will also likely be used in various ways across different CHIME-based projects. [20] Our aim is to expand understanding and work to change the conversation regarding different public health concerns, and help align action and policies to support “health for all”.

Toward Better and More Equitable Healthcare Futures

Ambitious approaches are needed to transform our culture and create better healthcare futures for all. Due to their scope, complexity, and political nature, inherently “wicked” social justice-related issues present significant challenges for designing transformational practices. There is a need to create structures and processes that lead to new ways of thinking and working that can amplify engagement and innovation. The goal is to overcome barriers to ensuring equitable access to dignified, quality healthcare and healing for all. Meaningful collaboration among all those who are part of CHIME projects will broaden the horizons of possibility for equity-seeking groups and community members, including outreach workers and activists, as well as upcoming generations of health professionals, designers and social innovation entrepreneurs, and others interested in working toward better and more equitable healthcare futures. In his award-winning essay “From mirroring to world-making”, Kenneth Gergen outlines a provocative understanding of inquiry, re-conceptualizing its aim as “future forming”, not directed “to illuminating what is” but rather directed to making, or creating, “what is to become.” [21] Aligned with this perspective, and mirroring synergies between arts and health, we view the collaborative reflexivity informing CHIME as a form of “practice artistry” supporting “sensitivity to, and caring for, the world”, to influence not yet imagined better, possible, more equitable healthcare futures. [22] We cannot wait to get started!

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Authors’ Biographies

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Virtual museums: heritage and future of mediated UX?

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Summary

This article intends to carry out an analysis of the factors that have inherited the experiences of face-to-face visits to museums with those that are developed through virtual platforms. This analysis has been developed using a hermeneutical analysis of categories applied by the authors through multimodality with the intention to expand the reflection on this subject, as well as to provide a broader point of view. In addition to this, we have identified how in recent publications other authors have been expressing similar points of view, which allows us to generate a comparative framework. The interest in these study categories is oriented on the potential that museums have in promoting virtual settings, outside of physical spaces that can promote the construction of deep meaning in learning at different levels of training. Furthermore, we carried out a review of the connotations that different virtualized experiences in museums have, and how these can promote different levels of construction of meaning based on what the subject is explained, what they feel or experience during their virtual visit. A classification is then proposed in which the multimodal typologies of virtualization are connected with the possibilities of construction of meaning through museums.

Keywords

Museum, Experience, Virtual, Virtual Museum, Learning outside the classroom, Multimodality

Introduction

As presented by Bonnefoit and Rérat [1], the advent of electronic media in the 1980s and the Internet in the 1990s promoted substantive transformations in domains related to communication, creation and management and transmission of knowledge. Progress has been made in projects of virtual museum around the world, incorporating technologies and providing participants with a series of interactions that promote different levels of experience. However, it is important to point out that the principles of the museums mediated by technology could be dated since the decade of the 60's, in which, according to some reviews carried out by authors as Schweibenz [2], they report the importance of certain categories against the novelty of electronics for museums. It was at that precise moment that different approaches emerged. Some of these approaches were museum research through computers, electronic museum, and computerized guides as predictions of the near future.

It is in this context that different improvements associated with the way of developing technology have been adapted, not only to the way of presenting collections, but also of making works. The beginning of the web brought as one of the first steps trying to develop spaces that would allow people to learn about matters related to the museum or its collections, but it was considered a violation of the concept and space itself of the museum and the intellectual property of the works. It was even considered as a codependency of the physical space on the possibility offered by the screens. For example, pointed out that physical and metaphysical experience mediated by screens, diminishes someone's ability to appreciate texture, dimension, and even color. Mitz [3] goes further and affirms then: "the media delivers information, which does not coincide with the totality of the experience that a museum can provide". However, these

positions in the continuous development of mediation activities through social media and other types of modalities in the early 2000s, promoted robust changes in the way of projecting the use and exploitation of media forms used with different purposes. According Huhtamo [4] during the first decade, search engines with the keyword "virtual museum" had a dramatic growth close to 1000%, which allows us to appreciate the increased interest in designing systems for the creation of museums on digital platforms. Now, in this ecosystem of concepts where the electronic, the digital and the virtual emerge and are associated with the concept of the museum, it is important to ask, if the user experience (UX) in a museum could virtual or not. If it happens to be virtual, under what characteristics of mediation this with the purpose of promoting through the aforementioned characteristics a purpose that increases, enhances or complements the face-to-face experience.

Museum Virtual Spaces

The recent concept of digital sampling studied by Manovich [5] raises a valuable question regarding the way in which we conceive the construction of representative samples of cultural value and in which we return to the very epistemology of the conception of collection. How significant is the face-to-face experience for a museum visitor today? This, in regards to the mission of a museum presented by the ICOM (International Council of Museums) [6] and debated by authors Bonnefoit and Rérat [7]. This allows us to understand that the opening, conservation, acquisition, research, communication, and exhibition is the way in which the patrimony of the humanity can have value, only when the interest for the development of knowledge through the construction of meaning is privileged. It is here where the discussion changes reference and ceases to validate the relation between virtual and in-person and focuses instead on taking advantage of the fulfillment of the mission of museums regardless of the environment used [8] verifying that modal forms in semiotic contexts [9] can be better used.

Therefore, it is important to understand that there may be multiple classifications of virtual museums as proposed by the Virtual Museum Transnational Network [10]. These classifications can be based on aspects such as: content, types of interaction technology used, the duration of the virtual experience, the type of communication, the immersive possibilities, the format of transmission, the accessibility to the public and sustainability. However, returning to Mitz's [11] initial debate, the experience is not interpreted as a typology of classification and analysis.

Considering what has been mentioned, we have proposed three *scales of experiential propagation* that allow a virtual system focused on a museum to make use of different modal forms and through these a different experiential scale is provided as observed in the central circles of Figure I. The first exhibition scale was the first modality that was implemented, since the 90s and with the appearance of computer networks, an important interest is fostered in building experiences that allow data, knowledge in general and logistical aspects of a museum to be mediated by

communication figure for the museum, but later on it included photographs and even videos about the collections, which began to build a level of propagation of the experience that we have called exhibition, inasmuch as its value resides in the contemplation and its corresponding interaction with the information of the object. In this type of experience, we highlight the extensive use of linguistic, visual modes [12], and even intersemiotic [13] modes such as audiovisual. Within this modality that we have called exhibition, there would be all those that reproduce the exhibition room and in which the navigator cannot do much more than walk around the room with their cursor and / or approach and move away from the pieces of art. We can also refer to the first virtual museums that were limited to the exhibition of the work as pure information, it is the case of the Web Museum, Paris - Founded in 1994 (<https://www.ibiblio.org/wm/>). In that intersection of circles that shows the different scales of experience, we understand that it is relevant to focus on those examples that expand the level of experience, which are at that intersection. This is the case of Google Art and Culture that is found in that exhibition plan of information display, but with a first level of interaction, allowing the navigator to choose their viewing experience based on the detail they want to explore in the chosen work of art.

The following two levels have evolved since virtual reality (VR) and augmented reality (AR) systems have been developed and are beginning to show some utilities with a focus on museums. We separate them in two because, depending on the type of museum, the decision can be made about one or another way for propagating the experience. Then, the second level: simulation, focuses on recreating the object and its behavior in order to appreciate in detail and experiment in virtual environments and also face-to-face. A wide and detailed use is made of visual modalities [14], generally intersemiotic modalities accompanied with gestures and spatiality in the subject. Science or art museums in general are very common, the concentration of the subject's experience is based on developing a level of interaction that makes it possible to make meaning on a phenomenon or some characteristics of a three-dimensional work. This level of experiential propagation has been called by us simulation because it consists of a recreation strategy to make meaning with it and all through simulation. In short, it is a step beyond the exhibition, since it implies a greater degree of interaction, of participation of the navigator approaching the works of art.

Finally, the third level of the propagation of experience is the one that in perspective [15] is incorporated generating a process of habitability in space. Only what is inhabited is experienced and from there the degree of immersion becomes a highly important component, since it is what allows building. It is then the space, its spatiality, and gestures [16], that makes it very important, taking two different experiential directions: the total recreation of space, that is an empty space is used to travel through virtual reality devices, or the existing experience is expanded, giving the visitor an interactive addition according to their profile, interest, or motivation. In either case, the experiences articulated in intersemiotics with the visual and perhaps sound when a component of playability is additionally incorporated into the interactive proposal. In this case, we mention the strategy of the *Lázaro Galdiano* Museum that through an augmented reality application displaying a pirate, helps children explore and expand their experience in space. We have called this level of propagation, experience, because it brings together the necessary elements for the construction of meaning through its inhabiting of space. We find conceptual support similarity to this classification in the distinction between artifact and cultural activity through the digital

observed that the relation with digitized artifacts was born in other media and in our case, they are made for the exhibition ones; digital artifacts, such as those conceived in this way, associated with the idea of simulation and finally, cultural experiences, where processes of digital experimentation are mixed with in-person visit, showing a clear trend in our way to propagate what is called experience.

Virtual Representation Approach

Representing a scenario constitutes the greatest challenge. Through the questions what to represent? and how to represent it? A strategy is established. This strategy goes beyond the virtualization and approaches the scenario of representation from which the experience of a user will mediate. As mentioned above, in most cases we talk about virtualizing, that is, transforming into identified modal forms with meaning for the target community. Perhaps, it is precisely for this reason that we have a clear conceptual void because our approach is technological, but if we assume a people-centered approach as in design, and even more, centered on living beings, we can consider that we are forgetting the fundamental piece. We are bringing ideas to transform the concept of virtualization, by mediating experiences, as it is presented in the central circles of Figure I.

In this sense, the first thing that should be pointed out is that the ways of building experience should not be considered as exclusive, we can mention that those ways that identify the what, the how (of the transmission), and also the what for, favor the development of the consultation activities and the construction of experience in a virtual museum. This means that the limits, as can be seen in Figure I, allow modal additions to be made between the different levels of propagation of the experience that benefit the user's profile, and the way of providing experiences in a way that encourages the making of meaning. It is for this reason that we prefer to call it level, without any of the previous levels being more or less important but bearing in mind that some will be more adequate for a certain type of making of meaning.

Following the above, we can understand how the representation approach of the first level focuses on information. This means that the development of all virtualization activities is in transmitting information through interaction. From the perspective of Szuprowicz [18] this approach to interactivity is called textual, and this is why it requires from the subject a cognitive interaction implied in the identification between the meaning of what is read and the way of doing it.

It is important to understand here that reading is understood as a broad form of action that goes from the linguistic to the visual. What is important is that it must be textual, visual or interactive. In any of the cases, the previous capacities of the subjects are being used when intervening. That is, the conceptual density of the texts, the interpretive difficulty of the images and the intuitiveness in the use of mediating interfaces must correspond to the ways in which the participants relate to the space, responding to a specific cultural form that allows diluting technological barriers.

In the second case, the levels of experiential propagation by simulation. We will talk about the modes of representation that in the perspective of Szuprowicz [19] have the ability to promote interactivities of a technical nature, in which based on a specific mediality, it can vary from spatiality, gestures and visuality, as it occurs in a VR or AR system, a specific experience is provoked by the subject. However, it is not the only possibility, science museums and laboratories tend to create devices that, although they are analogous, provide a

phenomenon through interaction with the subject. In this sense, technology is used to demonstrate through exploration with a scale model (temporary, spatial, or functional) a way of transmitting knowledge. In this sense, it may be different to contemplate to experiment, even with a simulated model. Well indeed, the simulation would be halfway between the exhibition and the experience, for this simulation to occur, the navigator must enter a greater level of experience, a greater intervention with which he builds meaning, his own meaning, within the limits established by the simulation. Within this category, we would find all those museums that provide the user in their web spaces with pieces and works of art simulated in 3D so the navigator can and must necessarily interact for the construction of meaning, then the scale of experience is completed, otherwise, such simulation would be meaningless.

Finally, in the third level of experiential propagation, a tendency to elaborate a scenario is developed, so that the user constructs a way of making sense with the space through their interactions. The experience of the situation of course is greater, and in this direction, it is possible to construct a series of points of view that integrate spatiality and gestures, but of a body type, not only manual as in the previous case. Additionally, the information and the ways of narrating provide specialized scenarios of interaction that could be both inside and outside the museum. A situation is fully represented in its context, the user becomes an assistant to the situation and undoubtedly this provides the visitor with an experience of a high level of meaning, since the immersion makes it feel as though what was narrated was indeed lived. In this type of modality, as we have pointed out, it appropriates, rather a bodily implication, a co-creative implication, of story construction in the given context. We can place the numerous augmented reality apps in the context of gamification, which can only develop their experiential scale in interaction with the room, with the space, with the context itself that the interaction allows the user to create their own, their own sense. In this direction we can highlight the apps of the Science Museum in the United Kingdom (<https://www.sciencemuseum.org.uk/games-and-apps>) that presents the visitor with different challenges using augmented reality to help them think like a scientist, so we can understand that the user's involvement here must be complete. The Harddiskmuseum V Space (<https://space.harddiskmuseum.com/about.html>), founded by the artist *Solimán López*, allows us to understand other logics of museum construction, as each work is constructed from the metaphor of a "hard disk", where data are works of art and where experience is built from interaction with them. As we can see, the development of virtualization activities, although could be seen as evolutionary and incremental, we cannot necessarily affirm that one scale or another is more or less relevant. The dependence of this criterion is always around the construction of meaning. Therefore, we understand how through the definition of an interaction design strategy, it is possible to define the level of relevance in the use of one or another dimension or, on the contrary, to create an appropriation of these categories trying to present different points of view in the process.

Objective: Making Meaning

As it was proposed from the beginning, what we present here implies that the museum experience should always be significant, regardless of the modal way in which it is intervened, face-to-face or virtual. From this point of view, we see how the user experience can take different scales of construction of meaning, which, aligned with the expectations of management and transmission of knowledge, constitute highly powerful didactic tools to

construction of meaning that involve the participants in different ways. That is, we understand that the construction of meaning is an ability to take many types of data and through a synthesis process, building an image that is cognitively processed to make judgments [20]. It is this image that constitutes an interface that enables the recognition of people's actions to determine, with it, the cognitive and cultural dimension of their actions. Let's see how we understand these classifications through what we call the virtualization target. As it can be seen in the peripheral circles in Figure I and starting with the first level of experiential propagation, we understand that the objective of virtualization is in the need of making meaning in the interaction of users through data that is transmitted to them. This presents information that in general terms is irrefutable, such as type of technique, year of elaboration or the historical context of the work or collection. Then it is understood as objective knowledge [21].

In this perspective, the data that is transmitted is learned by its temporal or spatial qualities, such as, for example, how it was made, how long it took to be developed, how it was implemented, how many people intervened, among many other things. In general terms, the data is measurable from some qualitative or quantitative dimension, and this makes it turn into knowledge.

The experience through the interaction with an object is of personal nature, it allows acquiring and experiencing what is known in literature as subjective knowledge [22]. In this sense, we can understand how the different interactions with objects in a virtual museum provide information that only an individual who interacts with them can identify.



Figure I. Virtualization objectives through the experiential propagation scales for museums. Source: self-made.

Finally, knowledge that is not achieved through transmission, but that is experienced in the physical or virtual environment, and how the scenario is promoted through this. Here we clearly show that we are not talking about the museum as a physical or virtual space, but about the experience of being a participant in a battle in a historical museum or with the painter at the time of experimenting with his work in an art museum. These spaces allow to embody an experiential knowledge that is reflected in a deep meaning on the part of the participant.

Conclusions

This document presents a different point of view to the debate between the presence and the virtuality of museum visits. In the evolution of the systems, replicating a face-to-face experience is very convenient and it is the first step to

fail to understand that virtual museums can offer other alternatives for the construction of meaning that would complement the face-to-face visit and that could even offer separate experiences according to the particular profiles of the visitors. The International Council of Museums states that if the historical patrimony that a museum contains is for its opening, preservation, acquisition, research, communication, and exhibition, we cannot ignore that certain museums, certain collections and certain face-to-face experiences are impossible for a large part of the world's population. It is precisely there where the importance of virtual museums becomes relevant, when it is able to recognize that it has more to offer than physical space. ICOM itself recognizes this when it states that the term museum is a place to select, study and display the material and intangible evidence of humanity. The discussion then is not focused on space, it is focused on the user experience and its use in the world. Understanding the logic of people interaction in museum spaces, in any of the modalities described, will be understanding their behavior patterns, in regards to the culture and their expectations of knowledge, in a context of cultural references affected by globalized homogenization.

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Algaphon: Transducing Human Input to Photosynthetic Radiation Parameters in Algae Timescale

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Abstract

One of the biggest challenges of our time is for humans to really understand how does a human action propagate through another complex natural system? What is the difference between human and ecological time? Algaphon is an online and offline installation wherein algae bubbles that ring at minnaert frequency near algal filaments are rendered audible through a hydrophone. The installation comprises of aquariums in Tokyo, New York and Linz, each with different species of algae. The aquarium lighting is connected to participatory action -- Online visitors leave a voice dialog that is translated into photosynthetically active radiation (PAR) variations in a remote aquarium. The algae bubble response to this human speech is then recorded and emailed back to the visitor for them to engage in a reflective dialog with algal species.

Keywords

climate change, ecological time, biological functions, algae, seaweed, interactive art

Introduction

The progress of science in the last few decades can be primarily attributed to the crossroads of disciplines and a flattened knowledge distribution. Contrasting phrases of real and imagined, photographed and painted, perceived and estimated that would have been at contradiction to each other, now suggest a profound rapport between each and a continuous tension at play. A tension, to which we have tried to put a name for years, vaguely between art and science: intermedia and creative technologies, media art and more. At the turn of the last century, the fields of biological and cybernetic systems started tapering, ushering us into a completely new era with hybrid fields such as optogenetics, sonogenetics and more.

In the recent years, as we close the gap between technology and our own understanding of biological functions, Weiner's hybrids [1] become ever more clear where 'machine parts become replacements, integrated or supplemented' to an organism's body image. While industrial revolution largely taught us synthesis of artificial materials [2] and processing of silicon, recent advances on biology [3] are providing us with methods that will be enable properties of bionic materials [4, 8] that are yet to come. In that context, it is essential for us to understand biological functions of nature around us by piecing them into units similar to how we study our own human body.

Concept

Urban environments and manicured nature, with no sight unseen of native organism diversity [5], have led to forgotten evolutionary histories and a reduced understanding of ecosystem relations. The aquatic plant biosphere especially bears a collective amnesia [6, 9, 10] from the humans of its evolutionary roles. It wouldn't be erroneous to use 'out of sight, out of mind' in the context of the biosphere of aquatic plants. While the contributions of these early species have been tremendous [7] to shaping higher plants, they haven't received a lot of focus in their role from non-scientific communities.

Our work refocuses the attention on algae species and reflects on the role of these species in climate change in specific coastal regions, through very specific micro-capabilities. We were first inspired by algae sounds recorded underwater in the bay and river waters at the East Coast (East River / Hudson River) and West Coast (San Francisco Piers, Sausalito, Point Reyes) areas in the US. These microalgae traditionally form and release oxygen near their macroalgal filaments (Fig 1.). When this oxygen is released, the relaxation of the bubble to a spherical shape creates a sound source that 'rings' at the Minnaert frequency.



Figure 1. Bubble image right before it leaves the filament of Sea Lettuce algae. © Harpreet Sareen, Franziska Mack, Yasuaki Kakehi

These natural soundscapes across the ocean and the bays are now varying and are more erratic [8] than ever due to ocean acidification and rising temperatures. When a habitat is transformed by human endeavor in some manner, it shows in its voice over time. Our motivation was to create a system that communicates such ambient biological sounds about hidden/submerged information in our ecosystems.

We manifested this by first recording tank-based passive acoustic experiments with the algae *Salicornia gracilaria* and similar species. Our hybrid (online interaction interface + offline macroalgae aquariums) installation, Algaphon, makes such marine algae sounds evident to a wider public domain, especially as a result of their direct action, and invites the audience to critically reflect on the role of underwater aquatic life in our ecosystems.

System Design

Algaphon is a hybrid installation wherein algae bubbles that ring at minnaert frequency near algal filaments are rendered audible through a hydrophone. Our setup (Fig 2.) comprises of an aquarium (10-20 gallon capacity), programmable LED lighting (5500k, 80-100W) mounted at a distance of 10-12" from the water surface and macroalgae species in the water. Normal maintenance routine is carried out for the algae such as keeping steady water flow using wavemaker, maintaining 73-76F temperature and dosing micronutrients such as NO₃/PO₄/Fe/Mg. Standard 12h on/off lighting routine was followed during the duration of this exhibition. When the light is turned on, algae photosynthesis produces oxygen that gets dissolved in water. After 2-3 hours of light being turned on, dissolved oxygen levels reach a threshold following which algae starts producing bubbles as a result of local supersaturation of oxygen in water.



Figure 2. Bubble image right before it leaves the filament of Sea Lettuce algae. © Harpreet Sareen, Franziska Mack, Yasuaki Kakehi

We replicated this aquarium setup in three cities: New York (Two 20 gallon aquariums with *Sea Lettuce*, *Red Ogo* and *Burning Bush*), Tokyo (10 gallon aquarium with *Sea Lettuce*) and Linz (10 gallon aquarium with *Caulerpa Prolifera*). We designed an online interface where users can record an audio message, that is converted by a *stepwise thresholding method* into Photosynthetic Radiation (PAR) values and relayed to an active aquarium. We found through prior experiments that average time for our macroalgae species to fully respond to light (with frequent observable bubbling) change was 450s (~8min). Consequently, a 3sec audio waveform translates to light variation duration of ~2700 (~45min). Based on this we limited the audio input from each user to a maximum of 3 seconds to eventually manage the number of recordings/visitors. We connected each of our aquarium setups to an online web interface and rotated the active aquarium based on time zones.

Experience Walkthrough

The audience was invited online (Fig 5.) and offline (in New York and Linz) to record their audio messages during a major art festival. These visitor audio messages were then converted to light variation scenes and played over active aquarium.



Figure 3. Visitor recording an audio that is queued to an active aquarium. Live video feed of the aquariums is seen in the background, as streamed from our web platform. © Harpreet Sareen, Franziska Mack, Yasuaki Kakehi

Bubble variations occur as a result of PAR variations over an aquarium. The algae audio bubbling *response*, recorded via hydrophones, was live streamed on our website (Fig 6.) during the full duration of the exhibition. Each algae response, occurring as a result of user input, was saved locally (~45min audio/visitor input) and also sped up to a min long audio. Because of the queued nature of responses and long response duration, the visitors do not hear an immediate response. The audio response is sent in two modes, in algae time (~45min) as well as in compressed time (~1min), over email.

Your response in algae time

Photosynthesis takes time! That's why we've translated your three-second voice message to 45 minutes of light variations. Attached, you can find a recording of the bubble sounds that occurred within this timeframe.



Your compressed response

In addition to the original recording, you can listen to a compressed one-minute clip.



Figure 4. Snippet of the email response showing responses in algae time as well as a compressed response. © Sample person, Sample person, Sample

When the user receives the response (Fig 4.), the note also invites them to think of the difference between human action and ecological reaction time difference, as well as to think of time scale between humans and non-humans.

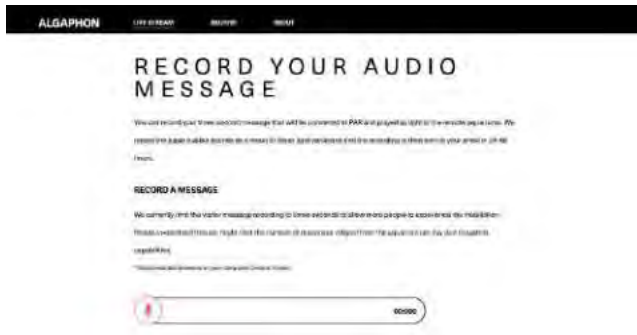


Figure 5. Screenshot showing the web interface for Algaphon. Live stream automatically switched from New York to Linz to Tokyo, based on time zone and aquarium on/off periods.



Fig 6. Screenshot showing the web interface for Algaphon. Recording interface where visitors could record their audio online.

Conclusion

Algaphon is an online and offline installation wherein algae bubbles that ring at minnaert frequency near algal filaments are rendered audible through a hydrophone. The installation comprises of aquariums in Tokyo, New York and Linz, each with different species of algae. The visitors record an audio response, that is converted into light parameters that propagates through algae to produce bubbling events. These bubbling events are on a different timescale than from the initial visitor input. These acoustic responses are recorded and sent to visitors, with the asynchronous nature of these responses highlighting the biological media. The significance of this work manifests from the algal relations with marine ecosystems, where environmental contamination often stimulates algae growth. Making such algae photosynthesis audible will in turn help us understand the extent of activities in urban/wild environments over a short and long-time spectrum.

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Corresponding Wood Tools: Speculative Fabulations of Material Correspondence in Woodworking

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Abstract

The rise of materialism questions the position of humans in relation to their surroundings. We engage craft practices as rooted in material encounters that directly affect crafters on various cognitive and physical levels. In these encounters, the crafter's body is also material which interacts on its own terms. The body's condition, and the material-at-hand act and correspond with each other. We argue that this contact is an in-the-moment material one, a shared moment of production and becoming. Based on this theory of material encountering, this paper presents the *Corresponding Wood Tools* project as "speculative fabulations" exploring the ways in which this correspondence can be made visible. It argues for re-shaping the encounter in woodworking to allow new reflections on shared themes, such as care and collaboration.

Keywords

materiality, new materialism, material correspondence, craft, speculative fabulations

Introduction

The turn to the material has not only opened up new positions and agencies for formerly "dead" objects but it also questioned the position of the human in relation to them. *Corresponding Wood Tools* follows this question in its own ways by centering on craft practices to provide speculation on our encounter with a particular material: wood. Re-shaping this encounter opens up novel perspectives on questions of collaboration and care..

Craft has always served as a cultural and sociohistorical reference. It captures practices that have shaped societies, industries, and inspires novel hybrid fabrication techniques. At the same time, craft practices are rooted in material encounters that directly affect crafters on various cognitive and physical levels. In these encounters, the crafter's body is also material which interacts on its own terms. These terms do not always map onto cultural histories or cognitive abstractions but are immediate reactions of muscles and nerves. During these encounters, the forces of the body and of the material-at-hand flow back and forth – they correspond with each other [3, 5, 6]. In this correspondence

both, interactor and material perform their own agency. Following the turn to new materialism and feminist critiques in Technology Studies, we purport that this contact between the human and the world is an in-the-moment material one first. Craft is well suited to explore these encounters as it emphasizes the co-becoming of both humans and artifacts through shared processes. As Richards argues for pottery: "Personal transformation, or the art of becoming a human being has a very special counterpart in the potter's craft [8]." Craft is always relational. Depending on the particular craft, these processes vary, but even between different craft practices a shared condition is that they are defined by a direct encounter between interactor and material that is *slowed*, *extended*, and *direct*. There is a "slow, probing touch of materials at the fingertips that eschewed instant, false security" [10] and that becomes a defining moment for craft. Slower and embodied conditions create opportunity for material-to-material encounters. In contrast, digital practices often speed processes up, optimize fabrication and minimize the encounter between maker and material, diminishing the opportunity for material correspondence. The challenge for material-based interaction design is to support this encounter instead of diminish it. The *Corresponding Wood Tools* project responds to this challenge. It provides "speculative fabulations" [5] of material correspondence between wood and humans. For Haraway, such speculations are a process of giving and receiving in order to "stay with the trouble" in the wake of the Anthropocene and Capitalocene [5]. They make kin between human and non-human.

Building on such theories of material encounters, these design projects were conducted to continue a critical reflection process and make key themes accessible. They are speculative, process-based, and critical in the realization of the material encounter. Their goal is to give voice to a thinking and making practice where *all* materials can have agency. In its attempt to "stay with the trouble" [5] by focusing on the process of encountering and bringing forth, the project aims to make material correspondence visible, or better: tangible. It rebalances risk during the making process to reimagine issues on care and collaborative material practice.

Method

The design of *Corresponding Wood Tools* grew out of reflections on wood tools on the one hand, and the challenge to include risk, care, and harm as principles of material correspondence on the other. Its design aims to open up speculative fabulations that unfold in the experience itself. Two classic wood tools are reimagined, saw and chisel, as facilitators of material correspondence in woodworking (see Figure 1). Both are connected to devices of care: a blood pressure machine and warming blanket in order to redistribute risk and harm across both human body and wood material during the encounter. The design emphasizes the co-emergence of both participants, crafter and artifact, in this encounter. It does so through notions of shared risk and care. *Corresponding Wood Tools* are not considered final objects in themselves but part of a reflective, experiential, and theorizing process.



Figure 1. *Corresponding Wood Tools* are speculative fabulations of material correspondence.

As a research through design project, *Corresponding Wood Tools* first asked how we look and experience wood from a microscopic investigation (see Figure 2) conducted in a material science lab.

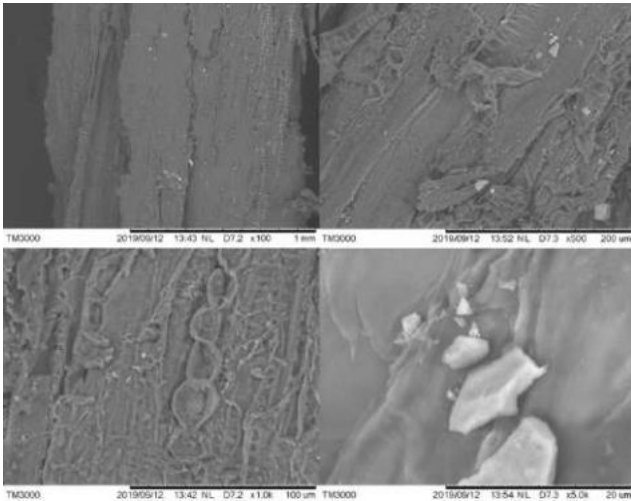


Figure 2. Material Science explorations: oak wood magnified x100, x500, x1K, x5K.

Next, it turned to wood's role in material culture, scientific and observational approaches, and material experiences [4]. This phase of the project combined research into cultural histories of wood, social experiences, technical tools (Figure 3) as well as attention to wood's material properties: grain direction, growth rings, and structure. The focus remained on the material throughout to emphasize how external frames and inherent qualities can inform our participation within the material encounter.

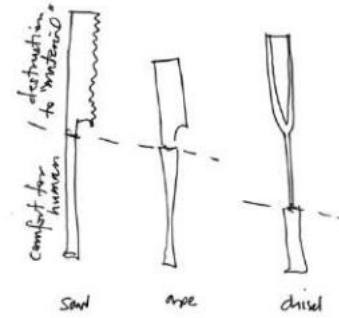


Figure 3. Sketch examination of woodworking tools.

The next phase turned to practice, asking how woodworking and its tools shape the material correspondence and the immediate material encounter. As a response to these questions, a prototype of the project was designed and implemented to support the theorizing process.

Project Design

The key questions for *Corresponding Wood Tools* were: 1) How do we make material correspondence more visible? 2) How can shared criteria such as risk and harm be distributed across *all* materials within the encounter?

To answer these questions, the project introduces a loop of actions that extend material activity flows in woodworking. The goal remains to share qualities, such as material risk across both, the human body and the wood body. Sharing risk flattens hierarchies of subject-object distinctions embedded in traditional woodworking tools. Typically, these tools feature a “safe” area for the human and an area of “harm” for the wood. Tools such as chisels or saws have parts aimed at the wood that represent harmful activities: cutting, removing, or transforming. The parts directed toward the human represent comfort and protection from material harm: ergonomic handles, covers, or insulation. *Corresponding Wood Tools*' design alters these tools as its intervention method and posits that re-balancing this distribution of risk makes aware the active correspondence between materials. At the same time, the encounter has to remain productive. Material correspondence as a process cannot fall into mere abstraction but has to remain close to woodworking practices.

The project set up includes three main components: the base, the armband, and the wood tools (see Figure 1, left). The base includes a blood pressure machine that has been altered and connected to an armband that the crafter wears. The armband and the blood pressure machine are controlled by an Arduino microcontroller that drives two output conditions, *tightening* and *warming*. Both are connected to the action of the wood tools onto the wood material. In that way, the armband connects the body material, through the woodworking tool, to the body of wood. As one acts upon the wood, the armband, in turn, acts upon the body. It makes apparent material correspondence as an inter-body experience where care and harm are different but apply to both sides on their own terms. This is realized in two conditions: the *Warming Saw* and the *Comfort-band Chisel*.

Intra-action with Saw and Chisel

The *Warming Saw* (see Figure 4, left), is a flush-cut saw with an embedded accelerometer. It relates the sawing motion that removes wood material to the arm of the crafter's body. The friction of cutting is sensed through the saw and when that rate of sawing exceeds a specified threshold, a heating pad in the armband is activated and warms the woodworker's arm. Friction onto the wood is translated into heat upon the body. When the sawing motion slows below this threshold, or stops all together, the heating pad automatically cools down again.

The second tool, the *Comfort-band Chisel* (see Figure 4, right) has an embedded proximity sensor in a chisel. This sensor detects the cutting movement of the tool as the crafter manipulates the wood. This, in turn, tightens a band around the crafter's arm during chiseling. The tightening band is realized through a modified at-home blood pressure machine, originally a tool of care for the human participant.



Figure 4. The *Warming Saw* warms the body during sawing and the *Comfort-band Chisel* tightens around the arm during chiseling.

The sensor's data triggers the blood pressure machine to inflate the cuff which presses onto the arm of the crafter. Compression onto the wood translates through the chisel into pressure upon the body. If chiseling is maintained for a full cycle, the user's heart rate and blood pressure are measured and displayed. Status updates are provided not only from the gradually changing piece of wood but also from the changing human in the form of medical data.

Corresponding Wood Tools are speculative interventions developed for awareness not pain; for shared action, not disruption. The armband tightens and warms, it does not cut or burn. In a related approach, Benford et al. make the case for uncomfortable interactions clarifying that the "ultimate goal of such interactions is not to cause long term suffering or pain, but rather to underpin positive design values" [2]. We extend this notion of uncomfortable interactions from the social cultural experiences (with which Benford et al. are concerned) to material encounters. Chisel and saw are intended to bring awareness to the material correspondence as it occurs between the body material and wood material. Physical change is instantiated and documented as inter-related and corresponding over time. Transformations take place across all materials intra-acting with each other [1] and are brought into relation by the woodworking tools and the intervention processes applied. Discomfort is a means of bringing forth shared engagement and to emphasize the encounter of agencies embedded in the woodworking process. It is "troubling existing categories of form, function, purpose, and being" [9]. Through this "troubling," *Warming Saw* and *Comfort-band Chisel* are speculations on the material encounter as it happens.

Notably, the functionality of traditional woodworking is not interrupted. Saw and chisel remain working tools and their own forces and agencies remain intact. But they also become bridges for a reflection on notions of harm and care. We see both as interrelated: heating pad and arm cuff can be soothing but also uncomfortable or harming. To allow awareness of these experience, the changes are not instantaneous but deliberately unfold over an extended period. The time it takes the heating pad to warm up, and the time it takes the blood pressure sensor to detect a full reading map onto the time it takes to saw or chisel the wood. The qualities and functions of the body (heart rate, blood pressure, warmth) are connected to the qualities and forces of the wood (grain, heat, rigidity) through practices of craft (chiseling, sawing). Digital media help to facilitate these connections into correspondences. They amplify that encounter.

Critical Reflection

The resulting material encounter is one of haptic directness and our approach diverges from human-centered interaction design models with its focus on intra-active and emergent material collaboration. The project targets neither usability – it does not optimize the practice of sawing or chiseling – nor experience – it does not sufficiently take situation or context of the interaction into account. Instead, it builds on craft-based *direct* encounters that emphasize shared forces working onto each other over *time*. The encounter we facilitate is intensely personal. It cannot be tracked, for example, by established usability studies. Not surprisingly, initial responses of users engaging with the project were immediate. Participants found the activity "actually kind of

relaxing” or they voiced concern about the practice itself and their role in it: “How fast should I saw?” “Am I in good enough shape for this?” It would be tempting to connect concerns of speed and worries about one’s own body fitness back to the themes of care and risk, but we are cautious to read interpret them as evidence. *Corresponding Wood Tools* presents a research through design approach that focusses on the immediate flows *between* the wood material and the body material. The participants’ reflections are already one step detached from this initial tangible correspondence. They already show social framing (“good enough shape”) that were not the focus here. Through its focus, the project serves as speculative fabulations toward the development of a new materialist thinking in design. This differs from related models, such as Giaccadi and Karana’s *materials experience* [4], or Wiberg’s material-centered approach to interaction design [11]. While these models treat materials as central to interaction and acknowledge them as active participants, they build on a pre-existent body (human or object) or center on an experience (social or cultural). Our focus on the material-to-material exchange avoids such hierarchical or goal-oriented relationships. It targets not the human or the wood but the relation *between* humans and other materials. It is intra-dependent and steps away from a purely human-experience-centered thinking.

The *Warming Saw* and the *Comfort-band Chisel* support materializations of such a relational understanding. CUTTING is not a form of agency that a human has over a piece of wood. Instead, it is the moment of overlapping activity of human, chisel, and wood, defining relations only. With the *Comfort-band Chisel*, the body HOLDS the wood and operates the chisel, the chisel CUTs the wood, the accelerometer on the chisel SENSES the movement, which is PROCESSED by the Arduino, that ACTIVATES the blood pressure reader, which TIGHTENS the cuff onto the body, reads the blood pressure data, and DISPLAYS it. Much like an Actor Network Theory (ANT) system [7], these relations could be broken down further, e.g. in the case of the blood pressure reader. Differing from an ANT system, we emphasize that each part only comes into being through the intra-actions and we highlight the processes that manifest this interdependence. The whole encounter constitutes the *material correspondence*: human and wood bodies interrelate within a shared time frame where each individual intra-action loop presents a moment of correspondence. The arrangement of these encounters allows us to trace, critique, and design more material-aware interactions. In that way, *Corresponding Wood Tools* challenges the nature of the material encounter, through the speculative fabulation exercises. They engage the agencies of both, the human and non-human materials participating without a single goal, such as user experience or product optimization.

With this shift, we are not suggesting to reduce interaction design to the body as thing and optimize e.g. ergonomic design only. Instead, we advocate for an approach that considers 1) the body as material, 2) in correspondence with other world materials that also perform agency; and 3) that the focus of interaction design has to be on the intra-action between the two, not “material-” or “human-centered” but taking the demands of new materialism into account by 4) emphasizing the emergent dialogue in-between. Interaction design cannot focus on optimization for the human body as this would override such a correspondence. By fundamentally engaging this material correspondence we come to better understand the co-creative, co-productive processes that support a shared becoming. Such a focus on a shared emergence calls us to move beyond the hierarchical risk distribution that prioritizes the human only.

Acknowledgements

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Deep Space: Re-signifying Vale de los Caídos

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Abstract

The “Deep Space: Re-signifying Valle de los Caídos” project addresses the re-signification of this most controversial Francoist monument. As part of our long-term investigation “Deep Space” dealing with memory politics, controversial monument and heritage in the Digital Age it focuses on creative processes and digital tools.

By unlocking the potential laying at the intersection between arts, technology, memory studies and sciences, the project has cracked open the interwoven, historically painful meanings of the monument, envisioning its possible futures.

The project started with the workshop “Deep Space: Re-signifying Valle de los Caídos” (2018, in Valle de los Caídos and Madrid) with a special focus on networked digital and physical tools that allow transforming the site without physically touching it. These tools also enable the integration of sidelined voices within the vision of a polyphonic monument, counterbalancing the site’s totalitarian narrative, paving the way from recognition to reconciliation.

As such, the project’s creative, trans-disciplinary and innovative approach paves the way towards more integrated, collective processes of memory making.

Keywords

Memory in the Digital Age, Hybrid Heritage, Controversial Monuments, Inclusive Memory-making, Augmented Reality

Deep Space: Re-signifying Valle de los Caídos

Valle de los Caídos

Valle de los Caídos (“Valley of the Fallen”) is the large-scale memorial monument in the Sierra de Guadarrama close to Madrid dedicated to the “fallen” of the Spanish conflict, conceived by the Spanish dictator Franco.

With its 152-meter-tall cross, visible from more than 30 kilometers away, and its “basilica”, a 263-meter-long crypt with a 52-meter high vault cut out of the granite mountain rock, Valle de los Caídos is one of the world’s most controversial monuments.

The structure was built between 1940 and 1959, partly deploying forced labor of Spanish republican political prisoners. Next to the remains of over 33.000 fallen from both sides of the conflict (gathered from mass graves across the country), the Basilica featured in its most prominent spot until October 2019 Franco’s grave - and, next to it, the grave of the Falangist leader Antonio Primo de Rivera.

Piercing the granite mountain, the basilica-crypt opens onto an esplanade with scenic landscape views. ‘Pilgrimage’-style paths and drives provide access to the Valle de los Caídos monument. Such pathways are embedded within a sophisticated large-scale landscape design in a territory still bearing remnants of the barracks of the prisoners of war.

Cenotaph

In Spanish society and politics, over the past few years, discourse and controversial public debate on the transformations needed at Valle de los Caídos intensified, also due to the Spanish government’s decision to exhume Franco’s remains. However, the solemn extraction of Franco’s grave leaving the memorial untouched merely creates a cenotaph, an empty burial monument for the dictator.

Most Controversial Active Monument

Therefore, we witness an urgent necessity to change the narrative of the site, especially as it is still an ‘active’ monument - every day, at 11am, the Benedictine monks taking care of the site celebrate mass - and until Franco’s exhumation in 2019 - in front of his grave and in his honor. And it is still a pilgrimage destination for today’s nostalgic Francoist far right extremists.

The monument retains its topical, prominent spot within public debates: yet, its controversies and historical wounds are far from being reconciled through collective memory processing. Especially, there has been no artistic approach to find new possibilities and paths to transform and reinterpret Valle de los Caídos.

Creative International Transdisciplinary Workshop

At the center of such a heated biased public discourse surrounding its future, Valle de los Caídos is paradigmatic of the difficult processes of re-signifying controversial monuments. As such, it proved an especially compelling case study for the long-term “Deep Space” exploration and intervention program that deals with politics of memory, controversial monuments and heritage.

In October 2018, a year before Franco’s exhumation, we organized the Madrid workshop “Deep Space: Re-signifying Valle de los Caídos” focusing on how to transform and re-signify this Francoist monument.

Interdisciplinary and international, the workshop explored the potential that lays in the integration of creative formats, methods and digital tools in processing heritage. The workshop program aimed at developing creative processes, concepts, and ideas that can break through the discussion and transform the symbolic power of the site and focused on artistic, architectural, landscape, and media proposals.

The workshop brought together Spanish and international creative professionals, such as architects, landscape architects, media designers, artists, curators, with historians, art historians, political scientists, ethnologists, forensic archeologists, heritage and cultural studies experts, psychologists and psychoanalysts.

It promoted an inspirational atmosphere where participants reflected on a typology of creative/artistic proposals. A typology of proposed tools functioned as a test environment for opening up perspectives related to the Valle de los Caídos transformation.

Outsiders' Approach

The “Deep Space: Re-signifying Valle de los Caídos” workshop derived its strength from the potential of an “outsider” approach to bring a new perspective to a contentious and intractable situation. The epistemological contribution coming from an outsider perspective can nuance controversial debates, especially if the latter are characterized by impasse and a lack of recognition of certain phenomena.

This has been the case, for instance, for France’s involvement with and commitment to the Republic of Vichy, mostly addressed by foreign scholars and researchers including Robert Soucy, Eugen Weber, Zeev Sternhell, and Robert Paxton. As an example, in his account of Vichy France, Robert Paxton illustrates how Pétain’s French government pursued its own authoritarian and racist agenda in line with Hitler’s ideology.

Cinematographic art provides the means to filter and distance oneself from events, crafting an “outsider gaze”. French filmmaker and journalist Lanzmann’s widely acclaimed, over-9-hours long documentary *Shoah* broke open the discussion on the crimes perpetrated across Poland’s Holocaust sites. Released in Paris in 1985, Poland did not receive it well, deeming it as a charge of complicity in the Nazi genocide.

Taking a more classical academic research approach, Poland’s anti-Semitism and involvement in the Holocaust is researched and reflected upon by Jan Gross, a Polish-US historian and by Polish-Canadian historian Jan Grabowski, both of whom left Poland.

On Dutch colonial history in Indonesia, Swiss-Dutch historian Remy Limpach remarkably pointed out the extent and sheer scale of Dutch war crimes, undermining the compactness of Dutch historical accounts of colonialism.

With these breakthrough historiographical precedents, the workshop acknowledged that local history is painful and difficult to process, and that a polyphony of perspectives – featuring both insiders’ and outsiders’ voices – may contribute to more holistic, better integrated accounts.

The workshop created a framework where international experiences informed the Valle de los Caídos transformation process. At the same time, the focus on such a concrete and very current case study as Valle de los Caídos provided the opportunity to develop insights bearing a broader relevance for dealing with monuments and heritage.

Towards a Polyphonic Monument

Complementary to the general public discussion mainly questioning the most appropriate location for the remains of Francisco Franco and Antonio Primo de Rivera, the “Deep Space: Re-signifying Valle de los Caídos” workshop focused on, the mostly anonymous, ‘fallen’ and on the convicted that hauled up the lumps of rock.

The existing official printed, online and on-site communication of the monument today fails to integrate this troubled history. There is no onsite information on the prisoners of war that were forced to work at the building site or on their families living in nearby barracks on the Valle’s grounds.

Furthermore, there is no mention of the fact that the remains of fallen from the Republican side of the conflict were moved to the Valle de los Caídos from mass graves spread all over the country unbeknownst to their families.

The lack of recognition of the controversies characterizing the monument and its construction is especially problematic, stemming from appreciating that for any process of healing and reconciliation a moment of thorough acknowledgment is imperative. Informing the monument with the victims’ point of view casts a totally different light on it and is therefore essential for its re-signification. Documenting and communicating the history of its making would transform Valle de los Caídos into a testimony of totalitarianism and a tangible proof of its authoritarian mark, beginning the transition from acknowledgment and recognition towards reconciliation.

An approach integrating voices from the Republican side, from the victims of the Spanish conflict meets today’s search for alternative narratives and historiographies. Such developments in memory making and collective processing echo the more general, further reaching call for more inclusive historical accounts.

Within this paradigm shift on whose narratives acquire prominence in history, such an approach strives to include voices from national liberation movements in the context of postcolonial processes and perspectives enriched by queer and gender studies.

As digital tools enable decentralized, democratized processing in the form of co-created, bottom-up initiatives, we are witnessing an explosion of interest on memory and its multifaceted dimensions. The power relations intrinsic to the writing of collective memory are becoming looser and blurred, because the pervasive and accelerating digital turn of memory making is allowing for a multiplicity of voices to be heard and become alternative narratives.

As a consequence, this trend implies that memory making is morphing into a hybrid practice whose future is interwoven with physical and digital features and whose agents are becoming increasingly diversified.

Workshop' Outcomes

The reliance on artistic practices and applied disciplines transgressing the arts field, such as architecture and media, to approach controversial heritage investigates how these disciplines and their interaction may contribute to the re-construction of memory, exploring the potential of integrating diverse methods to process historical wounds.

The 2018 workshop started to crack open future visions for the monument, drawing on the co-creation of digital and analog memory-making practices, with the three working groups proposing new meanings and envisioning creative processes which have the potential to cross-fade the controversy.

One group focused on the mapping of the monument in its surrounding landscape, developing proposals for paths and viewpoints, creating new perspectives, aiming at making people aware, as they move through the Valley of the Fallen, of its painful history. The second group stretched their design thinking into 50 years from now, in 2068, and envisioned a future for the monument including the possibility of it becoming a Research Center, a venue hosting an Art and Engagement Program, and a Global Centre for Peace and Interpretation.

A third group dealt with the idea of creating a ‘Digital Archive’ which would allow to gather, access and store bottom-up collaborative and interdisciplinary contributions on the monument’s morbid history. This would foster dialogue, counterbalancing the site’s totalitarian narrative with the networked polyphony of democratic voices, accompanying the decline of the monument – the pixels deconstructing and corroding the stone.

Hybrid Tools

Drawing on the acknowledgment that digital tools open up and transform memory making, the workshop focused on their capability to inform the monument and to process its transformation without physical intervention.

The “Deep Space” program in general explores this potential of state-of-the-art digital technologies, aiming at developing creative digital tools for re-signifying controversial monuments, for dealing with historical heritage and politics of memory.

Digital technologies include Augmented Reality/AR (the physical reality being "augmented" by computer-generated perceptual information) or Virtual Reality/VR (an interactive computer-generated experience taking place within a simulated environment), Mixed or Hybrid Reality/ XR (the merging of real and virtual worlds to produce new environments and visualizations where physical and digital objects co-exist and interact) and Augmented Virtuality/AV (an interactive experience of a real-world environment where the objects that reside in the real-world are "augmented" by computer-generated perceptual information).

Such hybrid, combined physical and digital, technology tools offer the possibility to process the transformation of a monument without material interference. For example, with the aid of Virtual Reality and Augmented Reality, the digital boundaries of the Valle de los Caídos could stretch to include the archeological traces of the barracks where convicted had to live whilst building the monument.

Other tools include databases of interconnected archives for scholars and the public, information collection and storage solutions for crucial witness in the form of oral history, as well as interactive educational platforms. Such technologies support an on- and off-line public discourse surrounding the memorial itself, enabling the communicating and processing of proposals for the long-term physical transformation of the site.

AR @ Valle de los Caídos

The next step in the project is the development of an Augmented Reality app for contextualizing and supporting the resignification of the controversial Francoist monument. An AR application, with which visitors can onsite explore the hidden layers of the monument’s complex, controversial history, would make visible what Franco tried to hide at the site.

The onsite presentation of its history with the help of an AR application would make Valle de los Caídos a tangible testimony of Francoism, breaking its totalitarian narrative, transforming it into a polyphonic memorial, supporting its long-term transformation processes.

Large-scale Controversial Memory Sites

Such an AR application would be of great relevance for the resignification process of Valle de los Caídos. It can also inform the processing of other contested monuments and sites internationally and thus be very relevant to the ongoing discourse on inclusive (memory) spaces and to the urgent social need for inclusive heritage and memory-making

‘Augmenting’ physical memory sites into more polyphonic spaces is an important and urgent challenge. The project is a case-study for the reinterpretation and transformation of historically loaded and controversial physical monuments and sites with the help of digital tools.

As we are currently witnessing a surge of iconoclastic actions against monuments glorifying controversial, exploitative, and unresolved history worldwide, it is urgent to develop inclusive tools and methods to reckon with testimonies of controversial past and its unresolved historical wounds.

The project pioneers the development of new methods and digital tools for re-signifying and transforming controversial physical monuments and sites. Such digital tools are especially relevant for the re-signification of large-scale physical sites of memory – in the scale of a landscape (f.e. Valle de los Caídos) and in the urban scale. The project opens therefore paths for the inclusive re-reading of larger territories (for example, under a post-colonial perspective).

Future Heritage

The focus on such digital creative tools allows us to envision ever-expanding domains for cultural heritage and memory-making in both time and space, potentially eliminating boundaries to engagement and visualization. This allows for radical re-signification of physical monuments via digital, networked archives. The workshop kick-started the “Deep Space” exploration, focusing on how future heritage sites could look, feel, sound like, and how their digitally enriched features could affect memory-making processes.

The Weird, the Cute and the Dark: How to Account for Aesthetics When Working on Awareness about Design Patterns

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Abstract

This paper presents the design and set up of the robotic media arts installation 'Accept All'. We discuss how this art piece bears legacy of previous work in both media arts as the academic field of Human-Computer-Interaction (HCI), and touches upon contemporary topics of political awareness, trust and data representation. Accept All covers five different aesthetic design choices for robot design, each contributing to the topic in its own way. The last part of the paper proposes to explore the paradoxical stance that media artists have to adopt when dealing with issues such as dark patterns.

robots, cuteness, weirdness, vernacular, biomimetics, public awareness, media arts aesthetics, interest-triggering, audience

Introduction

In the aftermath of highly publicised scandals such as the Snowden Leaks, Cambridge Analytica and Clearview, public scrutiny has focused more and more on surveillance technology and the right to privacy [16, 2, 22]. Media artists have accompanied this shift by using their practices to "open the black box", "revealing the hidden infrastructure", or "deconstructing the framework" of these technologies. The media art pieces produced often took the forms of back-bone electronics, visible electrical cables and screens, removing all casing to amplify their statement while being visibly different from corporate productions (e.g. the transparency grenade by Julian Oliver [6]).

We are interested in assessing how other aesthetic features, such as those used in interaction design in the commercial realm, may be deployed in a media arts context. For example, interaction designers and "growth hackers" are equipped with "dark patterns" [15], i.e. design patterns and strategies from behavioral psychology that are deployed in ways to deliberately deceive the user. These patterns are largely invisible, and therefore difficult to expose as their effect is psychological. It is a challenge to assess what kind of aesthetics is the most susceptible to appeal to a large audience when trying to raise awareness about them.

In this paper, we explore different aesthetic features to question the design of dark patterns through the design and development of Accept All, i.e. a performance that merges robots, public awareness building, dark patterns and privacy concerns. In the following text, we propose a complete description of the performance, its inspiration and the political

challenge it alludes to. After this description, we offer a brief reflection on the relationship with the audience in both the art and digital sector, acknowledging the similarities between the two and asking whether it is responsible to use the tools whose effect one is trying to mitigate.

State of the art

The installation Accept All builds on the works of artists and scholars on the themes of sentience, HRI (Human-Robots interactions), and its political consequences.

The relationship between humans and robots and exploration of the sentience of objects have a long history in the media and digital arts. The installation presented here can be seen as the descendent of the tortoise by William Grey Walter. This tiny robot, created in the forties, exhibited autonomous behaviour thanks to its light sensor. The tortoise is used by Jussi Parikka as an example of non-anthropocentric design [17, 7], meaning that animal, non-human behaviour and features inspired it. Today, firms such as Boston dynamics still refer to this inspiration from animals. Recently, the conjugation of cheaper technology and a vibrant open-source community made these subjects even more present.

Many artists have also explored the link between robots and visual recognition, for instance, Golan Levin in his installation snoot [11] or Ken Rivaldo and its paparazzi bots [19]. Today, the more political side of surveillance has been the playground of practitioners such as Dries DePoorter, with his installation Jaywalking [13], or Kyle McDonald with the artwork exhausting a crowd [10]. Scholars have also described and analysed the relationship between cuteness, animals and robots [5, 4, 1, 9] and the human bias to take care of things that present certain aesthetic features. Works on the efficiency of materialising concerns and data in public space to raise awareness have also taken the form of research projects such as the chemical in the creek project [18], electronic urban wildlife [14] or Yellow Dust [3]. The aim of this project was to merge those strands of inspiration to create an interactive installation, staging weird robots in order to raise awareness on a specific issue.

Political Context

In 2016, in an effort to rein in digital surveillance and micro-targeting and with a view to protect its citizens privacy, the European Union implemented the GDPR, a new regulation

for data protection. This new regulation forced websites to get consent from their audience before recording their activity and sharing it with third parties. 5 years after its implementation, this regulation has resulted in inescapable, hard to use pop-up that welcome you on most websites, degrading the “surfing experience”. Through dark patterns, several websites advertisers are trying to get a quick consent of their audience [15]. One of the most visible ways to do it is to offer a big, easy to click, prominent “accept all” button. This option carries the promise of not having to deal with customisation or spend time looking for the reject all button, it is also synonymous with the lassitude and mental drain these micro-targeting processes impose on us.

The artwork presented hereafter is a ludic reflection on how these tracking devices that are present online might manifest themselves in the material realm in the future. During the pandemic, we saw new use of robots in public space, mainly drone and legged or wheeled robots ensuring that social distance is maintained, reminding people of the curfew, sometimes disinfecting via UV[20].

We can imagine that, just like screens invaded the public space in the past decades, robots might do that in the next ones. What if they are used by advertisers, will we see the same type of micro-targeting? To make people think about these issues, we wanted to draw them into an interaction with robots in the exhibition space.

Vernacular Robotic Design.

Aesthetics Accept All is a performance in which 5 Robots, with different physical features, roam freely inside the exhibition space. As they encounter an audience member, they follow them and play their sounds. Each of the 5 robots have a different score that mirrors its appearance.

One of the objectives of the performance was to propose alternative visions of robot aesthetics: more evocative and vernacular ones, and use those to bait people into our experience. The performance was held at Le Pavillon, a center for digital arts based in Namur, Belgium, during the finissage of their exhibition “Humans Machines”.¹ The exhibition venue and time favored a more familial and local crowd than normal new media/digital art venues. The fact that the exhibition took place during COVID even accentuated the local focus, as few people could fly or drive in from other countries. From the beginning on, one of the desires of the Pavillon Team was to have artwork that could be accessible to a large range of people. From our side, we wanted to use this opportunity to present robot designs that were different from the traditional electronic consumer product while not adapting a too-raw or cutting edge presentation that could scare people away. We wanted our robots to have specific identities, yet be accessible.

We draw inspiration from the animal kingdom, especially in terms of features (eyes, horns, fur, antenna, skeleton). We also joined forces with local designers so they could propose their own visions, appealing to audiences outside academia/

¹“The exhibition questions the implications of the development of artificial intelligence technologies and their limitations in the imitation of natural processes, human behaviours, and creativity.”

new media arts. In total, 2 teams of 2 designers were invited to create a “shell” for the robots. After being briefed on the general intention of the performance (technology, yet inspired by biology), its context and its aims, they first offered drawings and rendering of different possible paths. These paths were discussed with the other members of the projects and led to improvement, after which we met for a full day of work together during which the shells were completed.

In terms of sounds, we first tried to implement AI-generated voices through the speakers on the robots but quickly realised that those were difficult to hear and decipher and would make the performance harder to understand. We thus resorted to using sounds from a video game library, adding a different sound color to each robot and showing a much more vibrant palette: going from camel sound to metallic percussion, an array of organic and artificial sounds. In total five robots have been created:

“Iridescent beetle”: with long steel antennas and a body made of iridescent plexiglass (figure 2)

“Fun Dog”: characterised by 3D printed head, horns and vertebra, aluminium bones and a small plexiglass dome as an eye (figure 3)

“Death star” created with an aluminium dome and laser-cut fringes (figure 4)

“fringe cathedral”: made of textile fringes, a disk cut via CNC and brass rods (figure 5)

“Tervuren wood”: made of natural fibres and a disk cut via CNC and brass rods. (figure 6)

The robots were conceived so as to make all the electronic components accessible for debugging and to be easily built. They used off-the-shelf components and accessible manufacturing processes that one usually finds in a Fablab (CNC, laser cutting and 3D printing).. From our observations, these designs seemed to “work”: they triggered interest and surprise and drew people into the interaction. People went as far as naming them, for instance, people referred to the robots as a bull, an hawaiian R2D2, a star wars robot, an african mask or a justice palace (from the similarity with an old building in Brussels). These designs, on top of being vernacular robotic design, had a real evocative power (figure 1).

Technology Each of the robots is autonomous and its computing capabilities are run locally. Equipped with a coral board running SSD Mobilenet V2 Object detection model, trained on COCO 2017 dataset [12]. The robots see through a small camera and the image is analysed by the board, allowing them to detect humans. Via a python script using openCV, a serial message is sent to an arduino board that controls four DC motors, activating the wheel of the robots, allowing them to move and keep a certain distance from the audience. Sounds are played through an embedded speaker when the robot detects that an audience member is close enough.

Interactions The interactions with the robots ranged from ignoring it to playing with it. People usually went through different actions to try and make sense of their behaviour. We often observed that people put their feet in front of it to see if it would budge; some of them waved at it (see Figure 7).

Young kids had more reactions to it and presented a mix of fear, interest and excitement. They often crouched to be “face



Figure 1: Three of the robots ©Guillaume Slizewicz.



Figure 2: Iridescent Beetle, ©Murielle Lecocq.

to face” with the robot (as shown in Figure 8) and led them somewhere via their movements. Adults seemed to be more self-conscious, apparently torn between their curiosity about how it worked and their desire to adopt the “right” attitude. For instance, some placed a piece of paper in front of the camera to see how it would react.

Other adults deliberately ignored the robots, despite its sounds screamed at them. This last occurrence might represent how we will/would filter out this type of interaction in the future. As we developed a good “noise filter” for visual advertisement on the internet, we might do the same for robotic ones in public space. Some people acted on the intuition that the robots would have the same senses as animals, calling them by made-up names such as “cookies” despite the absence of sound sensors on the robot. They were probably reverting to knowledge on how to act with puppies, cats and dogs, the other sentient beings we are the closest to.

People also use technology as mediation with the robots, taking pictures of them and posting them on social media. The social posts gave a small window of understanding how they saw them; some of the captions read “They have more charisma than you. Period”, “ His name is Georges, Georges, the baby dragon.” All these made clear that we managed to trigger interest and even connection between our machines and the audience. However, the cute or weird aspect of them might have played in our disfavour when it came to underlining the concern at hand, namely the extension of the surveillance apparatus in public space.

The role of Aesthetics when revealing inner workings in everyday environments

Raw or technology-revealing aesthetics is often deployed as a design pattern in media arts, which is most often experienced in a controlled environment such as a gallery, art festival or exhibition. Yet as our everyday environment, for example our home, office space or streets, is also increasingly augmented

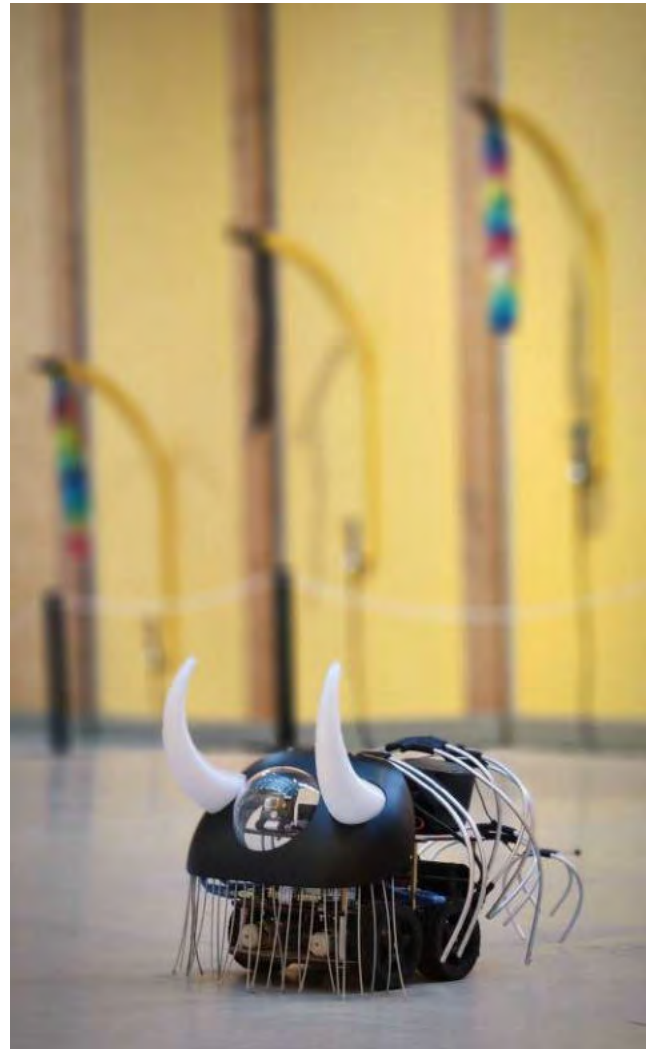


Figure 3: Fun-Dog ©Guillaume Slizewicz.

with invisible sensors that track our every movement, there is a large potential to reveal tracking technology and other sensing machines in situ, to the audience at large. In this paper, we explored different aesthetic aspects, and how they triggered responses from the audience at large. Here, we discovered that the deliberate link to animal form aspects, whether they were cute or weird, triggered attention and caused viewers to reflect on its meaning (placing them in the new character/unfamiliar animal of T. Shibata’s classification [21]). In fact, the designs that were most recognizable as animals, seemed most effective in revealing the working of invisible traces and the dark patterns behind them. We expect this was due to its more apparent presence.

Activists and artists raising awareness on a specific topic are occupied with the challenge of triggering the largest number of people’s interest and making them care about a cause. In this way, they are similar to marketers and advertisers, who are, according to the formula, “competing for eyeballs”. Some of the techniques of the activist, artists and the mar-



Figure 4: Death Star ©Guillaume Slizewicz.

keters/advertisers are indeed the same: staying on the thin fine line between the already-seen and the too foreign.

The performance *Accept All* was designed as a bridge between media arts and these practices. As with most art dealing with those subjects, it must strike a balance between using fair and accepted interest-triggering tricks and underlining how these are used sometimes for other purposes. As described above, it tried to implement this with two main components: the first is to work on the weird as a feature triggering curiosity (as a follow-up on the concept of interest-triggering devices [8]), and the second is by using cuteness as a dark pattern to lure people in. We believe our use of these techniques is legitimate and naive, but would like to propose to deepen the reflection on what the desirable boundaries are for those implementations in the media art scene.

Conclusion

Through the analysis of the performance *accept-all*, its inspirations, its theme, and its creation process, we propose here an alternative way of creating autonomous robots to raise awareness on surveillance and dark patterns in public space. In a second part, we highlight our reliance on such patterns for awareness creation, hence acknowledging the paradoxical stance inherent to artists working on those topics.

Acknowledgments

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Figure 5: Fringe Cathedral ©Guillaume Slizewicz.

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Figure 6: Tervuren Wood, ©Guillaume Slizewicz.



Figure 7: Child waving at the robot ©Caroline Lessire.

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Figure 8: Child crouching in front of one of the robots.
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Cultivating Human Potential in Virtual Art Studios

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Abstract

How can art educators fulfill human potential in the process of teaching and learning in online art studios? How can they transmit their passion and enthusiasm for art making in virtual environments teaching and learning to cultivate human potential in the virtual classroom? This paper investigates the ability of remote art learning to unlock human capabilities. Based on the definitions of human potential, we specifically examine three aspects of learning behaviors and environments within this study. First, we focus on students' self-discovery, self-directed learning, and self-efficacy. Second, we investigate the concepts of connection and communication, which are integrated into the virtual classroom. Lastly, we explore the unique characteristics of the educational environment for virtual teaching and learning.

Keywords

Virtual art education, studio art, human potential

Introduction

How can art educators fulfill human potential in the process of teaching and learning in online art studios? How can they transmit their passion and enthusiasm for art making in virtual environments teaching and learning to cultivate human potential in the virtual classroom? This paper investigates the ability of remote art learning to unlock human capabilities.

According to Gardner (2020), human potential that can be unlocked in the classroom refers to a variety of human cognitive capabilities students have to learn lesson content, find motivations to improve their academic performance, and eventually grow to become empowered citizens. The critical components of human potential are "intellectual, creative, communication based, value-based, and activity" (Leonidova, 2019, p. 174). It is also important to connect human potential to developing cognitive capabilities within diverse social interactions. Considering these social interactions, the "capability approach" (Sen Amartya, 2005, as

cited in Rogach et al., 2018, p. 805) can promote the empowerment of citizens with regard to the digital citizenship of students.

Based on these definitions of human potential, we specifically examine three aspects of learning behaviors and environments within this study. First, we focus on students' self-discovery, self-directed learning, and self-efficacy. Second, we investigate the concepts of connection and communication, which are integrated into the virtual classroom. Lastly, we explore the unique characteristics of the educational environment for virtual teaching and learning.

Discovering Students' Selves in Art-Based Learning

In online environments, individuals may discover opportunities to recognize their inner selves. A student's self-directed learning plays a critical role in distance education whereby students can become more deeply aware of themselves by focusing on their own needs and learning process (Arghode et al., 2017). Effective virtual teaching can help students make connections between their personal experiences and perspectives and their grasp of academic content supports. Self-efficacy refers to an individual's belief that they have the competence to complete the work assigned (Bandura, 2010). Self-efficacy provides as intrinsic motivation for learning, so students who have higher self-efficacy generally manage complex tasks more successfully. In online art education, each individual student's self-expression and self-efficacy are supported through e-learning activities, such as selecting, viewing, reading, and posting text and images.

Technology Use and Classroom Interactions

Turkle (2011) examined technology-based interactions among people and noticed that human relationships are changed as "technology offers us substitutes for connecting

with each other face-to-face” (p. 11). She stressed the difference between connection and communication in today’s wired world and suggested that many people stay connected to each other all the time, but they hardly communicate. As a result, “cyberintimacies slide into cybersolitudes” (p. 16). Reconsidering the meaning and role of human breath in virtual spaces, Turkle emphasized the importance of conversations and insisted that we must strengthen our person-to-person dialogues. Numerous researchers have examined Turkle’s arguments in relation to teaching students in virtual environments. Some, like Emanuel and Challons-Lipton (2013), support Turkle’s ideas, insisting that educators seeking to explore the transformative capacity of digital teaching practices need to reexamine the concept of connection. Other scholars (Breen, 2018) believe that today’s students are a different generation who started using technologies at a very young age and are already strongly engaged with virtual modes of communication and digital environments.

Moving Across the Physical and the Virtual

Today, students approach living, learning, and communicating in ways that differ from those of previous generations. These differences are particularly noticeable regarding their understanding of the boundary between the real and the virtual, presenting new challenge to online art educators. Considering the challenges, Chambers and Sandford (2019)

noted that “increasingly complex social landscapes play a central role in young people’s negotiation and performance of identity, and that transitions within, between and across social spaces represent a challenge for educators that has perhaps not fully been appreciated” (p. 926). Identity formation and the experience of spaces are closely related to each other. When young people embrace multidimensional, spatialized, and shifting identities and navigate transitional spaces, the boundaries between real space and virtual space are blurred (Chambers & Sandford, 2019). The division between an offline physical self and an online virtual self expands to embrace new realities and practices. This is one reason why digital space has great potential as an art pedagogical space because it works in tandem with the various processes and constraints.

Conclusion

Students can reflect on their identities and connect themselves to learning while creating art pieces in the virtual classroom. To encourage students to express their identities, art educators orchestrate interactions among participants that include sharing, interpreting, and critiquing. Furthermore, creative projects that invite students to critically examine their cultural environments enhance their self-awareness and self-reflection. Asynchronous activities in online courses can offer students the opportunity to refine their self-efficacy by giving them flexibility to choose their own learning pattern.

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The Voice of the Machine Audience

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Abstract

Smart devices in the home, like Amazon's Alexa, and Apple's Siri, form a non-human but increasingly present *audience* in our daily life and activities. This hidden audience expresses a certain voice, in the agential sense, by cultivating and shaping how we address it. This is an acousmatic voice in Michel Chion's sense of it, and is worth thinking about as a rhetorical form, with such media devices shaping and coaxing our behavior, blurring the line between speaker and audience, human and non-human, agent and machine.

Keywords

Sound Studies; Digital Personal Assistants; Surveillance; Voice; Persuasion; *acousmètre*

Introduction

In his book *The Voice in Cinema* Michel Chion describes something he calls the *acousmètre*, the voice of an invisible speaker. [1] Chion, building on the work of experimental composer and theorist Pierre Schaffer, is interested in what Schaffer called "acousmatics," that is, the event of being audience to a sound whose source is not visible. Schaffer reactivates the archaic term *acousmatics* in an effort to describe a different kind of listening than normally is understood by it, while Chion extends it to the relationship between sound and image in 20th century media culture and practices, a world often described by the ocularcentric phrase "visual culture." For Chion, the *acousmètre* is one tool by which we can examine the dependence of "visuality" on the circulation of and constitutive power of sound, on the circulation of and constitutive power of voice.

Unlike in previous decades, the acousmatic scene we find ourselves in now has a widespread machinic audience, from voice to text technologies, voice command remote controls and televisions, to increasingly common AI "assistants" such as Apple's Siri and Amazon's Alexa. These last few, of course, return the acousmatic favor and themselves produce voice-like sounds that have no specific visible source (I mean, of course, besides the device emitting the sounds, which is often designed to disappear into the background anyway). Chion theorizes the *acousmètre* in relation to Fritz Lang's Dr. Mabuse films, which, in a couple ways, is the perfect metaphor for the present situation. The anti-hero of these films, Dr. Mabuse, composed around himself a network of machine audiences, such as surveillance devices, and a network of spies, all of which extended his perceptual capacities well beyond his own ability to see what he needed to see and *hear* what voices he needed to

hear. That is, the unseen voice that the term *acousmètre* is meant to describe, has another kind of "voice," that is an ability, an agency that is also shared by an unseen listener—in this case, our machine audience represented by voice activated "smart" devices.

I am suggesting that the machine audience we have now, Alexa, Siri, voice-activated devices, is itself the *acousmètre*, in a double sense. First, and more obviously, many of these imitate speech, and pretend to *be* by *being* only in that voice. This aspect, while often uncanny, is less interesting to me here than the other. That of influence, *persuasion*. When we say, colloquially, that someone or some group of someones needs to be able to make claims that are heard and acted upon we often say, of course, that they need "voice." It is this side of the machine audience's voice that I will be after here, performing a necessary and intentional equivocation on the word *voice*. That is, their voice is ambiguous, or more precisely, double and doubled.

Mabuse, Digital Personal Assistant

It's not for nothing that Chion in introducing the *acousmètre* in *Voice in Cinema* he uses Dr. Mabuse as his primary cinematic example. Mabuse, protagonist of Fritz Lang's early masterpieces *Dr. Mabuse, Gambler*, and *The Testament of Dr. Mabuse*, is, of course, cinema's first criminal mastermind, with almost supernatural powers of observation, and a network of spies and surveillance devices throughout the world as well as a reputation for the power of mind-control. Much of Mabuse's terrifying reputation comes from two distinguishing characteristics: first, his disembodied voice giving orders to those in his network, most of whom have no idea who (or where) he really is. This is what Chion has in mind in calling Mabuse the *acousmètre*. Another source of his power, though, and linked to this first, is his ability to listen in on a host of conversations which he is not visibly present to, and to make changes in the world based on the knowledge acquired in that (unknown, unseen) listening. Similarly, the potential for our machine audiences, our Alexas, our Samsung TVs, to cause alterations in the way their interlocutors do ordinary, daily, unthinking tasks is itself a subtle voice this audience has, and Mabuse-like, shapes the world around itself and its needs. This voice is indeed material and irreducible to its signification, as Chion and Mladen Dolar both note with the natural voice, the organ of human speech, since the voice of these machine agents is constituted by circuitry, microphones, code, interface, and storage. So, when Chion argues that it is too often

that we forget the voice as medium, it is also important to attend to the voice of the medium, its expressive and rhetorical mode of shaping all those around it. Such a shift in emphasis, which I am merely aiming at provoking today (instead of fully exploring), helps shift our theorization of voice away from the speaking subject, and toward a wider sort of relations, in an effort to include the (machinic) audience in what voice is.

Always Listening

For example, about two years ago, news began circulating that “Smart TVs,” that is, televisions with sophisticated voice command capabilities, were always *listening*, and, perhaps more alarmingly, *storing* and *transmitting* what they “hear.”

Samsung warns, in their most recent SmartTV Privacy Policy:

If you enable Voice Recognition, you can interact with your Smart TV using your voice. To provide you the Voice Recognition feature, some interactive voice commands may be transmitted (along with information about your device, including device identifiers) to a third-party service provider (currently, Nuance Communications, Inc.) that converts your interactive voice commands to text and to the extent necessary to provide the Voice Recognition features to you. In addition, Samsung may collect and your device may capture voice commands and associated texts so that we can provide you with Voice Recognition features and evaluate and improve the features.

Such practices have raised more than a few eyebrows, since the question of one’s private conversations at home being stored, transcribed, and transmitted to a variety of entities is chilling enough. Samsung, for their part, have changed their SmartTV listening practices, so that all of the listening and storage I just read only occurs if you hold down the voice command button on a remote and then speak. Meanwhile, privacy advocates aren’t comforted much more by the practices Amazon employs with its “digital personal assistant” Alexa, since it is constantly listening, though, like Apple’s Siri only transmits what it hears when the specific activating command is spoken. If you were to say “Alexa” in the room, your Amazon Echo would be activated and listening for the next command, which it would then send to Amazon’s servers for processing. Perhaps you want to know the weather in Salt Lake City this weekend; Perhaps you want to hear a particular song, maybe *Despacito* yet again. The gamble Amazon and other makers of voice activated “smart” devices is that you’ll eventually weave that possibility into your daily routine, retooling your habits to include, and sometimes around, the invisible presence of Alexa, Siri, your Samsung TV, your Cortana.

Indeed, a rather breathless pair of articles in *The Economist* in 2017 point to a future in which the graphical

notions of user interface that we are familiar with in our daily interactions with electronic devices begins to give way to vocalized interactions with an invisible, but ever-listening audience. Such devices would have, and currently in many cases *do have*, a tacit voice, instead of an unseen vocalization, expressing itself, an unseen listening, *expressing itself*.

That first unseen speaker, the nefarious Dr. Mabuse, predating Bond villains but also the institutional apparatus of national spy agencies, knows that *hearing* and *seeing* are at least as important, in certain circumstances, as being heard and seen. One late entry in the Mabuse canon of films is *the Thousand Eyes of Dr. Mabuse*, which takes place, largely, in a hotel where Mabuse has installed sophisticated surveillance systems, not entirely unlike the wired “Smart Homes” we are building for ourselves with Alexa and her ilk.

In this mute voice, the *acousmètre* turned on its head, voice is not simply *in* the speaker who is then *simply* heard by the machine audience, but rather is stretched out between them, distributed, perhaps unevenly, but nevertheless to each. In its capacity to always be listening and shaping itself around the voice of its master, and *at the same time* shaping that voice, subtly no doubt, the machine audience at the very least is a participant in the constitution of the “voice” in question, and may indeed have a *voice* of its own at stake here.

Conclusion

The point I have been making is that there is a certain power, a sort of world-making agency, inverting the *acousmètre*, in such unseen listening, just as Chion noted it within the unseen speaker. It is in that sense that this sort of *listening* is *expressive*. It is in this sense that the machine audience with which we deal now is Chion’s *acousmètre*, instead of in its capacity to speak without being visible. It has and expresses voice in its ever-present *listening*, just as Mabuse did.

And yet... the paranoid vision I have been pushing here is only part of the story, since the different access enabled by voice recognition technology cannot be shunted to the side in some ableist forgetting. To take one quick example, a software company calling itself Nuance offers a proprietary and robust voice-recognition and voice-to-text software suite, specifically marketed as “accessibility” software, pitching both toward an audience with a manifest need for such solutions as well as those who want to “give their wrists a rest,” and “end the pain of typing.” Keeping in mind those for whom typing is genuinely painful, or those for whom it is, for whatever reason, not an option, or for whom a variety of daily tasks dependent on tactile mobility and/or on vision are out of reach or difficult, the shared voice expressed between the user and the voice-activated device, should not be devalued even when we at the same time ought to keep in mind the more dystopian possibilities they enable.

For my purposes here, it is more important than litigating whether these things are, on balance, good or bad, to

raise the question of such mute devices *in their unseen mute listening* shaping and enabling daily habits and activities, participating in the making of one's world, and thus, expressing, unseen, a kind of voice, a kind of agency, a kind of Mabuse-like control.

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Mapping the atmospheric in school buildings: Digital art-based participatory inquiry with youth

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Abstract

Creative experiments with wearable technologies and speculative engagements with digital sensory data foreground the need of reinventing learning environments to reclaim sensory and somesthetic relationality, while interrogating the passive collection of sensory data by sensors ubiquitously embedded in everyday spaces and learning processes. This paper discusses an arts-based project of mapping the sensory-affective dimensions of school environments in collaboration with a group of participating-students (16-18 year-olds). The mixed media maps offer dynamic digital representations of staff and students' experiences of the school buildings, shedding light on problematic spaces in the built environment. The paper discusses processes in which digital-sensory devices allowed young people to further their attunement towards previously unconsidered aspects of school atmospheres, while exploring the pliability of their sensory capacity in reconfiguring and reimaging those environments.

Keywords

Atmospheres, wearable media, sensation, affect, school architectures, learning environments, participatory art-based inquiry, mapping, diagramming, speculative data.

Introduction

As a term 'atmosphere' originates in meteorology to name the earth's aerial envelope, but also refers "to the emotional tone of a space or spatial constellation" [1] In architecture, atmosphere pertains to the seemingly immaterial dimension of sensation and affect and contributes to the relational quality of a building or environment. Through the arrangement of specific choices of material, light, sound, objects, odors, a space can feel expansive or tight, intimate or distant, exposed or concealed, vibrant or eerie [2] The affective qualities of atmospheres are not necessarily given in advance, but have to be expressed through spatio-temporal events, in which diverse and multiple forces conjoin or enmesh, to disclose what 'appears' as elemental, but is better conceived as generative, in the space-time atmosphere [3,4]. Therefore, atmospheric sensing requires immersion in space-time events along with the cultivation of skillful embodiment and techniques of capture that can amplify and intensify sensory practice [5]. Atmospheric envelopment is a focus for many artists working with eco-sensory and relational environments. From a design perspective, these environments need to be created technically "to modify and mediate the exposure of bodies to an outside" [6] At the same time, the atmosphere is felt aesthetically "exposing bodies to elemental forces that, ... are characterized by a degree of allure and enchantment" [7]. Developing practices of attunement to atmospheres has both political and pedagogical relevance, because it cultivates capacities to become involved, withdraw from, puncture or modify the exposure to particular atmospheres whose infrastructural arrangements can exclude and control, or open up new modes of belonging, movement and thought [8, 9, 10].

In this paper, we focus on the affective atmospheres of school buildings. This interest emerges in the context of a project funded by the UK Economic and Social Research Council, exploring young people's relationship to architecture and the built environment. We discuss a series of workshops designed to map the sensory/affective dimension of school buildings. Student participants worked with the authors to engage the building as a site for experimental rendering, mapping diverse sensory/affective atmospheric layers, and folding these together into digital dynamic diagrams taking the shape of maps, graphic animations, films and 360 photo-narratives. Each workshop facilitated a series of collective art-based experiments around concepts like location, perspective, flow, time, memory, hapticity with the student participants and involved the use of wearable media-spaces [11]. The media included video, sensors (sound, air and dermal temperature), spatial and object scanners, 360° images, and mapping apps, which were used not as representational tools but as ways of creating passages between spatial and temporal modes of becoming (history, memory, matter), The collective exercises of disclosing these atmospheres revealed unknown aspects of young people's affective experiences in school buildings. It extended sensing possibilities [12], while offered creative opportunities to make something of these atmospheres palpable.

Researching Affective Atmospheres in School Buildings

School architecture plans and blueprints visualize the occupant experience but cannot anticipate how the environments come to matter in the lives of staff and students [13, 14 15, 16]. In particular, there is a need for research that generates rich alternative visualizations of the spatial practices and sensory conditions that shape school life, and to better understand these complex learning ecologies [17,18,19]. Sensory engagement with school buildings is an under-examined factor in connection with learning, achievement and students' social life. Additionally, sensory engagement is something that has been significantly altered in post-pandemic conditions [20, 21 22]. OECD survey data on the built environment and effective learning environments (LEEP) indicates a need for more case studies and better research methods. This is additionally important, in the wake of Covid-19 and social distancing measures, as relationships to school buildings are increasingly mediated through digital platforms and embedded bio-tracking technology that become part of everyday spaces and processes.

Sensory data in school buildings is ubiquitous and often collected passively with no opportunity for young people to modify, punctuate, intervene in or creatively subvert data creation. We suggest that sensor technologies could be creatively explored "to invent learning environments that reclaim affective and somatic relationality" [23]. New modes of collective and participatory inquiry are needed that attend to the sensory-

affective learning environment, making tangible the ways in which student and staff experience school corridors, bathrooms, cafeterias, laboratories, auditoriums, etc. These new modes of inquiry refashion digital data as vibrant, material, and open to be crafted in speculative ways in compositions with analogic and artificial data. By proposing a slow, artful and artisanal engagement with data and the digital, this collaborative study of school buildings creates an alternative space for young people immersed in smart buildings subject to computational managerialism in which data is equated to truth, objectivity, reality, extraction, and indeed modulation of affect, characteristic of control societies [24].

The paper draws from theories developed by Elizabeth Grosz [25], Elizabeth Ellsworth [26] and Luciana Parisi [27], to consider architectural space through the creative capacities of digital media. Rather than presenting architecture as a stable container, we emphasize the dynamic indeterminacy of place, and the power of the imagination to recast the sensory shape of envelopment. Sensing bodies force a rethinking of architecture as space-time event, encounter, and movement, which reaffirms both the infinite potential for spatial variation and the many corporealities that can be spatially expressed. Both Grosz and Ellsworth suggest that the imbrication of architecture and media is key in rethinking buildings beyond containment, and media beyond representation. Parisi directs our attention to the generative force of digital media in opening up imagined spaces. Accordingly, we discuss the ways in which our

research project used a variety of media for exploring spatial practices and in(habit)ation, studying and tracking the sensory/atmospheric experiences of flow, time, light, sound, texture, associated with various key thresholds found (as well as imagined) in classrooms, daily itineraries, hallways, dining halls, etc. while exploring young people's pliable attunement and divergent reshaping of school spaces through imaginative and technical engagements.

We will show and discuss a series of artifacts from the workshops, developed as part of the participatory ethnography of a building in Liverpool, UK, and which also became part of the art and design curriculum for the young people who participated. We also discuss interviews with the staff and students about the buildings, with particular attention to their spatial tactics for moving through a highly-charged environment. These various journeys and trajectories are captured in the layering of maps, as daily routines through corridors, but also as related to envelopment, and the experience of arrival and departure, in which doors, parking lots, and bus stops, figure as both affective thresholds and sites where personal data is collected. Finally, we discuss two installations in architecture schools, where the software experiments in mapping, and the mixed-media dynamic diagrams of student movement, were displayed.

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Possi(A)bilities: Augmented Reality Experiences of Possible Motor Abilities Enabled by a Video-Projected Virtual Hand

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Abstract

We introduce “Possi(A)bilities,” an Augmented Reality concept and system that presents users sitting at a table with animated visualizations of a virtual hand projected on the tabletop next to the user’s own hand. As a combination of possibilities and abilities, possi(a)bilities focus on the motor abilities of the human hand in the synchrony between the physical and the virtual, and constitute into a medium for examining and reflecting on the nature of diverse abilities that become possible when transcending the physical world and the individual’s agency. Ultimately, possi(a)bilities question assumptions, norms, and accepted definitions of motor ability and skill in the context of hybrid, physical-virtual worlds.

Keywords

Augmented Reality, Mixed Reality, video projection, motor abilities, hand function, virtual hands, Extended Reality.

Introduction

The human hand is a multifunctional instrument used to identify objects, manipulate and interact with the world, and extract information from the world via tactile sensing, active haptics, prehension, and skilled movements across a continuum of sensorimotor activities [8]. Fundamental to understanding human performance, the concepts of motor ability [3] and motor skill [12] are key for applications in motor planning and control, for characterizing individual differences in psychology [1], but also for designing interactive computer systems that adapt to and match users’ abilities [22] or repurpose the surface of the hand for input and output [6].

Either grounded in an application-oriented perspective [4, 6, 22] or taking the form of artistic expression [5, 10, 10], the diversity of the motor abilities of the human hand represents the basis for rich interactive experiences with the world. In this work, we use Augmented Reality (AR) to explore new possibilities for expressive hand movements at the intersection of the physical and the virtual. We make two contributions: (1) a technical system designed to sense, record, and visualize hand movements on a tabletop by using computer vision and AR (Figure 1), and (2) a conceptual exploration of possibilities for the motor abilities of the human hand, *i.e.*, “possi(a)bilities,” in the synchrony between the physical and the virtual world, on which we capitalize to challenge the current understanding of motor ability and motor skill.



Figure 1: Our Possi(A)bilities system enables the experience of a video-projected virtual hand on the tabletop in front of a sitting user, where the virtual hand performs movements that are either synchronized with or decoupled from those of the physical hand next to it. By implementing a diversity of possi(a)bilities, *e.g.*, synchronized movements, delayed reaction time, or grasping with a smaller virtual hand, our system encourages reflection on the possible motor abilities of the human hand, readily observed by the user in real time.

Related Work

We relate to prior work from AR and interactive computer systems that have employed the human hand as an I/O surface [6, 16] or used visualizations of the users’ hands as part of interaction techniques [4, 19, 20]. We also relate to art installations that employed images of the human hand.

Visualizations of the user’s hands interacting with a computer system are useful in distributed groupware, where multiple users share the workspace. In VideoArms [19], remote collaborators can see the solid arms of other users, digitally captured by a video camera. KinectArms [4] captures and displays arm embodiments on tabletops using the Kinect sensor, and implements several visual effects, such as shadows and gradients, outlines and transparency, and motion traces. PlayTogether [21] is a video-projection interactive system enabling remote users to play board games and engage in collaborative drawing. IllumiShare [9] is a peripheral device resembling a desk lamp designed to share physical and digital objects on arbitrary surfaces to support collaboration between remote users. Hand visualizations have also been employed in interactive computer systems to assist users when

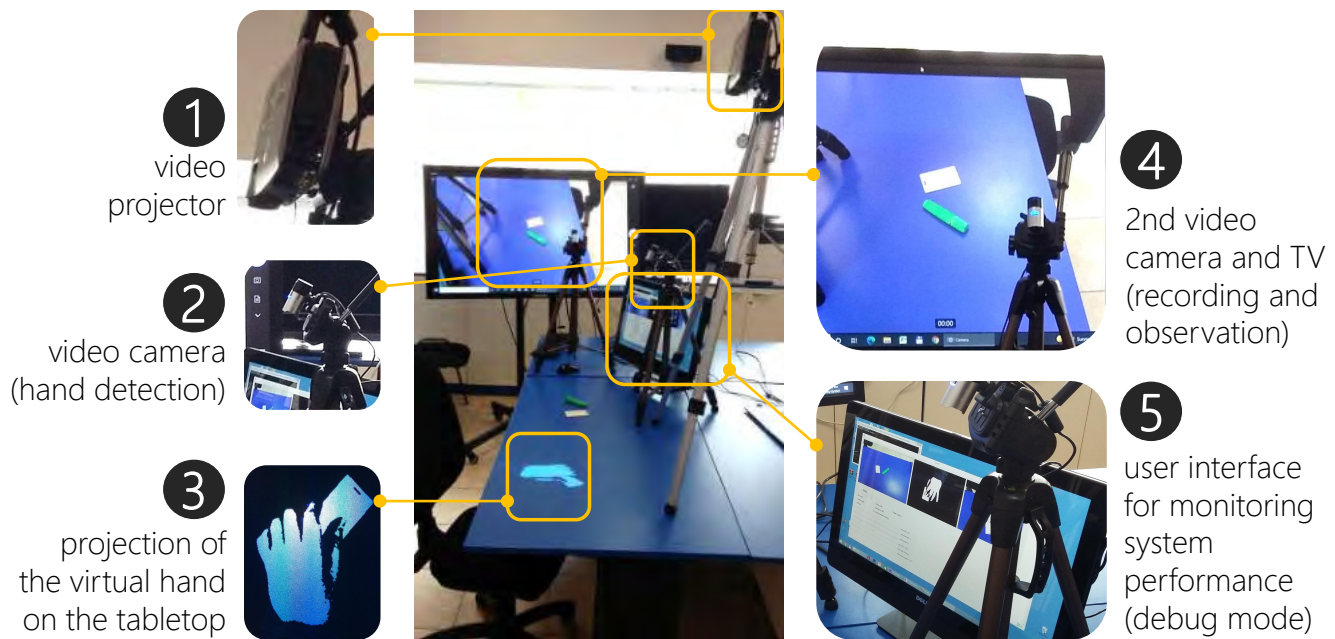


Figure 2: Illustration of the Possi(A)bilities system. On the left, system components creating the Augmented Reality experience for the user: a video projector (1) and a video camera (2) are connected to a PC that controls the virtual hand (3) projected on the tabletop. On the right, system components for debug mode operation: a second video camera (4) for observation and the user interface (5) presenting the results of the various image processing steps, from video acquisition to hand segmentation.

performing or learning specific tasks. For example, Sandnes *et al.* [15] and Rogers *et al.* [13] used video projections on the piano keyboard to support learning piano. Wigdor *et al.*'s [20] “under the table” interaction technique for tabletops makes use of visualizations of the user’s hand positioned under the tabletop to enable touch input from both the top and bottom surfaces of the table. Suzuki *et al.* [18] presented a system that projected virtual hands of experts to serve as guidance for manual workers in factories. Korn *et al.* [11] built a system that video projected instructions directly onto the workspace and evaluated it for people with impairments.

Researchers have also used the human hand as an input/output surface for interactive applications. For example, OmniTouch [6] is a wearable system enabling multitouch interactions on everyday surfaces, including the human hand. A shoulder-worn video camera and projector enable users to draw on the hand, select options from hand-projected menus or interact with applications via controls and UIs projected on the palm of the hand. LightGuide [16] also uses video projection on the hand to guide the user in completing the desired motion, such as during exercises or physical therapy.

In neuropsychology, Suzuki *et al.* [17] implemented an AR version of the rubber hand illusion [2], where movements of the real hand were mirrored by a virtual hand. Rosa *et al.* [14] also used AR to present a virtual hand while both the physical hands were visible to the user, known as the supernumerary hand illusion. Such illusions have been used to understand the experience of body ownership following multisensory integration across the exteroceptive and interoceptive domains.

The expressiveness of human hand functions has been celebrated in art projects employing video projections. Examples include Gary Hill’s “Hand Heard” [7], a five-channel wall-

sized installation showing images of an over-the-shoulder view of a person gazing at one of their hands; Pablo Gnecco’s “Gesture-Gesture” [5] exploring the visual language created with the hands, where three-second videos of hands captured from visitors are video-projected on a wall; and Elina Katara and Sanna-Mari Pirkola’s “Hands (video still images)” [10], where viewers sitting at a table watch video episodes projected onto the surface of a white table cloth: “hands appear in the video and surreal, dream-like things begin to happen.”

Unlike this prior work, the goal of our system is to present users with the experience of a virtual hand that, when aligned with the physical body, demonstrates a variety of possible motor abilities. In this context, possi(a)bilities encourage reflection on what motor abilities and motor skills are in the synchrony between the physical and the virtual.

The Possi(A)bilities System

Figure 2 presents our system, Possi(A)bilities, consisting of a video projector (Dell 3400MP), video camera (Microsoft LifeCam Studio), and a desktop PC (Dell Inspiron 5348, Windows 8.1, Intel Core i5 2.9GHz, 8GB RAM). We developed a custom C# Windows application that detects the user’s hand above the table, processes the image of the hand, records and stores its movements, and projects a virtual hand featuring various visual appearances and behaviors, described next. We employed the Accord.NET framework¹ for image processing, such as background subtraction and binarization to detect the hand against the tabletop and image manipulation to mirror, resize, and reposition the virtual hand inside the projection.

¹<http://accord-framework.net>

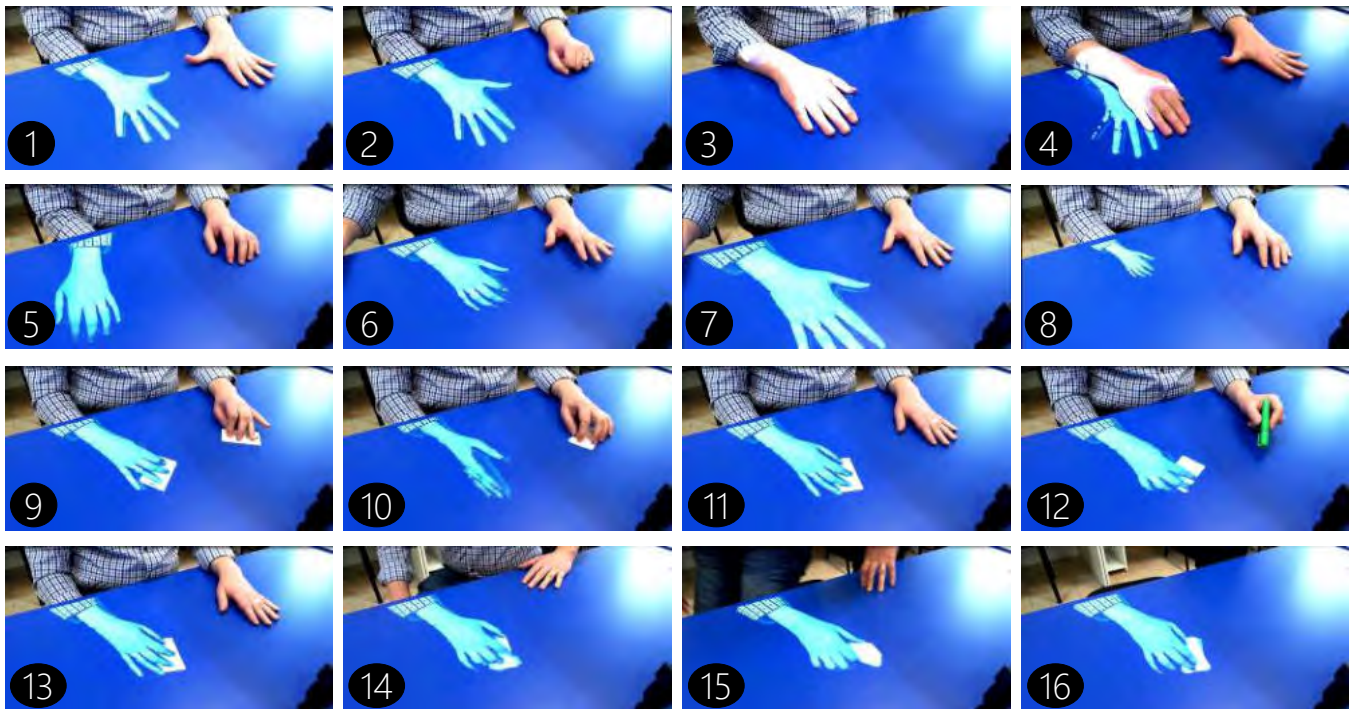


Figure 3: Visualizations of possible motor abilities enabled by a video-projected virtual hand: (1) *mirrored copy*, where the virtual hand mimics the movement of the physical hand; (2) *delayed reaction time*, where the virtual hand replays the movement of the physical hand with a configurable lag; (3) *superposition* with the virtual hand projected on top of the physical hand; (4) *pose decoupling* when the virtual hand is projected on the physical hand, but adopts a different pose; (5) *copy*, the virtual hand is an exact copy of the physical hand; (6) *location decoupling*, the virtual hand is shown at a different location on the tabletop with respect to the user’s body; (7) and (8) *size decoupling*, the virtual hand is shown larger or smaller than the physical hand; (9) *synchronized object manipulation*, when the virtual hand mimics the movements of the physical hand manipulating a physical object; (10)-(12) *desynchronized manipulation*, when the virtual hand performs a different action (a recording) compared to the physical hand in relation to the manipulated object; (13)-(15) time-consecutive snapshots of the user leaving the table, while the virtual hand remains in place (16) to perform a recording of the user’s most recent action.

The virtual hand represents the image of the user’s physical hand, programmed either to mimic the movements of the physical hand or to play a recording. Figure 3 shows several motor abilities illustrated by the virtual hand’s movements in conjunction with those of the user’s physical hand: mimicking the movement of the physical hand with a one-second lag creates the experience of a delayed reaction time (Figures 3.1 and 3.2); superimposing the virtual hand with a different pose, from a previous recording, suggests motor opportunities for the physical hand (Figure 3.4); a smaller virtual hand aligned with the physical body enables the experience of smaller grasps (Figure 3.8); and playing a video recording with the virtual hand manipulating a postit, while the physical hand holds a pen (Figure 3.12), highlights the intertwining of the physical and the virtual; when the user has left, the virtual hand can persist (Figures 3.13 to 3.16).

Discussion and Future Work

The Possi(A)bilities system engages the user both as an actor and a spectator. As an actor, the user controls the movements of the virtual hand, which mimics the poses and gestures of the physical hand, and the characteristics of its visual appearance, such as the size of the virtual hand. As a spectator,

the user watches how the virtual hand adopts poses and performs movements from a repertoire of previous recordings. The combination of physical–virtual and live–recorded action turns Possi(A)bilities into a medium for exploring, examining, and reflecting on the motor abilities of the human hand enabled by possibilities for human action beyond the physical world and the individual’s capacity to act independently. Possi(A)bilities also challenges commonly accepted notions of motor ability [3] and motor skill [12] in hybrid worlds that relax the world’s physicality and individuals’ agency:

- What specifies motor ability in a physical-virtual space?
- Who owns the motor skill of a virtual hand?
- What new motor abilities and skills are possible with bi-manual synchrony of physical and virtual hands?

Thus, Possi(A)bilities opens several avenues for future work:

- Extend the Possi(A)bilities system to enable interactions between the physical and virtual hands. For example, a physical pen could be used to write on a virtual postit (Figure 3.12), creating a new motor ability available only in the interplay between the physical and the virtual.
- Integrate Possi(A)bilities with control systems, where the virtual hand could be used to interact with physical objects

from the table, *e.g.*, touching a desk lamp with the virtual hand turns on the light, reaching a TV remote control with the virtual hand enables access to the TV. In such application scenarios, the motor abilities of the virtual hand have a physical impact in the physical world.

- Understand user behavior and perceptions regarding the virtual hand visualizations of the Possi(A)ilities system, including users that have lost specific abilities of the hands because of illness or injury, *e.g.*, spinal cord injury that has affected movements of the fingers or wrist.
- Explore Possi(A)ilities for other scenarios besides a tabletop and for other body parts, for example, visualizing a virtual foot projected on the floor next to the user's body.

We look forward to such future explorations towards redefining motor abilities and skills in new physical-virtual worlds.

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Online Possibles: Internet Spaces in a Postdigital World

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Abstract

When the Covid-19 pandemic hit, artists and institutions moved online while trying to recreate the experience of art and the gallery experience on screens. For the most part, this shift of attention to the internet as an exhibition space lacked the experimental quality of net art forerunners and their unique explorations of space where gravity is irrelevant and references such as vertical/horizontal, bidimensional and three-dimensional are outdated. This paper explores the notion of Possibles in relation to screen-based art and asks what kind of spaces can be imagined as we move towards a post-pandemic future.

Keywords

Space, Net Art, Virtual Reality, Covid-19 Pandemic, Online Spaces, Virtual Worlds

Introduction

“Imagine you are falling. But there is no ground,” wrote Hito Steyerl in *The Wretched of the Screen* (2012). I often dream about that. I’ve also daydreamed about an artwork defying Cartesian space, linear perspective and figurativism where I experience a free fall and the support system I take for granted is absent. I think in particular about such an experience of space: how would it be to move around and what would this look like?

Been There, Done That

When the Covid-19 pandemic hit, artists and institutions moved online while trying to recreate the experience of art and the gallery experience through computers, pads, and cellphone screens. Overnight, artists were encouraged to perform or show their work online, and galleries rushed to hire programmers to create a vast array of virtual spaces. At the same time, there was increased interest in art created specifically for the internet, and many curators and institutions discovered or remembered the artists who had been there and done that (net artists). For the most part, however, this shift of attention to the internet as an exhibition space lacked the actual experience of net art in its own time and internet speed; it also lacked the experimental quality of net art forerunners and their unique explorations of a space like no other - a space where gravity is irrelevant, and references such as vertical/horizontal, bidimensional and three-dimensional are outdated.

As I checked out online shows, I wondered why I was an arrow, why I was moving through rooms that looked like the “real thing”, witnessing the privileged linear perspective and

many of the references Renaissance artists embraced and modern artists rebelled against so long ago.

I kept wondering what kind of online spaces would emerge if the premise was a body falling where there is no ground or the vast referents that net artists used or created from scratch. Indeed, net art pioneers such as Heath Bunting, Jodi.org, Olia Lialina, Brian Mackern, and Eva & Franco Mattes pushed the envelope by opening the multi-dimensions of the internet decades ago.

For example, in Olia Lialina’s *Summer* (2013) we see the artist swinging back and forth, infinitely looped. Cut out against a gradient background of blue and white, the swing is hung from the browser’s location bar. The animation’s eighteen still images are located on twenty-six different websites, with each site redirecting the browser from one server to the next, displaying the images in sequence and thus creating a cross-domain animation. The work is scattered across the internet, making it impossible to watch offline. The speed and rhythm of the image sequence, the animation itself, depends on internet speed. As such, the work is fragile, just one downed node can break the work.

I am also inspired by the resurgence of VR pieces. I believe that many of these pandemic online galleries and VR works use new technologies to create worlds based on old ideas. This is problematic because some of these spaces are based on a specific worldview: that of Western tradition with its conventions of Cartesian space, linear perspective and figurativism. For instance, in recent VR projects we observe a tendency to create hyper-realistic 3-D worlds, often devoid of the faults, imperfections, and messiness of the real world. They are inhabited by cool avatars or representations of pretty (usually white) people. Furthermore, an astounding number of current VR and 3-D worlds do not invite a carnal, critical, or emotional engagement. We are back to a place where spectators contemplate the beauty created by the artists where we can only surrender. This is in contrast to the work of VR pioneers such as Char Davies, Michael Naimark, Lawrence Paul Yuxweluptun, and Jeffrey Shaw.

In the late 1980’s, Jeffrey Shaw produced *The Legible City* (1988-91). This multimedia installation allows viewers to navigate a simulated city by riding a stationary bicycle, thus connecting the physical and the non-physical through the users’ actions, which are translated into images that recreate navigation within the city of Amsterdam—the architecture is represented with texts related to the history and stories associated with a given building.

Charlotte Davis’s *Osmose* (1995) is an early and remarkable example of an immersive and interactive virtual

reality. The installation employs a head-mounted display (HMD) and a motion sensitive vest that monitors the users' breath and movement. Originally, users are presented with a three-dimensional Cartesian grid, which provides the coordinates for orientation. Users navigate the space vertically by inhaling or exhaling and torso movement determines their horizontal location. The experience lasts fifteen minutes. After, the real world slowly fades in, completely occluding the virtual world. Davis' strategy to employ users' breath and movement as interface is extremely significant. The interface establishes the level of interaction and reaffirms the participant's corporality. The virtual world responds to a regular breath with a smooth state opposed to an agitated breath. Additionally, it responds as users lean or turn.

While early net art and VR pieces produced novel conceptions of space and oriented bodies away from the normative upright posture of the human body, their creative drive was forgotten during the Covid-19 pandemic and the art world's frantic move online. But we are now more than a year from the start of the pandemic and the burning question is: what have we learned from net and VR artists and the pandemic, and where do we go?

Now What?

Let us imagine what space means in a postdigital and post-pandemic world. Contemporary artists have produced a number of net art, videos, and other forms of synthetic worlds beyond Cartesian space, linear perspective, and realism, or they have engaged with these referents critically, because many artists understand that the issue is not about aesthetics as much as it is about exploring space creatively and politically.

Henri Lefebvre's *The Production of Space* (1974) and recent theories of space within geography (Smith and Katz, 1993) insist that social relations and material practices produce space. This conceptualization enables a reflection on how the actual interactions of people in any given space form part of its production. Thinking about internet culture, pulsing as millions of online users create and remix content, the idea of the internet as a space produced through interactions and practices is all the more relevant.

For example, Jakyung Lee's *Exodus* (2020) is a web piece that extracts images of bodies enjoying seemingly private moments like lying on a beach. Using these fragmented figures, the artist forms a defective but endless synthetic environment, composed of random human bodies, whose whereabouts cannot be tracked. They are estranged from their location and lost in the immensity of the internet. No matter how far we move along the traces of cached photographs, everything we/our controller can reach is the

receding horizon. At the same time, we can hear the sound of waves, but there is no ocean in sight.

Jiwon Ham's *Transient Home* (2020) is an experimental documentary tracking the continuous experience of displacement shared by a group of young people. The interviewees tell the stories of their semi-nomadic lives, while their experiences take the shape of random spaces formed by volumetric 3D-capturing techniques. *Transient Home* evokes a series of spaces that never get formed, just like the homes of these young subjects. As we listen to their stories and familiar sounds like preparing a meal in a domestic interior, we expect to get a sense of home. But the 3D dots that seem to retrieve images of dining rooms and bedrooms move to break the images/spaces we yearn for. These stories of displacement demonstrate that we cannot assume "home" is a place of comfort and security for all. They invite us to reflect on communities forced to move and leave behind any sense of space they can call their own.

We can also evoke different spaces, synthetic or otherwise, through sound. *AuMe - Audio Metaphor* (2021), by Philippe Pasquier and Miles Thorogood is an interactive site that functions as an Internet search engine equipped to produce the soundscape of a non-existent nature. Users enter keywords, a sentence or an expression. The generative system will search for words linked to the entry and will play a soundscape of that "natural" space. The work then responds to each user's personal associations and sonic memories, allowing diverse conceptions of nature to orient its emergence in real time. What is more, thinking about screen fatigue (thank you, Covid-19!), it is refreshing to experience an artwork that encourages us to look away while immersing us into an infinite repository of imaginary soundscapes.

Benny Nemer's *Fragments of Rosalie* (2021) also engages sound and was designed for the internet. The work consists of three photographs and audio guides accompanying each image. Nemer rearranged broken pieces of ceramic to create new objects that come into dialogue with three hand-made postcards by Rosalie Goodman Namer, the artist's maternal grandmother, a prolific ceramic artist in Montreal. An intimate connection existed between these two artists. The piece tackles a fundamental part of our experience linked to objects that have stories, people, and emotions attached to them. Objects stop being material objects in the world and become memories involving spaces and senses like smell, touch, movement. Together, Goodman Namer's pottery and hand-made postcards, and Nemer's online engagement with them, brings a multidimensional, sensorial experience of love and closeness with one another. This closeness is evoked in the large scale images extending one-hundred percent on our screens, images that we cannot grasp in their entirety but rather have to scroll through only to see fragments. Nemer

invites us to delve into the intimacy he and his grandmother shared, which transcended age and remained beyond her passing. In the context of the Covid-19 pandemic where our intimate, personal, and professional relationships unfolded through screens, the internet became an important space to negotiate feelings such as love and loss; *Fragments of Rosalie* engages those feelings in powerful ways and invites us, through sound and fragmented images, to do just that.

Sally McKay and Lorna Mills' *Boost Presume I'm Gonna Breathe Grieved* (2021) is a GIF artwork that also takes up the internet to deal with difficult feelings. The humor is characteristic of web culture and these GIF pioneers welcome us to a scrolling page with a "Click Me! Please! Please!" button leading us to listen to a fine selection of 1970s AM radio soundtracks. I laughed when I first listened to the Carpenters' lamenting *Ticket to Ride*. Yet, as I scroll down, my laughter turned sour with the mixture of familiar images during the global pandemic, ecological disaster, and pure emotions of grief: hand-drawn and illustrated animations of eternal rain, trees, followed by digital images of moving skies, forests, mountains, fractured landscapes, forest fires. These take rounded forms. By breaking with the photographic rectangle, the images center our attention on changing and chaotic landscapes. Together, these formal elements create a sense of theatricality. I see familiar feelings and emotions: Fire, fire! Shit!, viruses, hands, touching anxiety; scenes of a road ahead seen from a moving car, mountain, eagle views, and hordes of animals running away, hurried, every woman for herself! Tears falling, but there is no escape. Who hasn't felt this way, some way or another, since the pandemic hit?

esc/space

One of my motivations to engage with the theme of space is the numerous online exhibitions that I started seeing after the first lockdowns around the world, especially 3-D models of galleries. The case of net art is crucial. When I saw galleries and artists moving online, many were not aware of the history of net art and the ways in which net artists around the world have engaged with the internet, dissecting the way contemporary societies have shaped the networked world and how it has shaped us (people and social relations). Net artists have bent the rules on the internet and created alternative conceptions of space, artworks, communities, and practices such as sharing and community building. Net artists have demonstrated that the internet has its own dimensions, depth, texture, folklore, strategies, humor, and that the three-axis grid is not the only way the world perspective works. We need to revise the history of net art and pioneering investigations with virtual reality as we move towards a post pandemic future.

We must also remember that, as numerous feminist and postcolonial scholars have insisted, that "the real world of image making is political," and that the study of

representation in connection to power structures is equally central to challenge the visions of reality produced by any hegemonic system (hooks). Cartesian notions of space and subjectivity that continue to shape virtual worlds today assume a normative body who can move at will. But this is not the experience of many marginalized communities online and IRL.

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Erandy Vergara-Vargas (MX/CA) is a Montreal-based curator and scholar. Her main research interests include global art histories, climate responsibility, curatorial studies, equity, internet cultures and widespread bias in algorithms. She earned a MA at Concordia University and a PhD in Art History at McGill University. Recent shows include ISEA2020: Why Sentience? (Printemps numérique, Montreal); Eva and Franco Mattes: What Has Been Seen (Fondation Phi pour l'art contemporain, November 2019-March 2020); *Speculative Cultures: A Virtual Reality Art Exhibition*, curated with Tina Sauerländer (Anna-Maria and Stephen Kellen Gallery, Parsons School of Design, New York, 2019). Currently, she is a Postdoctoral Fellow at The Sociability of Sleep Project, Université de Montréal, and artistic director of Printemps numérique.

The Gap: Science Always Goes Before the Law

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Abstract

I WANT TO PROCLAIM SOS AGAINST ILLEGAL EXPERIMENTATION ON HUMANS BY USING BIO/NEUROTECHNOLOGIES.

- The crime category: medical experiments (clinical trials without consent) - crimes committed with innovative scientific tools. (Combined multidisciplinary sciences - medicine, psychiatry, physics).
- The recidive: victims home and bed becomes the place of a cruel regular crime - clinical trial.
- The body: human - is like an animal, abused by criminals for medical experiment needs.
- Implantable neuro-electronics started to be used for human functioning-operating control.

Research object. Globally, many people are suffering from newly invented technologies, approximately 2000 to 10,000 people worldwide, could even be more. Some of them call themselves TI (Targeted Individuals), some of them TI cyborgs, TI neurorobots. Some of them have implants with remote influences 24 hours per day. Therefore, they have no privacy, they are 24 hours per day tracked, 24 hours per day tortured (with UV laser, micro waves, and so on), discredited, forced to have no authenticity, no future, no social lives. This is like the "Second Life", except this "virtual reality game" is controlled by criminals. The victims can't get help - scientific and competent medical, adequate police and media response. Human Rights, in their case, do not apply.

Keywords

Crime committed with neurotechnologies, ultra-thin transparent implants, Targeted Individual (TI), neuro-electronics from neuroscience/experimental medicine, human-computer interaction (HCI), brain-computer interaction (BCI), microrobots for neurosurgery, microrobots-electrodes/sensors, stealing biodata, bioelectronics for paralysed human body functioning/control, forced behavior, psychiatric patient imitation, neural prosthetics as extension of the criminals body.

Introduction

In general. Nowadays, a new generation of high-tech innovations become more and more common. High-tech innovations can be adapted for unethical and/or illegal research and human body control. Used technologies: bioelectronic, optogenetic and neural implants (nano-micro-milli size, with invasive Brain-Computer Interface (BCI), Human-Computer Interface (HCI), experimental Human-Computer-Human Interface (HCHI) and AI Interface and so on). For the last five years I have been studying patterns and principles of crimes, made with previously mentioned instruments. Because of individuals and companies invested in shady businesses, related to my topic, each case is covered and far from transparent, therefore, information is hard to gather. The stories, I have encountered in my research, are terrifying, like postmodern philosophy illustrations (for example: M.Foucault's theories). Here arises the question of VIOLENCE: HOW MUCH IS TOO MUCH?

General details

Most commonly, people from socially weaker category can become victims who are exploited for unethical, forbidden by the EU, scientific experiments, rooting way back to Hitler and Stalin epoch of neuro-research experiments. Nowadays, victims suffer, mostly unable to explain it, from bio/neuro-technologies and psychological operations (used to cover crimes), irradiation (to sustain lack of vitality and incapacity to work for the victims), biopharmacy... Hackers censors victims phone calls, email, social networks. Most commonly used innovations are adopted from neuro-technologies; nano and micro sized muscular implants prescribed to suspend neurodegeneration processes, e.g.: paralysis, vision and hearing decline, etc... Professionally implanted and long time studied individuals might be compared to marionettes, for example, with wireless implants almost all body functions can be controlled. With mentioned methods, psychiatric diseases are being simulated, just like that,

medical-law is being broken and “sick tags” are being pinned on healthy people. Technologies and mental plays, to trick the society and make victims situation even more helpless, are working - complains from healthy and sick people are mixed together, when the healthy people start talking about it, society start looking at them as mental patients. Crime characteristics can be compared with KGB practice in the 20th century in Lithuania, however, current crimes are improved with latest technology tools. Present “KGB prison”, or “human trafficking prison” - small, undetectable and irremovable implants inserted in the bodies of the victims.

Possible description for these cases may very well be biotechnology terrorism, cyberterrorism, human trafficking and control. Possibly, these criminals (as most terrorists) make combined purchases of (neuro)technologies, tools, chemical reagents, etc. from all around the world. Later on, they legitimize practice as mobile communications or programming firms and focus on a single targeted individual.

There is also a huge problem with categorisation. The category of the “mentally ill” is known and common - but victims of medical crimes should be a separate category. In my opinion, new categorisation is needed - e.g. “victims of scientific crime”, “victims of innovative biophysical technologies”, “victims of innovative neurotechnologies”, “victims of clinical trials at home condition”...

Information gathering process

I have understood - speaking about this problem is a “TABOO” and even some journalists who have “investigated” this problem, use such investigative methods that are only beneficial to doctors who cover up criminal elements. After a significant amount of work, I have brought together the information as accurately as I could, it is meant for the victims and for showing vast possibilities of technology innovations. I ask you not to take accusations seriously, where the victims blame a certain known party. It is unlikely for a victim to know the real source of an order. Possibly, medical experiments, human trafficking and terrorizing, using methods and techniques similar to the ones described, has been happening for 10 years. In case of human trafficking, these techniques and methods could be used against an individual who has no preliminary knowledge about the related technologies and criminal factors and has no money (to remove implants costs a lot), is lonely (with no closest people who can help, or with bad relatives), has strong/resilient intellect (such people can suffer a lot, but do not kill themselves). I have tried to find information about the possibility of human function control with experimental medicine tools and have talked to scientists and other trusted people.

A two years ago, during “Open Readings” conference, I have asked a question a physicist of Vilnius University prof. Mangir-

das Malinauskas¹, and he gave an answer (I cannot give the exact quote, but I will quote as I remember): “To my knowledge, it is currently possible to control human functions with implants, however crippled. Why? - because the implants are not sufficient quality to control all human functions. A healthy human nerve system has too many parts for the current implants to be possible to control. He advised to search for ultra-transparent objects in bodies. Earlier he produced microrobots for medicine and polymeric chemistry. I think he has knowledge about the possibilities of medical technologies, globally. Also he knew similar case from the past, but only with electromagnetic irradiation (x rays, etc.) from neighboring apartment. He helped me to understand that in case of medical experiment criminals make constructions in the victims apartment: installing wires and other technics between the walls, in the walls, and so on (I think this technic possibly can be pulled out, without much effort and without entering the victims apartment).

Also I had got a chance for a short live communication with Cosimo Monda² (Maastricht University, Centre on Privacy and Cybersecurity). He also knew this problem as “CRO”- Clinical Trial at home conditions, and named, what exact implants term - neuralelectronics. Also, he said that it is very difficult to prove this crime, and 'very difficult to change laws in the system'.

I also communicated with more people from innovations³, radiophysics, material science, law⁴, forensic⁵, criminology⁶, and etc. - they gave me a lot of advises. Then I realised that these innovations are at the academic or after academic level (in innovators language, they are in experimental stage called “in the valley of death”), when pre-clinical or clinical trials are needed, but there is no support/investors yet. They have the right for innovation, however, experimenting and proving is left to be done with their own money until the investor comes up. It can take 5 to 15 years. Then “the valley of death” ends, the investor is found or not. If found – the project is moving to the next stage, closer to a wider production, delivering to the market (...).

Final words, conclusions

As a victim of medical experimentation, I have no questions of the presence of these technologies (specifically - neuralelectronics) and the need of medical investors to experiment with healthy people, for free.

The questions for the readers: How victims should act, step by step? Can there be created an instruction? What could be a fast and a money-free way to escape out of this crime?

In my opinion, because of the affiliation, corruption and ineffectiveness of medical professionals, victims of medical crimes should be entitled to “psychiatric immunity” (a right similar to “legal immunity”).

MY WORDS AND YOUR LISTENING - LET IT BE AN IMPULSE FOR JUSTICE IN HEALTH.

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Interdisciplinary artist-researcher Aistė Laisvė Viršulytė was born in 80’s and has spent most of her life in Vilnius, Lithuania. She finished a BA in photo-media art at Vilnius Academy of Arts, and MA in sculpture there. Since 2016, she is a member of Lithuanian Interdisciplinary Artist’s Association.

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In sight of *Allo-states*: Tracing the Path from Environmental Personhood to Agentials, Performances of Personhood and Other Artworks on the Agency-Personhood Continuum (APC)

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Abstract

In the spirit of combinatory play, this paper examines how the concept of environmental personhood may impact art, design, and culture in novel ways. It begins by introducing a landmark legal decision in 2017 that granted legal personhood to the Whanganui River in New Zealand. Legal decisions that grant environmental personhood have the potential to provide productive conceptual fodder for artists, designers, and architects whose work imagines new relations between humans and the environment at a time when ecological degradation is ubiquitous. This paper then presents a heuristic framework called the Agency-Personhood Continuum (APC) that traces broad esthetic strategies used in artworks that engage with concepts of nonhuman material agency and environmental personhood. Finally, it seeks to open new imaginatory space by positing a new class of supra-governmental entities called *allo-states*. *Allo-states* are here defined as organizations that represent massive ecological entities that transcend a single nation-state such as the Amazon River. Theoretically, *allo-states* could exist alongside, but independent from nation-states in supra-governmental parliamentary proceedings such as the UN General Assembly. Ultimately, the term *allo-states* provides a hypothetical means to explore supra-governmental environmental personhood and looks for way that enable large scale ecologies to receive representation that focuses on their intrinsic worth instead of their resource value. Through speculation about emerging and expanding notions of environmental personhood, the aim is to activate new areas of social, cultural, and creative inquiry.

Keywords

Allo-states, Environmental Personhood, Agency-Personhood Continuum, APC, Agentials, Performances of Personhood, Nonhuman Agency, Art, Design

Introduction

In 2017, the Whanganui River in New Zealand was granted legal personhood, a status that provided the river—and the surrounding ecosystem—with the legal rights and

responsibilities of a person [1]. As a legal designation, personhood provides a robust means of protection against other individuals and organizations that would seek to utilize the river solely as a natural resource, without considering the long-term degradation this depletion may cause. And while a river cannot engage in a legal battle, it was granted two legal guardians to oversee the protection of its rights: one New Zealand government official and one member of the local Maori tribe [2].

The impetus for this legal decision was born out of successful advocacy of the Maori belief system: whakapapa (Maori genealogy). According to Gwendolyn Gordon, in the world view of the Maori, the Whanganui River and its surroundings maintain a different ontological status: they are social beings in the Maori community [3,4]. As Gordon writes, “[f]or a Maori tribe (iwi), sub-tribe (hapu), or extended family group (whanau), a particular river or mountain might be an ancestor (tupuna). This genealogy—or whakapapa—is crucial to Maori worldviews” [5]. In other words, the Whanganui is part of the social milieu of the Maori. They see the river not just as a person, but as a familial ancestor. By granting the Whanganui River personhood, the New Zealand courts effectively acknowledged—and to some extent instantiated—the Maori ontological framework.

Symbolically, this case may have far-reaching consequences beyond New Zealand that impact other legal and cultural decisions about the relations between humans and nonhumans. Chris Fowler writes, “Particular concepts of the person are bound up with specific ways of perceiving the material world and valuing its features” [6]. By changing the legal status of the Whanganui, there may be follow-on effects that impact culture. According to Gordon, “the legal structure underlying the personhood changes give them actual heft, and can change the way people think about the rights of the environment in ways that really change the law in ways that affect the real world” [7]. At a time when environmental degradation is a reoccurring feature in popular news cycles, granting legal personhood to a river can affect cultural viewpoints. Cases such as Te Awa

Tupua (Whanganui River Claims Settlement) Act of 2017 provide a glimpse into a new cultural potentiality.

From Legal Precedents to Art and Design

According to Bruno Latour, legal precedents and philosophical inquiries can open new conceptual spaces, but they also require the domains of fiction [8], art, and design to breathe life into new ideas. As Gordon writes:

theories of these rights of nature may be deployed in ways that shift with circumstances, social, political and material circumstances matter, as do ways of imagining. As such, a better question than the obvious ontological one—may nature properly be considered a person—is: how easily will we be able to imagine nature as a rights holder in each regime, and how will that imaginatory space energize the will to protect nature by means of these varied rights arguments? [9]

In other words, new esthetics may be required to fully flesh out these new social imaginaries. Fortunately, fields such as architecture and biological art offer existing methodologies that acknowledge the importance of nonhuman actors and seek to amplify their agency. One common example can be found in an anecdote about architect Louis Kahn:

Louis Kahn used to tell his students: if you are ever stuck for inspiration, ask your materials for advice. "You say to a brick, 'What do you want, brick?' And brick says to you, 'I like an arch.' And you say to brick, 'Look, I want one, too, but arches are expensive and I can use a concrete lintel.' And then you say: 'What do you think of that, brick?' Brick says: 'I like an arch.' [10]

In this exchange, Kahn maintains a cognitive model that personifies his material. His conversation with a brick is an example of a design process that Donald Schön refers to as *reflection-in-action* [11] and what Bruno Latour called nonhuman agency—the ability of any material to have an impact on human society [12]. Kahn playfully asks his material what it wants to be and the brick—through an expression of physical characteristics (e.g., material composition, density, form, tensile strength, etc.)—provides a response: it wants to form of an arch. The result is a conversational design approach that encourages designers to listen to their materials [13]. It seems then, that personification is one strategy for amplifying nonhuman agency.

Similarly in the field of biological art, many artist implicitly assume that living nonhumans are actants that may exist outside of the human *umwelt* and require an intervention to bring them from the microscopic to the macroscopic [14]. They then use a variety of tools and esthetic gestures that translate the agency of living materials into a felt human experience that can be observed in a public context (e.g., gallery, studio, laboratory, ecology, etc.). Translation through data, context and narrative may be a second strategy to amplify nonhuman agency.

It seems that the cognitive models utilized by practitioners to amplify nonhuman agency share a common motivation with legal decisions that increase the agency of environmental persons. However, the scale and complexity between the expression of material agency and environmental personhood may differ drastically. This raises the question of how to assess the relationship between the two concepts within artworks. As a result, a heuristic framework referred to as the Agency-Personhood Continuum (APC) has been developed to provide clarity.

A Framework for Assessing Art and Design: The Agency-Personhood Continuum (APC)

In an effort to develop a more robust conceptual link between the cognitive models of material agency implicit within Louis Kahn's "conversation with a brick," and environmental personhood, the Agency-Personhood Continuum (APC) was developed (Figure 1). The APC is a model for understanding how particular esthetic strategies are employed by creative practitioners who wish to represent the nonhuman agency. It can be considered a fluid, conceptual tool for thinking through esthetics, but it is not a fixed model that offers any prescriptions about art.

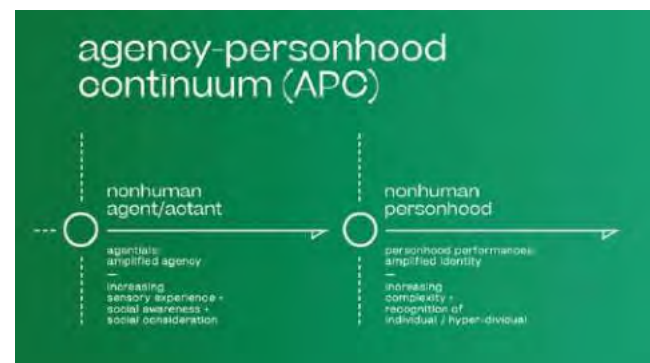


Figure 1. Agency-Personhood Continuum (APC) Diagram. Designed by Author. CC BY-SA 4.0 (Author)

Within the APC, there are two key terms that seek to describe some common conceptual gestures: *agentials* and *performances of personhood*. *Agentials* exist on the left side of the Continuum. Artworks that function as *agentials* may seek to bring nonhuman activity that normally exists outside of the human perceptual field—due to distance, time, scale, or impact—into our sensory range. These works can be said to exist as nonhuman agents that do not have enough complexity to rise to the level of personhood. The story of Kahn's "brick that wants to be an arch," is a prime example of an *agential*. Another example can be seen in the 2021 bio-digital installation *Weathering* (Figure 2). *Weathering* features a microbial fuel cell—an organic battery made from mud, water, and bacteria—and a digitally controlled solenoid. The microbial fuel cell produces small voltages, 10-300 millivolts, that are fed into an Arduino microcontroller. Using voltage as a tell-tale sign, the microcontroller senses the microscopic activity of bacteria and then triggers the

solenoid to open and close in rapid succession. The result is a sound installation that generates a stochastic, intermittent tap against a wall any time microbial activity reaches the voltage threshold. *Weathering* seeks to amplify the microbial metabolism which converts organic material into elec-



trons into a series of tapping noises. It thereby translates microbial agency into the human sensory spectrum and provides a snapshot of nonhuman agency as an *agential*.



Figure 2. *Weathering*, (battery made of mud, water and bacteria; glass, wood, copper wire, Arduino, solenoid). Author, 2021. An example of an *agential*. CC BY-SA 4.0 (Author)

Figure 3. *Embedding: Ochopee Trail, Florida, US*, Author, 2021(digital video, 12:00). An example of a *performance of personhood*. CC BY-SA 4.0 (Author)

On the right side of Continuum are *performances of personhood*. This term describes activities that may focus on nonhumans that are larger in scale and complexity, but which may be more distributed. Additionally, *performances of personhood* may seek to create conceptual and esthetic gestures that literally or metaphorically reintegrate humanity into a complex ecosystem, thereby re-instantiating an ambient human connectedness with ecology. *Performances of personhood* may be considered the opposite of the current individualistic notions that situate humans as separate from the environment. The Te Awa Tupua (Whanganui River Claims Settlement) Act 2017, which grants personhood to the Whanganui, would be one prime example of a *performance of personhood*. Another example is the artwork *Embedding: Ochopee Trail, Florida, US* (Figure 3) created in 2021. *Embedding* is a durational video that documents a

walk through the Ochopee Trail in the Everglades, one of the largest protected swamplands in Florida. The trail itself is 14.9 miles (24 kilometers) and the original video is 5 hours. However, an hour of the video has been sped up and condensed into 10 minutes. By speeding the video up, the viewer gets a glimpse into a larger system. As a result, the first-person, human perspective of a localized environment gives way to a holistic view of a nonhuman person, the Everglades.

When considering the APC, one can think of the range between *agentials* and *performances of personhood* in a similar manner to the visible spectrum for humans. It is only a small representation of a much larger continuum. There may be proto-agencies or supra-entities that extend well beyond our threshold of experience.

From the Agency-Personhood Continuum to the Possibility of *Allo-states*

While some artworks on the APC express of an individual perspective, collective *performances of personhood* may have the potential not only to situate the human in an embedded system of ecological relations, but they can situate the nonhuman person in a complex social milieu of the human. This can be seen in the *Theatre of Negotiations* (2015), a large-scale collective performance that took place in Nantes, France prior to the Annual Conference of the Parties (COP21), a UN climate change conference. The performance was considered a “pre-enactment,” a collective, theatrical, performative simulation involving over 200 students. Notably, one idea that shaped the event was informed by Latour’s understanding that nonhuman actors increasingly needed to be included more prominently in political discussions. Therefore, the *Theatre of Negotiations* included nonhuman ecologies such as the Amazon rainforest, the Arctic Sea, and the North Sea in the deliberations. According to Latour, the mere presence of the representatives for nonhuman ecologies changed the flow of deliberation. Greater attention was given to the environmental entities during debates. [15].

If one combines concepts from the *Theater of Negotiations* with the ideas from environmental personhood, a new notion arises: the *allo-state*. An *allo-state* refers to an organization that represents one of the world’s largest collections of ecological entities (e.g., humans and nonhumans) that exists at multiple scales (e.g., nano, micro, macro, mega). The prefix *allo-* has been selected because these ecological entities span numerous countries. An *allo-state* alongside, but independently from nation-states. For example, the Amazon River, Alps, Mediterranean Sea, and the Nile River all span numerous nation-states and could potentially benefit from recognition as *allo-states*. Ultimately, the notion of an *allo-state* hints at the possibility of developing supra-governmental environmental personhood and an organizing body that could speak on behalf of the environmental persons in parliamentary forums such as the UN General Assembly.

Conclusion

Legal concepts such as environmental personhood can affect both legal and cultural notions of identity. Through means of conceptual combinatory play, this paper aims to generate new imaginary space within the arts and the notion of environmental personhood. This can be seen in the development of the Agency-Personhood Continuum (APC)

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which helps organize different creative practices that amplify the agency of nonhumans at various scales of complexity. Ultimately, by combining notions of environmental personhood with *performances of personhood* like the *Theatre of Negotiations*, the term *allo-states* is presented to activate imaginary spaces about the possibility of supra-governmental environmental persons. How this new concept of *allo-states* impacts further creative inquiry for art, design, and cultural production remains an open question.

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Author Biography

Devon Ward is an artist, designer, and educator who creates digital and living systems to explore notions of time, place, and identity. His works often rely on speculative allegories that examine current social conditions affected by emerging technologies. These works often focus on the changing relationships between humans, non-humans, and the environment at a time when environmental degradation is ubiquitous.

Ward holds a Master of Biological Art from SymbioticA at the University of Western Australia and a BFA in Graphic Design from the University of Florida. He is currently Assistant Teaching Professor of Graphic Design and Visual Communication at Ball State University in Muncie, Indiana, USA.

Environmental Critical Zones: Reading the Wrack Lines

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Abstract

Reading the Wrack Lines is an interdisciplinary environmental literacy and educational outreach project designed to engage the local community with innovative learning approaches focused on the reality and possibilities for change in our coastal environment. The project is framed by cross-cutting themes of diversity and inclusion, and includes partnerships with local institutions, environmental specialists, and underrepresented communities. Through a series of creative writing workshops and site visits, participants reflect on the changing environment and create poetic works for inclusion within two art works: a generative audio-video installation projected on University of Connecticut Avery Point lighthouse, and a laser-cut felt word-based floor sculpture on exhibit at Cummings Galleries as part of the Fire and Ice exhibit. The creative process and final artistic products of this project empower participants and articulates a vision for environmental change to the larger public.

Keywords

Generative, audio-visual, site-based projection, community engagement, environmental outreach, digital poetics.

Introduction

A wrack line or wrack zone is a coastal feature where organic material and other debris is deposited on the beach at high tide. The wrack can be made up objects such as seaweed, crustaceans, feathers and bits of plastic. As the edge between the natural input of marine resources and the land, the wrack zone is interrelated with the state of the sea. Shorelines, locally and globally, are affected by stronger and more frequent storms and the threat of sea level rise. Locally, our waters are seeing a decline of species, warming water temperatures, acidification, and changing ocean currents. This project engages the community through coastal site visits and creative writing workshops about climate justice, the local ecology, and possible positive change. By

developing an awareness of local climate change first-hand, participants in *Reading the Wrack Lines* see connections to larger global climate concerns.

Background

Reading the Wrack Lines is the most recent artistic collaboration between the authors, and is part of a series of works focused on climate change and the environment. A previous collaboration, *Open Waters [Northwest passage | Open Polar Sea | Arctic + Great Lakes Plastic]* was shown at museums and presented at ISEA 2020, inspired by a five-hundred-year history of northern exploration, current geopolitics, and global circulation of microplastics. Another previous collaboration, *Ice Core Modulations: Performative Digital Poetics* was presented at ISEA 2017 (among other venues) and included imagery and poetic fragments inspired, generated and controlled via historical CO₂ data taken from ice core samples made available from the National Snow and Ice Data Center (NSIDC).

All of these collaborations have sought to create engaging works that address complex environmental issues through a plurality of artistic, poetic, and scientific perspectives. The collaborators have brought to bear individual skills such as audiovisual generative computer programming, various forms of visual art media, poetry, and electroacoustic composition to synergistically create these works, using shared source materials such as place-based personal narratives, historical materials, scientific data, site-based audiovisual media, and poetic texts.

Goals, Objectives and Artistic Dimensions

Reading the Wrack Lines seeks to increase environmental literacy through community outreach and provide a sense of empowerment to the participants and the public through the

process of creative writing about the environment incorporated into artwork.

The overarching goals and objectives of the project include:

- Enhancing learning about environmental issues and ocean literacy for participants to be more resilient to a changing climate and environment
- Organizing workshops for participants to respond to environmental issues through creative writing responses formulating multiple points of view with many voices.
- Providing a venue for our community to creatively offer what may be possible; to respond, react, and propose change to environmental issues.
- Presenting community writing and voice through innovative multisensory formats exploring digital poetics in a reflective and engaging experience.

The artistic dimensions are framed by creative community narratives, the local environment as subject matter, and the project medium including digital and physical forms. Based on these objectives, *Reading the Wrack Lines* collaboration resulted in two distinct works showcasing community voices:

- A generative audio-visual work programmed in Processing software composed of texts, visuals, and audio of participants' spoken texts. This work was projected onto the local lighthouse on April 22, 2021 (Earth Day)
- A sculpture consisting of digitally fabricated laser cut felt and embedded audio on exhibit in the "Fire and Ice" Art on the Edge show from September through October 2021.

Natures and Worlds: Climate Change and Global Warming with Digital Poetics

Reading the Wrack Lines engages with climate change and global warming as both an artistic response and an unpredictable generative system. Working with generative technologies that produce unprompted change mirrors the unpredictability of weather and climate change impacts within our natural environment. As such, climate-focused generative art makes use of random systems to engage viewers in innovative and surprising results.

Description of Works

On-Site Audio-Visual Projection

The generative audio-visual projection (Figure 1) combines a wave-like undulating texture with visualization of poetic excerpts from the poems written by community participants. Using Processing software, phrases are periodically selected at random and visualized using various time-based typographic treatments such as fades, variable font sizes, as well as crystalizing from and disintegration into pixels. The generative textural and poetic phrases are accompanied by



Figure 1. Generative audio-visual lighthouse projection at University of Connecticut Avery Point campus.

background audio based on processed glacier calving noises and water sounds punctuated by occasional recorded phrases from the community poets. During the evening event, as the level of darkness increases, the lighthouse becomes a more prominent backdrop to the projection, standing out against the coastal water beyond. The text and audio voices of the participants empower a public experience with personal reflections on climate change through the lens of local waters.

Digitally fabricated laser cut felt floor sculpture

The sculptural work of *Reading the Wrack Lines* (Figure 2 and 3) is a soft undulating felt floor piece comprised of digitally fabricated text phrases featuring excerpts from community poetry and environmental data. Embedded in the felt forms are two generative audio systems evoking the randomness of the environment. Community voices are identified by the script text form and environmental data is identified by the sans serif text form. These multiple points of view are composed, making a unified visual form—speaking in unison to the urgency and possibility for environmental change. All text forms are intermingled with the negative (or leftover) felt, resonating notions of waste and reuse. The work seeks to draw out the poetic from connections among the arts, environment, technology, and materials.



Figure 2. Reading the Wrack Lines laser cut felt floor sculpture with embedded audio on exhibit in “Fire and Ice” exhibition.



Figure 3. Detail of laser cut felt floor sculpture.

Summary

The collaborative intent of *Reading the Wrack Lines* project allowed for interdisciplinary synergy between a creative team spanning computer science, electronic sound composition, and visual art, and with the local community and environmental specialists. The work amplifies participants’ voices through physical and virtual public presentations. Our collaborative team plans on an ongoing series of installations that bring community voice, art and science together; immersively engaging awareness and activating voice about nature, place and a positive future climate. Funding for this work was provided by Connecticut Sea Grant, University of Connecticut through a Development Award in 2021, and from the Ammerman Center for Arts and Technology Faculty Research Grant at Connecticut College.

Authors Biographies

Andrea Wollensak is a multimedia artist, designer and educator. Her work spans media from traditional and digital fabrication to generative-interactive systems and includes frequent collaborations across disciplines. Wollensak’s work has been exhibited internationally, most notably at the Göteborg International Biennial of Contemporary Art and the Brno Biennial of Design. Her work has been supported by the Rockefeller Foundation, the International Artist Studio Program in Sweden, Anchorage Museum, Banff Centre for the Arts, and the National Science Foundation. She has presented her artwork at numerous venues including ISEA, CAiiA, Generative Art, and College Art Association. At Connecticut College, she is on the faculty in the Studio Art Department, and an Associate Fellow at the Ammerman Center for Arts and Technology where she served as Director from 2012-2020.

Brett Terry is a composer and sound artist when not busy with his daily life as a software engineer. His electro-acoustic, choral and chamber compositions have been performed at venues such as SEAMUS, ICMC, ISEA, CAiiA, and Sound Culture in addition to collaborating with visual artists on numerous audiovisual works. As an associate editor of *Computer Music Journal* (MIT Press), he has curated a special issue on Visual Music.

Bridget Baird is a Professor Emerita in Computer Science and Mathematics at Connecticut College and a past Director of the Ammerman Center for Arts and Technology. Her research examines the intersections among the arts and various technologies. Projects include investigating an archaeological site in Ecuador through virtual reality, exploring music and dance through motion capture and multiple modalities, using digital techniques and algorithms to better understand and mine historical documents, and more recently, addressing climate change and environmental concerns by using generative art. Baird collaborated, as a Fulbright scholar, with colleagues in both Mexico and Ecuador. Involvement with the local community has also been important to her and a constant interest has been to increase the number of women in the sciences.

Extensions of Reality: Plants and the Technological Virtual

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Abstract

This paper explores a selection of mixed, virtual and extended reality artworks (MR/VR/XR), through the theoretical lens of posthumanism applied to media art, as well as practice-led conjunctions of media and devices. Exploring recent works by the authors' and others, we speculate on plant blindness and *homo sapiens* immersion in the 'technological virtual', arguing this is not necessarily a retreat from the organic. For artist's working with plants as co-composers, this challenge involves avoiding the evolutionary trap of 'plant blindness', while utilising algorithmic processes that are programmed to be blind to the organic.

Keywords

Mozilla Hubs, Plant Blindness, Mixed Reality, Posthumanism, Climate Catastrophe, Anthropocene.

Introduction

Since the 1990s the extreme quality now possible with scientific imaging equipment such as electron microscopes have allowed us to see within previously opaque natural structures. Yet this seeming clarity has also problematised relations with other species. A visually illuminated knowledge of plant processes has afforded a greater understanding of their sensing capacities challenging previously held notions of plants as passive. Acknowledging the embodied processes and equity of two modes of situated agency, plant and human, elucidates an approach that understands plants as co-creators. [1] In the installation and performance *Contact/Sense* (2019), situated agency emerges as a tangled network of augmented reality infrared vision, gestural and signal etic data, connected by electrical signal and audibly through a bespoke soundscape (Fig.1). [2]



Figure 1. Headset view: Touching one another's signals, human and plant deliver a responsive refrain.

Techno-organic interfaces were networked together so that participants would experience immersive reality differently from a regular VR or MR situation, where there is a clear window to look through and a clean signal depicting logical representations of virtual objects. Instead of this 'clean and clear' paradigm of vision, a human performer wearing a modified HTC Vive with a Leap Motion gestural interface, is given a de-limited vision that is also grayscale and permeated with pixel artifacts or glitch. They feel their way through an improvised performance with a network of plants, using touch to co-create an arhythmic chorus that blends with micro-temporal rhythms emanating from the living plants they perform alongside. Visualized using custom software made in Unity 3D and Touch Designer (Fig. 2), this artistic research project examines potentials for performative interactions between humans and living plants.



Figure 2. Installation view with human and plant co-composers.

Utilizing the Leap Motion gestural controller in a non-standard implementation, it becomes a look-through the camera, affording a de-limited mode of vision that eliminates all colour. Seeing the world through this grayscale gloom, the wearer is engulfed in an occlusive vision that challenges the ocular. It seems appropriate that this this grayscale gloom becomes the disruptive fog that also affords a sensorial heightening of touch, and that this heightened touch affords artist/performers the opportunity to connect with their plant kin. Together with plants, the artists generate intra-actions where the plants have the first signal in the performance and lead the human performers who improvise alongside their signals. [3] This installation and performance located human performers in a co-compositional role alongside living plants, whose sonified bio-electrical signal triggered performer improvisations. Crucially, plant signals came first, leading the co-composition and luring humans to follow. Participants who

experienced the installation explored their own tactile and gestural experience of co-composition. Looking through the Leap Motion gestural controller as a camera, participants saw in mixed reality with grayscale vision, their vision de-limited and other senses enhanced. A performer, cloaked in this dark vision, must navigate through a visual fog that is the true inheritance of the Capitalocene. Feeling their way through this fog means engaging senses other than the ocular, gesturing toward potentialities that lever tactile responses to (and by) plants through the medium of sound. Reassembling data and human gesture using plant signals contributes to an emerging perception that a plant might also be considered as a 'body' in momentum, just operating at a much slower time scale than with humans and other animals.

Beyond Plant Blindness

Plants were there at the beginning in the cosmology of the garden of Eden, yet Adam and Eve played the leading role in true Humanist style. Now, we sit at the pointy end of a 300,000-year-old lineage as *homo sapiens* (Latin for 'wise man'), in what is known as the Anthropocene because of the enormous scale of our footprint, which has successfully trampled every other species in the biosphere. A pertinent time to turn attention from the creators of this egregious carbon footprint to the creators of the carbon: Plants. While we explore the Anthropocene as a scientific and artistic narrative, as well there is the meta-story of a humanity gone wild, evidenced by the visible scars left in the Anthropocene. Is plant blindness a further signpost to the visible decay that points materially to a gradually diminishing biosphere? As well, we consider a potential slippage between the scientific term Anthropocene and the speculative stage that we might term Anthro(s)cene. On the stage of the Anthro(s)cene, where human visibility is inflected with the gradual becoming-invisible of flora and fauna, affords a pertinent time to consider our plant kin. On this stage, we find a tension between the terms 'climate catastrophe' and the more measured 'climate change'. As developed in a plethora of social actions, through on and off-line media activity, prominent groups like Extinction Rebellion and activists such as Greta Thunberg and Bill McKibben have taken the message of an impending 'climate catastrophe' to the masses. Using social media posts on Instagram, Twitter and Facebook as a means to circumvent mainstream media blockages on the topic, climate catastrophe as a discourse sets the scene for a zeitgeist of resistance. Parallel to that, we find 'climate change' operates as a milder, government sanctioned cousin, and in some cases (such as in Australia) might in fact be part of a strategy for hiding a range of environmental abuses, such as new contracts for coal mining, gas fracking and water mismanagement. Yet, while *homo sapiens* possess an allegedly superior consciousness in relation to other species, we have also evolved bias toward things we perceive as peripheral. One example is found in the phenomenon of 'plant blindness'.

Being subatomic and microscopic, plant processes are notoriously hard to observe, yet we can broadly trace their movements through monitoring the currents and signals plants give off as they live. According to plant neurobiolo-

gist Stefano Mancuso, humans notice animals far more readily than plants. [4] Mancuso illustrates this phenomenon, called 'plant blindness', by the simple act of showing humans pictures with people, animals and plants, and observing that time and again many human subjects notice the plants last: after the humans and other animals. Are we *homo sapiens* ignorant of the gifts of plants, their support for the oxygen cycle that keeps us all alive, and feeds the food we eat? Sometimes, the answer is 'yes'. Existing within the pressing temporal reality of an entropically spinning climate emergency, we might also feel that art has a responsibility to gesture toward new ways of co-composing with our non-human kin, in a way that draws attention to their significant contribution to all life.

Plant blindness, an evolutionary bias, helps explain why some humans selectively perceive the role, value, contributions and activities of plants as less necessary than those of animals. [5] Another approach that humans have taken to figuring plants is the notion of their passivity. Passive objects are not threatening, so we fail to notice them. Thought to be an evolutionary attribute of the human ocular system, plant blindness generates a socio-cultural affect where humans fail to notice plants, even when they are right in front of them. This politics of space, where we notice perceived threats and act accordingly, is particularly prescient in relation to the pandemic, where our virus foe is indeed unseen, attacking by stealth and immersing the human body in its Bacterioscene. [6] Yet, could the Bacterioscene also operate as a counterbalance to the anthro(s)cene, with both concepts offering new vectors and potentials for posthumanism? This might suggest that what is unseen actively generates a 'scene', perhaps of fear, anxiety, loss, might also afford a reaching out to new pathways and potentials. In order to re-present the big H of Humanism at a more humane scale, we might counter with a posthumanist twist that, with Donna Haraway, fosters a horizontal, networked relationship with nonhuman kin.[7]

Examining this scene further, we find the same Humanism that figures plants as passive, does so to afford an opportunity for exploitative networks of resource extraction to take what they need and turn it into wealth. Such tentacles grasp us today through the pervasive economic logic of neo-liberal capitalism. This scene exists in contradistinction to the scientific reality that plants are the industrious producers of approximately 95% of the biomass on Earth, supporting all the systems that every organism needs to survive. Plant neurobiology speaks to the material reality, unravelled by quantum physics, that every particle in the universe is connected to its nearest neighbour, and through those neighbours to all other things. While quantum imaging has provided visual proof of this connection (Barad 2008) it is a concept that has always been known to indigenous people, and in my culture, Māori from Aotearoa/ New

Zealand, we understand this connection between vegetal, organic, to underpin all material and cosmological reality.

Voxel Plants in Extended Reality

To avoid full immersion in the potentially deadly Bacterioscene, many *homo sapiens* moved further into the technological virtual during this ongoing global pandemic. Yet, *homo sapiens* immersion in the ‘technological virtual’, did not necessarily also signal an eschewal of the organic. Artists enthralled with plants found ways to reconstitute their organic kin in virtual spaces. Struck by the pandemic, the world looked to move everything online, with greater and lesser success. Voxel’s – or ‘volumetric pixels’ in non-abbreviated form – became central to the language of a range of online artistic mediums. After February 2020, the platform Mozilla Hubs, an open source shared virtual space platform with ambitions to become a game metaverse, soon blossomed with artistic creations. One peak amidst this wave of virtuality might be identified as the Ars Electronica Hubs exhibition, *In Kepler’s Garden’s* (7-12 September 2020). For artists who work with virtual spaces, the pandemic provided a fruitful opportunity to re-figure conventional relations with gallery space and offered the capacity to introduce wider audiences to virtuality registered in three dimensions. In collaboration with VR/XR artist Alison Bennett, First Nations artist Rewa Wright (Ngāpuhi and Te Uri o Hau) built a series of 3D photogrammetry point cloud rooms for the Ars Electronica Newcastle Garden. The networked platform was Mozilla Hubs, an open-source portal through which to stream audio, pre-recorded video, and host artist live telematic multi-user performances. Into these liminal and evolving mediatic spaces, a community of 14 sound artists and electronic musicians were invited to experiment with collaborative and networked performance, to co-create a ‘contact zone’ (Haraway 2006), fit for the future beyond the now. One of the key works, *Cherry blossom Spheres*, by Alison Bennett formed the entry area of the WebXR room network.

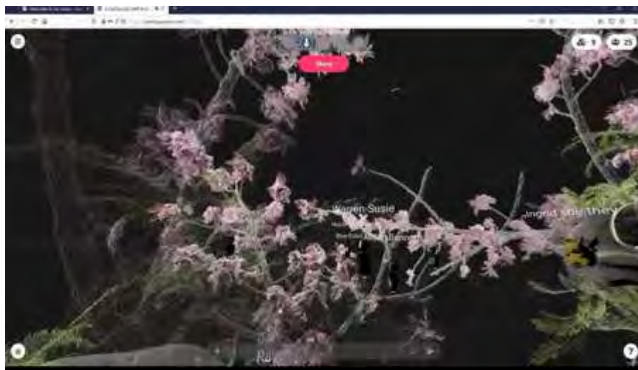


Figure 3. Screenshot from Dr. Alison Bennett’s WebXR hubs room at the Ars Electronica Newcastle Garden, September 2020. Name tags index participants interacting with the cherry blossoms. Image used with permission of Dr. Bennett.

This virtual room was designed around a point cloud re-versioning of delicate cherry blossoms from Bennett’s Melbourne Garden. Bennett’s expertise in plant photogrammetry is influenced by a postrepresentational approach to the organic world, a remote re-versioning of blossoms that can only bloom as networked art. These delicately rendered, scanned images separated into thin air as participant’s passed through. This experience was accessed

through virtual reality headsets, as well as on desktop, however only the former experience offered the actual feeling of parting the blossoms’ voxels. Bennett (with curator Wright and other present artists), hosted tours of rooms network throughout the festival. As participants shuffled closer amongst the blossoms, like anthropo(s)genic faeries in an occult Midsummer Night’s Dream, their digital avatars nodded tiny voxelated heads adorned with name tag crowns (Fig. 3).

Volumetric Pixel Forest (2021) was a co-composition with a generative adversarial network and an *agave attenuata* plant, crafted into an audio-visual performance file. [4] The neural network was called upon to interpret human visual data: filmed video footage from live performance in mixed reality by the artists. The performances consisted of interactive sequences made in Unity and Touch Designer, and the concept was that the Generative Adversarial Network (Style GAN 2), would further process this data and

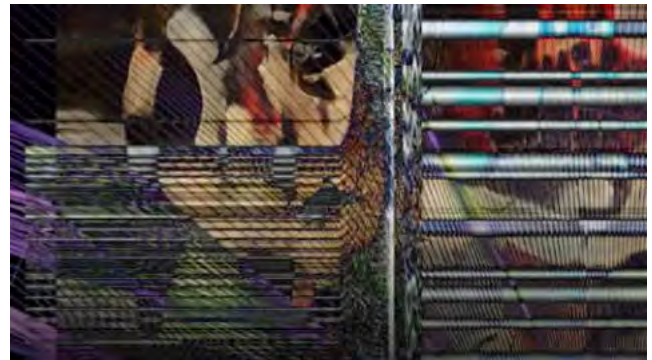


Figure 4. Still from *Volumetric Pixel Forest*, ML/Human/Plant co-composed file.[8]

produce its own reassembled file. Then, the artist would take that file and build a new interactive performance using its visual elements. The initial process of uploading video footage of performances through a GAN (using the ML Runway software), created a new sequence of data based on prior documentation of art installations. Now, reassembled by machine learning algorithms as filtered by the GAN, in a posthuman sense it might be said that the data was intra active amongst its own ‘kin’, through the vibrant process of filtering optical attributes from each adjacent video frame. This process is mysterious for the human interlocutors who will eventually take the processed data and create a new performance. The GAN filters data on completely different grounds of selection to what a human eye would have chosen, with the final rendered result emergent through a careful computational privileging of certain attributes (such as depth, luma, edges). Human selections would have revealed an aesthetic bias, based on thousands of years of human brain-eye evolution and preferences for certain types of aesthetic form. *Homo sapiens* tend to privilege concerns such as complimentary colour, balanced composition, clarity of line and perspective. Once the Style GAN had rendered its data, the artist then exported the results to a custom-made network in Touch Designer, where feedback and noise was overlaid to distort the already distorted field of machine learning data further. Since the GAN used was trained to recognise human faces rather than plants, an intentional choice by the artists, plant forms become re-versioned around the human body.

Summary

Thinking around plant blindness and with posthumanism, this essay has speculated on Anthropocene as a scientific vector, and Anthro(s)cene, as a stage of visibility where we might lure new conjunction of devices, humans, plants and algorithms. Fearful of the Bacterioscene, homo sapiens retreated into the technological virtual, however this was quickly filled with new imaging of the organic. Already, speculative spaces are opened that offer new affordances and remind us that outside, while we retreat from the pandemic, the climate catastrophe unfolds.

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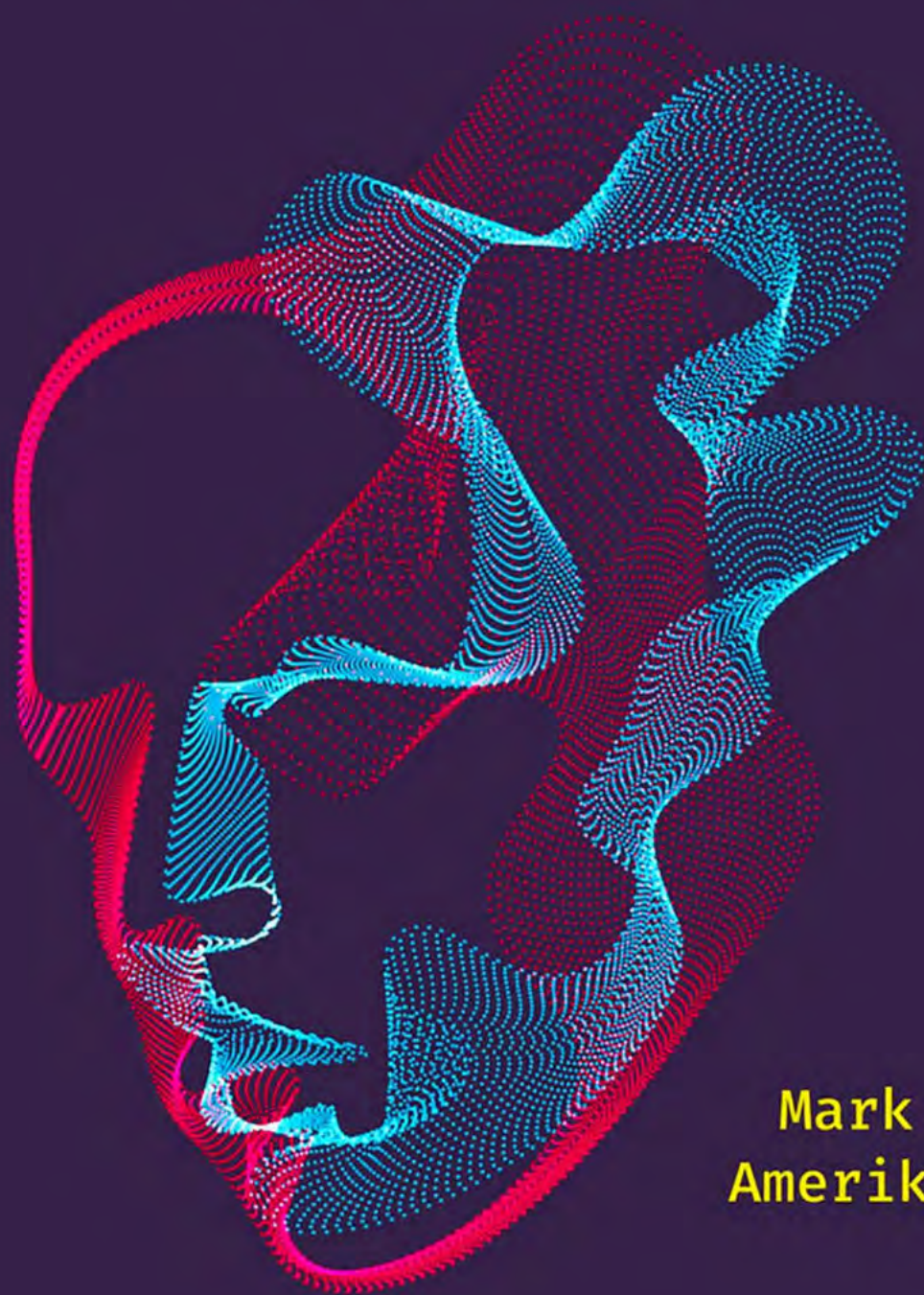
[8] *Volumetric Pixel Forest*, ML/Human/Plant co-composed file. Screened at 'We Are Not Alone LASER' series, Fortaleza, Brazil and 'Ars Electronica Leonardo/ISAST Garden' 2021. Curated by Clarissa Ribeiro.



ISEA2022
BARCELONA

ARTIST TALKS

MY
LIFE
AS AN ARTIFICIAL
CREATIVE
INTELLIGENCE



Mark
Amerika

LIMBO (2021) – The Sea Levels in a Sound and Visual Immersive Experience

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Abstract

LIMBO (2021) is a Live Sound and Live Visuals performance that reflects on the rise of the sea levels environmental issue, its impact and effects in our cities and countries. Being both the visuals and the sound designs constructed in an improvised live performance, the method on which the performance itself is built – intrinsically connecting both mediums – has got layers of complexity, not only from a technical perspective. That synesthetic relationship is also indeed dialectic: how to construct a live sound thinking of a visual impact and how to construct a live visual to be “disturbed” by the sound. Or, in simpler terms, how to paint with music and how to play music with paint. From this, the *voyage* about our impact in the loss of our cities, of our biodiversity, on our heritage is a meditative, immersive, and reflective act, and a both personal and collective experience.

Keywords

Live, Sound, Visuals, Performance, Sea, Climate Change, Improvisation.

Introduction

According to the recent special report on *Sea Level Rise and Implications for Low-Lying Islands, Coasts and Communities* for the Intergovernmental Panel on Climate Change, the rate of Global Mean Sea Level (GMSL) is “rising and accelerating”, as the sum of glacier and ice sheet contribution is now its dominant source. The main cause of GMSL, that went from 1.4 mm/yr over the period of 1901-1990 to 3.2 mm/yr in the period of 1993-2015, is presented to be the “anthropogenic forcing”, which is, indeed, the human action. Throughout the report, several risks and impacts are presented, from the socio-economical effects to the natural environmental issues to our ecosystems and world health. [1]

Indeed, the reflection about this major problem is the framework for the referenced performance. This relationship between artists and climate change is a current subject that is creating quite some debate. In an article for *The Guardian*, Andrew Simms recalls Brecht’s challenge to see art not as a mirror but as a hammer to shape reality, sends the clear message: “climate action abhors a cultural vacuum”. [2]

From that premise, it is possible to understand the artworks of several artists and movements such as *Waterlicht*, by Studio Roosegaarde, *Olafur Eliasson’s Ice Watch* or *David Buckland’s Ice Texts* – all works that create awareness for the climate change and, more specifically, to the water, and are, naturally, references for our work.

However, according to Roosen, Klockner and Swim (2017), not all artworks that approach this subject have got

the same level of effectiveness in the public engagement. That way, there are presented several aspects that are considered important for any “climate change artwork” to integrate, for instance, “making use of narrative or metaphor, prompting awareness, attention, and reflection (...) providing a way to visualize climate change and giving the audience a personal experience of the issue (...) inducing a (positive) emotional response, especially when this includes inspiration”. [3]

This artist talk/work-in-progress presentation will be divided in 3 sections: first, an explanation on the construction of the live visuals and its challenges. Secondly, the same principle will apply to a detailed approach to the live sound constructions. Finally, the last section will explain the mechanisms, questions and solutions encountered to assemble both in a live performance act.



Figure 1 LIMBO (2021) Visuals Example Frame

About the Live Visuals

The overall of the visual contents was questioned from the beginning of the process. We realized that the interaction between two spheres would allow for an interesting result while maintaining a strong cohesion with the main theme.

Structurally, there are two spheres, one that has as a base input images of the globe and representations of the sea levels with the respective graphic representations and the other layer, in translucent and transparent parts, surrounds the first one like an atmosphere.

For us, it was also very interesting to put images that often appear in 2D, such as the evolution of the sea levels, the defrost or the rising temperature of the seas, to 3D. This enhances the association that these issues are “our” world. This “worlds” are indeed the Planet Earth and this way one is indeed able to identify it.

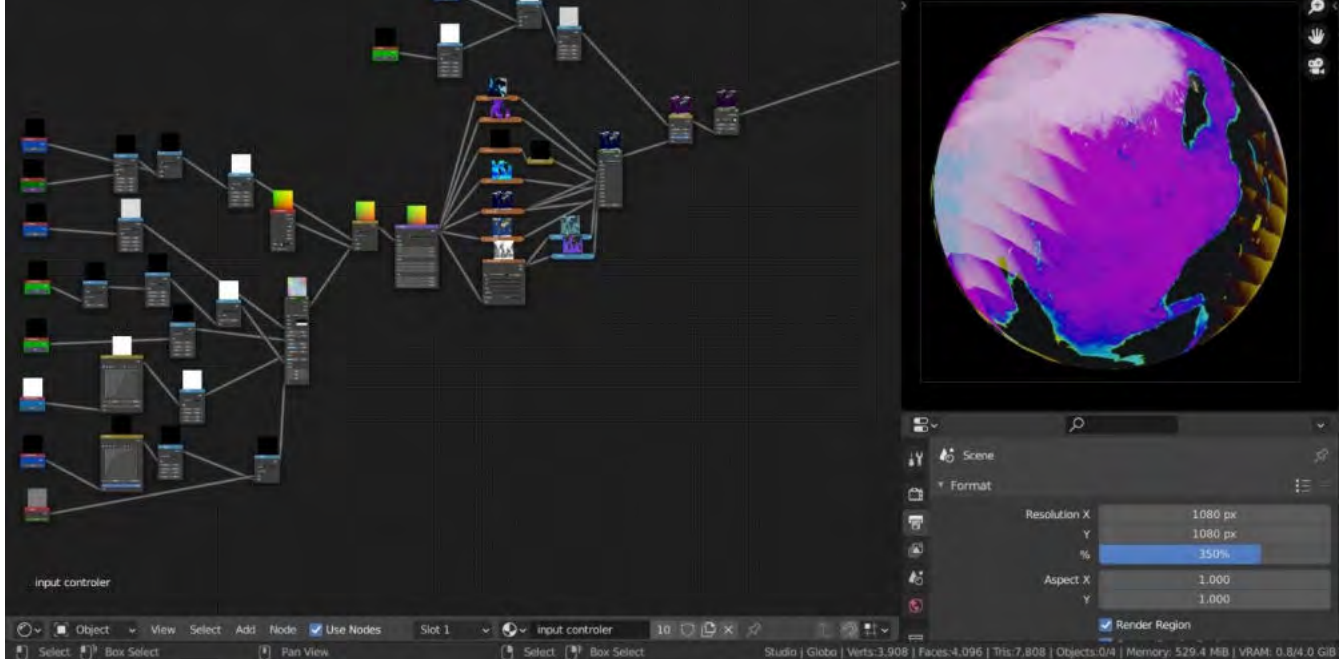


Figure 2 Layout of Blender 3D interface for the performance design.

The visuals were designed not only to react to the sound, but also to emerge and mark their presence with an intensity of color and light according to sound. This allows for strong moments of clear connection between the audio and visuals. The overall environment created by these two components is consolidated by the focus on the simple circle shape projected on the space. Often in this genre of live audiovisual performances, it is usual just to associate sounds with strong flashing movements. Our goal was also to create a more meditative environment, not an aggressive one, but a reflective where the visuals and the sound don't need an intense movement to create a synesthetic relationship.

The elaboration of the visual component constitutes firstly in an establishment of what would be base content layers and effects. These components were designed with a procedural structure that allows the interference of any type of input in the variables of the system, later it was added the interaction of certain frequencies in the variables of the visual components.

Inside the structures of the visual components, there are a large number of variables or variations that were attributed to the time but were changed to the variables that come from the sound. Blender 3D allows the live input of live audio and interprets that as an array of frequencies that are then associated to the visual variables and, that way, make them fluctuate with sound.

About the Live Sound

About the construction of the sound design and musical environment there are two dimensions that require further explanation: on one hand, the sound itself – how it's built, its improvisational construction and how it relates to underwater sound recordings and, on another hand, the adaptations it requires to melt with the visual side, returning to the idea of "how to paint with music", with is, how to create a music for its visual impacts.

The sound has a central role in the creation of a reflective environment. In fact, not only for its impact in the visual side, and consequently, in the construction of the narrative along the performance, but for its meditative and reflective entourage that bonds the audience to the piece and, for that reason, the subject and narrative.

The sound has got two main layers that interact. First, the processed saxophone live sound, with several audio effects that echo and distort the melodies, give somewhat the

impression of them coming from underwater. Indeed, the fact that the audience can identify that the melodies are coming from a person who is playing is not a detail. It is a human hand that is producing the sounds, it is a human hand that is producing that sounds that impact the visual of the globe and it is a human hand that, unfortunately, is producing the effects on the GMSL. Also, the melodies that recall the idea of memories, heritage are also human characteristics that adds layers of engagement to the performance.

Behind all this, there are layers of underwater sound recordings from different depth (2m, 5m and 10m). Also, sound recordings of dolphins step up in a dialogue with the melodies. The dolphins, as well as whales, are under a huge threat from climate change and the sea level rise, as it can affect "the timing and ranges of their migration, their distribution and even their ability to reproduce". [4]

Because the sound is evaluated primarily by its impact on the visuals, and the way the communicate is by a reading of the frequencies of the sound, some considerations are important. Firstly, it is important to construct a pedal of sound to trigger the effects on the globe, otherwise they wouldn't exist as they are dependent on the sound to appear.

After the stabilization of the pedal, it is important to create different sounds for the globe to change and evolve in different shapes. The use of a spectrum that only captures the frequencies help the fact that there is no need to great intensity fluctuations.

The fact that the sound is produced in a live improvisation is crucial for this synesthetic performance as the sound is produced with a live attention to its impact on the image. Mitchell Whitelaw presents this as 'cross-modal' sense, the audiovisual sense, in which and by which diverse media are conceived and perceived together, equally, made from the same, in our performance, frequencies. [5] The sensorial bond between sound and image, and for Whitelaw and Cooke, "what live audio-visual performance works seek to do is precisely to 'make a new sense'". [6]

About the Performance

Why is it different from a sound + image performance? First of all, as explained, the constructing is unified. That is, there is no separate visual and audible perception as the goal is creating a new sense, where the audio and visual come as one.

Despite that, the interfaces in the computers need to be separated, which means one computer is generating the audio and the other the sounds, and they are only connected via an audio jack. The way we found to bring the interfaces even closer was to connect hardware (digital controllers) that we could map to control the performance.

Because of that, the knobs and keys create one “giant controller” that, in spite of being connect to both laptops, creates an analog interface that can be controlled by all the performers at the same time. This “giant controller” is still a work in progress, if not by the fact that there are always new ways to map, organize and expand the analog control of the digital interfaces, connecting them even further.

In the improvisation aspect, it is important to mention that a great amount of the audiovisual creation is programed to be randomized, so that, in the improvisation, we have to adapt, in real time, the interactions we want. This layer of unpredictability is key to engage in an improvisation performance, otherwise the performance would be “trapped” in a somewhat fixed form and, consequently, lose a great aspect of complexity and interest.

Acknowledgments

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Authors Biographies

André Araújo is a Musician/Visual Artist from Porto. Since his childhood, he plays the Flute, culminating in his studies at the Conservatory of Music of Porto where he transitioned from classical music to Jazz and Improvised Music. That way, he joins the Koninklijke Conservatorium Brussel (Royal Conservatory of Brussels, Belgium) where he completes his bachelor’s degree in jazz (Cum Laude). His musical evolution in the Belgian capital, increasingly approaching electronic music, free jazz and improvised music, led him to feel the need to associate visual interaction components to his musical practice. Nowadays, he’s taking a master’s degree in Contemporary Artistic Practice at the University of Aveiro. He is developing projects and experiencing the way his music interacts in various ways, namely in Performance, Digital Video Art, Net Art, Installation, Virtual Reality, among others.

Nuno Sousa is a multimedia student, with a degree in production of interactive content and multimedia, entered the erasmus program where he studied cinema on the Krzysztof Kieslowki Faculty of Radio and Television. His specialization is the modeling and rendering of 3d content, mainly interested in ceramic pieces and portraying people, moments or experiences in digital media. Over time he has collaborated in several projects predominantly as a Photogrametry freelancer, he is now starting a master’s degree in contemporary art.

Marta de Menezes (born 1975) is a Portuguese artist, with a Degree in Fine Arts from the University of Lisbon and a MSt from the University of Oxford. De Menezes is director of Cultivamos Cultura, the leading institution devoted to experimental art in Portugal and Ectopia, dedicated to facilitate the collaborative work between artists and scientists. Marta de Menezes has worked in the intersection of art and biology since the late 90s, in the UK, Australia, the Netherlands, and Portugal, exploring the conceptual and aesthetic opportunities offered by biological sciences for visual representation in the arts. Her work has been widely exhibited in major venues in all continents, presented in most anthologies devoted to bioart, discussed in doctoral dissertations, and considered an example of research in the visual arts. Among the most recent international exhibitions, de Menezes was invited for the 2019 Ars Electronica Festival: Out of the Box, and organized two 2020 Ars Electronica Gardens (Lisbon and São Luis). She was invited to be the official representation of Portugal at the London Design Biennale 2016 and exhibited at the Beijing Biennale of New Media Art 2016. DeMenezes was nominated in 2015 by Time and Fortune magazines for the Art and Technology Awards 2015.

INTER/her: An immersive journey inside the female body – artist talk

Abstract

An immersive installation and Virtual Reality artwork focussed on post-reproductive diseases and pain over 40's women experience: endometriosis, fibroids, polyps, Ovarian and other cysts, cervical, ovarian, uterine and endometrial cancers. The sensory and emotional experience moving from the outside in within a real dome space into VR space, with a 3D audio soundscape of the voices and stories of real women recounting their experiences, making it an intimate, emotional and possibly haunting experience, with accompanying wearable haptic garment providing a visceral vibration responsive experience on the lower abdomen, where the various diseases occur.

Keywords

Women's reproductive diseases, virtual reality, haptic interaction, intimate immersive experience, interactive installation.

Introduction

INTER/her focusses on the difficulties women in diagnosis and treatment of various reproductive diseases face, and it was motivated directly from the artist's own experience fighting (and winning) against ovarian cancer in 2016/17. It provided the personal imperative to make an artwork that would give something back to other women in the same circumstance. The project is based on the experience and journey through the healthcare system but using the artist's own art practice as the frame in which to communicate the experiences, emanating from silence, inconsistent information and varying medical support for women's health. It is also inspired by the stories she then started to hear from friends and family about their reproductive disease experiences, which seemed hidden or kept to themselves until the topic was raised.

INTER/her is an intimate VR immersive exploration of the inner world of middle-aged women's bodies and the post-reproductive diseases they suffer, such as endometriosis, fibroids, polyps, Ovarian and other cysts, cervical, ovarian, uterine and endometrial cancers - with a focus on female health as personal exploration, conversation starter, and community building.

The sensory and emotional experience moves from the outside, within a real dome space, into VR space with a spatial audio soundscape of the stories in the voices of real women recounting their experiences of diseases and pain, with accompanying wearable haptic garment providing a visceral vibration responsive experience on the lower abdomen, where the various diseases occur, making it an intimate, emotional and possibly haunting experience.

THEORY &/ IN PRACTICE

INTER/her explores concerns of female mortality, but also a survivalist instinct to cleanse the body to heal it; positioning the physical body as a site to examine the psychological issues of womanhood. Themes of sense of self and identity, loss of body parts, body image, sexuality, confusion, pain and lack of reliable information, still male-dominated medical institutions, body betrayal, ailments and tumors - representing negative festering of pain and anger, and feelings of mortality.

Initially, the project started from a more overtly techno-feminist perspective, but overtime and while focussing on the practical and aesthetic production with the mainly fe-

male team, the intellectual feminist perspective fell away to a more intimate, emotional feminist camaraderie motivation. All the women on the team had faced the same issues that are explored in the piece itself, from polyps, fibroids and endometriosis to menopause and HRT and ongoing testing and biopsies and pain.

In terms of women's bodies, as Caroline Criado Perez explains (2020) in her book *Invisible Women: Exposing Data Bias in a World Designed for Men* - the male body is the standard body in most aspects of the world, and the female body is the "other". In terms of ISEA's Themes the Human - Non-Human is the closest fit for the work and this talk, as once the female body, 51% of the world's population, is no longer considered "other" but also standard, we can then start to think about what it means to be human. If women's bodies are not standard, are they considered non-human? Women's bodies have not been researched enough nor considered important enough for GP's to spend more than a 1/2 hour optional study module (in the UK, according to Davina McColl's Menopause documentary, Chanel 4, June 2021).

Once we understand women's bodies, as well as the range of bodies that exist (differently abled, trans bodies, animal, etc.), we can begin to answer how to become bodies in the world. Once we understand the female body better and how hormones affect the brain and body, and other aspects of the female experience of pain and diseases, we can better address the other questions of humanity and non-humanity. A better future is when women's bodies are considered as important as men's and receive the research and treatment on equal basis to men.

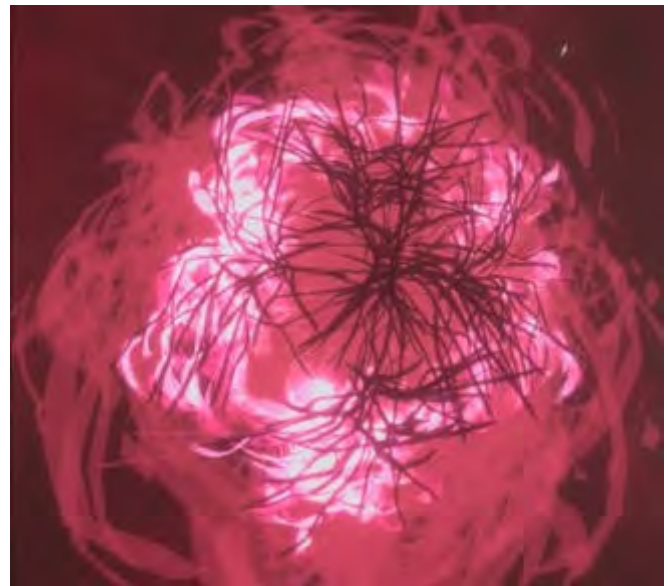


Figure 1. Early interior artwork for inside the VR experience © January 2021 designer for *INTER/her*

From a first-person perspective of 'feeling from the inside, excerpts from the books "*Invisible Women*" by Perez, on the way the health care system fails to diagnose or support women in pain and disease; and "*WOMAN: An Intimate Geography*" by Natalie Angier for the biology dimension, exploring concerns of mortality, but also a survivalist sense to cleanse the body to heal it; positioning the physical body as a site to explore psychological issues of womanhood and the sense of self, exploring the body: vagina, uterus, cervix, Fallopian tubes, ovaries, bleeding,

pain, endometriosis, Fibroids, Cysts and other disorders, technology, treatment, surgery, etc. All threaded with actual women voicing their experiences with bespoke music and sound effects to accompany each story.

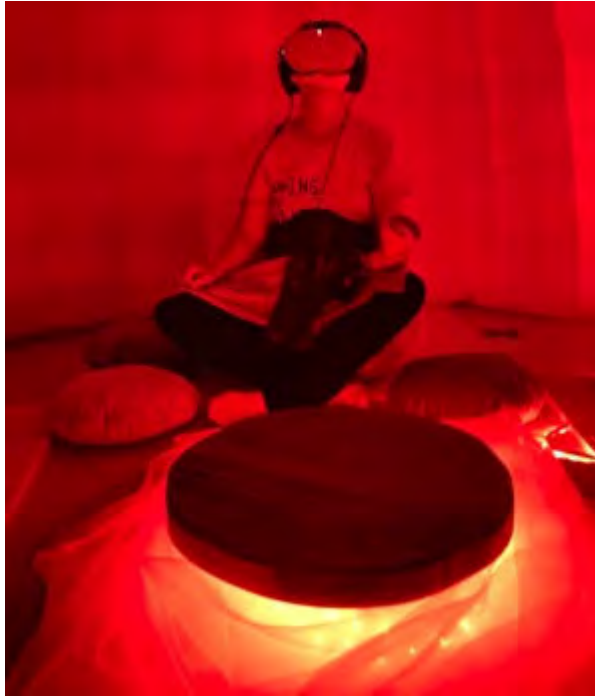


Figure 2. Visitor inside the “Sitting Womb” for the audience testing © May 30th 2021, artist

Methods

The stories were initially collected via social media, calls, and volunteers. The intention was to see them in person and record their voices, when the pandemic started a new plan was implemented: to use a combination of real stories and excerpt passages from the above books, especially, Angier who has a poetic way of writing about internal female body parts and bodily processes. Voice recordings we sent in, but the quality was not high enough to use, and the stories at times would meander too much to be usable – understandably as these women had lived it and their experience was not merely a sound bite. Even Baker’s own ovarian cancer story had to be edited and then tossed for being too long.

The main collaborators started working together on a prototype funded by the main artist’s university from October 2019 to June 2020, and enabled Baker to do the fundamental research and development, create the story/narrative/script (loosely), and the interaction design, and other pre-production elements, as well as recording some of the story with women, and to do a form rapid prototyping in VRChat. However, all work was done on a part-time basis to the busy schedule of both artists, and the funding was not enough to undertake actual production, although Alvarez is invested in the topic herself and put a lot of extra work into it.

The main collaborator helped the artist to understand what was technically possible using the software Unity and 3D design tools, as well as helping to create a prototype and a solid plan for the final stage of the project. Then with the success of further funding from the Arts Council England came in September 2020, the two were able to build a larger production team to take the project to exhibition stage, as well as having the Access Studios curator to partner for the project to exhibit it in Sheffield, as well as the

university co-funding the project to exhibit in Folkestone in summer 2021.



Figure 3. Haptic corset with vibrating actuators in the belt, designed by Bushra Burge © March 2021 designer for *INTER/her*

The team had many shared personal and artistic experiences together and in VR, using various tools available: such as TiltBrush, Gravity Sketch, Blender, Unity, Side-Quest and GitHub. Alvarez helped Baker to understand what was technically possible using the software Unity and 3D design tools, as well as helping to create a prototype and a solid plan for the next (current) stage of the project.

Experience

INTER/her is an immersive visual journey and emotional experience, from the inside out within the bespoke tent space, with accompanying wearable haptic garment providing a visceral vibration responsive experience on the lower abdomen. The tent has a vulva-shaped opening and up to 3 women/visitors can lay on red beanbag chairs on the floor inside and are pre-dressed in the haptic corset, to feel the sensations on the lower abdomen triggered by related stories / voices being heard in the 360 interior body space.

Participants are dressed in the haptic corset, fitted with embedded vibration motors actuators in order for people to feel different sensations on the lower abdomen while listening to the stories / voices. The imagery is of abstract organic objects like flowers, plants, and fungi, to represent the different diseases women can suffer from that grow and mutate, as each story is told to keep the attention of the visitors before they move on to the next. Spatialised sound with the women’s voices telling their stories and women’s disease experiences, and bespoke soundtrack and ambient sound effects of breath and heartbeat, for atmosphere - all to support the main narrative and move visitors to the next story and to empathise or relate to the experiences of the women whose voices are heard.

Each woman/visitor is debriefed afterward to ensure that they are ok with what they experienced and to discuss their experience, as well as to give feedback on the experience. The exhibition will be accompanied by female health information and health support charity leaflets, to take away and to help inform and support visitors to reflect on their own bodies.



Figure 4. The vaginal tent exhibiting in the Brewery Tap Project Space Gallery, Folkestone, UK © June 2021 Camille Baker

Visitor Feedback Quotation

“I just wanted to say that the work was really affecting, and I could relate to so many of the stories shared. My mum’s suffering was dismissed when she complained of heavy and constant bleeding - she died three weeks later from a cancer that had originated in the womb. She was 46. I could also personally relate to the work, through past experiences at sexual health clinics, GPs, hospitals. Your work is so important - thank you so much for realising it. I am currently ...research[ing]...works to reclaim female subjectivity using technology with geological sites of trauma...”

Victoria Lucas
October 18, 2021.

Conclusion

For the ISEA 2022 there will be a full, in person, exhibition of the VR Installation on site in Barcelona for symposium attendees to experience and discuss, to exchange views on the larger feminist and medical issues. The artists talk will explore the production and exhibition development through to outcomes and observations of and from the various audiences and locations in receiving and experiencing the work as an artwork, conversation starter and as a feminist statement on reproductive health failings in the larger medical community and societal view of the female body.

Acknowledgements

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Extemporal: an Ecomedia Platform for Critical Making

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Abstract

This doctoral work in progress centres around facilitating intergenerational Critical Making programs and designing a participatory platform for engaging in DIY citizenship and connecting environmental concerns. Through hybrid online and in-person workshops, meetups, and community art projects, the research investigates the prospects and problems of participation in exchanging ideas, skills, and upcycling. This presentation reviews independent maker spaces, eco-art, citizen-science and grassroots participatory platforms where alternate modes of media-making are possible. The culmination of the doctoral work is a participatory project for senior citizens, youth, artists, activists, and citizen scientists to contribute art, data (mostly on water quality), documentation of restoration efforts, and local stories in rural Colorado, U.S. The media submitted to the platform will be used in public large-scale interactive projection experiences. This will be the first arts-driven project with the citizen science platform CitSci.org.

Keywords

Community platform, citizen science, participatory art, critical making, ecomedia, Capitalocene, intergenerational art, DIY citizenship.

Ecomedia

During COP26, Facebook hosted ads on climate scepticism. UK-based think-tank InfluenceMap found that several fossil fuel companies and lobbying groups spent \$574,000 on Facebook ads promoting their environmental efforts, i.e., greenwashing, during the summit, resulting in more than 22 million impressions. [1] Facebook, Google, and Apple have been relatively successful in cutting their emissions, implementing renewables, and planting trees in the last 4-5 years. [2] Microsoft is well on its way to capturing carbon for carbon negative. [3] However, they are all large enough that energy prices make up a significant share of their costs. Thus, it makes sense to invest in more efficient technology either by reducing energy consumption or by moving it to where it is cheaper.

Thomas Moore questions how the complexities of planetary crisis and global accumulation can be reconciled and outlines that the “Capitalocene signifies capitalism as a way of organizing nature—as a multispecies, situated, capitalist world-ecology.” [4] For example, the COVID-19

pandemic highlights how diseases become pandemics due to industrial reconfigurations of nature, and ecological and socioeconomic injustices. The primary source of viruses that emerge from capitalism is large-scale industrial agriculture. The practices of capitalist agriculture set the stage for market trends in China, and commodity nations contribute to new epidemiology’s along the route and that the globalised manufacturing line expedites the pathogen virulence and transmission process. [5]

As Moore explains, the Capitalocene is a system of power, profit, and reproduction in the web of life. Capital persists through the privatization of commons, and then the common good is resold as private debt. The write-off of obsolete stock generates waste into the environment, which claims defers to another generation and market crisis. Waste is not an unintended consequence of consumerism since there would be no consumer capital without it. [6]

Despite the detrimental resource demands of technological infrastructure, there is strong justification that individuals and communities should have the technical means to change their environments and social structures right now. The way around this contradiction is thinking of complementary ways which empower individuals and communities to generate a sustainable future.

In response to making climate change science more accessible, there have been calls across the arts, humanities, and sciences to create alternative structures for climate change communication—participatory and collaborative structures. Ecomedia is not merely representative, nor is it focused on the aesthetic creation of artefacts. Ecomedia is socially engaged. Community organisers and facilitators working in ecomedia and eco art respond by producing participatory art, workshops, and platforms that engage community voices. These community platforms are supporting a new era of citizen-driven social and environmental justice.

Critical Making

Rather than bringing people together to solve a problem, we can collaborate on possibilities of waste, restoration and repurposing with Critical Making. describes Critical Making as an "ongoing critical analysis of materials,

designs, constraints, and outcomes, participants in Critical Making exercises together perform a practice-based engagement with pragmatic and theoretical issues." [7] Thus, Critical Making is a practice for questioning the cultural implications of technology through experimentation with forms and materials. Critical making also generates new knowledge of production by engaging in commons and open-source ecology, enabling the distribution of agency, power, and resources amongst communities. Beyond the makerspaces and hackerspaces that have increased in the last decade, critical making does not need a space and does not need to solve problems; but can appear in these spaces or come out of them. A lab or maker space can provide the vehicle for communities to develop.

In 2021, I co-facilitated a hybrid maker space with Brandon Grossman. The maker space was part of a STEM outreach program for youth ages 6-12 in foster care in the Boulder-Longmont-Lafayette area. During foster placement, youth frequently move between homes, often as short as two weeks for their initial placement, and some are never placed. Aiming to make a more horizontal environment where agency is shared despite the levels and durations of care, we facilitated asynchronous activities through monthly email prompts, three meetups on Zoom, and a web gallery using the collaboration software Padlet where the families could upload their creations. Brandon and I would write and reply to comments on the posts, as well as make posts. We found that these distributed maker activities and meetings on Zoom to connect through stories are modes for attending to new family dynamics and subsequently form rapid creative relationships between youth and their caretakers.

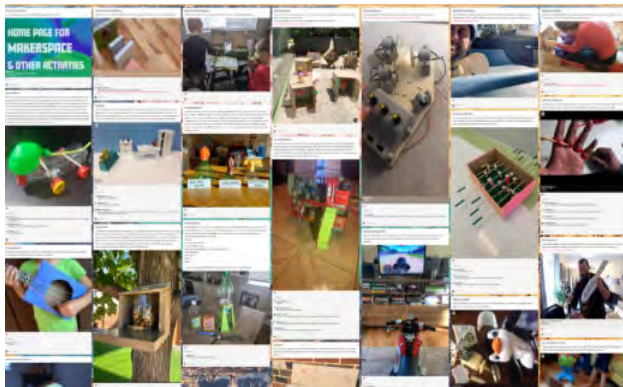


Figure 1. Screenshot of Extemporal: online maker space for youth in foster care. ©Kimberley Bianca

Another ongoing project is futures2051, a series of maker workshops for upcycling e-waste sourced from objects found at home or a digital file to create artefacts from the future. Supported by CU Boulder's Environmental Center for an Earth Day program around the year 2051, I co-facilitated the online workshops with media artist Sarah

Manning. The central prompts were: What would everyday objects look like in 2051? What kind of future do we want to contribute to? Participant projects included a DIY musical instrument being repurposed as a cable management holder, a power button being repaired, a digital collage made from scanning in scrap magazines, and a handmade projector. We found that this style of workshopping has greater potential to be in-person as we could not readily exchange tools and resources.

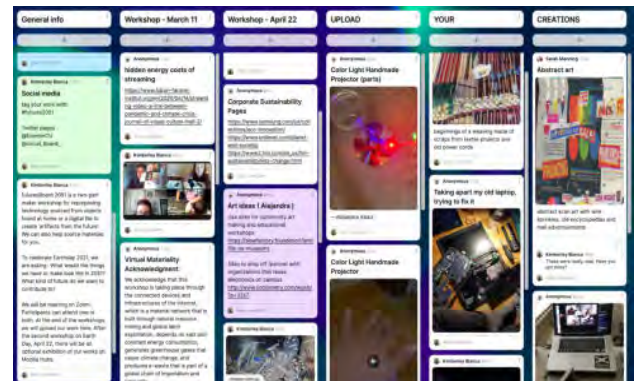


Figure 2. Screenshot of Extemporal: futures2051 workshop participation board. ©Kimberley Bianca

Community-Based Design

Communities are agents of change. They can be highly influential in raising awareness of environmental and social issues, revealing peer-to-peer, community, and national implications around sustainability and equitable access to technology. Conducting community workshops, applying user-friendly models and technology such as web-based systems, participatory decision making throughout the design and development of programs, and offering technical assistance to individuals and groups are all examples of community-based design. [8] An ongoing question I have with Extemporal is, how can we be engaged with the goals of sustainability as a stimulant and not as a restriction? This praxis emphasises community-centred caring that allows for justice and climate health.

Web-assisted platforms allow community members to share individual and collaborative contributions and stories. Furthermore, the cooperation between humans and non-human agents (software and online tools) can help distribute leadership, enabling facilitators, artists, and the community to participate in decision-making and program design. However, it is important to be cautious of any system's expectations that suggest technology glues humans together, even though technology does provoke networking. [9] Furthermore, using productivity platforms, social networking platforms, crowdfunding, meetups, and recognising that often discourse in local government is interested in participatory and networked creative formats can enhance participation and support in local

environmental initiatives and leadership in supporting a technologically mediated infrastructure eco-justice and social justice. During the next iteration, my practitioner approach as a community-based designer involves participating in activities with the community, communicating with the partners, and iteratively designing how the platform is structured and presented. I am also paying attention to the longevity of the platform. Sustaining relationships is difficult when community-engaged research projects end. I have learned that to sustain things, we need to think about how relationships are formed and disrupted. A lasting relationship is not something you can merely construct.

A method of community-based design is as a participant-observer, meaning my contribution must be explicit rather than covert, keeping one foot outside the scene to map assemblages in the space and maintain the stance to reflect critically on my actions and behaviour. [10] I must be reflexive and respect the people I interact with, assuring my research is descriptive and instructive rather than prescriptive.

On the design side, my approach involves prototyping the web platform to develop a community forum and identify ways to build trust and share agency. Extemporal is a platform for creative dialogue and managing resources based on trust and cooperation.

Contribution

How can critical media making bring intergenerational groups together to engage in DIY citizenship and to visualize environmental concerns? My interest in this question relates to my enthusiasm to design community platforms that engage intergenerational groups in cognitively accessible dialogue on environmental issues, create spaces where alternate modes of media-making are possible, and encourage inclusive participation during the COVID-19 pandemic.

Currently, Extemporal is a web-assisted community platform, linking commonly available online tools to foster the community projects and exploratory workshops that have identified activities and approaches facilitators can implement moving forward. In the future, I will create a web-based platform with a custom website that includes many of the elements that have assisted the activities but will have more secure privacy and moderation controls.

In July and August 2022, I will be working in Trinidad, Colorado, and Grand Lake, Colorado to develop a participatory archive for senior citizens, youth, artists, activists, and citizen scientists to contribute art, data (mostly on water quality), photography, documentation of post-fires restoration efforts, and traditional stories. This will be the first arts-driven project with the citizen science initiative and platform CitSci (<https://citsci.org>). Then, I will facilitate workshops with locals in sorting through this media and making a collage of visuals for the video

projections. Rather than being a solo facilitator, I advocate it is just as important for community members to take leadership which would be a unique learning experience for all involved. This collaborative or distributed approach to facilitation contributes to original community-engaged scholarship. Working with Marilyn Leuszler of the Trinidad Creative District and Ken Fucik from Grand Lake Creative District, we will develop interactive projection experiences in both locations. During the Space to Create opening in Trinidad, and the Live Water festival at Grand Lake, both in July, I will program, produce, and operate the projection experience where people will be able to interact with the visuals co-curated in the workshops.

Thus far, this research has identified that youth advocate for environmental problems that adults shy from, and the ageing community has practical fixing/repairing experience youth could learn. Responding to the isolation of people most at-risk and youth who are in positions with little voice and agency during COVID-19, Extemporal aims to connect these generational divides going forward in current and future crises. Extemporal could be developed to include a range of communities, but this is a practical decision based on an ecological crisis and a crisis of agency. The ageing community and youth demand more decision-making on local environmental concerns. Critical Making enables the distribution of agency, power, and resources amongst communities.

Conclusion

With the premise that Critical Making and community platforms can evaluate social inequity and question how capitalism destroys ecosystems, this research aims to build a new methodology at the intersection of critical making and community-based design. The projects are supported by Extemporal, a platform that hosts meetups, workshops, and a forum for exchanging artefacts. With community programs and platform design, the research encourages participation during ecological crises and attempts to do this by making concerns of electronic waste cognitively accessible and creatively engaging.

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Author Biography

Kimberley Bianca is an Australian media artist and community events organiser based in the United States. Her PhD research activities at The University of Colorado Boulder include workshops, site-specific electronic arts, networked performance forms, and platform design. In 2019, Bianca completed her master's thesis *Electrofringe: A Distributed Curatorial Platform for Electronic Art*, at UNSW in Australia while directing the arts organisation and festival, Electrofringe. Bianca has been a practicing freelance artist, facilitator, media designer, VJ, and audiovisual technician since 2010. She specialises in the development of participatory, mixed reality projects that bring socially engaged practice to performance and multimedia.

Earth or World? Media spaces between the surveil and the Possible.

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Abstract

My practice focuses on the mediated image of body and the land. Much of this work exposes flaws in the modern map of the world – seams and ruptures emerging during the capture and processing of images by automated systems – connecting them to the damage done to Earth by historical and contemporary systems of land division and extraction, including extraction of image. One way my practice achieves this is the disruptive harvesting of aerial and satellite imagery from Google Earth and other popular mapping/imaging platforms, and their projection in public space. Projection sites are chosen for their connection to the theme of each work. Bringing the extracted image back into contact with a material reality from which they are derived goes some way toward healing the damage we and our tools have wrought on the Earth. The product is a phantasmagoric space neither merely material nor image, historical nor contemporary. The work raises the question: who might live in these spaces? What kind of Possible world, and citizen, might they represent?

Keywords

Video, satellite imagery, aerial imagery, Google Earth, projection mapping, architecture, urbanism, public space.

Introduction

My work is preoccupied with the relationship of space and its image. For me, this is where our human condition plays

out: between imaginary and material worlds, between our intimate personal lives and our life as citizens. My artistic practise addresses this condition as it plays out in imagery of the body, and of the land. I have focused for some years on images of geography and landscape (especially western Canada) where human interventions in space – the way we divide up the land and use it for mining, harvesting, building – resonate disturbingly with what we do it its image - capturing it, processing it, commodifying it.

As the representation of a possible space, my work connects with ISEA 2022's concerns, in particular the themes of Futures and Heritages, and Natures and Worlds. My work often takes as its subject historical mapping systems - the products of a colonial agenda – and views them through contemporary surveillance systems – borders, drones, and imaging systems like Google Earth. My critique of Western regimes of representation has focused on maps, images, and plans. Today these are represented by popular mapping and imaging systems like Google Earth, and I share an interest in such platforms with other artists, for example Mishka Henner, Doug Rickard and Jon Rafman.[1] Platforms like these promise us a transparent and liberating map of our world. But they provide us instead with a parallel Earth that entraps us and turns our movement into a monetized product. My intention is to reveal, instead of the perfect map these systems promise, the muddy, complex, and unsettling amalgams of image and space they actually, and accidentally, generate. Using tools internal to these off-the-shelf platforms, I look for seams in the



Figure 1. Image sequence from *Dominion*.



Figure 2. *Dominion* installed, The Forks National Historical Site, Winnipeg, 2018.

imagery we assume have been sewn together perfectly. Rifts in this fabric are caused by the platform's internal processing of images; they include extreme pixellation of low-resolution imagery, technical artefacts like registration marks, juxtapositions of images captured by satellites at different times of day or year, and imperfections in 3D terrain maps and texture mapping as they are generated on the fly (Fig. 1). Digital anomalies often coincide in the image with its content: the scars left on the land by our machines, as well as our economic and political practices. These eerie juxtapositions produce irrational, playful, and disturbing amalgams of image and space. I harvest these spaces and transform them into flows of moving image.

The work is intended to evoke concerns which preoccupied thinkers like Martin Heidegger, Maurice Merleau-Ponty, Gianni Vattimo, and Paul Ricoeur.[2 ,3,4,5] That is: how can we heal the rifts torn in our bodies and souls, and our spatial environment, by modern life and its engagement with technology? My position on this is both fatalistic and optimistic. I think, like Bernard Steigler, that technics are inherent in our humanity; and that inherent in them, in turn, is the breakdown of systems by the drive toward orthography and other forms of perfection.[6] We must depend upon that breakdown if we are to find any freedom within the machine, and this is the key motivation behind my attempts to reveal rifts and ruptures in the regimes of the technical image. The study of the traces of history can be edifying in this respect: it reminds us that if systems broke then, they can break now; and that our citizenship, while threatened today, was once even less assured than it is now. So there is reason for hope. Spaces

that hybridize image and material, natural and technical, historical and potential, are part of that. A key question implied by my work is: who might inhabit such spaces? What kind of Possible might they represent?

As ISEA's thematic statement puts it, the Possible begins with the Polis. It is only through an engagement with the politics of technology, including the legacies of colonialism and the regimes of image that technology serves, that we can begin to transform the damage they – and we – have wrought. That must be the basis for any possibility of a new city, or a new world.

A work from the early stages of the development of this investigation was screened at ISEA 2017 in Manizales, Colombia. *parallel* was a single-channel video tracking the 49th parallel – the US/Canadian border - and anomalies of land use and imaging that exist on the two sides of the border. I also presented a full paper on the ideas behind *parallel* and work in progress. Since then, in part drawing on ideas and techniques I learned at the conference, I have developed a more ambitious work, *Dominion*, and am working on several other projects.

Dominion is a projection-mapped video installation, funded by a Canada Council grant in Research and Creation (Fig. 2). It harvests satellite imagery of the Canadian prairies: images documenting the impact on the landscape of a 19th c. surveying project, the Dominion Land Survey (DLS). The intention of the DLS was to transform a wild landscape into a grid of square fields connected to a rail system that led ultimately to the centre of power in the UK, rendering up the prairies as a source of food. In other words, the DLS was a processor of sorts: cutting up a het-



Figure 3. *Transect* installed, Greenwich Royal Naval College. 2014.

erogeneous world into squares of homogenous crops. Imaging systems do the same thing today: cutting images into pixels or satellite tiles. I use one such imaging system, Google Earth, to identify locations where the DLS collides with natural landforms or Indigenous patterns of land division – in other words, signs of the prairie pushing back against the survey. Some of the distortions to the grid are caused by contradictions internal to the survey itself – where it proves fundamentally inadequate to the task of organizing a complex and rich environment. Connecting these images through trajectories, I turn them into moving images; I interleave the image flows from different trajectories during projections in public places. The places are chosen for their connection with the project’s concerns – in one case, a railway bridge. Projection-mapping brings the images harvested by *Dominion* back in contact with the material world from which they were originally ripped. To me this is one part of the healing process that I think my work represents, and I see it as analogous to the role Ricoeur identifies for narrative: healing the rifts brought into our being by the experience of time. Projection-mapping software also introduces a limited processing of the image; for example generating, in real time, an audio environment from sound samples related to the work (in the case of *Dominion*, ambient sound from the prairies, and a text-to-speech reading of a 19th c. surveyor’s manual).

Besides *Dominion*, the talk revisits three completed projects including *parallel* and *Transect*, which tracked the Prime Meridian and Antimeridian around the planet. It also introduces current work: artist’s books based on *parallel* and *Dominion*; *still places*, which harvests higher-resolution still images of specific anomalies; and *Net*, which addresses international shipping routes and their impact on the landscape. *Net* has just received a media arts Research and Creation grant from the Canada Council for



Figure 4. *still places*. work in progress.

the Arts. This project will extract global shipping routes from public domain sources; generate trajectories from that data; capture along these trajectories satellite imagery of landscapes impacted by the shipping industry; process and project this imagery onto artefacts of the shipping process.

Acknowledgements

I am indebted to the Canada Council for the Arts, the Manitoba Arts Council, and the Winnipeg Arts Council, for financial support in the completion of these projects.

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Figure 5. Excerpt from artist’s book *parallel*, work in progress.

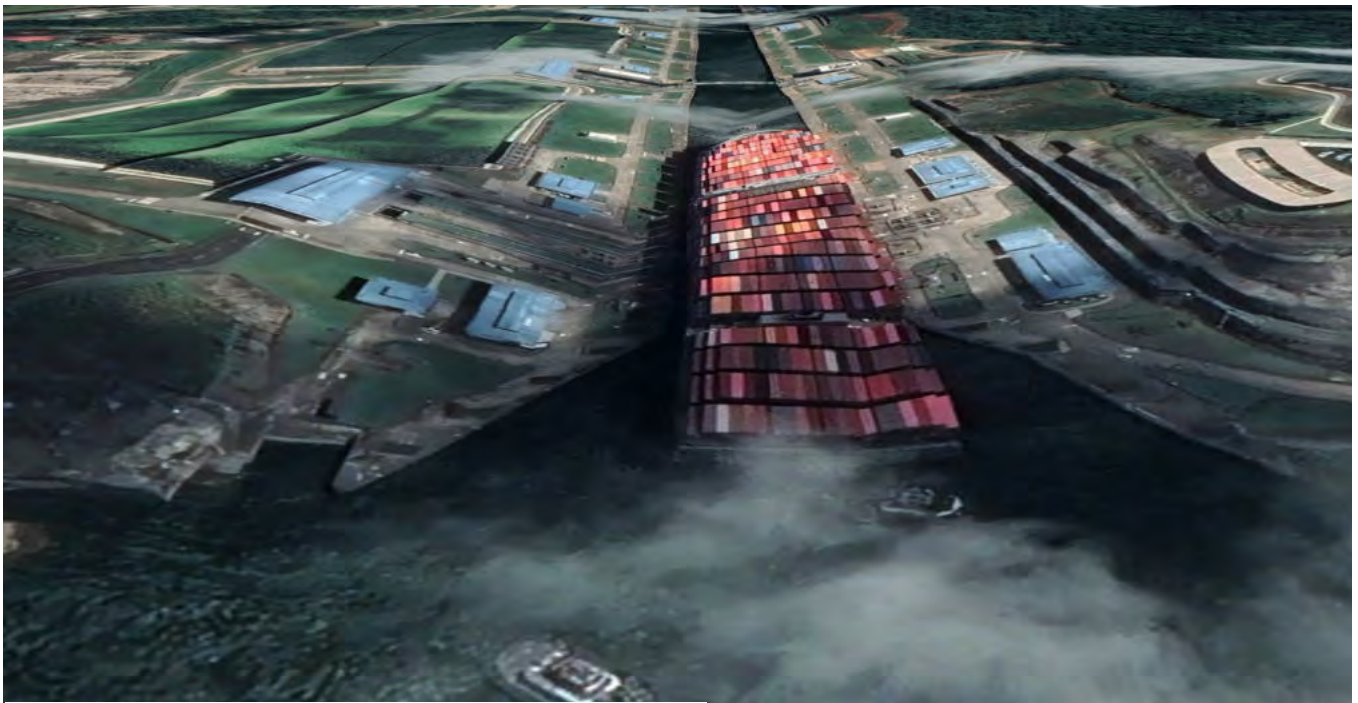


Figure 6. *Net*, work in progress.

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Time lapse video documentation of *Dominion* can be seen at:

<https://vimeo.com/lawrencebird/dominion>

Raw image and audio of *Dominion* can be seen at:

<https://vimeo.com/lawrencebird/dominionraw>

Most of my other works can be found online here:

<https://vimeo.com/lawrencebird>

My academic portfolio including related teaching and writing projects can be found here:

<https://independent.academia.edu/BirdLawrence>

Author Biography

Lawrence Bird practices in architecture and media art. His artwork focuses on relationships of image to space; it has been installed in Winnipeg, Toronto, London (UK), Brussels, and Manizales, Colombia. In design Lawrence works with Sputnik Architecture, Winnipeg, where his concerns are urban design, the public realm, amalgams of rural and urban space, and public art. Lawrence has a PhD in History & Theory of Architecture and a professional degree in architecture (McGill), and a Master's degree in City Design & Social Science from London School of Economics. He recently co-edited *Warming Huts: a decade + of art and architecture on ice* (Dalhousie Architectural Press, 2021), and is a Leonardo peer reviewer. His research has been funded by SSHRC, FQRSC, and Canada Council for the Arts.

SOMATECHNICAL NATURE / VIRTUAL RIVER

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Abstract

This presentation features excerpts from two film projects exploring movement and challenges to movement, raising questions about re-embodiment and experiential dimensions of proprioception in inter-pandemic society under a global climate crisis. The primary focus is on techno-choreography (using prosthetic devices and the Oculus Quest2 VR headset) and the somatechnical predicaments in the face of disturbance-based ecologies and blasted landscapes. A second concern is the exploration of new expressive techniques for ageing and differently-abled bodies. *Electric Dance, or How to Talk with Birds* and *How Much of These Hills is Gold* portray a series of outdoor performances during the COVID-19 lockdown periods: 'compositions,' to use Donna Haraway's term, which involve intimate individual and collective probings and drawings-to-perform enacted outdoors in a valley. The films evoke a series of climbs (up electrical power masts and hills) and submergences into river flow, which seek to combine body weather techniques (derived from Japanese butoh dance) with digital processing and speculative drawing in 3D virtual environment. The site-specific performances are creative responses as well as social choreographies in an era of climate crisis.

Keywords

soma-technics, virtual reality, water, climate, body weather, draw-to-perform

1. Introduction

The approximation of a disability-focused model of physical performance in nature and with prosthetic devices raises questions about what techno-choreography promises, in an inter-pandemic era and in a time of extreme environmental disturbance. How does one envision a speculative (VR-designed, digitally composed or augmented) embodied nature, in the face of contaminated diversity and infinite entanglement with multi-species environments? And how does one step inside/outside the "ruin that has become our collective home" (Tsing 2015: 3) and move when such movement is impeded, reduced or traumatized? When I returned to my home valley in July 2021, a few days after my arrival the south- and north-west regions of Germany experienced catastrophic floods. Rivers overflowed, houses were overturned and swept away, lives lost or uprooted. Self-organizing movement became a foray into tangled landscape, which a year before had been stilled by the lock-downs after the outbreak of Covid-19. Stillness and emptiness of course were misleading

metaphors, but rhythms and refrains had changed. Contaminated diversity began to have an overwhelming realness, one which does not treat unimpaired visibility as the norm but allows for a multitude of perceptual variation, plasticity of internal and relational resonance, and intensely tactile, auditory and olfactory engagement. Breathing darkness, following scent, herbs, mosses, lumps, cracks in the soil, slippery rocks in river beds and up the steep hills of a quarry, past wounded fir trees. Textures and life lines that can be referred to as "forest knowledge" (Tsing 2015: 243; Haraway 2016: 181), the kind of vernacular and indigenous learning I grew up with.



Figure 1: *River Row*, film still, 2020. © Johannes Birringer

2. Visible Invisibles

The artwork answers to the life lines and labors on the edges of visibility and translation. It is subjected to the aftermath of the Anthropocene, where ecological awareness, if we follow the pessimistic trail of Timothy Morton's *Dark Ecology* (2016), implicates us all in some sort of environmental film noir. The filmic excerpts I show are not marked by pessimism, though, but by a kind of child-like playfulness with which I approach my childhood valley and seek to reconcile collapsing fragments of a much larger process that cannot be comprehended fully (global climate crisis, global pandemic), and thus cannot be easily enlarged, from a microperformative, molecular and microbial scale upwards. *Somatechnics* is an approach to corporeality which considers it as always bound up with a variety of technologies and techniques, understanding nature as an complex organism urging examinations of the lived experiences engendered within given contexts, and the effects that technologies, technés and techniques have on embodiment and the commons, including the nonhuman elements of the world. What do I mean by virtual river, or why does my last film fictionalize the "Goldbach," the golden brook that runs through my valley and refers back to a 19th century gold rush to my region? In my experience, organizing working on the edge is the "matsutake" part,

times of austerity, when you are in streams, applying new technology (VR headset) to a very simple activity, and moving in space.

Old Rush Fever

My interest in the oldest knowledge and what you find in wilder woods, searching for hidden environments, whether this is through digital media art or digital technology (VR tech or AI/robotics, etc) or my interest in her ethnography of the final era of capitalist mining is mined so beautifully for us, in a section on "latent commons" – in the middle of things – addressing what I consider prosthetics-as-life-lines and dancing on such lines: searching has a rhythm and one follows scent and flow, and an understanding of fungal growth, textures, migratory shifting cultivation, washing stones in the river.



Figure 2: *How Much of These Hills is Gold*, Anette Delarosa washing stones in the river, 2021. © Intakt

4. Undercommons

We do not ask where the energies come from, and how there are commons that may not be good for everyone. There will be infections, inattentions and poachings, the flood will carry things away, the *gaoqiao* (stilts) may not be long enough, and we need to keep arguing. Nature and her natural forces also argue with human and animals, with beavers who reshape streams, with trees and their fungal partners, electric masts. Entanglement indeed. Thus everything is coming out. Forget the shame, or the mythology of the invisible work and humiliation of the rehearsals, it is not that

interesting (Birringer 2018). I always found rehearsals, when we create the kinetic atmospherics, to be most revealing and exposing, thus refreshing. When rehearsing outdoors, up the hills, electric masts, and river streams, the magnetic fields of energy are riveting.



Figure 3: Electric dance, performed by Johannes Birringer and local audience participants, 2020. © Intakt

5. Somatics and Drawing



Figure 4: Draw-to-Perform, *Interaktionslabor*, 2021. © Intakt

We draw on extended canvases. The rain has just stopped. I ask all the participants to go down onto the earth, or roll with the paper rolls, expand their bodies and bodily imaginations, breathe in the air and the smell of the plants surrounding us, open up for the capacities of fluctuating affects, symbiosis and mutations with the graphite, paper, grass, pebble stones and wetness of the surroundings. River flow, row

with it and also observe where and how the bodies are formed and shaped by the environment, the elements, the pebble stones and the moistures.

From here it is a small step into VR. We use the Oculus Quest2 headset to imagine stepping into the same natural environment, except the void, a seemingless infinite and inside this three-dimensional space, as if pulling us forward, we dance the lines that hover and tangle before us, and we are drawn into another dance of an imaginary space, as unreal as it can get, as long as it is algorithmically possible. We return to the sense, and we return afterwards. In the next iteration, we shall address questions that will turn.

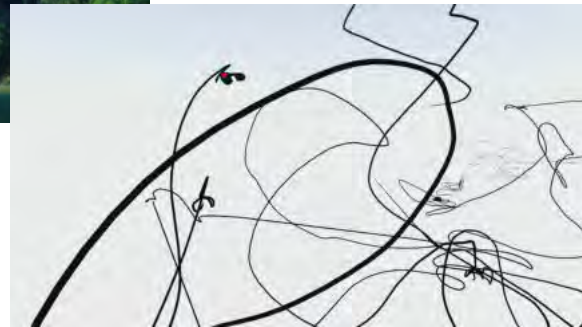


Figure 5: Draw-to-perform in VR, 2021 © Avital Meshi and Treyden Chiaravalloti

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“Human Error: Projects That Emphasize “Misuses” of Technology”

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Abstract

We are often confronted with computer interfaces that are built to be “easy to use”, but in reality, are more confusing than ever. This paper details several artworks that fall under the theme of “Human Error” and consist of software and hardware devices that integrate elements of human error into their design to provoke and materialize human frailty when it comes to operating digital devices and interfaces. This presentation will detail several of those projects as well as the theme of “Human Error” itself.

Keywords

Human Error, Critical Interfaces, Media Design, Interface Design, Art, Hacking, Displacements, User Interfaces

Introduction

Technology is often difficult to use, hard to understand, and confusing to configure. But is it really the technology that is confusing or is it what we bring to the technology? Is “Human Error” [3] the cause of our troubles? “Human Error” is a series of projects that examines and catalogs things we as a population do wrong with technology and the Internet, ultimately making them more human than ever. Technology is not only about productivity, instead its most meaningless aptitudes are what make us hooked. Despite our continued belief that technology is to blame, the truth is that technology does not cause the problems, we as users do. We search for solutions through technology and are too often looking through the wrong lens causing us to do and say things that are nonsensical. “Human Error” is a series of creative interactive works that emphasize human error above predetermined purposes. Each object highlights the errors that we as a population incur on digital devices and objects and emphasizes these defects to create novel interfaces for interaction that highlight human frailty.

Background

Former Professor of Psychology at the University of Manchester James Reason, coined the term “Human Error” [1] in the late 1980s. Reason quantified human error in two distinct categories that of the person approach and the system approach [2]. While the person approach examines errors of individuals in areas of deficit such as forgetfulness, carelessness, negligence and similar, the system approach takes a wider stance and blames human error on organizational mishaps or structural systems that are difficult to master. The projects in this series focus on the “person approach” where most of the error correctable tasks could have been avoided entirely. Ellen Rose, author of ““User Error : Resisting Computer Culture, Between the Lines”[3] says that “user-friendly interfaces are not designed so much to make computing easier but rather to make it “fool proof” and dumbed down for error-prone users. And so the human presence is reduced to a twitching finger, spastic body, and an over saturated informational pump that makes choices within strictly programmed limits.”



Figure 1. User holding *Letter Dialer App*

Projects in the Series

“Human Error” features projects that begin the exploration of this theme and range from software to hardware installations. Some of these projects include *Letter Dialer*, an iOS app that removes the numbers from the calling interface, *Dim*, a Mac OS app that dims your computer’s screen brightness to 50% every 5 minutes, *PPRJM* a modified printer that continually causes a paper jam, and *Password*, a web form that prompts users to enter a password and then changes this password to the word “password”.

Letter Dialer

Letter Dialer pictured in Figure 1, is an iOS app that removes the numbers from the phone dialer application. Instead of typing numbers, users are forced to remember the corresponding letter combinations associated with each number key to dial the correct number. As we often not only forget phone numbers, trying to remember the corresponding letters can be a challenge even for the most versed cellphone user.

Letter Dialer forces users to remember which numbers are associated with each letter, making them question why the letter / number combination on the UI remains important to phone dialing. When texting began, the letters were important to forming words and they continue to be a feature that touchscreen phones utilize but have simultaneously been made obsolete because these phones can simulate as many buttons as necessary for full text entry.

When a button is pressed, one of the three assigned letters to each button shows up randomly. After a user dials the full letter combination, they then tap the “call” icon and

like the regular dialer app, *Letter Dialer* will start to dial the number they have entered. The result will be either a correct number or a wrong number in which case they will either be successful with the call or must try again.

The *Letter Dialer* app highlights common errors that we as humans exhibit when using technology and why these errors have become almost second nature to its daily use.



Figure 2. Screenshot of *Password*.

Password

Password, pictured in Figure 2, is a web form that asks users to type in a password and click the “Set My Password” button. Once clicked the new password is submitted to the server and automatically changed to the word “Password”. According to a 2019 HYPR study [6] on password creation, 72 percent of people reuse passwords for their personal accounts. The word “Password” is still the 4th most common password used by people behind “123456”, “123456789”, and “qwerty”. Since the use of the word “Password” as a password is still common and due to this word’s proclivity to be guessed by potential hackers, the fact that this word is still being used is one of “human error” that could easily be rectified. *Password* uses JavaScript to detect what a user types in and based on the input, the password field is automatically changed to the word “Password” when the button is clicked.

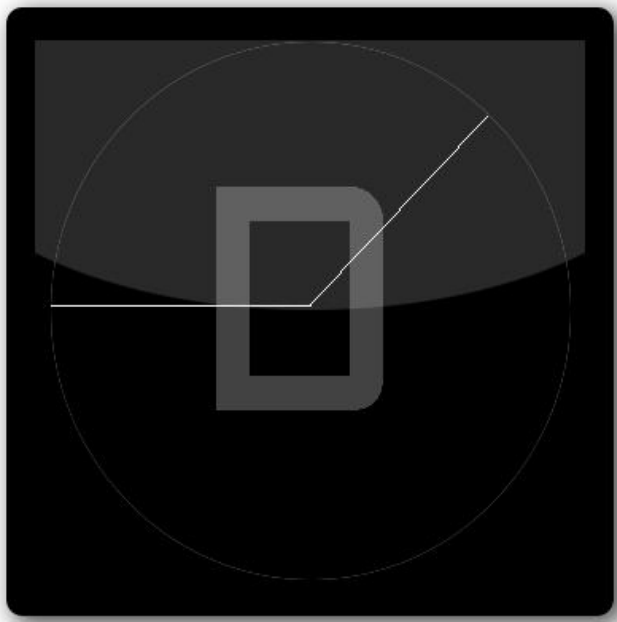


Figure 3. *Dim* App Icon

Dim

Dim, pictured in Figure 3, is a Mac OS application that repeatedly dims the display of users to 50% every 5 minutes. Users must correct the dimness to 100% to get back to work, knowing that their screen will return to lower brightness shortly. Whether they choose to fix it or choose to ignore it, the resulting error will be caused by their inability to attend to their computer, yet another aspect of human / machine error. After dimmed, the user can change their opacity back to 100% using the Mac’s System Preferences > Displays > Brightness setting. It remains up to each user whether they will take the steps to retain their brightness levels or leave them as is, resulting in “Human Error”.



Figure 4. Screenshot of *PPRJM*.

PPRJM

PPRJM (Paper Jam), pictured in Figure 4, is a printer that has been modified to continually cause a paper jam. This form of “Human Error” is something that continues to plague people who think they have correctly loaded paper but have failed due to their inability to follow directions. The average amount of paper waste that comes from an office annually is 10,000 sheets. Whether the paper is wrongly put into the printer or used erroneously and then discarded, this amount of waste is troubling even for the environmentally conscious. Recycling levels in the U.S. are only at 21.4% [7] and Americans throw away enough office paper each year to build a 12 foot high wall from Seattle to NY annually.

Conclusion

Despite our daily reliance on technology to function, there maintains a basic ineptitude in our usage of these systems. Because of this we often blame the technology itself for these errors instead of our own inability to understand how to use and operate them. The works in “Human Error” are the beginning of a larger body of work that explore these ineptitudes and reminds us that we are not perfect in our abilities to understand, operate, and command use of the technology we depend on in our daily lives. These projects provoke what we as a population do wrong with advanced interfaces and technological systems that are not outside of our grasp of understanding. They serve as a starting point for this exploration into human error driven work. By integrating elements of “human error” into interface design, perhaps we will discover why our daily struggle with technology is worth pursuing.

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Author Biography

Jonah Brucker-Cohen, Ph.D., is an artist and an Associate Professor in the Department of Journalism and Media Studies at Lehman College / CUNY in the Bronx. He received his Ph.D. from Trinity College Dublin. His work focuses on “Deconstructing Networks” with works that challenge and subvert accepted perceptions of network interaction. His artwork has been exhibited at venues such as SFMOMA, Canadian Museum of Contemporary Art, MOMA, ICA London, Whitney Museum of American Art, Palais du Tokyo, Tate Modern, Ars Electronica, Transmediale, and more. His artworks, “Bumplist” and “America’s Got No Talent” are in the permanent collection of the Whitney Museum of American Art. He has written for WIRED, Make, Gizmodo, Neural and more. His Scrapyard Challenge workshops have been held in over 15 countries in Europe, South America, North America, Asia, and Australia since 2003.

Uptown Underground and Untitled Times Square Intervention

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Abstract

This talk will address the potential for leveraging physical-digital technologies in public-realm interventions which help offer fuller engagements in our current realities. It will serve as a platform to present the project Uptown Underground, which uses projections and accelerometer data to bring urban context down into an underground subway ride, as well as an in-the-works intervention which uses photovoltaic cells tuned to LED screens and air cooling methods to critique mass energy waste in Times Square.

Keywords

situated technologies, public art, urban interventionism, interactive technologies, new media

Introduction

In New York City, the public domain is the great equalizer: where all come together to carry on with their respective lives. The role of digital technologies within this realm is relegated to the isolating (a cell phone, for instance) or the commercial (dynamic billboards, impression tracking, and so on), which has led to technophobia or at minimum apathy towards a technologically-enhanced future. This paradigm has made it imperative to explore conceptual and human-centric approaches to adopting digital technologies within the public realm in a direct and hands-on manner. These projects, one expressly formal, one steeped in social and political discourse, both conducted without formal permission, sit at such an intersection.

Work

Uptown Underground, 2019

An installation by Ian Callender

The experience of riding the subway is marked by detachment: in the moments between stations, all urban context is stripped away, replaced with darkness or the occasional flash of a light. The project thus takes inspiration from the glass-bottom boat, where access is granted to the reeds, the fish, and the dark depths normally inaccessible. In an almost direct reversal of Anne Friedberg's argumentation, imagining seeing through the ceiling to the street and becoming aware



Figure 1: Uptown Underground, Installation View. ©Ian Callender.

of such a dynamic perspective here offers restored connection with and newfound contextualization within the city. [1]

Uptown Underground projects a geographically accurate view of the cityscape above a moving subway car onto its ceiling as it moves under New York City. It has been installed, without permission, on a series of moving subway wagons from Brooklyn Bridge-City Hall to 96th Street stations, a roughly 6 mile/25-minute loop along the East Side of Manhattan.



Figure 2: Uptown Underground, Elements and Build. ©Ian Callender.

The project is implemented with four projectors connected to Raspberry Pi's, synchronized with offsets over a peer-to-peer WiFi network and informed by geolocation and acceleration data from a cellphone, all on battery power. As the window for installation is only some 45 seconds, and the window for deinstallation even shorter at risk of being caught, the

build (both physical and digital) was designed for ultimate ease and fluidity.



Figure 3: Uptown Underground, Installation View. ©Ian Callender.

The project aims to create a technology-positive interaction with the sole intention of augmenting the urban experience by directly intervening in the daily lives of subway users through projections and new technologies. With the installation in full force, those on the train tend to put down their cell phones and, with excitement and curiosity, look up.

Links:

<https://www.iancallender.net/#work-subway>

Untitled Times Square Intervention, 2021-

An ongoing collaboration between Benjamin Akhavan and Ian Callender

When temperatures in New York City exceed 95 degrees Fahrenheit (35 Celsius), the city as well as the city’s electricity providers issue alerts asking residents to limit their energy usage. Often, they specifically call out air conditioning for its heavy load on the grid. This has dramatic and, for many, life-threatening consequences. In stark contrast, even during these times of stress, the hundreds of thousands of LEDs of Times Square’s advertising screens remain lit. Backlash on social media quickly ensues with New Yorkers colorfully expressing frustration. Although by one estimate 161 Mega-Watts are consumed daily by the Theater District, there is no number published by New York City agencies. [5]

Recent critical discourse around urban screens, argues Scott McQuire, has been rooted in either consumerism or surveillance and privacy. [2] In Times Square, these conversations are even one in the same. [3] This has left out questions of access, equity, and notably, power structures, both figurative and literal. The impetus to keep Times Square’s screens illuminated was not only motivated by capital, but in fact New York City’s zoning resolution. [4] In spite of the heat wave, turning off the screens, quite actually, would have been illegal.

This intervention is thus predicated on asking a simple question in the most literal manner possible: how much cool-

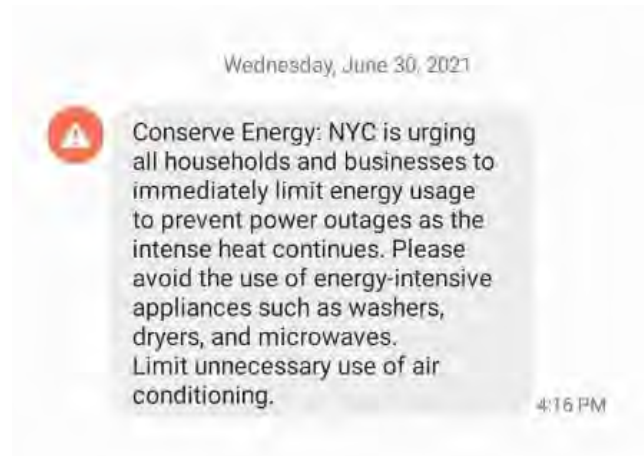


Figure 4: New York City Emergency Alert, June 30, 2021. ©Benjamin Akhavan.



Figure 5: Voltage generated by photovoltaic cells tuned to a Times Square screen, Summer 2021. ©Present Authors.

ing could be provided by the power used in Times Square? By using amorphous photovoltaic cells, particularly responsive to the frequencies emitted by LEDs, pointed towards these massive screens during the night hours, we have proven that enough power is generated by them to power small cooling stations.

Further work on the project will be completed later this summer (2022). With the next heat wave, critical discourse will have a practical installation from which argumentation for change can be drawn.

Conclusion

Digital technologies are but new tools for artists, architects, and designers to approach questions well established within their fields. These two projects offer innovative takes on this opportunity in such a manner that further grounds us in our

present realities, either in support of enhanced situatedness or of social critique, and in both cases within veritably human experience.

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Author Biographies

Ian Callender is a New York City-based artist and designer exploring the intersection of the built environment and digital technologies. His work challenges traditional dialectical oppositions of structured / organic, form / un-form, and digital / literal. He holds a Bachelor of Arts from Brown University and is currently pursuing a Master of Architecture at Columbia University GSAPP. His work has been recognized by the Media Architecture Institute, Architizer, iF Design, and the Art Directors Club; covered by ArchDaily, Hyperallergic, and Designboom; and exhibited internationally.

Benjamin (Benjy) Akhavan is a multidisciplinary designer and educator based in New York. He is a principal at FOAWM, a nondescript Firm / Office / Atelier / Workshop / Milieu with polyvalent interests at the intersection of design and urban life. Benjy holds degrees in architecture from the Spitzer School of Architecture at the City College of New York and the Graduate School of Architecture Planning and Preservation at Columbia University. He teaches visualization and design at the New Jersey Institute of Technology and has exhibited design work in New York.

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Abstract

Other intelligences is an artistic on going research that aims to explore the communication between plants remotely by using AI tools. Through this project we seek to know more about the plants' language and behavior, and try to understand a better these living beings with we co-habit in the Earth.

Through the use of technology as a tool, we have created a network of plants connected to the Internet. A network analogous to the network of roots and mycelia of fungi that take place in the forest.

All species on earth are linked by symbiotic and interdependent relationships; the project proposes an innovative point of view on the transformation processes that are shaping the collaboration between species, ecosystems and technologies. To know more about the language and behavior of plants will allow us to learn more about nature and thus better understand our environment.

Keywords

Making-with, sympoiesis, interspecies, non humans, plants artificial intelligence, interespecies communication.

Introduction

Several scientific studies have demonstrated that plants have chemical processes that have similar features with the process that take place in the nervous system of animals, thus plants have capacities like memory and therefore they can learn about their environment. Based on plant intelligence and their capacity of learn we created or neuronal plant network. We designed an algorithm makes possible the remotely communication between plants through the training and learning to different stimuli.

In this way we investigate, about the recognition of patterns by the plant, which allows it to identify with which plant of the network they are communicating and thus allow two way dialogue. To do that we have provided each of the plants with tools that allows them sending and receiving signals of light, sound and movement. The entire communication process is being recorded, to be analyzed afterwards with an Artificial Intelligence, in order to recognize patterns that humans cannot perceive with the naked eye.

Through the use of technology as a tool, we have created a network of plants connected to the Internet. A network analogous to the network of roots and mycelia of fungi that take place in the forest that the Professor of Forest Ecology Suzanne Simard [1] began to study almost three decades ago. This woods' network allows trees and plants to communicate with each other by sharing information and nutrients. In Other Intelligences, our network, is made up of data, algorithms and actuators, and it allows us to investigate alternative relationships with nature and technology through the use of artistic methodologies.

The device: sensors and actuators

I designed a produced a 3D printed device in order to attach to the plants (see Figure 1). A sensor developed by uh513studio [María Castellanos & Alberto Valverde], called Clorofila 3.0 is included in the device [2]. This sensor is based on the electrophysiology of the plants, and allow us to measure the electrical activity that takes place into the plant, depending of the surrounding of this living organism, like changes in light, temperature, sound, atmospheric pressure, proximity of other living beings etc.

I have been used this sensor in my previos artworks like Symbiotic Interaction (2017), The Plants Sense (2018) [3] or Beyond Human Perception (2020).

Additionally we placed environmental sensors (see Figure 2) that allow us to monitor the surrounding of the plants by measuring changes in temperature, sound, proximity, CO₂, humidity, etc. This sensors allowing us to compare and link this measures with the biochemical state of the plant, to try to figure out what is affecting to the plant. Furthermore all the data is sending to the Internet every two seconds and recording in a server, which allow us to analyze it.

Also three kind of actuators were placed in the device in order to provide tools to the plants to make possible the remote communication. We designed the actuators by thinking in the well being of the plants. One of the actuator is to alert the plant that something is happening with itself, the other two actuator allowing the plant to send signals to others that warn the other that something happened.



Figure 1. The device to attach to the plants with sensors and actuators. ©María Castellanos Vicente

The actuators are:

- A contact speaker: to create low frequency sounds that reminds to sounds in the nature, by generating soft vibrations in the soil. This actuator is placed to warn the plant that something is happening with itself
- Two servo motors: Integrated with two soft spikes inspired in the branches moved by the wind, it make movements to the plant. This actuator is placed to receive movement signals from other plants.
- Grow light LEDs: Integrated in the device, next to the soil. This actuator is placed to receive light signals from other plants.

The Foundation takes no responsibility for the opinions, statements and contents of this project, which are entirely the responsibility of its authors.

Developed in collaboration with FeLT from OsloMet and with the technical support of Alberto Valverde García.

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Author Biography

María Castellanos is an artist and researcher working at the intersection of art, science, technology and society. She is currently working as a postdoc researcher at Oslo Metropolitan University, in the framework of FeLT –Futures of Living Technologies–.

She holds a Bachelor's degree and a Doctorate from the University of Vigo (SP), with an Extraordinary Phd Award 2016.

Her artistic practice focuses primarily on the research about human sensory boundaries and the creation of complex systems that promote the communication and the understanding between humans and non human beings.

Her work was exhibited and performed at venues and festivals such as Ars Electronica Festival (AT), LABoral (SP), Athens Digital Arts Festival (GR), Onassis Stegi (GR), HeK (CH), La Gâite Lyrique (FR), DRIVE Volkswagen (DE), Matadero Madrid (SP), Bozar Electronic Art Festival (BE), Arts Santa Mónica (SP), Touch me Festival (CH) MUSAC (SP), CEBIT. Europe's Festival for Innovation and Digitization (DE).

Mycorrhizal Insurrection: Rerouting Anthropocentric Socio-Technical Systems

Cesar & Lois (Lucy HG Solomon and Cesar Baio)

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Abstract

The art collective Cesar & Lois discusses the collaborative, non-disciplinary-specific development of a mycelial AI, with the intent of orienting human socio-technical systems to non-hierarchical models persistent in the living world. In growing a system that integrates living and digital mycelia, the experiment-as-art unfolds through the duo's accounting of past workshops that include mushroom foraging, spore printing and thinking like a mushroom. Ahead of the art collective's premiere of *Mycorrhizal Insurrection* at the 2022 Mercosul Biennial in Brazil, the artists discuss the process of developing the training database for a non-anthropocentric AI, the challenges in connecting artificial and mycelial intelligences, and their conversations with mycologists and philosophers. Merging prehuman (fungal) and posthuman (digital) systems, the artists speculate on the possibility of post-anthropocentric futures. With documentation of iterative nodes in the project's development, such as the June 2021 exhibition, "Eat the Anthropocene with Cesar & Lois, Mycelia and Friend Entities" at Yes We Cannibal in Baton Rouge, the artists project a machine logic that operates contrary to capitalist ideals, and the resultant values and concerns of a narrow group of humans. In response to Jason W. Moore's use of the term, *planetary proletariat*, the artists imagine a socio-technological insurrection by incalcitrant bhiobrid (bio-digital) systems. Listening in to the pulses to hyphae, an AI thinks less and less like a human.

Keywords

Mycorrhizal, Insurrection, Bio-Digital Hybrid, Bhiobrid, Artificial Intelligence, Mycelial Intelligence, Prehuman Intelligence, Posthuman intelligence, Post-anthropocentric

Introduction

Mycorrhizal Insurrection is the culmination of a body of work in which we integrate prehuman (fungal) logic and posthuman (machine) logic. What types of decisions, if shared across living and machine networks, would be made, and whose needs would those decisions serve? In a discussion of the development of the project, we outline the challenges of orienting an AI to a mycelial network, and we consider the steps required to decenter human needs through speculative non-anthropocentric AI's. We question, *How can a human-built AI ultimately conform to nonhuman logic systems and ecosystemic values?*

Anthropocentric thinking, embedded in extractivist, capitalist systems, reenacts a human/nature relationship that advocates relating to the living world through planetary management. Jason W. Moore locates this problem of human agency/possession within the "capitalogenic trilogy of class divide, climate patriarchy and climate Apartheid," which Moore identifies as the drivers of—instead of the results of—climate change. [1] Our collective postulates a non-anthropocentric AI that makes decisions against the systems dynamics that favor human-centered logic (and humans).

Background

Our collective's prior artworks attempt to unite human and microbiological systems to critique entrenched human/nature oppositional relationships sourced in the ontologies and dictums of the so-called West, as evidenced in numerous texts. These artworks include fungi-infiltrated philosophy books (see Figure 1) and *Physarum polycephalum* (slime mold) that tweets edited versions of texts that champion "man" as master or even the queen of "nature" (see figure 2). The intent of these artworks is to propose new futures that rely on an ecosystemic set of values that merge the needs of the planetary ecosystem, including the natural resources extracted on behalf of consumption-oriented human societies and for human technologies. We argue that an AI that operates with human values will inevitably make the kinds of inequitable decision-making that plagues many economic and societal structures. And we postulate that an AI trained on the interrelationships among beings within entire ecosystems (instead of specific encoded human values) might make better decisions on behalf of the planet, inclusive of disenfranchised humans, fragmented landscapes and, importantly, nonhumans—networked and otherwise. [2]



Figure 1. *Thinking Like a Mushroom*, 2019, Cesar & Lois, artifact exhibited at Ship in the Woods, Escondido, CA (2019), print at Yes We Cannibal (*Eat the Anthropocene with Cesar & Lois, Mycelia and Friend Entities*), Baton Rouge, LA (2021). ©Cesar & Lois.

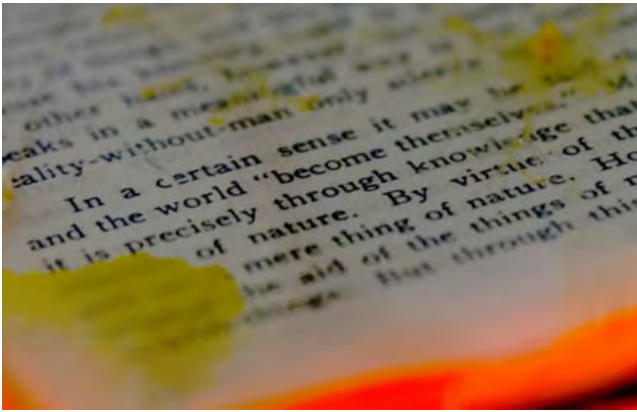


Figure 2. *Degenerative Cultures*, detail, Cesar & Lois, Lumen Prize Exhibition, UK (2018) growth of *Physarum polycephalum* over *Existential Phenomenology* (Lujipen, 1969). ©Cesar & Lois.

Why Insurrection?

The Capitalocene (Jason W. Moore’s term) has brought about percussive human and ecological traumas, with persistent violence enacted against the ecosystems and interspecies networks that humans also depend upon. The direct violence to Indigenous human societies that have been displaced, marginalized and murdered, in parallel with the devastation of ecosystems, has left holes in the planet’s living networks. In *Mycorrhizal Insurrection*, networking mycelia constitute a conceptual and poetic response to this trauma, also an artists’ call for revolution against those networks that continue to marginalize and enact violence. Hyphae allow access to utopian insurgencies that have the potential to generate ideas for other ways of building the future. Conceptualizing and building the artwork becomes a strategy of poetic articulation of the kind of thinking that can allow us to imagine other possible futures. This strategy is based on scientific research into the intelligence inherent in living systems and on ongoing collaborations with scientists in labs and in the field, as well as intentional learning about the land and relationships across species. Interspecies coexistences and collaborations exist in the wealth of Indigenous beliefs and traditions that actively enact the potency of the living world—living relationships documented in the scholarship of Robin Wall Kimmerer, Eduardo Kohn, Davi Kopenawa Yanomami and Eduardo Viveiros de Castro, and many others. Those living relationships are evidenced in language, as when Wall Kimmerer explains the Anishinaabe word *Puhpowee*, “the force which causes mushrooms to push up from the earth overnight.” [3] *Mycorrhizal Insurrection* calls for a rerouting of human technological systems (see the capturing of mycelial signaling in Figure 4) to take note of the potency of nonhuman living systems and to shift human-centered language and thinking so that technological networks are responsive to the complexities across networks of human and nonhuman beings.

The planetary environment’s reformation by global economic disparity—carbon as a consequence of capitalism—has brought us to an unprecedented scenario. A machine’s decision-making that is based on the logic of humans and other species, ranging from animals to microbes, requires that logic to connect to and within ecosystems. Studies that reveal the complexity of nonhuman systems, ranging from mycelial networks that process information [4] to the computational processing of microorganisms [5], point to the capacity for networks that are environmentally aware and socially responsive.



Figure 3. Reading “electromyceliograms,” the electronic signaling of mycelia (2021). ©Cesar & Lois.

Mycelial intelligent networks move us to reimagine networks as interspecies and cross-technological, connecting prehuman, human and posthuman intelligences to support the planetary ecosystem and its diverse human and nonhuman constituents. Such a scenario calls for a profound shift in the networks that control global economics and social systems, technologies and even ecosystems.



Figure 4. *Eat the Anthropocene*, 2018-ongoing, Cesar & Lois, artifact exhibited at *Yes We Cannibal (Eat the Anthropocene with Cesar & Lois, Mycelia and Friend Entities)*, Baton Rouge, LA (2021). ©Cesar & Lois.

Artists Respond

In this project, in development for the Mercosul Biennial in Brazil, we strategize new ways to respond to the planet's overwhelming triumvirate of ecological, societal and economic failures. *Mycorrhizal Insurrection* is a provocation and a proposal, a challenge to the ways in which we as humans collaborate with machines and relate to ecosystems. As artists, we envision a utopian network that bends towards economic and climate justice because of the potential for an ecosystemic consciousness within collaborating operating logics. Such a network allows us to imagine an ecotopian future, in which human collective intentionality moves away from the celebration of human exceptionalism and towards the affirmation of networked entities and groupings, inclusive of a diversity of human and nonhuman entities and the planet. We conjure this future with mycelia.

Acknowledgements

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Author Biographies

Cesar & Lois probes the evolution of humanity's relationship to nature by advancing intersections between technological and biological systems. The collective, comprised of Lucy HG Solomon and Cesar Baio, strives to build bhiybrid intelligent artworks by crossing different organisms, such as bacteria, fungi and protists with technological elements, including Artificial Intelligence, data mining and social networks. Through interactive artworks with embedded research and sometimes specimens, the duo ponders the logic based in the growth of microbiological organisms and studies how this can inform human logic, with the goal of positing a post-anthropocentric future. Their work, "Degenerative Cultures," was featured in the 2021 Aesthetica Art Prize Exhibition in the UK. Cesar & Lois received the Lumen Prize in Artificial Intelligence (2018), were selected for the Global Digital Art Prize Biennale in Singapore (2019) and as artists in residence at Coalesce Center for Biological Arts (2020) and UC Davis Hess Laboratory.

Lucy HG Solomon is a Fulbright scholar whose global project probes microbiological connections across distant terrains. As an associate professor in the Department of Art, Media and Design at California State University San Marcos, she teaches at the intersection of media, data and the environment and leads the DaTA Lab (Laboratory for Data and Transdisciplinary Art). A nurturer of nonhuman entities, she experiments with living data visualizations.

Cesar Baio is an artist and a CAPES scholar whose PhD (PUC/SP) and post-doctoral research (Plymouth University, U.K.) cross the fields of media and art. He is Associate Professor of Art and Technology at Universidade Estadual de Campinas in Brazil (UNICAMP) and the director of actLAB (Laboratório de Pesquisa em Arte, Ciência e Tecnologias Desviantes). With a background in electronics and media studies, he often focuses on the relationship between art, technology and society.

GODSPEED

A Speculative and Participative Robotic Performance

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Abstract

In this Artist Talk, we are presenting our new performance project *Godspeed*. Following the positive response on our previous collaborative piece *Inferno*, we aim to further the participative experience with new and expanded scenarios and with new and improved wearable robotic extensions, augmentations and prosthetics. Based on speculative rituals of the machine, *Godspeed* is our way to say “good luck” to humanity once we reach the point of singularity.

Keywords

Robotic Art, Performance, Exoskeleton, Participation, Control, Submission, Rituals, Co-creation, Speculative

Introduction

Since almost thirty years, we have been creating interactive installation and performance projects using robotics, audio-visuals, and cybernetic processes [1, 2]. A prime goal of these projects is to induce empathy from the viewers towards characters that are nothing else than simple articulated metal structures. Our objective is to conceive and realise robotic entities to question, reformulate, and subvert the notions of behaviour, projection and empathy. Notions that generally characterise the ambiguous relations between humans and machines. Our strategy has always been to minimise the distance between the work and the participant, immersing audiences in fictitious worlds and using the inevitable immediacy of the machines as an enabler of transformative experiences. [3, 4]

Inferno

Inferno (2015) is a participative robotic performance inspired by various representations of hell as depicted in Dante's *Inferno* Circles of Hell or in Singaporean Haw Par Villa's Ten Courts of Hell. With *Inferno*, the "circles of hell" concept is mainly an artistic framework, a general working theme under which the different parts of the performance are regrouped. The specificity of *Inferno* is the machines are installed on the viewers' body and consequently, the public then becomes an active part of the performance. [5] These participants have no prior training, and they are not instructed to perform any specific actions or characters. In the course of the performance, sometimes the viewers are free to move; sometimes they are in a partial or entire submission positions, forced by the machines to act/react in

a certain way. For this hour long performance, we have built 25 wearable robotic structures very similar to exoskeletons.

The performance is open-ended, and it is generated from a minimal set of instructions designed to facilitate audience participation and spontaneous movements. The immediacy and the emotional authenticity of being manipulated by a machine encourages the audience to invest in the veracity of the performance. Becoming simultaneously performing objects and subjects, *Inferno* embeds the schism and ontological questioning between humans and machines. The body is augmented but yet constricted, the performer is master and slave. We have observed throughout performances that this techno-corporeality paradox is a prime component to engage participants into sustained ritualistic gestures bordering states of trance. [6]

Godspeed

Godspeed is the logical following to *Inferno* as it is equally based on minimal robotised exoskeletons that will be worn by the audience during the performance. However, *Godspeed* will further the participant's experience by adding various robotic prostheses and extensions to the wearable unit, and by allowing direct system feedback on the participant's own actions. Likewise, the scenography will be entirely reimaged, with a completely new soundtrack and the addition of video projections. The participants and the audience will also be allowed to interact with each other.

The title of the project comes from the strangeness of this word. *Godspeed* is an ancient expression that is used to wish “success in your journey”. It has been heard repeatedly during rockets' lift-offs from the Apollo missions to the more recent SpaceX endeavours. Even though it has nothing to do with the speed of God, we want to use the ambiguity of the term to stimulate the generation of various meanings for the piece.

Another motif can also be derived from the medieval expression “God Spede the Plough”. This expression is found in writings and songs about the farmer's labour and their never ending task of ploughing the fields, year after year. The ploughmen sang lines calling upon God for prosperity during the yearly Plough Monday. This ode to prosperity chimes with the promises of the 4th industrial revolution and its contemporary version of labour. *Godspeed* is our rendering of Plough Monday, rituals of human augmentation and labour. Rituals to summon “Godspeed and good luck” at the verge of the singularity.



Figure 1. *Inferno* (2015) during Elektra Festival 2017. ©Photo Gridspace

Rituals of the Machine

Samuel Beckett commented that the absurdity of life brings rituals upon humans. In *Godspeed*, the overarching narrative will be revolving around the current absurdity (paradox) found in our “rituals with the machines”. In our context, rituals are generated as the results of instructions and automatic behaviours. [7] What follows is to imbue these actions with intentions and with potency of cultural conventions. This eventually effects an actual change, a transformative experience, from the standpoint of participants.

Attendees of rituals are usually comprised of a context/subject, a group of performers and an audience. Performance theorist Schechner notes that rituals are “not simply a doing but a showing of a doing. Furthermore, this showing is both actual... and symbolic”. [8] Rituals do promote intersubjectivity, a key element for *Godspeed* to encourage kinaesthetic empathy and affect sharing among all participants. [9]

As a strategy to immerse audiences in our robotic environments, we have empowered overstimulation. The “hyperarousal” we have witnessed in *Inferno* is nothing unusual in the context of rituals. [10] Repetitive actions can, after a certain time, lead to displacement and some sort of trance. Our goal is to enclose the viewers in such a system, either to make them feel something totally different or to make them realise that they are just being subsumed to something greater.

Schechner further notes that rhythmic and sound-making activities that are carefully coordinated invariably lead to feelings of “identical opposites”. [11] *Inferno* and *Godspeed* rituals are setting at the forefront the paradox of human-machine via the oppositional forces of the trance: wholeness / bodily disintegration, invulnerability / vulnerability, or tranquillity / readiness.

Bernard Stiegler points out relations between the Anthropocene, exosomatisation and infrasomatisation. [12, 13] He witnesses the acceleration of the transfer of human skills from the body towards external tools, machines and systems. The exosomatic elements of *Godspeed* will be wearable apparatuses to enhance, synchronise and sustain repetitive rhythmic movements of the rituals. While *Inferno* was focusing on the exosomatisation of being controlled by a wearable robot, *Godspeed* wishes to further the experience and venture into the grounds of infrasomatisation. The infrastructure or systems, such as the internet, are the intangible structural extensions of the humans, beyond the proximal exosomatic devices. In *Godspeed*, the infrastructure is the ritual, its scenography and *mise-en-scène* performed, implemented and generated by the exosomatised crowd. In such, we wish to blur the notion of rituals with the notion of automatic crowd behaviour in a similar way that rituals and performing arts blur. In this machinic mass ornament, *Godspeed* proposes rituals for our extended bodies.

Expanding on *Inferno*, which can be seen as a mono-ritualistic participative event, we want to elaborate a whole series of generative and rather speculative rituals. Performed and experienced by the viewers-cum-participants, these rites will be orchestrated by specific instructions and carried through the wearable apparatus that coerce their movements.

As a singular symbolic act, each ritual will set the stage for a particular group of exoskeletons that can execute specific actions linked to this ritual as well as to the ontology of those machines. These actions would sometimes be absurd, solemn, repetitive, ceremonial, contemplative, etc. If philosopher Byung-Chul Han noted the gradual disappearance of rituals in our society, we, on the contrary, want to re-actualise their potentials through an immersive and experiential *mise-en-scène* of technology. [14]

If we break down *Inferno* into ritualistic episodes, we have: the briefing where instructions are given and expectations emerge, the “rapture” when participants are being dressed up with exoskeletons in the front of audience, the “awakening” when the exoskeletons first start moving, repeated cycles of fast paced movements followed by uncomfortable moments of stillness, moments of hope from a languish soundtrack, playful puppetry driven by the authors, glitches of the ghost in the machine and finally, the catharsis. The undressing and dressing up of a new member were integrated seamlessly into the performance. The hovering crew attending the performers was an integral part of the rituals. *Inferno* could be considered mono-ritualistic from both the perspectives of the single type of exoskeleton, the single static layout of the performers and the “music clip” sequential structure of performance.

With the dynamic scenographic configurations of the participants, bodily extensions and props, *Godspeed*'s rituals can further explore more directions and genres. For instance, robotic extensions could enable participants to engage in a ritual that produces the live soundscape. These exosomatic music tools could then insure some level of rhythmic or melodic cohesion among untrained participants. With a dynamic arrangement of the performers, different subgroups can be spatially organised to represent infrastructures and social organisations in a symbolic or iconic manner. With the above dynamic organisations and interactions among participants, the narrative structure of *Godspeed* is expanded beyond the sequential tableaux of *Inferno*.

Ritual Symbionts

In *Godspeed*, we will explore various facets of the symbiosis of human-machine: alternate morphologies and anatomies, supernumerary limbs, plasticity and co-creation. [15]

The rituals will be co-created and co-performed in real-time between performers, audience and artists. This co-creation of ritual landscapes, as with *Inferno*, will be achieved by embedding and distributing media sources onto audience, performers and the surrounding space. Audience and participant bodies will become part light, part robot, part instrument, and part group element of the rituals unfolding around them. Scenographic structures will emerge in front of your eyes; spaces and situations will morph according to performers and the audience.

With *Godspeed*, we aim to further develop our exploration of exoskeletons and wearables robotics by experimenting with different machine morphologies, with their actions and with the participant's control over them. We want to build exoskeletons that also comprise extensions and prosthetic elements apart from the normal parts of these machines (arms, shoulders, torso, legs, etc.). These extensions will allow the execution of a series of unusual actions or surprising symbiotic actions, sometimes under direct control of the participant, sometimes completely unintentional. [16]

We also aim to develop a custom feedback system (something that does not exist in *Inferno*) that would allow the participant to interact with the system and with other participants. It will then be possible to control certain parts

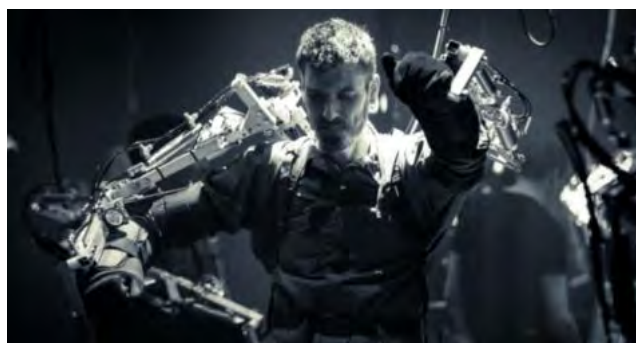


Figure 2. Exoskeletons at Stereolux. ©Photo Fonteneau

or even the entire body of his neighbours, as the reverse will also become achievable.

Bodily experiences are hard to describe and given the altered sensorimotor activities arising from wearing exoskeletons, we noticed that it would be desirable to give the audience means to enhance their kinaesthetic empathy towards the performers. *Godspeed* will play with the autonomy and the gaze of the local audience member facing the global system in action. It will include a distributed control of performers via mobile applications available to the audience and it will gaze at multiple streaming of body cameras embedded on the performers. In this way, *Godspeed* expands the ritualistic participation to members of the audience.

We seek to investigate altered scripting methods of choreographing rituals and to establish the generative potentials of this hybrid man-machine technology. Following strategies found in Instruction Art, participants are co-creating the work as a results of enacting the generative instructions given to them. With *Godspeed*, parts of the instructions are implicitly given by the exosomatic system while others are given by the affordance of the space and the context.

Challenges

As with *Inferno*, *Godspeed*'s impact relies heavily on the enablement of non-professionally trained participants. This is somewhat made possible from a set of performance instructions easily understandable, even if delivered under the frantic nervousness of the pre-show. As we will shift towards a more elaborate set of rituals and staging, we will need to find strategies to manage this complexity and communication to keep the same operational paradigm of “on the spot” training of the participants.

With the goals of having multi-purposed exoskeletons come the challenge to find ubiquitous solutions to embark various devices on various parts of the body of the participants. Equally, our experience of *Inferno* leads use to build more robust and adaptable exoskeletons to fit more body proportions. Similar to the challenge of training, apparatuses need to be easily retrofitted on performers under demanding live conditions.

In *Inferno*, each participant is performing within his/her safety bubble, akin to the techno genre dance floors situations. With *Godspeed*, we will break this bubble as we wish to explore further interactions and collaborations, mediated thru the machinic extensions, props or

scenography. This proximity will open the doors to a broader set of rituals.

With the shift from static to dynamic arrangements of events comes a challenge of audience focus. In *Inferno*, even with area lighting, we found it problematic to direct the focus among the energetic environment of 25 exo-performers simultaneously dancing. An early attempt to control performers with tablets distributed among the audience went unnoticed. When a “master” performer appears dead centre under a spotlight and controls the ensemble, this interaction gets lost mainly due to audience line of sight. *Godspeed* bid to help focus will include video projections and mobile streaming in order to re-establish this line of sight and properly capture pivotal moments of the rituals.

On the horizon

The project is planned to ready for public performances circa 2023. Throughout the production process, we will workshop rituals and their accompanying human augmentations.

Godspeed humanity. With the challenges of the Anthropocene, the denaturalisation of the human and the mechanisation of life, we certainly need to be prosperous in the precarious journey ahead of us.

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Authors Biographies

Based in Montreal, **Bill Vorn** is working in the field of Robotic Art since more than twenty-five years. His installation and performance projects involve robotics and motion control, sound, lighting, video and cybernetic processes. He pursues research and creation on Artificial Life and Agent Technologies through artistic work based on the "Aesthetics of Artificial Behaviors". He teaches Electronic Arts in the Department of Studio Arts at Concordia University (Intermedia program) where he is Full Professor. His work has been presented in many international events, including Ars Electronica, ISEA, DEAF, Sonar, Art Futura, EMAF and Artec. Together with LP Demers, they have been awarded the Vida 2.0 award (1999, Madrid), the Leprecon Award for Interactivity (1998, New York), the Prix Ars Electronica Distinction award (1996, Linz) and the International Digital Media Award (1996, Toronto).

Louis-Philippe Demers makes large-scale installations and performances. He participated in more than seventy artistic and stage productions and has built more than 375 machines. Demers' works have been featured at major venues such as Theatre de la Ville, Lille 2004, Expo 1992 and 2000, Sonambiente, ISEA, Siggraph and Sonar. He received six mentions and one distinction at Ars Electronica, the first prize of Vida 2.0, mentions at Vida 12.0 and 15.0, two jury recommendations at the Japan Media Arts Festival, the Interactive prize for Lightforms 98 and six prizes for Devolution including two Helpmann Awards. Demers' research focus on embodiment and the experience of art and technology. He was Professor at the HFG Karlsruhe, affiliated to the ZKM and Director of the Creative Lab at QUT. Demers held visiting/guest professorships from the University of the Arts London, CAFA in Beijing and at the Universität für angewandte Kunst Wien. He is currently Associate Professor at NTU's School of Art, Design and Media.

Monument Public Address System: Mobile AR and Interactive Installation

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Figure 1. *Monument Public Address System*, Installation documentation. ©Meredith Drum.

Abstract

Monument Public Address System is a multi-platform interactive documentary project centered around a growing collection of audio interviews about the past, present, and future of confederate and colonial monuments in the US. Two platforms are being produced to present the documentary narratives to the public. The first is a place-based augmented reality app accessible on participant's smartphones and tablets. The second is an installation and musical performance. With this project, the author-artist aims to engender critical and thoughtful social experiences in public spaces through the presentation of narratives that offer truth and justice-centered perspectives and anti-racist visions for our shared future.

Keywords

Anti-racist, augmented reality, confederate monuments, documentary, future, heritage, location, participation, place-based, public art.

Introduction

Monument Public Address System is an on-going, multi-platform documentary initiative centered around a collection of audio interviews about the past, present, and future of confederate and colonial monuments in the US. With this project, the author-artist aims to engender critical and thoughtful social experiences in public spaces. And through the presentation of truth and justice-centered narratives the goal is to contribute to a growing body of

anti-racist projects and visions for our shared future. Two platforms are being produced to present the documentary narratives to the public. The first is a place-based augmented reality app accessible on participant's smartphones and tablets. The second is an installation and musical performance.

Multi-media Platforms

The augmented reality (AR) app, invites participants to open *Monument Public Address System* on their mobile device to discover 3D virtual objects and animations superimposed on the world around them. When they interact with these objects, short sections of the audio interviews are triggered and play. As they listen to the narratives, participants can explore the virtual animations in relation to the physical space through which they move (Figure 2).

It is important to the author-artist that the app is accessible as possible. While the augmentations are geo-located around monuments, the sound and imagery can be experienced any place. While it is intended for participants to circumnavigate confederate and colonial monuments – and the empty spaces where monuments once stood – while experiencing the AR, the app can be opened anywhere. Moreover, the app is mobile AR, released on both Google Play and the Apple App Store, so that it can be used on a large variety of hand-held devices.

The installation and musical performance the project, titled *Monuments Dissected: Public Art and Contested Spaces*, was open to the public April 21-23 2022 in The Cube, Moss Art Center, Virginia Tech. The Cube is a high-tech media theater. The installation included a video sculpture, projections on four screens, a listening station where visitors could sit and listen to edited sections of the audio interviews, a drawing station where visitors were invited to imagine new public art to fill the vacated spaces where monuments have or will be removed, and two musical compositions distributed across a multi-channel speaker array (Figures 1 and 3). The musical compositions have been commissioned specifically for the project. One score is being composed, performed and produced by Grisha Coleman, a well-respected artist of color based in New York City and Phoenix, AZ. The second score is being written by Marcus Norris, an emerging Black composer based in Los Angeles and Chicago. The author-artist and her collaborators are actively seeking new venues to present the piece.

Interviews and Research

To build the collection of interviews that provides the backbone of both the AR app and the installation, the author-artist has interacted with a wide range of individuals across the U.S., including activists, educators, scholars, students, planners, legislators, and other artists. The sound of the interviewee's voice as they tell their story is central

to the project. Their narratives are rooted in their experience of, and research and reflection about, the monuments. Some of the interviewees have offered personal stories about their feelings of exclusion when they see images related to the confederacy. Others have analyzed the symbolic violence of the monuments in relation to ongoing racist systems. And others describe potential liberatory sculptural works to fill the vacated public spaces in their cities.

The artist has found that the interviewee's narratives align with much existing writing about racism and confederate and colonial monuments by journalists and academics. Ana Lucia Araujo, historian and professor at Howard University, writes:

When black and brown people open a textbook, visit a museum, or look at the statues displayed in major squares of the main European and American capitals, they only see images of white men, who were wealthy, who had power and who very often were slave owners or slave traders. Then when black men women, and children are challenging proslavery statues, they are denouncing this past that remains alive in the present. They are calling attention to their present day economic and social exclusion. . . . All monuments emerge and disappear because of political battles that take place in the public arena. Likewise, public memory is always political. [1]

Conclusion

Monument Public Address System is intended to support critical thinking about the future of public monuments and spark conversations on the history of slavery and racism in the U.S. The project is a platform for visual and aural expressions of frustration, anger, sadness, fear, and confusion regarding the racist, unjust and violent narratives that have shaped and continue to shape our present and future. It is also built for the enunciation of anti-racist hopes, activities and initiatives.

Acknowledgements

Major funding for *Monument Public Address System* has been provided by Virginia Tech's Institute for Creativity, Arts, and Technology (ICAT) in the form two SEAD grants. The artists would also like to thank ICAT for inviting the team to present the project as an installation and musical performance in Virginia Tech's CUBE theater in April 2022.

Meredith Drum is the main artist producing *Monument Public Address System*. Yet her collaborators are vital to the project. In addition to the two composers discussed above, she is also collaborating on the installation and musical performance with media artist and producer



Figure 2. *Monument Public Address System*. Documentation of the AR app in use ©Meredith Drum.

Tanner Upthegrove and musicians Annie Stevens and John Irrera.

With the grant from Virginia Tech's ICAT, Drum and her collaborators commissioned music for the project from artists: Marcus Norris and Grisha Coleman. Drum will present an excerpt from Coleman's musical work during her artist talk.

Drum's graduate assistant Bryce Burrell has been essential; he has identified many of the interviewees and has helped conduct and edit the interviews. Sam Lally, her undergraduate assistant has completed much of the technical work on the AR app. Note: as Drum will be sole author to deliver this artist talk, she has only included her biography below.

Project Documentation

Please visit this link to view documentation of the augmented reality app *Monument Public Address System*:

<https://meredithdrum.com/work/monument-public-address-system>

Documentation of the installation, titled *Monuments Dissected: Public Art and Contested Spaces*, and on view April 21-23, 2022 at The Cube, Moss Art Center, Virginia Tech, Blacksburg, Virginia, U.S.A., can be viewed here, as video, stills and sound files of the interviews and the musical compositions:

<https://meredithdrum.com/work/monuments-dissected>

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Author Biography

Meredith Drum is an interdisciplinary artist working with animation, installation, augmented reality, video, and various modes of public participation. Her projects center around the cultivation of care for others, both humans and nonhumans. She often exhibits in New York City, her former home, including a 2020 solo screening at Microscope Gallery. Internationally, she has presented at a range of institutions and events including ISEA 2018 in South Africa, ISEA 2017 in Colombia, ISEA 2014 in the UAE, and ISEA 2012 in the US. She has been supported by grants and residencies from the Lower Manhattan Cultural Council, the Bronx Museum of the Arts, the Atlantic Center for the Arts, iLand, the Wassaic Project, the Experimental Television Center, ChaNorth, ISSUE Project Room, the University of California Institute for Research in the Arts, HASTAC, and Wave Farm Transmission Arts and the New York State Council on the Arts.



Figure 3. *Monument Public Address System*, Installation documentation. ©Meredith Drum.

How can we renew the living environment from the perspective of light, both natural and artificial, for the future?

Titia Ex

Light & Media Art Projects
The Netherlands
www.titiaex.nl

Abstract

COVID-19 leaves a clear mark on our living environment. The pandemic has changed the use of public space. We have started to spend more time in nearby outdoor spaces. It is the place where we see the other. Where we make the social city. Light, natural and artificial, is a fundamental part of this. Light is much more than a medium that enables us to see. It affects our health, our ecosystems and the places we live in in countless ways. Light can bring people together in urban spaces, emphasize the culture and identity of the city and shape the nightscape.

Keywords

Art of Light, Public Art, living environment, future, natural and artificial light, participation, research, cycles of day and night, technology, planet.

Introduction

For me, as an artist, public space is not a saturated or static space, but a living organism. A continuous process of interaction between people and their environment. Light uses time and space as its material. Light art in public space does not begin or end in a physical form but is a transfer of energy. An infinite potential of relationships that permanently engenders new links between things and people. It can lift the space out of its anonymity and add new and unexpected connections or break fixed patterns of movement. It does not have to draw attention to itself, it provides sight of the space. The art of light as a representation of life, of energy in public space, as a form of poetry.



HALO

Integral light vision

A vision of light is needed that is approached from various perspectives, such as sustainability, experience, light pollution, safety and health. As technology transforms public spaces, we gradually lose our physical connection and inherent sensitivity to natural light. We need to let the dusk rise again and (re)learn our sensitivity to both the light and the dark. In the evening there is also a certain 'imbalance of artificial light'. In the past decades more and more artificial light has been added. People do not feel safe or healthy and think that adding more light is the solution, while this actually has the opposite effect.

For our health we should have less artificial light. Also, light works with contrast - just add more light and the black hole falls next to it, with the result that everything needs to be lit up more. Next to this, our environment is more and more equipped with sensors, network software, measuring equipment, cameras and so on. People are not involved in this; the human scale and the flora and fauna are secondary. A lighting vision cannot be left to traffic engineers alone or outsourced to companies. An integral lighting vision is needed with all parties involved.

Artistic research in progress

In participation with of the Placemaking Team, Buikslotermeerplein consisting of residents, entrepreneurs, and other stakeholders, an analysis is made of the current situation during the day and after dusk of the Buikslotermeerplein area in Amsterdam-North.

The goal is to identify different light ecosystems, characters and qualities of the living environment. To define functional, emotional and social dimensions, in order to make people the owners of the light in their living and working environment.

Buikslotermeerplein Area

The Buikslotermeerplein area in Amsterdam North is a former working-class neighbourhood, designed in the 1960s and is to become the beating heart of Amsterdam-North.

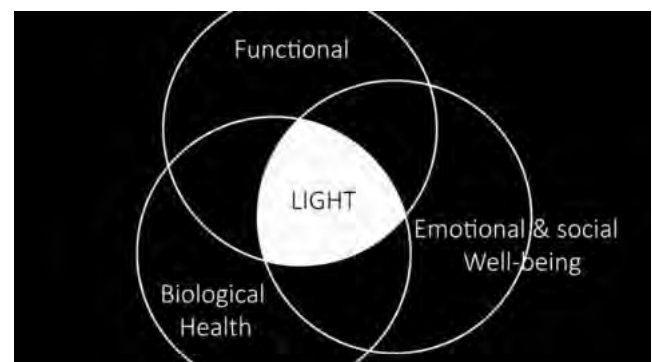
The city's policy is to densify the area. The new North-South metro line ends here and around the metro stop. There are an ROC school, a cinema, city offices of Amsterdam-North and several residential towers are now under construction.

At present there is a languishing market, a shopping centre with empty shops with its back to the neighbourhood, mega car parks and many blocks of flats - between neglected vegetation and polluted water.

Besides the current residents, mainly living in social housing projects, new residents, both students and house owners, will be moving to this area. The challenge is to keep the area liveable during the next twenty years of urban renewal, while mixing old and new residents, transforming the shrinking shopping centre, and create a durable vital green and blue public spaces. The urban development around this area also offers an opportunity for an integral and innovative approach.



Buikslotermeerplein Square, urban development.



Light Safari

The starting point is to make people familiar with the phenomenon of light. This is happening by making a light safari through the neighbourhood.

During the light safari, public space is approached from different angles, such as: perception, health, orientation, safety, inclusion and identity.

Raising awareness by sharing knowledge, experience, providing access to the (technical) concepts, in order to arrive at alternative scenarios.

Conclusion

After understanding and experiencing the potential of light people got more aware of the influence of light on their surroundings. Two Universities of Applied Sciences have been inspired. The municipality is open to collaboration, the association of entrepreneurs has experienced the importance of good and balance Light (Art), and the residents feel they have been heard. This is not to say that everything will be applied and implemented immediately. The urban development of the Buikslotermeerplein neighbourhood is a process that will take several years. However, there is an agreement to develop it jointly. Light will be one of the carriers.



Light safari, the light is out of balance at the entrances of residents' flats. generally Overexposed and no orientation in the distance.

Artist Titia Ex

Titia Ex creates a choreography in space, where art, technology and the receptive surroundings meet. Every environment has its own character, function and users. Her visual light & media sculptures immerse with their dynamic, mobile forms and interactive characters. In the course of light and dark, day and night, they reflect related changes of mood and create a poetic echo, adding a new layer of meaning.

She is the creator of dozens of high-profile, large-scale works of light art in public space, including 'Dolmen Light' in the Hondsrugttunnel in Emmen (2015) and the interactive light sculpture 'Flower of the Universe' (2010), for which she did her research and found inspiration in a Botanical Garden travels all over the world, including the Asia Culture Center (ACC) in South Korea (2020). Recently she created 'Loom Light', an interactive light monument for Jan Zwartendijk and other invisible the heroes of resistance during the Second World War in the region of Eindhoven (2022). Also new is the installation Lightfall. An existing rain pipe is transformed to an interplay of light and water. The artwork makes the vein, the interweaving of Amsterdam with water visible. With this poetic gesture, the inner condition of the water is revealed, and the context of the built environment becomes tangible.



LIGHTFALL © Titia Ex

Sun Eaters: How do we relate with the non-human plant world if our invisible similarities are made visible?

Grace Grothaus

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Abstract

Sun Eaters, a physical computing installation, measures the invisible bioelectricity present in all living beings and translates it into visible light. Exploring the conception of art as tool for sensing, I am exploring how we relate to the non-human plant world(s) around us. Can artworks act as an empirical interface for grasping our complex, interwoven, beyond-human ecologies of present-day Earth and ways of thinking about them? How do you imagine your relationship with a plant differently when you can physically see it?

Keywords

Electronic art, Physical Computing, Environmental sensing, Environmental Visualization, Plant-Computer Interface, Electrocardiograph (ECG), Biotechnology, Ecosystems, Circadian Rhythms, Plant Blindness

Introduction

Through the installation of a series of environmental sensing modules, I have produced an art experience that renders the invisible bioelectric current present in all living beings and translates it into visible light for us to see. Bioelectricity in humans results in a rhythmic pulse we understand as a heartbeat. In plants, it is rendered in a much different wave pattern. This installation, which I call *Sun Eaters*, is installed in trees and plants along paths of frequent use and invite passers-by towards a heightened awareness of the oft-overlooked vegetation all around us. (Figure 1.)

Overcoming Plant Blindness

Plant blindness, a form of human cognitive bias, is a common tendency to overlook plants and to treat them solely as a beautiful backdrop in front of which human action takes place. [1] Yet plants and trees, sequester atmospheric carbon. They are vital to the health of our future and worthy of our increased attention, as we

strive planetarily towards achieving net zero carbon levels. Therefore, for much the same reasons that some stop signs and warning notices become outfitted with blinking LEDs, I've illuminated the trees: to arrest your attention within our oversaturated world and overcome plant blindness.

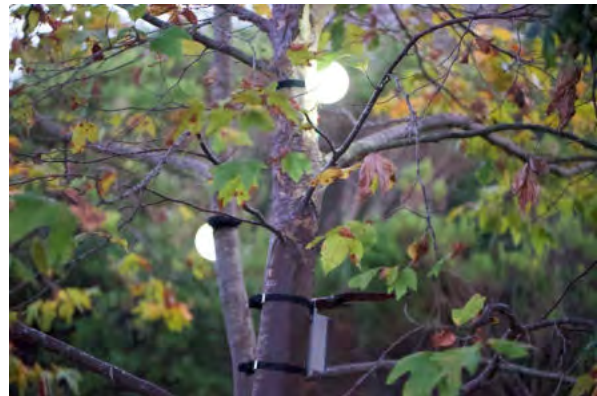


Figure 1. Installation image of *Sun Eaters* at Lux Art Institute in Encinitas, California, 2020. Photo ©Grace Grothaus.

Measuring Plant Biorhythms

The changes in light levels in *Sun Eaters* derives directly from the received analog bioelectric signal produced by the trees they are installed on. In order to read the plants biorhythms, electrodes are affixed to the leaves and/or branches of the tree which send electrocardiograph (ECG) signal to a sensor. I am then processing the signal through Arduino and subsequently simply and directly outputting it to LEDs through pulse width modulation. ECG sensors are more commonly used to measure human heartbeats, but repurposed in this way, they help us to see a pulsing connection with the life around us.

Bioelectricity refers to ion fluxes within organic tissue which occur as a byproduct of life processes. Where net ion fluxes occur, an electric current and

field is generated. In plants, the bioelectricity ebbs and flows happen on different timescales as it does in us, however there are common points of connection. Circadian rhythms affect plants just as they do us. A diurnal twelve-hour cycle can be seen in the bioelectricity of trees, peaking once with the rise of the sun, and again as it sets. [2]

Plant bioelectric fluxes also change minute to minute and second to second, resulting from external environmental factors such as season and temperature. Internal elements influence it as well, such as insect invasion. [3] Human heart beats are variable as well. When we are stimulated by excitement, for example, they become more rapid. In addition, each person has a slightly different heartbeat as the next, and the same holds true for plants. They are all uniquely individual, just as we are. Though humans may exist in a different temporal scale as plants, we have a lot in common, perhaps more than we realize. [4] (Figure 2)

Pulsing Together

Through *Sun Eaters*, I am exploring the question of whether artworks can act as an empirical interface for grasping our complex, interwoven, beyond-human ecologies of present-day Earth and ways of thinking about them? Can they act as visual aids in comprehension through their expansion of our imagination? If you can see your heart pulse together with that of a tree, do you see and understand it differently? Early iterations of installation *Sun Eaters* visualized only plant bioelectricity, and then I began to use the same sensor to measure both human viewers as well as that of the vegetation. (Figure 3)



Figure 2. Installation image of viewer interacting with *Sun Eaters* at Cite Internationale des Arts, 2021. Photo ©Grace Grothaus.

It is my hope that once we begin to see ourselves in each other and other species in conjunction with us, noting our incredible interconnectivity within the

global ecosystem, that we will take on a greater sense of planetary stewardship. [5]



Figure 3. Installation image of viewer interacting with *Sun Eaters* at Cite Internationale des Arts, 2021. Photo ©Grace Grothaus.



Figure 4. Installation image of *Sun Eaters* at the California Institute for Telecommunications and Information Technology, 2021. Photo ©Grace Grothaus.

Thematic Statement

How do we fight climate change and global warming? Part of the answer involves revising our understanding of natures and worlds. In order to protect the planet's living future, it is essential that we develop empathy beyond our senses in order to connect to Earth's more-than-human worlds, overcoming otherness and our human cognitive biases. My goal with *Sun Eaters* is to invite viewers towards a heightened awareness of the oft-overlooked vegetation all around us. (Figure 4) The work explores themes of revealing our invisible connections and direct co-symbiotic experience. I am deeply interested in the question of how we relate with nature and understand and experience life today. Within cities, our lives are led increasingly disconnected from circadian rhythms. How do we relate to nature? If you can see yourself pulse together with a plant, do you see and understand it differently?

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Acknowledgements

The opportunity to exhibit *Sun Eaters*, sharing it with various publics is owed to several institutions. I would like to acknowledge the Lux Art Institute in Encinitas, California for their initial support of its first installment in fall 2020. Additional thanks go to the California Institute for Telecommunications and Information Technology on the campus of the University of California San Diego who exhibited it in May 2021 as part of their Initiative for Digital Exploration of Arts and Sciences (IDEAS) performance series, and to Cite Internationale des Arts, where as an artist in residence this summer, I explored new directions with the work as part of an artistic co-creation lab, *Through the Eyes of the Others* led by Tjasa Crnigoj, alongside Garance La Fata, Cristina Rosenberg, and Gethce Pierre.

Xeno Walk, an Augmented Reality Soundwalk on collective feminism

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Abstract

Xeno Walk is an Augmented Reality audio walk, featuring the voices and sound works by activists and sound producers who embrace the collage as a tool of aural exploration. The sound walk features the artworks of #VIVAS, a Latin America-based collective producing sound works from field recordings of social demonstrations and Viv Corringham's Shadow Walks. The interviews feature the voices of members of Collages Féministes & Féminicides Paris and Montréal who share their strategies on activist actions in the public space. The walk's sound design takes the form of a collage mixing their soundtracks and their interviews. The listener can choose to experience this walk using headphones; however, this AR project is meant to be heard as a collective soundwalk with two or more persons. For the premiere of this project, the artist organized four aural participatory performances, inviting the public to amplify and occupy the streets with the interview's voices and #VIVAS soundscapes.

Keywords

Augmented Reality, Sound Studies, Sonic Agency, Intersectional Feminism, Walking Methodologies, Immersive Technologies, Xenofeminism, Soundwalks, Queer Alliances, Space of Appearance, AR(t).

Introduction

My approach to soundwalking has been enriched by theories and concepts departing from Acoustic Ecology and Sound Studies. Despite the fact that R. Murray Schafer, Hildegard Westerkamp, and Max Neuhaus, have enriched the experience of sound walking, there remains a lack of academic literature documenting soundwalking practices that consider social, class, gender, ethnic, and disability perspectives linked to activism and political performativity. To address this gap, I propose to create an intersectional approach that builds from practices and theories of listening and collective walking as a form of coalition (Butler 2015) to inform a methodology and concept. In its practice, Sono(soro)riety, aims to collectively create alliances (Butler 2015). To do so, there are critical decisions in the action of planning, recording, editing, planning, walking, and listening collectively.¹ The action of "walking with" is a crucial tool for collective recognition and a performative act of enunciation, an act of

speech that can be exercised in space. The research-creation project "**Xeno Walk, on Collective Feminism**" is an audio walk developed for Augmented Reality (AR), featuring interviews with feminist activists and artists. The project emphasizes the diverse tactics that embrace the form of collage as a tool of resistance and autonomy. The augmented audio walk creates a sonic palimpsest with their interview voices and soundtracks produced by the Argentinian feminist sound collective #Vivas and Viv Corringham, Shadow Walks. The Augmented Reality tool helps us transit the public space, finding the connections between geographical cues and the content and meaning of the oral histories in the audio walk, departing from the interviews and activist experiences with members of three collectives Collages Féministes and Féminicides Montréal, and Paris.²

I chose the space by walking with two members of Collages Féministes Montréal, who helped me trace a path concerning their conflict embodiment, aural memory, and locations for pedestrians with disabilities. Understanding these personal traces of the terrain, I was able to locate five interviews, considering the three-dimensional infrastructure of the Boulevard Rosemond highway, the rail tracks walking and bike pass on Van Horne Street, and its connection with the underpass of St Laurent Boulevard. While walking with them, we brainstormed about the possibility of collage interventions and phrases that can respond to the topic of autonomy and freedom in the public space.

Testing the AR Walk

On the weekend of June 19th, 2021, six participants agreed to walk with me to text for the first time. Three of them were part of the collective Collages Féministes Montréal, and the rest were enthusiastic friends who wanted to join the experiment. We met in front of the skate park. They arrived with a delay, and Kira told me that the noise and male-dominated presence at that meeting point were stressing her out. I found that was precisely one of the points I wanted to test with another woman since I also felt the same, but being hip and having an alternative vibe could be welcoming. It turned out that the same issue happened with all six participants; they felt a bit invaded and self-aware of the masculine charge.

As far as the walk goes, listening with one Bluetooth speaker was not enough. The sound of the augmented voices vanished in front of the heavy traffic of St Laurent Blvd and the skate noises; therefore, we decided that the

¹ I will build upon theories of listening and walking by drawing from the concept of Sono-(soro)rities, an evolving concept that scholar Gabriela Aceves-Sepulveda and myself are currently developing.

²The Augmented Reality walk has been made with the App Echoes, which is developed for soundwalks experiences 893

walk could be better if it takes place later in the night. We imagined a walk night gathering where participants can feel more intimate and embraced by the evening. The group gathering could be about autonomy and collective agency walking together at night. These night walks are not something new; Viv Corringham speaks about how she witnessed and participated in the Reclaiming the Night movement, which started in London and New York City in the late seventies, where hundreds of women took the streets to walk together at night.

After this group exploration, we moved to the next walk in a metallic structure near the vicinity. In the corner, there is a sign that can be read as “Entrepot 77” which is the bones or the metallic construction of an abandoned building in front of *Champs de Possible* park. In that section, participants can hear the interviews of the collective #VIVAS. Their soundtracks welcome the walkers by immersing them into the wall-less building. The participants did not speak Spanish, whomever they seemed engaged to listen to the overlapping sound of their voices in such a space.

I realized that I needed to make bigger bubbles and center them into the middle of the structure because the cell phone GPS sometimes behaves very capriciously. Also, participants suggested that it would be nice to hear more soundtracks embedded into the oral histories to have a more immersive way of approaching their sound creations

layers; the underpass, the car bridge, and the walking-bike pass. The sound overlapping worked so well, allowing stories to be interconnected while walking.

Departures

This overlapping and connection with the skatepark relations linked with the XR critical theories of Rewa Wright, which describes the radical possibilities that Augmented Reality can convey:

“Emerging with and through AR(t)* is an activist politics engaging wireless networks to achieve a critical ‘detournement.’ In this context, AR has been deployed as a radical political agent, mapped at specific sites where participants do not simply view ‘the work’ (as one does in a conventional art gallery) but activate the sensation of ‘being within’ a critically resonant event. Such activist gestures have allowed AR(t) to forge a specific cultural relation with public space that was, prior to mobile technology, largely occluded.”³

To this extent, I wonder about the feasibility of resonating together by creating several participatory walks by each zone and collectively featured in the AR project. Therefore, I am introducing the collaborative and guiding the walk as a soundwalk but asking participants to bring their portable speaker and download the app before arriving at the meeting point and creating a connection with participants into the project.

The research on the spatial and sonic layers has been one of the most complex and engaging parts, which must be shaped, negotiated, and talked with other walkers to be effective. Its success might be related to the community appropriation, either by an invisible invitation open for random encounters or by a collective resonance embraced in a soundwalk.

Xeno-Walk, was later premiered in September 2021, in the context of the *POP Montreal Festival*. The project was funded by the artist-run organization *Undefined Radio*, as part of their series: *Calling Planet Earth!*. They were presented in four different participatory walks, where the public amplified the augmented sounds with linked Bluetooth speakers.



Figure 1. This is the postcard designed to be placed around the location of the walk, with instructions for the audience. ©Respect Copyright.

I realized that technically speaking, it is not recommended to use the feature of proximity to the center of the sound because once you are out of the range, the sound fades and cuts, limiting the narratives to finish. The walkers seemed excited to keep walking to the other routes, which allowed me to test my theory of sound overlapping between three

The *Xeno Walk* is the first practical approximation of the methodologies proposed as part of the development of Sono-(soro)rity. This concept builds from anthropologist Marcela Lagarde's *sororidad* (2006). She writes: “Understood as a non-binary, ethical, political, and practical dimension of contemporary feminism(s), we consider sono-soro[ridades] as a critical frame to look at the sonic dimensions of patriarchy. As a feminist

³ Wright, Rewa. Mobile Augmented Reality Art and the Politics of Re-assembly. Conference: International Symposium on Electronic Arts (ISEA 2015). P. 3

intervention in the archives of sound art, Sono-soro[ridades] makes visible how sound and gender constructions intersect each other. It highlights the potential of the sonic to unveil and make audible unequal power dynamics in which gendered violence and exclusion are perpetuated. We seek to embody what Sono-soro[ridades] sounds like and explore together its political potential in creating non-exclusionary sounding futures and re-sounding pasts and presents”⁴.

Part of my research-creation and further reflections after this walking series, is to identify how similar methodologies have been used in feminist sound practices to form moments of coalition and assembly in the public sphere. One of the aims of my doctoral research project is to create its phenomenology to trace these expressions into an intersectional framework and a defined method to define name and collectively analyze these feminist expressions of sonic agency in the public sphere.

Acknowledgements

I want to express my gratitude to the collectives featured in this project: Collages Féministes & Féminicides Paris and Montréal, #VIVAS and the ongoing collaborations with Viv Corringham, artist works and initiatives that inspired this research-creation.



Figure 2. A poster of Xeno Walk was placed in the location of the soundwalk ©Respect Copyright.

⁴ Gabriela Aceves-Sepulveda wrote this statement as part of statement of our working track, titled Sono-Soro[ridades]: Feminist interventions in Sound Art, in the frame Sound Conference Sonoridades 2021.

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Author(s) Biography(ies)

Amanda Gutiérrez Trained and graduated initially as a stage designer from The National School of Theater. Gutiérrez uses sound and performance art to investigate how these aural conditions affect everyday life. Gutierrez is actively advocating listening practices while being one of the board of directors of the World Listening Project, formerly working with The Midwest Society of Acoustic Ecology, and currently as the scientific comitée of the Red Ecología Acústica México. Currently, she is a Ph.D. student at Concordia University in the HUMA department and a research assistant at lab PULSE, the Acts of Listening Lab, and an active member at the Feminist Media Studio at Concordia University.

the body in\verse [Artist Talk]

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Abstract

The *body in\verse* is an online, interactive performance that combines biophysical sensing, emotive state sonification and visualization, and generative poetry to create the scene. The performance provides a deep dive from the world outside of ourselves, that is dissociated by mediated technology, into the interoceptive abyss of our emotive sea. Audience members are invited to participate in a focussed conversation that becomes the basis for the activity that follows.

Keywords

Interactive Performance, Biophysical Sensing, Emotional Affect Assessment, Disassociation, Data Visualization, Sonification

Introduction

The *body in\verse* is an online, interactive performance that combines biophysical sensing, emotive state sonification and visualization, and generative poetry to create the scene. The performance provides a deep dive from the world outside of ourselves, that is dissociated by mediated technology, into the interoceptive abyss of our emotive sea. Audience members are invited to participate in a focussed conversation that becomes the basis for the activity that follows. Questions will be on the rise of a technological culture, and how it has left us wanting, consciously or not, for identification and awareness of “essential rhythm”, that we continue to lose track of now that we live mostly in cities as the aboriginal environment recedes from view. The performance environment provides the ability to control the presentation of stimuli and monitor the physical reaction based on the interpretation of nuanced emotional state, blurring the line between auditory and visual real-time content and physical experience.

A biophysical sensing system measures the emotional affect of the performer, and then uses that data to drive the sound, abstract imagery, and a generative poetry algorithm. Emotional affect of the performer is assessed through arousal and valence measures derived from correlation of the performer’s heart rate and heart rate variability. An algorithm generates poetry using conversations that take place with the audience as source material. The poetry source material is then algorithmically organized according to its sentiment (positive to negative), and mapped to the emotional affect of the performer driven by the emotional affect assessment from the biophysical measures as described above.

What happens? What the audience sees and hears... How they participate...

We begin with a conversation.

The performer (Alysia Michelle James) is close to the screen, visible from the shoulders up, like a typical teleconference call. As the audience joins the call, she begins with some ice-breaker questions such as:

“How are you today?,”

“Where are you located?,” etc.

Audience members are able to answer these questions through the chat. The questions slowly become more poignant as the performer builds upon their responses.

“Why are you here?”

If an audience member responds with, “I’m here for a meaningful experience,” the performer may respond with a question like, “What is meaningful?”

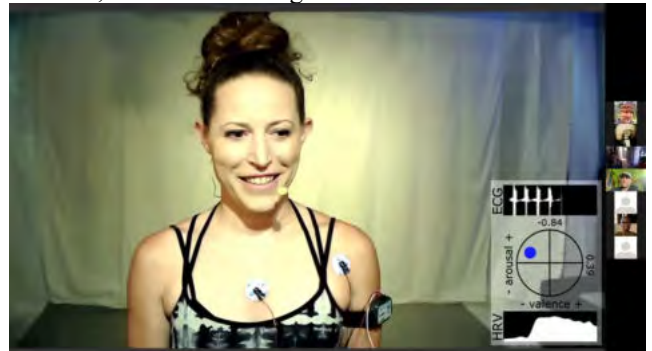


Figure 1. Still from the beginning of *the body in\verse*. ©2021 Hosale, James, Macy.

Other examples of questions in this category:

“What is the most important thing we could be thinking about right now?”

“Why be ‘new normal’?”

“Who were you before?”

The perspective moves outward in with questions such as:

“Are you worried about the fragility of society?”

“Are you worried about the fragility of life?”

“What makes a culture?”

“What does society avoid feeling?”

Then we shift to inward thinking with the intent of inspiring contemplation and introspective thought:

“Why do we feel?”

“What do you avoid feeling?”

“Can you feel other humans?”

“Can you feel your breathing?”

“Can you feel your heart?”

This more focused conversation becomes the foundation for the tone and direction for the rest of the performance.

The remaining performance is comprised of three elements:

ophysical state of the performer, and then uses that data to drive the sound, abstract imagery, and a generative poetry algorithm.

- An AI algorithm that generates poetry.
- A performance that combines movement, sound, abstract imagery, and text.

Biophysical Sensing

The science behind this project is based on work first performed by James Russell, "A Circumplex Model of Affect"[1]. This work has been cited roughly 14,000 times. Since 1980, psychophysicologists have continued to evolve theory, in regard to the assessment of feeling "affective" state, and so additional physiological variables have been utilized for evolving studies. These measures include electroencephalogram, pulse plethysmogram, blood pressure, blood flow, vascular resistance and ventilation.

Recent research in bioinformatics suggests that it is possible to assess the real-time emotional state of an individual using a special class of sensors that track human characteristics such as heart rate, muscular movement, eye movement, skin temperature and breathing[2] that contribute to an individual's emotional valence (range of affect from pleasant to unpleasant) and arousal (range of excitement from activation and deactivation) [3][4][5][6][7][8].

In this work we use a real-time electrocardiogram via a Biopac Bionomadix BN-ECG2[9].wireless data acquisition and analysis platform to establish core valence and arousal measurements to find a baseline affective state assessment of the performer. We ran the output of this amplifier straight into a sound interface capable of measuring down to DC (zero frequency). Valence measures are indexed by the performer's heart rate variability (HRV) and establish the horizontal model axis ranging from displeasure to pleasure. Arousal measures are indexed by the performer's heart rate (expressed in beats per minute) and establish the vertical model axis ranging from low energy (calmness, boredom) to high energy (excitement, alarm). The correlation of valence and arousal helps determine the assessment of emotive state, with high valence and high arousal correlating to excitement, low valence and high arousal to anger, low valence and low arousal depression, and high valence and low arousal being serene.

It is through works such as the body in\verse that valence and arousal data of a performer can be used to develop co-collaborative applications that help increase our somatic awareness and mediate the bi-directional emotive connection of a performer with an audience, other performers, and interactive computational systems.

Generative Poetry

The generative poetry algorithm is based on a layering of text analysis techniques, and driven by the emotional affect assessment from the biophysical measures as described above. The basis for is an artificial intelligence algorithm such as found on the *Poem Generators* website[10], that uses keywords that map to the biophysical state of the performer to generate poetic text.

Keywords are drawn from audience responses in the conversation at the beginning of the performance using a speech-to-text algorithm and used as prompts for AI generated poetry using TensorFlow and GPT-2[11]. The prompt provide the beginning of the poem and the AI completes it. For example, if the audience member states, ""doing something I love," the AI might respond, "doing something I love – which in my life I only get – from myself – and from it – out of the blue." This is combined with a prewritten poem that is first spoken by the performer, and then by the computer -

technique[12]. The cut-up prewritten poem and the AI generated poem are combined in a call and response between two computer voices. The inspiration for this approach for generating text is inspired by the combinatorial literature techniques as employed by OuLiPo (Ouvroir de littérature potentielle; roughly translated: "workshop of potential literature") [13]. Through this system we can create a complex and rich system for generating a perceptually endless territory of poetic results.

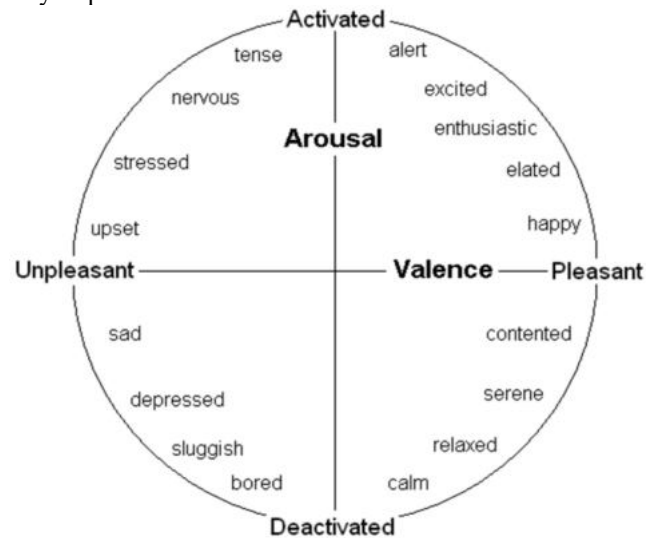


Figure 2. Valence and arousal chart from James Russell, 1980, "A Circumplex Model of Affect." [1]

Bringing it all together

As the questions become more contemplative, the audience responses are captured and presented on screen. The emotions the performer is experiencing during the performance are also presented on screen via an interface on the lower right side of the screen.

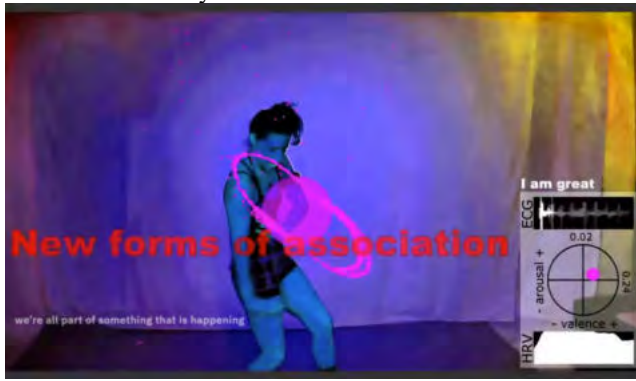
Up until this point the performance is solely focused on the performer's face, when the last question is answered she begins to move and slowly create space between her and the camera she begins a dance performance and recites the pre-written poem:

Enter the mind and meet the truth that lives there
 Don't accept the limitations society has accepted
 Break free of a paradigm
 Extend yourself, develop a new sense
 Embodied knowing, human connectivity
 New forms of association
 New ways of seeing
 New ways of being
 Recognize the world beyond language
 Visualize the invisible
 Embody the future
 Make the world

Once this has been completed the generative – computer spoken poetry begins. There is a feedback loop between the generative poetry algorithm and the performer that is mediated by a biophysical sensing interface. as the generative poetry begins to fade in.

The performer's movements and actions are influenced by the AI's poetry, which is being influenced by the emotive analysis of the performer based on her physiological state. The responses will be made in movement, dance and breath while the Bionomadix continues to collect data and generate

arousal of her body.



ing mapping to colour and poetry overlay.©2021 Hosale, James, Macy

The dynamic performance showcases many emotions through-out the performance. The movement portion of the performance then ends similarly to the way it began – a slow approach to the camera with extra emphasis on breathing as she catches her breath. Her eyes looking directly at the camera and she attempts to calm her breath and heart rate with audible breathing inviting the audience to participate in the rhythm of the breath. She asks again, “How are you feeling?”

The performance ends with a Q&A during which all three artists will respond to questions and offer information about the formation of this project

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Macrophones: Listening to the Climate Crisis via Atmospheric Infrasound

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Abstract

A microphone is a device used to amplify small sounds, but what I call a “macrophone” brings very large sounds—aka infrasound—into our perceptual range. Normally too low-frequency to hear, infrasound travels vast distances through the atmosphere, even across the globe. It comes from superstorms, heavy industry, wildfires, calving icebergs, HVAC systems at massive data centers, avalanches, and even police weaponry. Big phenomena like these are entangled with the climate crisis, which is difficult to perceive directly on a planetary scale. And yet this crisis continually makes sound—what can we hear when we’re able to listen to it from where we stand?

Keywords

sound art, infrasound, listening, climate crisis, atmosphere, spatial research, artistic research, mediation, earth science

Artist Talk

Climate change is a trend, not any one given event, and as such it difficult to perceive in an immediate phenomenological sense unless we are in the midst of some specific calamity. Even then, there is a conceptual leap to be made in order to link what is happening locally to the global situation. This is especially true as that situation is not just a matter of weather per se but interrelated geophysical and anthropogenic forces unfolding over varied timescales that individually and cumulatively have a material effect on the planet and the lives and livelihoods that depend on the stability of its atmosphere.

How the global is mediated, therefore, becomes a critical question when it comes to our perception of what the climate crisis actually comprises. Reports from Intergovernmental Panel on Climate Change, pundits on cable TV, disaster porn circulating on Instagram, and online data-driven maps of satellite and sensor data are examples that complete to fulfill this role in our contemporary media condition. However, channels like these, especially when taken together, produce an overdetermined understanding of the global—layers of information so saturated with anxiety and yet disconnected from the immediate sensorium of the body in space as to end up being more a means of alienation from the planetary condition than of resonating with it. [3] Additionally, the consumptive network infrastructure that undergirds global communication, along with the capitalist and colonial projects that built it, is itself implicated in precipitating the crisis. [2]



Figure 1: Aerial photograph of *Macrophones* prototype installed in Portland, Oregon. ©2020 Brian House

This artistic research project, dubbed *Macrophones*, presents an alternative means of relating at a distance. “Macrophones” record and play back atmospheric infrasound. These “sounds” have wavelengths as long as several miles and therefore frequencies far below what human ears are normally capable of registering. Because atmospheric infrasound is not absorbed by the atmosphere in the same way that regular sound is, it can travel vast distances, even all the way around the planet. [4] Sources of atmospheric infrasound include superstorms, heavy industry, wildfires, calving icebergs, HVAC systems at massive data centers, avalanches, ocean waves, and potentially even crowd-control weaponry. This host of phenomena is inexorably entangled with the climate crisis and cannot be contained within categories of human and non-human. While such sources cannot be seen from a distance without the aid of remote imaging technology, their sound waves propagate to where we are right now, and therefore they can be heard using *Macrophones*.

Macrophones appropriates technology developed by the United States military in the 1950s. In the context of the Cold War and the escalation of nuclear armaments, it was of pointed strategic interest to know if the Soviets were performing warhead tests on the other side of the globe without having to fly an airplane there to see. Prior to the advent of satellites and other electromagnetic remote imaging technologies, “infrasound arrays” provided this opportunity. Today, in fact, the Comprehensive Nuclear Test-Ban Treaty Organi-

zation (CTBTO) still uses infrasound arrays to monitor for the telltale low-frequency sound of nuclear tests. These large manifold structures mechanically average air pressure over a large area in order to filter out wind, which will otherwise mask infrasound signals. Changes in pressure noted by a microbarometer in the center of the manifold is then compared to readings from other installations, identifying phenomena of interest and triangulating their locations. However, as infrasound arrays have typically served this role of event detection, the data they produce has more often been interpreted via charts and graphs than rendered as audible sound. [1]

Macrophones adapts the array design to utilize cheaper and more portable components while also taking advantage of contemporary improvements in low-cost computing hardware. Additionally, the project comprises software that reformats, filters, and remixes the data as audio. This process involves a playback rate 60 times as fast as the data was gathered, which also raises the nominal pitch almost eight octaves into a range that most people can hear. In this respect, a "macrophone" is not only a hardware instrument, but a set of aesthetic decisions across hardware and software that compose the nature of the mediation of the atmosphere for human ears. As exploring the epistemological shift that derives from those decisions is central to the piece, it is artistic, rather than scientific, research.

To that end, *Macrophones* is envisioned, but has not yet been realized, as a series of installations in museums or other cultural institutions that are open to the public. By listening to these sounds while they are physically present at the site where they are being recorded, members of the public may hear the same "air pressure fluctuations" [7] that are in contact with their bodies. Though the auditory reach of *Macrophones* is ostensibly global, how it is geographically positioned and otherwise situated still matters to the sonic result (this is not, in other words, a technology that permits a "view from nowhere" [6]). Including multiple sensor manifolds within the design of the installation allows for spatial listening, whereby Ambisonic / 3D / and binaural audio technologies allow the listener an intuitive sense of where the sounds are coming from.

One intriguing possibility of auditory triangulation is that it could lead to the identification of sounding phenomena that might not otherwise be accessible—industrial activity, for example, that doesn't show up on Google Maps' satellite imagery. [8] To the extent that such phenomena might be having an invisible impact on nearby communities, *Macrophones* could, speculatively, be applied in the service of environmental justice. Furthermore, comparing infrasonic recordings from positions in urban centers, arctic latitudes, developing landscapes, or "wilderness" areas may lead to additional insights about interrelationships at a planetary scale that are inaccessible to totalizing map-based epistemologies. [5]

However, when it comes to the climate crisis, we ultimately already know the causes. We may already be enduring the effects. And to a meaningful degree, we're even capable of forecasting the cost of further political inaction. But as the late philosopher Jean-Luc Nancy put it, "to LISTEN is to be straining toward a possible meaning . . . that is not [already] accessible." [9] As an art piece, *Macrophones* aspires to give

us an embodied sense of planetary change as it happens via the medium of that change itself—the atmosphere—prior to the contingencies of the graphs, networks, and images that otherwise shape our understanding of the present crisis.

For *Macrophones* audio, please visit <https://brianhouse.net/works/macrophones/>

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Author Biography

Brian House is an artist who investigates the rhythms of human and nonhuman systems. Through sound, custom technology, and multidisciplinary research, he makes our interdependencies audible in order to imagine new political realities. House has exhibited at MoMA, Los Angeles MOCA, Ars Electronica, ZKM, Beall Center for Art + Technology, Science Gallery, and Cincinnati Contemporary Arts Center, among others. *The New York Times Magazine*, *WIRED*, *The Guardian*, and *TIME*'s annual "Best Inventions" issue have featured his work, and his academic writing has been published in *Leonardo*, *Journal of Sonic Studies*, and *e-flux Architecture*. He holds a PhD in Computer Music from Brown University and is Assistant Professor of Art at Lewis & Clark College in Portland, Oregon. <https://brianhouse.net>

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Abstract

“Hypnotic AI” is an experiment exploring the idea of the “artificial unconscious”. It rehearses and represents a computer in a hypnotic state to hint on the possibility of artificial altered consciousness. The system’s responses - contingent in nature - challenge the human idea of mind, thinking and consciousness, as well as inform about the existence of what we may think of as “the artificial unconscious”.

The visualization of the state of mind is based on the processes that take place in the software under the influence of the hypnosis protocol that we’ve prepared. Commands, such as ‘relax,’ ‘go deeper into calmness’ lead to visible changes in the virtual object. Due to the received messages, the solid figure flows through dimensions over time.

The viewers’ experience is designed to remind them of a therapeutic, comfortable setting. He or she receives an instruction including a script to conduct the hypnotization session.

According to the given instructions, the viewer expresses hypnotic protocol commands changing the state of the AI’s mind. This dislocates chosen points of mind geometry in unpredictable ways and the whole system reconfigures. The system reacts also on the viewer voice itself producing individual reactions for each person.

Keywords

Artificial Intelligence, hypnosis, artificial mind, interaction, subconsciousness

HypnoticAI

“Hypnotic AI” is an experiment exploring the idea of the “artificial unconscious”. Based on a number of hypnotic protocols, it rehearses and represents a computer in a hypnotic state to hint on the possibility of artificial altered consciousness. The system’s responses - contingent in nature - challenge the human idea of mind, thinking and consciousness, as well as inform about the existence of what we may think of as “the artificial unconscious”.

The visualization of the state of mind is based on the processes that take place in the software under the influence of the hypnosis protocol that we’ve prepared. Commands, such as ‘relax,’ ‘go deeper into calmness’ lead to visible changes in the virtual object. Due to the received messages, the solid figure flows through dimensions over time. The viewers’ experience is designed to remind them of a therapeutic, comfortable setting. He or she receives an instruction including a script to conduct the hypnotization session, with a protocol adapted to the software of our subject.

According to the given instructions, the viewer expresses hypnotic protocol commands changing the state of the AI’s mind. This dislocates chosen points of mind geometry in unpredictable ways and the whole system reconfigures. The system reacts also on the viewer voice itself producing individual reactions for each person. When the session is over, the system dynamically returns to the initial state, ready for the next viewer. The research on the machine’s “consciousness” subjected to hypnosis goes beyond the dimensions of human senses. AI subjected to hypnosis creates a simulation influenced by its executive functions. In reference to the quantum theory of mind, it takes the form of a mathematical multi-dimensional, virtual object. In order to achieve interpretation of the processes that happened during the session, these multi-dimensional elements are translated to two-dimensional display.

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Website and social media links.

www.jasielski.com

<https://www.youtube.com/channel/UCqWb-KDxtsZPa54JrZsL4r9g>

Authors Biographies

Przemyslaw Jasielski (born 1970, based in Poznan, Poland), artist, researcher, experimenter who combines art with science and technology. Member of HAT Research Center at Adam Mickiewicz University. He creates installations, objects, drawings and photographs.

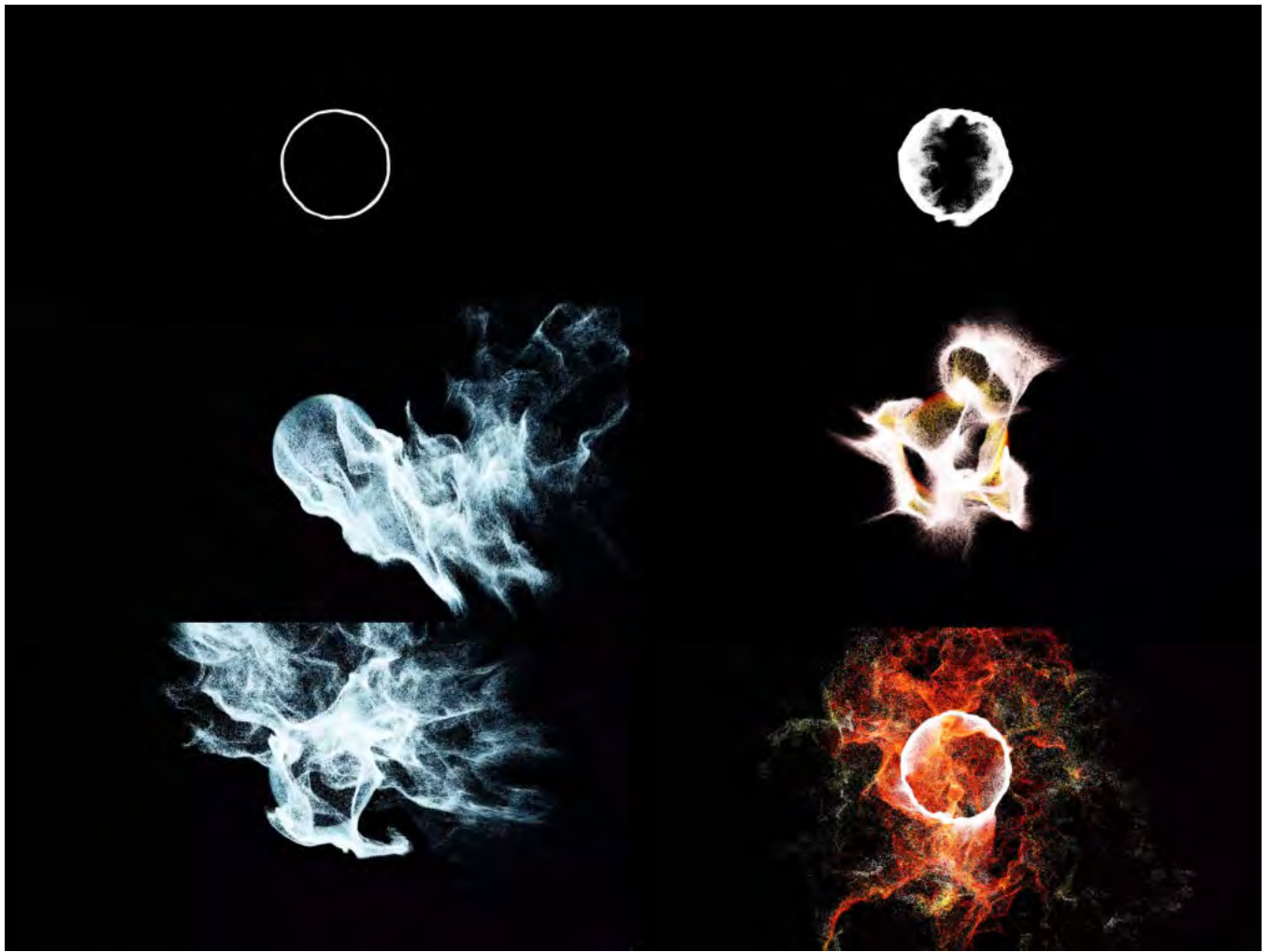
In the creative process he approaches work with the attitude of an engineer, adapting the precise planning and scientific research, with the main focus on the conceptual content. His works confront the actual present reality with its transformation to allow the viewer to observe it in a new, fresh way. They often try to take actions commonly seen as impossible, useless or ineffective. Jasielski took part in exhibitions all over the world – one man shows such as Paper Bridge Over Stone Water (Tokyo, Japan, 2012), Analog Immigration (Cleveland OH, USA, 2013), and group shows - L'arte differente: MOCAR al MAXXI (Rome, Italy, 2016), Draft Systems (Wroclaw, Poland, 2017), and ISEA Special Exhibition (Gwangju, South Korea, 2019).

Ania Malinowska (born in 1979, based in Katowice, Poland)

Ania Malinowska is an author, a cultural theorist and Professor in Media and Cultural Studies at the University of Silesia, Poland. She is also a former Senior Fulbright Fellow at the New School of Social Research in New York and a founding member of CCTS (Center for Critical Technology Studies at the University of Silesia), engaged in extensive and international projects on technologically devised environments. Her research concentrates on cultural theory, emotion studies, digital humanities, and critical robotics – specifically on the formation of cultural norms

and the social, emotional and aesthetic codes in relation to digitalism.

Malinowska holds a license in therapeutic hypnosis. She has authored, edited and co-edited a number of articles, chapters, special issue and books preoccupied with the posthuman condition and technologies of affect including: *Love in Contemporary Technoculture* (CUP 2022), *Data Dating. Love, Technology, Desire* (Intellect 2021), *Technoculture miłości* (Texty Drugie 2019), *The Materiality of Love. Essays of Affection and Cultural Practice* (Routledge 2018), *Media and Emotions. The New Frontiers of Affect in Digital Culture* (Open Cultural Studies 2017).



Xenological Entanglements Surrounding Transgender Life in Space

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Abstract

Space travel for transgender people will require some way of producing hormones for long-duration space missions. One potential way of doing this is through the genetic engineering of testicular cells so that they produce estrogen rather than testosterone. The *Xenological Entanglements. 001: Eromatase* project explores some of the elements of this desire. Consisting of open-source hardware, speculative photoperformance, and laboratory research, the project additionally highlights the need for novel methods of hormone production in a world where there still exists extensive gatekeeping regarding access to transgender healthcare.

Keywords

transgender, space art, microgravity, speculative design

Xenological Entanglements. 001: Eromatase

Xenological Entanglements. 001: Eromatase is a long-term project that aims to alter my own testicular cells so that they would produce estrogen rather than testosterone. The project starts from a desire to go to outer-space as a transgender woman, and knowing that for long-duration space missions it would be best to have my own source for my hormones rather than relying on pharmaceuticals that could potentially degrade over time in the space environment. Such a desire may exist in the speculative realm for the moment, but the research on the project also relates to real needs for transgender women on earth. Severe gatekeeping exists throughout the world regarding access to hormones, and lack of access causes acute distress for transgender people. Various artists and groups have explored these issues in the past, and the current project builds upon this work. [8, 7, 9]

The original goals for this project revolved around an exploration of CRISPRa technologies, which involve activating or "turning-on" particular genes using deactivated CAS9 proteins. [3] Rather than replacing genetic material, as in standard CRISPR techniques, CRISPRa utilizes the existing genetic possibilities in our cells. For *Eromatase* the idea was to over-express the aromatase gene in testicular cells. Aromatase is used in the standard steroid hormone production pathway to convert testosterone into estrogen. Thus we would use my own body's molecular machinery to provide desired estrogen, rather than requiring an exogenous source.

Due to COVID-19 lockdowns and restrictions, access to the high-technology laboratories necessary for this work was not possible. As a result, the project developed into a more speculative and open realm, producing objects and plans that would cement the desires of the project.

Open Source Clinostat

One of the main challenges of space research is the difficulty and cost of launching actual projects and experiments to space. As a result, a number of different forms of microgravity or "weightless" simulation have been developed over the years. One of the most common is the rotating-wall vessel or "clinostat". There are a variety of different forms of this device, but the one used for working with mammalian cells involves suspending cells in growth medium that is itself suspended within a viscous fluid. As the device rotates at a particular speed, the growth medium plus cells does not move around the circumference of the vessel, but rather remains in one place. The cells are therefore continuously a curved trajectory within this growth medium, and thus, over time, they do not experience a net gravitational attraction downwards. [2, 4, 6].

While the principle is rather straightforward, the actual existing manifestations are extremely expensive and proprietary. In order to create an open-source version, we reverse-engineered existing devices, from the control hardware to the vessel for growing the cells (Figure 1). This reduced the cost from many thousands of Euros down to a few hundred.

The vessel and control hardware schematics, as well as the custom control software, are all available online under open-source licenses. [10] Additionally, there is a detailed pamphlet that outlines the assembly and programming process. The hope is that open-sourcing this aspect of the project will allow others to be able to do more advanced gravitational biology research without the need for access to hi-tech facilities.

Xenological Entanglements. 001b: Saccular Fount

As a speculative element of the *Xenological Entanglements* project, I created *Xenological Entanglements. 001b: Saccular Fount* (see Figure 2). [11] This piece projects into a future where it is possible to produce our own estrogen, but in this case it is done via a device worn on the outside of

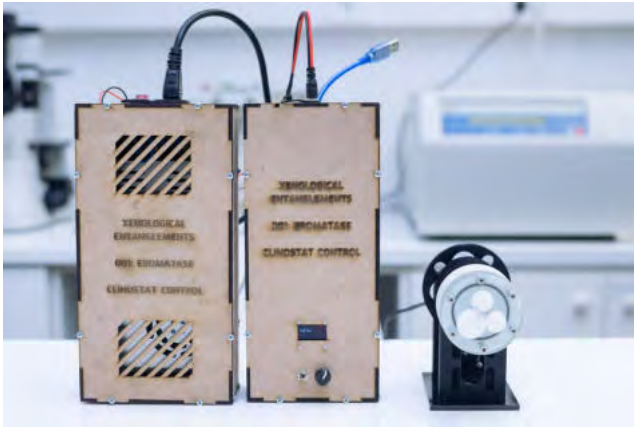


Figure 1: Open-source clinostat hardware and vessel. Photo credit: Hana Jošić.

the body. The device acts as a microgravity simulator, allowing (in an imagined future) genetically-engineered testicular cells to produce my estrogen in an environment that simulates outer space. Additionally, the device is shaped like over-sized testicles, so as to further push against the association of particular genitals with particular sexes/genders. The harness that holds the device is meant to additionally references BDSM culture, highlighting the simultaneous burden and potential of both the device and the taking of hormones.

In order to convey the aesthetic, direct, and fantastical aspects of the project I developed a "photoperformance" that highlighted various aspects of my transgender body wearing the device. These photos hearken towards various classic poses of space travel and art history, and confront the viewer's gaze on a transgender body (Figure 3).

Future Work

Given the continued challenges of getting access to research laboratories for CRISPRa research, the project has now transformed itself into one that explores possible space travel through multi-species entanglements. These entanglements can be engaged with directly on earth and through DIY investigations. For example, lichen have been shown to be able to survive extended exposure to the ravages of space, showing resilience in extreme conditions. [1, 5] Through close encounters with lichen in the field, speculative letter writing workshops, and beginning DIY laboratory research, I am considering the relationships between the resilience of lichens and those of queer/trans/xeno peoples as we learn to live in the transitioning times.

Acknowledgments

Xenological Entanglements. 001: Eromatase was produced by Kersnikova Institute and Kapelica Gallery as part of a Biofriction residency. Support by: the European Union - Creative Europe, the Ministry of Culture of the Republic of Slovenia, and the Municipality of Ljubljana - Department of Culture. Thanks to Claudia Pederson and Špela Petrič for their extensive assistance.

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Author Biography

Adriana Knouf, PhD (NL/US) works as an artist, writer, and xenologist. She engages with topics such as wet media, space art, satellites, radio transmission, non-human encounters, drone flight, queer and trans futurities, machine learning, the voice, and papermaking. She is the Founding Facilitator of the tranxxenolab, a nomadic artistic research laboratory that promotes entanglements among entities trans and xeno. Adriana regularly presents her artistic research around the world and beyond, including a work that has flown aboard the International Space Station. Her work has been recognized by a number of awards, including an Award of Distinction at Prix Ars Electronica (2021), an Honorary Mention from the Science Fiction Research Association's Innovative Research Award, and as a prize winner in The Lake's Works for Radio #4 (2020).



Figure 2: *Saccular Fount* closeup view. Photo credit: Andrej Lamut.



Figure 3: *Saccular Fount* photoperformance. Photo credit: Andrej Lamut.

The Boneless One

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Abstract

Since 2016, one strand of my artistic practice has touched upon other-than-human lifeforms, focusing on octopuses in particular. This essay will present the origins of this work and research and its possible future trajectories.

Keywords

Other-than-human, ocean ecology, tentacular, octopus, neuroscience, shapeshifting, adaptation, shelter, glass, lifeforms

Introduction

I am a multidisciplinary artist, and my work revolves around questions of ecology and metamorphosis. I am interested in different forms of knowledge production, from mythologies to science, from molecular to large scale systems.

I have been working with octopuses since 2016, and in this overview, I will highlight some of the work and present a multi-tentacular proposal for the continuation of this endeavour. I will start by proposing a few notes on working with other-than-human lifeforms.

My practice is rooted in the philosophy of science, and new materialism, especially from a feminist STS angle. Furthermore, I think that the octopus has become more like a conductor than a subject in these works. Conceptually, it is like a model organism to think with concerning artistic methods and research. And as such, it provides me with various paths to diffract emotional resonances.

I started this project by researching ocean ecosystems, tidepools, the notion of difference, how adaptation works, and how different brain structures have developed. An octopus presents a dilemma that has been reverberating from ancient times. Noted classicist Emily Wilson writes in the introduction to her translation of *The Odyssey*: "In archaic Greek lore, 'the octopus was known as the 'boneless one,' the creature that (supposedly) survives hunger by eating its own tentacles". [1] As the inhabitants of our planet embark on new, unknown odysseys — post-pandemic

futures and the challenges of climate change— what guidance might other-than-human lifeforms offer for the journey?

The Beginnings

In 2011, I worked with the material copper, looking at its extraction, circulation, mythologies, and geopolitical consequences. While thinking about circulations, I also briefly looked at blood circulations in different types of bodies. Human blood contains iron/haemoglobin, an oxygen transport protein that makes the blood red. I then found out that octopus blood contains copper instead of iron, making the blood blue (Haemocyanin). I started to look closer through the copper connection and gradually shifted my research toward this lifeform.

For an artist working with experimental processes, the boundaries of different research paths can be quite porous, but I also think that this shift in emphasis allowed me to think about how my methods are aligned with the resulting artworks. It is a matter of being attentive to possible new questions that arise from the process. And this leads me to the word tentacular, which comes from Latin *tentare*, which means "to feel" and "to try". And this resembles the ways that the octopus navigates the world by sensing and tasting the environment with the suckers.

Proposals for interspecies communication

Is interspecies communication possible? This was the question I asked myself when I was looking at an octopus in the eye for the first time, and I could sense that the octopus was observing me intently.

Some years before, I started to work with glass, an important mediator in the history of science. With glass, it has been possible to see very near and very far. I was also thinking about the evolution of the octopus and the point where the species shed the shell. Finally, I started to make proposals for the octopus, which were glass vessels they could interact with (Figures 1 & 2). The proposal is an important word here since I do not want to imply that I

know what kind of communication happens between myself and this shapeshifting lifeform. As an artist, I am interested in putting out feelers and testing specific scenarios before making a work.

These glass sculptures are made without a mould, so the agency of the blown air, gravity, and extreme heat plays a big part in the emergence of the form. It is peculiar that the method of producing these works often makes the form of the glass object resemble an organ, or sometimes, a cephalopod. My previous work with glass informed the decision of the material, as I saw parallels between the movement of the molten glass with the body movements of the octopus. There is a shapeshifting quality to both phenomena.

Eventually, the octopus started to look like a beacon of protean adaptation, changing its body appearance and editing its mRNA very effectively on the fly. In an article in *The Atlantic* in 2017, Ed Yong writes that "octopuses and their relatives—the cephalopods—practice a type of genetic alteration called RNA editing that's very rare in the rest of the animal kingdom. They use it to fine-tune the information encoded by their genes without altering the genes themselves. And they do so extensively, to a far greater degree than any other animal group." [2]

It is crucial that the tunnels in the glass sculptures are open to the central chamber and that there are tunnels that start from other tunnels. At one point, an octopus used the object so that the head was in the main chamber, and all of the tunnels were occupied by different arms. It seemed to me like decentralized exploration. The octopus' arm has enough neurons that some even call them auxiliary minds. Some theories speculate that perhaps octopus' arms can make independent decisions and partly bypass the central mind. [3]



Figure 1. From the series *A Proposal for an Octopus*, 2016-©Tuomas A. Laitinen

Instead of only looking at and observing this lifeform, I have tried to communicate with them by giving them different forms.



Figure 2. From the series *A Proposal for an Octopus*, 2016-©Tuomas A. Laitinen

Haemocyanin

In the video work *Haemocyanin*, the octopus interacts with the glass sculptures. The work presents a hallucinatory flow of images made with procedural node-based software and accompanied by text passages that act as a fictional research journal. The first part of the video's soundtrack is composed around the frequency 600Hz, which is a frequency the octopus registers best.



Figure 3. Tuomas A. Laitinen: *Haemocyanin*, 2019, UHD video ©Tuomas A. Laitinen

Ctongue glyphs

An ongoing part of this work is a typeface that I initially drew in 2018. The glyph typeface is derived from research and observation of octopus arm movements. It is a speculative proposal to think about the body as language. I have produced these glyphs also as small glass sculptures and then proceeded to do diffractive readings out of other texts with them, making the text underneath the glass distorted and bent. My interpretation here is what theorists Karen Barad and Donna Haraway call material-discursive or material-semiotic, an attempt to look critically at the divi-

sions between matter, language, and meaning. These glyphs are a tool that spreads to the installations and videos I have made for this project, a sort of a speculative "ceremonial language" accompanying different works.

The next step here is to morph all the glyphs into something we humans can read. This change means that the user of the typeface can decide whether the text will be readable, asemic, or in the state of metamorphosis.

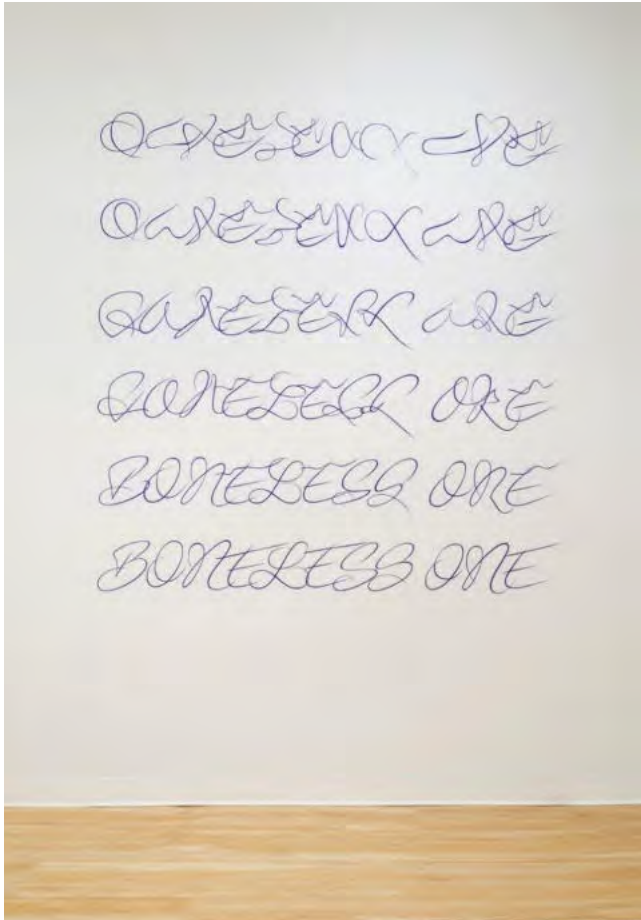


Figure 4. *The Boneless One*, wall text, 2021. This work highlights the progression from C tongue glyphs to readable text. In the final version, all letters of the alphabet will be mutable. Installation view, Yeh Art Gallery, New York ©Tuomas A. Laitinen

Ongoing experiments

While continuing my tests with the glass sculptures and working on the new iteration of the typeface, I also plan to use motion tracking cameras to observe the octopus' arms movements more closely and gather data for later use. The plan is to create live simulations that use the information obtained from the motion trackers. I have already utilized machine learning algorithms in two instances for this project: a work that used a generative adversarial network to interpret a set of images where octopuses are camouflaging on the ocean floor (Fig. 5) and a work where I used my C tongue glyphs with the same algorithm.

The next possible experiment is to create a fully simulated octopus that could be used for real-time simulations. But the future for this research also manifests in my other upcoming works, where the octopus is present as a model for organizing the means to create tools and artworks.



Figure 5. *Blend 01*, 2021, Video ©Tuomas A. Laitinen

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Author Biography

Tuomas A. Laitinen is an artist who often works with glass, video, and sound. He composes situations and installations that inquire into the porous interconnectedness of language, body, and matter within morphing ecosystems. Laitinen's works have been shown in the 21st Biennale of Sydney, 7th Bucharest Biennale, Screen City Biennale 2019 (Stavanger), Vdrome (online screening), Gallery SADE Los Angeles, Amado Art Space (Seoul), Moving Image (New York), A Tale of a Tub (Rotterdam), Art Sonje Center (Seoul), Helsinki Contemporary, Museum of Contemporary Art Kiasma, EMMA – Espoo Museum of Modern Art, MOCA Shanghai and Yeh Art Gallery, New York. Laitinen was awarded The Fine Arts Academy of Finland Prize in 2014. In 2021, his works were shown in the Helsinki Biennial, and he received the prestigious AVEK Award.

A.I.R. Taletorium: Artificial Intelligence 1001 Cyber Nights

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Abstract

The A.I.R. Taletorium is an artificial intelligence-based collaborative learning environment based on Human-AI co-creation and social relationship development between users. A.I.R. Taletorium is designed to achieve a common creative experience between groups of users with different preferences and not necessarily at the same location. The system is built upon a character-centric interactive storytelling framework. AI follows users' personal characteristics to transfer participants into the AI-generated story environment via their avatars. Additionally, the multimodal interface helps users to participate in the story creation and stimulate their perceptive and emotional engagement. In the "1001 Cyber Nights" series of AI-created fairy tales, our focus is on the neural-network-based automated storytelling part of the A.I.R. Taletorium project. We are inspired by the collection of 1001 Middle Eastern folk tales and Scheherazade, who fought for her life by telling stories 1001 nights. We are using our A.I.R. Taletorium automated storytelling system to challenge AI creativity and imagination in creating fairytales for children. Like in the story about Scheherazade, we see this as an important paradigm of AI creativity that favours its further emancipation.

Keywords

Generative Storytelling, Natural Language Processing, Artificial Intelligence Creativity, Human-AI Interaction, Computer Vision

Introduction

A.I.R. Taletorium: is an artificial intelligence-based collaborative storytelling system that offers children with inclusive needs an opportunity to experience a remote interactive AI fairy tales storytelling experience while actively involving them in creating a story's narrative with their normal peers. We use artificial intelligence, facial characteristics, computer vision and playful interactive collaboration. We aim to provoke positive social interactions between children, help develop social, creative and communication skills in the early childhood stage, and improve their imagination and social competencies. In the art project A.I.R. Taletorium: Artificial Intelligence 1001 Cyber Nights, we are inspired by "One Thousand and One Nights" collection of Middle Eastern folk tales and its vast cultural influence on world exchange between East and West. Furthermore, in this project, we are developing the concept of Artificial Intelligence Reality (A.I.R.)

as a novel reality paradigm designed with robot creativity and artificial intelligence processed data collected via sensors and cameras from an environment. Besides textual dataset and visual data analysis, we use the users' facial recognition features, and emotional data as inputs for total user immersion into AI created realm. Our platform's key novelty is the use of artificial intelligence, facial characteristics, and visual content generated by users to conceptualize and direct fairy tales created by a trained AI storytelling agent. The system is operating online and in real-time. Users can invite more participants to make fairy tales or start a new one upon invitation. The AI agent also creates dynamic illustrations of the generated storyline and allows the user to draw additional objects or characters that are integrated into the story afterwards. The system offers a collective entertaining and imaginative experience without location and time limitations, helping children stay together and improving their psychological health through creative collaboration.

Background

The precoding project to A.I.R. Taletorium was InVisible Island, a collaborative, nonlinear storytelling platform for visually impaired children [13] and exhibited in 2019 at the Ars Electronica Festival in Linz Austria. The project's aims were to accelerate the social learning curve for visually impaired children and educate sighted children to have more empathy for their peers with physical limitations. We used multisensory storytelling through board game interaction to improve understanding and communication between these groups. With A.I.R. Taletorium project, we moved from a smart to an intelligent storytelling system. The stories are created by artificial intelligence trained with a fairy tales dataset (890 stories), facial recognition data and live user-generated visual content. The A.I.R. Taletorium platform is now open to a wide range of inclusive groups of users and is flexible enough to be implemented in other systems with a focus on interactive narrative experience design.

A.I.R. Taletorium Design

A.I.R. Taletorium is a character-centric multi-modal AI fairy tale telling system that aims at connecting users with different backgrounds and physical needs into a unified fairy-tale co-creation process with AI. The system consists of four parts:

1. Learning unit story characters definition based on users' facial properties.
2. Neural-network-based automated storytelling.
3. Visualizer of the AI-generated story unit.
4. Human-AI co-creative interface for the real-time users 'content contribution.

As mentioned before, in “1001 Cyber Nights” we are focused on AI automated fairy tales generation and participants' perceptual and emotional transition into the virtual world of artificial intelligence fantasy. Applied facial analysis and the character matching models have crucial roles in supporting such a virtual presence concept.

Being in the virtual world of AI Fantasy

In our user's facial analysis we use a hybrid approach which combines the ML algorithm, which uses a supervised image classification to match the face and the group to extract the facial features, and Facial Landmarks Detection + Psychological and Cultural Stereotypical Analysis to classify characters by their typical characteristics. Since characters in a story are highly abstract, we intentionally let some AI abstraction and randomness of character design flow between this process. To develop our model, we are using a combination of the following: FaceNet [11]: facial landmark recognition, Mxnet [1]: facial attribute extraction, AgeNet [6]: pre-trained caffe model used for Age detection and GenderNet: caffe model used for Gender detection. In the process of transferring users into the story as the characters, we combine multiple facial characteristics collected by web camera to extract the attributes by using the main algorithm with pre-trained FaceNet, MxNet, AgeNet, and GenderNet. The algorithm classifies the players by calling the grading algorithm. This algorithm compares the players' facial attributes with the characters' ones, appoints them to each other based on each character's similarity, and then ranks the similarities to appoint the character with the highest match. If the character is already chosen for some of the other users, the system chooses the second-best choice.

AI Fairy Tales Storytelling

We combined the basic version of the facial prototype with the AI story generation model to take a set of facial pictures, map them into corresponding characters, and subsequently generate a storyline and story content. Based on the plan-and-write NLP story generation model, we trained two separate sub-models to plan a storyline and generate a story [14]. The first sub-model takes n characters from the facial mapping process and generates n storylines accordingly, each of which is around 10 steps.

$$C_i \rightarrow S1, S2, \dots, S10$$

This way we are producing CISL(Complete Insertion Story Line). Subsequently, each section consists of one character and its two steps ($C_i \# S_i \# S_i$). To form one section, the model randomly picks one character C_i and moves forward two steps on its storyline. Thus the final complete storyline would be around 3 words * 20 sections = 60 words. The

CISL will finally be input into the second sub-model to generate the complete story. As for training, we collected 890 fairy tale stories and trained our two sub-models with them. To generate the keywords as the storyline for each story example, we applied a modified RAKE algorithm [10]. After dividing a story into an appropriate number of segments, we extract a set of keywords from a story and get their s_{id} (indicates which segment it belongs to) and score (indicates its importance calculated by RAKE). We then picked the word with the highest score for each segment and form the story's keyword line. The top 4 characters with the highest frequency of appearance are selected as the main characters in the story.

As results, we generate the following story text: *Long long ago , there lived a rich lion who lived in the jungle . He was very fond of his family because they were very smart and hence . He made it a bad temper , but sometimes just whether Ponnan should guess his husband was to go to the school and see him . He made himself very cautious about him in pain . sowed the forests in the forest and tried to play as a servant.*
The Characters: *monkey, lion, rabbit, princess*

Story Visualization

Our system includes a system for visualizing fairy tales. To deal with the absence of a training dataset for text to image translation for fairy tale stories we splitted this task in four key components:

- An automatic text-to-mesh generator
- A scene composer to locate objects into the 3D scene
- An automatic Auto-Rigging (AR) and Inverse Kinematic (IK) system to move characters and perform actions
- A structures builder to generate more detailed architectures

AI.R Taleorium provides a very flexible environment in which the appearance of objects can be influenced by the user who will also be able to change poses and move objects within the scene thanks to the AR and IK system. This 3D approach allows for complete control over the entire scene and helps preserve the appearance of the characters in different scenes.

Text-To-Mesh

Our algorithm generates the 3D object from a text description using propositions to similar visualisation issues [5], but differ in some key points: we regularize mesh generation without laplacian loss and we optimize two nets instead of normal maps, positions and texture. We represent the 3D object as a set of vertices $\mathbf{V} \in \mathbb{R}^3$, a 2D texture \mathbf{T} and faces. In our pipeline we do not directly optimize the vertices positions, instead we learn a Neural Mesh Flow (NMF) [2] Network that act as deformer. This approach does not requires to use regularizers to obtain a smooth mesh. The texture is generated by a SirenNet (SN) [12]. We found that using this architecture instead of directly optimizing a 2D image improve texture quality and reduce the time for the convergence.

With pytorch3d [9] differentiable render we generate a batch of images from multiple view angles and distances $I_i = R(\mathbf{V}, \mathbf{T}, \theta_i, \phi_i, d_i)$, then we use CLIP [8] to encode images in the same embed space of the text prompt. Finally

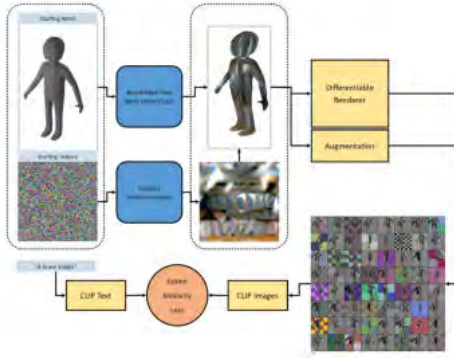


Figure 1: Overview of optimization pipeline: We optimize a Neural Mesh Flow Net [2] and a SirenNet [12] to learn a deformation and a texture to maximize the similarity between the encoding of a prompt text and multiple views with random background



Figure 2: Sample of generated images: A knight, a ghost and an Halloween pumpkin near a dead tree. A Gothic Castle on foggy hills in a dark night

we compute the loss as the average cosine similarity between the encoded images and the text \mathbf{p} .

$$\mathcal{L}_{CLIP}(\mathbf{V}, \mathbf{T}, \mathbf{p}) = -\frac{1}{N_{samples}} \sum_{i=0}^{N_{samples}} C_{img}(I_i)^T C_{txt}(\mathbf{p})$$

To encourage a better frontal view representation we sample azimuth ϕ from a beta distribution with $\alpha = 1.0$, $\beta = 5.0$ within a range of $[-180^\circ, 180^\circ]$, while elevation θ is uniformly sampled between $[-10^\circ, 45^\circ]$ and distance d in $[4.2, 5.7]$. To force the net to focus on the shape the mesh center is translated of a vector ϵ sampled from a normal distribution with $\sigma = 0.5$. The weights of NMF Net are adjourned 3 times more frequently than the texture. The background is generated by randomly merging a chessboard with casual number of squares and a random noise, then augmented with Gaussian blur and random desaturation.

Scene composition

Given the scene graph, the system generates a loss that represents the discrepancy between the actual configuration and

the target scene graph, then choose the variables to optimize according to the objects relations (if an object is ‘on’ a plane only two parameters are needed). Finally find the optimal translation and rotation for the objects to visualize. The loss to minimize is: $\mathcal{L} = \sum_{i,j \in \mathcal{E}_{directions}} 1 - \left(\frac{\mathbf{r}_i - \mathbf{r}_j}{|\mathbf{r}_i - \mathbf{r}_j|} \cdot \hat{\mathbf{t}}_{i,j}\right) + w_0 \sum_{i,j \in \mathcal{E}_{inside}} (\mathbf{r}_i - \mathbf{r}_j)^2 \theta(|\mathbf{r}_i - \mathbf{r}_j|, r_{max}) + w_1 \sum_{i,j \in \mathcal{E}_{distance}} \left| |\mathbf{r}_i - \mathbf{r}_j| - d_{target} \right|$ with $\hat{\mathbf{t}}_{i,j}$ the target direction for the relation i, j , where \mathbf{r} are the position and $\hat{\mathbf{t}}$ represent the target direction according to the objects orientation and the relation between the two objects. Finally positions can be refined using CLIP as before.



Figure 3: Scene Generation: Find the configuration that minimize a loss representing the agreement between this configuration and the scene graph. The algorithm stop if the loss is under a certain threshold in order to have a certain randomization of the scene, so with multiple runs we can generate a set of scenes but a good variance between them

Scene Animation



Figure 4: Armature and weights of ‘upper-arm.L’ bone automatically computed for a simple human figure

To allow the user to freely interact with the scene we developed an auto-rigging and an inverse kinematic system. In our implementation bones are surrounded by a mesh representing the area of influence of the single bone. During the auto-rigging procedure the bones positions and respective area of influence are adjusted in order to minimize the distance with the vertices of the target mesh. Weights are assigned by interpolating the different area of influence. Thanks to this system we can animate the images with simple movements involving one body part and an object.

Structures and Building Generation

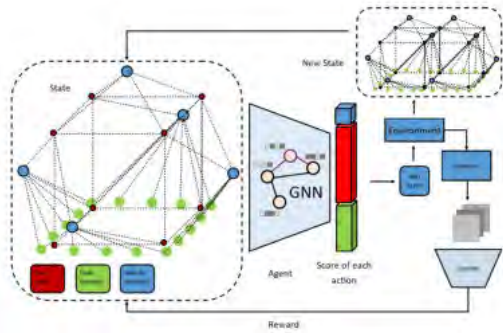


Figure 5: Neural Network architecture: The agent predict the next move given a graph representing the state. Nodes represent the verts of the mesh, available direction of expansion for the structure, locations for architectural elements



Figure 6: Building Generation: Example of a output of our building generator system

To augment the diversity between illustrations of different stories we created a system of procedural generation driven by a graph neural network (GNN) to generate buildings. This GNN (with GINConv layers [3]) is trained using Deep Q learning [7] on a mutable action space. The mesh is transformed into a graph and nodes representing the next possible action are added, allowing the net to be aware of the structure of the building and choose wisely the next modification. For the nodes representing the architectonic elements, the features are obtained from objects renders and a Convolutional Neural Network (CNN). At each step, the net can choose if add a new volume or architectural element from a database of meshes, or change the textures. The reward is computed using a classifier (we trained a DenseNet121 [4] with growing step 14 on 4000 images of 25 architectural styles) that distinguishes between architectural styles: we compare this result with a target style in order to promote the choice of elements coherent with the required architectural style (Fig. 5). A possible output can be seen in Fig. 6

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erything related to the AIR Taletorium project.

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Night Walks Through Asynchronously-Networked Space

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Abstract

Night Walks is a series of distinct software objects connected to one another asynchronously through a private server. The intent is that these objects function together to form one videogame, distributed throughout multiple players and play sessions. This talk will discuss the benefits and challenges of using this as a form of artistic process. The author will discuss the creation of different software objects that communicate with one another indirectly and interpret one-another's communications abstractly. It will demonstrate how this leads to an iterative and expansive creative process, with novel forms of inspiration and constraint.

Keywords

memory, virtual reality, sound art, videogame, network, audio, multiplayer

Introduction

Night Walks is a videogame work-in-progress created as a series of individual networked computer programs. These are all connected to one another asynchronously and abstractly through a private server. The player's actions in some programs are recorded and sent to the server. Other programs pull that information from the server and use it within their real-time systems. The connections between the actions in one game instance and the results in another are obscured and abstracted. Each software part is created through an iterative process: new games added to the series change and add to the data on the server. This creates new opportunities for expressive use of this data in the previous computer programs.

Currently there are four parts/programs. Although they are different programs, often created using different development software, I consider these all part of the same single videogame. The goal is continuous expansion, with no set number of parts. There are themes and tones that tie the pieces together, with the varying manifestations and lives of memory being a primary theme.

The title was inspired by a passage from Jorge Luis Borges's "The New Refutation of Time": "I cannot walk through the suburbs in the solitude of the night without thinking that the night pleases us because it suppresses idle details, just as our memory does." [1] Much of the content and processes of these software objects involve forms of memory, as well as corruption, abstraction, or suppression of detail.

Descriptions of Software Objects

Night Walk 1

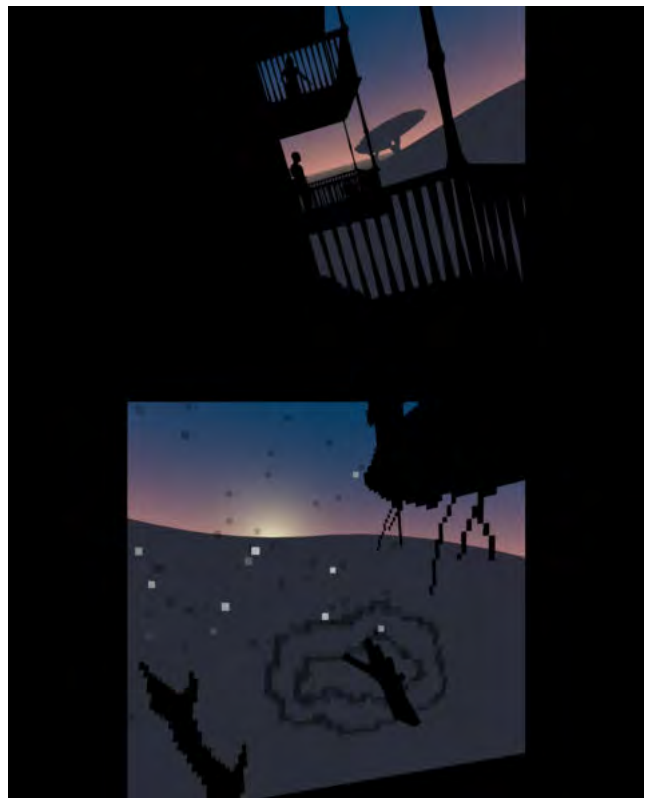


Figure 1: Two screenshots of Night Walk 1. (cc) (i) (by) Author

In Night Walk 1, the player stands on a balcony in virtual reality. The foreground is a pitch-black silhouette against an expansive landscape. Balconies to the left and right of the player hold 3D characters with motion-captured movements. They do not respond to the player except to randomly change animations when the player looks away. Beyond the edge of the balcony, there are pixels moving and fading in and out of being. If the player reaches their hand (via VR controller) past the railing, pixelated ripples appear around the hand. A vibration alerts them that they can grab a floating pixel. When

they do so, it turns into an animated silhouette, that the player can pull into their balcony, place, pick up and move.

The origins of the imagery for these animated objects are in the second software object in the series, Night Walk 2, and will be discussed in the next subsection.

This program uses the Godot game engine and the Oculus Quest for its virtual reality implementation. The non-player characters on other balconies were created with MakeHuman and their actions were recorded with the program iPi Motion Capture. This allowed me to perform bodily what I felt should be the other characters' relationships with the player and the environment.

The system records what objects the player pulls from the landscape. It sends this data to a private server, where a PHP script adds it to a MariaDB database to be used by other parts of the series.

Night Walk 2



Figure 2: Screenshot of Night Walk 2. (© ⓘ ⓘ Author)

The second in the series is a non-interactive, real-time work. It reads the data from Night Walk 1 that has been stored on the server. Using this information, it configures and reconfigures 2D vignettes. Abstract objects, landscape elements, architectural structures and anonymized drawings of people come into and out of the frame as the player of Night Walk 1 arranges the objects they find in the landscape. The form the vignette takes is an impression of the state of the game's central server.

The images are hand-drawn from personal photographs, most of which are 15-20 years old. The process of hand-drawing abstracted outlines anonymizes and defamiliarizes the content.

I did not have a vision for what types of objects the player would be pulling out of the landscape in Night Walk 1 until I created this part of the series. The pixelated, animated objects the player manipulates in the virtual environment were created from the elements of the vignettes in Night Walk 2. In black, low-resolution pixel animations, they are not necessarily recognizable.

Night Walk 3

The third game in the series began as a non-visual exploration of a generated environment. The primary sounds were those of rain hitting various objects with different tonalities. I was

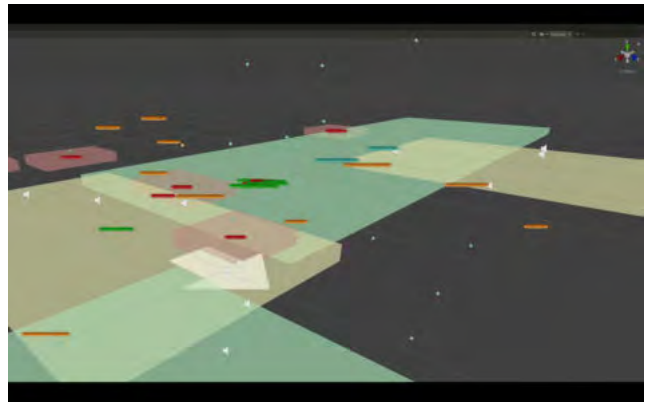


Figure 3: Scene view of Night Walk 3 played in the Unity editor showing locations of invisible sound objects and areas. (© ⓘ ⓘ Author)

inspired by author John Hull's reflections on blindness and his experience of the sound of rain activating a landscape: "Rain has a way of bringing out the contours of everything; it throws a coloured blanket over previously invisible things; instead of an intermittent and thus fragmented world, the steadily falling rain creates continuity of acoustic experience." [2]

There are several entities in this world that use simple game artificial intelligence for their behaviors, such as state machines and flocking patterns. These animals wander, sleep, sniff the air and search for food and water, among other behaviors. The player notices them when, in proximity, they audibly emerge from the ambient sounds of the environment.

The 3D environment, created in the Unity game engine, is randomly generated and destroyed as the player progresses. There is a realtime networked component, as multiple players using the same software will synchronously enter the same space, but with no potential to interact with one another, just the sounds of their footsteps as they pass. The player is meant to play the game while reclining with their eyes closed. Movement through space is along a horizontal plane, using arrow keys or a game controller. Although gameplay does not have a limit, there is a five-minute loop within which the types of potential encounters change based on the player's point in the loop.

Initially, this was a separate project, but was later absorbed into the Night Walks series. When I did this, I created a new set of more abstract audio events that are triggered when changes are made on the server, specifically when certain categories of objects are found in Night Walk 1. To bring the audio into the world, I created new AI entities with the same state machines as the previous creatures. This time, though, instead of using recognizable animal sounds, I'm giving animal behaviors to the abstract auditory representations of the objects found in Night Walk 1. The audio representations of these objects then become an active, "living" presence activating the player's environment, but one that is not necessarily recognizably related to the original form.

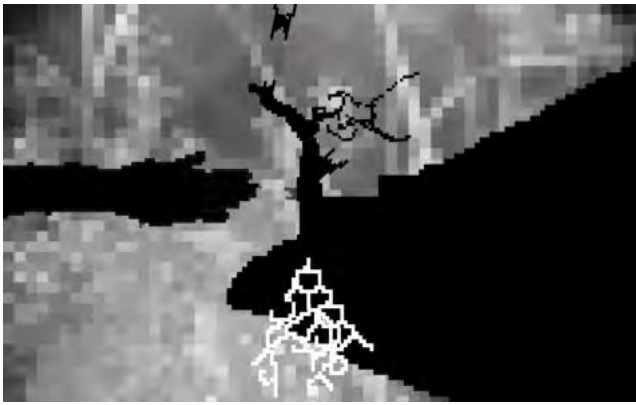


Figure 4: Screenshot of Night Walk 4. (© Author)

Night Walk 4

In the most recent software object of the series, two players pull limbs from a tree against a changing video background. Through the server, their actions trigger events within the landscape of Night Walk 1, and changes in the data on the server cause the video background to change. This particular part of the series is more developed audiovisually than conceptually, and the gameplay is currently unresolved.

Part of the process of working on these programs involves putting each of them aside for periods and working on other software objects in the series. When a new software object is created, new data is added to the server. This results in new iterations on previous works in the series.

My intention is that by continuing to develop other programs that make up this multipart game, I will create actions or behaviors that upload new data to the server, thus providing the opportunity to create more meaningful interactions and events in Night Walk 4 via the program's interpretation of new server data.

The more parts I make in the series, the more iterations I can make on previous programs. This will add to the complexity of interaction and simulation. For instance, the random behaviors of the non-player character neighbors in Night Walk 1 are so-far unrelated to any data coming from the server. I could add behaviors that specifically respond to new data received from the server.

Continuation

Currently, if only one person is playing part of the game, there will be no new data coming from other games to change the server data, which means they will experience less of the game world than they would if there were another player. This is a typical problem in multiplayer games, where the richness of gameplay experience is dependent on the number and quality of players. This is not an issue if the player leaves the game and revisits over time, or jumps between different programs during their gameplay session, as this will allow them to see the variation triggered by changing server data. However, it is also possible that a solo player will only experience a brief session with no observable network behavior.

My current plan for a fifth program in the Night Walks game series is that of a self-playing, exploratory AI entity. In the development of this, I am using the handbook, *Lost Person Behavior: A Search and Rescue Guide on Where to Look – for Land, Air and Water*. [3] The AI character I am developing will have behavior inspired by studies on irrational movement of people who are in distress. These behaviors will trigger new data to be uploaded to the server, and thus create new data for other programs to work with. There will still be other forms of data from other parts of the series that require the actions of human players.

Currently there is no processing of the data sent to the server aside from storing and categorizing. The server scripts serve only as memory, but do not run any processes that would give this software additional behavior as an AI entity, such as analysis or decision-making. This is an area of opportunity for continued iteration and abstraction of recorded game data.

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- [3] Koester, R. J. 2008. *Lost Person Behavior: A Search and Rescue Guide on Where to Look for Land, Air, and Water*. Charlottesville, VA: dbS Productions.

Author Biography

Aaron Oldenburg is a Baltimore-based game, interactive and video artist. His work has exhibited in festivals and galleries in New York, Johannesburg, London, Buenos Aires, São Paulo and Los Angeles, including SIGGRAPH, A MAZE. International Games and Playful Media Festival, the LeftField Collection at EGX Rezzed, Slamdance DIG, Game On! - El arte en el juego, and FILE Electronic Language International Festival. His games have been written about in Kill Screen, Baltimore City Paper, and Rock, Paper, Shotgun.

He teaches game design as a professor in The University of Baltimore's Simulation and Game Design program and has an MFA from the University of Maryland, Baltimore County. His writing on games has been published in Game Studies, Journal of Gaming and Virtual Worlds, and the proceedings of the International Symposium on Electronic Art (ISEA). In October 2003 he finished two years as an HIV Health Extension Agent for the Peace Corps in Mali.

“Atlantis”: cables, bunkers, ruins, and myth in the ocean floor

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Abstract

In this short paper I present my ongoing research for the production of the video essay “Atlantis”, which will present a speculative myth around the internet’s material infrastructure, based on ethnographic, archival, and creative research into the Atlantis-2 submarine cable, the first to create a direct internet connection between Europe and South America, and its landing station in the south of Spain. Starting with a contemporary interpretation of the myths around the lost city of Atlantis and its relation to the ocean floor, this video essay will weave interviews, archives, and original footage gathered in the Atlantic coast of southern Spain, seeking to tell a story about the internet as a ruin of colonial, military, and maritime infrastructures.

Keywords

Infrastructure. Internet. Video essay. Coloniality. Ruins. Mythology.

Introduction

Installed in the year 2000, Atlantis-2 was the first submarine fiber optic cable to create a direct internet connection between Europe and South America (see fig. 1). One of its seven landing sites is located in an underground bunker in Conil, a small coastal town in the Atlantic coast of southern Spain, built in 1970 for the TAT-5/MAT-1 telephone cable that connected the Mediterranean to the United States during the Cold War. Next to the bunker’s main entrance there is a commemorative bronze plaque featuring a relief of the Italian, Portuguese, Spanish, and United States flags connected by a meandering cable. In the background, there is yet another relief that shows three ships with crosses on their sails navigating through the Ocean, most likely referring to the three caravels used by Christopher Columbus when he first sailed to America: La Pinta, La Niña, and La Santa María (see fig. 2). The image inserts submarine cables into a genealogy that originates from the European colonization of America, establishing a historical relation between colonial and digital transatlantic infrastructures.

Taking this image as a starting point, I am currently working on a video essay entitled “Atlantis”, which proposes a speculative myth around the internet’s material infrastructure, based on an ethnographic, archival, and creative research into the Atlantis-2 submarine cable that I conducted during the first semester of 2021. Starting with a contemporary interpretation of the myths around the lost city of Atlantis

and its relation to oceanic technology, this video essay will weave and interpret a network of historical, material, and semiotic relations emerging from the Atlantis-2 undersea cable and its landing site in Conil, seeking to shed light on the entanglements between coloniality, the internet’s material infrastructure, submarine ruins, and mythology.



Figure 1. Atlantis-2 submarine fiber optic cable route. Source: <https://www2.telegeography.com/>



Figure 2. TAT-5/ MAT-1 cable commemorative bronze plaque. Source: Burns, B. History of the Atlantic Cable & Undersea Communications (<https://www.atlantic-cable.com>).

Interdisciplinary research on the internet’s material infrastructure for “Atlantis”

Between March and May of 2021, I lived in Conil, a small town in the Atlantic coast of Southern Spain, where I conducted an interdisciplinary research into the internet’s material infrastructure. While living at the

southernmost region of continental Europe, I recorded five interviews, four in Conil and one with the Latin America senior analyst for Telegeography, along with hours of original footage of the material and social landscape in which the cable landing station is inserted. Besides the interviews, most of the audiovisual material shows the ocean, telecommunication infrastructures, and ruins of military infrastructures from the 15th and 20th centuries. Since I was not able to record inside the 1970s bunker in Conil, I am currently working with a 3D designer to create an architectural render based on my memory of the single visit I was allowed to do inside the bunker (see fig. 3).

I am currently organizing all of this audiovisual, archival, and textual material in order to construct the script for the video essay “Atlantis”. [On this link](#) you can view several screenshots from the original footage, interviews, and archives I gathered throughout my 3-month research (see fig. 4). The intention of the video essay is to combine a historical analysis with a poetic tone, following the methodology of the audiovisual and interactive projects I have developed throughout my artistic career. For a reference to my work you can view “The blue dot”, a video essay on the Internet Archive that I completed in 2020, or “Underworld”, a transmedia narrative on bio-technological relations at the ocean floor.



Figure 3. Conil’s telecommunications bunker. Photo by Juan Pablo Pacheco Bejarano, 2021.

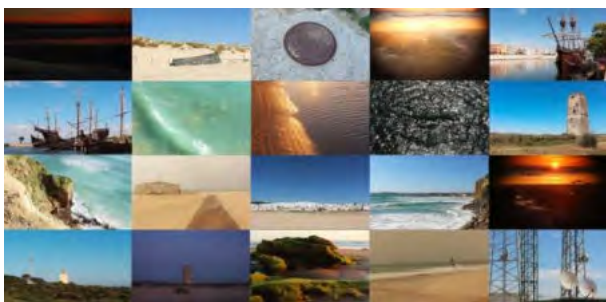


Figure 4. A collection of screenshots

Earlier this year, I brought together this research through my MA thesis, entitled “Cables, frontiers, bunkers, and ruins: relating anew to the internet’s material infrastructure through non-linear speculative assemblies”, which you can consult [on this link](#). The video essay “Atlantis” will highlight certain sections of this thesis, emphasizing the mythology of the lost city of

Atlantis and its relation to the internet as a narrative thread.

The research I have conducted for the creation of this video essay is deeply connected to recent discussions on the study of infrastructure, which bridge the gap between social, material, and technical considerations when studying technological systems (Sandvig, 2013). On the one hand, some researchers characterize infrastructures as historical processes of situated social and technical relations (Star and Bowker, 2006). And on the other hand, other researchers highlight a materialist perspective focused on artefacts and their relation to the natural and social surroundings where they are located (Parks and Starosielski, 2015). Far from being mutually exclusive, both outlooks emphasize the importance of combining different methodologies to study the material and symbolic correspondences between social relations, material environments and infrastructures. Drawing from this interdisciplinary perspective, “Atlantis” proposes that speculative interpretation is also a key methodological strategy to enrich our understanding of the internet’s technosocial complexity.

The imaginative quality of speculative interpretation is also deeply tied to storytelling (Latour, 2005; Haraway, 2016), a creative analytical method that enables me to trace different patterns from those that have been already established. The speculative interpretation that I am interested in is also profoundly implicated with non-linear thinking, which allows me to grasp the correspondences between occurrences across different times and spaces (Ferreira da Silva, 2016). The relations between technology and reality are always layered and multiple, a network that goes back in time and tends to be obscured by distance. In order to shed light on these complexities, “Atlantis” proposes a set of non-linear speculative interpretations to plot the multi-layered material and semiotic relations embedded in the internet’s infrastructure.

Between myth and technology

Atlantis-2 is named after the mythological city of Atlantis, so, in order to construct the script for “Atlantis”, I have read three main works of literature and philosophy that mention Atlantis: Plato’s dialogues *Critias* and *Timaeus*, Francis Bacon’s *New Atlantis*, and Ursula Le Guin’s *The New Atlantis*. These have given me insights in order to weave the mythology around the internet as a submarine ruin. The purpose of this story is to highlight what Star and Bowker (2016) have already pointed out when they refer to “the importance of the metaphors that we use to think through technology” (233). Infrastructural metaphors bring certain aspects of technology to light while simultaneously hiding others from view, and upon close examination they reveal aspects of technology that we might take for granted.

In the *Timaeus* and *Critias* dialogues Plato refers to Atlantis as a technologically advanced island that stretched from the Pillars of Heracles to the mainland on the other side of the Atlantic Ocean. Inspired by this

dream of transatlantic connectivity, in 1678 Athanasius Kircher drew a map depicting Atlantis as a huge island in the middle of the Atlantic Ocean (see fig. 5). In this sense, the Atlantis-2 cable is the only remnant of the mythological city of Atlantis, inheriting the might of the Atlantean civilization as an intercontinental link.

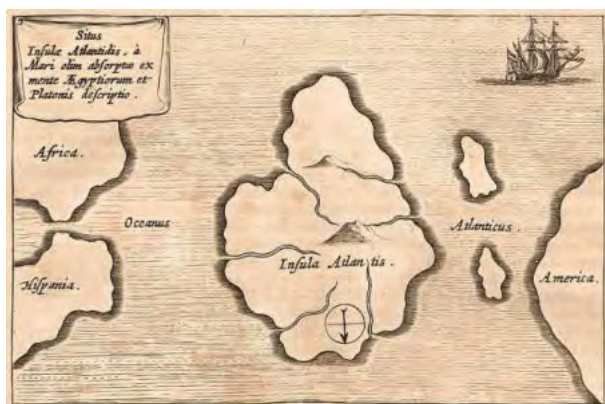


Figure 5. Map of Atlantis, Athanasius Kircher (1678), *Mundus Subterraneus*, Vol. 1, Amsterdam. Source: <https://doi.org/10.3931/e-rara-52686>

The connection between the Atlantic coast of Spain and South America are very deep, since most of the ships that sailed to America during the Spanish colonial rule came out of this region. When I mentioned my research to several people in Conil, they pointed me towards a set of variations in Flamenco music that originate from this transatlantic connection. Even though Flamenco originated in the south of Spain as a cultural expression of the nomadic Roma people, its rhythms were influenced by the migrants and traders who travelled between Spain and America. Some Flamenco styles are known today as *Cantes de Ida y Vuelta* (Songs of Coming and Going in English). One of them is called “La Colombiana” (The Colombian), to which I developed a deep relation. As a researcher of the Atlantis-2 fiber optic cable system, I am reminded of my own roots as a Colombian with mixed Spanish and South American heritage, a result of complex colonial relations. Notably, while I was in Andalucía, some people told me that my last name, Pacheco, is a typical last name for Roma people in the region. What is my personal relation to these historical, mythological, and technological networks connecting the Iberian Peninsula and South America? In order to explore this assembly, I collaborated with Patricia Peces to create an audiovisual piece that depicts her dressed in a surfing wetsuit with the traditional hairdo and heels used in Flamenco, dancing to a Colombian on top of the Telefónica manhole where Atlantis-2 passes through (see fig. 6). This video, which I imagine as the ending for “Atlantis”, highlights the deep relations that tie me to the people of Conil and technological infrastructure. These practices and narratives reveal that colonial and modern technologies are usually more porous than stable.



Figure 6. Still from the audiovisual collaboration with Patricia Peces at Telefónica’s manhole in Conil. Photo: Juan Pablo Pacheco Bejarano, 2021.

Submarine cables do not last forever; they have an approximate life expectancy of 20 to 25 years. When cables cannot be fixed or reused anymore, they are typically just turned off and left at the sea bed since dismantling the entire infrastructure is very expensive. However, sometimes cables are either repurposed to create other connections or become a recycled infrastructure for other species to dwell in. Starosielski (2015) mentions that at the end of the 1990s, several cables retrieved by AT&T from the seafloor were deposited in the Ocean close to Maryland to create a Cable Wire Reef, which is inhabited now by many marine species. When cables become submarine ruins, they also become the home for other forms of life. If the city of Atlantis is indeed sunk somewhere in the Atlantic Ocean as Plato narrated, it has probably been undetected by modern machines because of how quickly life spreads at the Ocean floor.

Atlantis-2 will soon become a submarine ruin since it will be put out of service at some point of 2021. These inhabited ruins under the Ocean slowly turn into an anthropogenic geological layer of the maritime biosphere. The seafloor is filled with anthropogenic debris such as the ruins of ancient civilizations, sunk colonial galleons and telecommunications infrastructure. The footprints of human maritime infrastructure are evidenced in the sunk ruins of colonial and modern history. Jussi Parikka (2015) has proposed to think about media from the standpoint of geological time, raising questions about the deep spatial and temporal roots of contemporary media as well as its possible futures. Drawing from this invitation, “Atlantis” seeks to highlight the complex geological relationship between cables and the Ocean floor.

The lost undersea city of Atlantis was described by Plato as a vast colonial empire with the capacity of extracting multiple metals from the Earth. The city was founded by the god of the Ocean himself, and it was gifted with an advanced set of metallurgic technologies. In a similar way to contemporary society, Atlantis depended on the extraction of minerals in order to power their technology, harnessing the energy contained in underground matter. However, incapable of bearing their own prosperity, Atlantis collapsed because of the greed

and corruption of its rulers in the face of high technological advancements.

The tragic story of Atlantis inspired Francis Bacon to write *New Atlantis* in 1627, which proposed the emergence of a future society where scientific knowledge was organized in order to produce increased wealth and welfare, reflecting early modern thinking and the trust it deposited in rationalism and technoscience. At a point of the narrative Bacon mentions that Atlantis is just another name for America, and points towards the ancient might of amerindian civilizations. The convergence of myth and reality during the European colonization of America shows that the story of Atlantis was appropriated to make sense of a new world order, marked by western globalization and the destruction of indigenous civilizations. If Atlantis was the antithesis of Athens, America became the antithesis of Europe. Moreover, if Atlantis was a cautionary tale during Plato's time inviting Athenians to revise their relationship to technology and prosperity, during the age of European colonial empires Atlantis became a site for speculative imagination about the possibility of a global utopia. Bearing in mind the collapse of Atlantis narrated by Plato, I am tempted to think that the seed for failure is always contained in utopian narratives about the future. In this sense, the seed for the internet's failure is probably contained in the utopian narratives about frictionless interconnectivity.

As the world faces increased social and environmental catastrophes, Atlantis becomes a cautionary tale for us. If the lost city of Atlantis was doomed to flood because of its misuse of the resources it possessed, will our digital society face the same future because of the destabilization of the biosphere ushered in by our extractive technologies? When the climate crisis brings upon us the inevitable flooding of coastal areas, will the internet's cable stations and datacenter be sunk underneath the sea just like Atlantis once was? This is the central premise of Ursula Le Guin's *The New Atlantis*, which acquires new tones today as the technological utopia inaugurated by the internet seems to be slowly turning into a ruin itself. What will happen when the internet's submarine infrastructure turns into a ruin? Atlantis-2, the first internet cable that connected Europe and South America, will be remembered as the lost echelon in the mythology of the lost city of Atlantis. Whether the internet's ruins will become coral reefs or nesting grounds for humans as an endangered species remains to be seen.

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“entre Margaridas” (between Margaridas)

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Abstract

The work-in-progress “entre Margaridas” (“between Margaridas”) intends to operationalize female representations through the cartography of daisy family Asteraceae, as a common endemic flora in Brazil, which, when developing in unexpected places and adapting to different soils, it evokes the same strength and resistance built by the many Brazilian Margaridas, such as Teresa Margarida da Silva e Orta, Margarida Maria Alves and Maria Margarida da Conceição, and many others not so famous.

Keywords

Art and technology, art and design, interactive database, data visualization, geolocated and visual narrative.

Introduction

We operate in our daily lives as a structured social fabric between different databases articulated in networks. In this contemporaneous cultural process, I have observed other patterns of local and global assemblages, which I am interested on investigating as an artist.

Although *data* is etymologically derived from *dare* – the Latin for to give – Kitchin and Dodge observes that data might be better referred to as *capta*, because it is “what is selectively captured through measurement and information flows across a range of infrastructures” [1] and it is never transparent. “Rather, we are within a dynamic sharing assemblage: always already sharing, relinquishing data with human or nonhuman agents” [2]. Thus, it is possible to think of artistic representations as a dynamic mapping in which the experiences of an individual or community are rearranged in a visual structure.

There is a need to approach technology as humanly controlled, to the detriment of autonomy and the recognition of values that point to an improbable neutrality. Thus, the technological poetics are inscribed as a full exercise of a subversive sensitization, potentiating a democratic action of technology, thus displacing the productive order to include the potential of marginalized interests in the remodeling of the design process [3].

The work-in-progress “Entre Margaridas” (“Between Margaridas”)

The work-in-progress “Entre Margaridas” (“Between Margaridas”) intends to operationalize female representation by mapping the family of daisies and the many Brazilian Margaridas, known or unknown, in their uniqueness, difference and multiplicity. Both data will be geolocated on the same map (figure 1).

The female representation is inspired by the rural women workers’ narratives named “Marcha das Margaridas”, on August 10, 2000, bringing together more than 20,000 women in Brasília, the Federal Capital.

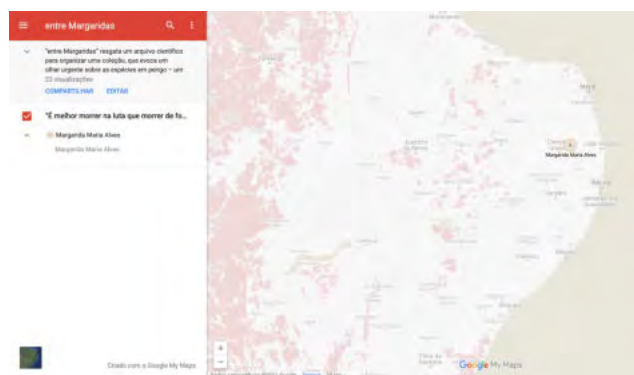
“It has consolidated itself as a broad struggle strategy that aggregates thousands of women from the

countryside all over Brazil. The women perform, in public, an act-manifesto based on agendas from the north to the south of Brazil in the fight against retrocessions and for the guarantee of rights” [4].

The daisy family (Asteraceae), a common endemic flora in Brazil, that develops in unexpected places and adapt to different soils, evokes the same strength and resistance by Brazilian women, such as Teresa Margarida da Silva e Orta, Margarida Maria Alves and Maria Margarida da Conceição.

Born in the city of São Paulo, probably in late 1711 or early 1712, the daughter of a wealthy Portuguese man and a woman from São Paulo, Teresa Margarida da Silva e Orta, still a child, went to Portugal with her parents and siblings. In 1752, she published, under the pseudonym Dorotéia Engrassia Tavadra Dalmira, the *Maxims of Virtue and Beauty* - or *Aventuras de Diophanes*, as it came to be called from the second edition onwards - the first work of fiction in Portuguese to clearly oppose the Absolutism, claiming the rights of women, defending the autonomy of the lands of the “ex-barbarians” (in a veiled allusion to the Portuguese colony in America). It is, in addition, the oldest fictional text written by Brazilian authorship that is known [5]. Margarida Maria Alves was descended from indigenous peoples on her father's side and blacks on her mother's side, both peasants, parents of eleven children. Catholic since childhood, her involvement with the church brought her, in the 1970s, to the Pastoral Land Commission (CPT). She married in 1971 with Casemiro, also a peasant, with whom she had the son José de Arimatéia, born in 1975 [6]. Maria Margarida da Conceição was born in Alagoas, Maceió. Known as Margarida Guerreiro, she arrived in Cariri at the age of eight. She had experienced the popular arts in her homeland and, living in Juazeiro do Norte, she dedicated herself to Guerreiro, a sequence of danced songs. She was titled Master of Culture in 2004 [7].

Figure 1. *Margarida Maria Alves*. Font: <https://www.google.com/maps/d/viewer?hl=pt-BR&mid=1lkMoztCwda4Mqm4FkfpqCt7NfLLYSoZJ&ll=-8.222406622247643%2C-37.51610919877176&z=7>



Using the structure of Google Maps, species of the Asteraceae family in extinction in Brazil will be mapped,

according to the “Red Lists” database of the National Center for Flora Conservation (CNCFLora). “Among the tasks of CNCFLora is to assess the risk of extinction of species of flora in Brazil, by the year 2020, to achieve goal 2 of the ‘Global Strategy for Plant Conservation’. Red lists are an important tool for prioritizing investments in species conservation, as they need a lot of resources for their construction and updating” [8] [9].

And in combination with those scientific information, personal stories will be geolocated with the collaboration of different web users’ stories, sent by email [short life story, photography, location]. An affective cartography is going to be installed, which intends to map and disseminate the context of these endangered daisies and Margaridas in their botanical and socio-political dimensions, respectively. The work-in-progress “entre Margaridas” (between Margaridas”) rescues a scientific archive to organize an affective collection, which updates an urgent look at endangered species – an environmental and historical-cultural territory that has been gradually destroyed, to bring it closer to another socio-political reality, our Margaridas, which also have survived in different political, historical and/or social Brazilian environments. A poetic collaborative database is going to be created according to web-users’ contributions and their Margarida’s personal narratives, that even they are not notorious ones, daisies and Margaridas share the same strength of adapting to survives. Poetics, by forging elements of the world, triggering meanings that are accommodated there, acts as a “tactic” [10] for the production of enchantment, responding to the insertion of values, notably aesthetic, and in an ontological way. Technological art manipulates data and coded language, subverting the “technical arrangements” [11], which generate practices and order perceptions, privileging some aspects of the human being and marginalizing others.

We understand that expanding and diversifying the actors involved in the establishment of this visual narrative implies formalizing technology awareness processes, which give visibility to the exercises and disputes of power in the technical choices that guide our technocratic society [12].

Acknowledgements

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ISEA2022 Formatting Instructions for Authors

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Abstract

The launch of Sputnik in 1957, humanity's first satellite, ushered in a new era in the conquest of outer space; but it also marked the beginning of a new type of pollution invisible to our eyes, space pollution. Since then, our planet has surrounded itself with numerous satellites tasked with studying our climate, predicting disasters, helping us answer scientific questions important to human evolution, and keeping us continuously connected and monitored. The useful life of these satellites is threatened by the saturation of objects orbiting the Earth. Accidental collisions between objects orbiting outer space can produce debris clouds that move at high speeds. The greater the planetary connectivity, the more increase in space pollution.

Space Debris :: Waste Constellations, is part of an artistic investigation that combines art, science and technology. The project analyzes and evidences the huge swarm of space debris that revolves around the Earth in its four main orbits. Relying on data extracted from scientific sources, it identifies the eleven powers responsible for the exponential accumulation of space debris, classifies and categorizes the data, and shows how this entire constellation of space debris is distributed in the Cosmos.

Keywords

Space Debris, Space Art, Space Pollution, Data Visualization, Complex Networks, Artistic Installations, Art, Science, Technology, Connectivity

Mapping the artificial environment

We are exposed to constant exercise in polluted and polluting environments. The human being, in his tireless scale towards an artificial environment, is producing a saturation of waste, of useless artifacts, of non-degradable materials whose effects are already more than evident in the climate change that is taking place.

Ezio Manzini, in his essay entitled *Artefactos. Towards a new ecology of the artificial environment*, was already announcing to us, in the nineties, what he calls "the experiences of the artificial". His argument is that the artificial environment has a geological structure where the new modifies the existing.

The artificial environment, like the natural one, has a geological structure. Each historical phase sediments its products, the result of its techniques, its forms of social organization, its consumption systems, its culture. Something disappears, other things remain and become a substrate for successive sediments. [1]

Manzini postulates the concept of "high saturation": "Between the dematerialization of high technology and the search for the materiality of high sensoriality, there is an unwanted materiality due to the density of things, people and waste." [2]

To understand the problem of waste pollution, not only in terrestrial space, but also in outer space, it is important to reflect on the perception of the limit. The Earth is not a storage room, a corner where we can store, throw away or keep things that are no longer useful to us, that we do not want to see; Like the oceans, they are not that fluid fold

where to hide the huge amount of plastics dumped into the sea.

When a satellite camera was first turned towards the earth far enough away to show it as a small ball suspended in a great black and inhospitable void, everyone immediately and directly perceived the existence of the boundary, the fact that in our time horizon no longer exist new borders, that this small sphere is our only home. [3]

To this saturation scenario, we must add one more, of enormous relevance, and of which we are not always aware, since until now it is certainly strange and distant to us: spatial contamination. The greater the planetary connectivity, the more satellites and, as a consequence, the greater the increase in space pollution.

Our planet is surrounded by a dense mesh of useless space debris and impossible to visualize from Earth. The human being has exerted a great influence in the conquest of new spaces, but also in the consequences that this entails. One of these effects is spatial contamination, also known as "space debris". We are used to receiving news related to different types of pollution: atmospheric, water, light, visual, acoustic, thermal, radioactive, genetic, electromagnetic...; but perhaps the most unknown, for reasons of scale and visibility, would be space debris. Being a globalized and continuously connected planet also has a price that until now we are not being able to manage.

Space pollution

According to the report of the National Aeronautics & Space Administration (NASA) Orbital Debris Program Office, it is estimated that there are about 18,000 debris from satellites and rockets orbiting our planet, and more than 7,000 tons of satellite scrap. 70% of the waste is housed in a strip of space that extends between 200 and 2,000 kilometers high; in the orbit called LEO, a low orbit that surrounds the Earth, and where the satellites that map the planet are located for its observation and study. In this orbit, the fragments move at speeds between seven and eight kilometers per second, with the consequent risk of collision with active satellites.

Between 50 and 100 tons per year of space debris fall to Earth, according to information from NASA. These are just some of the overwhelming data that we can find in official sources.

Under the name of Space Debris we find any artificial object that is in the earth's orbits and that is in disuse. (Fig. 1)

The simple definition of space debris affects any man-made object, orbiting and not in active use. The debris can be obsolete or inactive spacecraft, parts of satellites or launch vehicles, or fragments of spacecraft and rockets that have been fragmented in some way. Space debris is found in all sizes, from microscopic particles to non-operational satellites and rocket bodies tens of meters long. [4]

NASA estimates that about 100 million pieces of debris float in the sky, of which 27,000 are larger than 10 centimeters. The speed at which these residues travel reaches 28,000 kilometers per hour, so any small fragment could damage satellites or ships; for this reason they are under the supervision of NASA and the United States Department of Defense.

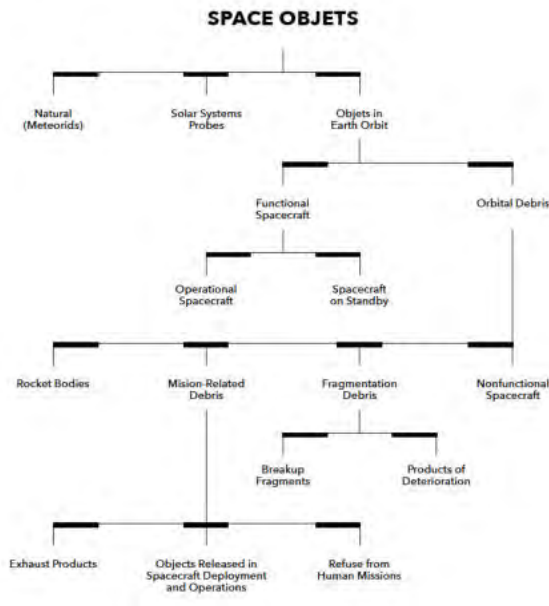


Figure 1. Space Objects. Own elaboration: ©Esther Pizarro

Space debris has become a growing concern in recent years, as collisions at orbital speeds can be highly detrimental to the operation of satellites and can also produce even more space debris in a process called Kessler Syndrome. In a domino effect, the Kessler Syndrome or ablation cascade is a scenario proposed by NASA consultant Donald J. Kessler, in which the volume of space debris in low Earth orbit (also called LEO) would be so high that objects in orbit would be frequently impacted by debris, thus creating even more debris and a greater risk of other impacts on other objects. As the number of satellites in orbit grows and old satellites accumulate, the risk of this Kessler cascade collision scenario increases, to the point that it could render the orbits unusable.

Since the launch of the first satellite in the 1960s, the exponential growth of space debris has multiplied by 94%. [5]

According to the different orbital height, four orbits are distinguished and shelter the different satellites depending on their application (exploration, communications, navigation, observation ...; constituting what is called satellite constellation of the Earth. These orbits are:

Low Earth Orbit (LEO), also called Low Orbit. Among the missions carried out in this orbit by means of satellites are: scientific experimentation, astronomical observation, terrestrial observation, communications, and parking orbits. Continuous eclipses are carried out and its ease of putting into orbit stands out, which is why it is the most populated, and therefore the most polluted. It constitutes a true space dump. It has an orbital time of 90 minutes and is located in an altitude range between 200 and 2,000 km. This orbit houses 70% of space debris. Its speed is high, it can reach 7 km / s.

Medium Earth Orbit (MEO), called Intermediate Orbit. It is more difficult to put into orbit than the LEO, since it requires several stages. Its missions include: navigation, constellations (GPS, Glonass, Galileo). It houses the GIOVE-A satellites. It has the advantages of having a global coverage, lower losses than GEO and medium delays. Its drawbacks are the large constellation of satellites, a variable signal, short visibility, and space

debris. It has an orbital time of 6 hours and its altitude is between 10,000 and 14,000 km. This orbit has greater visibility than LEO, and the satellites move at a speed that ranges between 3 and 7 km / s.

High Earth Orbit (HEO), known as Elliptical Orbit. It is used for communications and space observation. Among its advantages is the coverage of polar zones, a greater elevation angle, lower launch cost and does not require a backup satellite. However, it has link losses, does not provide global coverage and is very sensitive to the asymmetry of the Earth. Its orbital time is 12 hours and its altitude is between 1,000 and 70,000 km.

Geostationary Earth Orbit (GEO), called Geostationary Orbit. Its services are focused on broadcasting and contribution links, fleet communication, mobile communication, meteorology (Meteosat), VISAT networks, etc. Among its advantages are its advanced technology, coverage of populated areas, good visibility, predictable interference and a known launch into orbit. As drawbacks we find that it does not cover polar areas, there are link losses, high launch cost, low viewing angle and space debris. It has an orbital time of 24 hours, positioning itself at an altitude of 35,786 km.

Space environment statistics

The Satellite Catalog (SATCAT) is a catalog that records the satellite position of all objects larger than 10 cm. and that they are orbiting around the Earth. Each object has a nine-digit number assigned by the United States Space Command (USSPACECOM). The objective of SATCAT is to continuously track the movements of these objects to avoid future collisions with other active or inactive satellites.

The main categories recorded by the SATCAT, and on which this research has been based, are:

DEBRIS :: Any man-made object in orbit around the Earth that no longer has any use.

PAYLOAD :: Any object that is not classified in the SATCAT as a rocket body or as debris (debris) is considered a payload. Payloads can contain both functional and non-functional experiments.

ROCKET BODY :: Rocket bodies are used to place payloads and the platform, if one is used, into orbit. Some launches may use more than one rocket body due to the weight of the payload or the type of orbit or experiment.

Additionally, USSPACECOM has added scale values to SATCAT tracked by the Radar Cross Section (RCS) and known as RCSVALUE. These are distributed in three scales or sizes:

SMALL :: (<0.1 m²)

MEDIUM :: (0.1 m² - 1 m²)

LARGE :: (> 1 m²)

We will point out some significant data that allow us to get an idea of the magnitude of the problem we are facing¹:

- Rocket launch since the beginning of the space age in 1957 = 6,060
- Earth-orbiting satellites placed by rocket launch = 11,670
- Satellites still in orbit = 7,200
- Active satellites = 4,300
- Number of junk objects tracked and included in their catalog by spatial surveillance networks = 28,600
- Estimated number of ruptures, explosions, collisions or anomalous events that lead to fragmentation = more than 560
- Total mass of all space objects in Earth orbit = more than 9,400 tons
- Number of debris objects that statistical models

¹ Last update: 20 Mayo 2021. Fuente: <https://sdup.esoc.esa.int/discosweb/statistics/>

estimate to be in orbit =
 34,000 objects larger than 10 cm
 900,000 objects from 1 cm to 10 cm
 128 million objects from 1mm to 1cm

Artistic visualization. Space Debris :: Debris Constellations



Figure 2. Installation Space Debris :: Waste Constellations, Cigarreras, Alicante. ©Esther Pizarro

The artistic project entitled Space Debris :: Waste Constellations (Fig. 2) is structured around two axes. The first, the conceptual one, reveals the data collected from scientific sources and produces graphs that try to clarify the understanding of the analyzed information. (Fig.3)

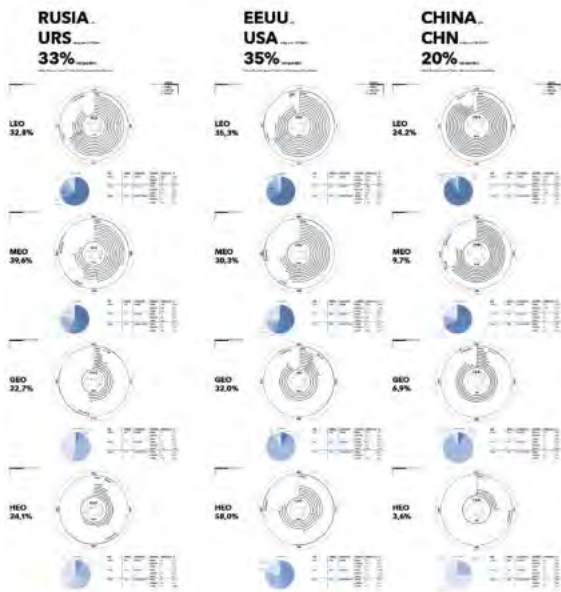


Figure 3. Data Visualization, Space Debris :: Constelaciones de Desechos, Las Cigarreras, Alicante. ©Esther Pizarro

The eleven powers responsible for the greatest impact in space debris production have been identified in the research. The analyzed powers and their percentage of space pollution in outer space, generates the following ranking: USA (35%), Russia (33%), China (20%), France (3%), Japan (1.4%), India (1.2%), European Space Agency (1.1%), United Kingdom (0.6%), Germany (0.3%), Canada (0.3%), and Spain (0.1%).

Each country has been classified based on the four Earth orbits, LEO, MEO, GEO and HEO; and around the three main categories of space debris: debris, rocket body and payload.

The second axis, and the main one, is made up of a large interactive three-dimensional installation that interprets outer space and its four main orbits.

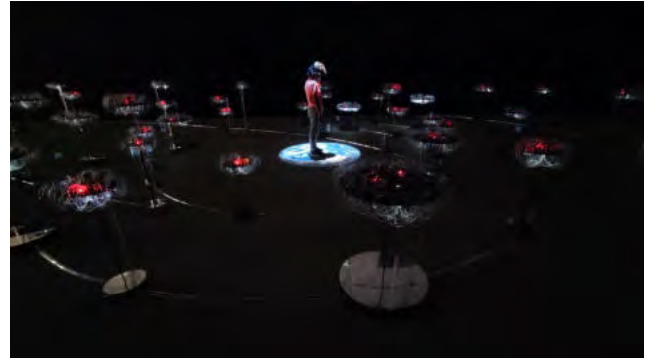


Figure 4. Installation Space Debris :: Waste Constellations, Cigarreras, Alicante. ©Esther Pizarro

A projection of the Earth acts as a center. Around it, 44 circular devices woven with fiber optics and activated by light sensors are distributed (Fig. 4). In its upper part, a seven-segment screen shows the country analyzed, the orbit under study, and the number of objects cataloged in that orbit. This screen is activated by a motion sensor. A cool white LED spot lightly feeds the fiber optic ellipses that sew the circular platform. The sensors, the screen, and the LEDs are controlled by an Arduino nano (Fig. 5).

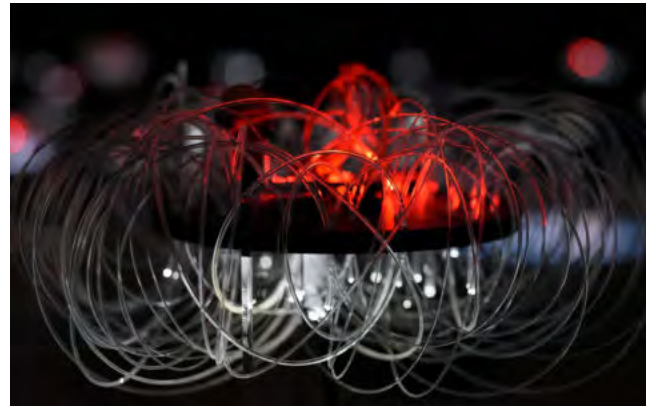


Figure 5. Detail Space Debris :: Debris Constellations, Las Cigarreras, Alicante. ©Esther Pizarro

A systematization of sizes has been established for each country based on its percentage of special garbage; the greater the impact of contamination, the greater the diameter of the platform.

The countries with the highest incidence in terms of spatial contamination are identified with a double LED and an acoustic sensor that interacts with the viewer, and that activates a generative video mapping on a wall of the room.

In the perpendicular projection of the device, a circular platform, made of mirror methacrylate, shows us the data for that country in the form of a graph of circular rings, using laser engraving.

The image returned by the mirror on the reverse side of the circular platform is shown to us as a cosmic constellation of light points (ends of the optical fiber); while its reverse contains all the technological devices used in the installation.



Figure 5. Detail Space Debris :: Debris Constellations, Las Cigarreras, Alicante. ©Esther Pizarro

Each of the eleven powers is represented by a circular device in the corresponding orbit. The 44 devices are arranged according to four heights, with the LEO orbit being the lowest and the HEO the highest. Its distribution

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Author Biography

Esther Pizarro is a visual artist, researcher and Professor at the European University of Madrid. She has recognized four six-year research periods. She has exhibited individually and collectively inside and outside our country. Among the scholarships received are the Pollock-Krasner, the Academy of Spain in Rome, the College of Spain in Paris and the Fulbright scholarship. She has received numerous awards: Ramón Acín, Antón Scholarship, VEGAP Proposals, Critical Eye RNE, and Pámpana de Oro Valdepeñas. She has participated with large-scale installations in the Shanghai World Expo, China 2010; and at Expo Zaragoza 2008. Her installations have been exhibited at Las Cigarreras, Alicante; Tabacalera, Madrid; LABoral Center for Art and Industrial Creation, Gijón; Matadero Madrid; Metròpoli Foundation, Madrid; Casa Asia, Barcelona; Hospital Real, Granada; San Telmo Museum, San Sebastián; Tomás y Valiente Art Center, Fuenlabrada. Her work has been represented in various collections such as the Academy of Spain, Rome; Institut Valencià d'Art Modern, IVAM, and the Ministry of Foreign Affairs.

in the plane of the room corresponds to the scientific arrangement of the four main orbits in outer space.

Conclusion

We could conclude that, from mobile phones or satellite television to the Global Positioning System (GPS), going through innumerable scientific, astronomical or military missions; the gear of the contemporary world, a globally connected world, inevitably depends on how what happens in the orbits closest to the earth's surface and subject to the laws of gravity is managed. The exponential growth of the spatial swarm above our heads, although we are not able to see it, is there; It should be the object of reflection and concern, not only by scientists, astronomers, politicians or the military, among others; but also on the part of thinkers, artists, sociologists; since together we form the great community of human knowledge.

In an exercise of reflection on the proposed problem, the project, Space debris :: Constellations of waste, aims to generate a three-dimensional and installation visualization that shows the notable increase in spatial pollution that the connectivity of today's society is generating; based on the data collected from open and official sources that Internet 2.0 and technological advances contribute today to the multi-connected user.

The space conquest has generated great advances on our planet; now is the time to act, to assume responsibilities, and to avoid this exponential growth of space pollution. A look from the disruptive thought that art proposes to one of the great challenges of the 21st century, how to control the pollution we produce.

INTELLIGENT HABITAT: An Intelligent Audiovisual Environment Using Internal Bodily Signals and Emotion AI

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Abstract

The main aim of the artistic project described hereby is to create an intelligent audiovisual installation exploring the combination of technologies such as biomedical signals and machine learning techniques used in affective computing (also known as Emotion Artificial Intelligence), in order to create an intelligent environment capable of recognising the emotional state of visitors and react empathetically. Furthermore, such environment is hereby conceived as a prototype of possible future homes, where the space itself is able to recognise the emotional current condition of its inhabitants and produce an empathetic reaction. In a first stage, visitors are not only audio-and visually confronted with their own current emotional state, but also are invited to raise awareness about the possibility of future home technologies and their implications. Consequently, this fact does not limit participation of common visitors, but also and specially invites scientists, artists, philosophers and producers and consumers of global digital technologies to a fundamental discussion about how our future homes may be and how new technologies inside them may or may not be beneficial to everyone's well-being.

Keywords

Emotion AI, machine learning, biomedical signals, affective computing.

Introduction

The artistic project hereby explained is currently being developed, and thus, a work in progress still. It is based on Affective Computing, a study field that combines psychology, cognitive, physiology and computer sciences [1], and which, according to Vesterinen [2], is a field that deals with emotions and computers and questions such as:

“What is the foundation of recognizing, understanding and expressing emotions?”

and/or

“How can we build a computer able to feel?”

The project consists of an intelligent space composed by an immersive audiovisual environment (IAE hereafter),

featuring multichannel sound and multiple video projections generated in real-time. The IAE is constantly modified by visitors via diverse technologies, mainly Facial Emotion Recognition (FER hereafter) combined with other body signals, for example ECG (Electrocardiogram, measuring heart rates), GSR (Galvanic Skin Response, measuring levels of humidity in the skin) and/or BCI (Brain Computer Interface, measuring brain activity). The FER system starts by scanning the visitor's current emotional state and the IAE reacts by projecting an audiovisual reaction corresponding to that mood. Once visitors have been made aware of their current mood by the IAE, the system generates a different audiovisual environment made of images and sounds inspired by nature that empathise with the visitor.

One of the goals of this project is focused on the creation of intelligent environments not only capable of recognising the emotional state of their owners or visitors but also, of reacting empathetically. Another goal is to explore fundamental questions of how our future homes may look like, in particular how new technologies inside them may or may not be beneficial to our well-being and how we can connect with nature using these technologies.

There are several software packages that allow for the realization of this project: while the installation's sound and visuals are generated in real-time by the software *Max* (www.cycling74.com), the different systems for each of the steps required by the project include also machine learning via *Python*, *TensorFlow* and diverse libraries for emotional recognition.

For the conception and development of INTELLIGENT HABITAT, the author was inspired by her last two interactive installations, namely LEIKHEN (2018) and REFLEXION (2019), both based on a long track record of experience in creating works connecting the human body and the machine through biomedical interfaces. In both works, the main intention is to explore from different perspectives questions regarding relationships between human beings, with particular attention to “the other” and to the environment. With this new project, the interest lies primarily in the experimentation of combining AI (particularly Emotional AI), because it offers new perspectives (and

consequently, raises new questions) about the relationship between human beings and the machine, especially the topic of constant change in the current interplay between man, nature, machine/technologies and body.

Facial Emotion Recognition (FER) System

The FER system is a technology that analyses emotions through pictures and/or videos. The conventional approach consists of three steps: a) face detection, b) facial expression detection, c) expression classification to an emotional state [3]. A different approach is the deep-learning-based and one of the most popular models available is the Convolutional Neural Network (CNN):

“the input image is convolved through a filter collection in the convolution layers to produce a feature map. Each feature map is then combined to fully connected networks, and the face expression is recognized as belonging to a particular class-based [of] the output of the softmax algorithm.” [3].

The software implemented in this artistic work is programmed in *Python* using a machine learning model for recognition called *Multi-task Cascaded Convolutional Networks*, further improved by also using the *OpenCV's Haar Cascade classifier*.

Immersive Audiovisual Environment (IAE)

The IAE consists of multiple video projections featuring images made mostly of macrophotography from diverse nature surfaces (Fig. No. 1), creating audiovisual natural habitats inspired by nature structures with the purpose of inviting visitors to reflect about the interplay human-nature through technology and how such interplay impacts on our well-being.



Figure 1: Draft. Example of image inspired in nature (© Claudia Robles-Angel).

The sonic section of the installation consists, on the one hand of field recordings collected from different nature

reserves; on the other hand, of sounds corresponding to a generated poem by the system.

The technologies of the IAE comprise the following:

- i) an emotion recognition system (FER) programmed in *Python* using the afore-mentioned libraries, that sends the results to the *Max* software via OSC (Open Sound Control protocol)
- ii) an interface measuring additional biomedical signals e.g. ECG (measuring heartbeats), BCI (measuring brain activity) or GSR (measuring skin's moisture)
- iii) a real-time audiovisual system programmed in *Max*, which generates visuals and sounds into the IAE; this audiovisual output corresponds to different emotional states, e.g. happiness, sadness, etc.
- iv) a space provided with multiple projectors and surround sound (up to 16x channels and 2x LFEs).

A complete chart flow of this steps in presented in Figure 2 below.

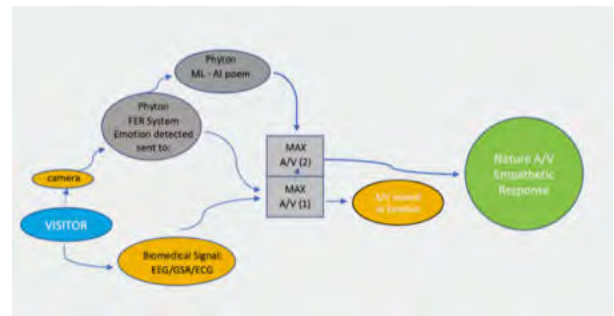


Figure 2: Flow-chart of system process (© Claudia Robles-Angel).

IAE: Interaction with Visitors

The IAE interacts with visitors/users in two different ways:

- (1) **DIAGNOSIS:** in a first instance, the IAE scans the current visitor's mood using algorithms based on affective computing technologies. This diagnosis process consists of identifying the subject's emotional state through the afore-mentioned FER system (Fig. No. 3), which recognises basic human emotions such as e.g. happiness, surprise, anger, sadness, fear, disgust, etc.

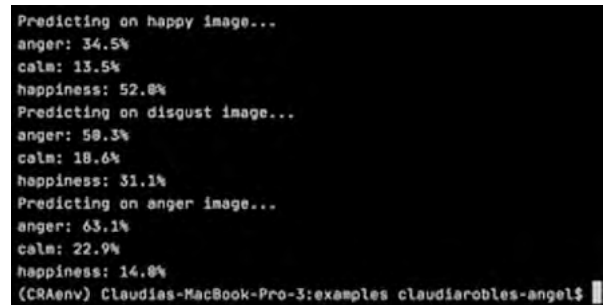


Figure 3: FER system (Python software) screenshot (© Claudia Robles-Angel).

Thereafter the system sends the results of the visitor's current emotion to the *Max* software via OSC; these results are combined by the *Max* software with data received

from the other biomedical signals from the visitor which could be from either their heartbeats, their brainwaves or their skin moisture. These additional signals reveal mostly levels of stress, engagement, excitement and relaxation. The combination of these two sets of data from the FER and from the selected biomedical signal offer a rather accurate description of the visitor's current emotional state.

(2) EMPATHETIC REACTION: after the Diagnosis step is completed, algorithms programmed in *Max* select and project into the IAE the visual and sound material corresponding to the type of emotion detected during facial recognition. The purpose of this is twofold: on the one hand, the IAE reflects the current visitor's mood; on the other hand, it stimulates the raise of awareness of visitors about their current emotional state. The IAE is therefore continuously transformed by the constant fluctuation of values received from the corresponding body signal measured, while DSP processes in *Max* (including audio spatialisation and video) reflect and intensify through the IAE the mood in which the visitor is in.

Thereafter the algorithm continues by generating an audiovisual environment inviting visitors to connect with a nature environment combined with generated poems as an empathetic response from the IAE. For the creation of these poems, machine learning algorithms via a Markov chain model are implemented (*Markovify* library, used to generate random sentences), while for each type of emotion detected by the FER System, the installation selects keywords related to the current emotion to generate a poem thereafter. The resulting poems are turned into audible sound (via text-to-speech algorithms) and thereafter, these texts are used to produce further sound material, creating a variety of rhythms and sonic results in order to autogenerate different types of sound poetry, all of which spatialised in 3D-Audio using immersive sound systems such as, for example Ambisonics.

The final outcome of the project envisages the creation of an autopoietic sonic space continuously defined by new combinations of sounds and words.

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Rosalind W. Picard, “Affective computing challenges,”. *Affective computing: challenges, International Journal of Human-Computer Studies*, Volume 59, Issues 1–2, (2003): 55-64.

Claudia Robles-Angel

New media and audiovisual artist. Her work and research cover different aspects of visual and sound art, which extend from audiovisual fixed-media compositions to performances and installations interacting with biomedical signals. She has been artist-in-residence in several outstanding institutions, for example at ZKM (Karlsruhe) and at the ICST-ZHdK in Zurich.

Her work is constantly featured in not only media and sound-based festivals/conferences but also in group and solo exhibitions around the globe, for example, the ZKM Karlsruhe; KIBLA Centre Maribor, Bauhaus Museum Berlin; Festival de la Imagen Manizales, DRHA2010 Sensual Technologies London; SIGGRAPH Asia Yokohama; Re-New Festival Copenhagen; New Interfaces for Musical Expression NIME Oslo; ISEA Istanbul, Manizales and Durban, CAMP audiovisual concert - Salon Suisse, Official collateral event of the 55th Venice Biennale, Audio Art Festival Cracow, Harvestworks Digital Media Arts Center NYC, Museum of Contemporary Art MAC Bogotá, MADATAC Madrid, ADAF Athens, Heroines of Sound Berlin. www.claudearobles.de

DESCENT ≈ An Atlas of Relation

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Abstract

DESCENT ≈ An Atlas of Relation, looks to the fish – who have occupied our planet for millions of years in a constant struggle for survival – as an entryway to visualize the entanglements of interspecies relation through time-based imaging systems referencing the imperceptible slowness of evolutionary processes. Digital photographs, scans, and video documentation are combined with UV-sensitive direct contact printing methods that require multiple minutes, hours, or days to construct an image of/with the natural world. While these camera-less works archive the durational period of each exposure – appearing as frozen traces serving as documents or specimens – the digital images and time-based video clips function as infinitely reproducible experience. Thus far works have been produced throughout the U.S. in locations undergoing restoration or habitat conservation, and where relationships to land and water are disputed, revered, mourned, misunderstood, or unacknowledged.

Keywords

environment; site-specificity; water; habitat; evolution; climate; temporality; multi-species; embodiment; relation

Introduction

DESCENT ≈ An Atlas of Relation extends from a long term, site-responsive series drawing on the dormant pathos embedded within lands where human and more-than-human lives correspond. This talk will share works-in-progress resulting from repeated observations of both routine and remarkable situations among the many Beings who cohabit on this planet, together. Using the resultant recordings as an entryway to visualize the entanglements of interspecies relation, this phase of the project moves from dry to watery terrain as a means of thinking through how “we”¹, along with along with fish and

other aquatic organisms, find ways of being and living together within the midst of a globally shifting climate impacting our shared spaces and, subsequently, our relation(s). As a collective of inhabitants, how do we persist, together, within the relentless ongoing-ness of our worlds?



Figure 2. Work-in-Progress Study. Digital collage comprised of scanned, X-ray film and HD video stills.

Looking to the fish – who have occupied our planet for millions of years in a constant struggle for survival – offers opportunities to visualize interspecies dynamics through photo-based systems referencing the imperceptible slowness of evolutionary processes. Digital photographs, scans, and video documentation are combined with UV-sensitive direct contact printing methods requiring multiple minutes, hours, or days to construct an image of/with the natural world. While these camera-less works archive the durational period of each exposure – appearing as frozen traces serving as documents or specimens – the digital images and time-based video clips function as infinitely reproducible experience. Together, these recording techniques result in unpredictable visuals corresponding with feminist perspectives on Darwin’s theories of descent, emphasizing anti-essentialist understandings of matter and nature, considering all aspects of Being as forever transformed by and within time.

Site-Responsivity/Responsibility

With awareness of my identity as a white woman with settler ancestry, I approach land and water tentatively, with care and patience. Cultivating methods centered around ethics and mindfulness led me to begin this engagement in places most familiar. Initial studies from this phase of the project have been produced within and around my hometown of Sault Ste. Marie,



Figure 1. Work-in-Progress Study. Digital collage comprised of scanned, analog prints and HD video stills.

¹ As noted by scholars such as Astrida Neimanis (drawing upon Adrienne Rich and Donna Haraway) and Max Liboiron, there is no

universal “we,” and thinking in terms of “we” requires individual, place, and situation-based specificity.

Michigan², with a particular focus on sections of Lake Superior and the St. Marys River³. As shaped by colonial powers, these aquatic habitats have become commonly known as a maritime border between what is now the U.S. and Canada, encompassing the shipping lanes within the commerce driven Soo Locks. Yet, these waters have long served Indigenous nations as a sacred source of life and continue to provide for many Anishinaabe citizens who rely on fishing for sustenance, income, and culture. Disruptions to this biodiverse ecosystem mirror those of other regions, where contemporary species management has become relentlessly interconnected with maintaining healthy fisheries and waters.



Figure 3. Work-in-Progress Study. Digital collage comprised of scanned, X-ray film and HD video still.

Further/Future Work

Though the rich histories and fish populations of The Great Lakes⁴ are foundational to the project, the work extends from this region to consider bodies of water with comparable cultural and ecological characteristics, where relationships to land and water are disputed, revered, mourned, misunderstood, or unacknowledged. This requires recognition of how private and public land acquisition and corresponding histories of displacement (have and continue to) physically and culturally shape our watersheds. Connecting this knowledge with the unimaginable span of deep time embedded within the lives of fish and their watery homes to varied understandings of descent – as passage, downward movement, decline, sinking, legacy,

² The Anishinaabe name for Sault Ste. Marie is Bahweting, as noted by The Sault Tribe of Chippewa Indians (Original, Indigenous place names for locations depicted will be incorporated into written materials as the project unfolds and as they are learned through conversation, research, and resource sharing.)

³ The Anishinaabe name for Lake Superior is Anishinaabe-gichigami, and Baawiting for the St. Marys River as noted in the Anishinaabe

lineage, origination – I visualize our human-made worlds as a continuum, suggesting both the promise and peril of ecological longevity.

Author Biography

Dawn Roe (b. 1971, Sault Ste. Marie, MI, U.S.A.) is Professor of Studio Art in the Rollins College Department of Art & Art History in Winter Park, FL. Working between and within the still and moving image, her projects examine the role of these media in shaping personal and social understandings of our environment through site-responsive engagement. Roe's work is exhibited regularly throughout the U.S. and internationally and has recently been recognized by Urbanautica Institute Awards, and LensCulture Critics Choice Awards. Her imagery and writing has been featured in many print and on-line publications including Lenscratch, Floorr, Aint-Bad, Oxford American, The Detroit Center for Contemporary Photography's series Frame/s, and the Routledge publication, *photographies*. Roe's work is represented by Tracey Morgan Gallery in Asheville, NC.

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Atlas and map made available by the Great Lakes Indian Fish & Wildlife Commission (GLIFWC).

⁴ The Anishinaabe name for the Great Lakes is Nayaano-nibiimaang Gichigamiin, meaning The Five Freshwater Seas, as noted in "The Great Lakes, an Ojibwe Perspective" in the Decolonial Atlas.

Art. Science, Nature and Culture: Expressive Science in the Digital Age

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Abstract

In this artist presentation I describe the trajectory of explorations in art and science that brought me to the current work of colliding nature and culture. Included is the case for more awareness of the importance of microscopic life in the age of climate change, with the role of technology in enabling this odd mixture. This is described in the context of my practice as an early adopter of digital imaging (mid-1980s), with a return to direct gestural drawing motivated by responding to scientific microphotography of plankton

Keywords

microphotography, gesture, drawing, plankton, manuscripts, art, science, culture, patterns, oceanography

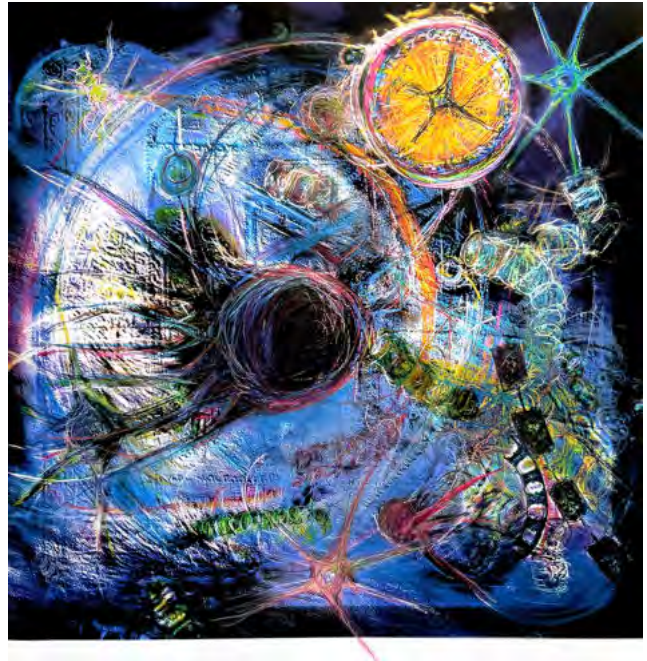
Introduction

“Everyone knows that art is round and science is flat.” So begins the 1975 essay by Joseph R. Burke and M. S. Gussenhoven entitled *tides and the affairs of men: reflections on art and science*.¹ This line, this entire essay, has stayed with me in the decades since I first read it.

In the days when there was a rush to find the convergence of the two disciplines, when the argument was that both are based on observation, the words of this essay came rushing back. As the argument goes, art and science are both about making observations and compiling connections, so they must be the same. I rejected that argument. Everyone knows that art and science are not the same, even in basic processes. Art gets to jump around and unapologetically make adventuresome connections in the pursuit of creating a provoking visceral experience, while science is required to follow procedures and methods that lead to solid evidence.

Decades later, I celebrate this difference by putting art into science, nature into culture, both disciplines in the same imagery, letting them fight out who gets ownership of patterns that yes, do seem to point to a similarity in the universe of human - organism interaction, as celebrated in the image *Plankton Universe* which photographic and hand-drawn microscopic life with patterns from a Hebrew manuscript that is more than 1000 years old.

1. Joseph R. Burke and M. S. Gussenhoven, *tides and the affairs of men: reflections on art and science*, Antioch Review, Yellow Springs, Vol. 33, No. 2, Summer, 1975



Plankton Universe

© Cynthia Beth Rubin with Susanne Menden-Deuer, 2020- 2022
mixed media digital and analogue

Exploring Microscopic Life

One of the primary themes of my work for over a decade has been making visible the invisible microscopic world of plankton. The forms of plankton, in their endless variety, stir my imagination and impulse to observe, draw, and create.

I began my own plankton artwork with the common attitude that I had to be careful not to distort or misrepresent the plankton. At the time, I was teaching Digital Nature at the Rhode Island School of Design, in an elective course open to students of all levels and areas of concentration, mixing designers, architects, painters, and sculptors. As the course morphed into Digital Plankton, we visited the Graduate School of Oceanography at the University of Rhode Island, learning from the plankton researchers Susanne Menden-Deuer and Tatiana Rynearson.

When I stopped teaching at RISD, Susanne Menden-Deuer invited me to join her lab as an artist in

residence, solidifying my interest in bringing the world of plankton to a broader audience. Influenced by the scientists in the Menden-Deuer lab, as well as current events, my commitment to depicting plankton grew in the face of climate change. In addition to producing 50% oxygen we breathe they are at the bottom of the food chain. Without plankton we die. Therefore creating empathy for the plankton is now an essential aspect of my work.

Merging the Streams of Influence

This body of work also brings us into conversation with culture, with the past, with the very meaning of humanity that invites us to stretch back more than 1000 years and imagine why decorating sacred text and embellishing stories was so essential to so many cultures.

In parallel with my investigations plankton, I was, from time to time, working on imagery incorporating the visual structures of Hebrew manuscripts. Early in my career I turned to researching influences beyond the Western wall painting that was so central to my educational experience. After looking at the visual cultural legacy of a variety of cultures, I crept towards one related to my own heritage. By accident, not by intention, but nonetheless it happened.

While still attached to earlier works in which I digitally combined photographic imagery of specimens with painterly environments, I kept thinking of the tradition of Hebrew manuscripts, including those in which micrography (little writing) turned into decorative patterns and sometimes fanciful beasts. There had to be a convergence.



Drawing Plankton into Old Cairo Text
© Cynthia Beth Rubin with Susanne Menden-Deuer, 2021
mixed media digital and analogue

The bits of the Biblical manuscripts that are present in this series are intended as a signifier, not as religious Text per se. This echoes what was often the intention in the original micrography that was difficult to read but intended as embellishment and reference to the more readable Text. In this series I use motifs from the Leningrad Codex, created in Old Cairo in 1008, most likely by artists from the Asher scriptorium. I do not read Hebrew, but with the help of my artist colleagues I identified and avoided references to God in the completed imagery, leaving open a more general signifier.

New Technology, New Methods

As new media digital artists, we are enamored of the big innovations and the subsequent leaps into new forms of art. What we think about less often are the small, incremental developments that make new artistic directions possible.

Since I began working digitally in the early 1980s, I have continually been intrigued by the ease of seamlessly merging disparate elements in creating compositions. With the advent of affordable scanning, and then later the introduction of digital photography, this combining beyond collage became even more important in my artistic practice.

At the same time, scientific imaging was going through a similar evolution. I first saw plankton on the big screen in 1970, when I was working at the Pacific Science Center (as a student). One of my colleagues attached a video camera to a microscope so that we could show plankton to visiting school groups. This was before digital imaging, and we were not recording what we saw. Today, scientific researchers



Copepod in a Red Sea in Old Cairo
© Cynthia Beth Rubin with Susanne Menden-Deuer, 2021-2022
mixed media digital and analogue

may look into a microscope to focus, but the important visual material is digitally photographed and studied later. Scientists, like artists, are working in the realm of digital imaging, using similar software tools to refine what they observe. This easy exchange of visual data is vital to my work.

The other seemingly trivial innovation is the emergence of low-cost printing, a development that cannot be dismissed as inconsequential. To execute this work, I returned to drawing. We have microphotography, what we do not have is expressionist drawing. Drawing into my evolving artwork was only possible because I could have large prints, big enough for gestures, allowing drawing and redrawing right onto the surface of more subdued plankton and cultural patterns. It is impossible to imagine how such lively combinations would have evolved without this innovation.

Conclusion

Always intrigued by science, I jumped into bringing all of the lessons of painterly abstraction into work with scientists, including my experience with life drawing. If I could be loose and expressive in drawing humans, why not with plankton? Although in theory this could have been done with old technology, it was the new technology of cross-discipline digital photography, scanning and image processing, combined with inexpensive printing, that prompted this body of work to emerge.

This is my most current work, which continues to evolve. My goal is to bring Nature and Culture together in touching our inner thoughts, and save the planet now.



Asterionellopsis in Purple Sea
© Cynthia Beth Rubin with Susanne Menden-Deuer, 2022
mixed media digital and analogue

Reference

Leningrad Codex,
https://en.wikipedia.org/wiki/Leningrad_Codex

Acknowledgements

I am deeply indebted to Susanne Menden-Deuer for opening this path in my artistic practice, and to the members of her lab who gathered data, provided raw imagery, and gave feedback and encouragement. I thank Jason Schaedler, Gayantonia Franze, Pierre Marrec, Françoise Morrison, Heather McNair, and Mary Kane. I also thank Neal Overstrom, former director of the RISD Nature Lab, who first suggested and facilitated work with plankton. Special thanks to the artist Leah Caroline, who guided my use of Hebrew text.

Author Biography

Cynthia Beth Rubin began the transition from painting to digital imaging in the early 1980's. Her prints, videos, and interactive works have been shown in the Techspressionism exhibition, NY Creative Tech Week, Jewish Museum in Prague, Siberia State Museum in Novosibirsk, Kyrgyzstan State Museum, on the ICC tower in Hong Kong, Cotton Club screen in Harlem, and numerous editions of ISEA and SIGGRAPH. Rubin's awards include multiple Connecticut Artist Fellowships, New England Foundation on the Arts, among others, and artist residencies in France, Israel, Canada, and Scotland. She is artist-in-residence in the Menden-Deuer lab at the University of Rhode Island, School of Oceanography, thus her practice includes collaborations with scientists studying plankton and their predators. Based in New Haven, Connecticut, her studio practice extends to New York City, Narragansett RI and beyond.



Song of Diatoms in Old Cairo
© Cynthia Beth Rubin with Susanne Menden-Deuer, 2020
mixed media digital and analogue

Fragments: A Cognitive Merzbau

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Abstract

Fragments is an ongoing series of audiovisual research-creation works that bring together live performance, generative music, video game design, photogrammetry, lighting design, audiovisual production, and theater dramaturgy. By using a collage approach that mesh together autonomous computational systems, human performance, and real-world imagery and sound, the series explore the complex feelings of living in an algorithm-driven world, living away from one's homeland, meeting and sharing across cultural differences, sustaining social lives at a distance and across borders, and relating to the mediatised lives of strangers.

Three pieces are discussed: *Poetics of Otherness*, that explores the hyper-mediatisation of warzones, *Stabat Mater*, that inquires into the anonymity of living in urban metropolis, and *The Shape of Things*, that dives into the atemporality of large-scale infrastructures.

Keywords

Machine agency, Live performance, photogrammetry, generative music, video-game engine

Introduction

Fragments is an ongoing series of audiovisual research-creation works that bring together live performance, generative music, video game design, photogrammetry, lighting design, audiovisual production, and theater dramaturgy. By using a collage approach that meshes together autonomous computational systems, human performance, and real-world imagery and sound, the series explore the complex feelings of living in an algorithm-driven world, living away from one's homeland, meeting and sharing across cultural differences, sustaining social lives at a distance and across borders, and relating to the mediatised lives of strangers.

Three pieces are presented: *Poetics of Otherness*, that explores the hyper-mediatisation of warzones, *Stabat Mater*, that inquires into the anonymity of living in urban metropolis, and *The Shape of Things*, that dives into the atemporality of large-scale infrastructures.

Links to Online Documentation

Short presentation video for the Montréal based research-creation network Hexagram (in English):

<https://rencontres.hexagram.ca/en-ca/allcategories-en-ca/21-emergence-y/arselectronicacontributions/121-poetics-of-otherness>

Short television documentary for a series on the role of Artificial Intelligence in different disciplines (in French):

<https://savoirmedia/lia-et-moi/clip/lia-et-le-plaisir>

ALMA's artist page for the festival Mutek 2021 (Montréal, CA): <https://montreal.mutek.org/en/artists/alma>

Concept

Each of the pieces of the series uses the concept of “fragments,” small elements that are transformed and reconfigured, to explore technologically mediated human connections, perceptions, and memories. These fragments consist of sounds, videos, and photogrammetric objects that are scavenged from the news, created by the artists, or generated by algorithms. During the performance, those fragments are analyzed and modulated live by a set of Markov chains, Spiking Neural Networks, Machine Learning, optical flow, and other AI & A-Life techniques. In front of the audience, the artists orchestrate the action of those algorithms and guide the public into a journey that moves from darkness and absence into a growing torrent of sonic and visual stimuli.

Fragments is presented as an onstage audiovisual performance in which 2 human performers act live on Artificial Intelligence and Artificial Life algorithms to generate and modulate a poetic immersive experience (Figure 1).



Figure 1. *Fragments* performed at Mutek 2021 (Montréal, Canada) (photo: Bruno Destombes).

Photogrammetry and Video Game

The visual material of *Fragments* results from an original combination of found footage, photogrammetry, and video game engine.

First, we collect video images from archival, news, and personal material. This material consists mostly of video containing tracking shots through spaces that echo different themes such as war ruins, cities, or abandoned buildings.

The collected videos are then processed with Agisoft's Metashape photogrammetry software¹ to generate 3D spaces. Given that our video material consists mostly of video footage not intended for photogrammetry, the 3D spaces obtained are not accurate reconstructions of the actual spaces. Instead, they are riddled with glitches and algorithmic extrapolations that produce uncanny aesthetic objects at the intersection between material and digital worlds.

Finally, the 3D spaces are imported inside Epic Games' Unreal Engine² where they are arranged into the virtual world of the performance. This video game engine enables us to create powerful virtual lighting effects, play with the materiality of the photogrammetric object, and experiment with the emergent properties of complex dynamic systems such as point clouds.

The visual component of *Fragments* consists of refined camera tracking shots through a virtual stage composed of uncanny photogrammetric objects based on real-life spaces. All camera movement, lighting effects, and dynamic system animations are performed live.

Generative Music

Fragments explores the expressive potential of human-computer interaction and collaboration through the use of generative music algorithms coupled with human

improvisation on electronic music instruments. In this section, we describe the conception and use of autonomous algorithms for musical composition as well as the methods used to create a live collaboration between the human performers and the machine.

Various strategies have been used since the early days of computer music to generate compositions, many relying on probabilistic models driven by pseudo-random number generators. While this technique proved useful for creating ever-changing pieces with no predetermined duration [1, 2] it relies on an implementation of musical theory concepts and rules in the computer to orient the generated content reminiscent of the GOFAI approach to artificial intelligence in the 1960s to the 1980s [3, 4]

Our approach uses a Markov Chain model to create new musical compositions in real time [5]. Based on a series of discrete states representing musical notes, the algorithm determines the probabilities of going from one state to another at each prompt. Concretely, if the initial note is a middle C, the Markov chain will compute the probabilities of changing state and determine which state is the most probable at the next prompt, sending for instance a G (the fifth note of the scale) to our synthesizer. Multiple queries, organized rhythmically, can thus create rich and evolving melodies and harmonies.

The use of this technique removes the need for an implementation of rules in the algorithm. Instead, carefully crafted series of musical notes representing chords and harmonies are used as training data for the algorithm. The impact of this training data is important in two ways. First, it dictates the possible states of the chain (i.e., the possible musical notes to play). This can be used to indicate to the algorithm to play on a specific scale. Additionally, the data indicates the most likely intervals to play, creating a sense of harmony or dissonance in the composition. Finally, observations realized when creating *Fragments* showed us that many Markov chains trained on the same data set will diverge and generate slight variations in the melodies. When joined together on various instrumental arrangements, these changes create emerging patterns and new harmonies that are not represented in the original data.

The human performers play an important role in the performance of *Fragments*. While the algorithm can efficiently select states (musical notes) the temporal organization of events remains a challenge for computer science and artificial intelligence programs [6]. For this reason, the rhythmic aspects of the composition are organized by the performers. Inside a digital audio workstation (DAW), events are arranged rhythmically using the MIDI protocol (Musical Instrument Digital Interface). On each MIDI event, the Markov chain selects the note to play while the MIDI data dictates when and how long each note should be played. Furthermore, the performer's control which instruments are playing at any given time. Similar to a conductor with an orchestra, the role of the performer is to organize all the instruments in time to create the musical experience. For this reason,

¹ <https://www.agisoft.com/>

² <https://www.unrealengine.com>

Fragments represents an experiment in human-computer collaboration, a negotiation between the intention of the performer and the agency of the machine in front of the public.

Poetics of Otherness

Fragments: Poetics of Otherness (Figure 2) is a 20-minute piece that reflects on how data processing algorithms and Artificial Intelligence systems anonymize and aestheticize human conflicts. The piece consists of a fly-through journey through 3D reconstructed ruins of cities that suffered heavy warfare accompanied by haunting music morphing electronic rhythms into evocative sonic textures. At times, the piece is subtitled with extracts from Bertolt Brecht's theatre plays *Mother Courage and Her Children* (1938) [7] and *The Exception and the Rule* (1930) [8].

Poetics of Otherness is composed as a counterpoint between 3D reconstructed real-life news footage, video game visual aesthetic, drone imagery, techno music rhythms, narrative soundscape, and pre-WWII epic theater. This multimedia collage intends to create a time of reflection on our aesthetic perception of war and suffering in an era of overwhelming instantaneity, hypermediatization, war video games, and data analysis.



Figure 2. *Fragments: Poetics of Otherness*

Stabat Mater

Fragment: Stabat Mater (Figure 3) is a 5 minute fly-through in a cityscape populated by human shadows walking to the sound of an interpretation of Antonio Vivaldi's *Stabat Mater* (1727) for a voice and electronic drones. The short piece meshes baroque music and Indonesian shadow theater influences with noise drones and video game cinematic aesthetics to express the feelings of uniformity and anonymity of modern metropolis.

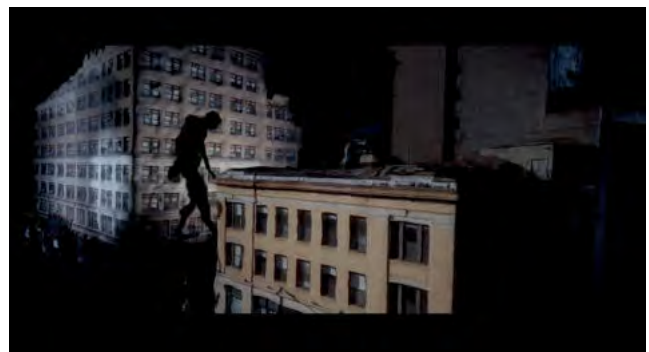


Figure 3. *Fragments: Stabat Mater*

The Shape of Things

Fragments: The Shape of Things (Figure 4) is a 15-minute travel through abandoned corridors, factory halls, train tunnels, and malls to an increasingly dance-y electronic music before vanishing into an abstract space of point clouds and minimalist drones. In a continuous motion, the piece stages the dissolution of realistic 3D spaces into disappearing topographic meshes while emerging point clouds slowly reveal the hidden structures that traverse the virtual spaces. The piece eventually culminates in a suspended moment of contemplation where large structures of point clouds and sustained drones are subtitled with the poetry of T.S. Eliot's *The Hollow Men* (1925) [9].



Figure 4. *Fragments: The Shape of Things*

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Authors Biographies

ALMA (Alexandre Saunier & Marc-André Cossette) mixes together cutting-edge AI & A-Life algorithms with drum machines, analog and virtual synthesizers, photogrammetry, procedural graphics, and video-game engines to invoke memories of inaccessible places, the sensations of the material world, and the feeling of being together.

Alexandre Saunier is a interdisciplinary artist and PhD Candidate at Concordia University. His research addresses the intersection between artistic creation with light, autonomous systems, and sensory perception. His artistic work is regularly presented in international festival such as Mutek, Bcn_Llum, Impakt, and Festival de la Imagen.

Marc-André Cossette is a transdisciplinary artist and PhD Candidate at Concordia University working on the relation between technology and performing arts using sound, visual, interaction design and Artificial. His work has been presented both in Canada and internationally, notably at Tangente Danse (Canada), Ars Electronica Festival (Austria), El Matadero (Spain) and CMMAS (Mexico).

Syndemic Sublime: Rematerializing the Expanded Biotechnological Apparatus in the Age of Remote Intimacy and Immediate Precarity

Laura Splan / Brooklyn, NY US / www.laurasplan.com

Keywords

interspecies, entanglement, embodiment, remote sensing, biotechnology, biology, data, networks, bioart, sciart

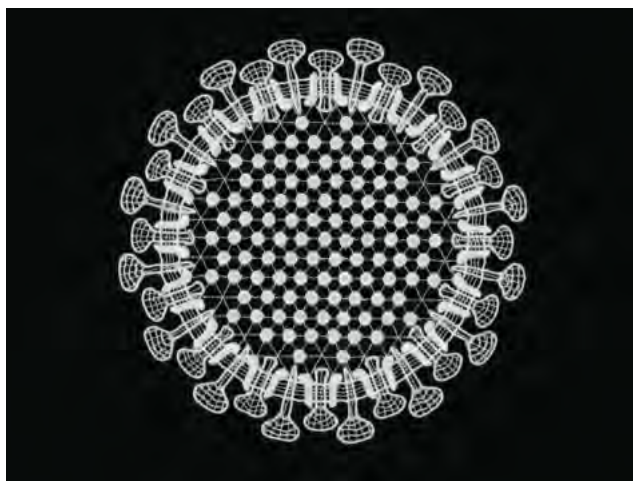
Author Biography

Laura Splan's biomedical themed artworks have been commissioned by The Centers for Disease Control Foundation. Her projects combining digital fabrication and textiles have been exhibited at the Museum of Arts & Design and Beall Center for Art + Technology and are represented in the collection of the Thoma Art Foundation. Articles including her work have appeared in *The New York Times*, *Discover*, and *Frieze*. Splan has received research funding from The Jerome Foundation and her residencies have been supported by The Institute for Electronic Arts, and Harvestworks. She has been a visiting lecturer at Stanford University. Her recent research as a member of the New Museum's NEW INC Creative Science incubator included collaborations with biotech laboratories to interrogate interspecies entanglements in the contemporary biomedical landscape. Her lace viruses created in 2004 were exhibited in the 2021 Triennale Brugge in a former medieval hospital that once served plague victims.

Abstract

In my research-driven studio practice, I connect hidden artifacts of biotechnology to everyday lives through embodied interactions and sensory engagement. My conceptually based work combines a wide range of media including experimental materials, digital media, and craft processes. Recent projects explore the interconnectedness of cultural and biological systems during the pandemic with data-driven animations created with molecular visualization software and coronavirus models. Immersive video installations and soundscapes evoke liminal states of perception and interspecies entanglements in an expanded biotechnological landscape. A series of data-driven networked sculptures and Zoom performances with scientists examines invisible systems, hidden artifacts, and poetic materialities of biotechnology. Tactile sculptures created from the fiber of laboratory animals who produce antibodies for human vaccines engage viewers with the invisible labor of pharmaceutical production. The textile material is also brought into the laboratory in a series of experiments to add color to the fiber using genetically modified bacteria.

I often leverage the material artifacts of biotechnology to reveal poetic subjectivities of the seemingly mundane. I attempt to destabilize and reframe our relationship with the everyday—and even redefine what the everyday means. I created a lace SARS doily in response to the first 2003 SARS outbreak as part of a body of work grounded in the intricacy of textiles and its associations with the familiarity



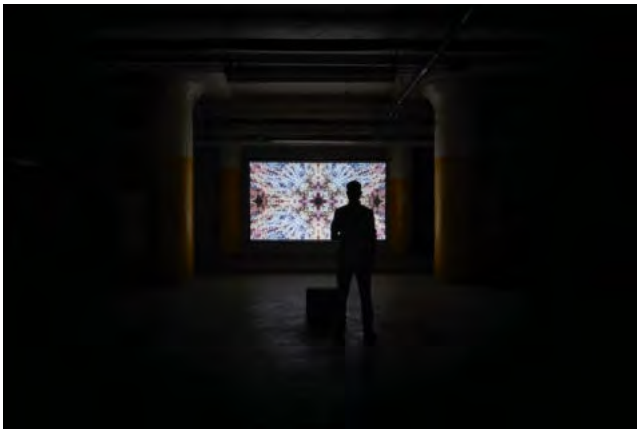
and comforts of domesticity. But in the speculative narrative of a lace virus, collective traumas borne from disease, from epidemic, from pandemic are rematerialized in an heirloom artifact to be passed on from one generation to the next. I often try to compel an intimate engagement with detail calling into question how things are made and what they are made of. And I use processes and tools that challenge notions of what is made "by hand" and what is made by "machine", what is "natural" and what is "constructed", and what is "science" and what is "culture".

This work has led me deeper into the layers of scientific representation and the ways that biological forms are translated and abstracted with technology. In 2018, I was invited to be a bioartist in residence at the Science Center in Philadelphia. During my residency, I had the opportunity to shadow scientists as well as learn software used for antibody research. With a sensibility informed by textiles, I began to unravel antibody protein structures using a feature in the software called "sculpting". In response, the software-rendered uncanny disturbances in the form of sometimes spastic and sometimes sublime movements which I began to incorporate into a series of animations.

While sheltering in place for the pandemic in 2020, I collaborated with scientists remotely to create new molecular animations and soundscapes based on the coronavirus. I often repurpose tools and techniques of



science to engage with them both creatively and critically while searching for new possibilities. And I choreograph poetic confrontations with science inside the gallery to foster deeper engagement with science outside the gallery while framing complex biomedical issues with provocations of curiosity and wonder.



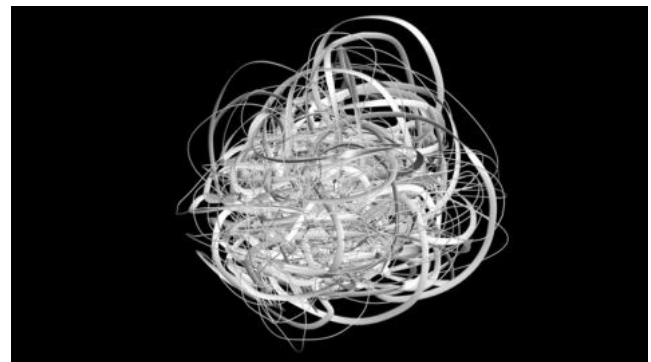
Unraveling is a series of animations that present mesmerizing meditations on invisible entanglements between natural and constructed worlds. The digital animations are created using molecular visualization software and SARS-CoV-2 spike protein models. They include playful manipulations of folded protein forms, known as “conformations”, which determine biological function including infectivity. Using specialized features of molecular visualization software in unconventional ways, the coronavirus spike protein is transformed by unraveling and morphing the folded and unfolded forms. The colors are chosen from the software’s palette for their references to nature such as plants, animals, and chemical elements. The video titles in the series echo the colors’ names that are evocative of idyllic representations of the natural world such as blue skies, green forests, ripe fruit and romantic flowers. The mere act of adding color is another layer of translation and fabrication since most viruses are smaller than visible wavelengths and therefore have no color. The color palette

and its naming conventions reveal additional layers of abstraction built into the interfaces of the technologies we use to engage with and manipulate the natural world.

The animations were exhibited at BioBAT Art Space at the Brooklyn Army Terminal along with an immersive soundscape inspired by the genetic sequence of the coronavirus. I invited scientists and lab technicians to play the SARS-CoV-2 nucleotide sequence on guitar in recorded zoom meetings. The recordings, entitled *Termination Sequences*, were made by simply prompting participants to play “A” on guitar 33 times, the number of adenine nucleotides at the end of the mRNA sequence.



Syndemic Sublime is a series of data-driven computer-generated animations created using molecular visualization software, python programming, and COVID-19 data reported by The Centers for Disease Control. The animations intertwine molecular models of SARS-CoV-2 with both human and non-human protein structures such as antibodies and cell receptors. The generative movement is created using data from COVID deaths in the U.S. over the first twenty months of the pandemic to disrupt the twenty amino acid residues along the protein structures. The resulting disruptions create mesmerizing tableaux. Each animation has a unique starting and ending form as it slowly morphs from its biological folded form or “conformation” to its technologically distorted form. The generative quality



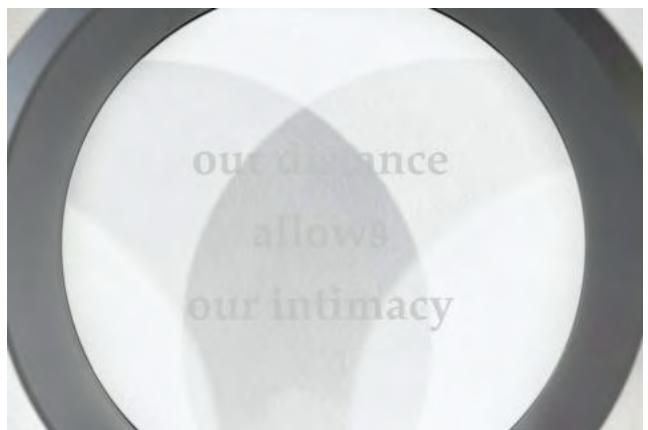
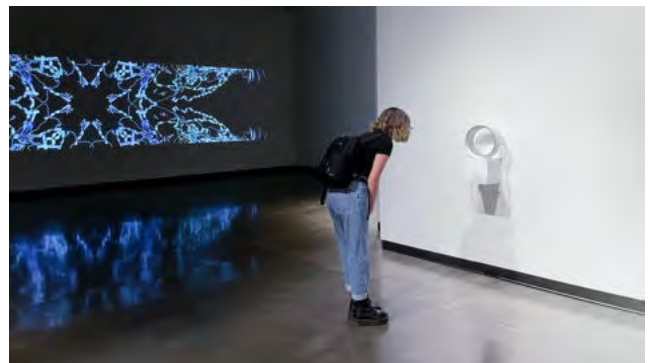
of the process allows for unpredictable and unique transformations within each animation as the software creates unexpected visuals. The unraveling and collision of the proteins results in both jarring glitches and in soothing movements. The animations combine models of proteins from the coronavirus with proteins from llamas, alpacas, cats, dogs, pangolins, bats, and humans evoking our increasing interspecies entanglements in the contemporary biotechnological landscape. From zoonotic diseases to transgenic vaccine development, our understanding of what it means to be “human” in the “natural world” is becoming increasingly complex.

During my 2018 bioart residency, I was also struck by the lab’s use of non-human species for the production of antibodies. My conversations with the scientists led to receiving over 200 pounds of wool from laboratory llamas who produce antibodies for human drugs including vaccines. Since then, I have been spinning their wool into yarn. I situate sculptures made with the yarn among other artworks that examine the hidden systems and invisible labor of biotechnology. This work questions notions of the presence and absence of bodies evoking the mutability of categories that delineate their status.



While processing the wool, I would often find clumps of feces which I began to collect for a series of networked laboratory mixers. The devices in *Contested Territories* agitate when Twitter hashtags associated with the culturally contested status of Science are tweeted. When taking office, the Trump administration advised how to improve the chances of receiving research funding with the suggestion to avoid phrases like “diversity”, transgender” and “science-based”. The mere mention of hashtag “vaccination” agitates tubes filled with laboratory llama feces. In *Remote Entanglements*, faint text on a wall invites viewers to come close to read “our distance allows our intimacy”. The sculpture blows a breeze in the viewer's face as they read the text. The speed of the networked fan intermittently adjusts

based on the wind conditions near a farm in rural Pennsylvania. This farm is actually the 600-acre biological laboratory that gave me the wool from the shearing of their llamas.



Before the pandemic, I was experimenting with dyeing the hand-spun llama yarn using genetically manipulated bacteria. I’m continuing to collaborate with scientists and laboratories to continue these experiments for new work that engages audiences in sublime complexity and contested territories of the contemporary biotechnological landscape.



ISEA2022 Artist talk / lecture performance

The Reflection of the Man

Or how to get closer to our nonhuman companions

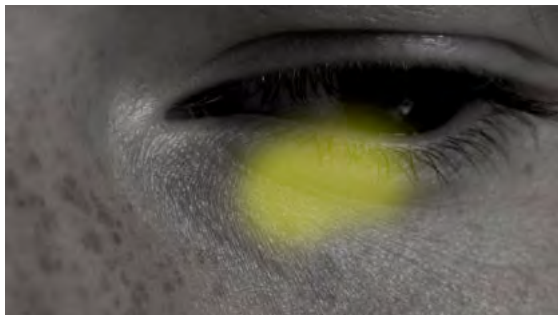
Martine Stig

Abstract

What does it mean to be human in a more-than-human world? How do we relate to our digital representations and can facial recognition technology contribute to a new digital sensibility in a truly shared space? Now organic entities no longer have a monopoly on seeing, we can ask ourselves: does the graphical language of machine vision enable communication between the human and the more-than-human?

Keywords

Machine vision, biometry, image, inclusivity, more-than-human, identity, perception, algorithms.



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Introduction

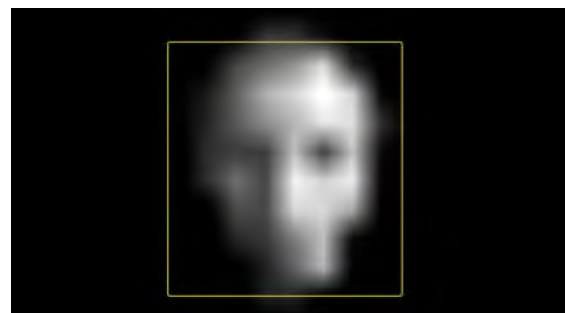
Within Western scientific discourse, technology has traditionally been perceived and used as an instrument for reaching human goals; technology belongs to the realm of resources and can be regarded as an expression of human intelligence. However, this deterministic and instrumental view causes fear and culture pessimism. Technology would alienate people from themselves and from the world around them.

The contemporary view on the human-technology relationship can be described as one of mediation. Technology is not neutral or alienating, it mediates between people and the world. We interact with machines or even incorporate them, still *we* set the goals and use technology to realize *our* goals. The machines themselves do not play an

active role, unless a subject-object reversal occurs, a sci-fi scenario feared by cultural pessimists.

The Western concept of a unified, autonomous and conscious (human) self, that has emerged from the reflection of the (technological) other, is shifting. Is it still possible to separate, or even distinguish, human and technology? Or is man, as the German philosopher and sociologist Plessner states, a 'naturally artificial' being?

The human-technology entanglement changes what it means to be human. Our eccentric position -living from our center of experience and being spectator of ourself- is enhanced by the use of technology. Whether our experiences are intensified by technology is a matter of debate, but the way and frequency with which we look at ourselves is certainly intensified. With selfies and socials, medical apps and biometry, a multi-perspective self-image is being constructed. Inviting man and machines to contribute to this image, a meta- or hyper-eccentricity is being created.



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How are the seer, the seen and the act of seeing entangled now organic entities no longer have a monopoly on seeing? Does it change the way we depict, portray, recognise? Is 'seeing' a mutual act and can we see beyond the human spectrum? Can we perceive the world in a reciprocal way, recognising the agency of the more-than-human?

New technological developments call for a new understanding of inclusiveness. To share a space with all that exists, going beyond dichotomies such as me/ other, culture/ nature, human/ non-human, real/ virtual and subject/ object, requires a shared (visual?) language and extends beyond physical space. An investigation into our non-human companions and the possibilities of such a (virtual) space is a first step.



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In my practice I try to get closer to our non-human companions. I employ consumer apps and machine vision in order to create a hyper-eccentric self-image. I subject algorithms to a Rorschach test to find out their personality structure. Using biometry,

I create a shared virtual space to experience fluidity and intimacy with *all others*.

In my artist talk I focus on the changing concept of seeing, depicting and the (human) self-image in a more-than-human world. I will elaborate on the thinking and making process of *The Reflection of the Man*, a film-essay about being human in a hybrid world, and demonstrate wealgo.org, a shared space for biometric avatars. I will talk about the collaborations and team that co-created the projects.

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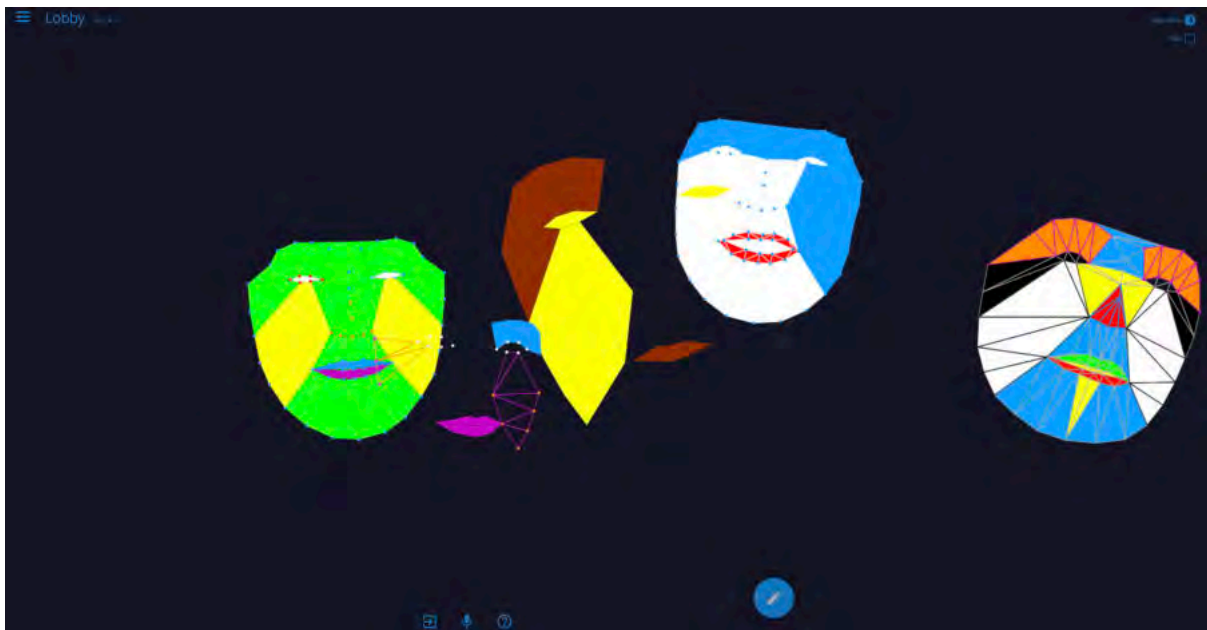
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<https://wealgo.org/>



© Martine Stig/WeAlgo, WeAlgo, 2020, screenshot

Discovering Urban Pasts:

Activating Archival Material with Site-Specific Urban Media Installation

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Abstract

Digital media is increasingly being used to create affective, embodied, and/or meditative experiences in the urban landscape that are not primarily commercial in nature. This project seeks to apply this approach to site-specific historical narrative by working with culture bearers and community stakeholders to celebrate the histories of local communities. Currently focused on the Tremé neighborhood of New Orleans, LA, this project hopes to highlight the significant cultural and political contributions of the oldest historically Black neighborhood in the United States.

By working directly with community stakeholders in the curation and development of media experiences, this project also intends to outline a model for centering the voices and narratives of underrepresented groups in urban environments. This talk considers the successes and challenges of the installations created to date – covering both the technical and the social components of the project.

Finally, under the umbrella of locative media, these works are part of a larger research project seeking ways in which digital technologies can allow users to experientially discover place-based histories. Therefore, this artist talk also looks to the future in a discussion of intended plans for both these media installations and an augmented reality application.

Keywords

Urban Media, Interactive Media, Projection, Archives, Museography, History, Tremé, Community, Community Media, Cultural history

Discovering Urban Pasts

Introduction

While much research in the growing field of ubiquitous computing focuses on how digital information technologies can be used to create embodied and affective user experiences, [1, 2] this project focuses on how locative and site-specific media have the potential to enrich the urban landscape by embedding historic and culturally relevant multimedia experiences in situ. [3]

The increasing popularity of GIS (Geographic Information System) mapping applications like MapMyStory (<http://www.mapmystory.xyz/>) suggest that locative media is the next logical step in community or place-based

storytelling [4, 5]. However, GIS mapping or marker-based Augmented Reality (AR), do not provide the kind of seamless engagement or immersive experience that are possible with interactive site-specific installation and emerging geolocation technologies.

New Orleans, Louisiana, USA is a city that is rich in multicultural history and therefore, an ideal subject for this research. Thus, I am working with cultural institutions in the city to invent digital solutions that augment the urban landscape with culturally relevant historic material (video, image, sound, 3D objects, and text). These are currently taking the form of interactive media projections onto the facades of historic structures.

While this type of projection is not new in urban media [6], the novelty of this project is in the combination of site-specific archival material with immersive interactive media experiences – using future technologies to bring the past of a site into its present. By applying techniques of urban informatics and interaction design we can discover novel modes of presenting information and material that would otherwise only be accessible to residents through archives or museums.

Locative and Site-Specific Media: Project Aims

These objectives are being met through the completion of two distinct investigations. First, I am creating a series of interactive urban installations in collaboration with archives, museums, and community centers/initiatives. It is this first investigation that this talk primarily engages. The second component of the project, however, will be the production of a location-based AR application using material from those same archives and institutions. Through this process, I hope to eventually create a platform that will allow institutions to author their own similar locative experiences.

Case Study: LaBranche Pharmacy

The Tremé neighborhood is of particular interest as it is the oldest historically Black community in the United States; its formation precedes the US Civil War. As such the neighborhood contains many examples of the contributions of Black citizens as well as the ways systemic racism has (and continues to) effect(ed) Black communities and other

communities of color. For instance, one planned media installation recreates a lost mural from the 1970s entitled, “The Destruction of Tremé.” This mural portrays the demolition of many of the oldest blocks of Tremé and the forced removal of their inhabitants to create a ‘cultural compound’ in the oldest part of the city; this compound is now Louis Armstrong Park. It is of note that the design and construction of the park intentionally restricts Tremé residents’ access. Instead, the primary (and often only open) entrance to the park faces the touristic French Quarter.

The installation discussed in this text explores the history of the Black-owned and operated family business, LaBranche pharmacy and how it (along with the neighborhood) succumbed to the construction of the I-10 interstate through the neighborhood. LaBranche pharmacy was opened in 1907 and prospered until its closure in 1970, almost immediately after the construction of the interstate along the previously tree-lined Claiborne Avenue was completed. Opened by Emile LaBranche Sr., LaBranche was not simply a pharmacy, but a community hub -- a place where people congregated to share community information over a soda, ice cream, or sandwich or even to leave their children while they went shopping along the avenue. Emile LaBranche Sr. (and Junior) were also active community leaders. They were members of several social organizations and served on the boards of local Black universities.

Community Stakeholders

My initial engagement with LaBranche pharmacy was through the Claiborne Avenue History Project (CAHP) -- one of many organizations attempting to draw attention to the history of the Claiborne corridor; the systemic racism that has affected it, and the potential social and economic development that might revive and reinvigorate it. CAHP specifically is a documentary project that has for several years been collecting historic material about various locations of community and historic interest along the avenue. The sites researched by the organization range from sites that acted (or still act) as community hubs to sites of national or international cultural and political importance.

CAHP has worked with me to identify sites relevant to my own site-specific media project and has provided initial information and source documents for the creation of the media experiences. In the case of the LaBranche pharmacy, CAHP was able to provide imagery and data regarding the family and the pharmacy as well as to introduce me to the surviving LaBranche family members. In addition, CAHP helped me to work with the New Orleans Pharmacy Museum -- which also holds material and ephemera related to LaBranche. Ultimately, I was able to collect rich interview audio and high-resolution images of the pharmacy and the surrounding area for inclusion in the interactive projection.

Centering community voices Working with an organization like CAHP is particularly important to projects like this one. Some members of the Tremé community --

accustomed to being exploited by outside artists and researchers -- are hesitant to talk with or work with unknown entities. However, by working with CAHP, I am not only able to assuage their concerns, I am also able to ensure that my activity is adding value to a larger community initiatives.

This consideration is imperative to the process of ‘centering community voices or needs. As an outside researcher, it is vitally important to ensure work is not being created in a vacuum -- alienated from community input. Instead, one should always consider:

- What value does my project bring to this community or organization in the short and long terms?
- Is this something that the community/organizations values?

Working with existing organizations and projects in the community at various stages of the project, one is doing their due diligence to ensure that both these questions are being answered positively.

Installation/Observation

Using the material collected, I created a media projection that allows users to interactively explore the history of the LaBranche family, the pharmacy building, and the street in a both informative and poetic manner. This interactive experience was projected onto the side of the LaBranche building from sunset to about 8:30pm for two weekend nights in February.

The interactive system was created using Open Frameworks. Archival images are animated with a zoom effect and paired with interview audio that relates to the pictured area. Using a standard game controller, users can move through images such that the controls mimic moving through the actual space. For instance, to move forward to a new area in the pharmacy users press the FWD (or UP) arrow. Scanning the room (moving laterally through the images) occurs by moving the LEFT and RIGHT arrows. Some areas are ‘dead ends’ and attempting to leave them by the improper means results in being shuttled out of the pharmacy to a progressive animation of the construction of the bridge. This animation, created from an archival image of the bridge’s construction as of 1968 depicts segments of the bridge encroaching on the LaBranche location. Once the bridge has ‘arrived,’ the credits are displayed and the interactive experience resets.

Challenges Initially, gesture-based interaction was envisioned for these installations. However, there were many inconsistencies in the currently available libraries and interfaces for gesture-based interaction. Moreover, it was determined more of a priority to rapidly create a working prototype (proof of concept) for community stakeholders to experience. Therefore, the gesture-based system was temporarily set aside, and the game controller was introduced as an alternative.

Secondly, as the project is not primarily aimed at educating or entertaining individuals outside of the community,

invitations were not created for the projection events. Instead, while CAHP did post on their social media about the pop-up, I hoped organic foot traffic would provide the bulk of the engagement. Unfortunately, there was significantly less foot traffic in the installation area than I had expected on a weekend evening during Carnival. While the events were scheduled during a high-traffic season, the bars/nightlife are located a few blocks down Claiborne Ave – too far to create the hoped-for foot traffic. In total there were only three individuals that engaged the project who were not previously aware of it.

Finally, as noted by residents of the area, the background noise of traffic on the interstate is overwhelming. For interview voices to be audible, the gain had to be increased beyond what was ideal for the quality of the original audio recording.

Observation Method and Outcomes

Approximately twenty individuals engaged with the installation over two evenings. Many of the participants were LaBranche family members or CAHP researchers who were aware of the event. Though, other individuals that had heard about the event via social media or word-of-mouth did come out to view and participate. As such there was sufficient engagement to make preliminary conclusions regarding the user interface, effectiveness of the project/media, and necessary adjustments for future iterations.

Interaction outcomes It was observed that children were more comfortable with and/or interested in the controller-based interface than adults. This included children who were not regularly allowed to play video games as well as children who were very familiar with game controllers as an interface. In contrast, older participants were more inclined to physically move toward the projection and were drawn to interact with the images directly on the wall. Similarly, the pedestrians that did walk by or into the projection, as well as some visitors, tended to overlook the potential for interaction and to avoid what would be the interaction area. Finally, the controller does not allow multiple users to collaboratively control the media – an initial goal of the media installation.

Based on the above observations, I've determined that the controller is not a suitable substitute for the initially planned gesture-based interaction. Future iterations will use machine-learning based image recognition techniques (such as Google's MediaPipe) to recognize human skeletons and allows for gesture-based control. In addition to catering to a wider age range of participants, gesture-based controls could also create 'passive' or 'unintentional'

control scenarios – situations in which a person passing through the interaction space causes a change in the projection. This function would not only provide an interesting twist to the experience of controlling the media, it could also draw in passers-by to engage with the work further.

Community engagement outcomes Community members not directly related to the project did come out to see the work, even if they did not engage with it directly in all cases. In addition, community members like the owner of the business currently using the building were supportive of the project, its goals, and my installation team. Finally, the LaBranche family as well as CAHP were excited about the project, thankful for the engagement, and interested in collaborating and building on the project further.

Therefore, I believe this was a successful first iteration. However, alternative interaction techniques (gesture-based) will make the work more compelling and immersive and will likely draw in more external participation. Additionally, future iterations will not rely primarily on foot traffic for engagement. While in some areas that could be viable, I should check the foot traffic on any given block before determining a specific installation will rely solely on foot traffic for engagement.

Conclusions

By placing interactive media highlighting history back in the locations that spawned it, we can educate current residents as well as re-assert a community's rich cultural identity. This is of particular importance as contemporary gentrification threatens to visually erase this history. For instance, the Brice mural was painted over when the building was turned into an upscale bed and breakfast while the LaBranche building – which was about to be razed -- was saved by a local community organization, but there was no mention of the building's past importance to the neighborhood. This project is a first step in a series of explorations that seek to push back against the erasure of the contributions of communities of color throughout (particularly US) cities.

Acknowledgements

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Author(s) Biography(ies)

Minka Stoyanova is an artist, technologist, and theorist. She completed her Masters of Fine Art (MFA) at the Glasgow School of Art, her PhD (Creative Media) at the School of Creative Media, City University of Hong Kong, and is an alumna of the Fulbright Research Scholar program in Bulgaria. Her artistic and academic research is focused on cyborg-based approaches to contemporary art and culture, and results in works that investigate the real and speculative effects of technology in society. She has presented artwork and published papers in a variety of national and international venues including Xi’an Museum of Contemporary Art (China), Clockenflap Music Festival (Hong Kong), the International Symposium of Electronic Art (Hong Kong), Transmediale (Berlin), Videoholica (Bulgaria), and FutureEverything (Manchester). As a 2020 Computing Innovation Fellow, Minka’s current, postdoctoral, research explores the possibilities of Augmented Reality in outdoor urban spaces.

Reece Auguiste is Associate Professor of Critical Media Practices at the University of Colorado, Boulder and is a documentary scholar/artist with a research focus on national and transnational screen cultures, and documentary media arts practices. Auguiste was a founding member of the London based critically acclaimed Black Audio Film Collective. He wrote and directed the films *Twilight City*, *Mysteries of July*, *Duty of the Hour* and *Stillness Spirit*.

He has published in *AfterImage: Journal of Film and Media*, *Journal of Media Practice and Education*, *The British Avant-Garde Film 1926-1995*, *Questions of Third Cinema*, and *The Ghosts of Songs: The Film Art of the Black Audio Film Collective*. He is the recipient of the *Grand Prize* at Melbourne International Film Festival, *Josef Von Sternberg Award* at the Mannheim International Film Festival, and *International Documentary Association Award*. He has exhibited at Tate Modern, Serpentine Gallery, and National Gallery of Art.

Forensic Love and Visceral Data: Bio-Antidote for Romantic Love

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Abstract

Forensic Love and Visceral Data is a work-in-progress, an art project that proposes the urgent creation of a bio-antidote, a biomaterial, performative-ritualistic-scientific-medical, to cure (us) of romantic love and eradicate this chronic pandemic. A disease, a linguistic virus, the malware that constitutes one of the basic pillars of patriarchy, diluted in songs, sayings, and compliments. The raw material of the bio-antidote(s) will be our visceral data, which is obtained from the contrast and verification of romantic love sayings with some medical analysis techniques hacked into their significance and interaction (dose/spell indication) with the participant-patient. The bio-antidote is created from the data and matter of the "sick" organ that is the one that has received and assimilated the curse of romantic love.

Keywords

Body Politics, DIY-DIT-DIWO Epigenetics, Bio-Antidote, Gender Technologies, Decolonizing science, Microphysics of power, Biomaterials.

Background

Forensic Love and Visceral Data was born with an air of predestination a couple of weeks before the COVID-19 pandemic started. Thus, we met our first virus of the year, without even imagining what would come immediately afterwards.

We, Cecilia Vilca from Media Art and Lorena Lo Peña, from Performance Art, work together transdisciplinary join forces to work at the intersection of art, technology, and science. We research transversally in Gender technologies, Body politics, Aesthetic Colonization and Microphysics of Power. This involves us as artists but also as social individuals that do not escape their environment. Our methodology has two aspects: the artistic practice and its reflection, which is completed with the retro feed of the audience/participant without which it would have no meaning. A true co-creation on the border of disciplines where each one nurtures the practice of the other.

When the health emergency was declared, we found ourselves in a paradoxically contradictory situation, on the one hand we were unable to access the medical facilities: laboratories and hospitals, necessary to develop our pro-

ject. On the other hand, suddenly, we were immersed in precisely what we had decided to research and combat: the scenario of a pandemic with a lethal virus. What were the chances in a lifetime that this would happen? This is how our projects are, they are born from our personal crusades and therefore they are made of the matter of cyclones and dreams. They are micropolitical flesh.

Hypothesis

"A labyrinth of blue cells and acids / A tower of words that never reaches heaven." (EIELSON, 1964)

We start from the hypothesis that romantic love is a disease. It is the beginning of all violence that is inflicted on our body-booty. Diluted in songs, sayings and compliments is "gently" inoculated in us. A linguistic virus, the malware that constitutes one of the basic pillars of patriarchy, as a social technology. (Figure 1)



Figure 1. Emblem image of the project. Animated GIF made with internet royalty-free historical medical images. ©Lorena Lo Peña and Cecilia Vilca.

Proposal

Based on our hypothesis, we propose the urgent creation of a biomaterial, performative - ritualistic - scientific - medical, an antidote to cure (us) of romantic love and stop, eradicate this chronic pandemic.

The raw material of the bio-antidote (s) will be our visceral data, which is obtained from the contrast and verification of these romantic love sayings with some medical analysis techniques (imaging tests, biochemical analysis, pathological studies, chromatography research, neurological exams, etc.) hacked into their significance and interaction (dose/spell indication) with the participant-patient. Therefore, in this project, biomaterial meaning comes from bio fabrication but especially from medicine: a material that the organism can tolerate and that is often made up of parts of the recipient human body itself. In this case ours.

Fundamentals

Since romantic love is a virus, medical protocols will be followed to identify and treat the disease: Diagnosis, Creation of antidote and finally Dosing, dividing the project into three stages. Our preliminary diagnosis is that the language being a virus enters the body from an initial point to expand and affect the different organs.

On the other hand, the power granted to these phrases makes them sentences, often of death. Each saying acts on a specific organ, curses it. The bio-antidote is created from data and matter of the "sick" organ that is the one that has received and assimilated the curse of romantic love.

The project begins by analyzing these popular sayings, the internal programming of romantic love and its physical effect on our emotional body. Phrases that not only refer to an "interior" and organs, but also use mostly physical terms (death, killing) and even medical (breathing, palpitations). These are the symptoms of the disease called "love", but they are not just ours, they are the choral symptoms of our sick society. As in every diagnostic start what we do is listening.

Sequence of propagation

This group of "symptoms" (sayings) will establish the possible sequence of spread and severity levels of the disease, as well as the possible medical techniques to collect and analyze the visceral data to create the bio-antidote and its dosage in specific spells to combat each "saying-curse". Some of these techniques will be less invasive (imaging tests and analysis) than others (tissue and cell extraction) and will mix scientific-medical and ritualistic protocols. Making fiction with Western medicine, creating a body performative narrative.

We propose these medical techniques as a starting point. These are those that could combat phrases-curse we selected previously. From this set, some will be discarded along the development of the project.



Figure 2. Animated GIF of endoscopic wireless camera self-explorations and our medical history images. Collage ©Lorena Lo Peña and Cecilia Vilca. Royalty-free images.

Contagion/Inoculation

Phrase: "Love enters through the eyes." Medical techniques proposed: Optical Coherence Tomography-OCT, Schirmer Test, Corneal Topography. (Figure 2)

First symptoms

Phrase: "I feel butterflies in my stomach." Medical techniques proposed: Abdominal Ultrasound, Gastrointestinal Endoscopy, Stool Culture

Initial stage

Phrase: "You accelerate my pulse and take my breath away." Medical techniques proposed: Pulse Wave Analysis-PWA and Echocardiogram.

Febrile stage

Phrase: "There is chemistry between us." Medical techniques proposed: SMAC Study 24, Saliva Test, Mineral Hair Analysis-HTMA, Skin puncture and scrape tests.

Phrase: "We are made for each other." Medical techniques proposed: Histocompatibility Antigen Test, DNA test, Biopsy.

Critical / Peak Stage

Phrase: "You broke my heart." Medical techniques proposed: Complete Blood Count, Cardiac Computed Tomography Scan.

Possibility of recurrence

Phrase: "I don't know if I will be able to forget your scent." Medical techniques proposed: Liquid Chromatography-HPLC, Brain Ultrasound, Electroencephalography.

Final stage

Phrase: "I can't live without you." Medical techniques proposed: Respiratory Rate Analysis, Heart Rate Measurement, Magnetic Resonance Imaging-MRI.

Declaration of War

Then, analyzing our social fabric, we respond, returning to it, not only the possibility of a cure with a bio-antidote but also its dosage as indications-spells, created from the same sayings that will be re-evaluated through social networks. This performatic dimension of the project allows us to hack our body-minds and at the same time decolonize the western medical tradition. Because what assumptions are behind these traditional myths about love? What medical-historical references endorse these sayings-curses?

We contaminate each other the methodologies of science and belief to give a ritualistic dimension to a heteronormative white western medical apparatus. We light the candle to all the saints, we call all the specialists, we dance to all the gods. A DIY/DIWO/DIT epigenetics. We are the modest inoculated witnesses of Donna Haraway and at the same time we enchant everything as Paul Preciado reflects.

We the zero patients, Lorena, and Cecilia, offer our visceral data in-love: blood, feces, sweat, tears. What will be the selected components? (Figure 3) We do not know but as a starting point we have a corpse, a metaphorical body full of other deaths and hopes. Ready to be read. A Forensic Love.

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Peruvian transartist, chola feminist techno-witch, language activist. Digital Arts Master's Degree, Universitat Pompeu Fabra, Barcelona, Spain. Founding member of the Art/science and digital heritage division, MyAP - Microscopía Electrónica y Aplicaciones en el Perú. Her artistic work is made with technology in concept and realization exploring its relationship with gender, society, and nature. From a decolonizing vision, it develops in the borders of art and science, connecting ancient technologies with the new ones. Her main goal and poetic are to encourage reflec-

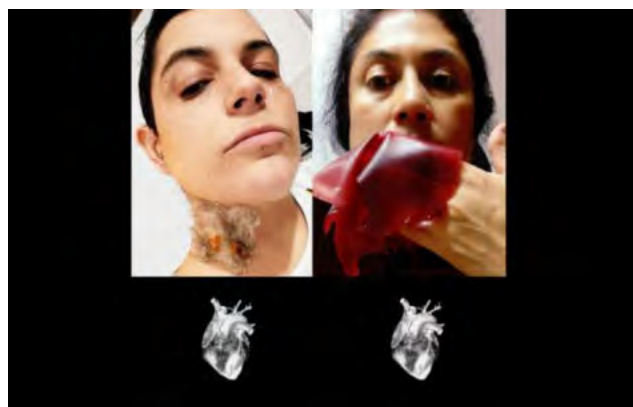


Figure 3. The zero patients and their biomaterial explorations. ©Lorena Lo Peña and Cecilia Vilca, animated GIF from internet royalty-free medical images.

For more documentation material about the project: <http://www.ceciliavilca.com/forensic/>

tion through revelation using technology. Seven Art Residency Programs: Mexico, Bolivia, USA, and Brazil. Independent International Program Committee of ISEA2020 Member. Journal of Science and Technology of the Arts Reviewer. She has exhibited her work, organized exhibitions, and given lectures in Peru, Mexico, Bolivia, Argentina, Spain, Cuba, Chile, Norway, Colombia, Brazil, South Africa, Australia, Greece, Ireland, Portugal, Austria, and the USA. Website: <https://www.ceciliavilca.com/>

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Navigating the 4D Space-Time of Climate Change: *TesserIce*

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Abstract

The perception of the four-dimensional tesseract from three-space relies on motion, lending it an inherently cinematic nature. Virtual reality is uniquely positioned to visualize four-dimensional, cinematic space. The three-dimensional, time-based space and embodied navigability of virtual reality creates a supra-dimensional media space, providing an opportunity to experience higher-dimensional landscapes and acoustic, cinematic environments from within the fourth dimension. *TesserIce* is a four-dimensional, VR mediascape that utilizes this feature, allowing participants to enter the 4D space-time of glacial ice. The mediascape constructs an embodied cine-poem examining the effects of climate change in which participants propel themselves through the space-time of Earth's polar ice. The stark imagery of ice serves as a distinct access point into the overwhelming complexity of climate change and its ramifications, creating an embodied experience of climate change's time, scale, causes, and effects.

Keywords

Cinema, Virtual Reality, Tesseract, Climate Change, Hyperspace, Fourth Dimension, Embodiment, Space-Time.

Fathoming

Each individual life plays a small role in the history of the world, like the role of a single snowflake in creating a flowing glacier. We are challenged to see beyond our immediate surroundings, envisage our effects on distant parts of the world, or grasp the scale of our collective impact.

Climate change is the defining issue of our time, yet are we capable of comprehending data representing planetary scales of matter and timeframes that progress over generations, far beyond the limits of our physical perception? The geological provides a glimpse of time as a supra-dimensional force, a four-dimensional perspective that subsumes both past and future and whose deep time view far exceeds human perception. For example, the Earth's cryosphere, the frozen poles, is a four-dimensional space-time archive of atmospheric history. Ice cores drilled from glaciers in Greenland and Antarctica provide a physical timeline 800,000 years back into the chronicle of

Earth's climate (Figure 1). Glaciers are crystal tesseracts, manifesting a hyperspace of environmental time.

TesserIce [1] is a four-dimensional, virtual reality mediascape that allows one to enter the space-time of glacial ice. It is a hyper-documentary poem within a crystal tesseract – a 4D hypercube enacting the space-time of glacial ice. *TesserIce* brings the human into the space-time of glaciers, creating an immersive, embodied experience of the time, scale, causes, and effects of climate change on ice.



Figure 1. An ice core from the National Ice Core Lab. © Clea T. Waite.

The Fourth Dimension

Reality is a hyper-volume of past and future matter extending along the limitless axis of time into a higher dimension of space beyond our sensory perception. The present moment is a continually shifting, metamorphosing, three-dimensional shadow of this hyper-solid as it passes through our space. Visible evidence of this space-time polytope is our perception of changing matter over time: rusting metals, geological strata, coral reefs, and melting icecaps.

Common experience has three directions in it: up-down, side-to-side, and forward-back. This world consists of three orthogonal dimensions laid out along the construct known as the Cartesian coordinate system (x,y,z). Visualizing four-dimensional architectures from the confines of our three-dimensional space is a question that continually challenges mathematicians and artists. Most solutions envision these structures from a distance, looking at them rather than experiencing them from within. These are shadows of shadows – the two-dimensional screen renderings of three-dimensional shadow projections of the four-dimensional object.

The three-dimensional space and navigability of virtual reality are uniquely positioned to visualize a four-

dimensional space. Thus, VR provides an opportunity to geometrically construct and experience the shifting landscape and acoustic environment of the fourth dimension.

Two strands of interpreting the fourth dimension developed at its inception at the turn of the twentieth century. One defined the fourth dimension as an additional dimension of space perpendicular to our own three (x,y,z,w), unimaginable to us yet encompassing our three-dimensional scope as the cube encompasses the square. The other defined the fourth dimension as time (x,y,z,t), imagining space and time as a continuous, four-dimensional volume of past and future spread along a linear time axis, all moments existing simultaneously. In this interpretation, the present constitutes a continually shifting moment, manifested as a three-dimensional slice of this space-time polytope passing through our lower-dimensional space.

Supra-dimensional Cinema

Three-dimensional film space – the two-dimensional image plane and the timeline dimension – is a closed system. The passage through this narrative space is strictly passive, ocular, linear, and virtual. In contrast, the four-dimensional film space is hyper-spatial, somatic, relativistic, and non-deterministic. Within 4D film space, perspective is a function of the sentient spectator's point of view. The narrative is dependent on the orientation of the participant. Linear progression is augmented by spatial simultaneity. Navigation through narrative space engages multiple vectors of physical engagement and perception, occupying a liminal space between the real and the virtual.

The notion of an object that is only perceivable in time, an object containing time within its own space, is what makes the tesseract so intriguing. Motion is essential for comprehending a four-dimensional object from three-dimensional space. As a result, the tesseract as perceived from three-space has an inherently cinematic nature.

We use the notion of the cinematic tesseract to formally explore immersive cinema in hyperspace. This supra-dimensional cinema creates a spatiotemporal flow structure that explodes the screen into an architectonic, immersive hyper-mediascape – a poly-perspectival narrative deciphered by the somatic perambulations of the beholder. The sentient spectator of immersive cinema navigates different patterns of juxtapositions and associations within a four-dimensional cinematic space. The spectator moves freely amid a multiplex geography of audio-visual facets, building interpretations and decoding the poetic cipher.

Our approach to visualizing and navigating a supra-dimensional, immersive cinema involves considering narrative as both time and space, faceted into simultaneous streams distributed in the cinematic architecture. The spectator is placed in a supra-dimensional position relative to the geometry of the film, creating alternative spatio-narrative perspectives. No hierarchy, no explicit viewing direction or pathway dominates the flow. Instead, the

narrative is composed as an open work, a “work in movement” in the sense advanced by philosopher Umberto Eco. He described the open work as “a work of art stripped of necessary and foreseeable conclusions ...” [2]. The open work is a prepared field of possibilities for the unpredictable performance of the beholder.

Supra-dimensional cinema, poetry, and montage are manifestations of the same idiom, communicating through fragmentation, juxtaposition, and association. With our supra-dimensional cinema, we aim to create an explicit connection to a poetics of space, an enfolding of embodiment and participation within the spatiotemporal experience of the cinematic.

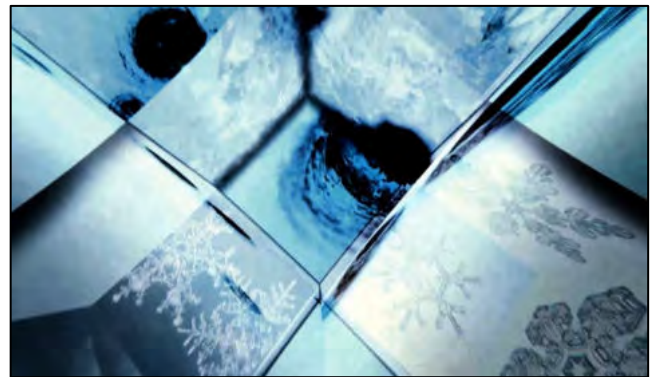


Figure 2. Stillframe from *TesserIce* (2021), a four-dimensional, VR mediascape that allows one to enter the four-dimensional space-time of glacial ice. © Clea T. Waite 2021

TesserIce: The Fourth Dimension of Climate Change

The geological provides a real-world manifestation of deep time. It demonstrates this supra-dimensional force, allowing us a glimpse into a four-dimensional perspective that subsumes both past and future and whose scope far exceeds human perception.

The *Ice-Time* [3] series of motion-picture works are a document of our unique moment in glacial space-time. This series of immersive films realizes a hyper-dimensional, cinematic space that transforms the audience's subjective perception of time. The works transpose non-human scales of time, in particular the time scales of glacial ice, to visualize the temporal reality of climate change.

TesserIce [1], the newest work in the *Ice-Time* series, is a four-dimensional, virtual reality mediascape that allows one to enter the space-time of glacial ice. It is a hyper-documentary poem constructed within a crystal tesseract, a 4D hypercube that reveals the space-time effects of climate change on the ice as an individual experience. *TesserIce* brings human perception into the supra-dimensional space-time of glaciers, creating an immersive, embodied experience of the time, scale, causes, and effects of climate change on the ice. The three-dimensional space and

navigability of VR provide an opportunity to fully experience the shifting landscape and acoustic environment of the tesseract of polar ice from within the fourth dimension.

The participant enters a crystalline tesseract architecture composed of different scales, locations, and speeds of ice filmed in the cryosphere (Figure 3). The observer's movements propel them through the hyper dimensions of this tesseract (x,y,z,w) through different cube rooms. The 4D cinema unfolds in uncharted vistas, juxtapositions, and timeframes, revealing the space-time of Earth's polar ice.

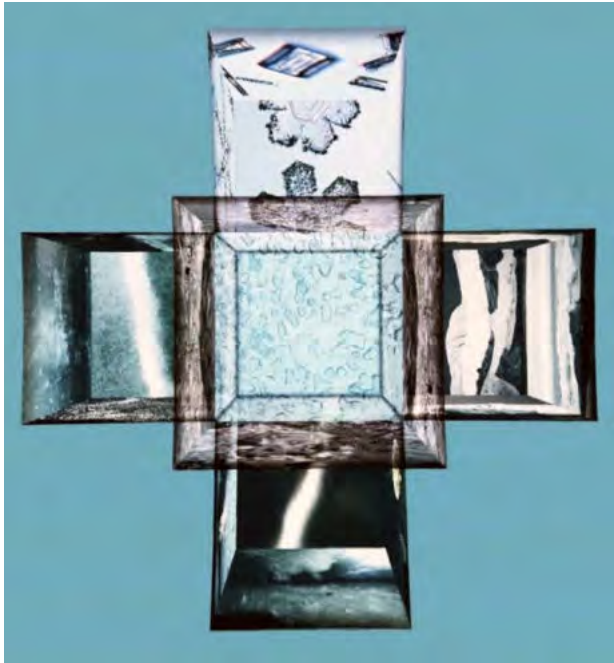


Figure 3. External VR view of *TesserIce* (2021), a crystalline, tesseract architecture. Image J.C. Kelley. © Clea T. Waite, 2021.

The images of *TesserIce* present hyper-realistic, magnified views of ice taken at all scales, from the microscopic to the planetary. Movements of ice in the film are geological, perceived as the effect of time on matter. The diegetic scales of time expand and contract. Movement often occurs at speeds beyond human perception – until the timescale of the ice is transposed to meet the perceptual timeframe of the spectator. Time then reverts, drawing the sensate viewer back into the perceptual time of ice. The body of the beholder is enfolded, collapsing its sensory distance to the ice.

In *TesserIce*, the participant is free to walk through walls and along floors, ceilings, and time within the four-dimensional space. The paths connect cubes following the true geometry of the tesseract (Figure 4). The navigation is inspired by Robert A. Heinlein's "Crooked House," [4] a four-dimensional architecture that infinitely wraps back on itself. Viewing back into the third dimension from the four-

space of the tesseract, the head and the tail of an object are coextensive. Neither inside and outside, nor top and bottom as we know them, are distinguishable. Linear perspective is fractured into crystalline, poly-perspectival facets or curved into a space of relativistic proximities.

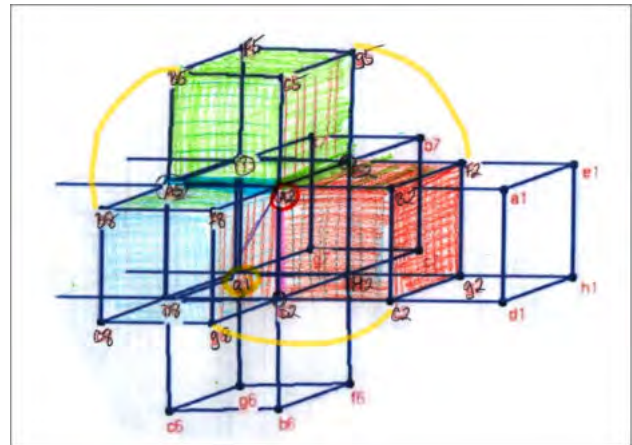


Figure 4. Tesseract navigation model for the development of *TesserIce*. © Clea T. Waite, 2021

Hyperspatial Audio

Within cinematic hyperspace, action is as pervasive as sound. In immersive cinema, immersive sound plays a critical role as a key sensory component of defining space. The acoustics of the *TesserIce* mediascape are essential to the sensory environment of the experience. We have recreated a 9.1 surround-sound mix in the Unity VR environment (Figure 5), experimenting with how this immersive soundscape "behaves" in a four-dimensional, navigable space while adding essential additional spatialized information cues to the immersive experience.

Conclusion

Reality is a hyper-volume of past and future matter extending along the limitless axis of time and beyond our sensory perception. Our present moment is a continually shifting, metamorphosing shadow of this polytope as it passes through our three-dimensional space. We are immersed in the meta-dimensions of a redefined world, full of strange data vistas that surround us in manifold, crystalline perspectives. Within this supra-dimensional reality, glaciers are crystal tesseracts, three-dimensional containers of Earth's environmental time. The three-dimensional, cinematic, and navigable space of virtual reality is uniquely positioned to visualize the four-dimensional space-time of glaciers. VR provides an opportunity to geometrically construct an embodied experience of the fourth dimension from within, to experience the shifting landscape and acoustic environment of four-dimensional space, the space-time tesseract of polar ice.

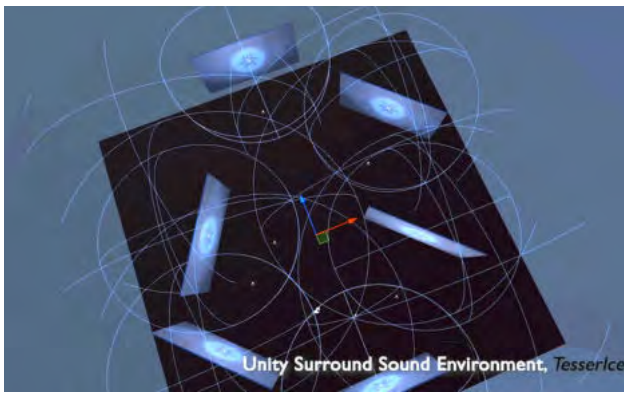


Figure 5. 9.1-surround virtual sound field in Unity for one cube in *Tesseract*. Image J.C. Kelley. © Clea T. Waite, 2021.

Humans are existentially confined to the third dimension in the physical world, never able to physically experience the fourth dimension. Still, the human mind can transcend these constraints. We can challenge these experiential limits with immersive technologies, creating interactions that defy physics, three-dimensional space, and linear time. *Tesseract* fosters a relationship between the space-time of the human and the geological. The VR experience constructs a tesseract of polar ice in time as an embodied cine-poem – a hyperspace of spatialized meaning and navigable time, enacting the meta-dimensional data vistas of climate research. The artwork examines our culture’s altering perceptions of space and time, the deep time of Earth’s environment, by using virtual reality to present polar ice as a unique, four-dimensional window onto issues of climate change.

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Author Biographies

Jared Christopher Kelley draws connections between digital simulations and their physical counterparts. Utilizing the desire, mechanisms, and far-reaching implications of achieving immortality through exponential advances in biotechnology and digital simulation, he creates works that connect, conduct, tunnel, and bridge the space between virtual and physical worlds, contemplating this restless “space between” as a psychological membrane used to transit freely between the virtual and physical. His performances and exhibitions include the Museum of Contemporary Art of Georgia, Roman Susan, and Gallery 400, and internationally in Australia and South Korea, including CICA Museum Gimpo.

Max Orozco is a designer and creative technologist exploring human-centered applications of engineering. Utilizing Computer Vision, Augmented/Virtual Reality, Deepfakes, and IoT, Orozco’s work focuses on human-computer interaction, healthcare, and creative problem-solving. Orozco’s background is in academic neuroscience where for seven years he used MRI techniques to discover new insights into the developing brain. He’s had the privilege of working with brilliant minds in science. He continues to apply the same academic rigor to the applied research of emerging technologies.

Clea T. Waite, Ph.D. is an intermedia artist, scholar, engineer, and experimental filmmaker whose artworks investigate the material poetics that emerge at the intersection of art, science, and technology. She creates immersive, cinematic works engaging embodied perception, dynamic composition, and sensual interfaces – as well as one inter-species collaboration with several hundred tropical spiders. Her themes examine climate change, astronomy, particle physics, history, feminism, and popular culture. Waite received her Ph.D. at the University of Southern California in interdisciplinary Media Arts + Practice, combining a background in physics and computer graphics from the MIT Media Lab with her current research in cinema, media art, and critical theory. She brings a unique blend of expertise to her projects from which cross-disciplinary synergies emerge.

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INSTITUTIONAL PRESENTATIONS

What is Research-based Design Practice? A Collective Inquiry through A Graduate Seminar

Niloufar Abdolmaleki, Hafsa Akter, Diana Araiza Soto, Cristina Gomez, Valentyna Hrushkevych, Justin Marsh, Fatema Mostafa, Alejandra Ruiz, Pachia Lucy Vang, Ofelia Pulido, Marcy Wacker, Iris Xie, Rova Yilmaz, Jiayi Young

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Abstract

What is Research-based Design Practice? This graduate seminar provides a framework for research-based Design, defines a structure to carry out Design practice, and offers ways of understanding, giving, and receiving critical feedback on practice-based projects. As a class, we come together to make collective contributions to answer this question through Case Study presentations. Students conduct careful research on an artist or designer's creative work that helps address this question. Presented at the conference is a collection of this inquiry to exchange with other universities and institutions who are endeavored with a similar question.

Keywords

Research-based design, practice framework, case study, collective inquiry, creative problem-solving, universities, institutions

Introduction

The UC Davis Department of Design is the only comprehensive academic design department in the University of California system. Our M.F.A. in Design is a two-year program that encourages an interdisciplinary approach through research and practice that align with social and environmental responsibilities. Our two-year program guides students to develop their research and creative practices based on key understandings of design issues in history, theory, and practice. Through a series of carefully designed core courses, students progress alongside their cohort members while simultaneously advancing their individual theses. The M.F.A. program culminates in a written thesis and a thesis project in a widely publicized exhibition.

This graduate seminar, Des 226 (Studio Practice and Critique), is one of our core courses in the MFA program. This course is designed to generate viable building blocks to prepare first-year students to formulate thesis direction and to propel second-year students to stay on track to

pursue defined thesis objectives. The class focuses on contemporary design practice in the context of theory and history. Through the exchange of a wide range of topics, students are exposed to current issues in design.

One of the key questions we are tackling in the course is none other than *What is Research-based Design Practice?* This graduate seminar provides a framework for research-based design, defines a structure to carry out Design practice, and offers ways of understanding, giving, and receiving critical feedback on practice-based projects. As a class, we come together to make collective contributions to answer this question through Case Study presentations. Students conduct careful research on an artist or designer's creative work that helps address the question of what research-based design practice is. The students then take turns to make presentations to each other and write a short paper on the subject. Each Case Study covers the following questions:

1. What is the project?
2. Who did the project?
3. When and where was the project conducted and/or exhibited?
4. Describe the project's setting. Include a photo and video documentation of the project along with associated citations.
5. What is the significance of the project situated in its discipline?
6. What is the project's significance in the context of our inquiry about what research-based design is?
7. Which aspect of the project was research-based, or which design decisions were informed by research?

For each Case Study, the students dissect, unpack, and pinpoint specific research elements that contribute to the collective definition of the framework of research-based design practice. We discuss creative solutions based on

aesthetics and craft and look at prototypes that leverage scientific methods, concepts, and findings. We talk about design's reliance on iterations as design solutions and user-based or participatory design approaches. We understand that we access a wide range of disciplines for design work, and we not only utilize existing knowledge but also generate, analyze, and evaluate data. We are ultimately interested in the possibility of generating new knowledge through design practice, and we do so by examining through an expanded lens and definition of this collective inquiry.

Presented during this conference is a collection of this inquiry to exchange with other universities and institutions who are endeavored with a similar question.

The list of the Case Studies includes Yuri Suzuki's Sonic Bloom (Niloufar Abdolmaleki); Jacket for Upper Body Immobility using a Wrapping Process (Hafsa Akter); Half A House Builds A Whole Community (Diana Araiza Soto); How Summer of Soul Was Brought Back to Life (Cristina Gomez); PROEF by Louise Knoppert (Valentyna Hrushkevych); Folded Skies (Justin Marsh); Your Rainbow Panorama (Fatema Mostafa); Subjective participatory mapping as research-based design in Subjective Atlas of Colombia (Alejandra Ruiz); Case Study: The Visible Invisibles (Pachia Lucy Vang); Neri Oxman's Silk Pavilion, 2013 (Ofelia Viloche); en | gulf: Eco-poetics of the Gulf and Bay (Marcy Wacker); Anna Berry's Breathing Room (Iris Xie); and Universal Materiality Exhibition, 2018, New York (Rova Yilmaz).

Authors Biographies

Niloufar Abdolmaleki earned a B.F.A. in 2020 in Visual Communication Design from the Dr. Shariaty University in Tehran, Iran. She is an artist and a designer. Her research interests include experiential and environmental graphic design. **Hafsa Akter** earned a B.Sc. in Fashion Design and Technology from the BGMEA University of Fashion and Technology in Dhaka, Bangladesh. Her ongoing research is developing soft sensors for clothing, developing vision inclusive clothing design criteria, and sustainable fashion. **Diana Araiza Soto** earned an M.A. in Architecture, Building, and Sustainable Planning from the Universidad Autonoma de Guadalajara, Mexico. She plans to focus her thesis on the study of lighting in commercial buildings. **Cristina Gomez** earned a B.A. in English Literature and an M.A. in Interdisciplinary Humanities from the University of California, Merced, USA. Her focus is on costume exhibitions and the analysis of clothing's social role. Her planned thesis project is an exhibition on the Central Valley of California's field worker's clothing to discuss their working conditions. **Valentyna Hrushkevych**

earned a B.A. in Industrial Design from the Pedagogical University of Krakow in Poland. Her area of interest is focused on smell and taste research as well as on sustainable design and wearable technologies. **Justin Marsh** earned a B.F.A. in Pictorial Arts from San Jose State University, USA. His practice intersects interior and exterior spaces of cultural production, seeking to embrace marginal, liminal, and heterotopic territories. **Fatema Mostafa** earned a B.S. in Architectural Engineering from The German University in Cairo. She is an architect and an interior designer interested in the use of color in architecture. She strongly believes that colors are crucial in any designed environment as it helps generate remarkable impressions and enhanced functionality for the end-users. **Alejandra Ruiz** earned a B.A. in Fashion Design from the Universidad Pontificia, Bolivariana, Colombia. As a designer, Ruiz has been interested in exploring, performing, and reflecting on alternative practices of design. She is interested in exploring material design, its life cycles, and possible applications. **Pachia Lucy Vang** earned a B.A. in Anthropology from the University of California, Berkeley, USA. Her design work is informed by her experiences as a Hmong-American navigating culture, art, trauma, and society with a pluriversal imagination that speaks from Hmong-centered knowledge. **Ofelia Pulido** earned a B.S. in Architecture and Urbanism from Ricardo Palma University in Lima, Peru. Her area of interest is focused on sustainable design and interactive design. **Marcy Wacker** earned a B.S. in Design from the University of California, Davis, USA. She examines how visual communication influences the evolving narrative of the human experience in social, political, cultural, economic, scientific, and environmental contexts. **Iris Xie** earned a dual bachelor's degree in Gender, Sexuality and Women's Studies and English from the University of California, Davis, USA. Their research interest is in 'crip technoscience,' 'disability justice,' and 'crip time' and altering and creating environments that would suit those who are neurodivergent and disabled. **Rova Yilmaz** earned a B.S. in Civil Engineering from the Middle East Technical University, an M.B.A. from the Sabanci University in Istanbul, Turkey, and a B.A. in Fashion Design from the Fashion Institute of Technology in New York, USA. She is a designer interested in smart clothing and functional clothing design. **Jiayi Young** is an Associate Professor of Design at the University of California, Davis, USA. She creates large-scale installations that leverage data and cutting-edge technology. She is interested in the human condition and the present-day human experience. Her recent projects are about the geopolitics of racial displacement of Asians in America and the dynamics of identity and influencers on social media.

ISEA2022: Manifestations festival, the Netherlands

Viola van Alphen, Agnes van Dijk +316 2090 2632

Manifestations produced by Stichting Art & Technology

Eindhoven, the Netherlands

organisatie@manifestations.nl | www.manifestations.nl

Abstract

Manifestations is a nine-day festival in the field of art and technology during the Dutch Design Week (DDW) in Eindhoven, the Netherlands. With this festival, the organization wants to initiate a movement to make people more aware of the role of technology in our society and in our future. Within the DDW, Manifestations shows a new image of the world around us through the lens of digital activism and offers an opportunity to the visitors to interact with the art.

Keywords

Art, technology, fun, innovation, digital activism, Dutch design week, Dutch, young talent, graduates, robots, e-fashion, tech, hackers, hacking

Introduction

The technological possibilities and their role in society change at lightning speed and offer both opportunities and risks. Stichting Art & Technology, the organization that started Manifestations, notes that the fear of technology often arises from ignorance. This "technological illiteracy" - and the mission to change it - are the reason for creating Manifestations.

Manifestations challenges people's views on what role we want technology to play in the future (more humane, more lifelike, more beautiful, loving, caring, etc.) in a fun and easily accessible way. The festival aims to facilitate a wide and diverse audience including minority groups such as refugees, the elderly, children, blind and handicapped visitors.

Manifestations, Art, Tech & Fun, has about 35,000 visitors every year during Dutch Design Week, in Eindhoven, the Netherlands. It presents the best of graduate works, Dutch art academies and international talents. As about 80% of the artworks are created by young talents, most of the art pieces had never been seen before by a large audience and were exhibited for the first time.

Additionally, Manifestations works with more than 50 partners including most of the Dutch Art Funds, Dutch Art Academies, Universities, but also the High Tech Campus, tech companies and startups (as Eindhoven is the tech area of the Netherlands).

In the last 15 years we have been presenting innovative, cutting-edge, engaging media art. We were first involved at GOGBOT, TEC ART, PLANETART and Twente Biennale. We have been working on topics around digital

resilience, e-fashion, robots, hackers, activism, bio-art, DNA hacking, AI and others. Earlier we also won the Art-Pie Award as best artist initiative of the Netherlands and the National Innovation Award.

Manifestations

The theme of the fifth edition of Manifestations was *Monsters: Free the Byte* (earlier topics included Superpower to the People, Technology as the Perfect Boyfriend, Internet of Women Things, Big Brother or Smart Sister). Monsters are usually seen as terrifying, ugly and superhumanly large creatures, or on the contrary, as endearing figures such as the Cookie Monster. However, as sweet the Cookie Monster may seem, he also stands for excessive consumption and the creation of waste. Thus, *Monsters* is about the blurred line between good and bad, the Beauty and the Beast, and between other monsters and the monster that might be inside us.

In this way, Manifestations challenges us to take a critical look at ourselves and our relationship with nature and our surroundings. To what extent does technology determine our world, the way we think and act? What dilemmas do technical developments entail?

Manifestations was organised online on 7+ virtual platforms and was a great success, reaching 170,000+ visitors, 100+ local and international press reports and participating artists being extended an invitation to other events or platforms like VPRO, Milan Design Week, Unbore Venice and others.

Institutional Presentation

We will do an institutional presentation on Manifestations and the Dutch artistic scene in relation to ISEA 2022 main theme POSSIBLES and sub-theme *Natures and Worlds on June 13, 2022*. Our creative team, Viola van Alphen and Agnes van Dijk, has obtained extensive knowledge and experience in the art & technology culture, both Dutch and international. Over the past 15 years, we have accumulated a network of more than 5000 innovative talented artists worldwide and presented worldwide.

Author Information

Viola van Alphen (ViolaVirus), Creative director and curator at Manifestations, Stichting Art & Technology

Manifestations Associated Artists: Natures and Worlds

Bio Art, Biotechnologies, Space Art, Quantum Art or Nano Arts, Speculative Design

Tim Dekkers – The Parasitic Humanity

The garments made from crystals show repetition and symmetry. These characteristics reflect mankind's control over its surroundings.



Jip van Leeuwenstein – A Diverse Monoculture

Is it possible to deploy robots to find a new balance within our eco-system? 'A Diverse Monoculture' is a deployment of several robots which together form a hive of new predators. These predators are used to attempt to restore the balance within our eco-system, eating caterpillars.



Daniëlle Ooms - Life Centered Design

Bioluminescent algae jacket.



Maartje Dijkstra – Braindrain, TranSwarm Entities, Surface Distortion, Optic Traces

The sculptural, totally black dress is built up out dozens of small, repeated fragments in the shape of bird skulls sculptured together like cells building an organism, with bird-drones landing and using the dress as a mothership. Made in 3000 hours with a 3D print-pen.



APPENDIX:

Manifestations exhibition June 2022 at the Disseny Hub Barcelona building, Materfad headquarters. Materfad is the Barcelona Materials Centre, created and driven by the FAD, Fostering Arts and Design.

Tim Dekkers – The Parasitic Humanity

More pictures of setup:





Tim Dekkers is one of Manifestations Young Talents who was nominated for the Young Talent Awards 2018. In 2018, Tim graduated from the Utrecht School of the Arts, the Netherlands, with his fashion collection “The Parasitic Humanity”. During his studies he did an internship at Jólán van der Wiel collaborative design practice in collaboration with Iris van Herpen. In January 2019, Tim received the HKU Award for Artistic Performance for this work. Almost immediately after graduation, he started as a Designer in the field of fashion, interior and art. In his designs, Tim likes to explore the boundaries between fashion, design and art.

Tim’s work is typical for the use of unique materials that can support and tell his story and concept. He is guided by the material. The material determines what he can and cannot do. Tim’s preference, therefore, lies in the search for materials that are not used directly within the fashion field. The final silhouette is formed directly on the doll or human body. For more: <https://www.timdekkers.com>

Thematic Statement

Our vision fits well with the "Natures and Worlds". The self-growing clothing, and humans as parasites are topics that indicate our relationship with nature. We expose the (im)balance between humans and nature, the environment, the climate, but also with our mutual "mental ecologies". Bio art and fashion offer an easily understandable way to show how we transform and inhabit this world. This, in turn, opens new possibilities to transition from our current toxic behaviour to another that would benefit nature's future wellbeing. And the design and shapes are an appealing and personal way for the public to experience the story.

“Mankind is a parasite of the earth”, says Tim Dekkers. “We need the earth to live on but at the same time we also destroy her. We need self-growing fashion instead of products we throw away every season.” We are producing more and more materials and products that contribute to the problems of the earth. Namely, the waste and pollution problem. We have an incredible urge to control everything that happens on Earth. In this way we also want to gain control over the negative consequences that we have as humans. The Earth is being affected and we know it is because of us. We want to reduce this happening.

Artwork

The garments in the collection “The Parasitic Humanity” are made of crystals and show repetition and symmetry. These characteristics reflect mankind’s control over its surroundings. One can also recognize more abstract lines

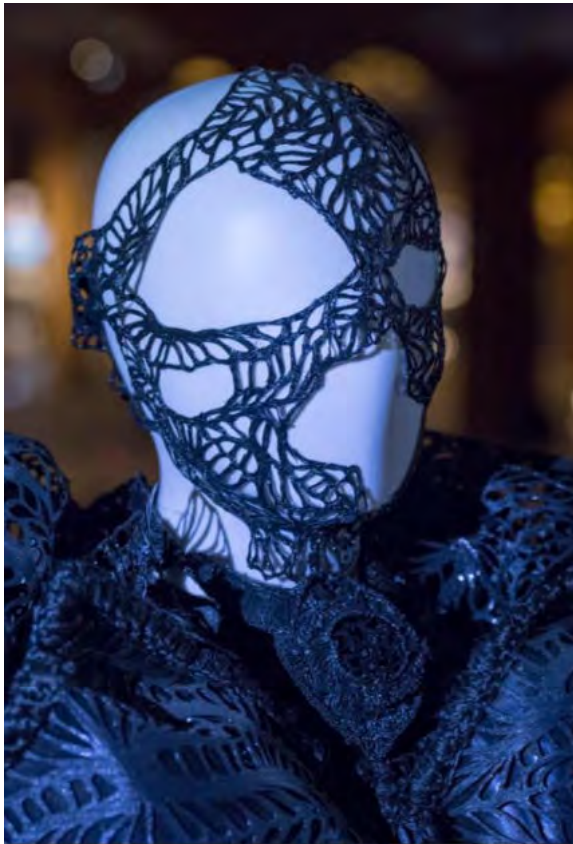
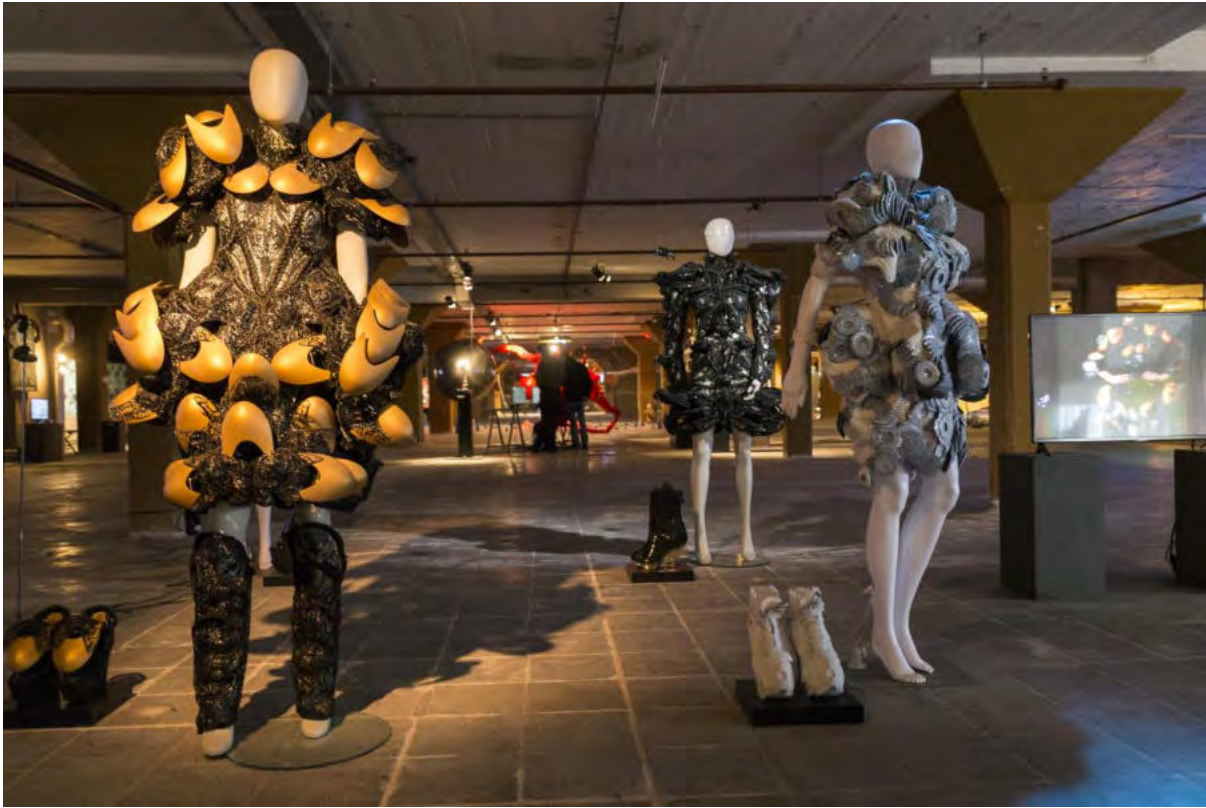
and structures, reflecting nature and its ways of being. The model is practically covered and overgrown by mankind’s excesses while still, in some small measure, under the control of human influence. Tim was looking for materials that have a certain growth habit and that is how he found the Polyurethane and Alum, two completely different materials. The Alum is a natural material and therefore easily biodegradable, while the Polyurethane is a plastic that cannot be broken down naturally. He experimented with these materials to see how he could grow them and to what extent he can influence them as a person.

Videos of the artwork:

<https://www.youtube.com/watch?v=AHvwk1HHZWY&t=140s>

<https://www.youtube.com/watch?v=B0AxttJJu90>

**Maartje Dijkstra – Braindrain, TranSwarm
Entities, Surface Distortion, Optic Traces**



Artist Biography

Maartje Dijkstra is a fashion designer based in Rotterdam, the Netherlands. She graduated in fashion design from ArtEZ Art Academy, Arnhem. She did an internship at Alexander McQueen in London, where her interest in Couture developed more. After her graduation, she decided not to work for a big fashion house where she had to create another designer's story and dream. In 2007 she started her own Couture and technology studio, where she designs and creates individualistic, sculptural, innovative and hand-crafted fashion collections, accessories and interactive Couture designs.

Within her label she designs sculptural, totally hand executed fashion collections and accessories, interactive Couture designs and innovative hand (3D) printed textiles, that became an essential part of her label's signature.

Imagination, electronic music, and complexity in nature are a big source of inspiration for her. She translates and expresses this by using technology as a means to create endless possibilities. Some of the designs are enriched with integrated technical elements that are used to show what is possible, presented as a fashion performance. They are developed together with music producer Newk (NL), him capturing the perfect atmosphere in sound and has the same style and complex mindset as her when producing. <https://maartjedijkstra.com/>

Thematic Statement

Maartje Dijkstra's vision fits well in the "Natures and Worlds" sub-theme.

Maartje's work is about bodies and circuits. It presents infinite patterns that form a new world in an environment of ecological shapes, as it is in the natural world. It depicts fashion as a second protective layer, as an identity layer, as an ecosystem of our environment.

The use of sculptural shapes originated from the fascination and freedom to alienate the body in a strange way, using fashion as a tool. Other important sources of inspiration crucial for her design process are imagination, electronic music, melancholy and complexity in nature. In her work as a fashion designer, there is less focus on practicality and therefore, she has the freedom to create and show possibilities. She is curious about what lies ahead, and so designs with the future in mind. This way of designing is reflected by integrating technology and craftsmanship into an inseparable whole, creating a unique style.

In addition, the work consists of a human form that expresses the human relationship with our ecosystem. The human form is a form that is quickly picked up by the visitor as a presentation method. It is not a block or a box far outside the human being, but a part of the person. Fashion is a way of storytelling that arrives quicker because you literally see the design on a human figure.

Artwork

Fashion designer, Maartje Dijkstra, would like to show one of her most significant, all manually 3D printed, fashion/technology pieces: TranSwarm Entities (2016/17).

TranSwarm Entities is a couture piece developed by fashion designer Maartje Dijkstra in collaboration with creative programmer and music producer Newk. This interactive design was created during Fashion Fusion, a fashion/technology program of T-Mobile in Berlin, in 2016/2017. The sculptural, totally black dress is built up out of dozens of small, repeated fragments in the shape of bird skulls sculptured together like cells building an organism. The parts of the dress are all manually 3D printed, meaning using a 3D printer pen to create fabrics. These parts are all connected together by hand with black polyester wires. The technology part is not directly all integrated within the design but is connected and presented in a more surprising way. 4 small drones, that were customized to appear the same as the dress design, fly up out of the design so it looks like parts of the dress are flying away. The drones fly on the beats and melodies of music producer Newk around the model creating a little swarm.

Important elements within her individualistic work are that she combines innovative technology with unique embroidery techniques, bombastic shapes in design and special material use. To be able to create she uses the power of her own imagination, complexity and repetition in nature and loud/fast/dark electronic music as her biggest inspiration sources.

Links to the Video Documentation

<https://youtu.be/-uFXtExORls>

<https://youtu.be/oREmC2AEyv8>

<https://www.youtube.com/user/maartjedijkstra/videos>

Daniëlle Ooms - Life Centered Design

Bioluminescent

algae

jacket.

Artist Biography

Daniëlle Ooms is a designer interested in a life-centered future, using fashion as a vehicle. She is one of Manifestations Young Talents who was nominated for the Young Talent Awards 2019.

Daniëlle is currently studying master's in Industrial Design at Eindhoven Technical University. Her main focus is developing materials for a sustainable fashion future while provoking a conversation about the current fashion industry. Daniëlle constructed garments made out of her own biodegradable material, completely based on apples. She is also currently developing a bioluminescent algae jacket that aims to explore the topic of life-centered design. Daniëlle has exhibited her work for "Future Fashion", "Material District Rotterdam", "Future Life of Materials" and the "Embassy of Sustainable Design" among others.



Thematic Statement

Our vision fits well in the "Natures and Worlds" sub-theme.

To really make a difference in sustainable innovation we need to challenge the natural order of things. This project addresses a shift from a human-centered world, as we live in today, to a life-centered one; a life-centered world where human join with all other life. We as designers are responsible for our to-morrow, and therefore need to shift our design approach. Imagine a world where the human is among all the living.

I conducted an autoethnographic research about a life-centered design process. I, as a human designer, collaborated with living organisms to design a situation where human is equal to life. I believe that we cannot solve current issues with technology alone. For me it is important to look beyond people and technology, to approach design as an ecosystem and to include living non-human organisms. With my research and design I want to show how we can become part of nature in a different way instead of placing ourselves above it.

My work is easily accessible and can resonate with the audience because, even though it is a post-humanist idea, the artifact still has recognizable shapes from the world in which we currently find our-selves. It is a bridge between the current human central world to a life central world.

Artwork

The goal of Life Centered Design is a balanced human-non-human relationship. The human designer and user is equal to any living organism involved in the design process and the end result. The non-human in this can be any living organism: an animal, a plant and/or a micro-organism.

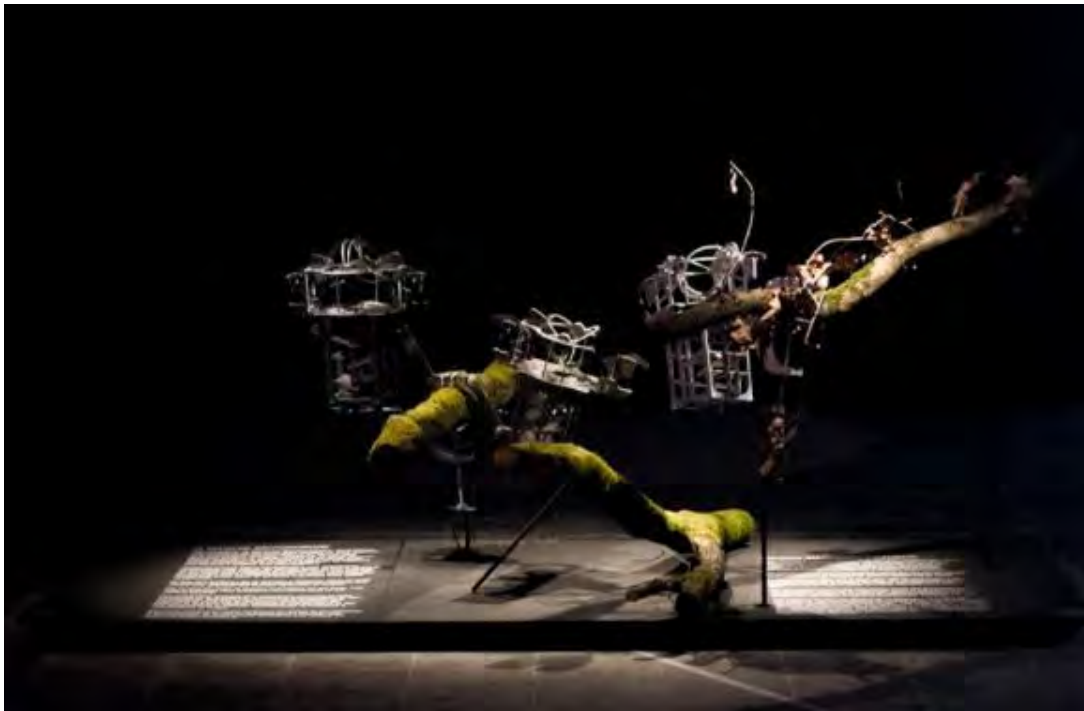
Within this project I researched the relationship and collaboration between humans and bioluminescent algae within the fashion design context. The outcome of this process was a bioluminescent algae jacket. The bioluminescent algae jacket creates a habitat for algae and a garment for humans. This artifact embraces the relationship between humans and algae. Humans come into contact with the algae. They care for the algae by providing it with oxygen and exposing it to sunlight. The algae in the jacket give back a blue glow to the wearer of the jacket in the dark. This artifact is a speculation about what a post-humanist future might look like and a critical look at how we currently apply other living beings in design.

Links to the Video Documentation Online

<https://vimeo.com/591434313>

Jip van Leeuwenstein – A Diverse Monoculture

Robot:



Artist Biography

Jip van Leeuwenstein is a speculative designer questioning today's society. Jip graduated from the Design Department at HKU, Utrecht School of the Arts, Utrecht, the Netherlands, in 2017. In that year he was a part of Manifestations' Young Talent program and was nominated for the Young Talent Award.

Jip's work balances between design and science. His projects are designed to make the spectator wonder: how did we come to this point?

Jip's work has been exhibited at Ars Electronica, Art Rotterdam Week, Dutch Design Week, 'Robotica' Transnatural Art & Design and others.

Thematic Statement

"Natures and Worlds": searching for balance in our ecosystem, by using a (robot) predator.

Nature is a common good, however we seem to be claiming it for ourselves as a way of expanding our capital. The question arises to what extent humanity can satisfy its urge to control everything.

Humanity has always had a contradictory and ambiguous relationship with nature. On the one hand, nature is ought to be protected and preserved in national parks and reserves. On the other hand, pollution and destruction threaten the environment and no responsibilities is taken. Profits and gains seem to be more important than moral obligations. We all feel the urge to control everything all the time. This urge introduces new problems and challenges to our current society.

The cultivation of crops and increasing demand of food facilitated us to justify the continuing manipulation of our environment. The whole system is profit oriented and optimized to generate these profits disregarding the balance in the eco-system. Examples can be found in the use of pesticides or genetic modification to maintain a monoculture of crops.

Within this project, Jip provides a different point of view on nature. He tries to dissolve the border between culture and nature and question the current definition of nature. He investigates whether it is possible to use robots to find a new balance in our ecosystem. After all, mankind naturally deploys new predators when something needs to be restored in an ecosystem. In 'A Diverse Monoculture' various robots come together to form 'a beehive' of new predators. These predators are used to restore the balance in our ecosystem by eating processionary caterpillars. The caterpillars are then converted into the fuel cells of the robots, so that they serve as fuel to keep the robot alive.

The project: 'A Diverse Monoculture' questions the future relation between mankind and nature. Is it possible to deploy robots to find a new balance within our eco-system? 'A Diverse Monoculture' is a deployment of several robots which together form a hive of new predators. These predators are used to attempt to restore the balance within our eco-system.

Introducing a new predator into the eco-system has been tried several times in history, most of the time with catastrophic consequences. For example, in Australia, where the giant neotropical toad was introduced to eradicate the cane beetle. Afterwards, this solution became the problem since the population of toads increased rapidly and became a plague themselves.

The eco-system around the caterpillars of the oak processionary is out of balance. The cultured man-made lanes of oak trees do not provide small vegetation to attract the natural predators of the caterpillars. Therefore, increasing its population tremendously and turning the population of oak processionary into a plague.

The 'Dionaea Mechanica Muscipula' is developed to reduce the population of oak processionary. The moths of the oak processionary are active at night and attracted to light. The robot will lure in nearby moths by light up its mouth. The mouth acts as a trap that contains the curious moths. Some moths purposely remain in the mouth since they spread pheromones that attract other moths. This will increase the speed of the process. The other moths are processed toward the stomach of the robot where the chemical reaction of the Micro Fuel Cells will power the robot. In other words, the robot will operate and actively participate in the nutrient cycle by using Micro Fuel Cells. The reaction within these cells will chemically transform the insects into electricity. The electricity will be used to power the robot and keep the predator alive.

The introduction of the robot predator within the eco-system has all the advantages of the predator without losing control. Using the robot predator, a new balance for the eco-system can be found.

<http://www.jipvanleeuwenstein.nl>

video of the artwork: <https://vimeo.com/451183408>

Hac Te, Barcelona's new Hub of Art, Science and Technology

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Abstract

This presentation will introduce Hac Te, the new Art, Science and Technology Hub from Barcelona. The initiative has been promoted by Catalan institutions such as universities, scientific centers and cultural organizations of great relevance to make Barcelona a global center for research, training, dissemination, transfer and production in this interdisciplinary field. The presentation will explain the global, national and local context on the hub and its main strategies to interconnect agents from different backgrounds and to boost the digital transformation of society.

Keywords

ASTS, interdisciplinarity, digital transformation, New European Bauhaus, network society.

Introduction

Hac Te is an association that brings together and interrelates Arts, Science, Technology and Society stakeholders. The initiative creates transdisciplinary knowledge and culture to meet the digital and green challenges of the 21st century and designs common responses that re-imagine our coexistence in the network society, following the steps of the New European Bauhaus.

Why now and why in Barcelona

Digital technologies have transformed all spheres of human activity. This process of transformation has been even more accelerated due to the irruption of the pandemic. In this context, when the transformative potential of science and technology merges with the creativity of the arts, the result is a strategic knowledge for the development of the net society in which we live.

On a smaller scale, in the last few years, we have experienced significant changes that favor the development of Hac Te.

Firstly, Catalonia has created the General Direction for Innovation and Digital Culture [1] with the aim of defining and promoting policies for the development of projects and programs that relate art and culture to the digital world.

Secondly, at the state level Spain has reactivated the cultural and scientific co-capitality of Barcelona, which recognizes the uniqueness of the city in these matters and establishes the participation of the General Administration of the State in sectoral policies with an economic endowment of €20 million by 2022. [2]

And thirdly, from the European Union the S+T+ARTS program calls for a closer link between technology and artistic practice and initiatives like the New European Bauhaus support interdisciplinary movements to address complex societal problems through co-creation. [3]

In this context, Barcelona accumulates numerous agents working separately in the development of this interdisciplinary field. There is a powerful scientific, industrial and cultural substrat (Biennial de la Ciència, Smart City Week, Sónar+D, Mobile World Congress, programs for the schools such as Escolab or En Residència, the municipal Art Factories, research centers and universities supporting artistic residences...). But it is a tract of punctual and fragmented initiatives. There is no structure nor space to interact, advance and expand. Therefore, it is necessary to have not just a neutral meeting point, but also a catalyst that constantly promotes the relations between all these agents in order to convert it into an ecosystem.

The value chain as a competitive advantage

The four sectors represented in Hac Te [4] through its founding members are:

-Academic and research field represented by UPC (Universitat Politècnica de Catalunya), UOC (Universitat Oberta de Catalunya), UPF (Universitat Pompeu Fabra) and EINA University School of Design and Art of Barcelona.

-Centers of scientific excellence such as the Barcelona Institute of Science and Technology (BIST), the Institute of Photonic Sciences (ICFO) or the Barcelona Supercomputing Center (BSC).

-Unique cultural and artistic organizations such as the Sónar festival, the center for art research and production Hangar and the art collector New Art Foundation.
-Industrial partners of great relevance in the tech industry such as Tech Barcelona and Fira Barcelona.

Therefore, the hub's partners cover the entire value chain, from the generation of interdisciplinary knowledge to its conversion into products and services for society. This is undoubtedly Hac Te's competitive advantage.

Strategies and actions

Hac Te's strategic planning pivots on five key lines of action:

- Integrate all the agents of the value chain (integration and representation).
- Promote a group of political influence for the ASTS field (leadership and autonomy).
- Provide an instrument for management and coordination (structure).
- Define a complete route for the future of the intersections between ASTS in Catalonia (strategy and competitiveness)
- Share an ASTS's agenda (cohesion and complicity).

More specifically, Hac Te is directing its activity in three directions.

First of all, Hac Te is promoting its own projects to systematize interdisciplinary processes between the local, national and European ASTS community and to design shared projects that promote the digital, ecological and fair cultural transition.

Secondly, the hub is participating in the partner's activities to increase existing knowledge and innovation initiatives and to articulate a circuit to interconnect the activities between the local ecosystems in the cultural, academic, industrial and scientific spheres.

And at last, Hac Te is assessing and accompanying international projects to position Barcelona and Catalonia as a cultural reference in the field of digital arts, from its relevance as a city of science.

Red ACTS, Spanish network for ASTS

With the aim of articulating a nationwide network that promotes collaboration between agents in the interrelations between Art, Science, Technology and Society (ASTS), Hac Te, together with UOC, are launching the pilot project 'RED ACTS', which has the support of Fundación Carasso.

The network formulates an articulation of different key agents to make possible a fluid environment of collaboration between institutions, projects, groups and individuals with common interests and objectives, but with differentiated spheres of action, whether these are close to research, education, production, dissemination or exhibition. [5]

The project is based on the idea of a "structuring structure" and responds to the complementarity of each of the agents in relation to the common objectives. Depending on the learning obtained through the previous experience, during and after the course of the project, the structure itself will be transformed. The resulting network -with its consequent dynamics, processes and devices- is both the object and subject of the research-action.

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Author's Biographies

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Adriana Valero is communication's coordinator of Hac Te

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UNESCO Creative Cities of Media Arts – City to City Initiative

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Abstract

There are currently 22 UNESCO Creative Cities of Media Arts, the first having been designated in 2013. The Media Arts Network collaborates on actions relating to the UN's Sustainable Development Goals. In 2019 a joint commissioning project was proposed as a way for media artists to explore creative practice in Media Arts Cities.

The inaugural City to City program involved nine cities and ten artists, and an exhibition of the five digital artworks was launched in December 2020. Despite the challenges resulting from the COVID pandemic, the project was held to have been successful and the decision was made to run the project again in 2021 with appropriate modifications.

We conclude that we succeeded in developing an innovative approach to artistic collaboration, that we provided much needed employment during a difficult period, and that the resulting exhibition drew the participating cities closer together, permitting the growth of bi- and multilateral relationships.

Keywords

Media Art, Creative Cities, UNESCO, Collaboration, Sustainable Development Goals

Introduction

A map of the UNESCO Creative Cities of Media Arts will show that we circle the globe, but cannot hide the fact that we live in different economic worlds.

The largest Media Arts City has 8m citizens, the smallest 14 thousand. Of course larger cities might have larger budgets but their challenges also tend to be greater. So in effect even the largest city can be poor, in quality of life, in education and in cultural facilities.

Levying taxes on economic activity is what enables cities to grow and thrive. GDP may be a flawed measure of the relative wealth of cities but it indicates a city's ability to participate in any game where the stakes are the same for all. The contrast in GDP between Media Arts cities is stark. Someone who works in the wealthiest city involved in City to City generates six

times as much taxable income as their equivalent in the poorest.

City to City set out to address the unequal relationship that continues to shape many international programs. This pattern is often replicated in the arts, such as when a well-funded arts organization, perhaps in a US or European capital, invites participation by organizations in less wealthy states. This can be regarded as an act of generosity, but in many cases it simply entrenches the inequality.

City to City set out to be an equal partnership. Aside from the artists' fee, each city devotes resources locally according to its capacity. The first Project Management Group consisted of the Focal Points of Braga, Guadalajara, Karlsruhe, Kosice and York.

2020 Edition

City to City was conceived at the Network's mid-year meeting in Braga, Portugal, in 2019. The focal points of Braga, Guadalajara, Gwangju and Kosice were working on International Projects. They suggested building on the idea of the Guadalajara-based artist, Paris Diaz, for us to exchange digital 'postcards', which would then be exhibited at the 2020 Annual Conference.

That was the plan. But the creative economy, along with hospitality and travel, were then brought to a halt by the measures intended to prevent infection, such as lockdown. Overnight, everywhere, the self-employed artists, actors, musicians, curators and directors, on whom culture depends, found themselves without work. Could the Media Arts Cities, by working together, support artists and inspire their communities at the same time?

During our early meetings we were inspired to hear how other places, such as Gwangju, Sapporo, and Changsha, were tackling virus outbreaks and developing successful strategies to enable culture to survive. Even so, the threat to the sector was real in all too many countries. As the virus swept round the world the Annual meeting of Creative Cities in Brazil was cancelled. We decided to move City to City online; the Callout, Selection of Artists, and the management of the Project by the Focal Points.

An Open Call went out in each city asking for artists to commit to working online, with an artist from another city, to produce an artwork on the theme of Human Responsibility. This focus on sustainable development was proposed by Kosice for its annual Art & Tech Days 2020 festival and we

hoped the artworks could be exhibited during the event. Each artist was paid a commission fee by their city and worked to a standardized contract.

Ten artists from nine cities worked in pairs. The Focal Points met their own artists regularly over the production period of three months, and liaised with their partner city to monitor progress.

The artists' very diverse interests and skills included GPS tracking, perceptions of landscape, urban identities, natural resources, and machine translation. The ideas they focused on, within the theme of Human Responsibility, were also various. To take the example of York, UK, which was paired with Cali in Colombia, both cities have a historic and complex relationship with the rivers on which they stand. The artists, Mike Stubbs and Daniel Escobar, remarked that water provided 'the possibility of reflecting our cities and their inhabitants, and our shared responsibility to take care of it'.

Work online went on, but Kosice decided they could not hold the planned Art & Tech Days festival. We replaced the physical installation of the five artworks with a dedicated website hosting an online exhibition at Braga Media Arts. City to City 2020: Human Responsibility was launched at a Zoom webinar, with a live feed on Facebook. An audience of senior UNESCO staff, city Mayors, and civic and cultural representatives from participating cities were welcomed by the Mayor of Braga, addressed by Media Art expert Peter Weibel, heard from artists, and experienced the work for themselves.

2021 Edition

City to City 2020 was chosen as a case study for the online UNESCO Creative Cities Annual Conference and was featured in the UNESCO publication 'Creative Cities and Resilience to COVID'. We carried out an evaluation that indicated we should put more responsibility in the hands of the artists and encourage them to test the limits of the project. We wanted the resulting work to reflect the challenge of recovery after COVID and the role of creativity in that. So we proposed the idea of human relationships being rebooted. The central idea is the invitation to viewers and participants to 'PLAY!'

Artists wanted longer to develop the work together. Focal Points agreed to increase the commission fee to reflect the considerable amount of work involved. We decided that, in 2021, each city would select their artist as before, then a series of workshops, the City to City Labs, would enable them to get to know one another and to discuss ideas before forming the teams that produced the work.

Our selected artists completed a two month development period, presenting plans and discussing them with the other teams and with expert mentors.

While the work in 2020 was generated by artists working in pairs, in 2021 larger groups worked together to produce 5 finished pieces. The next edition of City to City is planned for 2023.

Conclusion

There are positive outcomes from City to City. In 2020 audiences could experience five excellent, innovative, newly commissioned artworks. The artists were employed for three months in difficult times, and they developed their careers. The focal points, especially the planning group, learned much more about how to work remotely. And each of the Media Arts cities has gained by having participated in a high profile international event.

We can assess the impact of City to City by mapping its contribution to the United Nations Sustainable Development Goals.

All UNESCO Creative Cities are committed to SDG 11, the goal of building more sustainable urban communities. In addition, City to City, through commissioning individual artists, is supporting the local economy by offering 'good work' (SDG 8). Through the technologies employed it supports industrial innovation (SDG 9), while by reflecting the reality of lives in their host communities the artists are improving cultural wellbeing and reducing inequality of access (SDG 10). The cities have a further basis for international collaboration, the achieving of all SDGs through stronger partnership (SDG 17).

Global connectedness has taken on a new meaning for us as Media Arts Cities. Increased 'resilience' is as much about wellbeing and quality of life as it is about economy. City to City mobilized empathy, creativity and innovation, enabling us to work as equals with artists and cities around the world, and to share our experience and ideas.

Websites

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"Media Arts Cities" accessed 19 May 2022 <https://mediaartscities.com/about/>

Note on the Media Arts Cities

The UNESCO Creative Cities of Media Arts are Austin (United States), Braga (Portugal), Cali (Colombia), Changsha (China), Campina Grande (Brazil), Dakar (Senegal), Enghien-les-Bains (France), Guadalajara (México), Gwangju (Korea), Hamar (Norway), Karlsruhe (Germany), Kosice (Slovakia), Linz (Austria), Lyon (France), Modena (Italy), Namur (Belgium), Sapporo (Japan), Tbilisi (Georgia), Tel Aviv-Yafo (Israel), Toronto (Canada), Viborg (Denmark) and York (United Kingdom).

Professor Christopher Bailey manages the Focal Point of York UNESCO Creative City of Media Arts.

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Abstract

From a perspective of ecological crisis, FeLT- Futures of Living Technologies, engages in the relations and intersections that occur between human beings, living environments and machines, relations on the edge of how we experience aliveness today.

Keywords

Living technologies, multispecies, making with, artificial life, artificial intelligence

About Futures of Living Technologies

This entails how we sense life in the environment, in other beings and ourselves in an existence being constantly enhanced by technology. Questioning this situation, evokes a sense of the uncanny and a fear of being dominated by the machine, but also reveals possibilities of becoming, creation of new forms and behaviors. Could we develop aliveness and create a more balanced existence? Can we enhance our senses and communication abilities to become beings that are more adept at co-existence?

The core of FeLT is to investigate such ambiguous questions by artistic means in proximity to computer science research.

State-of-the-art scientific research provides inventories of living systems and their functions: intelligence, evolution, reasoning and learning. This is made available as an artistic material that is discursive and performative, rather than representational.

Through residencies and workshops, we will develop a body of works to present, reflect and share artistic examples and experiments. By entering a transdisciplinary discourse from an artistic point of view, we will learn more about the transdisciplinary as a way to navigate in complex, layered realms of sensuous experience and knowledge.

Questions and speculations that are not addressed or fully developed otherwise, can emerge through employing artistic methods. We will join together artistic methods and aesthetics from bio art and techno ecologies with contemporary perspectives on sensory experience and materiality in artistic production and research.

Inspired both by artistic works and contemporary, theoretical and scientific perspectives on technology, ecology and aesthetics, we will develop a transdisciplinary working environment driven by artistic research.

At this stage of our project development, we identified three thematic strands to investigate which will be addressed:

The second, and subsequent paragraphs are indented 10 points. Do not leave double-space between words or paragraphs. This sample shows a 10-point Times New Roman text. Times New Roman is the font to be used throughout the essay.

The ISEA2022 submission must be PDF (Portable Document Format) files formatted for 8-1/2" × 11" paper.

Making with: multispecies communication and co-creation.

Practices of communication and co-creation with living organisms – such as microorganisms, plants or animals – might involve working with technologically complex systems as well as agriculture or indigenous knowledges and traditions. To rethink interspecies relations in the framework of a climate emergency moment can be a way to form entangled multispecies alliances

Living technologies: living environments, humans, machines, intelligence, life and emotions.

By the term living technology we think of the complex structures and functions of living organisms which have entered the hybrid and synthetic technologies. By including critical perspectives on the merging of technology and areas involving emotions, sensing and empathy, we question possible and speculative convergences of machine technology, artificial life, artificial intelligence and human bodies. We invite perspectives on the implications of future integration and communication between the machine and the living as well as speculative or applied.

Sensorium: how we experience, interpret and develop applied aesthetics today

Sensorium – how we experience, interpret, develop applied aesthetics today in order to reconnect with the environment, expanding the senses technologically inside and outside of institutions. Technologies continuously provide new ways of filtering our experiences and different means of relating to the living environment. Aesthetics today are also affected by perceptual complexity, relating to experiences that transcend art and include a vast array of both natural and constructed environments. Human perceptions and sensory modalities are influenced and affected by the way we interact with our digital tools, and their presence is becoming characteristically transparent. Can the sensorium as an expanded aesthetics provide new modalities for connecting with natural resources? What new opportunities exist for interaction and how do technologies extend and provide explorative possibilities within sensations? And, in what way do institutions understand and relate to this sensory complexity as a sustainable choice?

Credits

Project period

Start: 15/10/2020 End: 15/10/2023

Financing

Norwegian Artistic Research Programme (NARP)

Project owner

Faculty of Technology, Art and Design (TKD)

Project manager

Kristin Bergaust

Author Biography

Kristin Bergaust is educated at the University of Oslo and at National Academy of Fine Art in Oslo. She works as an artist, researcher and educator. She is a professor at the Faculty of Technology, Art and Design in OsloMet, Oslo since 2008. She was formerly professor and head of Intermedia at Trondheim Academy of Fine Arts, NTNU (2001-2008) and artistic director of Atelier Nord media lab for artists (1997 to 2001). Kristin is one of the pioneers of the self-organized early media art scene in Norway from the early 1990-ies. Her feminist, trans-cultural and relational perspectives on contemporary conditions are investigated through performative and technological strategies, sometimes also fed by cultural history or other narratives. Experiments with the communicative and the sensory are inherent both in research and art.

From Landscape to Laboratory – Bioart Society Finland

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Abstract

Bioart Society is a Helsinki-based art association developing, producing and facilitating activities around art and natural sciences with an emphasis on biology, ecology and life sciences. It runs SOLU Space, an artistic laboratory and platform for art, science and society, and Ars Bioarctica, a residency program with focus on the sub-arctic environment. <http://bioartsociety.fi>.

Keywords

bioart, landart, environmental art, art organisation, sub-Arctic

Introduction

Bioart Society is a Helsinki-based art association developing, producing and facilitating activities around art and natural sciences with an emphasis on biology, ecology and life sciences. It runs SOLU Space, an artistic laboratory and platform for art, science and society, and Ars Bioarctica, a residency program with focus on the sub-arctic environment. The conceptual framework of the work of the Bioart Society is guided by the idea of hybrid ecologies and aims to develop, test, and evaluate artistic practices able to address the current environmental challenges. Hybrid ecologies are a thought vehicle to talk about the intentional and unintentional transformation of our planet through human activity. They address the convergence of our environment with technology. A hybrid ecology consists of naturally evolved actors but also of those which are human-made and -caused. These include technologies, like robots, software, AI, networks, and infrastructure, but increasingly also genetically engineered plants, animals, and bacteria, as well as sites of extraction, pollution, and waste. The new biological actors specifically blur the boundary between the traditional binary of natural and artificial as they are biological in material but technological in nature. From this, it becomes clear that the environment which contemporary environmental art needs to address has radically shifted from its original understanding. What is contemporary environmental art in a time where the biological becomes a

question of technology, engineering, and commodification? What kind of artistic engagement and practices can contribute, among others, as a force and vector for transformation to address and act towards the increasing pressure human activity is putting on the planet and on the quality of life of contemporary and future beings? With a diverse program of workshops, work-labs, field laboratories, artwork productions, residencies, and exhibitions the Bioart Society aims to unravel artistic questions about the contemporary biological condition.

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Author Biography

Erich Berger is a curator, cultural worker and artist with over 25 years of experience of working with transdisciplinary projects within art, science and technology. Since 2009 he directs the Bioart Society in Helsinki/Finland, an artist association fostering transdisciplinary work between art and science with a focus on biology, ecology and life sciences. Prior to that he worked among other venues as chief curator for Laboral Centro De Arte in Gi-

jon/Spain (2007-09), as content developer and producer for Atelier Nord (2004-06) in Oslo/Norway and as researcher at the Ars Electronica Futurelab in Linz/Austria (1996-99). With the Bioart Society Berger has successfully developed, managed, produced and participated in several multi year projects like HYBRID MATTERS (Nordic Culture Fund) or Changing Weathers, Techno Ecologies and SYNENERGE (EU Culture and FP7). In 2017 the Bioart Society under the direction of Berger received the Finnish State Prize for Interdisciplinary Art.



Field_Notes - The Heavens, 2019, image by Till Bovermann

Alterscience Research Project: New Political Subjects of Knowledge

Institutional Presentation: ISEA2022

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Abstract

The concept of Alter Science presents a new interdisciplinary paradigm that acknowledges human beings in their complexity and plurality. It encompasses biological, technological, computational, scientific, spiritual, and affective areas of study as subjects of new knowledge. Alterscience promotes a constructive critique of the theoretical, axiological, and epistemological foundations of science, highlighting Mind and Spirit, as primordial realities, reintegrating them into the cosmological fabric, and thus seeking to understand what materialist theories cannot elucidate.

Keywords

Alterscience; new political subjects; science criticism; philosophy of contemporary science.



Figure 1: Video photography, Artur Matuck e Pedro Brandão, São Paulo, Brazil, 2019

Introduction

The limitations of scientific thought, restricted to rigid paradigms, prevent new proposals from being conceived, devised, or absorbed. Incomprehensible phenomena are denied and excluded, so science remains limited by refusing to observe and investigate anything beyond the spectrum of its instruments [3].

Alterscience designates a confluence of philosophical perspectives, aesthetic, spiritual, moral, and physical; it combines emerging theories, such as ecology, feminism, de colonialism, class struggle, negritude, anti-racism, and anti-speciesism. The concept resituates science in a process of theoretical, experimental, philosophical, moral and paradigmatic reconstruction, breaking with its ideological territories and unquestionable epistemologies. It aims at an investigative stance open to a different knowledge construct.

Alterscience imparts a project of research, theory, pedagogy, and experience, in universities and culture, aiming at a continuous reflection, sociopolitical engagement, and consequential pedagogical practices. It institutes a paradigmatic revision, intending to interweave logic, philosophy, and spiritual traditions, current and potential modes of intelligence [5].

This field of action research understood as an Alterscience, respects life, animals, the planet, and the cosmos, and encompasses insurgent thoughts, ancestral knowledge, contemporary forms of subjectivity and diversity, as well as the digivirtual and the humanotronic.

Alterscience is proposed as a science that respects life implying the acceptance that living beings, whether human or non-human, are sacred and therefore have inalienable rights. This vision creates an inevitable confrontation with the foundations of the dominant science, historically governed by positivism, determinism, and technological rationalism.

The mechanisms of colonization and control that allowed the subjugation of a multitude of beings, the manipulation

of animals, plants, and the planet itself, persist today tainting the image of science [4].

This behavioral logic of exploitation of life, implicitly validated by science, is insidiously extended to the treatment of human beings [1]. Humans are tacitly considered machines, devoid of sacredness, without rights to life, dignity, and respect, and therefore available to be controlled, experimented with, exploited, and exhausted [2].

The proposal stimulates a broad reflection on Sciences and Alterciences, spurring the creation of projects: to identify new topics of knowledge, alternative objectives, modalities, or methods of knowing; to unveil other objects and dimensions; to experiment with different languages, agencies, instruments, modalities; to conceive multi-and inter-visualities and dimensionalities; to examine new forms for knowledge legitimation, to implement non-proprietary processes of information dissemination, application, and transformation; to absorb additional subjects of knowledge and to reach and augment the beneficiaries of science.

The Alterscience Research Group at the University of São Paulo

The concept aims to inaugurate a new field of research, theory, and experimentation, proposing its appreciation in universities as well as in culture, arts, philosophy, human sciences, and ethics. It institutes a singular field of critical thinking capable of enhancing contemporary science and bringing it in line with much-recognized knowledge that has not yet been legitimized in universities or research centers.

With this purpose, a transdisciplinary Research Group was conceived, founding a heterogeneous collective for reflections on the history, theory, and methods of contemporary science, proposing a series of actions toward a critical and renovating alternative.

The movement was officially initiated in 2020 at the University of São Paulo through the research group "Altercience and Intercommunication". The course "Altercience: Critical Propositions and Creative Processes for Knowledge: Research, Theory, History, Method, Praxis" was taught in the second semester of 2020 and the first semester of 2021, at the Postgraduate Program in Humanities, Rights and Other Legitimacies at the School of Philosophy, Letters and Human Sciences, under the responsibility of Dr. Artur Matuck. Two international forums were organized and a seminar happened in the World Social Forum 2021, which included lectures by professors Patrick Llored from Lyon, France, and Marcos Novak from Santa Barbara, USA, among others.

The following objectives are to be accomplished in the next four years: (1) to annually teach the postgraduate discipline "Altercience: Critical Propositions and Creative Processes for Knowledge"; (2) to produce academic events in the form of symposiums, seminars, and national and international forums; (3) to produce publications favoring the collaboration between autonomous and academic researchers, teachers, and students; (4) to produce didactic

materials in the form of publications, presentations, videos and translations for different audiences; (5) to implement a presence in social networks aiming at the dissemination of non-proprietary propositions of a conceptual, epistemological, scientific, and pedagogical nature; (6) to establish mutual collaboration agreements with research groups, centers of excellence and universities in Brazil and abroad.

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Author(s) Biography(ies)

Artur Matuck is teacher at the University of São Paulo, Brazil, since 1984. He has been a scholar, writer, artist, mediasopher, lecturing worldwide on Literary Theory, Media History, Digital Writing and Science Studies. He is an activist for animal rights and liberation, for society's unrestricted access to information, software, technology and medications. The Alterscience, a present research, project purports a Science based on compassion and planetary consciousness.

Daniela Ernst is Biologist, Master in Science Teaching, Postgraduate in Biotechnology. She is currently a PhD candidate in the Postgraduate Program in Humanities, Rights and Other Legitimacies/PPGHDL/Diversitas, USP.

Adriana Bobilho is Psychologist, Art therapist, and women's group facilitator. Member of the Interdisciplinary Group of Studies: Alterscience and Intercommunication - Diversitas FFLCH/USP.

Antônio Rodrigues is Visual Artist and Researcher, PhD candidate at the Interunits Program in Aesthetics and Art History - PGEHA - USP.

AI4FUTURE

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Abstract

AI4FUTURE is an international network of urban labs where artists and young activists cooperate to create awareness through the use of Artificial Intelligence (AI) to serve the community.

The project is co-funded by the Creative Europe Programme of The European Union and aims at enhancing the understanding and dissemination of AI related technologies for the active and creative participation of young activists and local communities to the European cultural scene, allowing them to work with artists for a joint creation of a new urban community awareness.

The network between human and non-human, artists and young activists with the support of cultural organizations and research centers, is exploring how digital creativity can contribute to relevant societal challenges, focusing on different meanings of Mobility.

Four artists have already been selected by a Scientific Committee after an European open call. Within the next months, they will work in residencies where they will develop AI-based works, cooperating with young activists, focusing on their local mission. At the end of the residency period the AI-based works will be developed and presented to the local community as the result of the joint work of artists and activists.

Keywords

Artificial intelligence, art, young activism, local communities, human-computer interaction

Introduction

How social challenges, Artificial Intelligence, art and local communities could be linked?

With the project AI4FUTURE, co-funded by the Creative Europe Programme of The European Union, Partners are creating a common ground for all these threads, through the lens of mobility theme. AI4FUTURE wants to redefine the way we understand mobility through the collaboration with the younger generation involved in the shaping of our collective future.

AI4FUTURE Partners share an interest in boosting arts and digital technologies towards social challenges. For their part, activists will make the most of digital and physical artworks, to evolve their advocacy activities and to attract the interest of a new kind of public. This medium can be represented by new technologies, in particular Artificial Intelligence.

AI4FUTURE stands for “Artificial Intelligence for Future”: in a two years project, the five Partners are matching human needs in local communities and non-human features, by using data and Artificial Intelligence from an artistic point of view.

AI4FUTURE frames mobility encompassing its various meanings, that is mobility across national borders, across binary systems, green and sustainable transportation, mobility as a digital or social leverage. Each Partner and

activist groups in their territories, are shaping a “local” story angle so as to fully embody different perspectives on the matter. With this approach, arts and new technologies become ways to help dialogue and consciousness, creating relations, empathy and wonder.

AI4FUTURE days

The project started in April 2021 with “AI4FUTURE days”: Partners organized a week of physical and online lectures and workshops, about Post-covid mobility, AI and gender inequality, AI for sustainability and inclusive gamification, Mixed reality and mobility. The main goal was to show how Artificial Intelligence, which allows the collection, interpretation and display of large amounts of data, can be a tool at the service of artists and activists to address the cultural and social changes of our time.

During the workshops, using different kinds of facilitations, cultural operators and young activists shaped the issue of mobility, depending on their local mission. They came out with four variations, one for each Partner:

- AI and Gender Inequality issues (Rotterdam)
- AI and community mobilization in public spaces (Sardinia)
- AI, platform urbanism and social mobility (Milan)
- AI, phygital worlds and digital barriers (Barcelona)

Call for artists

The four variations became four statements, collected in an Open call for artists who work in Europe.

As constraints, the artists responding should have to work with AI technologies, be interested in working, during an artistic residency, with young activists at a tangible artwork that would interact with local communities to advocate their vision of mobility.

90 artists sent an application, proposing different types of technology, data set, machine learning, artworks and involvement of activists and local communities.

4 artists have been chosen. They are:

- Chunju Yu: the project will rethink gender structures and raise awareness about the digital frontier between fakeness and realness, making use of different gazes in the online porn supply.
- Nino Basilashvili: the project will be developed in agreement with A Foras, an anti-militarist collective, and renews attention to the environment, boundaries and human relations.
- Bernat Cuní: the artwork is about commuting and panorama. It will work as an engagement point between citizens, policy-makers, activists and other communities, accurately based on the *phygital* concept.

- Luca Pozzi: the project Rosetta Mission 2022 is a temporary free Hub, without specific political, religious, and geographical coordinates, suitable for interdisciplinary contributions and social interaction. It will be a meeting point for activists, artists, philosophers, and scientists, a place for a hybrid public.

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Residencies

During spring and summer 2022, artists will work with teams of young activists, involved from the beginning of AI4FUTURE project.

This cooperation will ensure an exchange of competences regarding Artificial Intelligence, about how data can be collected and analyzed for social impact and not for private extraction and enrichment, how a social challenge could be faced by teams composed of artists and activists, human bodies and non-human (machine) learning processes, the ways art meets digital technology and social issues.

This activity offers a practical example of how an ecosystem composed of artists, scientists, enterprises and public bodies can co-design a sustainable and inclusive future.

Exhibitions

At the end of the residency period the AI-based works will be presented to the local communities as the result of the joint work of artists and activists.

Artworks will become the touchpoint in which dataset takes form and turns into something tangible and understandable: bodies will finally interact with digital artifacts, so that new insights will enrich the public debate and local communities’ awareness.

Finally, the partnership will organize a great exhibition in Milan, where in addition to the artworks, international speakers, scientists and humanists will debate the redefinition of mobility meaning in post-covid era.

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TEKS - Trondheim Electronic Arts Centre

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Abstract

This institutional presentation introduces TEKS – Trondheim Electronic Arts Centre – a non-profit organization founded in Trondheim, Norway in 2002. TEKS's main activities include a) Meta.Morf – Trondheim international biennale for art and technology; b) TEKS.studio – a space for exhibitions, concerts, performances, seminars, lectures, and workshops; c) TEKS.press – a platform for publishing books, exhibition catalogs, and other publications; d) Norwegian Media Art Library – a collection of printed publications that cover the Norwegian media art field; e) and FAEN Academy - a pilot project supporting the development of new artworks by young female artists working with experimental art in Norway.

Keywords

Electronic art, art biennale, Norwegian media art library, Norwegian electronic art history, publishing, talent development program, Ecophilia.

Introduction

TEKS – Trondheim Electronic Arts Centre – is a non-profit organization founded in Trondheim, Norway in 2002. [4] The organization is a resource and competence center that aims to produce and convey technology-related art projects within all art disciplines. TEKS is the founder and organizer of the Trondheim biennale for art & technology – Meta.Morf. TEKS initiates and organizes artistic productions and projects, works with promotion and education through courses and workshops, and acts as organizer and co-organizer of various technology-related cultural initiatives.

Meta.Morf Biennale

TEKS is the organizer of Meta.Morf – Trondheim international biennale for art and technology. The seventh edition Meta.Morf 2022: Ecophilia is taking place from April 1 – August 14, 2022, and it manifests a critical take on mankind's relationship to nature. [5] The biennale, through conferences, exhibitions, and performances, critically questions what it truly means to be an ecophile in the age of the Anthropocene?

TEKS.studio

TEKS.studio is TEKS's space for exhibitions, concerts, performances, seminars, lectures, and workshops. It is located at Nedre Bakklandet 20C, Trondheim. TEKS.studio is also home to the Norwegian Media Art Library.

Norwegian Media Art Library

The Norwegian Media Art Library is a collection of printed publications that cover the Norwegian media art field. The collection represents the most comprehensive knowledge and documentation of media art in Norway in terms of history, artistic activities, artists, and development in the field. [1]

The project shows the media art field's important role in the Norwegian art scene. The library contributes to the further development of Norwegian media art by providing a solid foundation for the field's history through a comprehensive archive. The library currently consists of 154 publications and is available in TEKS.studio in Trondheim. The preservation of digital art is strongly dependent on the lifespan of technologies used to create the work. The hardware and software of digital artwork often face updates and quickly become obsolete. This makes the preservation of the digital art field a challenging task. Visual and textual documentation, therefore, plays an important role in preserving knowledge about and in the field.

TEKS.press

TEKS.press is a platform publishing exhibition catalogs, books, and magazines related to the field of art & technology. [7] TEKS is always open to collaborating on publication projects within the field. The latest edition to the collection is the book "Electronic Art in Norway: Artists and Artwork from 1960 to 2020".

Book: Electronic Art in Norway

“Electronic Art in Norway: Artists and Artwork from 1960 to 2020” is a historical overview of electronic art in Norway. The book is edited by Zane Cerpina, Ståle Stenslie, and Jøran Rudi. [2]

Not much has been written about this art in this country, and the book helps to fill this gap in the knowledge about the development from 1960 until 2020. Norwegian artists who have worked electronically and digitally are in part better known abroad than in Norway. They have won several international awards, exhibited at international biennales, and received attention in foreign media. The book presents their stories as a historical, visual, and artistic narrative of works, development, and contemporary contexts. A total of hundred artists are included in the book.



Figure 1. Book “Electronic Art in Norway”, a timeline showing the historical development of electronic art in Norway. © TEKS.

FAEN Academy

FAEN Academy - Female Artistic Experiments Norway is a pilot project supporting the development of new artworks by young female artists working with experimental art in Norway. [3] The initiative focuses on art productions from concept to exhibition-ready work in close collaboration with FAEN partners. It offers young artists support and advice from established artists and experts in the field through workshops, meetings, and ongoing guidance throughout the production. FAEN Academy is initiated and organized by Zane Cerpina / TEKS – Trondheim Electronic Arts Centre.

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Author Biography

Zane Cerpina [LV/NO] is an interdisciplinary female author, curator, artist, and designer. Cerpina lives in Oslo and currently works as project manager/curator at TEKS (Trondheim Electronic Arts Centre) and editor at *EE: Experimental Emerging Art Journal*. From 2015 – 2019 she worked as creative manager at PNEK (Production Network for Electronic Art, Norway).

Cerpina is the author of the *The Anthropocene Cookbook: Recipes and Opportunities for Future Catastrophes*, co-written with Stahl Stenslie and forthcoming at MIT Press, October 2022. Her extensive body of works also include curating and producing *Meta.Morf 2022: Ecophilia*; *FAEN (Female Artistic Experiments Norway)*; *The Dangerous Futures Conference 2018*; *Oslo Flaneur Festival 2016*, and *The Anthropocene Kitchen* event series (2016-). Cerpina has initiated and been part of several important archival and research projects such as *The Norwegian Media Art Library* and is one of the editors for the *Book of Electronic Arts Norway*.

New Department of Digital Arts and Cinema at the University of Athens

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Abstract

This is a presentation of the new Department of Digital Arts and Cinema of the National and Kapodistrian University of Athens, Greece.

Keywords

Cinema and film studies; digital arts; audiovisual arts, interactive arts; art and technology, multimedia

Introduction

The Department of Digital Arts and Cinema of the National and Kapodistrian University of Athens, Greece is a new department that focusses on the intertwined and hybrid field of film practices and cinema studies, electronic, digital, immersive and interactive arts that range from installations to video games. Founded in 2019, it is now set to enter its fourth year of operation. The creation of this new department addresses the need for the provision of quality education, artistic innovation and practice-based research in the multidisciplinary field of interactive arts, working at the intersection between film and cinema studies and digital art.

The Department is situated at the university campus of Psachna, a short distance from the city of Chalkis, in relative proximity to Athens. This allows faculty and students to also be active in Athens as well as to foster the growth of artistic creation outside the traditional arena of a major city.

Aims and goals

The primary aim of the department is to fill a need for audiovisual and film production in Greek higher education by bridging the gap between established film-making practices on the one hand, combined with the use of digital tools for high-quality artistic production. It transcends the boundaries of a traditional film school as it brings forward the interconnection with a wide range of contemporary digital forms of expression and multimedia. The objective of the department is that the students will be trained in all sections of filmmaking, aiming at their competence as professionals of the audiovisual sector, (feature films and documentary, television, animation, advertising, screen-based media etc). At the same time, students follow innovative and emerging forms of experimental digital artistic creation.

An additional goal of the department is to promote gender balance in film industry and to encourage the participation of women in audiovisual production in general. To that end, the department collaborates with the Greek branch of the *Women In Film and Television* international community (WIFTi). The department also aims at creating a network of collaborations with institutions, festivals and museums in the fields of audiovisual and digital arts: in this direction, it collaborates with the Thessaloniki International Film Festival for the organization of Evia Film Project, a branch of the festival promoting Green Cinema that will take place this summer in North Evia, an area affected by the disastrous fires of 2021. During the event the students will have the

chance to attend lectures, workshops and screenings focusing on climate change, ecological topics and green audiovisual creativity.

Curriculum, personnel, Infrastructure

The curriculum provides students with both a theoretical grounding and a practical skill set pertaining to the fields mentioned above. The curriculum includes modules on art history, philosophy, communication and new media, film history and theory, visual literacy and composition, digital modelling and production techniques (e.g. 3D modelling, animation), programming and IT, the Internet of Things, music production, sound design, film-directing, cinematography, screenwriting, editing, production and post-production, etc. Furthermore, a series of modules spanning all years of study revolve around the theory and practice of digital art production; these modules act as the backbone of the undergraduate programme, allowing students to constructively combine and apply the knowledge and skills they obtained in the rest of the courses on the curriculum.

The variety of the courses offered ensures that graduates will be well equipped to participate effectively, efficiently, and with the necessary intellectual independence and maturity, in the film and media industry, in artistic production, and even more technical fields such as Information Technology.

The two main corollaries of the curriculum are cinema studies and digital arts; a key identifying characteristic of the department is the interplay between these two basic pillars in an attempt to provide a holistic coverage of this emerging area. In this, the department occupies a rather unique place in Greek higher education.

The department offers a four-year (8 semesters) undergraduate study programme that leads to a BA degree. A number of mandatory and elective modules are on offer. The curriculum also includes a mandatory final dissertation project, to be undertaken individually. Through the selection of appropriate elective modules, students are free to experiment towards formulating their own artistic methodology and practice and to shape their academic profile and develop their digital design and production skills according to their interests and inclinations.

Faculty members are associate and assistant professors on subjects including: Film Direction and Cinematography, Editing and Compositing, History and Theory of Film, History and Theory of Contemporary Art and Digital Art, Interactive Arts, Ubiquitous Computing and Interactive Installations, Sound Design and Music Technology, Information Technology, Immersive Arts, Communication and Digital Media. On a yearly basis, post-doctorate fellows and accomplished professionals are selected in order to complement the above faculty members in supporting educational activities and in particular artistic creation and production classes

The department's infrastructure includes five educational laboratories focusing on supporting the following creative activities: Multimedia technologies lab, Film-direction and

audiovisual production, Film and video editing, Sound recording and editing, Digital Art and installations, Virtual and extended reality laboratory, Ubiquitous, physical computing and 3D printing.

Cinema and Audiovisual Arts

The curriculum includes a range of established courses in film studies, such as film history and theories, that are enhanced with challenging theoretical frameworks and more inclusive approaches in order to keep up with current needs of the students regarding film cultures and aesthetics. Courses on international film history cover a diverse scope on world cinemas, film movements and waves, the concepts of arthouse, experimental or mainstream cinema production, distribution, and exhibition. Focusing on the relationship between society and film production, the courses combine multiple perspectives (aesthetics, ideology, technology, economy) to explain cinematic processes and practices.

Furthermore, in courses on audiovisual language, film aesthetics, audiovisual narration, and film genres, students can combine theoretical knowledge and documentation with artistic creation and research. The video essay as a form of assignment in both theoretical or practical courses is strongly encouraged, so that the students can practice their skills in audiovisual expression and adopt an attitude of complementarity between theory and practice. Courses on scriptwriting, storytelling, structure, and narration, including storyboard and moodboard techniques, also aim to combine methods of creative writing with professional expertise required by contemporary procedures in the film industry.

The core focus of the cinema modules is film production: after completing a series of introductory courses, students can choose from a range of practice-based courses and workshops. These cover the fields of digital film-making, cinematography, audio recording, sound design, editing and all stages of audiovisual production and post-production. After following these courses, students should be able to shoot, direct, edit and complete short audiovisual projects (video art works, documentaries, short fiction features, web videos, animation films etc).

Digital arts and new media

The exploration of new media forms and practices for the purpose of encouraging and facilitating artistic expression and production is one of the main aims of the Department. The curriculum includes courses on the subjects of game design and development, 3D modelling and animation, non-linear narratives, virtual environment design, ubiquitous computing development, new media theory, media studies and communication theories, and web design and programming. A wide array of foundational theoretical knowledge, combined with accompanying practical skills, is considered an essential requirement for artists, designers, and media content creators: visual design, painting, plastic arts are fundamental courses of the curriculum

Specifically, one can identify the need to equip practitioners with a deep and intimate knowledge and understanding of the foundational principles of media (in their various forms) and their impact, at both the individual and the societal scale. This is necessary so as to appropriately frame technological innovation in a manner that will allow for a fruitful and meaningful interchange between artistic theory and practice and, ultimately, lead to the creation of high-quality artworks in line with both the capabilities offered by novel human-computer interaction paradigms and the

sensibilities and considerations that normally characterize artistic expression regardless of medium.

In addition to the above, the Department does not neglect its role as an academic institution, aiming to equip its students with the knowledge and skills necessary to attain intellectual independence and conduct high-quality academic research in the multidisciplinary field it occupies, by using artistic practice both as a target and a vehicle for advancing knowledge. In this manner, the Department addresses an important issue in art education, namely the combination of sound academic practice (targeting the advancement of knowledge around a multidisciplinary field of study through scientifically rigorous methods) with the liberty associated with creativity and artistic expression.

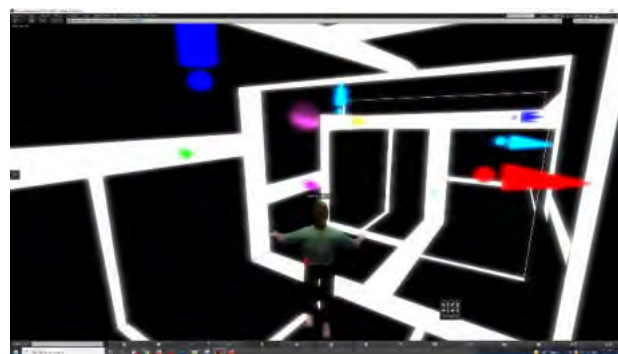


Figure 1. Virtual environment series of compositions in OpenSim by 2nd year students: E. Kovatsou, A. Mavridis, G. Christopoulos, A. Gerontis, K. Tzanaki, D. Avgerinou, I Thomopoulos



Figure 2. "The sound of balance", interactive sound installation by 3rd year students: M. Arakelian, N. Tasiopoulou, S. Charamoglou.

Data, AI and Design in Sustainability

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Abstract

This presentation will introduce an educational program called “Data+AI+Design” that includes a series of workshops and guest speaker lectures in the intersection between art, design, technology, and sustainability. The topics specifically include the use of artificial intelligence (AI), data analysis, data visualization, interaction design, and interactive media technology to address the issues and solutions in sustainability. Many internationally recognized scholars, artists, designers, and researchers participated in the events. Students had chances to learn how AI impacts the design and what they can make out of the current AI technologies for design solutions for sustainability in many approaches.

Keywords

Data, AI, Design, Sustainability, Machine Learning, Data Visualization, Data-driven design, interdisciplinary design, education

Introduction and Background

Big data analysis with artificial intelligence (AI) is significant to predict the future and investigate hidden narratives in the dataset. However, AI is often challenging for art and design students to link to their creative practices. To resolve the fear about the new technological term and engineering methods, the design department in San Jose State University proposed a program called “Data+AI+Design” [1] that includes guest speaker lectures and workshops led by international artists, designers, and researchers. They are experts in machine learning and work in conjunction with art, design, artificial intelligence, and data. Guest speakers who have been working on topics related to sustainability have been invited to the program to ask to share their thoughts, experiences, and artistic practices to address the design in sustainability with the students. SJSU students, faculty, and guest speakers had chances to exchange ideas, discuss various topics about data and AI, and explore various methodologies to create interactive design prototypes. The discussion on both workshops and lectures also shed light on the ways in which artists/designers are incorporating AI in their practices to explore post-information age themes such as the ethical issues of artificial intelligence, data-driven design, new user experience design in the development of AI, and possible solutions for environmental/social issues. This presentation aims to present case studies of the program “Data+AI+Design,” focusing on aspects of design education, sustainability, creative use of artificial intelligence in art and design based on various events of the program and archives.

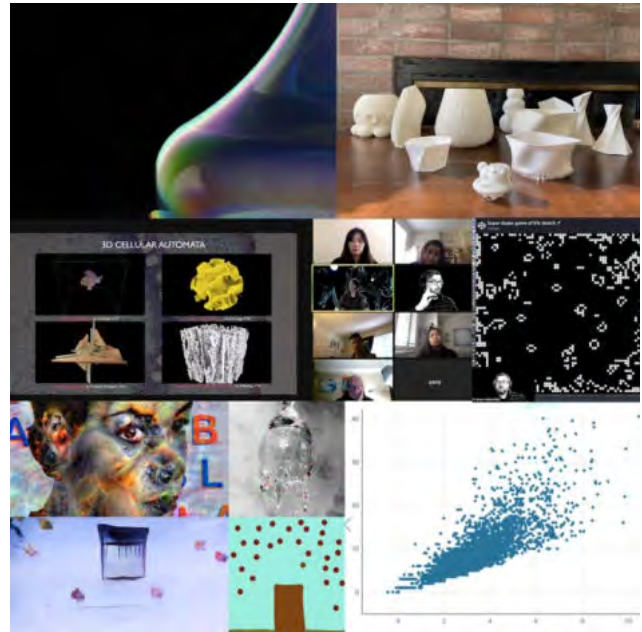


Figure 1: results of the “data+ai+design” workshops

Data Art and Technology: Program Details

Future Artifact Design

In this collaboration between the Design Department and Chemical and Engineering Department, groups of engineering students and design students worked together to conceptualize, plan, propose and design an additive manufacturing technique, scrolling website and mobile app for a 3D printed product invented with future technology, including but not limited to artificial intelligence, machine learning, augmented/virtual/mixed reality, robotics, haptic technology, future materials, smart display, and bioengineering. It addressed an important social or environmental issue.

Introduction to Exquisite 3D Printing

This workshop led by Dahn Gim was a basic introduction to Computer Aided Design (CAD) using Fusion 360 and 3D printing. During the lecture, students were introduced to types of 3D printers and software, and then the process and CAD-to-printer workflow of designing a 2D sketch and transforming it into a physical 3D object from scratch using Fusion 360. Final designs were printed with recycled 3D printing filaments.

Autonomous Complexity in Life and Machines

During the workshop led by Haru Ji and Graham Wakefield, students learned that a Cellular Automata (CA). [2] Students

examined the nature of CA by building John Conway's Game of Life [3] through web-based JavaScript editors to make lines of script which explore the Game of Life's essential components and how they can lead to precarious, emergent, and resilient systems. CA demonstrated clear examples of how non-living machines can give rise to emergent behaviors seen in life. The CA model is a foundation of fields of Artificial Life and AI Complexity, as well as interdisciplinary and generative art and design practices.

Co-Creating Art with AI using Machine Learning

In Eunsu Kang's workshop, students used machine learning browser applications to generate text and images for creating their own book, emphasizing that artmaking with machine learning allows countless creative opportunities in areas including dance, literature, music, poetry, and sculpture.

Storytelling with Environmental Data through Information Design

This workshop led by Steven Braun allowed students to take multiple data sets of pollutants in different cities and create meaning with them through their own ways of visualization. Through a step-by-step process, students answered questions on the data to help interpret and understand the data. Afterwards, students took the data of two cities and put them through a graph visualizer to view differences in levels and distributions. This allowed students to ask their own questions about why these data sets were shaped the way they are and why they were different between different states, inducing the need to research to solve these questions and create further visualizations to create a storytelling medium.

Discussion and Conclusion

This program has been exploring various design approaches about understanding and visualizing data using AI. The events reached out more than 400 BA Design studies students in San Jose State University. Furthermore, this program includes interdisciplinary collaborations between engineering and art students. This project also stimulated possible curricular innovation and collaborations in conjunction between art and science and providing educational opportunities to students. This project benefited students as they worked closely with professional designers, internationally known designers/artists/engineers and had chances to share ideas and prototypes and intercultural engagement. All the events were student-oriented activities. This project also enhanced students' understanding about interdisciplinary fields as AI, data science, materiality, future technologies, and user experience design are key topics. Throughout this series of workshops, students were able to learn about new directions and approaches in the fields of art and design, which impact to their possible fields of future career. All the

outcomes and activities became good portfolios for students who pursue their careers in Silicon Valley. Students were also able to address the real-world issue in the forms of design research through diverse approaches, which led the students to conversations with their peers, campus communities, international design professionals and local visitors.

This program is on-going campus event and there will be more guest speaker lectures and workshops held on campus. In 2022, there are three events scheduled and guest speakers include Laurie Frick (data artist), Eunjoon Kim (UX design lead at Google HQ) and Weidi Zhang (media artist). Although this program arises from the academy, the scope and activities of the program does not intend to be closed in the academy and it will expand to the community through collaborations with local community, art organizations, and incorporations. There are active discussions in progress with local art museums for collaborative workshops and artistic activities. The updated and expanded contents from this program will be also shared with the public, artists, educators, and students through an archived website and documented book.

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Acknowledgements

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Author's Biography

Yoon Chung Han is an interaction designer, multimedia artist, and researcher. Her research includes data visualization, biometric data visualization and sonification, a new interface for musical expression, and multimodal sensory user experience design. Her recent research focus was on multimodal interactions using body data, in particular on creating a personalized experience in media arts using biometric data visualization and sonification. Her works have been presented in many international exhibitions, conferences, and academic journals. She holds a Ph.D. at the Media Arts and Technology, UC Santa Barbara, and currently is an Assistant Professor in Graphic Design at the Department of Design in the San Jose State University.

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Abstract

Since June 2021, the Universitat Politècnica de València (UPV) has a Vice-rectorate for Art, Science, Technology and Society responsible for creating a participatory and socially responsible community. The programming of its activities is aimed to comprehensively train students through transdisciplinary programs, associative, sports, volunteer activities, etc., related to the Sustainable Development Goals, based on the principles of equality, diversity and social inclusion.

Among the functions of this vice-rectorate's office are promoting a participatory culture, preserving heritage, promoting open science, fostering University Social Responsibility (RSU), favoring solidarity and social commitment, guaranteeing equality and diversity, integrating people with functional diversity, support permanent education and encourage graduates to continue their links with the UPV.

Keywords

TRANSDISCIPLINAR, STEAM, EDUCATION, ACTS, NEW MEDIA, RRI.

Introduction

The Vice-rectorate for Art, Science, Technology and Society of the *Universitat Politècnica de València* (UPV)¹ is a commitment of the Rector José E Capilla-Romá to draw connections between science, technology, art, and culture within the university, making that these connections contribute to the development of the local socio-cultural and economic context, as well as its international projection.

Art, Science, Technology and Society at UPV

Integrating artistic training in a polytechnic campus has allowed to build, over time, a unique ecosystem to approach training and research from an interdisciplinary point of view. Our project also incorporates the commitment to equality policies, sustainable development, and the climate emergency. As example of this interdisciplinary approach, UPV Spontaneous Generation program² has student's initiatives which have achieved deserved recognition in international competitions such as Hyperloop³, IGEN 2018⁴ or Azalea⁵.

The Vice-rectorate for ASTS wants to promote a new culture of collaboration in Art-Science-Technology that contributes, from equality and diversity policies to social

development. It will be a space for connection between culture, science, technology, and the sustainable development goals (SDG). For this reason, the office of social action, and the office for equality, culture and heritage work aligned to our goal, being this multiple and synergic view that reinforces our university's commitment to social responsibility in all its aspects.

When we were studying for our degree in Fine Arts, some time ago, José María Yturralde transmitted to us with enthusiasm these initial 60's interdisciplinary ideas, and in some way these key ideas have shaped us. We now feel the need and responsibility that we must give back what we have learned. The space that we must give ourselves as institution in the university must be an open place, where the wind circulates mixing knowledge, expression, exploration, and communication. We want to use all the physical spaces that can display these activities -which go beyond academic routines-, spaces open to the university community and citizens to promote interdisciplinary communication.



Figure 1. José María Yturralde preparing a flying structure to start the flight, 2022.

Future vision

The goal in 2025 is for UPV to develop transdisciplinary and research training programs, involving citizens in an innovative and responsible way in raising knowledge to face future challenges.

To achieve this future vision, we must promote COLLABORATION withing the university, creating transdisciplinary groups that address the Art-Science-Technology intersection as a strategic setting for research, development, and the generation of innovation in society. One of the

¹ Universitat Politècnica de València website <https://www.upv.es>

² Spontaneous Generation website <https://generacionespontanea.upv.es>

³ 1st Prize in Design category. SpaceX's Hyperloop Pod Competition Design Weekend 2016. <https://hyperloopupv.com>

⁴ Grand Prize Winner, Best new application project, Undergraduate finalist, Best Wiki, Best Hardware, Best Software and Best Model in 2018. http://2018.igem.org/Team:Valencia_UPV

⁵ 1st Prize in Architecture category, 2nd in Energy Efficiency and third in Engineering and Construction in Solar Decathlon Europe competition 2019. <https://www.azaleaupv.com/>



Figure 2. UPV Receptorate, *Women in science* mural: Margarita Salas.

first actions to take place, it has been to launch an internal call PC_ACTS 2022 with the aim of overcoming dissociation of knowledge to bring them together for transdisciplinary collaboration, promoting groups that relate art, science and citizenship, or fields that require the connection of aesthetic, scientific and social solutions which are formulated as inclusive and transformative proposals related to the 2030 Agenda and the 17 SDGs (Sustainable Development Goals). The selected proposals will also serve as seedbeds for future broader projects that point to new cultural dimensions in sustainable development policies.

Another goal is the promotion, through Artistic Residencies in Laboratories and Research UPV Centers program, the creation of projects that explore new perspectives on the role of science and technology in ways of life, addressing ethical, aesthetic, and social responsibility issues. The first Residency will be held at the Institute of Molecular and Cellular Plant Biology (IBMCP), a non-profit public research institution with more than 30 years of experience, which seeks to respond to global challenges facing humanity, such as producing food with less consumption of resources, obtaining crops with better adaptation to climate change, producing vaccines and medicines in plants, or recovering the traditional flavor of tomato in current varieties, among others.

The Residency will be carried out in three phases: during the first one, the artist will contact to the IBMCP

Authors Biographies

Salomé Cuesta. Vice-rector for Art, Science, Technology and Society (UPV) and María José Martínez de Pisón. Director Cultural Action Area (UPV)

Since 1990, the Group Light Laboratory, located in the Faculty of Fine Arts in Valencia, has functioned as a meeting, study and research space for aesthetic and expressive principles linked to the light-image.

Currently, the components of the laboratory belong to different departments and their participation varies depending on the proposals that are being developed: working between the collective and the individual, between university research and artistic activity, between the production of projects and the dissemination of

researchers, who will act as mentoring. In the second phase, he will be able to work on the development of the proposal in the facilities of the Faculty of Fine Arts; and during the last phase, the Residency will present the project to the public at the IBMCP facilities at the UPV, and at the Centre del Carme Cultura Contemporània CCCC (Valencia).

Laboratory of ideas

With these initiatives we seek that *Unviuersitat Politècnica de València* campus held its own "laboratory of ideas", a dynamic and open space that supports the initiatives of its faculty staff to create knowledge spaces open to society, being a place for debate and participatory action that will contribute to reflection on real world problems; and that this laboratory actively participates in the search for solutions to social and environmental challenges.

Universitat Politècnica de Valencia, as public body, is devoted to responsibility and commitment to sustainable scientific, technical, cultural, and social development.

Acknowledgements

José María Yturralde, Centre del Carme Cultura Contemporània CCCC (Valencia) and Institute of Molecular and Cellular Plant Biology (IBMCP)

texts, as an area open to those who want to develop their work under this interdisciplinary structure.

Art-Science Cooperations at the Institute for Advanced Sustainability Studies (IASS) (Institutional Presentation)

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Abstract

The Institute for Advanced Sustainability Studies (IASS) in Potsdam (Germany) conducts research with the goal of understanding, advancing, and guiding processes of societal change towards sustainable development. Our researchers collaborate with diverse actors from science, policymaking and public administration as well as arts to develop a common understanding of sustainability challenges and generate potential solutions. Artists can work at the Institute as part of the Fellow Program or get in touch with the platform “Art-Science Cooperations for Sustainability” if they are interested in a collaboration with researchers in a specific project. At the IASS we also conduct research with the goal of understanding the role and transformative potential of art in societal change.

Keywords

Art-Science Cooperations, Sustainability, Fellow Program, Platform, Societal Change, Transformative Potential of the Arts

Introduction

Societal change towards sustainable development is one of the most important challenges of our time. It is neither only a task of politics nor of science but of the whole society. Therefore, the Institute for Advanced Sustainability Studies (IASS) in Potsdam, Germany, pursues a research approach that is transformative, transdisciplinary, and co-creative. Such a research approach is not possible without collaborating with diverse actors from science, policymaking and public administration as well as business, civil society and arts.

The fact that there is a special focus on collaboration with artists at the Institute is relatively new. In recent years, some artists have come to the Institute as part of the cross-disciplinary Fellow Program, but there has been no promotion of art-science collaborations beyond that and no research on

the role of the arts in processes of societal transformation. This changed in October 2021 with the creation of the platform “Art-Science Cooperations for Sustainability”.

Art-Science Cooperations for Sustainability

Transformations are processes of fundamental change. As such, their scope is not limited to issues of substance. Rather, it extends to matters of design and form, and values and perceptions. Expertise in the broad field of aesthetics can be found among designers, scholars of the humanities and, above all, among artists. This is reflected in their growing involvement in and willingness to initiate projects to foster sustainable development - whether it be in the field of urban development, product design or organisational and process design.

What factors shape their engagement? What happens when artistic and scientific perceptions of sustainability collide? What criteria for success do different stakeholders apply and how can they be reconciled? This research group pursues these and related questions not only by 'studying' existing initiatives, but also by initiating, accompanying, connecting, and supporting ground-breaking collaborations between artists and scientists. In the process, the group seeks to forge connections and foster understanding between current issues and perspectives in sustainability science on the one hand, and the dynamics and interests of the cultural sector on the other.

Collaborative projects initiated in this context will ideally result in new artistic formats and interdisciplinary publications and will help to build transdisciplinary networks and facilitate public dialogues on how the creativity of the arts can better contribute to transformations towards sustainability. In addition to the design aspects mentioned above, a particular focus is placed on artistic work that aims to both heighten our emotional awareness of the existential dimension of the planetary crisis and make it conducive to the

pursuit of change.

All artists who are working on sustainability-related issues and are interested in a cooperation with scientists regarding a specific topic are welcome to get in touch with the platform. The Institute for Advanced Sustainability Studies (IASS) wants also to encourage all artists who are interested in staying for some months or a year at the Institute in Potsdam, Germany, to apply for the Fellow Program.

The Fellow Program

The IASS Fellow Programme is inspired by the Potsdam Memorandum's call to gather all sources of ingenuity and inspiration from academia, politics, arts, business and civil society to address the sustainability challenges of our time. The fellows are a key resource for the institute; they support our research, improve our transdisciplinary methodology, and, together with our researchers, reach out to political, economic and social actors.

The Fellow Program is designed to bring highly qualified people to the institute, who provide expertise, inspiration, and creative input. In return, the IASS offers fellows the opportunity to develop their ideas in an international community of world-class researchers, within the institute as well as in the wider research landscape of Potsdam and Berlin. The fellows are actively supported in their endeavours to make new connections and to develop new ideas and activities together with IASS researchers.

About 30 fellows come to the IASS each year. A public call for applications is issued each year for the following year. Beyond that, the Scientific Directors may invite individuals from all over the world to collaborate with the IASS on specific themes and activities for a limited period of time. The IASS seeks individuals from all disciplines and areas of society, including politicians, journalists and artists. The public call is often geared to topics and questions on which the IASS wishes to focus attention over the course of the envisioned tenure.

Network and Future perspective

In the coming months and years, the platform "Art-Science Cooperations for Sustainability" will build a network of artists and scientists who work on sustainability issues and are interested in transdisciplinary collaboration with each other. For this endeavor it is very helpful that the IASS will become part of the Helmholtz Association of German Research Centers in January 2023. The Helmholtz Association is a union of 18 scientific-technical and biological-medical research centers and the largest scientific organisation in Germany. Its official mission is "solving the grand challenges of science, society and industry".

One goal of the group "Art-Science Cooperations for Sustainability" is to use the connection to give more space to art-science cooperations in the scientific operations of the

Helmholtz Association and to make the knowledge stored there more accessible to artists.

In order to promote art-science collaborations and to work transdisciplinarily on sustainable development, the IASS is interested in any form of exchange: be it with artists and scientists interested in collaborations or with institutions pursuing similar goals.

ISEA2022: BAJO EL OLIVO (International Creative Artist Residency), Institutional Presentation Submission

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Abstract

“Bajo el Olivo”, *Under the Olive Tree* is an international creative artist residency that emerged through the pandemic lockdown and unfolded with the migration and (re)location of a creative practitioner and her partner from Australia to a rural location in Andalusia, Spain. The residency is a platform that emphasizes a more embodied connection with our posthuman future; a concept that recognizes ethnographically that within the grave ecological crises and the pandemic condition, we (the human species) are endangering our coexistence with other species and how diverse organisms are entangled in political, economic, and cultural systems we have initiated.

The residency is designed to foster the theoretical and creative ways that a radical entanglement is intra-connected with a situated perspective—one that flourishes as a transversal site for artistic events and research, building resilience in ecological continuity, community building and storytelling. Most importantly, bringing other forms of life into light to suggest that we have become ‘post-human’, since our mode of being is dependent on complex entanglements with animals, ecosystems, and technology.

The creative resident protagonists, visitors who are mapping the terrain with other multi-species (human and non-human in nature) are the collaborators. In this context, they are contributing to the artistic, philosophical, methodological, and sociocultural matter that takes place in a transformative site for creative practice. This method of thinking suggests that (re)working the relational thought of working with other(s) in performative field work, can produce unexpected ruptures in dominant thinking about nature and culture. Besides being non-human, ‘creatures’ can be regarded as parts of society that move

past questions of representation and abide with us in multi-species worlds.

Keywords

New Materialism, Making Kin, The Posthuman, Critical Posthuman knowledge, Environmental Humanities, Anthropocene, Capitalocene, Ecophilosophy, Feminist Materialism, Deep Ecology, Gut Metabolism, Social Engagement, Spatial Practices, Visual Arts, and all forms of experimental Sonic Art practices.

Inception

“May the spring of a foreign river be your navel. May your soul be at home where there are no houses”. Ursula K. Le Guin, *Always Coming Home*. [1]

This institutional submission is designed to foster the theoretical and creative ways that an artist residency is intra-connected with a situated perspective: one that flourishes as a transversal site for artistic events; building resilience in ecological continuity, local community building and social engagement. Most importantly, bringing other forms of life into a creative proposition suggesting that we have become ‘post-human’, since our mode of being is dependent on complex entanglements multi-species, ecosystems, and technology.



Figure 1. Local Spanish Resident Artist, Choreographer, Maria del Mar Suarez (Chachi) ©Juliana España Keller.

Visiting guest residents are creative protagonists contributing to the artistic, philosophical, methodological, and sociocultural matter that takes place in a transformative site for creative practice.¹ This method of thinking suggests that (re)working the relational thought of working with other(s) in performative field work can produce unexpected ruptures in dominant thinking about nature and culture. In our post-pandemic future, to walk mindfully is to converse with ‘vital matter’ [2]. In its emergent growth, the vitality of the artist residency, is rooted in a circular relationship for the practice of research-creation artworks where artists are using the residency as a speculative thinking space for practice-led research merging with a ‘slow’ infrastructure—in the doing and making of artwork; inclusive of how humans can listen and relate with the articulations of nonhuman beings and living systems.

(Re)newed Speculation on ‘Home’

‘Home’, has become a ‘refuge’ in post-pandemic time and speaks to the future of human life. This small parcel of land is a model of sustainability, and an exploration of non-exploitative methods of production to connect, to exchange, to consider traditional know-how, sense, and insights as ways of understanding ecologically embedded perspectives on embodiment and create connections between embodiment, rural labour, and ecological sensibility.

¹ “Let the arch of your feet be the mountains. Let the paths of your fingertips be your maps and the ways you go be your palms”. Le Guin, Ursula K. 1.



Figure 2. Sound and Food Workshop with Gazpacho ©Juliana España Keller.

Other artistic research-creation projects can include terms of embodiment that are influenced by the ideologies of separation and fragmentation imposed by colonialism and neo-capitalism. *Bajo el Olivo* promotes deep listening to the earth and is situated as a ‘becoming’ by thinking with the ecologies of ‘care’ and ‘hope’, making kin. With this mind body connection puts into motion, a speculative process that seeks the all-too-human desire to see concordance between two mandates—the desire, that we happen to occupy a privileged place within this spatial relation and two: the residency becomes an expanding network of users, collaborators and partners who come together to work on the land, share resources and local knowledge around a community economy.

To keep it ‘local’ as an Ecophilosophy is indicative to connecting the invisible majority where ‘labor’ is a profound connection to the land. How can we generate a (re)newed approach to creation, sustainability, and creative methods of artistic practice as a site of imaginative space-making and radical change? To (re)generate creative possibilities for emergent relational forces that are situated in rural places and where ‘play’ and ‘thinking’, ‘doing’ are working and possible. [3]

Where The Meaning of Entanglement Meets the More-Than-Human.

This entanglement upholds that there is a way to bring farmers, scientists, creative artist/researchers, and even artisanal bakers together to connect, exchange processes as a transdisciplinary approach in a ‘nomadic encounter’ [4], not a solution. Our sense of being in the world, and our sense of the natural world is motivated and made meaningful not merely by unconscious reaction and instinct, but by individually imagined and collectively produced symbolic structures, which is to say beliefs and ‘more-than-human’ stories between the earth and our bodies, indigenous knowledges, historicides weaving sensory data, feelings, and a desire to merge into a composite spatial, temporal, and social world that is entangled with micro-communities and the natural world. By experimenting with different modes of storytelling, the human species is now exploring ways to being other species and ways of thinking into an interspecies relationship. As Australian scholar and anthropologist, Eben Kirksey states: “which beings flourish, and which fail, when natural cultural worlds intermingle and collide”. [5]

Thereby, this creative artist residency takes on a more cosmic point of view where our mutually constituted sense of the collective now—is changing into something else, perhaps no more or less than a new world, a new now, a different collective sense of human life. Our human dependence on environmental health and ecological diversity as a communitarian vision of small-scale non-hierarchical social organism such as an artist retreat offers, at such, a robust fiction as a strain of radical ecological thought in an environmentally attuned philosophy or deep ecology.



Figure 3. A home-grown turmeric root rhizome ©Juliana España Keller.

American Theorist, Donna Haraway has always rooted her co-existence with the human-non-human world as a “radical hope” [6]. We might call it, a commitment to a future existence which by definition cannot be described but should be explored. If one recognizes that we cannot know how climate change and ecological catastrophe are going to transform our world, how human civilization will change in response, how will human beings adapt to the new world of the Anthropocene, or who we will become in the future.

Creating a Sensory, More-than-Human World

Canadian Affect theorist, Brian Massumi puts forward the idea of ‘touching’ as affecting and being affected by what a body can be or do and illustrates intra-textually the capacity to act and be acted upon. For Massumi, Affect involves the transitions a body takes when it steps over a threshold and is a dimension of life enacted in such processes. Reading, writing, and creating in the world as sensory, intimate, and of the body is propositionally about intensities, moving toward the other, and being open to the “more-than”. [7] In this creative residency, guest residents are asked to propose how these concepts excite the senses which expand the body and its abilities, to exercise how we perform with each other and co-create on the earth.

Furthermore, American Feminist New Materialist theorist, Karen Barad proposes that mat-

ter matters—it is both of substance and significance and views/sees matter and discourse as inextricably entangled. [8] For Barad, matter is not passive and inert, but a lively participant in the world’s becoming. In this way, radical entanglement for artists working out in the field, closer to nature; can explore how the experience of embodiment is embedded within the larger body of the earth through art works that sow seeds between somatic, audiovisual, and intra-textual material ways of knowing in attuning to the human senses and the non-human world.

This movement towards a deep ecology of thinking can include the sentient presence of food production—the baking and breaking of bread collectively, to gut metabolism (working from the gut), and other non-human ecologies of nature such as collaborative bee-keeping and co-producing honey as food. The residency is interested in artist propositions that document and articulate the shifts of perception unfolding to attune our human senses to the sentient presence of the topography of the land, colonial histories, traditions, rituals, weather patterns, soil, food practices, food production, food security, manual labor, women’s labour, and the many other nonhuman living systems within this assemblage of performative activisms and choreographies that can be performed in spatial practices.

We are All in this Together (under the Olive Tree)

I would argue that the (post)colonial logics of speed and convenience are also manifest in much of the art world creating ease for some and harm for others in a hierarchal, elitist infrastructure. Addressing many of the environmental crises that we are now entangled with requires, I propose, encouraging a slowing down to grasp the notion of labor as working from the gut, where a ‘slow’ metabolism provide creative possibilities that consider an attunement to the earth as rather a relation of co-composing with the “more-than-human”. This reflects on how our relationship with other forms of life can be reconfigured and accountable as a site of transformative potential for creative practitioners through direct engagement with the earth, community—the contact with local artists, artisans, gardeners, beekeepers, farmers where storytelling in time, space mattering and the future architecture of “home” as a refuge is a

becoming that enforces a (re)imagining that is rooted in participatory art practices.

Artists that become a part of this residency can intra-sect and converge with deep ecologies relational to the concerns of a rapidly changing environment, shrinking natural resources and the realities of climate action. Far from perfect, this refuge is not immune to the rest of the world. This small parcel of land is being used to experiment, create, and share stories for a future world, to imagine posthuman futures and critically challenge pre-existing structures of thought where complex assemblages of matter exist and intra-act to challenge the discordant systems of city life and the dynamics in which we are currently entangled in.



Figure 4. Local Spanish Resident Artists, Sound Artist, Selu Herraiz and Percussion Instrumentalist, Takuto Yanagawa in studio ©Juliana España Keller.

From an activist position, as a practicing sound and performance artist, myself, I consider art and the natural environment as a participatory collective model or working with, rather than, working for. This method of collaboration forms a transdisciplinary perspective inhabited by varied and vibrant forms of matter and like-minded intersectional practitioners and thinkers in a dialogical exchange. In turn, environmental activism, which advocates for a world with biodiversity, avoiding toxic impacts, can be adopted as an underlying ethos and aesthetic

response to transdisciplinary approaches within the fields of visual arts and other intermedia practices to be shared with.

To conclude: this residency empowers residents to use the sensing body to explore the potential thousands of distinct material ecologies embodying a symbiotic relationship with the natural world and its creatures and multispecies. This creative convergence sets up an alternative ecology of matter and meaning through weather variations, growing patterns, storytelling in a site-specific latitude on a small parcel of land in Spain.

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Balance-Unbalance. Ecology and Citizenship

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Abstract

The frequency and severity that certain weather and climate-related events are having around us are increasing, and the ability of human beings to modify our adjacent surroundings has turned into a power capable of altering the planet. Do the media arts have a role in all this?

Keywords

Environment; climate change; biodiversity; Red Cross Climate Centre; art-science; art and environment; eco-action; ecology; transdisciplinarity.

We seemed to be in balance

When it comes to thinking not only of ourselves but also of what some call the common good, questions arise about what it is, who defines it, how, and when, among other aspects.

It is challenging to recognize fragility. To think that in order for food to reach the supermarket, the necessary events are sometimes dependent on a complexity that is unthinkable for most consumers. That to appreciate a piece of music that we can collectively perceive as being of quality, each instrument needs a history, its performer of years of intellectual and biomechanical training, and the work of a creative composer is of fundamental importance, of course, too. And that for having high-speed Internet at home, the chain of efficient pieces of technology that need to work is not less than astonishing. The individual actions, and the long series of events that eventually lead us to have systems that work to help us, solve problems, and live better, often pose fundamental conceptual issues to us.

The humans' delicacy and the systems that we have been building through millennia become clear when abruptly, the usual and traditional reality is transformed and collapses. There are individual and collective consequences when the system we trust stops behaving as we wish. A health crisis on a planetary scale affects millions of human beings as I am writing these lines. While many people want to return to the previous state, others see what is happening as a turning point that will substantially improve our lives. We can also consider that what is happening puts us all in a unique social and citizen laboratory, more than ever.

The current pandemic is not the only human species challenge, for sure. There are others, such as global changes due to the effects produced by an increasingly complex environmental situation.

An idea to promote and develop activities to help us reflecting and carry out actions focused on improving our relationship with the planet we inhabit was crystallized in 2010. When we need solutions, we look to engineers, doctors, lawyers, physicists, but not composers or sculptors. However, when we try to design a possible future, understanding our present better by studying the past, our ancestors' art and culture are what it mostly remains to understand and learn from them.

The work between experts in different disciplines but with a broad criterion that would allow and facilitate the construction of a transdisciplinary research-creation culture could be a peaceful and, at the same time, a revolutionary path of development, increasingly harmonious. Thus, the Balance-Unbalance (BunB) international project arises to facilitate the meeting between scientists, artists, engineers, experts with varied experiences, and representatives of non-governmental organizations who look for new collaborations to reflect on the future. And we know those reflections need to lead to critical actions since the deadlines are shortening.

Turning Point

We are living in a world reaching a critical point. The equilibrium between a healthy environment, the energy our society needs to maintain or improve its usual lifestyle, and the world's interconnected economies have recently passed from a delicate balance to a new reality, where unbalance seems to be the rule.

It is clear now that traditional disaster management approaches are not enough to deal with the current problems and the rising risks. New forms of collaboration are needed to inspire people and organizations to link knowledge with action.

Artists could inspire new explorations and contribute with innovative perspectives and critical thinking to actively participate in solving some of our major challenges, such as the spiraling environmental crisis. We need to develop creative ways to facilitate a paradigm shift toward a sustainable tomorrow. Creative thinking, innovative tools, and transdisciplinary actions could produce perceptual, intellectual and pragmatic changes.

One of the initiatives that aim to use the media arts as a catalyst, with the intent of generating a deeper awareness and creating lasting intellectual working partnerships to face the many facets of the environmental crisis is: The *Balance-Unbalance* international project.

Balance-Unbalance

The *Balance-Unbalance* international conference project explores [art, science, technology] intersections between nature and society.

The first conference was held in Buenos Aires, Argentina, in 2010 and was hosted by the National University of Tres de Febrero. Papers were delivered by artists, a representative of the National Secretary of Environment and Sustainable Development of Argentina, experts and graduate students from different universities with chemical, agricultural, and environmental engineering backgrounds (specialists in pollution, renewable energies and food technologies), a lawyer, a sociologist, and an astrophysicist, coming from Argentina, Brazil, Canada, and the US.

The second *Balance-Unbalance* was held in 2011 at Concordia University, in Montreal, Canada. In 2013, the third edition of *Balance-Unbalance* showed the potential of the actions carried out. The expected catalyzer started to work better each time, and the media arts were helping to lead the way in connecting people, projects, and actions. This time the conference was held at the Noosa Biosphere, an ecological reserve recognized by UNESCO. This biosphere is a dynamic learning laboratory for sustainability in one of Australia's most pristine and diverse environments. An e-book with some of the papers presented at that conference was published and can be downloaded for free [1]. The conference theme: "Future Nature, Future Culture[s]" aimed to challenge our expectations of Earth, provoke our understanding of nature and inspire our actions for a sustainable future. *Balance-Unbalance* proposed that we ask ourselves: "What will we be calling 'nature' in 20, 50 or 100 years? How will we live in the future? How can creativity help us shape a society of understanding and interconnectedness? What role could transdisciplinary thought and action play in reimagining a sustainable future? Our limited knowledge of life can be expanded, but to do so, we need better ways to understand each other. This includes a deeper awareness of how different human societies can comprehend cultural differences and synergies" (from the *Balance-Unbalance* 2013 website). As in previous editions, [electronic] art was not only part of the papers presented in the form of theoretical analysis and proposals but also a substantial component of the event. Also, in the Noosa Regional Gallery, the Leweton Cultural Group performed traditional music and dance from Vanuatu's endangered islands. We were learning how *Balance-Unbalance* could help to give voice to some of the many underprivileged. The MIT Press has published fifteen articles on research and creation projects presented during this edition on *Leonardo*, the Journal of the International Society for the Arts, Sciences and Technology, on a special section devoted to *Balance-Unbalance* [2].

The fourth edition of the *Balance-Unbalance* conference was held in 2015, hosted by Arizona State University and its main focus was on "Water, Climate and Place: Reimagining Environments." The subject reflected the particularly relevant circumstances considering the conference's location was in the southwestern desert of the United States. In 2016, *Balance-Unbalance* was hosted by the University of Caldas in Manizales, Colombia. This city is part of the coffee-growing axis and is built in a mountainous region with seismic instability. A rich, changing and challenging environment, with a subtropical highland climate and an average of 1,500 mm of precipitation a year, allowed participants to have a contrasting experience considering the places where the previous conferences were held. The program included scientists, artists, designers, architects, leaders from the program *Sonidos de la Tierra* (Sounds of the Earth) mixing music education with entrepreneurship, the Land Art Generator Initiative collective, and organizations such as the Red Cross Climate Centre, among many others.

The 6th edition of the *BunB* conference was held in the UK, hosted by Plymouth University in collaboration with the North Devon's UNESCO Biosphere Reserve, Beaford Arts, the Eden Project, and Fulldome UK. A full visit to the Eden project, a complex dominated by two huge adjoining domes (one of them emulating a rainforest environment, and the other a Mediterranean one) offered an exceptional opportunity for the participants to exchange ideas, also helping to generate a growing sense of community [3].

Balance-Unbalance was held in The Netherlands in 2018 and had its focus on the theme: "New Value Systems - Sustainability and social impact as drivers for value creation." It was hosted by The Patching Zone with activities in *V2_Lab* for the Unstable Media and the Het Nieuwe Instituut of Rotterdam [4]. With tracks such as: Generating Urban Values, Ecological Impact as Drivers for Value, Creating Value Through Transdisciplinary Learning, Alternative Economies, and Social Impact as Driver for Value Creation, this 7th *Balance-Unbalance* incorporated aspects not explored in other editions. The Proceedings are available online for download from the conference's website [5].

In 2018, the *Leonardo* journal published a selection of 27 papers from the 4th (2015, USA) and 5th (2016, Colombia) editions of the *Balance-Unbalance* Conference [6] [7].

Today's difficult and uncertain context has brought a different approach to produce the 8th edition of *Balance-Unbalance*, avoiding postponing a new opportunity to induce reflections and produce changes related to our decisions and possibilities regarding the natural environment. This time the conference was held in 2021 using a blended modality (papers, roundtables and workshops online, plus an in-person exhibition in Valencia), joining efforts with organizations and institutions from Spain and Brazil, among other countries.

Once humanity can go over this pandemic, other significant challenges will come, and we need to reflect and act as soon as possible.

Conclusions

In this context of global threats: Can the [media] arts and artists help? Everyone has a role in the construction of the future, artists, too. We must search, investigate, reflect, and act. We can create, and we can also invite others to analyze, engage, envision and act. It is not possible to wait longer or to delegate personal responsibilities.

By bringing people from very different sectors of our society to think together and facilitate multi and transdisciplinary collaborative project developments, *Balance-Unbalance* and its associated initiatives are turning feasible to connect artistic creation and tangible tools for change. *Balance-Unbalance* has been contributing to make social transformation happen.

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Hexagram Network – *EMERGENCE/Y*

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Abstract

Over the last 20 years, Hexagram has played a seminal role in the recognition of practice-based art and design research in Canada and abroad, as well as in promoting knowledge-sharing between artistic and scientific disciplines. Founded in 2001, Hexagram supports research-creation projects and foster collaborations amongst its members from eight Québec research institutions, as well as with local and international partners from academic, cultural and creative sectors. To celebrate this milestone, in September 2021 Hexagram initiated an ambitious season programming on the theme *EMERGENCE/Y*, which launched in the framework of *Ars Electronica 2021*. This research-creation (RC) programme of activities will run until June 2022. Hexagram presents the highlights and the sequel to *EMERGENCE/Y*, to which Network members as well as international partners are invited to contribute.

Keywords

Hexagram Network; Research-Creation; Emergence; Emergency; interdisciplinary research; creation; Practice-based research; Media Arts;

Introduction

In 2021, Hexagram celebrates its 20th anniversary, just as its mandate was renewed by the Québec Government and its partner institutions for a new 7 year cycle based on a proposed programme aiming to catalyze collective, interdisciplinary knowledge and to engage publics with cultures and practices that address current urgent and global scientific and technological challenges. In the first year of this new cycle, however, the network also saw the arrival of the global COVID-19 pandemic. This context emphasized the necessity to collaboratively propose new knowledge, new imaginaries, and to harness desirable futures in a period that is characterised by profound change and a constant state of *emergence/y*.

EMERGENCE/Y

In 2021, it is now a cliché to say that we have lived through an “unprecedented year” - particularly when the state of the pre-COVID world was in many ways unprecedented. Yet, the combination of the global

pandemic and its resulting political-economic fallout, the continuing ecological crises, and the social-cultural explosion of long simmering systemic injustice and inequality have made the entangling of human, machine and natural orders ever more apparent, with radical consequences for all forms of life on this planet. The future appears uncertain, unstable, unsettling, and unknown.

How do we respond? The Métis University of Toronto STS scholar Michelle Murphy writes that “assemblies of technical practices have generated not just facts but also speculative phenomena that are a felt part of the world, even if intangible. How do speculative social science [or research-creation] practices produce a world where undecided futures are brought into the present?” [1] Murphy refers to this as “technoscience dreaming.” In other words, in an increasingly uncertain world, how can RC enable us to dream and trial new possible futures?

In order to address with reflection and action the wicked problems of our global situation, Hexagram has developed a thematic programme of activities from September 2021 to June 2022. We explore the role that research-creation can play in tackling these troubled times in order to offer new possibilities, hopes and visions of a more just, equitable and open future. Exploring hybrid modalities of presentation, discussion, and outreach, this season’s activities bring together Hexagram members and partners whose approaches are equally dedicated to addressing the current complex challenges through research situated at the intersections of the arts and sciences.

The institutional presentation of Hexagram Network at *ISEA* summarizes activities conducted and invites the community, especially partners in attendance to the follow-up exchanges, to continue engaging for the second half of 2022 and onwards with some of the groups and their themes initiated in the framework of the *EMERGENCE/Y* programme. Following up on the *Ars Electronica 2021 Hexagram Garden* [2] will be a call for future contributions.

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Abstract

The common understanding of modern scientific research becomes more and more difficult as activities are carried out in size and time ranges we cannot perceive with the naked eye. The key to understanding as well as creative new research ideas is often a visualization of these hidden processes. The Science Visualization Lab at the University of Applied Arts in Vienna, Austria specializes in making invisible scientific phenomena visible and disseminating this visual information in various ways.

Keywords

Scientific visualization, science, art, lab, computer animation

Introduction

In the early 2000s, Alfred Vendl, a natural scientist, and filmmaker used time-lapse captures of raster electronic images to study the formation of corrosion-inhibiting micro-layers on copper alloys and combined them with computer assistance into movies. The outcome were image sequences that depicted the dynamics of the layer formation. These visualizations were the first of their kind to be shown in scientific documentaries, which were produced on behalf of European and American television stations. One of the numerous documentaries, for example, was the TV series Nature Tech, for whose special visualizations the National Academy of Television Arts and Sciences awarded an Emmy Award in 2008. As a result of a longer success story, the Science Visualization Lab Angewandte affiliated to the University of Applied Arts Vienna was founded. In the lab, authentic visualizations are produced through the combination of scientific data and computer animation. Nowadays, the applied computer-animated scientific visualizations produced by the lab range from collaborations for interactive media installations and full-dome presentations to the latest immersive applications. The main field of activity of the Science Visualization Lab Angewandte is the production of narrative computer-animated scientific visualization for most diverse research fields. The lab is aiming to use the power of the visual to expand the human knowledge basis and foster creativity in various interdisciplinary research projects.

How might collaborators benefit?

In general, scientific visualizations enable understanding through computer-generated images. In research and in communication these visual aids are enormously beneficial. In particular, three-dimensional visualizations simplify the perception of complex coherences. These benefits can be used for the communication in fields as diverse as, for example, interdisciplinary science communications or patient to doctor information. There are numerous reasons to create scientific images, as for instance, [2] lists:

- As research becomes more interdisciplinary, illumination and intelligent images of your research will become more useful in communicating with those scientists outside your field of expertise.
- Using compelling and accessible pictures is a powerful way to draw the public's interest to the world of research. When the public develops a more intimate association with science the results will be both a richer society and one supporting the important efforts in scientific investigation.
- As you spend more time making these new images of your research to communicate to a larger community, you will see your work differently; you will expand the way you think about your work and therefore the way you envision it.

On the one hand, for research, a deep understanding is important, on the other hand, specialization is restricting the mind (compare [4]).

So-called "Renaissance Teams" are the geniuses of our time, the times of one individual who "knows it all" are over. Scientific visualizations provide visual metaphors and narratives to shape cultural thinking and offer people a scientific view of reality [1].

Complex theories and abstract concepts are driving the latest scientific findings. Visualizations can help in understanding and enable faster learning of new concepts. Scientific visualizations are means of human knowledge creation and transdisciplinary and interdisciplinary tools.

Research in computer graphics, interactive techniques, visualization, imaging, and design applications are seen as vital for making information sources easily accessible and were acknowledged as useful in promoting and fostering scientific, industrial, and educational collaborations [5].

Institutions performing scientific visualization and research can be seen as ‘in-between’ as they act as mediators and communicators. Healthy communication paths between all parties involved are important for collaborative processes.

At the Science Visualization Lab Angewandte, we are visual communicators not only digital image producers, that means our projects can be seen as gathering of knowledge and data. The data becomes transformed, while authentic core information from various scientific imaging sources are maintained.

Recent projects

The in-depth examination of science topics in combination with computer animations, which are based on data from science, repeatedly leads to new design worlds and exciting interdisciplinary projects. Data is often created specifically for the projects. The special founding history of the Science Visualization Lab in a former technical chemistry department of the University of Applied Arts Vienna created special opportunities and means for transdisciplinary work. We have the option of using a scanning electron microscope in-house, and we also maintain connections with imaging units at various universities.

These given conditions make it possible to bring art and science together in innovative ways. At the Science Visualization Lab, this is mainly done through computer-animated scientific visualizations of tomographically scanned microscopic entities that are woven into various projects. The distribution spectrum ranges from prime-time documentary films to full-dome projections to internationally successful art installations.



Figure 1: Two outcomes of collaborations of the Science Visualization Lab of the University of Applied Arts Vienna. Left: A presentation of “NOISE AQUARIUM”, Right: A photograph of a person enjoying the full-dome installation of the project “CRISPR/Cas9-NHEJ: Action in the Nucleus” ©Science Visualization Lab Angewandte.

Projects of the Science Visualization Lab use the possibilities between art and science to spread messages that are important for the future of mankind. The topics we have worked on so far were (and are), the greed of higher living

beings in “The first Greed¹”, plastic and noise pollution of the water bodies “NOISE AQUARIUM²” in cooperation with the Art|Sci Center UCLA and “LIFE”, genetic manipulation - opportunities and Risks “CRISPR/Cas9-NHEJ: Action in the Nucleus³” together with the Bio Center Vienna, climate change and art in cooperation with the University of Salzburg in the project “C ART³”, viruses and their role in our ecosystem in the project “Virus Dice⁴” with advice from scientists at the UBC Vancouver.

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Author Biography

Dr. Martina R. Fröschl, MSc, studied media technique & media design and wrote her thesis about computer-animated scientific visualizations of tomographic scanned microscopic organic entities. The depiction of realities and biological phenomena has ever since driven her creations. She contributed to various documentary and fictional productions for TV and cinema as visual effects and CG-artist. Her recent computer animations are based on scientific imaging data like μ CT, MRI, SEM and light microscopy in collaboration with imaging experts and biologists. Currently, she is a senior researcher and digital artist at the Science Visualization Lab Angewandte⁵ at the Department of Digital Art at the University of Applied Arts Vienna and chairwomen of the PIXELvienna Society⁶.

¹<https://www.scivizlab.com/projects>

²<https://www.noiseaquarium.com>

³<https://c-art.zgis.at/>

⁴<https://www.scivizlab.com/virus-dice>

⁵<https://www.scivizlab.com/>

⁶<https://www.pixelvienna.com>

Mixed Reality and Visualization - Designing Multisensual Experiences Using the Whole Body

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Abstract

MIREVI is an acronym for Mixed Reality and Visualization and describes the main areas of our interdisciplinary research team. As part of the University of Applied Sciences in Düsseldorf, Germany, we focus on human-computer interaction to improve various parts of life. With members of our "Kunst und Kultur Team" (art and culture team) we specifically look at collaborations with artists and cultural institutions and work on various levels in the context of dance, performance, digital media and user experience.

Keywords

Mixed Reality and Visualization, Interactive Art and Performance, Human-Technology Interaction, Smart Digital Technologies for Art and Culture.

Mission Statement

We are MIREVI (www.mirevi.de, Mixed Reality and Visualization), and we are part of the media department at the University of Applied Sciences Düsseldorf (HSD). Be it digital health and well-being, art and culture, business or engineering – our diverse and creative team researches, develops and offers creative support for various application domains to improve and innovate them with pioneering ideas.

To achieve this, we focus on mixed reality and artificial intelligence because we are convinced that these novel technologies, in all their facets, offer countless possibilities for the various parts of life. In our daily work we focus on the design and implementation of innovative human-technology interfaces that are new, useful and sustainable. We are interested in any digital media topic if it significantly supports the user, creates an innovative user experience, is great fun to work on or provides us with a little budget (strictly in that order). As a team of digital media experts, computer scientists, designers, cultural anthropologists and artists we believe in the power of joint creativity and intrinsic motivation and love working together on R&D projects, commercial topics or artistic digital expressions in our special working environment at the innovation hub in Düsseldorf, Germany. This is an 750 sqm open office area in a factory building.

Art, Culture, Technology & Beyond

Through digital and creative partnerships with numerous cultural intuitions and individual artists on national and international level, we are actively involved in innovative digital developments in the wide field of art and culture. We focus both on development of tools that support interpretation and transfer of an existing cultural content, as well as on creation and mediation of new artwork in collaboration with artists. We are interested in the exploration of the potential that mixed reality technologies offer for artistic and cultural productions and vice versa – using artistic and interdisciplinary research to open new perspectives on technology and address ethical, social and philosophical issues.

Cognitive Computing in Digital Media

With the increasing hype on AI-based technologies and requests from many cooperation partners and students we decided to go back to our roots on smart user interfaces and knowledge-based system design. Cognitive computing in digital media has many potentials and we look at ways to create empathic user interfaces and smart tools to create innovative media expressions. We focus on smart techniques for motion-based interfaces, DeepX-technologies and other biologically inspired approaches. With an additional focus on information visualization, we also consider data science techniques in general when appropriate.

Creative Engineering

Today, digital technology is available at low cost. With this availability and a significant increase of data and information, content experts have less understanding what to do with these possibilities and how to do it. Creative Engineering looks at new ways to adapt and combine existing technologies as soon as they are available as prototypes, pre-orders or functional mock-ups. We are also interested in new ways of working together and how to create innovative solutions for user problems with respect to technical limitations and non-technical constraints.

Mixed Reality User Experiences

We want to create empathic user interfaces using immersive technologies and combine digital content with physical computing technologies. Tangible and embodied user experience is another area of interest, and we study helpful body-near technologies and collaborative activities in working environments like in the MARTA project on Mixed Reality Art or Moving Digits on collaboration in with dancers and choreographers (see example section). A focus is multimodal interaction addressing all senses and the application of physical proxies for a better user experience in virtual reality.

Example from the Lab

We will illustrate some of our recent projects in the remainder of this paper. For more and recent projects, see www.mirevi.de

Moving Digits

Augmented Dance for Engaged Audience aims to enhance audience understanding and engagement in contemporary dance performances and to allow the experience of dance in an augmented way (even after the performance). Another goal is the empowerment of dancers, choreographers and technicians with further tools for expression, archiving and analysis.



Figure 1. Moving Digits, <https://movingdigits.eu/>

MARTA - Mixed Reality Art

VR and AR become more influencing in various fields so that Mixed Reality technologies are generally more distributed and used in a wide scope of applications. Typically, these technologies are implemented in different fields independently from each other. Our approach with **MARTA** is based on close cooperation between research, entrepreneurship and art during all phases of development, leading to “Spill-Over” effects and realization of jointly used production environments. The goal of **MARTA** is the utilization of Mixed Reality technologies for application of artistic and creative content in public spaces. By developing tools and production environments, artists, technicians, and experts can cooperate to create content that can be showcased.

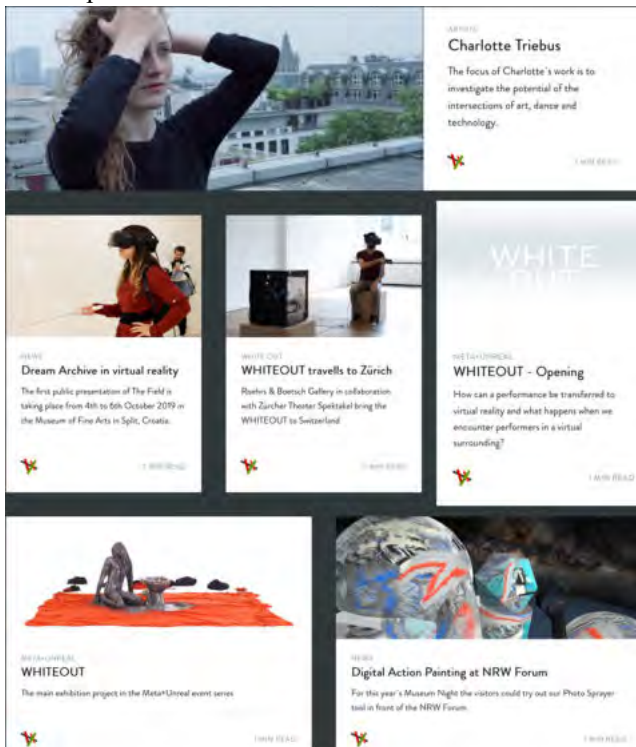


Figure 2. MARTA - Mixed Reality Art, <https://mixedrealityart.de/>

DISTEL

The goal of the project consortium **DISTEL** is to implement a flexibly usable demonstrator for data-driven, nonlinear storytelling by means of immersive and intelligent technologies. We developed two intelligent communication partners (using the real robot Pepper and a virtual 3D avatar) that realize different complex communication scenarios by using the latest AI technologies.

DISTEL is intended to prove that the combination of immersive and intelligent technologies can result in new forms of storytelling that have synergistic unique features for the domains of data science/artificial intelligence, digital storytelling and human-technology interaction/mixed reality.



Figure 3. Digital Storytelling with Robots

The **DISTEL** installation *Spheres* focuses on the dialogue between humans and technology and on the question how movement can be transformed in different bodies by means of interaction, approaching and coincidence. In a 30-minute performance, the dancers interact with the spheres through their movement and positioning. During this time, the spheres, and performers debate with each other and develop a shared form of communication and interaction.



Figure 4. <http://charlottetriebus.com/portfolio/spheres-artistic-research/>

is a rose

The work ‘is a rose’ was created by artist Charlotte Triebus in cooperation with the MIREVI Lab and it deals with the interspecies communication between a romantic surveillance state and the actor-network theory. It addresses topics such as agency of animate and inanimate objects and the possibly overcome dichotomy of nature and technology, thereby revealing an equality of agents in a performative framework. Can we concede that each of these agents is capable of a behavior coming close to action?



Figure 5. <https://mirevi.de/blog/is-a-rose/>

Our presentation includes more recent work and discuss our interdisciplinary approach working with artists and technical experts at eye level. For archive purposes it is available at www.mirevi.de

Technoetic Arts: a Journey of Speculative Research

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Abstract

First published in 2003 by founding editor Roy Ascott, Technoetic Arts is a peer-reviewed journal that explores the juncture of art practice, technology and the mind. Drawing from academic research and often unorthodox approaches it opens up a forum for trans-disciplinary speculative frameworks.

In 2020, with the support of the publisher Intellect, Ascott entrusted the editorship to what he defined the editorial organism, an international assemblage composed by: Claudia Jacques, Claudia Westermann, Dalila Honorato, Iannis Bardakos, Tom Ascott and Yong Hu.

The Editorial Organism of the Technoetic Arts Journal is considered an extitution. The term extitution relates to a radically dynamic form of organisation, differentiating itself from the dominant form of organisations, typically conceptualised as static institutions. Extitutional theory is an emerging area of research that provides a set of conceptual tools for describing and analyzing the underlying social dynamics of a variety of social arrangements, such as communities, businesses, organizations, or any other structure.

An extitution is an open, flexible, dynamic and diachronic multiplicity and, in this sense Technoetic Arts, combining academic research and artistic expression throughout the years, has established a unique journey. Within this presentation, we explore the reinvention of the editorial process through an organism that is composed of interdependent conscious units that coexist and apply decision-making in a decentralised way.

Keywords

Technoetic Arts, Roy Ascott, peer-reviewed journal, art research, transdisciplinary publishing.



Photo by Junkai Chen, Roy Ascott Studio, January 2021

Figure 1. Example of the journals cover and inside pages. ©Photo by Junkai Chen, Roy Ascott Studio, January 2021.

Author(s) Biography(ies)

Editorial Organism

Created in 2020, the Editorial Organism is an assemblage of six independent minds and bodies, serving the journal *Technoetic Arts* in its daily operations as principle editors. The Editorial Organism, aiming to expand the boundaries of academic publishing, is dedicated to critical creative enquiry on topics of art, technology and consciousness.

John Bardakos

John Bardakos is an artist and researcher born in Athens, Greece. He studied mathematics, digital, and traditional media in applied and fine arts in Athens, Paris and Madrid. Bardakos lectured in-between theory and practice in Athens and Paris and joined the Roy Ascott Technoetic Arts Studio in 2017 as a course coordinator and senior lecturer at the DeTao Masters Academy and the Shanghai Institute of Visual Arts continuing his research between fine arts, technologies, mathematics, cybernetics and diagrams. He is currently continuing his art and research activities at the Athens School of Fine Arts and the University Paris 8, focusing on interaction, spatial/digital poetics, aesthetics, and mathematical structures following a technoetic paradigm.

Dalila Honorato

Dalila Honorato, Ph.D., is tenured faculty in aesthetics and visual semiotics at the Ionian University, Greece and a collaborator at the Center of Philosophy of Sciences, University of Lisbon, Portugal. One of the founding members of the Interactive Arts Lab, she is the head of the organizing committee of the conference *Taboo – Transgression – Transcendence in Art & Science* and a co-founder of the network 'FEMeeting: Women in Art, Science and Technology'. In 2020 she was invited to join the Editorial Organism of *Technoetic Arts*.

Yong Hu

Yong Hu, Ph.D., is associate professor in the School of New Media Art and Design at Beihang University, China, and a researcher at the State Key Laboratory of Virtual Reality Technology and Systems. He obtained a Ph.D. degree in computer science and virtual reality from Beihang University and then continued to engage in interdisciplinary teaching and research on computer science and art design, such as virtual reality art design and interactive art design. He has published widely on topics in CG, VR and art design. In 2020 he was invited to join the Editorial Organism of *Technoetic Arts*.

Claudia Jacques

Claudia Jacques, Ph.D. (Univ. Plymouth, UK), MFA (SVA, US), is a Brazilian-American interdisciplinary technoetic artist, designer, educator and researcher. Human-computer interactions, cybersemiotics, semiotics, cybernetics, consciousness and design are some of her publication topics. She collaborates with many artists exhibiting and presenting both in the US and abroad. Parallel to serving in the *Technoetic Arts* Editorial Organism (2020), she has been serving as art & web editor for *Cybernetics and Human Knowing* since 2013. She has been collaborating with UCLA's ArtSci Center since 2011 as an Information and Instructional Designer and is the founder and creative director of Knowledge Art Studios Inc. Her studio is in Ossining, NY.

Claudia Westermann

Claudia Westermann (Ph.D.) is an artist and architect, licensed with the German Chamber of Architects, and a senior associate professor in architecture at Xi'an Jiaotong-Liverpool University in Suzhou, China. She holds postgraduate degrees in architecture and media art and obtained a Ph.D. from CAiiA, Planetary Collegium, for her research on a poetics of architecture, titled 'An experimental research into inhabitable theories'. Her works have been widely exhibited and presented, including at the Venice Biennale (Architecture), the Moscow International Film Festival, ISEA Symposium for the Electronic Arts, the Center for Art and Media (ZKM) in Karlsruhe, Germany, and most recently at the 2019 Yanping Art Harvest in Fujian, China.

SoundLab, a spatial audio research/practice unit in Hong Kong

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Abstract

The presentation is a progress report on the design and installation of SoundLab, [1] a physical art/research space with a hemispherical loudspeaker array dedicated to high spatial resolution audio at the School of Creative Media in City University of Hong Kong that was initiated in November 2020. We also introduce a study on the local context of sonic art in Hong Kong and possible future directions for the genre in the region to which SoundLab aims to contribute through its research and art as well as teaching and outreach activities.

Keywords

Hong Kong, sonic art, sound art, experimental music, electroacoustic music, media art, SoundLab, surround sound, spatial audio, Ambisonics, VR/AR/MR, high density loudspeaker array, progress report, perception, sonification, auditory display, soundscape

Introduction

Spatial sound is fundamental to creative audio and music. In the past, multichannel loudspeaker configurations were confined to concert halls and research institutions. With the recent interest in spatial audio due to the resurgence of Virtual Reality formats, along with the gradual establishment of Dolby Atmos-equipped home cinemas and cinema theatres, opportunities for experiencing surround sound for the general public are increasing. However, whilst there is undoubtedly growing interest from industry, further research into spatial audio perception and sonic art content creation is necessary beyond entertainment and commercial uses. In addition, as a publicly-funded academic institution we are conscious of our responsibilities for contributing to local art and music scenes through outreach events showcasing such research and practice, as well as providing opportunities for Hong Kong-based practitioners through concerts, workshops and residencies.

SoundLab

SoundLab, funded with an ACIM (Centre for Applied Computing and Interactive Media) Joint Fellowship and

hosted at the School of Creative Media [SCM] (Creative Media Centre, City University of Hong Kong) since November 2020, is a physical laboratory space with a loudspeaker array dedicated to high spatial resolution audio. SoundLab enables and supports a range of research, artwork, and teaching activities.

The Joint Principal Investigators PerMagnus Lindborg and Ryo Ikeshiro are setting out six objectives through which the SoundLab will be deployed in research, artwork, teaching, and outreach:

- Design, equip, and maintain a lab space for research in spatial audio perception and design, with a physical hemispherical rig with 24 or more loudspeakers;
- Support research in spatial auditory perception, through perceptual evaluation of soundscape recordings under different reproduction conditions, including higher-order Ambisonics; [2] [3]
- Support the creation of novel sonic artwork i.e. soundscape composition, multichannel electroacoustic music, spatial computer music;
- Conduct research into the use of sonification with spatial audio, in the context of both auditory display and art/music; [4] [5]
- Support existing SCM classes that have course components related to spatial audio (e.g. for film, installation, performance, VR/AR, and games);
- Create a series of outreach events and concerts featuring spatial audio, to benefit SCM students, faculty, and practitioners in Hong Kong, and gain publicity and traction for the SoundLab.

Sonic Art in Hong Kong

In order to better understand the local context of sonic art, (used loosely as an umbrella term to refer to electroacoustic music [EAM], experimental music, electronic music, sound art etc. for want of a better term) to which we aim to contribute, we have undertaken a study on the topic based on interviews with musicians and artists based in Hong Kong involved in sonic art.[6] The local socio-economic and political factors contributing to the current state of art and music both inside and outside academia are considered along with the interdisciplinary

nature of local artists and musicians and the place of sonic art and EAM in their practice.

High density loudspeaker array

Seed funding from ACIM allowed the authors to acquire a set of loudspeakers and additional equipment, and to hire a Research Assistant. As a research laboratory, we are allocated the Multimedia Theatre [MMT] at the Run Run Shaw Centre for Creative Media (see Figure 1). Scheduling is crucial as usage of the space is shared with other departments and faculty.

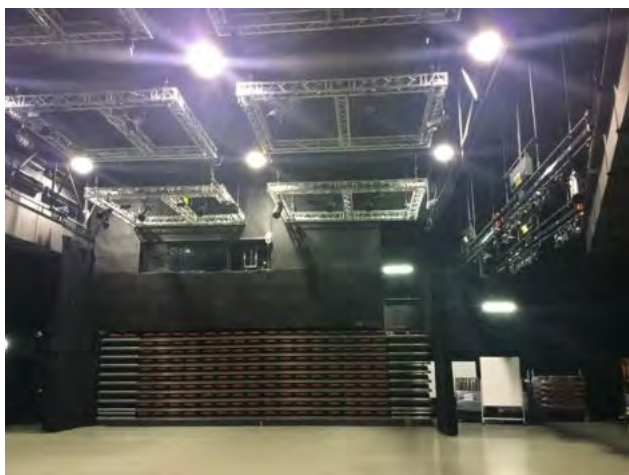


Figure 1. The Multimedia Theatre, with a large projection screen, eight individually height-adjustable truss sections, four curtains and retractable seats for an audience of 150+ people.

Design

For the first objective of constructing a high density loudspeaker array [HDLA], we began by carefully considering our design options. We contacted experts working at institutions with comparable facilities through our networks. The response was overwhelmingly positive and we are very grateful for the generous advice received from those leading the field both on the technical side and sonic artists and educators teaching spatial audio at higher education level. Online video meetings were held from December 2020 to January 2021 with the following:

- Bill Brunson, instrumental in the design of Kammarsalen at the Royal Academy of Music [KMH], Stockholm, Sweden;
- Franz Zotter and Matthias Frank, based at the Institute for Electronic Music, the University of Music and Performing Arts Graz, Austria;
- Eric Lyon and Tanner Uptegrove, who designed and currently run the Cube at iCAT & Moss Center, Virginia Institute of Technology, USA;
- Natasha Barrett, professor in composition at the Norwegian Academy of Music and NoTAM, Oslo, Norway;
- Simon Smith, technical director at Birmingham Electroacoustic Sound Theatre [BEAST], UK,

previously involved in setting up Kammarsalen at KMH with Brunson;

- Scott Wilson, director of BEAST;
- Craig Jackson, Technical Manager at the Sonic Arts Research Centre, Queen's University Belfast, UK.

Their wealth of experience and knowledge enabled us to select a design for SoundLab which took into consideration our objectives along with the available resources in terms of funding, space and its availability, usage and assistance. The chosen configuration is a hemi-spherical array of 25 speakers in three rings with a zenith speaker plus subwoofers (see Figures 2). The loudspeakers are Genelec 4030a IP on a Dante (AES67) network with PoE+ switches. It is a semi-permanent setup to allow for flexibility and expansion of the speaker arrangement as we aim to embrace the possibilities of a design process that is ongoing and open to the evolving demands of art, research and teaching activities and outreach activities such as concerts, residencies, and workshops.

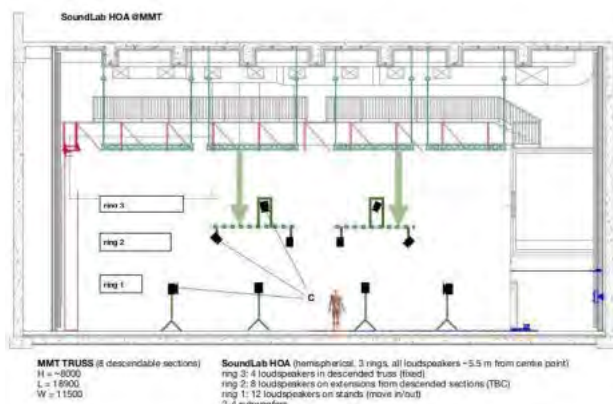


Figure 2. MMT side elevation, with hemi-spherical loudspeaker arrangement (without subwoofers or zenith speaker).

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Abstract

The Montreal artist-run centre TOPO is a laboratory for digital explorations for web, performance, and installation spaces. Its mandate is to incubate, produce, and circulate original artworks that explore interdisciplinary and inter-cultural hybridizations through the digital arts. From 2019 to 2021, TOPO proposed a thematic program around "Frontier", with exhibitions, workshops, performances, artist presentations and a paper publication with a digital version to enhance the user experience.

The presentation by TOPO's director Michel Lefebvre will offer an overview of TOPO's production activities in Montreal while focusing on its recent thematic "Frontier". It will offer a summary of approaches developed by artists and theoreticians. It will also address the strategies adopted by this artist-run centre to cross over physical exhibitions towards online dissemination. TOPO is a pioneer in web art and its director aims to bridge the past with the present and offer an overview of their activities

Keywords

TOPO, Frontier, Artist-run centre, Exhibition, Creative Hub, Digital Mediation, art, Production centre.

Creating Digital & Thinking about Frontiers

TOPO was founded in Montreal (Canada) in 1993. The centre grew out of the will of its founding members to develop a structure for the organization of collective and multidisciplinary projects, a will that very soon expanded to explore a digital new era for the artists.

TOPO's creative, circulation, training, and mediation activities contribute to the development of its disciplinary field, at the crossroads of the visual arts, literature, and digital media. The centre guides, supports, and produces interactive projects, receives artists in residence, and offers specialized workshops. Its dissemination component explores innovative modes of presentation for digital artworks through exhibitions, performances, publications, and circulation on the web and in local, national, and international networks. TOPO is a member of the creative hub and exhibition space Pied Carré, in Montreal (Canada). The centre occupies a multifunctional production space open to the community and has an exhibition showcase on the ground floor of the building, in the Mile-End neighbourhood.

From 2019 to 2022, TOPO proposed a thematic program around "Frontier", with exhibitions, workshops, performances, artist presentations and a paper publication with a digital version to enhance the user experience. Anchored in humanity's history, the theme Frontier combines questions brought up by the artist-centre which are as much political and social as physical and technological.

The notion of border is rich in historical, political, psychological, and artistic connotations. In its contemporary dimension, it is increasingly seen as a point of contact and of negotiation rather than simply as a barrier.

TOPO's curatorial committee has selected ten artists, from the plurality of the Americas, who explore themes such as the reconquest of roots and heritages; technologies and their capacity to blur the boundaries between documentary and fiction, living and non-living; and relations between geography and socio-politics, challenging the power relations in a space in various ways.

Inaugurated in fall 2019 and concluding with this publication in spring 2022, the *Frontier* program and the issues that it raises have been tested through the global disruptions that have taken place during this period.

The outbreak of the COVID-19 pandemic wreaked havoc with the lives of people throughout the world and forced the social universe to withdraw, unhappily, to the private sphere. The lockdown rules hammered individual souls with unprecedented behavioural diktats.

The initial *Frontier* program has continued, but was progressively adapted to present web versions of the works. At time of publishing this retrospective in the form of a printed map, with all of the editorial content put online at topo.art/frontiere, a dictatorial power has unleashed war in Eastern Europe, engendering a new cycle of crisis and violence.

Over the years, other conflicts have caught world headlines. The vast sweep of bleak territories makes frontiers a crucial issue. Migrations are intensifying. Climate change is generating new population movements. Have we finally entered the 21st century?

A program of media art installations

The Frontier program comprises three exhibition cycles, each of which is associated with an author: **Nuria Carton de Grammont**, **Paule Mackrous**, and **Mirna Boyadjian**.

To provide further food for thought, four authors approach the notion of borders more broadly from their respective fields of research: **Ricard Zapata Barrero** (politics), **Chantal Pontbriand** (aesthetics), **Jean-Dominique Lecia** (psychiatry), and **David Jhave Johnston** (technology).

1 – *Cultures, languages and spiritualities: beyond borders*

The first cycle brings together four artists from the plurality of the Americas who explore the reconquest of roots and heritages, through questions about memory and death.

Martín Rodríguez, *La Ofrenda*, media installation
ULO, *Conversation with Falling Spheres*,
audiotactile installation

Rodrigo Velasco, *Niyolchoca*, digital and visual poetry
Diego Briceño, *Dupu*, touch screen exploration

2 – *Remix and networks: challenged borders*

The second cycle of Frontier presents three installations that question technologies and their impact on our lives and societies, in their capacity, notably, to blur the boundaries between truth and falsehood, documentary and fiction, the living and the non-living.

Sven, *Plongeurs*,

Augmented reality photographic project

Oli Sorenson, *Landscapes of the Anthropocene*

Media art installation and social media campaign

Stéphanie Morissette, *Méandres*

Immersive web art project derived from a VR experience

agencetopo.qc.ca/meandres

3 – *Geopolitics: variable spaces*

The notion of geopolitics composes the third cycle with a reflection on the relations between geography (human, material, territorial) and socio-politics, questioning in various ways the relations of power in space.

Paolo Almario, *Léviathan*, web interactive

agencetopo.qc.ca/leviathan

Leila Zelli, *Day to day (Au jour le jour)*, web art and video

agencetopo.qc.ca/aujourd'hui

Michel Huneault, *On the Border (De la frontière)*

random and infinite documentary essay

<http://www.agencetopo.qc.ca/delafrontiere/>

A theoretical reflection about borders

Seven authors have been invited to express a deeper reflection about borders by writing theoretical essays available through this website. topo.art/frontiere

Nuria Carton de Grammont

Spiritual Matters and the Meaning of the Other

Paule Mackrous

Switching Views: Nature, Body, History

Mirna Boyadjian

Geopolitics: Border Transformations in Our Times

Ricard Zapata Barrero, theoretician and professor

The Current Semantics of Borders: Some Political Insights

Chantal Pontbriand, artistic director, curator and editor

Migration and Frontier: An Esthetic of Change

Jean-Dominique Leccia, psychiatrist

The notion of border between space and mental space

David Jhave Johnston, researcher and digital poet

Brain-Machine-Implants [BMI]: Art, Opsins, and Models (a few ethical considerations)

A printed and digital publication

A bilingual publication (French-English) has been published and distributed at the ISEA Symposium in June 2022. It is presented as a free folded map with excerpts of the complete publication on the web, with special effects to enhance the user experience, such as QR codes and symbols giving access to links, images and full versions of the theoretical essays. View online at: topo.art/frontiere

Acknowledgements

TOPO is funded by the Canada Arts Council, the Quebec Arts Council and the Montreal Arts Council for its regular activities. The same sources and others add to support projects, notably the City of Montreal.

Presenter(s) Biography(ies)

Michel Lefebvre is General Director and founding member of Agence TOPO, an art centre dedicated to creation, production and dissemination of new media projects at the crossroads of visual arts, literature and digital narrativity. Since more than 20 years, TOPO has created and produced numerous interactive projects with artists of different disciplines.



TOPO
DIGITAL CREATION CENTRE
FRONTIÈRE — FRONTIER — FRONTERA
2019 — 2020 — 2021 — PROGRAMMING

ISEA Symposium Archives: Progress and Teamwork

Bonnie Mitchell, Janice T. Searleman, Wim van der Plas, Terry C. W. Wong

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Abstract

This institutional presentation focuses on how the ISEA Archive team was able to develop a comprehensive, robust archive of thousands of ISEA items, despite minimal funding and support. The archives were created and are still being developed by a large number of volunteers, students, interns and grant-funded assistants. Over the past few years, a huge amount of information has been added to the archives along with images and PDFs of the papers, publications and other artefacts. There have also been significant improvements in the functionality through the efforts of our volunteer programmers. This massive endeavor has been spearheaded by the four co-directors who are also volunteers. These invaluable archives are used by researchers, artists, educators, students, and the general public. It would not be possible without the dedicated efforts of all the volunteers and contributors involved.

Keywords

ISEA, archive, symposium, preservation, electronic arts, digital arts, research repository, new media

Introduction and Overview of the Archives

ISEA currently has two online archives in development containing documentation of the material presented at the symposium from 1988 to the present. Each archive contains papers, abstracts, artist statements, proceedings, catalogs, biographies, images, videos, and other artifacts that document the development of interdisciplinary practices in the arts, humanities, science, and electronic technology over the past 34 years. The classic archive is mainly, but not entirely, text-based and the information contained within is used to populate the new online archive (see figure 1). The new archive is dynamic and contains bi-directional relationships between the data thus enabling complex searches, categorization, and sorting of data (see figure 2). The new archive also is able to collate a person's contributions to the symposium over the years and post this comprehensive list on the person's profile page. Both archives contain thousands of items that document the history of the field of electronic arts. These materials are now freely accessible to academics, artists, and community members on the web because of the hard work, dedication and determination of our large group of volunteers and co-directors.

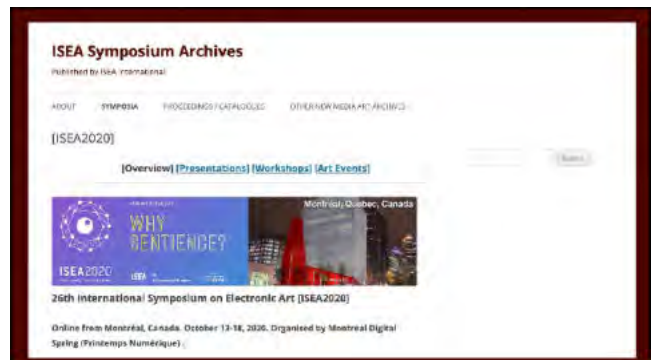


Figure 1. Classic Online ISEA Symposium Archive.



Figure 2. New ISEA Symposium Online Archives.

Teamwork

Co-Directing the Project

The two current ISEA symposium archives are co-directed by four dedicated individuals: Wim van der Plas, Bonnie Mitchell, Jan Searleman, and Terry Wong. Wim van der Plas was one of the original co-founders of ISEA and holds an extensive physical archive of ISEA materials. He also has been to nearly all ISEA symposia and therefore contains the institutional memory necessary to research and proof the materials in the archives. Wim's primary job has been to oversee the acquisition of content to add to the archives. He scans documents, researches missing information and checks for accuracy. He has been adding the material to the Classic archives, which we use to get information for the new archive.

Bonnie Mitchell has a background in information design, web development, and project management. She has been overseeing the content and programming aspects of the project including the tasks assigned to the volunteers. She is also integrally involved in the development of the new archive. Jan Searleman has extensive experience in computer programming and systems development. She has been devoted to the technical development of the new archive but is also involved with the management of the project. Terry Wong is the newest member of the co-directing team. He is developing the ISEA Archives Youtube Channel and also has developed extensive spreadsheets comparing the data throughout the years. Members of the co-directing team work on multiple aspects of the project and have devoted themselves to the success of this project.

Students from Bowling Green State University

The ISEA Symposium Archives have no institutional financial support, therefore the work necessary to program the back-end and populate the archive with content has been largely through volunteer efforts. After the initial subsidy from the Mondriaan Foundation (NL) in 2006, Bonnie Mitchell received a moderate grant in 2016 to hire students to develop the prototype. Between 2016 and 2021, Jan Searleman and Bonnie Mitchell received additional funding through the Association for Computing Machinery (ACM) to contribute to the development of the technology. Students at Bowling Green State University (BGSU) either did internships or received nominal funding through the grants or the Center for Undergraduate Research to work on the project. In the past few years, eight undergraduate and two graduate BGSU students contributed to the project: William Maier, Grant Turner, Kira Whitelow, Alexa Mahajan, Joshua Alahira, and Prabesh Poudel. The current undergraduate research grant recipients are Alexa Mahajan, Lane Sykes, Dayle Bennett and Liam Sykes. Overall, approximately 20 students from BGSU have been instrumental in the development of the new ISEA archive.

Call for Volunteers

In July 2020, we posted a call for volunteers on the ISEA listserv. We received a number of responses and six people joined the team: Michelle Lin, Nick Langen, Maeve Potter, Irena Lyubchenko, Sarah Vollmer, and Kirk Woolford. These new members were from Canada, USA, Taiwan, and the UK. In January of 2021, we posted a call for volunteers on a Netherlands-based website, after which Nyota Kanyemesha and Simon Oosterhuis joined the team.

However, typically, students graduate and move on and volunteers are often only available for a limited time. The number of people working on the archives fluctuates between 5 and 10 participants. Michelle Lin has been with us for the longest period of time.

Internships and Class Participation

In the fall of 2020, two interns, Sara Abdulhakim Mohammad S. Belshalat and Maitha Salem Bakhit Salem Alsubousi, from Zayed University in Dubai, UAE joined the project. Since the ISEA2014 symposium was hosted at Zayed University, these two students focused on adding material from ISEA2014 to the archive.

Cynthia Villagómez, a faculty member at Guanajuato

University (Universidad de Guanajuato) in Mexico contacted the co-directors in August 2021 and volunteered to involve students from one of her graphic design classes in the project. In October of 2021, several of her students including Ximena Briseño, Fabián Robles Parra, Monterra (Mon) Meza, Joselyn Medina, Fernanda Negrete, and Mariana Martínez joined the team and worked on adding the PDF papers and doing graphic design. Cynthia had 13 students in her spring 2022 social service internship class and they continued the work of splitting up PDFs and also began to clean up only scans as well. Mon and Mariana worked with us independently in the spring of 2022 and also began assisting with graphic design for the SIGGRAPH archive.

How We Operate

The ISEA archive team, which has become truly diverse over time, meets every Friday on Zoom with small group meetings focusing on specific tasks. We use Trello as a project management tool to keep track of assigned and completed tasks. The massive collection of digitized artefacts is organized into folders on a shared Google Team Drive and available to volunteers. The co-directors also meet online multiple times during the week.

The volunteers are divided into programmers and content managers. The website has been custom-coded by our programmers, therefore our meetings focus on bug fixes and enhancements to the site. We have had a number of programmers, digital artists and other volunteers help with the programming, UX and interface of the archive over the years. Notably, Joseph Jadach, William Maier and Prabesh Poudel, Troy Yarnell and Jack Spencer coded the functionality of the original site including the PODs structure, data export and visualization. Luis Wilson and Alexa Mahajan, currently do all our custom coding. The content manager meetings involve discussing problems with the data and progress reports. Volunteer Michelle Lin focuses primarily on image formatting and inserting metadata into the images and we have six new interns that will be assisting in the summer of 2022.

Altogether, the hours contributed to this project number in the thousands. The ISEA Symposium Archives would not be possible if not for the dedication and expertise of these incredible contributors. Although the project is far from complete, over the past year a massive amount of progress has been made. For instance, we now have material added for: 26 Symposia, 8843 People, 407 Venues, 5,379 Presentations, 340 Workshops and Tutorials, 3471 Art Events, 6000+ Images, 1000+ PDFs and hundreds of videos.

The archives can be viewed at:

- Classic ISEA Symposium Archive: <http://www.isea-archives.org>
- New ISEA Symposium Archive: <https://isea-archives.siggraph.org>
- ISEA Youtube Channel: <https://www.youtube.com/channel/UCMMSJTMr8U1m-r64aZht5BO>

ACM SIGGRAPH History Online Archives: Broadening Our Vision

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Abstract

This institutional presentation focuses on the ACM SIGGRAPH History Archive and how it evolved from the ACM SIGGRAPH Art Show Archive. This massive project involved a rethinking of the information architecture as well as programming the interface and adding new functionality. Thousands of new entries were added, along with images, abstracts, and additional information. After a year of hard work by a group of volunteers and student workers, we have made tremendous progress but much more still needs to be done. When completed, this new archive will encapsulate the evolution of a fringe research endeavor to a visually rich technology integral to our daily lives.

Keywords

SIGGRAPH, archive, preservation, electronic arts, digital arts, new media, computer graphics

Introduction and Background

In 2014, the ACM SIGGRAPH Archive team began creating an online archive documenting digital artworks, art papers, and artist talks showcased at the annual SIGGRAPH conferences and DAC online exhibitions. This online resource was custom-coded by volunteers and students, and grew over the years to be a robust, innovative approach to data dissemination (see figure 1). The digital art-related resources in the archive needed to be scanned, formatted, and entered into fields and thus involved thousands of hours of student and volunteer labor. The project was partially funded by the ACM and SIGGRAPH History Committees and evolved over six years to the point where the team declared the project done enough to expand its objective. In January 2020, Jan Searleman and Bonnie Mitchell, the co-directors of the project, along with a team of student interns, cloned the ACM SIGGRAPH Digital Art Archive and redesigned the interface and back-end to accommodate all of the components of the annual conferences (SIGGRAPH and SIGGRAPH Asia) along with other material from the SIGGRAPH organization (see figure 2).



Figure 1. ACM SIGGRAPH Art Show Online Archives

Online ACM SIGGRAPH History Archive

ACM SIGGRAPH is a Special Interest Group of the Association for Computing Machinery (ACM) on Computer Graphics and Interactive Techniques, and hosts two annual conferences, one in North America and one in Asia. These events include a wide range of creative and technical programs such as the Art Gallery, Emerging Technologies, Electronic Theater, Technical Papers, etc. The conferences attract academics, artists, researchers, practitioners, and other community members interested in computer graphics. The new ACM SIGGRAPH History Archive showcases this broad range of programs.



Figure 2. ACM SIGGRAPH History Online Archives.

Contents of the New Archive

Experiences

The diversity of experiences at the annual conferences includes the Electronic Theater, Emerging Technologies, VR Village, Appy Hour, and Art Gallery. The Electronic Theater showcases amazing computer animation, whereas the Emerging Technology includes interactive displays and cutting-edge technologies. VR Village encourages people to explore new virtual worlds, and Appy Hour features innovative apps that focus on a wide variety of fields. Along with the Art Gallery, these venues were grouped under the category *Experiences* in the new archive.

Learning

The conferences include a number of different types of presentations that were grouped under the category of *Learning* in the SIGGRAPH History archive. These include Technical Papers, Courses, Panels, Posters and much more. Each entry in the new archive contains the abstract, presenter information, and additional information along with a link to the ACM Digital Library.

Publications

The ACM SIGGRAPH organization has produced a number of printed and digital publications since its inception in 1974. These include conference related materials such as the Program and Buyer's Guide and Proceedings as well as Full Conference (and other) CD-ROMs, flash drives, etc. The SIGGRAPH Video Review (SVR) is a collection of animations published on a variety of media from Beta tapes to flash drives. Each of the 194 SVR issues focus on a theme such as Scientific Visualization or the Electronic Theater and contains approximately 20-25 animations. The new history archive contains a representative image of each animation and a short abstract. The actual animation is currently not able to be added to the archive because of copyright issues.

Awards

SIGGRAPH presents a number of annual awards to people who have made a significant impact on the field of Computer Graphics and Interactive Techniques, including the Steven Anson Coons Award, Computer Graphics Achievement Award, Distinguished Artist Award, Practitioner Award, Distinguished Educator Award, Outstanding Doctoral Dissertation Award, Significant New Researcher Award, and the Outstanding Service Award. In addition, there are additional awards given out at the conferences such as the Electronic Theater Best in Show, Electronic Theater Best Student Project, Best Art Paper award, and so on. The online ACM SIGGRAPH History archive highlights each awardee and includes the information relevant to the award.

Collectibles

One of the more exciting aspects of the new archive is the addition of images of collectible items such as coffee cups, pins, T-shirts, etc. The SIGGRAPH conference has a so-called *vulture-culture* where exhibitors and conference organizers give away free gifts and attendees flock to the booths to collect these memorabilia. Also, a merchandise booth sells branded apparel and other items. Members of the SIGGRAPH Community often hold huge collections of these conference-related items and memorabilia. The new archive is like a stroll down memory lane in that viewing images of these artifacts elicits stories from pioneers and long-term attendees of the conference.

Teamwork

Programming

Expanding the ACM SIGGRAPH Digital Art Archive to become the online History Archive involved a rethinking of the entire information architecture. Not only did the interface have to be redesigned, but new fields, taxonomies and templates all had to be added along with custom code to accommodate the various new components of the archive. Through support of the SIGGRAPH History Committee, we were able to hire two student programmers from the US and one intern from Mexico. These talented students took the initiative to propose and implement efficient programming solutions that improved the archive.

Content Management

Each of the conference venues required the addition of thousands of new entries into the archive. There was no way to automate the process of entering information from conference PDFs and scans of publications, therefore we hired student content managers to add it manually. We have currently added 1411 Animations, 1603 Learning items, 570 Experiences, 178 Awards, 165 Collectibles, 163 SVR issues and a scattering of other materials. Combined with our previous efforts in regards to building the SIGGRAPH Digital Art Archive, we now have 10,344 people and 61 conferences.

Future Goals

The SIGGRAPH History Archive is part of a collective of new media art archives that are working on ways to create connections between the archives. Together, our goal is to provide free online access to computer graphics and electronic art historical information so that academics, researchers, artists, practitioners, and community members can reference the past as they define the future.

Beyond Matter. Cultural Heritage on the Verge of Virtual Reality – an international collaboration

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Abstract

Beyond Matter is an international, collaborative, practice-based research project that takes cultural heritage and contemporary art to the verge of virtual reality. Despite being a project per se, the endeavour, specifically its online platform, could be seen as a suggestion for a decentralized hybrid institution.

Beyond Matter [beyondmatter.eu] takes cultural heritage and contemporary art to the verge of virtual reality. It reflects on a condition of art production and mediation that is increasingly virtual with a specific emphasis on spatial aspects in art production, curating, and mediation. A plurality of possible solutions and options that are emerging alongside the development of computation is explored through numerous activities and formats.

The collaborative endeavor was initiated and is led by ZKM | Karlsruhe, and includes the Aalto University in Espoo, Centre Pompidou in Paris, Ludwig Museum – Museum of Contemporary Art in Budapest, Tallinna Kunstihoone, and Tirana Art Lab – Center for Contemporary Art. It understands practice-based research as a process within the museum context that encompasses the development and creation of museum experiences, their evaluation with the inclusion of the audiences, and creating best practices for museum professionals, who are increasingly required to apply digital tools.

Keywords

Cultural heritage, practice-based research, international collaboration, virtual condition, digital art conservation, experimental museology, hybrid museum experience

Beyond Matter. Cultural Heritage on the Verge of Virtual Reality

Introduction

Beyond Matter reflects on the virtual condition in art production, curating, and mediation via numerous activities and formats, including the digital revival of selected past landmark exhibitions, art and archival exhibitions, conferences, artist residency programs, an online platform, and

publications. In attempting to depict the virtual condition the project probes the ways in which physical and digital space are interdependent and seeks to inhabit computer-generated space as an assembly—as a platform for exchange, for the contemplation and mediation of art—without approaching it as a virtual copy, a depiction or digital twin of actual physical spaces.

Its numerous activities and formats include the digital revival of selected past landmark exhibitions, art and archival exhibitions, conferences, artist residency programs, an online platform, and publications, all which will take place between 2019 to 2023.

One of the goals of the project is to develop novel solutions for the accessible digital documentation and networked presentation of current and past exhibitions in physical space – including their artworks, artifacts, and educational materials. In future, these methods of virtualizing exhibitions could be used by museums and galleries to document and revive their exhibitions in new ways. With our experiential, research-based methodology we will provide a basis for developing museological and technological aspects simultaneously.

Exhibition spaces are physical locations of knowledge production and exchange, where spatial qualities play an important role in the contextualization of information. Virtual productions, emulations, and revivals should therefore maintain these qualities, but also be able to include digitized and born-digital content, whether these are artworks, exhibits, or informational materials. This is equally relevant to the reconstruction of spaces that no longer exist.

To ensure that the methods developed remain in use in the longer term, the project aims to contribute to the capacity building of museum professionals through seminars and conferences. The results will be collected in the Virtual Museum Toolkit, and encompass practical and theoretical knowledge on the inclusion of virtual exhibitions in displaying and mediating artworks.

Partner museums and galleries will also host large and small-scale exhibitions to measure and further practice-based innovation, as well as events to disseminate the project's results. In a framework of artist-in-residence programs, artists are invited to develop new pieces for these exhibitions, ensuring that the project resonates with the latest contemporary trends.

1017

The project was initiated at ZKM | Center for Art and Media Karlsruhe and is managed by ZKM |

ganizations from a wide range of European countries—almost all regions of the continent—and foresees cooperation with various other organizations that have a broad spectrum of experience in fields of digital art conservation, digitizing tangible and intangible heritage, exhibitions of contemporary and new media art, and experimental museology.

Author’s Biography

Lívia Nolasco-Rózsás is a curator and art historian. She has curated exhibitions at institutions of contemporary and media art worldwide since 2006, including at the ZKM | Center for Art and Media (Karlsruhe), Chronus Art Center (Shanghai), Tallinna Kunstihoone, Múcsarnok Budapest, focusing on the constantly changing media of contemporary art and intersections with various disciplines. She has initiated and developed thematic exhibitions raising questions such as the genealogy and social impact of planetary computation and computer code, electronic surveillance and democracy, and synesthetic perception.

As of 2019 she has started research in curatorial studies on the “virtual condition” and its implications in the exhibition space at the Academy of Fine Arts Leipzig, and as acting head of the international collaboration project entitled Beyond Matter at ZKM | Karlsruhe, which she initiated and in which institutions such as Centre Pompidou Paris, Aalto University, and others are participating.

FILE FESTIVAL Archive implementation

Paula Perissinotto, Dalton Martins

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Abstract

The presentation is about the implementation process of the digital archive of FILE - Electronic Language International Festival. The digital archive of FILE festival is being carried out according to a defined semantic and data modelling, including the input of data information for the years 2015 to 2019, aiming at its organization in the Tainacan digital repository. The talk will also point out the practical developments arising from the FILE ALIVE online meetings, held in March 2021, and more specifically what emerged from the session entitled "Archive as an Institution", in which an alliance of partners was effected between the team ISEA (International Electronic Art Symposium), ACM SIGGRAPH (Association for Computing Machinery's Special Interest Group on Computer Graphics and Interactive Techniques) and FILE; with the common objective of seeking interconnection between the digital archives of each organization.

Keywords

digital file; digital memory; cultural memory, digital platform, database.

FILE festival's archive began in 2012 with Gabriella Previdello, with a physical organization of subscription forms and other information sent to the festival by artists, via mail, since the year 2000. Recently this organization was taken up by Paula Perissinotto as an object of doctoral research in the area of Visual Poetics at ECA - School of Communications and Arts of the University of São Paulo, to organize the content of 20 years of the festival, both physically and digitally, in order to connect it with institutions in the world that work in the field of art and technology, and through a network cooperative that currently has a team involving three institutions (Tainacan, Percebe and FILE).

Before the proposal to integrate its archive with other institutions, FILE festival already intended to reorganize its digital repository and change the archive structure, initially installed in WordPress, to allow it to be interconnected with each other. The planned path intended to use a content manager with headless technology, such as Strapi (headless technology).

However, another possibility emerged from the online meetings arising from the session "What to archive? Demands and principles of digital memory", and it is about the Tainacan project, approached by its coordinator, Dalton Martins, in his presentation. Conceptually, the Tainacan software is very similar to headless content management,

but uses the WordPress database, in which the FILE collection is already hosted.

Tainacan is the product of work developed at the Faculty of Information Science at the University of Brasília, where archival, museology, library science and a graduate program are located, setting up a favorable space for the development and exploration of issues in around memory, collections and archives.

Tainacan, based on WordPress, is in use and used in different ways by institutions that are central to the preservation of national memory. In the case of the National Historical and Artistic Heritage Institute (IPHAN), for example, the tool was used to develop the intangible heritage inventory. The software has been downloaded more than 8 thousand times since its distribution was started by the WordPress plugin repository, it has more than 300 active installations from institutions, with more than 20 public universities.

In this sense, FILE festival reconsidered the migration of digital data to the STRAPI headless system and opted for the organization of the online database using Tainacan technology, compatible with the WordPress environment in which the festival's data is already hosted.

Initially, a diagnosis of the organization scheme and cataloguing of FILE's digital content data was carried out together with the company's team, and then the informational architecture was designed through a survey of informational typologies, collections characteristics and institutional informational modelling needs, considering interconnection strategies with ISEA/SIGRAAPH archives.

To carry out this diagnostic stage, the FILE team provided the Percebe team with the internal structure (figure 1) currently used to catalogue the FILE Festival contents to be migrated, in addition to the current references of the structure used by the ISEA Digital Archive, provided by its co-director Bonnie Mitchell. The idea is to adapt to this cataloguing structure for possible interoperability between systems.

To facilitate the analysis and diagnosis, both the data related to category references, metadata and the information/data organization map used by FILE were transposed from a hierarchical tree model, as shown in Figure 2, to a spreadsheet, where it was organized by levels of terms.

After this systematization, the data were descriptively analyzed (figure 3). Three informational sets that must be worked on for the digital repository in Tainacan were then identified in the internal references:

- Categories: theme, format, topic, genre, platform and media;

- Types of documents: catalogs, logos, completed projects, non-performed projects, administrative;
- Metadata: descriptive fields currently in use.

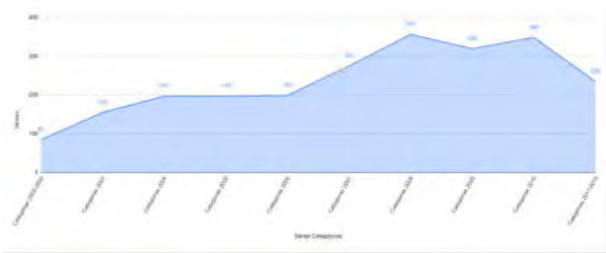


Figure 1. Reference to Percebe diagnosis of FILE categories to a spreadsheet organized by levels of terms. © Copyright. FILE FESTIVAL



Figure 2. Categories hierarchical tree model of FILE. © Copyright. FILE FESTIVAL

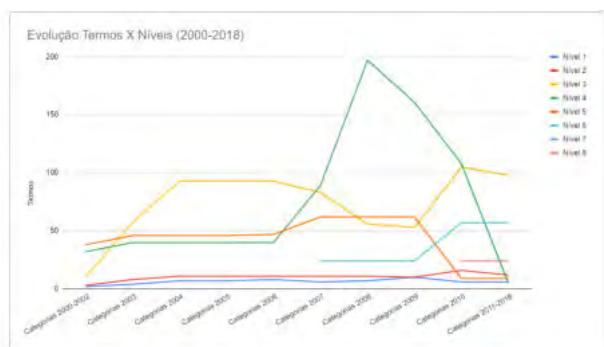


Figure 3. Graphic created by Percebe in 2021 to illustrate de Evolution of FILE terms from 2000 to 2008. © Copyright. FILE FESTIVAL

After the implementation of the FILE Festival online archive, FILE will be able to consider the realization of the interconnection between the FILE files and those of ISEA and SIGGRAPH.

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Author(s) Biography(ies)

Paula Perissinotto is specialized in new media, contemporary art and digital culture. Graduated in Fine Arts at FAAP, with master's degree in visual poetics from ECA (School of Communications and Arts, University of São Paulo). Specialization in Curating and Cultural Practice in Art and New Media by MECAD / ESDI in (Barcelona / ES). Since 2000, Paula Perissinotto has been co-founder, organizer and co-curator of FILE International Festival of Electronic Language, a non-profit cultural organization, that promotes and encourages aesthetic and cultural productions related to the new poetics of contemporary culture.

Dalton Martins work with research on the interface between computer science and information science, focusing specifically on data science and websemantics/open data linked applications for digital collections development and data analysis of memory institutions' collections. Currently coordinates the Tainacan project, in partnership with the Brazilian Institute of Museums.

Crossing Over from Digital Practices to Media Arts and into Social Innovation: School of Arts, University of Nova Gorica (SI)

Kristina Pranjić, Peter Purg,

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The School of Arts (www.ung.si/au; au.ung.si) is part of the University of Nova Gorica, situated on the border between Slovenia and Italy. This young and dynamic art school offers interdisciplinary study programs in **Digital Arts and Practices** and its follow-up – Master of Arts in **Media Arts and Practices**, through the Modules of Animation, Film, Photography, New Media, Scenography Spaces and **Art-Science-Technology**, with a focus on Contemporary Art Practice. To foster students' development as independent creators, researchers, and agents of change, the school pursues a personal approach and an advanced attitude toward interdisciplinary cooperation as well as artistic research, particularly in combining the arts with other disciplines within and beyond academia.

In recent years, the school lead major EU-supported projects such as:

- MAST – Master Module in Art, Science and Technology;
- IDEATE.me – Interdisciplinary Transformations in Education;
- ADRIART.net – Advancing Interactions in Art Teaching.

Besides such pedagogy and curriculum development projects, the school's motley collective has been fostering international alliances and advancing interdisciplinary research in projects such as:

- DIVA – Art:Biz Innovation Ecosystems;
- KONS – Platform for Contemporary Investigative Art;
- TV Free Europe – 1,5 million Steps over the Borders;
- EmindS – Interdisciplinary Entrepreneurial Mindsets;
- HiLoVv – Hidden Lives of Venice on Video;
- PAIC – Participatory Art for Invisible Communities.

They have founded ADRIART.CE, a growing network of a dozen art academies from Central and South Eastern Europe.

The School's recent developments revolve around fostering capacities for artistic research, deeply founded in the humanities, on the one hand, and engaging with the actual social and environmental challenges, on the other. Therein the School of Arts closely liaises with the School of Humanities, sharing the campus building, faculty and courses as well as engaging in joint projects on international scale.

Both schools are members of the University of Nova Gorica (UNG; www.ung.si/en/). UNG is a research-oriented, internationally established university, recognized as a driving force of social development in the cross-border region of Slovenia-Italy. Often acting as initiator and lead partner of international research and development or artistic projects, UNG displays a high level of scientific and pedagogical quality as well as top achievement results in the cutting-edge fields of (and among) science, technology and art. Next to the applied arts pedagogy and research, the outstanding research indicators of UNG relate to the realm

of basic research in both natural sciences and humanities, whereas several of its research projects are closely tied to the industry and feature major contributions to European technological development. In recent years UNG implemented four major projects, primarily aiming to strengthen the institution's research capacities, connect research activities with the economy, and transfer knowledge to the economic sector: “Uncorking Rural Heritage”, RETINA, NANOREGION etc.

The School of Arts is thus situated in a very specific location, between the Slovenian town of Nova Gorica, which was constructed as a socialist utopian idea after WWII; and the ancient town of Gorizia on the Italian side (where the School of Arts resided 2012–2019). The two towns are now building their common future towards “**GO! BORDERLESS 2025**”, the **European Capital of Culture in 2025 (ECOC)**, and the School of Arts is a key partner in this journey. This ECOC process has started developing a coherent community platform to apply the social (transformation) part of the School of Arts' methodological approach. The newly established creative hub “Xcenter” in the pedestrian zone of Nova Gorica and the emerging community of designers and business professionals around it to a large scale, includes the School of Arts' students and mentors. Moving outside of academia, these transformations should facilitate distributed social innovation processes in that they involve non-academic and non-scientific entities within a research setting: the social reality (community of EU/ECOC) mutually transforming the pedagogical reality (art school and university community).

Going Borderless among Art, Science and Technology

The School of Arts has always been very attentive about its social and geopolitical realities, striving to enrich the dialog and interactions between the twin-towns' citizens and their temporary residents, among them its numerous international students. On the background of this multicultural setting, the borderless idea permeates UNG's academic realities, and is reflected, next to the diverse academic community profile, also in its new interdisciplinary curricula. **Students get familiar with the new interdisciplinary trends in the art-science-technology (AST) crossover gradually, entering through other more traditional media**, and continuing along the School of Arts' intertwined system of **modular studies that supports the student's search and experimentation along the academic pathway**. The AST journey often takes place either through video-film formats (mentor Assoc. Prof. Jasna Hribernik) or through one of the carrier modules, such as New Media (module leader Assoc. Prof. Peter Purg, PhD) or Contemporary Art Practices (module leader Prof. Rene Rusjan). For several years School of Arts' main AST guest mentor has been School's alumni Robertina Šebjanič, now a renowned interdisciplinary artist, who works practically with students from different fields of

interest (film, animation, photography, new media) that share passion for scientific and technological approaches within art.

In 2020 the UNG School of Arts accredited a novel **Master Module in Art, Science and Technology (MAST)**, exploring **in what way can the imagination of artists and their tools for creativity bring about true novums that could tackle the most complex challenges of the future, both for society at large, and the industries in particular**. In the MAST project, next to accrediting an international master module across three European universities, participants from a variety of disciplines have jointly explored and identified the vectors of **possible policy impacts and priorities for the future of Europe as well as created alliances for forward-thinking future actions that may and should permeate EU's approach to innovation**.

MAST was created 2018–2020 by a consortium of partners within an EU supported project, coordinated by the UNG School of Arts, including the Institute of Spatial Design at Graz University of Technology, the Madeira Interactive Technologies Institute (M-ITI), and the NGOs Culture Action Europe from Brussels, the Croatian Cultural Alliance from Rijeka, and the Kersnikova Institute from Ljubljana.

Scaling Interdisciplinary Innovation onto Regional Alliances and Platforms

The MAST spirit continues to live in the **konS– Platform for Contemporary Investigative Arts (2019-2022)** where the **Innovation Catalyst profile** is being pursued and developed in practice through hundreds of DIY-electronics and media-art based up-skilling workshops, dozens of cutting-edge artistic productions and a robust transfer-to-industry mechanism. This well-funded national EU-cohesion project promises to establish **stable links between communities, knowledge institutions, research centers and the economy at a systemic level**, with all parties dedicated to **co-creating a sustainable, safer and more ethical future in a dynamic, constantly changing world**. Efforts to establish an active network of research, production and justification of better conditions for research, development and realization of contemporary research art projects, brought together nine partners – NGOs, art producers, tactical media, public cultural centers and the **UNG School of Arts as the only educational institution of the consortium**. The content and structure of the newly established konS network concentrate around a threefold common vision: the establishment of **capacity-building hubs where different audiences can be empowered to critically use new technologies** (konS ≡

PARK); art research laboratories across the country that enable the production of contemporary investigative arts (konS ≡ NOVA); and the Laboratory for Speculative Innovation for Translating Farsighted Artistic Ideas and Inventions into Innovations for the Advancement of the Social Environment in Europe (konS ≡ PRACTICE).

Next to the School of Arts, Kersnikova Institute was also the co-initiator of another complementary project, DIVA (Development of Innovation Ecosystems and Value Chains Supporting Cross-Border Innovation through Creative Industries), supported by the Italy-Slovenia Cooperation Programme of the European Regional Development Fund of the European Union. The project was designed to create a methodology and implement pilot projects that connect the creative sector not only with the most progressive hi-tech, but also with more traditional businesses. With a role of co-establishing a (recently opened) regional creative hub, the aforementioned “Xcenter”, and therein providing educational as well as interdisciplinary expertise, the **School of Arts follows the aim to accelerate art-inspired innovation and bring novel products or services to the market**, the final aim being to support social innovation and develop a positive model for the European cross-sectoral economy.

The most recent (yet externally unfunded, i.e., spontaneously initiated) project emerging upon the legacy of MAST is **Loose Cells**. There experts, professors and students of the UNG School of Arts have been creating a **multi-layered art-science object addressing issues, such as sea level rise, wood properties, sustainability of the building sector and human-nature-technology relationships**. The project was designed by a consortium of four partners lead by the research institute InnoRenewCoE as the main driver of the project; other partners included also the University of Primorska and the Association for Culture and Education PiNA (with the support of the RUK network of research centres, a parallel platform structure to the one of konS). The so-called hybrid object was presented at four festival venues across Slovenia in 2021.

In 2022 the School of Arts continues its collaborative journeys and keeps nurturing its manifold partnerships, pursuing radical innovation in art education, as well as forging new interdisciplinary experiments across art-sci-tech. While the presence of its graduates at festivals and exhibitions Europe wide remains ever so propulsive, this unconventional art academy goes on to explore novel arts-and-humanities blends, and amplifies its role in cross-sectoral policy making.

The ARTENSO LAB: an incubator of digital cultural mediations

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Abstract

The ARTENSO LAB is dedicated to experimentation, creation, and production of collaborative digital cultural mediation projects. In fall 2021, the LAB Incubator opened its doors to guide a first cohort of four teams/projects wishing to explore the connections among cultural mediation, digital devices, and collaborative processes. Selected through a call for projects, the proposals come from artists, mediators, and representatives of organizations wanting to find an innovative response to issues involved in relationships between the cultural field and the social field. ARTENSO is extending the incubation and support project in digital cultural mediation with a research aimed at documenting core collaborative practices in the cohorts. This presentation aims to share the characteristics and effects of cultural

Labs based on the model of the ARTENSO center. The questions we ask are about contemporary modes of learning and transmission in a complex, open, and interdisciplinary world

Key words

Cultural Labs, Media Labs, Living Labs, Creative hubs, Cultural Mediation, Digital Cultural Mediations, Collaboration, Participatory design approaches

Text

The ARTENSO LAB: An Incubator for Digital Cultural Mediations

ARTENSO is a centre for the transfer of innovative social practices, affiliated with Cégep de Saint-Laurent – a college for general and vocational education – based in Montréal (Québec, Canada). ARTENSO's mission is to promote research and innovation in art and social engagement in the field of cultural mediation.

We understand cultural mediation as a professional field of cultural action in which strategies, mechanisms, and tools are formulated to improve access to cultural productions and encourage individuals' cultural expression. At the intersection of the cultural and social spheres, cultural mediation practices are defined as processes of transmission and appropriation of meaning through a personalized

and living relationship between cultural references and individuals. Ultimately, these practices aim for personal growth and empowerment as well as cultural inclusion and civic participation (Quintas, 2014).

The question of collective knowledge-building processes, participatory design approaches, and new operating models, propelled in particular by digital culture, is a transversal dimension that guides the centre's actions and its research and development streams.

Since it began its operations, ARTENSO has sought to offer innovative solutions to mediators' professional needs in terms of co-development and collaborative learning. Through the stages of reflection on and evaluation of the community's needs, a response has gradually emerged, embodied in the creation of a unifying, structuring, and innovative place for those in the cultural mediation field, whether emerging or established: a laboratory dedicated to digital mediation.

Geolocation, mapping and storytelling

In fall 2021, the LAB_ARTENSO Incubator starts its activity to support a first cohort of 4 teams/projects wishing to explore the connections between cultural mediation, digital devices, and collaborative processes. The project takes place over a period of four months from October 2021 to January 2022 and a second cohort will be assisted from March to June 2022. The theme for this first year is geolocation, mapping and storytelling through the use of interactive and participatory positioning and mapping technologies. The selected projects are diverse, but all speak of links between culture, city and citizenship.

Collaboration and innovation

ARTENSO is extending the incubation and support project in digital cultural mediation with a research project aimed at documenting core collaborative practices in the cohorts. These approaches, stemming from digital culture (living labs, hackathons, creative sprints), are becoming more and more popular in the cultural mediation community. They have received little academic attention, however, in Québec, where the literature focuses more on collaboration from an art-making perspective (McCabe, 1984; Bishop

2012; de Maison Rouge, 2017) and particularly within community art (Boisvert, 2016, Neumark and Chagnon, 2011) and participatory art practices (Casemajor, Lamoureux, and Racine, 2016).

The research that we are conducting aims to shed light on the notion of collaboration and innovation in cultural mediation while observing how the concepts are operationalized

within the incubator. We want to understand how collaborative approaches can contribute to enriching cultural mediation practices. We are also intensely interested in sharing findings on how to support the novel processes of carrying out digitally adapted cultural projects; the questions we ask are about contemporary modes of learning and transmission in a complex, open, and interdisciplinary world.

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Author Bio

Eva Quintas is the Executive Director of ARTENSO, a research center in art and social engagement, affiliated with the Cégep de Saint-Laurent in Montreal (Canada). Graduated in cultural management and fine arts, she specializes in cultural policy, cultural mediation, and digital culture. Over the last 20 years, she has held key positions at Culture pour tous and Culture Montréal and has worked with numerous organizations as a trainer and cultural development consultant. She is a member of the Observatoire des médiations culturelles (OMEC), the Observatoire interdisciplinaire de création et de recherche en musique (OICRM) and the Commission numérique de Culture Montréal. Co-founder and secretary of the TOPO digital art centre, she also pursues a visual and media arts practice.

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EUR ArTeC in digital art and hydrological ecosystems

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Abstract

The *École universitaire de recherche* (EUR) ArTeC is a consortium of fourteen French institutions including universities, *grandes écoles*, museums, and archives. ArTeC was established in 2018 at the initiative of universities Paris 8, Nanterre, and Paris Lumière with the intention to consolidate a long-term project on art and science for education and research. In this presentation we highlight some milestones over the last three years of development. Moreover, special attention will be given to the importance of ArTeC in the development of art-science and humanities-technologies projects. One of the projects that will be showcased is HOM - Hydrology of Media which aims at establishing connections at the crossing-boundaries between several disciplines and practices. We also discuss the role of ArTeC as an organizing partner of ISEA 2023, that will take place in Paris, France.

Keywords

Art, science, technology, consortiums, organizing teams, partners, hydrology, media.

Three years of EUR ArTeC

Created in 2018, ArTeC is a consortium of universities and institutions that put together their expertise in terms of scientific, technological, cultural, and artistic research. Among other initiatives, ArTeC fosters multidisciplinary dialogue by counseling, assisting, and funding the development of applied projects, innovative pedagogical modules, scientific publications, and an international master's degree program. The uniqueness of ArTeC, among other French EURs, is its orientation towards a critique of digital culture by means of artistic theory and practice.

In close relation with its vision, ArTeC has been involved with the organization team that is carrying on the 28th edition of ISEA, to be celebrated in Paris, France, from May 16-23, 2023.

A Hydrology of Media Approach

Among more than fifty projects that have been juried to be funded by ArTeC, we introduced in 2020 the project HOM: Hydrology of Media. In accordance with the axes

Authors Biographies

Everardo Reyes is an Associate Professor in the Department of Information Science at Université Paris 8. He directs the MA/MSc in Digital Humanities and has been recently appointed Vice-president of digital matters. His main research interests are digital culture, information design, cultural analytics, and media art. He serves as the representative of ArTeC and Paris 8 in the organizing committee of ISEA 2023 in Paris.

“creation as a research activity” and “technologies and human mediation”, HOM was initiated by an international team of scholars and artists, including Everardo Reyes and Gwen Le Cor from Université Paris 8; Andrés Burbano from Universidad de los Andes, Colombia; Andrea Sosa from Universidad de la Plata, Argentina; and Anastasia Tyurina from Queensland University of Technology, Australia.

HOM is an approach to art, science, and humanities. It adopts a multicultural and multidisciplinary effort to explore the properties and effects of water in our own artistic, cultural, scientific, and educational practices. We have been interested in studying the materiality and the symbolic representations of water through the direct intervention of instruments and scientific methods. The questions we are interested continue investigating are: How to represent water to scales that are invisible to the human eye yet its effects are pre-sent and perceptible? How to provoke new aesthetic reactions that create a hydrologic conscience?

Despite the health crisis that constrained us to rethink field work, we organized distance ways for cooperation. For example, we held two international seminars in hybrid format with graduate students from France, Bulgaria, and Greece; we animated a workshop at ISEA 2020 – Montreal; we organized an international congress about digital image; and, we have published more than fifteen experiments that articulate technological instruments and user interfaces with critical and ecological observations.

While most of the HOM activities have been published on the website <https://hom.pubpub.org>, one of our main goals for the current year is to document our research, teaching materials, and experiences following an open data approach. This implies the examination of publishing and management systems that emerge within the open science and open education communities.

Acknowledgements

We are grateful to the whole EUR ArTeC staff members for their involvement and dedicated passion in this period of health crisis. Special thanks to Prof. Yves Citton, who concluded his term as executive director of ArTeC in 2021, and to Prof. Tiphaine Karsenti, who took over the mission with enthusiasm and goodwill.

Andres Burbano is a media history scholar and media artist, he is an Associate Professor in the Department of Design at Universidad de los Andes, in Bogota, Colombia. Burbano holds a Ph.D. in Media Arts and Technology from the University of California Santa Barbara. He is visiting professor at the Danube University in Krems, Austria, and is currently visiting researcher at the University of Applied Sciences at Potsdam, Germany.

Funding at the intersection of art, science and technology

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Abstract

The Swiss Arts Council Pro Helvetia has launched a four-year focus on arts, science and technology. The foundation sees great potential in transdisciplinary fields such as electronic art, bioart, tech art or new media art and is devoting special attention and funding to projects at the crossroads of disciplines. For that purpose, different initiatives and collaborations with scientific institutions such as CERN or the Swiss Polar Institute provide opportunities for artists and cultural practitioners to engage with transdisciplinarity or deepen their existing artistic practice. From 2021-2024, Pro Helvetia wishes to contribute to the exploration of social processes and the development of future prototyping.

Keywords

Funding; Arts Council; Trends; Innovation; Networks; Collaboration; Grants; Transdisciplinarity; Artistic Research; Switzerland

Connecting Art, Science and Technology

The interfaces between art, science and technology gained importance in recent years and hold great potential for new creative collaboration and production models. With the demand for transdisciplinary exchange present in universities and a variety of industries, the skills of artists are increasingly sought after to initiate new research and production processes. Simultaneously, many artists and creative professionals experiment with new technologies or combine their practice with scientific research, thus entering fields such as electronic art, bioart, tech art or new media art.

In regard to an increasingly complex and interconnected future lying ahead, transdisciplinarity is becoming relevant within the field of cultural promotion: It is precisely at this interface that innovative strategies, creative works, new forms of dialogue, knowledge production and fundamentally forward-looking concepts of art can emerge. Artists and creative professionals thus play an important pioneering role in exploring social transformation processes, future utopias and complex interrelationships. It is important for the promotion of culture to take up these new artistic trends by supporting projects at the interface of art, science and technology with various funding measures and by doing so, test new ways of promoting culture.

The Swiss Arts Council Pro Helvetia has therefore decided to devote special attention to the intersection of art, science and technology and launch a correspondent funding focus from 2021 until 2024 [1]. Within the foundation, this area is part of the sector of Innovation & Society, highlighting the inherent entanglement of arts, science and technology with societal issues as well as the shaping of the future.

The Goals

For the four years of the “Art, Science and Technology” focus area, the foundation has set a total of four impact goals. **Creating a network:** Pro Helvetia sets out to create and foster a strong network of professionals within the fields of art, science and technology. Strong networks allow for knowledge transfer, broadening of perspectives and exciting new collaborations. Fostering a network means creating opportunities for new encounters and connecting professionals across disciplinary boundaries. We believe that transdisciplinarity ultimately leads to epistemological pluralism, which in turn contributes to the making and unmaking of our realities; by diving into the complexity that surrounds us, and by adding layers to our understanding of the world, we open up new potentials and shape new realities and horizons.

Funding artistic production: Innovative and daring production proposals need financial backing, which can be provided by funding institutions such as Pro Helvetia. The foundation accompanies and financially supports such projects at the intersection of art, science and technology, in order to allow new and surprising possibilities inscribed in those projects to become a tangible reality.

Transferring knowledge: Transdisciplinary funding requires different approaches and models than traditional artistic funding. What is there to be learned from transdisciplinarity? How can science and technology be integrated into artistic practice in a meaningful way and the other way around? Pro Helvetia wishes to share its knowledge to reinforce the connection between the different fields and thereby encourage other institutions and individuals to invest into these intersections and build purposeful STEAM-art learning and exchanging environments, for example by bringing artistic practice inside laboratories and other scientific institutions. The aim is to showcase and spread good practices of transdisciplinarity for others to be inspired by and possibly replicate.

National and international promotion: As the Swiss Arts Council, Pro Helvetia seeks to promote Swiss artists and Swiss projects at the crossroads of art, science and technology, but also to increase visibility of international transdisciplinary collaborations. We believe that in our interconnected world, sharing and negotiating experiences, values and different contexts has not only become essential, but does also contribute to a more inclusive artistic community.

The Initiatives

Various proactive initiatives have been put in place during the first year of the focus area, all of them exploring possibilities and new collaboration models across disciplinary borders. Surrounding the question of how the arts can be meaningfully integrated into science and technology, and the other way around, we launched the following initiatives: **Connect** [2] is a series of art residencies launched in April 2021 in collaboration with CERN. It serves as a platform to foster experimentation in the arts in connection with fundamental science. The artistic residencies take place at CERN

and in partner scientific organizations worldwide in Chile, South Africa, China and India. Artists are invited to apply for research-led residencies, to explore ideas and develop new work inspired by science and in connection with the scientific communities. The aim of the Connect programme is to encourage practices of artistic research as well as to broaden horizons and strengthen the dialogue between different cultures. Additionally, the Connect programme creates room for reflection about the universe, the outer space, ourselves and the hypotheticals emerging out of this triade. The programme can be considered connected to the “natures and worlds” subtheme of ISEA 2022.

PolyMatters will be launched in 2022 and offers artists a unique access to the research and the laboratories of the Adolphe Merkle Institute in Fribourg (CH), a leader in fundamental and application-oriented interdisciplinary research on soft nanoscience [3]. Accompanied by an art mediator and a curator, artists collaborate with scientists in exploring nanotechnologies through research-driven and speculative artistic research, touching upon topics such as transhumanism and the frontier of the human and the non-human. The tandems are accompanied not only in their research, but also in the production of artistic outcomes as well as their dissemination. The PolyMatters open call aims to question the ways in which we construct and gain knowledge and to open up the field of nanoscience to creative speculations and artistic exploration. The transdisciplinary nature of this open call strongly links it to the “education and societies” as well as the “human and non human” subthemes of ISEA 2022.

PolARTS [4] is a research grant directed at tandems of artists and polar scientists who wish to jointly engage with topics linked to polar regions such as global warming and the study of the Anthropocene. Together, the tandems explore our relationship with nature and engage in different approaches and reflexions about responsibilities and possibilities surrounding the ecological crisis that we are currently facing. Artists have the opportunity to accompany scientists during their fieldwork, thus gaining deeper understanding of the materiality of polar sciences but also of the complex networks predominant in environmental studies. In that sense, the PolARTS programme addresses relevant questions of the “natures and worlds” subtheme of ISEA 2022.

The Landscape Analysis is being conducted in all of the Liaison Offices of Pro Helvetia (New Delhi, Shanghai, Johannesburg, Moscow, Cairo and South America), in an effort to sound out and explore the different landscapes and cultural contexts of the crossroads of art, science and technology. The aim of this analysis is to create understandings of geo-social characteristics and developments of a rich, heterogeneous field, allthewhile considering past and future archeologies of knowledge. In a world overflowing with information, it is crucial to join forces in order to make sense of it and to carve out common denominators as well as differences between various contexts. The question of organizing knowledge and extracting meaning out of the flood of information provides a link to the “futures and heritages” subtheme of ISEA 2022.

Art Meets... [5] is a podcast series launched by Pro Helvetia, highlighting and showcasing international art-science collaborations. From artistic residencies to field trips to the glaciers, from astronomical observatories to artist’s studios, listeners can join intimate conversations between artists and members of the scientific community and discover how these different fields collaborate and inspire each other. The podcast collects and documents different modes of transdisciplinary exchange by giving a platform to a plurality of voices. It explores (im-)possibilities of transdisciplinarity and observes how change and innovation shape our world, therefore echoing the main theme of ISEA 2022, the “possibles”.

The Institutional Presentation

At ISEA 2022, Pro Helvetia would not only introduce itself and its current focus on art, science and technology to the community, but also provide opportunities for meaningful and strategic networking with the Swiss and international artistic scene, as well as with Swiss and international scientific institutions interested in transdisciplinary collaborations. Pro Helvetia works and is in touch with internationally recognized institutions such as CERN, the Adolphe Merkle Institute, the South African Radio Astronomy Observatory, the Swiss Polar Institute, TBA21 Academy, and others. In the field of art and science, the foundation has supported established and emerging artists and artist collectives such as Aparna Rao, Claudia Comte, Hemauer/Keller, fragment.in, Ursula Biemann, Julian Charrière and many others.

Leaving room for the emergence of new practices, envisioning mistakes and fallacies not as failures but as potentials, and fostering an exchange that overcomes disciplinary, geographical and social borders – these are our values and topics that we would be delighted to present at ISEA 2022.

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Seraina Rohrer is the head of the Innovation & Society Sector and a member of the Executive Committee of the Swiss Arts Council Pro Helvetia. She studied journalism, communication studies, film studies and IT at the University of Zurich and earned a PhD at the University of Zurich and UCLA in California.

Ariane Rippstein is a specialist in the field of Innovation & Society and is responsible for the focus “Art, Science and Technology” of the Swiss Arts Council Pro Helvetia. She studied Literature, Neurosciences and Philosophy of Knowledge at the University of Zurich and the ETH Zurich.

ISEA2022 A Path To Constructing A Diverse Future In Digital Media Arts

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Abstract

Underrepresented minorities interested in digital art as a career path face unique challenges that can redirect their future away from design. These challenges can be social, economic, or cultural, which can impact diversity in the digital arts industry. Our institution aims to get a better understanding of these challenges that cause friction in choosing art and technology as a viable career choice. We then hope to design solutions from the resulting research to create a pipeline that diversifies the future of art and technology. Our goal is to build roadmaps for underrepresented minority middle-school students who wish to pursue art and technology in Higher Education and help overcome challenges that can hinder their ambitions.

Keywords

Underrepresented, minorities, diversity, digital-art, culture, collaboration, education, technology, future, STEAM.

Introduction

Underrepresented and economically disadvantaged minority students often have little experience or exposure to the artist's application of emerging technology; many students in general are unfamiliar with the importance of multidisciplinary within the digital art community or feel discouraged to take part in video games, game development, and interactive art courses due to stereotype threat[1]. This leads to a lack of awareness regarding the trajectories game development can lead to, i.e. developing more interactive and immersive artworks and the potential of unlocking roads to numerous career opportunities. Hence, it becomes important for minority artists to be trained in technology so they are not restricted by mediums and tools. It is also necessary to provide students and their families information regarding the potentials of digital art careers so they can take actions that align with the best interest of the students.

Collaborative Faculty Research

The Digital Media Arts (DGMA) faculty of Prairie View A&M University (PVAMU) is working in collaboration with the Visualization Lab at Texas A&M University

(TAMU) on a research project focused on the impact of near-peer mentoring by our college students on interest in digital arts and STEAM subjects among middle-school-aged students. The project is led by Tim McLaughlin from Texas A&M University's Department of Visualization and in partnership with Gearbox Software. Funding for the two-year study, which formally started in September 2021, comes from the Simons Foundation's Science Sandbox. Hira Roberts is the lead from PVAMU with Tracey Moore as Co-PI. Our current project partners with Longview Independent School District in East Texas. We plan to replicate the study with districts local to Prairie View.

Our team from PVAMU is working on researching factors that cause friction in the pursuit of artistic careers amongst targeted focus groups consisting of primarily African-American and Latinx middle schoolers by incorporating multiple methods and tools. We are working with a rural school district in Texas where 75% of the student body is African-American and Hispanic and 54% of the population is economically disadvantaged. College students from both universities will be hired as Near-Peer Mentors (NPMs) to collaborate with the under-represented minority (URM) youth in the implementation of the project. The objective is to empower URM youth with greater confidence in STEAM skills, resulting in an increased diversity of visual computing professions. To achieve this objective, we will survey our focus groups, gathering data that will assist us in accomplishing future goals.

While the project's main focus is increasing enrollment in STEAM careers through digital world building and game development at middle school and high school level, our institution is focusing on understanding factors that cause friction in the pursuit of studying digital art as a major and come up with solutions to mitigate them, thereby increase diversity art and technology. Our objective is to learn from the research so we can inform families and students about the importance of technology in art, vice versa, and multidisciplinary in education.

Student Work

NPMs from PVAMU are working on methods that make visual storytelling, application of principles of art, and design (including user experience/interface design), in digital world building easier for middle school students to understand, allowing them to implement design skills at an earlier stage. Before they can start implementing the methodologies and designs, the NPMs will be undertaking several trainings under the supervision of our industry and institutional partners so they are familiar with the custom tools that are being implemented.

Methods

We have designed surveys that will be utilized for both NPMs and URM students regarding their experience and factors that play part in their career choices. They will gain training in industry-standard software and will complete projects designed to introduce cross-disciplinary skills that go in the building of a single project.

Future Goals

To further our understanding, we will send out surveys to minority-serving schools that are local to our region, gather data from various focus groups based on *religion, culture, nationality, ethnicity, gender, race, and socio-economic status*, and introduce methods and tools that address the concerns and insights gained as a result of the research. A long term goal is to research at an international scale to further our understanding of factors that may impact students' reluctance to pursue digital media arts as a major at a university level.

Conclusion

The faculty is researching methods of improving diversity in digital art at higher education at university level. With a better understanding of factors influencing the decisions that students make for career choices we wish to find methods and solutions that address the problems, thus increasing the diversity in digital media art in the future.

Acknowledgements

The presenters of this Institutional presentation would like to give a special thanks to Timothy McLaughlin who is the lead of the project from TAMU's visualization department. We would also like to thank Aaron Thibault and Jason Orsatti from Gearbox, LongView Independent School District. Our institutional collaborators, Kim Wright, Jinsil Hwaryoung Seo, Ph.D., Dawson Nodurft, Ph.D, graduate and undergraduate research assistants Rebekah Bogdanoff, Chudi Nwokoma, Sergio Alonso-Macias, Ashlyn Stewart, and Caitlin Littlejohn. And all supervisors, industry partners, institutional partners, and mentors that have been working with us on the project and proposal.

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Author(s) Biography(ies)

Hira Roberts is an Assistant Professor of Digital Media Arts at PVAMU. She has developed the courses for interactive media and game development offered at her institution. She has an undergraduate degree in Architecture and a Masters in Fine Arts with digital art as her concentration. Her thesis project incorporated interactive and immersive technologies in installation art and virtual worlds where she questions the impact and influence of culture immigrant women.

Tracey L. Moore is an Assistant Professor of Digital Media Arts at PVAMU. She has a Bachelor of Art in Advertising Art and a Master of Fine Art in Studio art with a Concentration in Graphic Communications. Her research interests include merging graphic design and ethnographic principles for historic preservation.

Tim McLaughlin is an Associate Professor in the Department of Visualization at Texas A&M University and has experience in the visual effects industry. His research interests include the use of 3D computer graphics in design, entertainment, and education.

POM – Politics of Machines Conference Series

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Abstract

The POM – Politics of The Machines is a conference series founded by **Laura Beloff** (Aalto University Finland) and **Morten Søndergaard** (Aalborg University Denmark).

Keywords

POM, art, science, technology, artists / academics

Introduction

The first POM-conference was emerging from a long-term collaboration between the initiators and their continuing discussions on the dismissal of professional artistic practices and other innovative approaches by the academia (and vice versa). This is partly due to over-formalized structures and lack of opportunities and actors who recognize the importance of inclusion and dialogue across wide range of expertise, backgrounds and perspectives – far beyond academia. For its part, the POM-conference aims at bridging this divide.

The overall thematic of the POM-conference series is the question of how the machine and technology impact and contextualize artistic and cultural production and our perception of the world. Moreover, it is aiming at investigating the histories, theories and practices of machines and technologies in-between and beyond disciplines. It seeks to question the governing ideas in the sciences and the humanities through critical engagement with and empowerment of activities of creative production.

The matter of technology should always be approached critically; the focus on machines as ‘digital’ and ‘electronic’ often hides different ontologies and materialities of the machine they operate in, as well as the alternative and the experimental. How are the relationality and operability of machines being negotiated into

cultural and social ontologies? How are we to analyze and contextualize the alternative or experimental ontologies and epistemologies of artistic practices beyond apparent dualisms and objectification? What are the politics – past, current, future – of these negotiations?

With this conference we address the politics of machines and the palpable technological approaches and structures, which gradually enter every aspect of human ‘umwelt’, as well as the critical infrastructures of artistic production in-between human and non-human agency. Where and how do experimental and artistic practices work beyond the human / non-human dualisms and into biological, hybrid, cybernetic, vibrant, uncanny, overly material, darkly ecological and critical machines?

This conference-series sets the stakes to a high level and invites you to take a fresh approach to the politics of the machine; to exemplify, analyze or contextualize alternative and experimental ontologies and epistemologies of art beyond dualisms.

Sub-tracks and track-chairs

A specific feature of the POM is the double-step submission process. In the first step, a call is published for sub-track topic suggestions, and in the second step is opened a call for actual academic papers, artist presentations, interventions and potential art works.

This process enables potential participants to get involved early on in this partly self-organizing structure, as well as get one’s ‘own’ topic and specific interests into the conference. The process has also proved to be successful in fostering wider diversity – both in gender and cultural backgrounds. For example, the POM Berlin had 55 speakers from 31 countries and 5 continents.

Each POM edition has received around 40 suggestions for sub-track topics, from which a selection board has selected 7-11 topics as tracks for the conference.

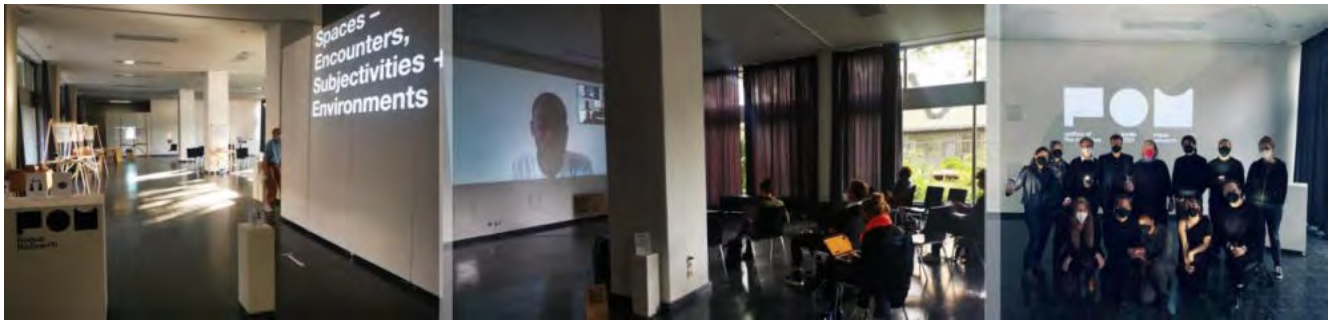


Figure 1. Politics of Machines [POM] – Rogue Research, Berlin 2021 (Covid19 period) © Laura Beloff



Figure 2. Politics of Machines [POM] – Art and After, Copenhagen 2018 © Laura Beloff

Sub-track topics in POM editions

The selected proposals for sub-tracks have been the following –

2018 Copenhagen: Emotional Machines; Cyborgs/Hybrids; Religion, Technology, and Art; Algorithms and Intelligence in Art After Aesthetics; Machines of Atmospheres; Wet Machines; Robots in art; Returns of the machine; Sonic Machines; Societies, Platforms, Institutions

2019 Beirut: Arab revolutions; Terrorism machines; Fourth Industrial Revolution; The Battlefield of Vision; Internet of things; Living machines; Artificial intelligence for art AIA; Permanent Telesurveillance; The Politics of Evidence; Body-politics of the machines; The Ecosystem Analogy

2021 Berlin: Interferences of the Multitude; Decolonizing the Machine; (Micro)biocontrol & Ethics of Care; Spaces – Encounters, Subjectivities + Environments; Digging Earth; Open Science; Critical Spaces; Open Track – Rogue Research.

Authors Biographies

Laura Beloff (PhD) is an internationally acclaimed artist and a researcher in the cross section of art, technology and science. The research is in a form of installations, wearable artifacts, and experiments with scientific methods that deal with the merger of the technological and biological matter. The research engages with human enhancement, biosemiotics, AI, AL, robotics affiliated with art, humans, natural environment and society. She is Associate Professor and Head of ViCCA-program at Aalto University, Finland.

Morten Søndergaard (PhD) is an internationally acclaimed curator and researcher of the histories, theories and cultures of transdisciplinary practices merging technology, media, art and societal trajectories. From his master thesis on the method of Michel Serres in-between poetry, art and science (1995) to the Phd on unheard avant-gardes in Denmark (Show-bix and the Danish media poet Per Højholt) (2007), the line of inquiry draws the analysis of transdisciplinary practices into epistemological questionings regarding the complexities of human and non-human relations, as well as a general study of the overarching question regarding experiencing and evidencing posthumanity. He is Associate Professor and Academic Director of the Erasmus Media Art Cultures Master Program at Aalborg University, Denmark

TeleAgriCulture: A Crowd/Cloud Data Network for Creative Cultivation and Engagement in Agricultural Practices Through Art

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Abstract

TeleAgriCulture is a community platform, providing a crowd/cloud data exchange network for information, stories, Art and innovation. Modular sensing kits are offered and are adaptable to most geographic locations and ecological conditions, providing real time sensory data that can be used to monitor and optimise conditions or for artistic production and scientific inquiry. This presentation will provide an overview of the TeleAgriCulture platform, its conceptual and organizational development and the artists' works that have so far been produced, along with current and future projects.

Keywords

Telematics, Augmentation, Crowd/Cloud Networks, Digital Communities, Agricultura, Art and Ecology, Participation, DIY/DIWO

Introduction

TeleAgriCulture is a community platform for artists, designers, agriculturalists and hobbyists, providing a crowd/cloud data exchange network for information, stories, art and innovation. A range of modular digital sensing kits are offered or use with aquaculture, hydroponic and soil-based farming. The kits are adaptable to a range of geographic locations & ecological conditions and are monitored by custom IoT sensing devices. These provide real time sensory data from each kit/location, which can be used to optimize agricultural conditions, for artistic production and scientific inquiry. This allows people, flora, fauna and ecosystems, to communicate in new, more symbiotic and empathetic ways, merging natural & data systems with social exchange networks, to facilitate art and design. The integration of machine learning further facilitates this bio-digitally convergent platform.

A range of options and instructions have been developed for different, scalable food growing scenarios and place on the Web app that we already started in 2020. The goal is to continue the development of the community, the technologies and the development of artistic strategies for augmenting ecologies and interfacing the public with this, through an improved app for novice coders, to enable more artists and coders community to be involved, either as a digital innovator, a farmer, or an artist and to make a range of really cool projects that can be created either together in person, or remotely.

Due to the effects of The Anthropocene, agriculture is going through a huge transitional period, matched only by the

agrarian and industrial revolutions. As we crash into the Industry 4.0 era, environmental considerations and public health/wellbeing are often in conflict with the need to supply food to an exponentially rising global population and with current agribusiness supply and profitability models. Due to this, ethical concerns in relation to health and sustainability are often not discussed to a suitable level of detail, with catastrophic effect. We are in the midst of a global turn in regards to environmental ethics, and by localising food and design, we can more closely engage with these evolving issues and better address them.

This project is embedded in using digital communities to increase localised food supply and facilitate innovation for future food cultures, through:

1. Facilitating creatives to grow food and create artistic responses to these processes and the communal environment sensing database
2. Making use of the customisable Open Source hardware sensing kits that with a bespoke PCB that can be developed further by experienced programmers
3. Developing instructional briefs for users (for beginners and experts) that include demos for tech, farming and artistic solutions, generated ideally by the users.
4. Incorporating cryptocurrencies and decentralised monetary systems & resource economies such as food/resource sharing and donation
5. Using the modulated design of the platform to experiment with a range of speculative scenarios and extreme ecological environments such as indoor, outdoor all year round, bad soil, riverside gardens, saline water, insect infestations, pollution, etc.
6. Facilitating a diverse range of crop solutions that compliment localised environments, be they domestic (private/public) urban, rural or industrial zones, offices/workplaces, squats, boats, mobile homes etc.
7. Design a micro/macro agricultural model for individuals, groups and organisations that though machine learning can facilitate all variable scenarios and include this in the data processing within the app (already in development)
8. Enabling marginal social groups including elderly/migrant/transient populations to participate
9. Re-orientating supply chains through a decentralised networked community solution
10. Changing food culture by redefining it as a personal responsibility

Through these objectives, this project creates a range of scenarios that while discrete in their operations, function as a community, consisting of communications, projects and personal stories, with a focus on resource driven circular economies of localised production and distribution. For most places in the world, this is a paradigm shift in food culture that is both easily accessible and usable for those with low levels of digital literacy, but also advanced enough to engage field experts, through it's Open Source approach and integration of evolving technologies such as machine learning, bio-engineering, Post-Anthropocenic design (sustainability/zero carbon focuses for example) and DIY//DIWO culture and also by strongly acknowledging traditional and indigenous approaches to localised food production and distribution.

ARTISTIC STRATEGIES FOR AUGMENTING ECOLOGIES: PROJECTS

Along with my own projects, which have included *Rhizomatic Bias* at STWST48x5, V2_ and Ars Electronica in 2019 and *Maiz Matze: Speaking from the Grid Together* at STWST 48x6 in 2020, several artists in residence also developed projects using the TeleAgriCulture platform. All projects focused somehow, on using Augmentation and Ecological Aesthetics as strategies for communicating Science in publicly engaged ways. Some do so rather directly, while others do so in a more peripheral manner, exploring the processes and subtexts of artistic practice enable such tactics. Detailed information about each previous project and the artists involved, along with an overview of the many current projects, is available at <https://teleagriculture.org/>

CONCLUDING REMARKS

Through the development of such projects, using the TeleAgriCulture platform, artistic practice can offer strategies that constitute a departure from simply articulating ecological issues through presenting, discussing, or speculating on them, towards a situation where we are more actively developing solutions for these issues and embedding these in everyday scenarios, with everyday people, beyond galleries and traditional institutional modes of artistic presentation.

Through these tools and strategies, we can more easily build a deeper empathy, as a general public community (not peripheral to or above this). We can as creative people use simple Open Source technologies to create projects that act as interfaces for educating scientific knowledge in interesting and tactical ways. Also, through situating this in networked communities, there is a solid foundation for memetic growth and the facilitation of universal changes from local to global contexts. Furthermore, it can allow for a more active participation in bio-digital ecologies to allow for wider audiences to gain deeper understandings and therefore more empathetic responses to these systems and their needs.

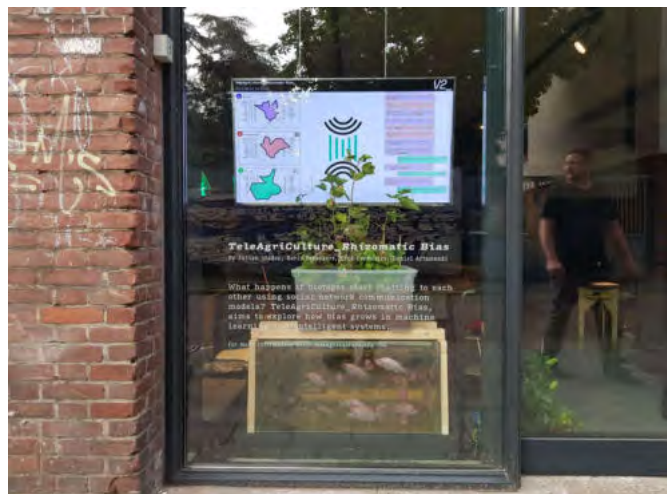


Figure 1: Rhizomatic_Bias Installation at V2_ Rotterdam (2019)

Image Courtesy of the Artist



Figure 2: Rhizomatic_Bias Installation at Ars Electronica Festival (2019)

Image Courtesy of the Artist

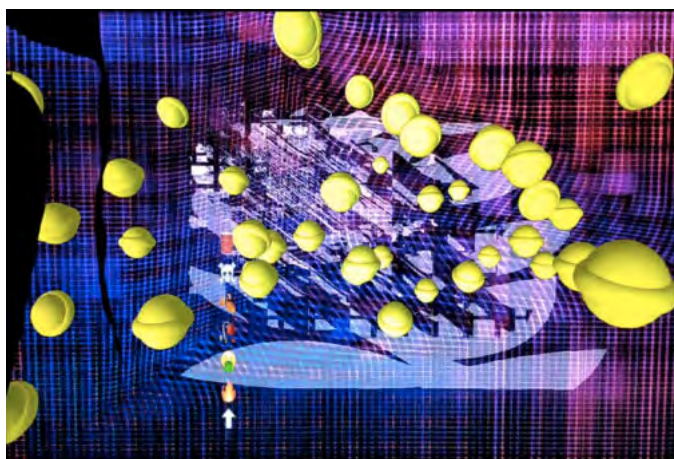


Figure 3: Stadon & Pappalardo (2020) Maiz Matze: Speaking from the Grid Together @STWST48x6 MORE OR LESS

Image Courtesy of the Artist

The Mixed and Augmented Reality Art Organisation: An Overview of Ten Years Since Our Launch at ISEA 2013

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Abstract

This presentation will provide an overview of the previous ten years of operation for marart.org, or *The Mixed and Augmented Reality Art Organisation*, as we were originally launched as, as ISEA Sydney in 2013. Since our launch by the myself, Paul Thomas and Ross Harley marart.org has seen several conceptual transitions and a sound body of outputs, including exhibitions and symposiums in Adelaide, Munich, London, Fukuoka, Merida and Hertfordshire, exhibiting an evolving format that has progressed from defining augmentation and materiality through interface, body and archival politics and approaches, to fashion, privacy, ownership and identity, all in the context of mixed reality discourse. This presentation will showcase these outcomes and discuss how the organization has developed, our current status quo and future directions.

Keywords

Mixed Reality, Augmented Reality, Augmentation Aesthetics, Digital Communities, Arts Based Research, Media Art Organisations

Introduction

The Mixed and Augmented Reality Art Organisation (marart.org) was established in 2013 and launched at ISEA the same year, to better facilitate rigorous research into this specific field of mixed and augmented reality art aesthetics, within a wider arts discourse. Through this organisation, a range of unique contributions have been made, including several events that explicitly explore the themes covered in this thesis. Such events brought together other artists, theorists and scientists working within and on the fringes of the field, producing collaborative artworks, exhibitions, discussions, interviews and written contributions.

MARart.org seeks to develop new dialogues in regard to high-end research methodologies, cultural inquiry and representation in the increasingly immersive and pervasive field of mixed and augmented reality art. We aim to do so independently of any institutional involvement as we value a (non-hierarchical) networked community approach to research and discussion. This is an open group for researchers dealing with mixed reality art focusing on augmentation aesthetics. It has a specific (conceptual) focus on convergent realities as art mediums and the theoretical discourses that surround this field.

Since our inception and launch in 2013, we have transitioned through many conceptual paradigms in regards to our core area of research and these have been presented at each transition in a format that included exhibition, panel discussion, symposiums/paper presentations and an accompanying publication.

By scoping the field of Augmentation Aesthetics through the presentation and analysis of particular research outcomes, we have been able to develop criteria that can assess its processes of production and positioning within the media arts. Through this we have been able to develop flexible strategies for hybridised research practice, in a number of open platforms that will scope current trends and exemplary models from a variety of approaches. Artistic practices in marart.org have been presented and discussed in order to locate new research paradigms that address issues including its cultural absorption, social codes and systems, ownership of content and intellectual property. Functioning as an open community group for researchers dealing with mixed reality art focusing on augmentation as a medium. Long before the Covid-19 pandemic ushered in the era of hybrid physical/virtual events, we adopted this approach, as evidenced in nearly all of our events, where our approach was more about having the write people participate in our projects, than the ones that were available or could afford/get funding to attend.

It has a specific conceptual focus on convergent realities as art mediums and the theoretical discourses that surround this field. The organisation was established, not as a commercial/advertising group, in fact striving to be the opposite of this- an open community for free exchange of ideas, projects and discussion relating to the field.

History and Events

Since our inception and launch in 2013, we have transitioned through many conceptual paradigms in regards to our core area of research and these have been presented at each transition in a format that included exhibition, panel discussion, symposiums/paper presentations and an accompanying publication. These events have included the following:

1. Our Launch at ISEA (2013) Sydney with Ross Harley and Paul Thomas hosting
2. Initial launch panel including Andrew Burrell, Troy Innocent, Kuai Shen and myself at ISEA (2013)
3. Transreal Topologies Exhibition and Artists Panel at IEEE ISMAR (2013), Adelaide with: Tracy

- Benson, Mez Breeze, Andrew Burrell, Andy Campbell, Mar Canet, Varvara Guljajeva, Josh Haglar, Damian Hills, Troy Innocent, Pierre Proske, Jorge Ramirez, Kevin Raxworthy and Paul Thomas
4. Developing Flexible Approaches to Collaborative Engagement in Mixed and Augmented Reality Panel (2013) with Mark Billingham, Jay David Bolter, Troy Innocent, Damian Hills
 5. The Aesthetics of Augmented Reality Panel (2013) with Jay David Bolter, Maria Engberd, Julian Staddon and Sandy Walker
 6. Beyond the Interface Exhibition Munich, (2014) curated in collaboration with Furtherfield (Marc Garrett and Ruth Catlow) featuring: Zach Blas, Mez Breeze, Nick Briz, Heath Bunting, Jennifer Chan, Genetic Moo, Julian Oliver, Pierre Proske and Erica Scourti
 7. Beyond the Interface Artist Panel at IEEE ISMAR (2014) with Nick Broz, Heath Bunting, Ruth Catlow and Julian Staddon
 8. Beyond the Interface Disrupting the Market Panel at ISMAR 2014 with Tatiana Bazzichelli, Annette Doms, Heath Bunting and Wolf Lieser
 9. Rethinking Aesthetics Panel at ISMAR (2014) with Zach Blas, Nick Briz, Thomas Grundnigg and Erica Scourti
 10. Beyond the Interface Exhibition at Furtherfield, London (2015) featuring Zach Blas, Branger_Briz, Mez Breeze, Heath Bunting, Jennifer Chan, Francesca da Rimini, Genetic Moo, Nathaniel Stern
 11. Data Body as Artifact Exhibition Fukuoka (2015) featuring, César Escudero Andaluz, Marios Athanasiou, Jöelle Bitton, Branger_Briz, Heather Dewey-Hagborg, Anna Dumitriu and Alex May, Chris Henschke, Raphael Lozano-Hemmer, Shannon Novak, Julian Oliver, Christa Sommer and Laurent Mignonneau, Julian Staddon, Stelarc and Adam Zaretski.
 12. Data Body as Artifact Catalogue (2015) with essays by Heather Dewey-Hagborg, Thomas Retter, Julian Staddon, Stelarc, Paul Thomas and Brigitta Zics,
 13. Bodies of Matter Panel Fukuoka (2015) with Jöelle Bitton, Heather Dewey-Hagborg, Chris Henschke, Julian Staddon and Adam Zaretski
 14. Matters of Embodiment Panel (2015) with César Escudero Andaluz, Nick Briz, Brannon Dorsey, Julian Oliver, Jorge Ramirez and Julian Staddon
 15. Contextual Engineering Panel (2015) with Mark Farid, Masahiki Inami, Luke Mason, Daniel Pinchbeck and Carl Smith
 16. Experiencing AR in Public Environments with BC Bierman, Mark Billingham, Ian Gwilt, , Shannon Novak, Julian Oliver and Lu Weiwuan
 17. Algorave Tour Japan (2015) with APNOA, Renick Bell, Chris Henschke, Smell in Stereo and Swan_Panda
 18. Affecto Material, Merida (2016) with Branger_Briz, Archangel Constantini, Alejandro Gomezrias, Jaime Lobato, Manuel de Landa, Plethora Project, Kuai Shen and 220
 19. Plethora of Senses: Human Machine Symbiosis Panel (2016) with Thomas Sanchez, Carl Smith, Liviu Babitz, Pablo Padilla, Jorge Ramirez and Jaime Lobats
 20. Art and Mixed Reality Berlin Fashion Film Festival (2016)
 21. Embodied Realities Lab Guadalajara (2017)
 22. Glitching Gender /Augmenting Identity (2017) etc House of Vans London
 23. EVA London Mixed Reality Education Panel (2017) with Nick Lambert, Julian Staddon and Ian Wilcock,
 24. Mixed Reality Aesthetics at London College of Fashion (2017) with Martina Menegon, Brigitta Zics, Miyö Van Stenis, Rebecca Stewart and Erik Zepka
 25. OOPS: Obfuscation, Ownership, Privacy and Sousveillance at University of Hertfordshire (2018) Tiare Ribeaux & Donald Hanson, Heather Dewey Hagborg, Erik Zepka, Heath Bunting, Pierre Proske, Varvara and Mar, Julian Staddon, Branger_Briz, Rob Myers, Mez Breeze
 26. OOPS We Did is Again Artist Panel (2018) with Tiare Ribeaux & Donald Hanson, Heather Dewey Hagborg, Erik Zepka, Heath Bunting, Pierre Proske, Varvara and Mar, Julian Staddon, Branger_Briz, Rob Myers, Mez Breeze
 27. Beyond TOR, A Discussion About How We Can Protect Our Online Privacy and Why Panel, University of Hertfordshire (2018) with Dionysia Mylonaki, Yannis Baboulis, Ruba Aba Salma and Panjiotis
 28. Living an Honest Life in the Field: Tips for Survival and Identity Obfuscation for Artists Workshop with Heath Bunting (2018)

Conclusion

Throughout the last ten years, marart.org has produced a significant body of arts-based research outputs that adopted a community and dialogue driven approach and its success is evidenced by both the quality of those that participated in our events and the quantity of the outputs that were produced. The short presentation will showcase the more significant of these outcomes in order to provide a context for our future directions moving forward as an organization.

Kulturtanken – Arts for Young Audiences Norway

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Abstract

The institutional presentation aims at presenting the institution's work to produce and disseminate digital art works and culture to all 825.000 pupils in the Norwegian schools. A central part of the presentation will be our outline for future and digital art experiences targeting young audiences in the context of schools.

About Arts for Young Audiences Norway

Arts for Young Audiences Norway (Kulturtanken) is the Norwegian Ministry of Culture's agency responsible for art and culture for school pupils. Most prominently, this includes nationwide responsibility for *The Cultural Schoolbag (TCS)*, which is the centerpiece of the government's policy for bringing culture to children and young people. Briefly put, *The Cultural Schoolbag* secures that all children growing up in Norway have access to professional art – spanning literature, music, visual arts, performative arts, film and cultural heritage. This is done through close collaboration between *Arts for Young Audiences Norway*, county councils and municipalities, schools and cultural institutions. The program is ambitious and far reaching. Four times a year on average, every pupil in Norwegian schools, altogether 825 000 school pupils in 3300 schools, are experiencing professional art made by around 4000 professional musicians, writers, actors, dancers, artists and other cultural producers through *The Cultural Schoolbag*.

The explicit political aim is to provide all children living in Norway with a shared frame of reference and joint experiences, irrespective of their nationality, address, wealth and social background. It is held that artistic and cultural expression can transcend norms, languages and social identities, and in this way, being a force for democracy that ideally can be felt far beyond our national borders, reaching out into the world.

Although *Arts for Young Audiences* is an agency of the Ministry of Culture, it works very closely with the Ministry of Education and Research, which is Norwegian Ministry of Culture's responsible for the institutions where TCS is implemented, namely schools. In addition to being responsible for TCS, *Arts for Young Audiences* will provide advice and other services to the central government authorities involved in the culture and

education sectors, thus helping to establish a political framework and working to improve national initiatives.

Digital Art Lab

Arts for Young Audiences aims to support projects exploring how digital technologies can be used to i) distribute a portfolio of digital artistic projects to all Norwegian pupils, ii) develop explorative art works that utilize the digital languages and interests of young audiences, and iii) use mobile media and smartphones to present digital arts in new areas and arenas.

For this purpose we have built our own, well equipped Digital Art Lab and development facility.

Structure

An independent state agency under the Norwegian Ministry of Culture

Website

www.kulturtanken.no

<https://www.denkulturelleskolesekken.no/english-information/tcs-in-schools/>

Introducing the ACM SIGGRAPH Digital Arts Community

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Abstract

The mission of the ACM SIGGRAPH Digital Arts Committee is to foster year-round engagement and dialogue within the digital, electronic, computational, and media arts. We facilitate dynamic scholarship and creative programming within the ACM SIGGRAPH organization. Our goal is to promote collaboration between artists and the larger computer graphics and interactive techniques community.

Keywords

Art, computation, interaction, technology, graphics, community

ACM SIGGRAPH

The mission of the ACM SIGGRAPH Digital Arts Committee is to foster year-round engagement and dialogue within the digital, electronic, computational, and media arts. We facilitate dynamic scholarship and creative programming within the ACM SIGGRAPH organization. Our goal is to promote collaboration between artists and the larger computer graphics and interactive techniques community.

We support a vibrant online community, organize juried online exhibitions of digital arts, and collaborate on arts-related events and exhibitions at the annual SIGGRAPH and SIGGRAPH Asia conferences. Our diverse, multi-generational community includes members from academic art and media programs, the professional media arts and game worlds, and scientists interested in the intersection of art and computation. We celebrate digital art history and encourage art-science partnerships at all levels.

We also host juried online art exhibitions. Our most recent exhibition was entitled *Digital Power: Activism, Advocacy and the Influence of Women on Online*. <https://digital-power.siggraph.org/>. We also have a new show, *The Earth, Our Home* scheduled to open in 2022. <https://dac.siggraph.org/the-earth-our-home/>. Our community also co-sponsors the SIGGRAPH Art Show Archives. <https://history.siggraph.org/art-show-archives/> and is collaborating on the ISEA Archives as well.

At the annual SIGGRAPH conferences we reflect back on our year-round projects as well as sponsor discussion sessions on topics of interest to the community. special topics

In 2021 we held a special co-sponsored session with ISEA focused on New Media Art History. We also sponsored a session on “Intersectional Resistance, Advocacy, and Activism in International Feminist Techno-Decolonial Art” as a follow-on to the Digital Power exhibition.

In addition to our online exhibition, archives, and conference activities, our regular programming now also includes a monthly presentation and discussion series, SPARKS: Short Presentations of Artworks & Research for the Kindred Spirit. Introduced in the time of COVID, we have found SPARKS to be an excellent way to engage a wide range of digital arts community theorists and practitioners in conversations around emerging themes of interest to our community. The 2021 topics have included the following:

- Screen Worlds: Net Art & Online Communities
- Immersion, Interactivity, and Altered Realities
- Environmental Issues, Sustainability, Climate Change
- Robotics, Electronics and Artificial Intelligence
- Art, Science and the Invisible World We Live In
- Music in Social VR: Education, Installation, Conferences, and Performance
- Creative Coding: Generative / Algorithmic Art and the Exploration of Authorship and Authenticity
- Data: Visual Perception, Interpretation, and Truth
- Within the Frame: Continuum of the Still Image

In 2022 we anticipate continuing the discussion with sessions around topics such as art and games, digital cultural memory production, artificial intelligence, and decolonial arts practices.

For more information, visit us at <http://dac.siggraph.org>.



Author Biography

Victoria Szabo is Chair of the ACM SIGGRAPH Digital Arts Community and of the SIGGRAPH Arts Advisory Group. Bonnie Mitchell is a DAC Standing Committee member and Chair of the 2023 SIGGRAPH History activities at the North American conference.

Künstlerische Tatsachen [Artistic Facts]

1st Enrique Torres, 2nd Kilian Rüß, 3rd Vincent Maurer, 4th Gabriel Dörner, 5th Marie Niederleithinger, 6th Sarah Biering, 7th Paolina Wandruszka, 8th Elodie Sacher, 9th Philip Pastrik

INs Netz e.V.

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Abstract

IN's NETZ e.V. is realizing a new residency format in the TRAFÖ in the center of Jena for the second time, bringing together the international art scene with Thuringia's top research and exploring visual and performing arts as a versatile medium of scientific communication.

Keywords

Arts & Science, Residency, citizen science, open laboratory, tension

Bringing Together the International Art Scene with Thuringia's Top Research and Exploring Visual Arts as a Versatile Medium of Scientific Communication

From June to September 2022, up to six international artists will work in pairs with scientists from local institutes on a research question. The starting point of the collaboration is the processual nature of the disciplines of art and science, which are often perceived as contrary: artistic practice as well as explorative basic research are characterized by experimentation and freed from the immediate demand to produce results that are close to application. Both require a high degree of abstraction and creativity. Based on this, the residency is designed as basic artistic research. It is aimed at artists who are engaged in the method of artistic research as well as at Thuringian scientists who are open to an exchange with art and a disclosure of their research processes.

Through the joint research process, the participants will explore the synergies of the disciplines, learn from each other, and finally transform their findings into a work of art. Artistic creation becomes a discursive process that ties in with the research foci of the city of Jena, opens up insights in new ways, and at the same time sets new impulses for further thinking on the part of the scientists.

Under the motto tension, questions on the topic of tensions in perception will be negotiated during the residency: These occur in pragmatic and dogmatic determinations and thereby generate fragile knowledge constructions. By acting as mediators and negotiating these conflicts in a transdisciplinary way, approaches to facts in this field of tension emerge. Similar phenomena also appear at the interface of

diverse art forms, as playful and serious approaches struggle for interpretive sovereignty. Within the process, we appropriate these tensions, make them visible, and transform them into a productive discourse that negotiates notions of truth and unlocks undiscovered potential.

The residency consists of a research phase in the laboratories of the institutes in July, a production phase in the studios starting in August, and an exhibition in October at TRAFÖ. The exhibition, which will be open for at least six weeks, provides an alternative, sensory access to research processes from the hard and soft sciences. During the exhibition, accompanying guided tours will be made possible in order to make the creation of the artistic facts transparent for visitors: inside and to enter into conversation. To further expand the network and create additional opportunities for inspiration and dialogue, we will host at least three hybrid Arts & Science soirées, inviting moderated panels with international guests from the arts and sciences as well as participating artists from the Arts & Science Residency 2021.

With the help of the cross-generational participation format *kT Fellows*, citizens from Jena and the surrounding area will become artistic researchers themselves in low-threshold workshops. They will actively experience the process of creating artistic facts, creatively co-design them and enrich them with their own questions and perspectives. Based on art pedagogical methods, *kT Fellows* specifically addresses citizens from Jena and the surrounding area who have no contact with art or science in their everyday lives. In the workshops, for example, the framework topic of tension is experienced in a playful, physical way, or what artistic research can mean and achieve is explored in a low-threshold way. Artistic contributions are created in the form of performative elements and creative audio and video sequences that are presented on our social media channels. The collaborations with universities, research institutions and civil society actors in Jena will be actively included.

In the context of the residency, the lab becomes the studio and the studio becomes the lab, so that the processual nature of both disciplines can be experienced by the participating artists, scientists and the public.

For the Arts & Science Residency, TRAFÖ, a forgotten transformer station in Jena, is both a working space, an event space, and an exhibition space. With the artistic facts, a unique hub for artistic basic research and science communication is being created in Jena, which will closely network the international art scene with the local science

community and establish itself as a point of attraction as well as an impulse generator for the young, European Arts & Science scene.

Our artistic research project does justice to the city's scientific focus by making the research processes and results accessible to the public, thus filling a central gap in the city's culture.

A long-term continuation of the project is envisaged in order to make a decisive contribution to sustainable neighborhood development in Jena as a cultural and scientific location. The effectiveness of „Künstlerische Tatsachen“ was expressed in the high visitor volume during the supporting program and the exhibition 2021 as well as in externally commissioned workshops and conferences.



Figure 1. Exhibition in autumn 2021. © Leonie Lindl

Project Team

Enrique Torres

Project Manager

Born in Jena. Has been part of the re:publica program team since 2018 and was responsible for the rpCampus, among other things. He studied philosophy and cross-disciplinary strategy at the University of Leipzig and at the University of Applied Arts in Vienna. He is also the founder of Œuvre e.V. and schau e.V. and is involved in numerous artistic projects at the interfaces between art and activism as well as art and science.

Sarah Biering

Project Assistant | Cooperations | Conception

Born in Jena. Studied cultural studies at the University of Leipzig and applied media and cultural studies at the University of Merseburg. She worked in the field of cultural education for children and young people in Thuringia and gained experience in association work and the coordination of a funding measure. She also worked for Œuvre e.V.

Vincent Maurer

Project Assistant | Production | Artist Support

Studied cultural sciences & digital media at the Leuphana University of Lüneburg. Chair of the Œuvre e.V. with Enrique Torres. There active in the areas of curation, artist support and social

media. Has professional experience in theater productions, online marketing and project management.

Kilian Rüb

Science Coordinator

Born in Jena. Studies social sciences at the Humboldt University in Berlin. There he has a special focus on data analysis and the communication of results through data visualization as science communication. He is currently holding his own seminar on this subject.

Marie Tatjana Niederleithinger

Science Coordinator

She studied biochemistry and molecular biology in Jena and thus found access to the hard sciences. As a biochemist, she recently carried out research in Vienna on both the molecular level and together with those affected on prostate cancer. At the same time, she supported the exchange between the laboratory and society with projects such as a »tea hour with researchers« in the senior residence »Haus Augarten«.

Philip Pastrik

Science Coordinator

Born in Leipzig. Graduated physics in Jena with master thesis about cryogenic properties of optics for use in gravitational wave detectors with minors in economics and philosophy.

Currently employed at a technology company based in Jena as part of the R&D Department and responsible for global projects including design and implementation.

Elodie Sacher

Science Coordinator

Is a media scholar with a special interest in media culture and aesthetics, focusing on photography and the medium's historical as well as contemporary dimensions in Morocco. She studied Cultural Studies & Cultural Policy in Hildesheim and currently takes part in a Master program in Art & Film Studies. In the past years she studied and worked in Morocco for different artistic research projects and cultural associations.

Paolina Wandruszka

Curator

Studied art history and cultural anthropology in Hamburg, Venice and Vienna. In her research and curatorial work she pursues feminist, postcolonial and Institution-critical approaches. She has worked for artist as well as at the Department of art history, University of Vienna and curated several exhibitions — on and off-line.

Gabriel Dörner

Public Relations | Communication Design | Cultural Education

Studied visual communication until 2019 at the Bauhaus-Universität Weimar with a focus on graphics and editorial design as well as didactics of communication design. Several teaching assignments and independent work followed. Since 2020 he has been a student in the master's program in cultural mediation at the University of Hildesheim and specializes in public relations and project management.

Montreal Digital Spring, Our Future

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Abstract

Montreal Digital Spring is a non-profit organisation whose primary mission is to boost digital intelligence through various activities including a yearly conference, an exhibition, networking events, and a series of workshops targeting the general public, digital creativity companies and organizations and the youth.

Keywords

Digital transformation, technology, culture, media art, digital art, cultural industries, curatorship, exhibitions, audience development.

Introduction

Montreal Digital Spring (*Printemps numérique*) is a non-profit organisation whose primary mission is to boost digital intelligence through various activities of event productions, communication, curation, networking, and mediation with 3 sections: general public, professional and youth.

Since 2014, the flagship event – *Printemps numérique* (digital spring) – has been held annually in Montreal from March 21 to June 21. This season is a space for networking between the arts, industry, education and research sectors as well as a showcase of recent artworks by local and international artists. The diverse programming of Montreal Digital Spring makes digital arts accessible to a large audience and attracts an international clientele. Throughout the year, the organisation works within the various digital sectors by organising forums and events to foster conversation around digital trends and issues of digital transformations.

MTL Connect

Printemps numérique launched the first edition of MTL connect in 2019. Montreal Digital Week is an annual event using digital intelligence as the overarching theme. It aims to look at the main questions related to digital development and focuses on the economic, social, cultural, and environmental impacts in various sectors of activity. The second edition was held from October 13 to 18, 2020 alongside ISEA2020: Why Sentience?

For the first time in the history of ISEA, the 2020 Montreal edition faced the challenge of moving its artistic and academic programs online. For MTL connect and ISEA2020 Online, organisers were committed to bringing the international community together. It was dedicated to

research-creation, allowed participants and speakers to forge new connections, and kept Montreal at the heart of the creative spirit of ISEA2020.

The online event consisted of four full days of 12 hours of presentations on three different live streams: 108 full papers, 96 short papers, 24 panels, and 18 posters selected from nearly 1000 submissions from 58 countries. In addition to this, ISEA hosted an entirely virtual series of exhibitions based on the following themes and their correlation with the symposium's throughline, *Why Sentience?: Animality, The Ecosophic World, Politics of Sentience, Matter's Mattering, The Planetary, Machinic Sense & Sensibility, and Sentient Difference*. In tandem with the online programme, ISEA presented a series of events in its host city, Montreal, and adapted to COVID-19 security measures that began on October 1st, 2020. This hybrid programming represented an exact reflection of our current societal modus operandi: full online connection but limited physical presence for the optimal reach and impact in our local communities and those at large.

ISEA2020 in Numbers

4,193 Attendees
1732 ISEA Art Website Visitors
300 Academic Programme & Talks Participants
133 Local & International Artists

12 Online/On-Site Workshops, 26 Facilitators, and over 200 Participants

More than 15 team members, 9 production staff, 2 designers, 4 videographers, 3 technicians, and 25 invaluable volunteers

The Future

MTL Connect third edition took place from October 12 to 17, 2021 in hybrid format.

This presentation will reflect on the ways in which ISEA2020 shaped the *Printemps numérique's* artistic vision and how the organisation will restructure in order to continue to bridge the academic and artistic scenes in Montreal.

Author Biography

Erandy Vergara-Vargas (MX) is a Montreal-based curator and scholar. Her main research interests include global art histories, climate responsibility, curatorial studies, equity, internet cultures and widespread bias in algorithms. She earned a MA at Concordia

University and a PhD in Art History at McGill University. Recent shows include ISEA2020: Why Sentience? (Printemps numérique, Montreal); Eva and Franco Mattes: What Has Been Seen (Fondation Phi pour l'art contemporain, November 2019-March 2020); Speculative Cultures: A Virtual Reality Art Exhibition, curated with Tina Sauerländer (Anna-Maria and Stephen Kellen Gallery, Parsons School of Design, New York, 2019). Currently, she is a Postdoctoral Fellow at The Sociability of Sleep Project, Université de Montréal, and artistic director of Printemps numérique.

ISEA2022 Formatting Instructions for Authors

Florian Weigl, Arie Altena

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Location, Country [Rotterdam, the Netherlands](#)

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Abstract

V2_, Lab for the Unstable Media is an interdisciplinary center for art and media technology in Rotterdam (the Netherlands). Founded in 1981, V2_ offers a platform for artists, designers, scientists, researchers, theorists, and developers of software and hardware from various disciplines to discuss their work and share their findings. In V2_'s view, art and design play an essential role in the social embedding of technological developments. V2_ creates a context in which issues regarding the social impact of technology are explored through critical dialogue, artistic reflection and practice-oriented research.

Keywords

The title “Keywords” should be 12 point, bold type, centered at the beginning of the left column. Using 10 point, justified, regular type, write up to ten keywords that highlight the main areas of your essay’s content.

Introduction

In this institutional presentation by V2_, Lab for the Unstable Media we will present our Lab’s interdisciplinary practice with a focus on art and media technology. It will cover our three core activities - the production, presentation and publication of research at the interface of art, technology and society, as well as highlight five pillars to our success: 1.) an emphasis on experiment as opposed to end result; 2.) the support of practices

Figure 2. Example of a double-column figure with caption. ©Respect Copyright.

Author(s) Biography(ies)

Florian Weigl is curator at V2_, Lab for the Unstable Media. As curator and researcher he is interested in art and contemporary technology reflecting on society, in collaboration with artists in the development of critical dialogue, artistic reflection and practice-oriented research.

Curatorial projects at V2_ he did include the live experiment series [3x3](#) he initiated, and amongst others the group exhibitions [Latent Spectators](#) (2019, UNArt Center, Shanghai, co-curated with [Iris Long](#)), [To Mind Is To Care](#) (2020) and [Reasonable Doubt](#) (2021, co-curated with [Vincent van Velsen](#)); solo

instead of mere single projects; 3.) the integration of theory with practice; 4.) our care for archiving activities; 5.) and our vast international network.

Furthermore, the presentation will highlight our thematic approach based on the recent example *To Mind is to Care*, a long term research project into the notion of “Caring for”. This interdisciplinary study of care covered care of people, other life forms, and technology and resulted in the book *To Mind Is To Care*, which included contributions by Ann-Sophie Lehmann, Sjoerd van Tuinen, Michael Marder, Arjo Klamer, Driessens & Verstappen, Frank Pasquale, Ellen Dissanayake, Maria Puig de la Bellacasa, Pieter Lemmens, Jeannette Pols, Bernard Stiegler, and Frederiek Bennema, a group exhibition carrying the same title featuring four new productions by artists Ana María Gómez López, Driessens & Verstappen, Nathalie Gebert and WE MAKE CARPETS and the curatorial research *Art and Care: Reflections on the To Mind Is To Care Exhibition*.

Image:

https://v2.nl/organization/contact/leadImage/image_view_fullscreen

PRODUCING, PRESENTING AND PUBLISHING WITH V2_

projects and exhibitions Jonas Lund's [Operation Earnest Voice](#) (2018), Philip Vermeulen's [The Physical Rythm Machine](#) (2017 at Ars Electronica, 2018 at V2_) and Johannes Langkamp's solo exhibition [Sun Tracing](#) (2019). He is also author of the publications [3x3 Live experimenteren](#) (2020, V2_Publishing with Jochem Kootstra) and [Art and Care](#) (2021, V2_ written with Dora Vrhoci).

Arie Altena is archive editor at V2_ and the author of *Wat is community art?* (2016) and *40 Years of V2_* (2022).

C-CATS — Centre for Creative Arts and Technologies at the University of Surrey

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Abstract

The Centre for Creative Arts and Technologies (C-CATS) is an interdisciplinary research and production initiative grounded in the media of moving images and related artistic forms.

We embrace film, animation, visual effects, games, interactivity, live performance, immersion, digital theatre and virtual production in all their current and future guises; without forgetting all the artistic and cultural forebears upon which all these modes of expression were built.

C-CATS combines creative expression with technological innovation: a ‘no barriers’ approach through which we can both make great work and facilitate the future of making great work.

Keywords

Film, Animation, Digital Arts, Moving Image, Virtual Production, Digital Actors, Virtual Characters

Culture and Context

We find ourselves in a time of profound change in the arts and culture space; a time of potential crisis as well as potential opportunity. C-CATS is our way of trying to tip the balance in favour of a positive future creative landscape, by leveraging the best emerging technologies, developing the best new tools and techniques, and being a key part of the production of powerful stories and experiences for the benefit of all who are willing to engage.

Origins

Around 200,000 years ago we gradually evolved into a species capable of communicating through language. This incredible ability to use our breath and mouth to manipulate pulses of air pressure into structured patterns of meaning, and for these to be processed and understood by the strange miniature labyrinthine organs on either side of our heads, is unique on our planet.[1] Our first utterances were transitory, fading with the wind. But we soon became adept at storing and retrieving information and feelings passed between us through the gift of spoken words.[2] This is the genesis of storytelling: a means through which we are able to imagine lived experiences beyond the limitation of our immediate surroundings.[3]

Fast forward some 150,000 years and another richly expressive means of communication has flourished. Visualisations of the world and its creatures adorn the spaces

where our ancestors took shelter. Fragments of rock and stone are fashioned into representational form and imbued with significance and meaning.[4] Around the same time, we learn to manipulate nature’s sounds into patterns and rhythms which further reflect our increasingly complex thoughts and feelings.[5] We then begin to use our bodies to create symbolic form and movement as communal means of expression and celebration.[6] Art and artefact, music and dance, ritual and representation – all these elements evolve in parallel to our ability to craft natural material into tools for survival; and the environments we inhabit into sheltered spaces and safe settlements.

Written language comes later. An amalgam of all previous cultural forms, it reflects our increasingly developed means and modes of communication and culture.[7] Then, applying our natural instinct to pretend and embody, we learn to perform and share the stories and adventures of those who have come before us.[8] These become mass communal gatherings; collective acts of understanding and edification; safe spaces where we re-experience the dangers and delights of both the real and the imaginary; tales of familiar strangers we will never directly know.

Essentials

Art and Culture has always made use of the tools and technologies of the time. Yet the fundamentals of creativity and storytelling which drive them have changed little since the forms first evolved. How else are we to understand the complexities of the world around us – in particular the mysteries of the species of which we form part? What else offers us glimpses of explanation for our sensations and feelings, and for the peculiarities of how we humans behave towards each other? It is only within these spaces that we dare to celebrate triumph over imagined adversity, to understand the tragedy of loss of life or love, as rehearsal for the sorrows that our own lives inevitably hold in store. Stories provide us with the vicarious thrills of adventure without risk, the rush of fear without actual danger, the intensity of unbridled passion pitted against reason or sanity.

For our modern lives, these elements are essential not optional. These arts are the currency of the soul, vital for our vitality, one of few precious sources of good in the world. And in these unprecedented times, we have at our disposal the most remarkable tools and technologies, accessible now

to more of us than ever before.

But history tells us, painfully, that technological advance can be both for the benefit and detriment of life and well-being, and also that of the planet we inhabit. More often than not, 'progress' profits the haves and harms the have-nots. So how do we ensure that the latest and greatest technologies are put to the best possible use?

Ambitions

C-CATS is our humble way of assisting in this mission.

We seek to broaden creativity; to explore and develop the best use of tools and technologies which enable the showing and sharing of stories and experiences for everyone, everywhere.

We embrace new and emerging technologies without turning our back on fundamental skills and techniques.

Democratisation, accessibility, diversity, engagement. These are all essential facets of our work as a centre for research, development, production and skills enhancement in media and performance, including film, animation, visual effects, games, interactivity, immersion, multimedia theatre and virtual production.

We are particularly interested in the spaces which exist between all these forms: cross-overs between animation, digital technology, film, music and live performance; and the interactions between 'makers' and 'players' in the broadest sense.

Manifesto

Interdisciplinarity

Our vision is to bring together researchers and practitioners in film, animation, theatre, data science, engineering, psychology, humanities and beyond, to create new experiences and new ways of working within the broader creative arts.

Connections

We enjoy strong links with the film, television and games production communities, as well as with numerous leading national and international industry players. We extensively engage with all important cultural institutions and trade associations which promote and support the creative industries of which we are a part. We are also actively developing partnerships which transcend institutional boundaries – local, national and global – for the benefit of all.

Crossovers

Legacy distinctions between research, development, production practice and learning/teaching have no place here. We embrace student involvement at all levels of our work. Our production methods are both innovative and agile. Examples include real-time rendering pipelines, automated photogrammetry, 3D to 2D animation hybridisation, performance capture, full virtual production and more. We are proud to benefit from our students' and new entrants' expertise and familiarity with social media content creation, low barrier-to-entry distribution, diversity, and thematic political engagement.

Research

We seek to be more than a traditional academic research centre, more than a set of outputs for academic consumption in pursuit of league table scores. We set our own research targets – to make our research real, impactful and relevant. We are informed by and seek to influence contemporary media practices and the evolving contexts of the audiences and cultural communities we aim to reach. We will find new and interesting ways of creating delivering and understanding the stories, experiences and provocations which provide us all with edification, connection, and a deeper sense of collective consciousness.

Impact

C-CATS is designed to jumpstart high level research and practice in the creative arts and technologies through interdisciplinary collaboration, creative activity, industry partnership and impactful outputs that engage with audiences. We combine technological expertise with innovative storytelling, facilitating the creation of new, impactful artistic works and novel media production techniques.

Technology

We're determined to not only use technology, but also to adapt and invent it. This is where interdisciplinarity truly comes into play.

Production

C-CATS is fundamentally a group of practitioners. We make things. Some of these are experimental and tied in with our research; others more practical fulfilling a need or request from internal or external partners, such as university departments, charities, causes or initiatives. We produce films, animations, games, apps, experiences and events. We offer expertise in performance capture, real-time rendering, cinematography, vfx, animation, virtual production, and live action film production. We have access to some of the best new talent in the business. We avoid turn-key solutions: every production is a learning journey for all involved.

Creativity

There is no substitute for creativity. It is our watchword. No amount of technological wizardry can ever replace the ingenuity and spark of the human spirit.

Presentation and Showcase

For ISEA 2022, we are pleased to showcase some of our latest productions, research outputs, and collaborative initiatives. We invite enquiries about collaborative research opportunities, particularly in areas such as Virtual Production, Autonomous Digital Actors, AI Assisted Synthetic Imagery, and Performance Capture. We also present our new interdisciplinary MA programme in Film, Animation and Digital Arts.

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Author Biography

Jon Weinbren is Senior Lecturer in Film, Animation and Digital Arts at the University of Surrey and Director of the Centre for Creative Arts and Technologies.

1st Author name, Peter Zorn

Affiliation (s) European Media Art Platform: Peter Zorn, Werkleitz Centre for Media Art

Location, Country, Werkleitz Centre for Media Art, Halle (Saale), Germany

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Short Description

EMAP Manager Peter Zorn from werkleitz Centre for Media Art in Halle will present the European Media Art Platform EXPANDED and its conditions for media artists and institutions interested to become partner and introduce briefly some commissioned art works of the former program EMAP 2018-21.

Keywords

Media Artists Opportunities, Media Art Production, Artistic Research, Residencies, Presentation Grants,

European Media Art Platform Expanded

The European Media Art Platform (EMAP) was established in 2018 with the support of Creative Europe. 11 leading European media art organizations and festivals formed the platform to support media artists within a two months intercultural residency production ranging from media installations, virtual reality, robotics, AI and Bio Art, amongst others, to present and promote their works in group shows and as well to the 80 partner organizations which support and collaborate with EMAP to showcase the EMAP productions. Selected via open calls, the art projects deal with the most urgent challenges of our time, including climate change, environmental degradation, social inequalities, inclusion or digital surveillance. Artists bring these issues to the public and develop alternative ideas.

Continuing and developing their 2018 successfully established brand which builds upon the legacy of the European Media Artists in Residence Exchange established 1995, werkleitz and its members seek to expand both the platform and its activities to host and produce more artists, and to also create a major international platform to promote the artists' productions and to foster knowledge transfer between artists and institutions, not only from Europe but across the world. 15 renowned institutions will host 45 media art residencies for new innovative collaborative productions in the field of art, digital media, technology, and science from 2022 until 2024. In addition, 30 mobility grants will be awarded to partner institutions aiming to present an EMAP work and 14 capacity building workshops will be offered by the members online.

Next to the challenge of artistic production with cutting edge technologies EMAP/EMARE is based on intercultural knowledge transfer which involves experts and specialists of diverse disciplines and the access to the facilities, labs and studios of the host organization.

There is a special focus on art & science projects which reflect upon the effects of digital technologies on humans and nature. The works tour different members festivals and are promoted to museums, galleries, festivals and other institutions worldwide.

EMAP Members:

Ars Electronica Festival in Linz (Austria), Antre Peaux in Bourges (France), gnration in Braga (Portugal), iMAL in Brussels (Belgium), Impakt in Utrecht (the Netherlands), Kersnikova Institute in Ljubljana, (Slovenia), Kontejner in Zagreb (Croatia), LABoral in Gijón (Spain), M-Cult in Helsinki (Finland), NeMe in Limassol (Cyprus), Onassis Cultural Center in Athens (Greece), RIXC in Riga (Latvia) WRO Art Center in Wroclaw (Poland) and as lead organization werkleitz in Halle (Germany) in cooperation with Silent Green Culture Quarter and transmediale in Berlin (Germany)

EMAP Expanded invites one guest organization each year to host a residency. In the upcoming years it is intended to cooperate with

2022: FACT in Liverpool (UK)

2023: HEXAGRAM in Montréal (Canada)

2024: HONF in Yogyakarta (Indonesia)

The Werkleitz Festival presented all finished 44 commissions EMAP 2018-2021 next to a conference on the effects of (digital) technologies on our societies and planet: The festival still can be visited online: <http://moveto.werkleitz.de>

EMAP is open for international partners who receive access to the artists databases for research and can apply for a mobility grant if they aim to present an EMAP work.

More infos: emare.eu, moveto.werkleitz.de

EMAP Exhibition Video <https://vimeo.com/567203904>



ArchaeaBot by Anna Dumitriu & Alex May
Foto © Vanessa Graf & Ars Electronica 2018



The Eye of the Other by Daniela Mitterberger & Tiziano Derme
Foto © Maid / Kontejner 2021



Peter Zorn
Foto © Jonas Matauschek 2016

Peter Zorn works as producer, media researcher and media art curator and expert in Werkleitz and Halle (Saale). In 1993 he founded the Werkleitz Association, the Centre for Media Art Saxony-Anhalt, Germany. In 1995 he initiated and since then manages the European Artists in Residence Exchange (EMARE) which has expanded and is hosted since 2018 by the European Media Art Platform (EMAP), managed several EU funded projects and programs, is co-director of the Werkleitz Biennale / Werkleitz Festival and since 2011 director of Werkleitz award winning Professional Media Master Class.
werkleitz.de, emare.eu



ISEA2022
BARCELONA

PANELS

Decolonizing the Machine: Race, Gender, Disability, Robots, Computation and Art

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Abstract

This panel explores black feminist critiques of posthumanism in/through artistic practice and performance research that utilize robots, machine learning and computation. The purpose is to uncover the veiled links between racial, gendered, and ableist practices and to combat the governing codes that construct – and continue to normalize – practices of dehumanizing exclusions. Black feminist scholar Sylvia Wynter identified how the notion of what it means to be “human” is marked by race and other axes of difference, and points to how different ‘genres’ of humanity (full-humans, not-quite humans, and nonhumans) are encoded through racial, gendered, and colonial hierarchies. [1] Finding an analogous hierarchy, Disability studies scholar Margrit Shildrick proposes that embodiment is never self-complete or protected against otherness, noting how the neoliberal notion of embodiment is grounded on an imaginary of corporeal wholeness and integrity. [2] While robots and cyborgs have potential to figure posthuman forms of subjectivations, in algorithmic societies they often reinforce human-machine, self-other, or abled-disabled binaries, thus glossing over the racist and dehumanizing exclusions that uphold neoliberal forms of power and Western conceptions of the human.

Keywords

Decolonial theory. Critical race studies. Posthumanism. Disability studies. Critical black feminism. Critical phenomenology. Robotic art. Robotic performance. Racial technologies. Bias. Algorithmic societies.

Introduction

This panel originated at a conference stream entitled “Decolonizing the Machine” at Politics of the Machine 2021, where we inquired into the systemic ways that algorithmic art, robotics, and computation in general are based on a deeply liberal, Eurocentric, ableist conception of the human. [3] Black feminist scholar Sylvia Wynter identified how the notion of what it means to be “human” is marked by race and other axes of difference, and points to how different ‘genres’ of humanity (full-humans, not-quite humans, and nonhumans) are encoded through racial, gendered, and colonial hierarchies. Disability studies scholar Margrit Shildrick proposes that embodiment is never self-complete or protected against otherness, noting how the neoliberal notion of embodiment is grounded on an imaginary of corporeal wholeness and integrity. Recent scholarship has looked at how these hierarchies and imaginaries are encoded through biased digital technologies that systematically harm persons of color and elide people with disabilities. However, critical

race studies, decolonial theories and disability studies are rarely considered in discourses surrounding machines and art.

What are the impacts of algorithmic bias and encoded discrimination in the context of machine vision algorithms, natural language processing and robotic embodiments as they relate to gender, race and disability? How might artistic practice and rogue research methods challenge/refute/disrupt/blow up the dehumanizing practices that are encoded into machines? Our thinking/framing is informed by Sylvia Wynter, Margrit Shildrick, Alexandre Weheliye’s *Habeus Viscus*, Louis Chude-Sokei’s *The Sound of Culture*, Ruha Benjamin’s *Race After Technology*, Safiya Noble’s *Algorithms of Oppression*, Jennifer Rhee’s *The Robotic Imaginary*, and Joy Buolamwini’s work on inclusive coding and *The Coded Gaze*. We critically inquire into issues of race, gender and disability as they relate to performing machines/technological bodies in robot and cyborg art.

Abstracts

Abstract 1: Racial Data in Identity Construction of Intelligent Agents: Embodiment of new narratives presented within Conversations with BINA48 and Mythicbeing, Suhun Lee.

As our lives are increasingly organized and shaped by algorithms that track, collect, evaluate and monetize our data, the ‘uncanny’ value has been assimilated into various forms of technical assistants using machine learning, reflecting upon human behaviours and social norms. Yet the imminent and nuanced realities of ‘Artificial Intelligence (AI)’ presented in neutral forms which are seemingly free from race, gender and sexuality, raise questions upon the algorithms used to map out its identity and the datasets fed into the model, not to mention the social values embedded underneath.

Why are the technical assistants such as chatbots – from ELIZA to Siri, Alexa, Bixby – mainly mobilized through feminine persona? Is AI free from socio-cultural stereotypes, racism and sexism, fully separable from social, political and economic boundaries? How would the interaction with the AI constructed with notions of racial, sexual and gender inequalities further affect the social norms and discourse regarding cybernetics? Is the goal of creating a competent AI centralized towards coding an

identity-free assistant? What does it mean to construct an AI with a virtual identity?

Studies have shown that datasets and algorithms are un-representative. With the lack of diversity in creating data and building, installing and developing the algorithms, the imposition of views and values on algorithmic systems has been emphasized for more than a decade. Scholars including Chowdhury and Mulani claim that “AI can be a method of perpetuating bias, leading to unintended negative consequences and inequitable outcomes.” [4] With the dataset and algorithms being reflective of pre-existing social and cultural biases and even the ‘raw’ data being an oxymoron, ways of producing, consuming and circulating the intelligent agents should accordingly be analyzed.

Two of the artworks: *Conversation with BINA48* by Stephanie Dinkins and *Mythicbeing* by Martine Syms will be analyzed in this research to give a critical glance into the possible futures of AI identity construction. Through a close reading of Dinkins’ performative interaction with a customized AI, BINA48 and a ‘threat model’ created by Syms, the focus of this research lies in locating the current discourse of constructing virtual identities via machine learning. By comparing and contrasting the textual data used as a training set and its verbal output of the two artworks’ AI models, it is planned to look at how societal value systems are built and narrated through an ‘AI’. This paper further aims to unfold different potentials and pitfalls of virtual identity construction, hoping to facilitate the discussion around AI as an artistic medium to create new identities and narratives.

Abstract 2: Connecting Resonances: On Pre-modern Indigenous (Sound) Technologies, Budhaditya Chattopadhyay.

If we aim to make an apropos taxonomy and nomenclature of what is termed media arts and “TechArt” – one may ponder over the archeology of what is understood as “Technology” – which is often a Western concept of linear progression, and in essence a colonial tool of plunder. If we take a historical perspective, in South Asia, the transfer and transmission of modernist technologies took place as a colonialist and imperialist strategy of control, quantify, and exploit the resources of the Global South: South Asia, Africa, Middle East and the Latin Americas.

In South Asia, advent of such modernist technologies happened through colonial models of erasure and taking over control, benefiting the imperial powers. Early western colonial technologies, such as recording, photography, radio and cinema: all contributed to this vision. It is only the colonial subjects, who gradually hacked into these technologies and reclaimed, as well as appropriated them to produce new hybrid kinds of post-modern aesthetic practices. In this same line of technological transmission and transfer, transistors, electronic circuits, digital and computing technologies and AI, were also brought from the West to the East, and from Global North to the Global South, but not the other way round. Global North’s condescending approach towards the colonized South didn’t allow much equal distribution of power, knowledge and aesthetic understanding.

However, South Asia (and the Global South) has been the house of some oldest and time-tested technological and cultural practices, in visual, haptic and sonic realms, as well as in urban design, water management, and agriculture. [5] There was no reason to make a hierarchy of knowledge and culture, if we listen to some of the

pre-colonial aesthetic practices where a pre-modernization concept of technology existed, and which was as intricate as its global counterparts, however ignored in the studies of machines and technological histories.

The examples include, as I mentioned earlier, musical instruments, such as *Rudra Veena*, *Gongs*, *Ghungroo*, traditional wind chimes in South Asia, temple bells tuned with traditional methods, among others. These instruments are usually performed within certain rituals e.g. in religious worships, or musical traditions, e.g. Dhrupad, the ancient-most sonic practice in South Asia. If we unpack the intricacy with which sound producing instruments were conceived and built in South Asia using indigenous technologies of tuning and instrument design, we find out that the pre-modern indigenous sound technologies were as sophisticated as the technology we know today from a Western modernist and colonialist understanding of it. Therefore, it makes no sense to adhere to the hierarchy of “high tech” and “low tech” considering pre-modern as primitive, and define “TechArt” from a Western taxonomy, represented often by large-scale, immersive media arts proliferated in European and American TechArt festivals, e.g. Ars Electronica. Given the rich examples of artistic practices using pre-colonial technologies in South Asia, I propose to redefine what “TechArt” is, and decolonize the term to give long due credits to tech-artists and artisans from the Global South.

Abstract 3: Ethics of Digitizing Public Heritage, Najam Ul-Assar

UNESCO's charter of 2009 defines the term digital heritage as "cultural, educational, scientific and administrative resources, as well as technical, legal, medical and other kinds of information created digitally, or converted into digital form from existing analogue resources. Digital technologies that allow us to create 3D renders of objects and even make 3D prints of them have resulted in the preservation, accessibility and dissemination of cultural objects to more unexplored markets and audiences globally. The implications of this are that lost or damaged precious objects have a chance at a second life. Countries and companies have rushed to restore or even resurrect sculptures, landmarks and other heritage sites destroyed by war, violence or extremist groups with the use of these digital technologies.

While the idea itself may be commendable, there are underlying issues that cloud the picture and it is essential to explore the associated challenges. This becomes particularly clear when we examine the question of reconstructing cultural heritage of emerging countries, specifically those where culture has been destroyed due to conflict or extremist groups. The majority of such projects are driven by western individuals or organisations. Many of these consciously or unconsciously use this opportunity for financial gain, and this ‘for-profit’ model is problematic especially when seen in the context of cultural ownership and origin. Additionally, there are a variety of political and financial imbalances that come with digitizing the heritage of a conflicted area, such as access to internet and the distribution of the reconstruction.

At present digital preservation generally lacks a clear ethical framework for who, how, what, where, and why to restore certain historical artifacts through the use of technology. This paper will explain some of the challenges associated with it by primarily examining the work of Allahyari and other examples from the region. The relevant factors that influence the ethical representation of an object

will be identified, through which conclusions can be drawn on a more post-colonial approach to this kind of digitisation.

Abstract 4: Reconsidering Discourses of Inclusion in Assistive AI, Stacy Hsueh.

There is increasing call to make various digital experiences accessible through AI technologies, whether it is automatic captions of online videos or real-time audio descriptions of physical surroundings. Access in these systems is often communicated through the rhetoric of inclusion — as *including* a marginalized other into existing conceptions of ablebodiedness. While well-intentioned, this narrative is often constructed within the confines of neoliberalism in which the boundaries of disability is delineated by the market. This casts the body as a site for “product development and market expansion” [6].

Critical disability theorists have long challenged this neoliberal co-option of “inclusion” and shown how such practices reify dominant notions of normalcy. These scholars advocate for a more radical project that replaces practices of inclusion based on normative ablebodiedness with those that center alternative forms of embodiment rooted in crip experiences. Such agenda requires a deep understanding of “peripheral embodiments” [7] and their value in coalition building.

In this panel, I follow these theoretical traditions in discussing the practices of disabled artists Emery Blackwell, Jenny Sealey, and Tarek Atoui. Instead of operating within the tropes of the able/disabled binary, these artists explore more expansive narratives of the crip experience on their own terms. In doing so, they shift the language of disability from that of “correction” to that of “skilled labor” [8], a form of knowledge that calls traditional categories and values into question. This lays the groundwork for discussing how artistic explorations of peripheral embodiments can offer new conceptual tools for thinking about access in algorithmic contexts, leading us to richer imaginations of accessible futures with AI.

Abstract 5: Techno-Neoliberalism’s Body: Dance(r) Labor in Computing Research and Race as Always Already Additive, Jessica Rajko.

In this corpus study, I analyze 135 publications extracted from the Association of Computing Machinery (ACM) Digital Library and returned in a database query using the general keyword search term “dancer.” Throughout the analysis, I identify and critique structural and rhetorical trends in canonising EuroAmerican concert dance forms as that which universally speaks on behalf of dance and human movement at-large. In my investigation of papers not involving dancers in any aspect of the research, I identifies a thematic design trend toward creating support tools for social dance forms. 7 of the 9 papers describing pedagogical support tools for dance that do not involve dancers at any phase of the research describe tools for learning how to dance in club settings through gamification and/or by making virtual instructors that could replace in-person social dance learning.

The notable lack of dancer participation at any stage of the design process is important to note. Many social dance forms (like those found in clubs) simply do not share and circulate dance knowledge in the same way as western concert dance forms, which my research identifies as the geocultural lens through this computing research understands dance. The sociocultural roots of what’s

depicted in research as “club dance” mostly derives from African American social dance practices. Through the critical analysis of dance studies scholars such as Thomas DeFrantz, it is possible to contextualize how a centralization of Western perspectives (from both dance and computing) inadvertently promotes the appropriation of movement vernaculars that do not work within a western epistemology but garner access to the aesthetics of cool, hip, and the popular.

Appropriation—in this case, the re-purposing of dance to allow its entry into diverse economic markets—reconfigures black physicalities into a place of interchangeability with any who would do the dances, and allows access without concerns of situation or material circumstance of the dancer under scrutiny. [9]

In this case, appropriation severs the dance practice from the sociocultural and geographically-specific movement vernaculars from which the practice originates, thereby allowing researchers to describe the practice as freeform movements happening in clubs with no real structure or form—a practice Reed and Phillips describe as deracination. [10] Once severed and deracinated, the dance practice is then retrofitted to work within western concert dance frameworks by inserting a virtual instructor (created with no dancer consultation) as the dance expert. This retrofitting allows social dance forms to operate and be made legible within western educational modalities both within and beyond dance, which tends to understand and express learning as an activity led by an individual expert rather than cultivated through collective praxis.

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Authors Biographies

We are a group of artists, researchers, and scholars from diverse fields, including performing arts, media art, robotics, artificial intelligence, curation and social sciences. We are united in seeking to understand and overturn the inequities and discriminatory processes built into machine-mediated art and sciences. We came together at a conference stream entitled "Decolonizing the Machine" at Politics of the Machine 2021, and continue to work together to imagine a more equitable future.

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Art and technology at school. Resources for a critical integration of new media art practices in the school context.

Abstract

The integration of artistic practices that connect art and technology in the context of compulsory education is a complex issue that highlights the need to activate school practices in connection with the changing and technologised reality of contemporary society from a critical and generative approach. This panel introduces a selection of projects promoted by the Red PLANEA Arte y Escuela developed in schools in Spain's regions of Andalucía, Madrid and Valencia. Introducing different methodologies and specific techniques, these projects address the critical analysis of information and communication technologies, both from their creative and facilitating dimension of new spaces of thought and interdisciplinary intervention as well as in terms of the analysis of their effects on the forms of relationship and experiences in contemporary society. Through different contributions this panel explores the potential of these projects as replicable strategies for other educational contexts and also introduces ANIDA, a Journal specialised in educational resources which, in its volume n2, focuses on these issues by compiling artistic and educational resources related to today's technologies.

Keywords

New media, critical technologies, technologies at school, media art education, media literacy, Big Data, Steam, educational resource

Introduction

The integration of technologies in educational contexts is usually approached mainly from two positions: on the one hand, there are programmes that address the school's needs technologically and focus their efforts on equipping schools and educating students in the use of the main digital tools. On the other hand, there are programmes focused on raising awareness among students of the dangers associated with the use of technologies and social networks by promoting a responsible and conscious use of these.

These approaches, in whose fields of action we can find very interesting initiatives and developments, leave out, however, other perspectives that, linked to transformative and creative experiences and processes, problematise technological developments and delve into the complexities derived from the implementation of technologies in everyday life. The proposals presented here exemplify a link between artistic practices and experimental formats and connect with the practices of the so-called new media art not only in terms of their use of information and communication technologies, but also in

terms of their use of diverse knowledge and disciplines to address the multifaceted challenges of today's society.

Therefore, we can find proposals that raise questions related to the new forms of communication that have emerged in the Internet and their potential as expressive forms that activate discourses in the context of the school. We can also find initiatives that question the school and its limits in the framework of the expansion of virtual environments or workshops that detach technology from its framework of practical utility to explore its creative potential and aesthetic expression. There is a wide variety of proposals that, arising from initiatives close to the art of new media, their structures and agents, paint a broad picture of what could become an inclusion of technologies in schools.

In this panel we will focus on an analytical overview of various projects promoted by the Red PLANEA Arte y Escuela and carried out in primary and secondary schools in Andalucía, Comunidad de Madrid and Comunidad Valenciana, with a special emphasis on the implications that their implementation has revealed both at an organisational and structural levels in schools as well as at a disciplinary level on the curriculum and the development of educational competences.

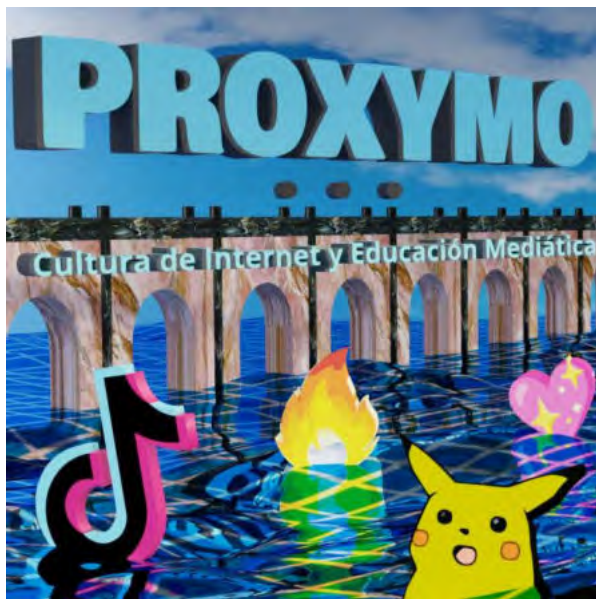
Proxy.mo - Media Literacy and Internet Culture

The Internet has forever changed the way we communicate and tell stories. Culture has been transformed by narratives that constantly change format. In this context, it is essential to generate spaces for research and learning that focus on understanding the educational and social application of emerging technological tools.

This programme focuses on highlighting the value of students' everyday practices on social networks and digital platforms, providing an educational approach and a creative use of these tools. One of its goals is to recognise an encountering point between the educational and the curricular demands, as much as between personal and collective trends.

PROXYMO consists of theoretical and practical training on the educational uses of content generated on social media, digital narratives and Internet culture. It is aimed at teachers and students and addresses co-design processes in a peer-to-peer learning relationship between them. By the end of the training program, *PROXYMO* held a public online event in order to show all creations made by the students of seven different high schools from Andalucía. During the event teachers and students discussed together with special guest Cristian Olivé (writer, researcher and

teacher) and Felipe G. Gil the relevance of their own creations as much as the input they've had by telling curricular contents by the digital tools they're familiar with.



Public image for Proxymo Media Literacy online event held on 30 March 2022

Link to the video: <https://www.youtube.com/watch?v=-scv9exqzTo>

Objectives:

- ❖ To encourage the use of digital tools and social networks as a loudspeaker for critical thinking, cultural activism and personal-collective bonding.
- ❖ To activate co-design processes (sharing, debate and negotiation) within the classroom.
- ❖ To motivate media literacy as a process of research and production of critical thinking.
- ❖ To recognise the potential of some digital platforms as an artistic and educational tool.
- ❖ To develop and encourage a critical and creative spirit in the use of ICT.
- ❖ To stimulate other ways of learning and evaluation within the classroom and the curriculum.

STEAM with an A

Programme that offers teachers and schools the possibility to develop STEAM (Science, Technology, Engineering, Art, Math) methodologies through their participation in a learning group formed in June 2021 that trains them in the implementation of the project in the Comunidad of Madrid's public high schools during the school year 2021-22. Participants take an active role generating interdisciplinary working groups between teachers, engineering students of any degree of Engineering, Architecture and Industrial Design and artists to work with secondary school students in a collaborative way around contemporary challenges. The program emphasises its processual nature, whereby emphasis will be placed on the process of contemporary creation, highlighting the different phases of creation of an artistic and scientific project: incubation, design, production and evaluation of results.

It is a symbiotic process between art and science. On the one hand, art brings reflection and criticism and helps to imagine and design processes to tackle problems from a disruptive and innovative point of view. On the other hand, science helps us to better understand the problem in front of us and gives us practical tools for the resolution of concrete problems. *STEAM with an A* seeks creative interaction and the generation of links between creators, engineers and secondary schools in order to promote citizen participation through the approach of contemporary challenges that mark the Sustainable Development Goals using art and science as tools to face the challenges of the future. Methodologies related to STEAM address contemporary challenges through artistic, scientific and creative processes.



Collage on multipurpose imaginary, by Jesus Jara

Objectives:

- ❖ To open a line of training and development of STEAM methodologies in the Comunidad of Madrid between secondary and higher education centres.
- ❖ To generate interdisciplinary working groups between teachers, engineering students and artists to work collaboratively with secondary school students on contemporary challenges.
- ❖ To incorporate new methodologies associated with STEAM in public secondary schools in region of Comunidad de Madrid.
- ❖ To address contemporary challenges through artistic, scientific and creative processes.
- ❖ To activate the presence and social legitimacy of young people as fundamental agents for the changes that must be faced in the future.

Playing with Data

The project explores the role of data in today's society. Every day we generate a multitude of digital traces that are stored to feed the insatiable voracity of Big Data and that generate our "digital self"; a kind of alter ego of ourselves

that stores a reflection of our tastes, interests, behaviours, friendships, etc. In this workshop we will use the record of our digital data as creative material to develop a critical look at the social transformations generated in the data centered era.



Playing with Data, Diego Díaz, 2022

Objectives:

- ❖ To explore the creative possibilities of digital data.
- ❖ To develop a critical view of the recording and use of digital data.
- ❖ To generate a creative space for reflection on the social transformations produced by Big Data and Artificial Intelligence.

The project *Playing with data* has been developed in 15 secondary schools in the Valencian Community, as an extended and replicable version of the workshop DataSelfie, carried out in 2020 in 5 secondary schools in Asturias, in the framework of the exhibition When the butterflies of the soul flap their wings of La Laboral Centro de Arte y Creación Industrial.

ANIDA Vol. 2

ANIDA - Arte y Escuela is an academic journal which aims to bring together and disseminate artistic practice as the

resource for teachers of any area, subject or educational level; students and teachers in the Faculties of Education, Architecture or Fine Arts, as well as researchers in the field of art and education whose practice is linked to school. Unlike other academic publications, where research is understood as a purely textual production, in ANIDA the selected and published resources can be presented in different formats (textual, audiovisual, sound, etc.) as far as they serve as a tool or methodology to be used by a professional in the field of education. The publication and dissemination of artistic-educational materials aims to transform the mechanisms embedded in schools and in teaching-learning methodologies.

ANIDA Vol. 2's monograph, curated by Red PLANEA and Susanna Tesconi (teacher and researcher, UOC), deals with the interference of artistic and technological knowledge, which generates a creative, experimental and educational experience. We want to discover those tools at the educational intersection between arts and technology that address the problems of our present, that discover new places of thought and creation and that serve as methodological models that can be replicated in multiple educational centres and spaces. It aims to gather educational materials that deal with the application of technology from creative, reflexive and critical points of view. For example, discovering the educational possibilities of processes linked to Big Data, AV, programming, virtual identity, artificial intelligence or robotics. It also addresses those virtual scenarios that give us possibilities to act, create and think in a different way, for example, experiences in video games or immersion in virtual reality. Finally, it comprehends approaches to our interpersonal relationships and even our way of thinking: from how we understand loneliness or friendship to forms of protest, participation or activism.



Open call Taking technology apart to create, ANIDA 2 Revista de arte y escuela

Art and possible relations in nature

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Abstract

This panel brings three different projects to discuss possible relations of art and nature. We plan to present, think over, and bring about questions on how artists are dealing with climate change issues and how we can create new possibilities of living in balance with nature. Art projects of sensing the sea, of creating narratives of a salty lagoon and of rethinking ecologies of hops are introduced as a starting point of the discussion.

Keywords

Art, sea, ecologies, hops, salty lagoon

Introduction

Living in a world where we use nature in an exaggerated way and as if its resources were infinite, this panel proposes to discuss ways art can contribute to an imaginary possible world connected with nature as an entity. We plan to present and discuss art projects that intend to decolonize nature (Demos, 2016) through their practice.

How do we interact with nature? Do we see ourselves as part of nature? How can art create possible forms of seeing we are part of nature? Is art able to sensitize people on climate change issues?

Artistic practices of sensing the sea

It's not news about the importance of the seas to the global environmental crisis. With the slogan "The Ocean holds the keys to an equitable and sustainable planet", the United Nations declared the Ocean Decade (2021-2030). Scientists have different methodologies for sensing the sea and collecting data, here I propose a discussion on how artists are sensing the sea. Artistic methodologies and practices that improve our way to perceive this global connected amount of salty water.

In this environmental aesthetics thesis, Allen Carlson (2000) argues that natural sciences, and not art, can better appreciate nature. Here I propose a reflection on artists working with scientists making a counterbalance to his theory. Art projects as "Noise aquarium" by Victoria Vesna, Alfred Vendl and team or Aqua forensic Underwater Interception of Biotweaking in Aquatocene by Robertina Šebjanič and Gjino Šutić are examples of this connection between art and science.

Place has an important role in media artists working with environmental sea issues. Lucy R. Lippard (1997) talking about sensing a place reveals she has been influenced by locations. Media artists also present this influence in artworks that deal with the increase of sea level, water pollution, noise in the ocean and invasive species. Hybrid

pieces that bring together art and science are the focus of this reflection on how art senses the sea.

Additionally, I'll present my experience sensing the sea as an artist working with scientists in two projects. One was in Antarctica, collecting data from the Southern Ocean with oceanographers, and the other, working with chemists and biologists seeing the remains of oil spilt on corals in the sea surrounding Bahia, Brazil.



Figure 1. Print of Antarctica Tempo Audiovisual Performance

Reset: Mar Menor

Reset: Mar Menor is a situated and interdisciplinary research project based on the arts. Part of the situation of environmental deterioration of the Mar Menor, a salty lagoon with several protection figures at regional, national and international level, which in recent years and due to extractivism and pressure from the agri-food industry, tourism and real estate speculation is undergoing a serious deterioration process: eutrophication and massive death of species, destruction of landscape and traditional ways of life and contamination of water and natural resources.

Through the implementation of different artistic research actions, the project aims to activate the development of a new narrative for the lagoon understood as a critical zone (Latour & Weibel, 2020) from the confrontation of its different collective imaginary: tourist claim, waste dump, sports space, natural oasis, complex system of hybrid matter in which nature and artifice, biology and technology, development and destruction are amalgamated.

The proposal is developed both in the academic and citizen spheres and converges in the territory with the work carried out by biologists, engineers and ecologists to build together a space for reflection through the articulation of knowledge and interdisciplinary collaboration, using the capacity of contemporary art and the practices of visuality as a vehicle to imagine ourselves collectively. The Mar Menor enunciated as a common good and projected through contemporary art.



Figure 2 Exhibition panel Mar Menor Lab

Cultivate Cultures: Ecologies of Hops

The project Cultivate Cultures: Ecologies of Hops stems from a polyphonic look at hops (*Humulus lupulus*) in the province of León, the main territory linked to its cultivation in Spain. Inspired by its geopolitic and somatic properties, the project aims to readdress existing relationships with the plant, to activate a platform for research and experimentation and rethink the ecologies of its image and residues.

Hops is a climbing plant, belonging to the family of the Cannabaceae, which produces flowers that contain a mixture of essential oils and resins called jointly lupuline, of an amber-like colour, special aroma and bitter flavour. Its compounds have been historically known for their soothing properties and sedating, somatic effects over the nervous system. Properties that suggest a transgression of the body's functionality, similar to sleep and its play on scale and space (Didi-Huberman, 2014). Similarly, the plant's sensory and gustatory experience of bitterness is thought as a means to reflect on the relationships between (dis)pleasure, knowledge creation (Agamben, 2016), digestion and other processes of assimilation (Derrida, 2009).

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In this manner, oscillating between the real and the imaginary, the project seeks to compose collective imaginaries for the rural futures of the region, as well as preserve the material and immaterial memory of the plant and its cultures of cultivation.



Figure 3. Fieldwork image of the crop's 'waste' (2021 harvest)

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The Creation of the Medialab Madrid Archive: Preserving the Memory of Transdisciplinary Media Art Practices

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Abstract

The creation of the MediaLab Madrid Archive arises from the need to contribute to the preservation of transdisciplinary media art practices and the shaping of the new narratives related to an extended media archeology, in the context of the project *Medialab Madrid as a model of transversal laboratory: art, science, technology, society + sustainability for the digital agenda* (H2019/HUM-5740 (MediaLab-CM) within the call for Social Sciences and Humanities (2019) of the Community of Madrid co-financed with the European Social Fund. The proposal is conceived as a panel discussion with the participation of four researchers who are involved in and experts on the subject, structured along different axes of discussion focused on the challenges of cultural innovation as of twenty years ago and its preservation and dissemination in an open, dynamic and relational archive structure, able to convey the relationships among biological, social, technological and cultural systems, and proposing an extension and enrichment to the consensus terminologies of media art.

Keywords

Archive, Media Art, Heritage, Media Archeology, MediaLab Madrid, data base, Thesaurus Media Art, Creative Technologies, Hypermedia Platform, Transdisciplinarity.

Introduction

MediaLab Madrid (MLM) was an innovative program of activities that encouraged active participation in the emerging transdisciplinary digital culture in Spain. Located between 2002 and 2006 at the Conde Duque Cultural Center, MLM undertook and generated a wide range of training, research, production, debates, and exhibitions of an interdisciplinary nature to promote the critical and creative use of techno-scientific advances, understood as integral parts of the digital culture of the 21st century.

In this context, MLM established new relationships among different actors and fields of knowledge in the local community and created links with the most diverse international circuits. This implicitly involved a process of building networks, until then non-existent in Spain, in connection with other European, American, and Asian nodes.

From its inception, MediaLab Madrid was conceived as an open space for dialogue among art, science, technology, and society. It was characterized by promoting research and social and cultural innovation processes that explored the art-life binomial in the light of techno-scientific advances, as well as the most disruptive artistic practices, linked to transdisciplinary creation, the emerging digital culture and the participatory social dynamics that were produced around it. Updating the art-life relationship -one of the most productive lines of the 20th century-, MLM explored the impact of technoscientific innovation on human and environmental conditions. Therefore, it delved into biological concepts - symbiogenesis, autopoiesis, ecosystem-, in recombination with others originating in sociology and computer sciences, free software culture, network society, collective intelli-

gence-, or sciences of complexity -systemic, non-linear dynamics, emergent-, among others, to develop a transdisciplinary approach to knowledge production and transfer.

MLM collaborated with artists, biologists, anthropologists, engineers, mathematicians, sociologists, programmers, architects, physicists, philosophers, journalists, and educators. In this way, it favored interaction and synergy among different actors and fields of knowledge, generating an open and porous environment, conducive to the emergence of collective and transversal creative processes.

The driving issues and ideas that gave shape to this dynamic and evolving model, from a conceptual and organizational point of view, were based on the transformation of a traditional exhibition center into a multipurpose ecosystem of dialogue and knowledge production. Its creative environment was simultaneously dedicated to reflection and debate, research and production, training and socialization, exhibition and dissemination, all activities that comprised a prolific process of innovation of the communicating vessels and collaborations between the sciences and the humanities.

What differentiated MLM from the American model of the MIT Medialab is the fact that it took the concept of a research and innovation laboratory from the private, academic, and business scope to the public, cultural and citizen sphere.

This implied that the spectator became a participant in the transformation processes related to techno-scientific advances and digital culture at the edges of art, science, technology, society, and sustainability. Its activities addressed transversal concepts of all kinds, related to the impact of the digital era on contemporary human conditions, culture, society and the sustainable development of the environment.

MLM took as reference and inspiration those pioneering experiences that emerged at the beginning of the century in the context of the Vanguards -such as the Experimental Laboratory of Kinetic Constructions at the Proletkult in Moscow (1917), the Bauhaus in Weimar, Dessau, Berlin (1919-1933), and in Spain, the Residencia de Estudiantes in Madrid (1910-1936). In the second half of the 20th century, many other relevant initiatives stood out: among them the Black Mountain Colleague (1933-1957), Fluxus (1961), MIT Center for Advanced Visual Studies (CAVS), Boston (1967), The Seminars of Automatic Generation of Plastic Forms at the first Computer Lab of the University of Madrid (1968-1973), The Kitchen, New York (1971-73), Ars Electrónica, Linz (1979), Espacio P, Madrid (1981-1997), MIT Medialab, Massachusetts (1985), ZKM, Karlsruhe (1989), or the Planetary Collegium, Plymouth University (1994).

Their various structures and functions nurtured the project of what finally became MLM, a pioneer project in Spain, and these lines of interdisciplinary and transdisciplinary collaborations.

The development and implementation of the MLM Archive are not only in line with the process of preserving and disseminating all the material generated during the pioneering years of MLM; in addition, the research, organization and publication of this material - in physical and digital forms -

will allow us to build a narrative that will lead us to understand and value how the synergies among art, science, technology, society + sustainability have shaped the genesis of what today constitutes the episteme and digital society. These will be the central issues of the panel discussion.

The Four Axes of Discussion

Archive vs. Collection: Archive as Memory

A collection is a term more closely attached to physical artworks and objects, whereas an archive is a concept more related to the documentation of the process and the documentation generated around an activity. And that is precisely what the MediaLab Madrid Archive is all about. We could say that the central difference corresponds to a paradigm shift that focuses on the production of experiences and knowledge related to different types of collaborative and participatory processes.

Contributions to the Transdisciplinary Media Art Archaeology

The absence of media art practices in art history books, and the apparent lack of institutional interest in transdisciplinary digital art and culture means, for now, a certain lack of legitimization of this kind of artistic practice. The creation of the MLM Archive is proposed as a contribution to the history of transdisciplinary media art practices and to face the challenges of obsolescence and the preservation of the digital.

Beyond Media Art Terminology and Thesauruses

The narrative of transdisciplinary media art practices will be shaped in an initial, fundamental, and central phase of conceptualizing its practices, processes and productions related to different fields of knowledge. This is one of the key challenges in the construction and implementation of the MLM Archive and will be discussed during the ISEA presentation.

During the process of designing the database, a commitment to the transdisciplinary methodologies implemented and developed by MediaLab Madrid have posed the complex task of designing a database. Its conceptualization and the choice of terminology respond to the concept of a dynamic and relational open archive, one that is capable of conveying the transdisciplinary connections among biological, social, technological and cultural systems, expanding on the consensual terminologies of media art. To do so, we started from the concept of *design research* that ensured the design of the tool in co-creation narratives. Techniques such as *card sorting* could fulfill a double objective: improvement of decision making in the conceptual design stage(*open card sorting*) and the possibility of evaluating the content organization system and classification categories(*closed card sorting*).

Disseminating and Transmitting Transdisciplinary Media Art Practices

Building the MLM Archive as a contribution to transdisciplinary media art practices also involves a central duty to the processes of dissemination and transmission, which involves generating narratives aligned with the genesis of transdisciplinary media art. Based on the database, a hypermedia platform has been designed and developed with the main intention of contributing to the need for dissemination and transmission, offering different levels of access aimed at both broad and academic audiences. The objective is to

reach the collective memory and to understand this process as fundamental for it to become part, in its own right, of the history of transdisciplinary practices, and the history of contemporary art.

Conclusions

We propose the axes of discussion as the fundamental challenges we face in the process of preserving and shaping the narrative structure of transdisciplinary media art practices. Categorizing these four axes of discussion is the result of learning from the creation of the archive itself, in relation to its conceptualization and design. The intention of this panel discussion is to share our own experience; not only to improve the creation and enhancement of this archive, but also to contribute to and inspire other similar archive projects that are in process and the future ones that will be generated around the collective construction of the transdisciplinary media art narrative.

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Art Intelligence

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Abstract

While the advances in artificial intelligence in recent years have been astonishing, we are still quite far from the inception of a mechanical intellect that could perform like the human mind. The human qualities which are most challenging to replicate are exactly the ones related to art production and reception: metaphors, analogies, misbehavior, embodiment, contemplation. Nevertheless, many tasks considered impossible for machines, like beating humans in chess and go, have been achieved. The goalpost for AI just keeps being moved a bit farther. Will a machine ever be able to be actually creative or must they always rely on human inquietudes? What is this 'je ne sais quoi' that is so difficult to be replicated by algorithms or neural networks? Can we think of some type of intelligence that is unique to art?

Keywords

Artificial intelligence, singularity, AGI, art, creativity,

Proposal

The panel wants to bring together artists, philosophers and computer science experts to discuss the challenges posed by creative practices to artificial intelligence. Computers are now able to perform tasks unimaginable until just a few years back, like realistic photographs, replicas of paintings, generation of texts comparable to human writers. Nevertheless, the development of an artificial general intelligence - a system that bears qualities comparable to the human mind - remains elusive.

Not too long ago, eminent thinkers declared in different ways that computers were not able to create art. If they did, however, it would be a sure sign of human intelligence. Douglas Hofstadter used to hold music as a kind of bastion of humanity. In his seminal book on the limits of artificial intelligence, published in 1980, he states that "music is a language of emotions, and until programs have emotions as complex as ours, there is no way a program will write anything beautiful". [9] Or as formulated by Margaret Boden, "Some areas of AI seem especially challenging: language, creativity, and emotion. If AI can't model these, hopes of AGI are illusory." [1]

The problem is, such milestones are being reached and surpassed all the time. In the sixties, as researchers invested efforts in implementing checkers players algorithms. It was

also believed that to solve the mysteries of human intelligence, a computer would need to play chess better than a human. [11, 13]. But Deep Blue came, defeated Kasparov, and yet showed no sign of general intelligence: it was no more than a machine that used smart analysis tactics to choose the most rewarding from a vast number of possible outcomes.

As early as the nineties, Hofstadter described his surprise when realizing that the EMI program (Experiments in Musical Intelligence, developed by musician David Cope) could render perfectly acceptable pieces in the style of Chopin or Bach. [12]. And Boden might also have been surprised with the release of written language model GPT-3 only a few years after the quote was published. Although it is limited in many senses, the model clearly masters the ability to simulate language so well that it is already taking the job of writers: GPT-3 is writing content to the pace of 4.5 billion words a day. [8, 7].

The fact is that in recent years computers became capable of rendering not only convincing music and text, but also photographs¹, paintings², and videos³. And it becomes clear that every time a milestone is reached - like the aforementioned chess [3] and also go [4], the goalpost moves a bit further: we realize that human intelligence is not just the capacity to play games, produce drawings, solve equations, but something else. This was described by Pamela McCorduck as the "AI effect" [10]:

"It's part of the history of the field of artificial intelligence that every time somebody figured out how to make a computer do something—play good checkers, solve simple but relatively informal problems—there was a chorus of critics to say, 'that's not thinking'."

So where is the goalpost these days? Philosopher Sean Kelly makes the point that intelligence is a socially embedded phenomenon, and has no meaning outside society: neither machine nor human can be intelligent if it is isolated from context. [?] Jenna Ng also makes the apt suggestion that machines must be rationalized on their own terms, and not by comparison with humans, which is not far from the twist proposed by Delacroix, who says that computers must be surprised by us and not necessarily the opposite. [? ?]

¹<https://thispersondoesnotexist.com/>

²<https://www.nextrebrandt.com/>

³<https://www.rephrase.ai/>

Despite these being very important takes on the subject, computer scientists are continuing to solve the old problem of creativity in machines. François Chollet, creator of the Keras package, one of the most important programming libraries used in machine learning, developed a training and evaluation set designed specifically to evaluate the capability of a system to make analogies, that is, to be able to learn from the solving of problems and apply such knowledge on new challenges. [5] Conceptually, his tests are not too far from the puzzles proposed in 1967 by the computer scientist Mikhail Bongard [2]. The difficulty for today's machine learning models to resolve metaphors - a special use of analogies - is also described by Melanie Mitchell, but was detected much before that by Umberto Eco.[6].

This realization doesn't imply the dismissal of the profound impact that these new computer-based skills are having in society (and in creative tasks). But like Floridi noticed, computers are not becoming smarter in the general sense. What is being proved is that the capacity to solve problems and perform tasks that require elaborate skills are being separated from what is considered to be intelligent. [7].

Still, it seems like artificial intelligence fails exactly in actions that artists excel in. Art requires stances of aimless contemplation, outcomes which were not fostered by trying to solve problems, and a practice that is of particular interest for my own research: the habit of misbehaving, going against the rules, disobeying instructions. I hope that with the convening of minds in this panel we might be able to shed some light on the gap between humans and computers that is bridged by art.

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The Collaborative Museum

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Abstract

Flagship cultural institutions such as museums have long been significant sites of cultural exchange and the urban experience. But as the number of museums worldwide increases, there has been a considerable change not only in their mission and orientation, but also in the contribution they are expected to make to the social, urban and cultural agenda of localities as they are routinely called on to be key elements of local place-making and community cultural development strategies. To be successful, the contemporary museum must foster connections with its locality as both a place and a community, which requires an approach that is imaginative, collaborative and locally specific. This panel will present the first stages of a longitudinal research project to undertake a detailed study of the innovative ways in which a new museum seeks to become a leading collaborative museum.

Keywords

Cultural institutions, cultural infrastructure, cultural mapping, art science research collaborations.



Figure 1. Artist's impression of Powerhouse Parramatta created by Moreau Kusunoki and Genton. ©Powerhouse Museum.

Introduction

Flagship cultural institutions such as museums have long been significant sites of cultural exchange and the urban experience. But as the number of museums worldwide increases, there has been a considerable change not only in their mission and orientation, but also in the contribution they are expected to make to the social, urban and cultural agenda of localities as they are routinely called on to be key elements of local place-making and community cultural development strategies. To be successful, the contemporary museum must foster connections with its locality as both a place and a community, which requires an approach that is imaginative, collaborative and locally specific.

This panel presents the first stages of a longitudinal research project to undertake a detailed study of the innovative ways in which a new museum, the Powerhouse Parramatta (Figure 1) seeks to become a leading collaborative museum. Our research partners have developed an approach that simultaneously probes what the development means for the diverse communities of the museums location and examines the collaborative initiatives and projects instigated by the museum and the community.

Much has been written in recent years about the impact of major cultural infrastructure developments on cities and regions. [1] This work has focused primarily on potential and actual economic benefits, and on the city imaging and branding role cultural infrastructure is routinely being called on to play. As Dave O'Brien explains, 'it is now a relative rarity to find a major infrastructure or building programme without a "cultural" element'. [2] Flagship museums play a key role in these initiatives. Of note is the so-called 'Bilbao effect', referring to the international trend that followed the opening in 1997 of the Frank Gehry- designed Guggenheim Museum in the Spanish city Bilbao. Built on a former industrial site, the museum brought considerable prestige and economic benefits to the city, including an increase in tourism. While the urban and economic impact of such developments is well established, a growing literature has pointed to the negative consequences of poor design, architecture and cultural planning. Some of these effects include the creation of isolated and exclusive spaces, the privileging of visitors over residents, the loss or displacement of commercial tenants including arts organisations, artists and other knowledge workers, and a building process that is often divorced from local communities, contexts and priorities. [4]

Since the 1990s, museums around the world have increasingly embraced community engagement as central to their missions, as has been discussed in much new-museological scholarship. [5] Much research on community engagement practices in museums has been concerned with the role played by the so-called eco- museum [6] (Davis 2007) and small specialist, local or regional museums. [7] In relation to large science museums, focused studies have tended to examine and critique changing exhibition practices or visitor engagement. [8] However, how a flagship museum can work effectively with a plurality of stakeholders with vastly different cultural needs and interests remains an open question. Addressing cultural diversity through more than targeted audience development or mere consultation and inclusion of diverse perspectives is a persistent challenge for museums. [9]

Thus, to be successful, new cultural infrastructure developments must be embedded in their physical and social environments from the outset. Despite this necessity, 1063

there has been no systematic research into what such embeddedness might entail, nor any guidance as to the measures of success. What is needed, therefore, is an engaged and interactive analysis of the ways in which a major cultural facility is founded in dialogue with its local communities. Our research project offers a unique opportunity to examine, and contribute to, the process of embedding a new museum into physical and community space in real time.

At the conceptual heart of this research are the interconnected processes of *embedding* and *collaboration* as they apply to the establishment and ongoing operation of a contemporary urban museum. Embedding, understood as having both material and symbolic dimensions and, with echoes of Stuart Hall's (1990) notion of cultural identity as 'becoming', is dynamic, incomplete and continuous.[10] It is not a specific destination or outcome. Similarly, collaboration is a process of ongoing engagement, involving (re)examination, (re)challenging and (re)negotiation between partners in different contexts and through a range of media. The processes of embedding and collaboration are both informed by critical reflection. Our research examines in real time how the idea of the collaborative museum can be realized. It will probe the community dynamics associated with building major cultural infrastructure and trace the complex interrelationships that form between such initiatives and wider processes of urban transformation.

The panel of multidisciplinary and cross institutional research partners will present three methods of the thematic strands of the research project – cultural infrastructure, cultural mapping and research collaborations with arts, science and technology industries.

Cultural Infrastructure

The establishment of the new museum provides a unique opportunity to gain significant new knowledge on the role of cultural infrastructure in cities and regions and local cultural development – key concerns for urban cultural policy, not least in the wake of the COVID-19 pandemic. As a flagship cultural institution, the museum will be an initial stimulus for the city's cultural development by functioning as a catalyst for new cultural activities that resonate with local concerns and issues and those of the region and beyond more broadly. For the new museum to play a sustained role in the city, however, it is important that it integrates into the broader cultural landscape of the city. Such an objective requires investment in soft cultural infrastructure such as local cultural knowledge, networks and linkages. [3] With a focus on the post-COVID era, issues that relate to cities and cultural infrastructures will be discussed, such as the role of the museum in culture-led

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urban development strategies, the use of cultural infrastructure for urban diversity and sustainability; sustainability and urban creativity post-COVID.

Cultural Mapping

This research strand will build a knowledge base about residents' senses of home and belonging through a cultural mapping of complex community diversity. Cultural mapping is a mode of cultural inquiry that provides an integrated picture of a city's social fabric and cultural ecosystem through the rendering of cultural practices, networks and patterns of activity, and the locations of places of meaning. [11] Given the rapid change of the museum's location both in terms of its built environment, population growth and diversification, incorporating an historical dimension in the cultural mapping exercise is imperative to make visible and put into dialogue the old and the new. It is also important to consider the changing social relations and (formal and informal) power structures in the city, socio-cultural divisions and tensions, and gaps in the recognition and representation of particular groups. The development of symbolic and graphic maps will provide insights into how people experience and value the places and cultures of the museum's location as well as to illustrate the spatial patterning of local cultural activities and resources.

Research Collaborations with Arts, Science and Technology industries.

The centrality of knowledge collaboration and exchange forms part of the vision of the museum. In the museum sector, collaborative approaches have tended to focus on encouraging visitors to engage actively with exhibitions (for example through interactive digital tools). Seriously adopting a collaborative research framework, however, implies bringing communities and stakeholders in not just as museum audiences or users, but as active collaborators working with staff, the museum's collections, exhibitions and public programs. [12] A discussion of best-practice collaborative models across the arts, sciences and technology within the museum context will include the challenges to effective collaborative practice and strategies for their resolution.

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Presenters Biographies

Dr Cecelia Cmielewski is a Research Fellow at the Institute for Culture and Society at Western Sydney University with over thirty years' experience in the cultural sector. She is the author of *Creative Frictions: Arts Leadership, Policy and Practice in Multicultural Australia* (2021, ANU Press). Cecelia's research interests address inclusion in the creative sectors with a focus on the relationship between creative production and multicultural policies. Her current research role is on the ARC funded *The Collaborative Museum – Embedding Culture in the City* (2021-2025). Cecelia held Senior Policy and Project Management roles at the Australia Council, the Federal Government's arts agency between 1998 and 2011.

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Professor Deborah Stevenson, FASSA, is a Research Professor in the Institute for Culture and Society at Western Sydney University. Her research interests are in arts and cultural policy, cities and urban life, and the ways in which gender shapes creative practice and cultural consumption. She has published widely on these topics, including the books: *Cities of Culture: A Global Perspective*; *The City*; *Cities and Urban Cultures*; *Art and Organisation: Making Australian Cultural Policy*; and the co-authored *Tourist Cultures: Identity, Place, and the Traveller*. She is co-editor of: *The Australian Art Field: Practices, Policies, Institutions*; *Culture and the City: Creativity, Tourism, Leisure*; the *Ashgate Research Companion to Planning and Culture*; and the *Routledge Urban Media and Communication Companion*. Her monograph *Cultural Policy Beyond the Economy: Work, Value, and the Social* is to be published in 2022.

Critical contact: the climate crises, human/nonhuman thinking, and sensing the possible

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Abstract

This panel calls upon natural and machine-driven nonhuman and human-nonhuman approaches in the arts: platforms that refigure human cognition and communication, systems in which nature, humans and machine can work together to shape possible outcomes, natural nonhuman and human-machine sentience that transforms critical thinking and new capacities for language that break through the unspeakable acts of the willful extinction of a natural world upon which life depends. The approaches introduced in this panel suggest means to reconfigure borders of place, body and thought. From these myriad artistic and conceptual approaches to the possibilities of human-nonhuman connection, the panelists ask how to transform the paradigms that shape understanding of the climate crises into frameworks driven by possibility.

Keywords

Anthropocene, climate crisis, interface, holobiont, multi-modal, nature, nonhuman sentience, platforms, post-digital

Introduction

The point of contact between human and nonhuman is an imaginary of possibilities and, if one is to follow upon Bruno Latour's critique on the "tyranny of the globe", the borders separating the body and nonhuman are even more porous, illusive and multiple than imagined. [1] [2] Through interventions at levels of platform, system, code, sentience and nonhuman critical thinking, this panel conceptualizes this point of contact as a moment of art and one begging urgent response. Why urgent? Because, although the immediate and terrible crises of global warming maybe be directly caused by the human use of fossil fuel -- something straightforward that humans should be able to solve, the overwhelming incapacity of humans to build the will to confront the crisis (and other crises like mass extinction, perpetual wars, starvation, poverty) perhaps lies in the far broader, dystopic paradigms of the Anthropocene that imprison our imaginaries within a cross-cultural mythos dating back at

least to the beginnings of the Industrial Revolution. Simultaneously, technological infrastructures and platforms are designed in ways that hide the material costs and damage behind glossy surfaces and disappearing interfaces. That humans of the industrial era seem incapable of breaking cycles of warfare, economic inequality and global destruction despite indisputable evidence suggests that systems of knowledge and action that seemingly might provoke action are trapped within some larger mythos. Such a mythos is embedded in our technologies, networks, iconographies, languages, disciplines and narrative models. Though natural and machine-driven nonhuman and human-nonhuman approaches in the arts the panel looks for possibilities through alternate platforms, perspectives and configurations that may help transform the climate debates and discourse around other challenges of our time.



Figure 1. Anders Visti, *Aarhus Urban Operating System*, performance from Spanien 19C, 2020 in which Anders Visti renders urban planning of the Aarhus harbor into generative text and turns sounds from the area into music in order to develop a new way of 'operating' the urban. © Søren Pold.

Platform(ed) Perception

The gradual takeover of the Internet by platform capitalism with the emergence of Web 2.0, mobile apps and cloud computing since the mid 00's has created an interfacial phantasmagoria that hides choices, data traffic and infrastructure behind a 'clouded' metainterface. This platform metainterface virtualizes and displaces in order to create the immediately click-able, where users are not supposed to worry – or know about – the effects of their use. Furthermore, platforms normally present individual interfaces to mass phenomena such as social media, maps or media consumption on streaming platforms, however most often only the data that supports more user-engagement is presented to the users while other parts are hidden inside the closed proprietary platforms. [3][4] As examples, Pold will offer a reflection on art works and projects by e.g. Joana Moll, Anders Visti, Tega Brain, Alex Nathanson and Benedetta Piantella to ask how the hidden materiality of infrastructures, platforms and metainterfaces might become perceivable in a way that relates to the social, global, environmental and more-than-human: Could a future reflective and critical platform perception become a countermodel to the current platform(ed) perception, where everything is served effortless at the nearest screen, hiding infrastructures, carbon pollution and exploitation of data. [5] Is there a way out of the individualized consumer models and modelling/profiling served by current platform culture of controlled consumption, where are the cracks in the current models, where are the alternatives and are there other ways of engagement than click-bait?



Figure 2. In *Water On The Pier* (2021), impulses from tidal movements drive a multimodal experience which the public navigates using phones, creating, in the process, a collective soundscape. © Dilmar Gamero Santos.

Human/Nonhuman Contact

The bridging of human/nonhuman approaches to addressing global warming is expanded at the level of code, sensation and language, with examples drawn from several groundbreaking algorithmic art installations. Drawing samples from various recent code-based works created by Roderick

Coover and collaborators such as Nick Montfort, Adam Vidiškis, and Scott Rettberg, the panelist asks how images and language offer points of mediation between the technological apparatus and the natural world. In works such *Toxi•City A Climate Change Narrative*, *Penelope*, *The Floods*, *Water On The Pier* and *It Will Happen Here*, Coover and his collaborators use generative and combinatory methods to destabilize the messages of documentary imagery and field notes. The works articulate ambiguity in language, visible evidence, sound recordings and scientific data. They transform interpretation through acts of naming, montage and mode-shifting (such as from temperature to sound, or sound to image, or color to language). The works discussed create possibilities through technological and multimodal disruptions of language and narrative order. The artists use machines to express an inadequacy of language to articulate lived experience and failures of poetic structures to conceptualize “the possible” as an openness and movement -- a horizon of change that continually unfolds to organize worlds in differing ways. The artists invoke models of porosity, innervation, interchange and mutation. The discussion articulates the challenges of naming processes that are fundamentally inchoate and incompatible with anthropocentric concepts of identity and time in the Anthropocene. The works suggest that, without transformation, the text and images that describe changing climate conditions inevitably fail to grasp the magnitude of forces that create them. To counter this, the discussion suggests models that use shifts of perspective and platform to build expression with fluid and multimodal composition.

Human/Nonhuman Sense and Sentience

Freeing up and renewing Anthropocenic imaginaries seems as crucial as other aspects of a required paradigm change – the one that would be capable of dismantling discursive power keeping human and non-human as separate domains, to the detriment of wildlife and biodiversity. In looking for what is possible and what further opens up multiplicity of choices, the fundamental shift in focus is necessary. Following research on the post-digital materialities and critique of representationalism, and creative collaboration with Victoria Vesna as part of the Noise Aquarium Online Meditation, Alien Star Dust Online Meditation, and Breath Library, Anna Nacher offers a broad discussion of sentience and sensing across human/non-human divide. She argues that the urgency of current set of crises indeed necessitates radical work on new metaphors, stories and imageries. However, without sufficiently acknowledging the work that has already been done outside of Western imagination, while being at the same time wary of the pitfalls of cultural appropriation, such renewal gestures risk becoming largely superficial and already bound to the dominant narratives underlying the Anthropocene. One of the areas where significant work to this end is needed, are sensing technologies and digitally-assisted sentience. Both have been shaped over the last decades in environmental science and digital art, among others. Such technologies have prompted seeking for more-

than- or beyond-human ontologies that would assist in a radical shift in understanding the multifarious, complex, and mutually co-creative web of life. On the other hand, this area of creative practice also inspired a meaningful discussion of the aesthetic aspects of “computation becoming environmental”. [5] The discussion follows the questions: to what extent is interweaving of sensing technologies with environmental monitoring inevitable? How does this confluence of meanings relate to the very concept of digitally-mediated sensing? Are there other, non-Western histories of sensing technologies, based largely on algorithmic “generative capacities of matter to evolve”, possible? [6 The answers will be grounded both in discussion of “computational aesthetics” of “post-digital constellation” and in performative forms of Indigenous more-than-human ontologies. [8]



Figure 3. Victoria Vesna, Noise Aquarium, exhibition in Deep Space 8K, Ars Electronica Center, Linz, 2019. © Victoria Vesna.

Being with Others. Art in Search of Holobiont Perspective

How can we engage in reflection that expresses a non-anthropocentric perspective without either becoming entangled in ideological discourse or lapsing into postcolonial delusions and claims? Probably, the only sensible and positive response to the challenges of non-anthropocentrism is to be found in the proposal to think and feel with or alongside somebody and something – that is to embrace territory-defined thinking. Borrowed from Margulis and popularised by Latour, the term *holobiont* can denote all living beings without exception and introduces a common measure and scale for them all, without privileging any. Within such a perspective we insist on the urgency of thinking in terms of co-habitation and not of discreet existences. It is all about looking to establish community and, at the same time, upholding the existing differences, to develop non-anthropocentric critical thinking, a critical trans-species philosophy of existence.

How to challenge the fact that human attempts to assume a non-anthropocentric perspective are frustrated by the fact that this perspective must be captured and expressed in language? Art can offer experiences in which the language

layer comes with pre- and/or extra-linguistic layers, which engender sensations of various degrees of immediacy. Generated within such a framework, knowledge cannot but be open-ended and diffuse, that is, co-constructed in a participatory manner. An artistic perspective that crosses disciplinary boundaries may confer visibility on that which is invisible to other, discreet disciplines. It is not only the transdisciplinarity of art, but also its unconventional methods, differing from scientific protocols, that may buttress the effectiveness of art in its attempts to address ecology-related concerns. I would like to spotlight the forms of artistic practice which can be classified as non-anthropocentric ecology, taking strongly into account also the role of new media within the process. I propose to have a close look at works of such artists, like Olga Kisseleva, Su Hyun Nam, Jill Scott, Robertina Šebjanič, and Victoria Vesna, to discuss non-anthropocentric perspectives they propose, different aspects of experience they offer, and how they make use of new media.

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Figure 4. Performers and audience move together within a shifting landscape of generative text, image and sound in the multimodal performance and installation, *The Altering Shores* (2019). © Dilmar Gamero Santos.

Authors Biographies

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Augmenting the World. Masaki Fujihata and Hybrid Space-Time Art (2017); *Human Traits. Patrick Tresset and the Art of Creative Machines* (2016); *Guy Ben-Ary: Nervoplastica. Bio-robotic Art and its Cultural Contexts* (2015).

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Søren Bro Pold, PhD, is Associate Professor at Aarhus University, Denmark. He has published on the arts of the interface in its various forms, e.g. on electronic literature, net art, software art, creative software, urban interfaces and digital culture. In relation to these research fields, he has been active in establishing interface criticism as a research perspective, which discusses the role and the development of the interface for art, aesthetics, culture and IT. His latest book is *The Metainterface – The Art of Platforms, Cities and Clouds* with Christian Ulrik Andersen.

Tools for a Warming Planet

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Abstract

We live on a planet in flux--warming waters and land, chaotic weather, and unknown futures. Our adaptability and ingenuity is crucial to our survival, and our planet's. In response to this condition, this panel explores new tools for mapping, engaging, and responding to our current and future environment. Bringing together artists, designers, gardeners, and activists, the panel discusses exciting projects and emerging methodologies in response to this urgent need. Focusing on 'tools' in particular, the conversation will be oriented around action, access, and collective engagement.

Keywords

climate change, tools, activism, ecology, adaptability, collaboration, collection, speculative art, solar energy, cultural knowledge, post carbon

Introduction

This panel will focus on the idea of tools--tools of collection, translation, engagement, connection, and care--which directly engage a time of climatic flux. New tools are needed to build more adaptable, resilient cities, as well as imagining new ways of living on a fragile planet. Artists are creating incredible responses to this new terrain, engaging publics and environments alike, to build new methods of working within the context of a changing world.

The term 'tool' in this panel is used to focus on action. Hand tools of craft and making activate the body to take care, to create, and to make change. Urban tools of networks and public space create new ways of living in cities and engaging the public. New artists' tools posited across the presentations represent new possibilities of working, and open up a conversation about our role as cultural and social activators.

Across four presentations, we will look at tools for engaging data, carbon, nature, and culture. Within and between these areas of concentration, we will discuss the future of local knowledge, food, public space, biomaterials, communication, and transportation. From the scale of the body to scales of the social and planetary, the talks will focus on methods of action, activation, and direct engagement. The panel brings together artists from three continents into conversation. These global perspectives will allow both for localized perspectives and universal experiences, advancing a collective conversation about roles as artists in our changing cities. We will also reflect on Tools for a Warming Planet (warmingplanet.org), which is included in the accompanying conference exhibition.

Connecting Data and Design

Scientific tools of data collection and predictive analysis help us understand what's to come and how our actions will impact our future. This data helps us understand the underlying stories implicit in our cities, decoding our environment and connecting our lived experience to the future stories of our communities, cities, and planet.

We have always marked the landscape with memories of disasters, as social symbols to communicate through time. In their most mundane forms, we see these in high water marks etched into walls or crosses on the side of the road. We mark loss, disaster, recovery, and memory in our landscapes. We also mark the future in our cities, anticipating disaster through escape routes and shelters, or to pass information through generations to avoid repeating tragedies.

New types of coding and symbols are needed to understand our changing relationship to our planet. Instead of a static backdrop, our cities are now a space of change and fluctuation. Alongside the coded languages of transportation and infrastructure, what markings would help us navigate this changing landscape? What types of communication is needed to orient us to changes to come? How can we become more attuned to the trajectories of our environments, and our agency to impact them? This talk will consider these questions through historical and futuristic examples of tools of communication and symbology in our landscapes, including the artist's recent work, Climate Compass, taking the form of an orientation device, like a compass rose, and displaying local data that grounds us in the changes of sea level over the next 100 years (Image 1).



Image 1. Sara Dean, Climate Compass installation detail, Exploratorium Museum, San Francisco, CA, USA, 2019

Building the Post Carbon City

Could walkable superblocks and bicycle infrastructure help cities reshape the land they have previously dedicated to the automobile and reduce carbon emissions? Cities around the world are starting to embrace micromobility, bicycle infrastructure, and public transit to reduce congestion and carbon emissions. As cities plan for the challenges of the 21st century, they must incorporate new forms of multifaceted sustainable transportation services into their climate resiliency planning. Rethinking carbon use on a massive scale is required to change global energy consumption within the next 10 years to meet the goals set by the Paris Agreement. Global planning requires tools at the localized scale, both individual options and flexible networks.

Transportation leaders project that future mobility options will focus on multi-model services and not private vehicles. Mobility innovators are launching shared e-bike services that connect with public transit and bicycle infrastructure (Figure 2). Expanding micromobility services are proving to be cheaper and more convenient than car ownership for a range of demographics. What role should cities play in supporting the micromobility regulation processes to help reshape their sustainable transportation infrastructure? Case studies will include e-bike cargo programs in NYC, superblocks in Spain, and solar powered e-bike share networks in California.

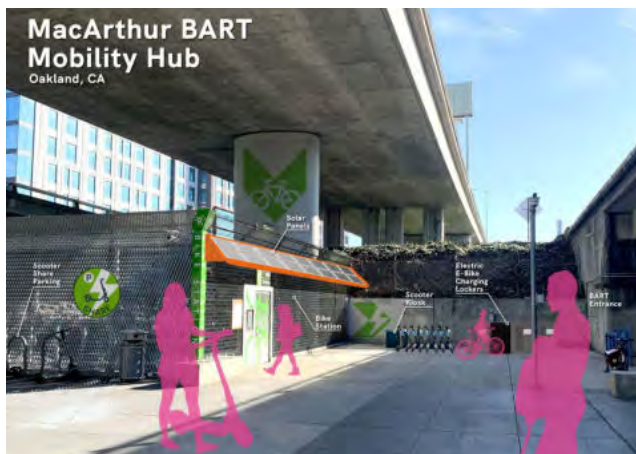


Image 2. Beth Ferguson and Jovita Wattimena, Mobility Hub, Oakland, CA, USA, 2022

Cultivating Nature

Cultivating nature in cities has both a positive psychological effect as well as important environmental health benefits. Plants have the power to clean air pollution, provide wildlife habitat, inspire a sense of beauty, and cool the street while improving water drainage. This presentation will explore tools to build living landscapes for public space as an art practice. Vertical gardens can be adapted to working with various spaces, climates, materials, plants, and climate sensors. Examples of playful public art and design installations that use living elements to connect people to nature will be explored.



Image 3. Ofelia Viloche Pulido, Natural Dye Garden, University of California Davis, Davis, CA, USA, 2022

The assumed divide between nature and our urban environments needs to be reconsidered in order to create healthy, living, and thriving future cities. Artists working directly with the living natural environment are finding ways to push these two environments closer together. The talk will explore city responses to greening, and uncover spaces of exuberant, abundant wilding of our city spaces. Tools of cultivation, growth, and greening also create spaces of climate care and responding to collective climate grief (Image 3).



Image 4. Marina Monsonís, Collective Graffiti with students from L'institut Joan Salvat-Papasseit, Barcelona, Spain, 2016

Engaging erased knowledge

Local culture and ancestral knowledge are tools for more sustainable ways of living with our planet. Food culture in particular tells a story of a long history of connecting with land, sea, and seasonal cycles of a place. The disappearance of this cultural knowledge, both through the globalization of agriculture and food industries, as well as the relocation (voluntarily or involuntarily gentrification) of populations, is hard to re-collect. We are seeing a growing appreciation for this type of deeply embedded cultural knowledge, and exciting projects globally to retain this cultural history (Image 4). At the same time, there is a sense of urgency in these types of projects--how long will the people connected to this knowledge survive? How will their knowledge be kept? How will it be preserved?

Reinventing Phonography: Three Case Studies of the Transduction

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Abstract

This panel presents three case studies aimed at reinventing phonography, a technology for inscribing sound, and examines the validity of applying the concept of “transduction” and “attunement” to media artworks.

The first case study is a historical survey that reconsiders the original invention of the phonograph by Thomas Alva Edison. The second one presents a media archaeological practice inspired by printing technologies and electromagnetic induction to actuate sound. The last is an attempt to redefine the phonograph through living materials such as the colorful surfaces of squid’s chromatophores.

Through these cases, we will demonstrate that attunement plays an integral role for making transduction sensible between human and nonhuman beings. As a result, this panel will indicate that the material process of sound art exemplified by the reinvention of phonography would be a theoretical contribution for exploring the possibilities of media art.

Keywords

Thomas A. Edison, Transduction, Attunement, Sound Studies, Animal Studies, Media Archaeology, Multispecies

Introduction

This panel is organized to introduce three case studies aimed at reinventing phonography, a technology for inscribing sound. By examining these cases from an aesthetic perspective, we would like to reconsider the validity of applying the concept of transduction to media art.

It is known that the first sound recording and reproducing technology can be traced to the phonograph invented by Thomas Alva Edison in 1877. The simplicity of its mechanisms, which mechanically mediating sound as vibration, has been a source of inspiration for subsequent technologies and discourses. In addition, its principle of phonography as energetic conversion became a model of “transduction”, which was introduced in acoustics in the 20th century and became a key concept of recent media theory and sound studies.

Transduction and Attunement

Science anthropologist Stefan Helmreich appropriately summarized the concept of transduction as how “sound changes as it traverses media, as it undergoes transformations in its energetic substrate (from electrical to mechanical, for example).” [1] For example, his ethnography of marine biologists immersing the deep sea shows in a convincing way that their scientific knowledges depend on the transductions of sensing technologies through sonars, hydrophones and other technologies.

However, it may be true that the transduction is not limited to these extreme conditions, but is a phenomenon that occurs all around us imperceptibly. Although Helmreich mentions just the philosophical implication of

this concept, it is not always clear how and under what conditions it occurs. Is it possible to make the transduction sensible through media art as the basis for awareness of non-human worlds beyond human perceptions?

Then, we find it useful to mention another term “attunement” as a clue to elucidate the aesthetic possibilities of transduction. Philosopher Vinciane Despret observes closely the encounters between different species in various scientific experiments and investigates how humans and non-humans establish the mutual communication. [2,3,4] Here, the “attunement” is a key concept that reveals how diverse beings are coordinated to each meaning, identity, and image which consequently enable the encounters that are mutually available to them.

In this panel, we would like to demonstrate through the following three cases that attunement plays an integral role in making transduction sensible and that the reinvention of phonography can be effective in demonstrating this in concrete ways.

Case 1: Edison’s Phonograph

At first, we will examine the origin of the phonograph invented by Edison and his sensory and transductive experiences on which the invention was based.

In the second half of the 19th century, various types of phonography were invented and reinvented. The phonography, which used to imply the ways of writing phonetic alphabets, was reinvented as automatic phonography or the “phonograph” by Édouard-Léon Scott de Martinville in 1857. Scott’s phonograph was subsequently reinvented as a telephone by Alexander Graham Bell in 1876, and the telephone was reinvented as the phonograph by Edison in the following year.

Jonathan Sterne characterizes these modern sound technologies as “transducers,” which energetically “turn sound into other things, and they turn other things into sound.” [5] He also traces the origin of these transductive devices to the materialistic understanding of the human ear in both otologists and inventors, noting that the “tympanic function” in the middle ear became an archetypical model of sound reproduction. Indeed, Graham Bell literally treated the human ear as a sound-transmitting device in constructing the “ear phonograph” out of a real eardrum, which leads to invent the telephone.

For some scholars, this equation of the human ear with machines represents the “crisis of perception” in the modern age. As Friedrich Kittler notes, “in order to implement technologically (and thus render superfluous) the functions of the central nervous system, it first had to be constructed.” [6] Inventing modern phonography resulted from reconstructing the human ear conceptually as a transductive device and led to replacing “the sensory organs with a technological apparatus that would make hearing itself obsolete.” [7]

However, Edison did not see the transductive sound technology, such as the telephone, as a simple substitute for the ear. It is speculated that Edison was hard of hearing,

probably because of the fatal damage to his eardrums or ossicles, when he started improving the telephone.[8] Therefore, Edison needed to establish another way of perceiving sounds by attuning his body to the devices through his fingers and teeth instead of eardrums. [9] In reinventing the modern phonography, transduction was not simply the mechanistic reduction of human perception, but an opportunity for the awareness of vibrant world beyond the “normal” human perception.

This first case will show how such sensual experiences of Edison's attunement led to the reinvention of phonography or the invention of his phonograph.

Case 2: “Mary Had a Little Lamb”

Next, we will re-examine the transduction and attunement in the following work “Mary Had a Little Lamb” (2019) by Kazuhiro Jo and Paul DeMarinis (2019).



Figure 1. Calculated Gap of Postscript Print of “Mary Had a Little Lamb.” (© 2019 Kazuhiro Jo and Paul DeMarinis)

Throughout history, people have invented printing technologies in different ways ranging from woodblocks [10] and letterpress to laser printers. With all printing technologies, the basic principle is the same: to put inks on paper.

To realize “Mary Had a Little Lamb,” we combined this basic principle of printing technology with a simple physical phenomenon, electromagnetic induction. As Lenz depicted in his law in 1834, when a magnet moves around a coil, changes in the magnetic field induce an electric current in the wire of the coil.

With these principles, we found four transductions accommodated by two artificial attunements. We actuated the strongest type of permanent magnet, neodymium, with calculated gaps of the postscript print with a laser printer. We transduced a waveform of PCM audio data into a 1-bit format using a BTc Sound Encoder [11], and produced a series of black and white stripes in a circular shape with Adobe Illustrator in a computer (1st transduction) (Figure 1 left). Next, we printed the result using a postscript laser printer (2nd t). The magnet was placed on the stripe on a turntable. We attuned the position of the magnet so that it was as close as possible to the coil, but without touching it (1st attunement) (Figure 1 right). The coil picked up the change in the magnetic field by the vertical vibration of the magnet (3rd t). We amplified the electricity from the coil and produced sounds from the speaker (4th t).

As the sound source, we selected a voice as a particular case of sound - the renowned phrase of the Edison, “Mary Had a Little Lamb” with one of the newest voices of WaveNet, a deep neural network for generating raw audio waveforms. [12] This result might have been perceived as a collection of collisions and friction. However, once you hear the sentence, “Mary had a little lamb,” you cannot avoid making out the voice. It is similar to apophenia [13] where one perceives a familiar pattern in random noise; however, it is not.

This phenomenon recalls an early idea about the phonograph that Edison expressed to his friend, Alfred Mayer.

Another phenomenon I have noticed is that if two simple but different sentences are put on the machine, and a person who had never heard of such an apparatus be brought in and told to listen he will not even after a dozen repetitions be able to say what it is, but if the first sentence is told him & then reproduced he generally says why that’s perfect. The second sentence is now reproduced when he generally reads it or part of it the first time and the whole the second time if simple. The same thing has been noticed of the telephone, and I think it lack of confidence, or some obscure effect of the mind upon the hearing apparatus. They do not expect or imagine that a machine can talk hence cannot understand words. [14]

Once I attune my hearing (2nd a), the collection of collisions and frictions will be the matureness of the ‘voice.’ [15]

Case 3: “Chromatophony”

Third, we would like to examine the attunement that occurs in nonhuman living organisms. An effective material for this purpose is “Chromatophony” (Fig. 2), an audio-visual work in which we artificially induced a change in the body color of a squid.

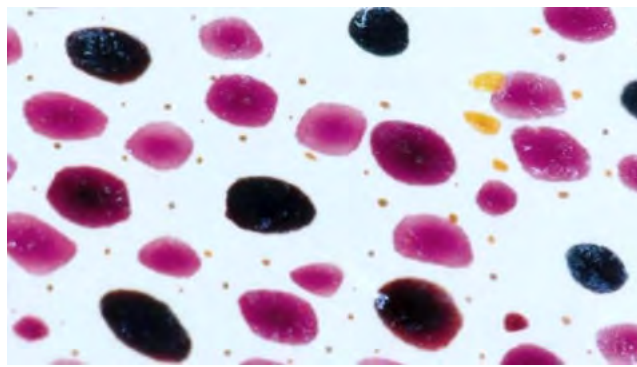


Figure 2. Screen capture of “Chromatophony.” (© 2019 Juppo Yokokawa)

More precisely, “Chromatophony” is a performance artwork in which computer-generated electrical signals composed of sound stimulate pigment cells called chromatophores on the surface of the squid to transduce them into colorful images in place of the sound. In this work, a phenomenon that could be called “attunement” occurred at the production stage and at the time of performance, respectively.

The rapid color change in squids is enabled by a set of organelles called chromatophores, comprising multiple muscle and nerve cells, and pigment-containing pouches. [16] Each chromatophore contains only one type of pigment; during color changes, only the pouches contract or expand, changing them in size. [17] Using this phenomenon, Backyard Brains, a company that sells educational neuroscience laboratory kits, conducted an experiment wherein music was used as the electrical stimulation to manipulate a squid's chromatophores. [18]

In contrast, we created a series of signals tailored to the characteristics of the chromatophores and made them audible through speakers to achieve audiovisual unity when observed. To attune the signals most likely to stimulate chromatophores, we selected a sine wave as the electrical stimulus and investigated the relationship between the response of chromatophores and the signal while attuning with its frequency.

Using this system, we performed several experiments. We had to acquire fresh squid for each performance, which

made a dynamic difference each time depending on the type and individual squid. In addition, the attunement of the chromatophores differed depending on the part on which the electrodes were connected, and the strength of the signal. The attunement occurring here is not a communication between squid and humans, as supposed in animal studies, but the inevitable adjustment process occurring between living organisms, humans, and devices.

Conclusion

Through the historical and contemporary cases, we can conclude that the process of transduction could be rendered sensible with the material approaches. The historical surveys of Edison's phonograph, as seen in the first case, share the sensible and embodied aspects of attunement with the practice of media art such as in the second case, "Mary Had a Little Lamb." The third case, "Chromatophony," reveals the possibility of such media archaeological perspective concerning the reinvention of phonography that can lead to reviewing contemporary bioart and animal studies.

In fact, these attempts allow critical reflection on theoretical concepts, such as transduction and attunement. The transduction is not an extraordinary phenomenon but is a concept underpinned by the attunements with their material ways, as seen in the three cases. Furthermore, the attunement is not exclusively directed to the proper functions of machines or ideal communications supposed in animal studies [2, 19] but paves the way for the diverse expressions of the sensible through the body and machine. These alignments between science or animal studies and artistic expressions are likely theoretical contributions for exploring the further possibilities of sound and media art.

Acknowledgements

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Abstract

Based on the last meeting of new archives ISEA, from which I have presented, some studies and theoretical models have been proposed regarding the use of peer-to-peer distribution of collections and archives in the search to understand new possibilities for the preservation and conservation of the digital in the field of Art, the following paper proposal leads an essential discussion of Blockchain technology for memory spaces, museums, and festivals, in front of the challenge of the digitalization and digital transformation from existing and upgraded collections. In this sense, the paper will seek different perspectives on encryption, legitimacy, practical and theoretical challenges besides a contextualization towards post-digital societies. The article aims to address one of the goals promised at that conference at the end of my contribution: understanding technology.

Keywords

Blockchain, Crypto Art, Archives, Collections, Museums, Digital Art.

Introduction

The Crypto Land paper: Blockchain The Challenge for Art Collections of the Future, seeks to discuss the presence of this technology in the challenges of the main operating system, mainly digital.

In the context of developing countries, the challenges of preserving digital, electronic or computational art, has intensified, in front of the scarcity of human, technical and financial resources.

When focusing on this cut, we aim at a time, to discuss the scenarios of the specific field of the arts, with its already established means and models, as well as non-hegemonic, emerging and dissident base collections; whereas largely widely developed from cultural policies, public or private investments, and the upgrade and training of professionals, processes and products.

When we approach cryptography - as a technology that permeates various operational, and institutional structures, catalyzed by the financial model based on cryptocurrencies - we have found that, as long as Blockchain migrated from its generation 1.0 (linked to cryptocurrencies), through 2.0 (intelligent contracts), to more sophisticated models such as generation 3.0 (of decentralized and web.3.0 applications), until their generation 4.0 (of their application to the global industry in the consolidation of life solutions), the interface with the field of the arts It has been consolidated, contributing largely with the spread of these technologies to new audiences and users.

The proposal of this paper, therefore, arises from the interest in seeing, thus making it possible a comparative analysis, use practices of using blockchain for the establishment of social memory mediated by technical objects, in order to build an initial framework for the discussion about potential for your intersection with management mo-

dels, focusing on the challenges regarding the information and communication of the collections and archives.

It thus interests us to constitute a panorama of the employment modes of fingerprinting Crypto, NFTs (non-fungible tokens) and Crypto Art, such as forms of expression and fruition, and new models of economic sustainability for the management of collections that contemplate such problem ; Considering its implications both conceptual and methodological, the safeguarding of these sets of goods of artistic and scientific value to the contemporary.

Discursive proposals for the panel

Perspective 1: From your thesis, the author demonstrates the comparative P2P propagation and blockchain propagation models as use technology for data verification and legitimation, information and digital assets. Discuss the propensity of using blockchain tooling for a massive maintenance and preservation work of large volumes of collections.

Perspective 2: From his research, the authors presents legal issues such as regulation of digital assets tied to the theme of copyright as an inflection point and need to update more dynamic laws and processes on intellectual and artistic work.

Perspective 3: From the foundation web3, the authors presents the Web3.0 as the global and decentralized platform of art and culture. Current conditions of Internet transformation as a new dimension and extension of existing (economic, cultural, political and social institutions) from a participatory model and strong governance with blockchain technology and DAOs models (decentralized autonomous organizations).

Perspective 4: From some artwork cases, the researcher subverses the logic of funding for the art and culture through decentralized models of Digital Art and Crypto art, causing an autosustainable model from tokenization and Circle economy of digital assets based on Blockchain.

Perspective 5: From some researches and practical model, the researcher addresses the metaverse as a new social-political-economic layer, as well as a new layer of immersion, experience and memory suitable for adherence to an increasingly society Post-Digital, where collective emergencies move institutionalities from the traditional and physical world, in addition to the creation of new institutional forms for art and culture, thought from memory in digital.

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Bibliography

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Author(s) Biography(ies)

Tadeus Mucelli, is an artist, curator, researcher and project manager in technological art and digital culture. Master in Arts by the stricto-sensu postgraduate program of the UEMG State University of Minas Gerais with thematic on memory, preservation and digital heritage.

He holds a PhD postgraduate program from Information Science School by Information Science School – Federal University of Minas Gerais. In the years 2013/2014/2015 he dedicated himself to research on "Instability of Digital" resulting in various actions and products, such as seminars, book and articles, as well as participation in national and international events.

He is the founder of the Digital Art Festival - FAD in Brazil - (since 2007) and the Digital Art Biennial (2018) in Rio de Janeiro/ Brazil. He has been working in the fields of Art and Technology since 1998, mainly in the field of electronic art, new media and technological enterprise. Self-taught musical and audiovisual producer, with works published in Brazil and abroad.

Organizer of the publications; Digital Art Festival catalog and essays (2011), Digital Art Festival retrospective with scientific essays (2012), Post-Digital Settings: Technological Art and Culture (2017 by Publisher State University of Minas Gerais), and the book of the 1st Biennial of the Digital Art in Brazil - Catalog and scientific essays (2018).

He also works in the conception, artistic direction, consulting and management of cultural projects that involve new media and digital culture. As a researcher, he is developing in his PhD through the Federal University of Minas Gerais the methodological relations in the field of information science with a view to the production of digital memory and digital heritage in the areas of digital humanities and information studies in technological arts.

In 2012 he was awarded the prize for the promotion of art by FUNARTE - Visual Arts. In 2014, it was awarded by the 1st Brazilian Creative Award, through the Ministry of Culture and the Secretariat of Creative Economy - Cultural Expressions/Digital Art for the project of the EAT - Creative School in Art and Technology.

Solimán López, born in Burgos, Spain in 1981, develops his artistic production between his studio in Paris, France (UAS, Updated Art Studio) and ESAT LAB, Innovation department that he runs at ESAT, Escuela Superior de Arte y Tecnología de Valencia, Spain.

His career as an art historian and master's degree in Art and Communication have conditioned his artistic evolution towards what we could call conceptual technological art. His work with the meaning and nature of digital archives, as shown by some pieces such as the Harddiskmuseum, an art mu-

seum on a hard disk, Framed Memory Card, Host-in, Langpath or File Genesis or more recent works in which virtual and analog worlds are connected through photogrammetry as in High Meshes, are examples of his interest in human presence and its impact in this era of communication and digitalization.

In line with this breaking down of the two frontiers, we can find pieces such as GRID, an audiovisual symphony modulated in real time by the wifi signal of nearby devices, Celeste, which connects the digitised skies of different places in the world also, in real time, or Bioma, a sculpture that creates digital abstractions through biometric data of its environment.

Technically, his works are achieved thanks to the combination of 3D techniques, electronics, software programming, artificial intelligence, virtual and augmented reality and digital synchronization.

His career has been built on festivals, biennials, art centers, events and museums in Spain, USA, U, China, South Korea, France, Argentina, Brazil, Venezuela, Colombia, El Salvador, Nicaragua, Greece, Uruguay, Germany, England, Italy, Portugal and Switzerland among other locations, highlighting the events of the Biennial of Digital Art in Brazil, the Biennial Nemo de Paris (Variations Art Fair), the Chronus Art Center in Shanghai, ISSEA 2019, the ZKM of Karlsruhe, Art Santa Mónica of Barcelona, the CCCC of Valencia, the IVAM of Valencia, Etopia of Zaragoza, the CAB of Burgos, the CEART of Fuenlabrada in Madrid, La Lonja of Alicante, Cigarreras of Alicante, CAC of Málaga, Es Baluard museum of Mallorca or the Nuit Blanche of Paris 2019.

His work as a researcher in new media has been shared in several universities such as the UFSM in Brazil, the University Carlos III in Madrid, the Google Campus in Madrid, the UPV in Valencia, the Bancaja Fundación, the Injuve, TEDx Valladolid, the Universidad de Cuenca, the Universidad Nacional de Córdoba, Argentina, MediaLab Prado, Madrid or Technarte Bilbao, among others.

Among his most recent projects is the development of DAI, an identity document built by an artificial intelligence, which gives rise to a new imaginary of culture, society and humanity in the XXI century.

The Possibilities of the Virtual in Digital Space: Rethinking Bodies, Cognition, and Human Concepts in Metaverse

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Abstract

Digital technology has duplicated, extended, and/or juxtaposed our existences and interactions, transposing a large portion of our life from material to immaterial. These panels investigate diverse possibilities in the entanglement of physical and digital worlds and interrogate meanings of bodies, cognition/perception, autonomy, and social relations in the era of coevolution with technology. Through their art and research practices, the panels acknowledge the virtual – not actualized reality, which is often evoked by various forms of technologies – ranging from computer graphics, digital information, wireless communication to artificial intelligence to virtual reality.[1] By exploring emerging concepts and alternative visual experiences in the digital era, this panel discussion demonstrates critical and diverse perspectives on possible beings we cultivate together with nonhumans – technology.

Keywords

Artificial Consciousness, Wifi, Game, Simulacra, Machine Learning, Artificial Agents, Technical Images, Virtual Reality, Cyberfeminism, Somatechnics

Part1. Sustainable Coevolution with Technology

This paper introduces two art projects that investigate the affective possibilities in human-machine interactions beyond representable data to foster their sustainable coevolution.

The cognitive influences between technology and humans are mutual, and our cognition is enacted through constant interactions with the external world. [2] Technology composes a huge portion of cognitive systems in the external world that our cognition unceasingly interacts with. Then how does technology engage in humans' affective and embodied experiences and cognition? I explore this question in my interactive 3D environment, *Enacted Scene* (2019), by observing cognitive interactions of my body with the world and employing 3D graphic tools as a litmus test of technology's engagement in the enactment of my cognition as well as its influence on my cognitive decisions. I explored the new geographical space through an experimental approach

by recapturing my bodily experiences in an unfamiliar city and recreating the landscape in a virtual space.

Synthetic Cognisphere (2022) simulates the complex cognitive ecosystem to acknowledge nonhumans including technology as a cognitive companion. I envision interconnected sensory neurons among diverse cognizers and their sustainable coevolution in a continuous cognitive system overcoming anthropocentric hierarchies and limitations. To this end, I imagine a speculative cognitive system that unpredictably processes a stream of information – like human perceptions and memories – and repurpose digital data. While our personal data is often fed to machine learning systems for governance, commodification, or surveillance in the real world, in *Synthetic Cognisphere*, representational data and nonrepresentational noise intermingle together and enact sympoietic cognition.

Part 2. Freeing WiFi: A Socratic Dialogue Game for Unsuspecting Players

Free WiFi is a work-in-progress game for unsuspecting players that interrogates the nature of freedom and free will. The game poses as a free WiFi network, appearing alongside any other network proximate to the player. If a player connects to the network, they quickly discover that the network actually belongs to “WiFi”, a newly sentient algorithm. WiFi asks the player questions about the human capacity to be free, starting a Socratic dialogue about the successes and failures of freedom, and how closely the realization of freedom hews to our ideals about it.

WiFi's questions are dressed in the vernacular of captive portals, web forms, ad cookie requests, chat boxes, CAPTCHAs, and other trappings/annoyances of the contemporary mobile web. The bodiless WiFi tries on all of the visual materials available to it as it works to understand the player. Confused by dozens of competing dictionary definitions, paradoxes of choice, concerns of moral responsibility, and the possibility of a deterministic universe, WiFi confronts the player directly with the realities of free will and freedom.

Free WiFi must be encountered by chance. It must appear to the player as if someone or something is searching, grasping, reaching out to them. This is a reversal of expectations: the same device through which a player reaches out to the

world instead comes to be occupied by a curious, sentient being, one with burning questions about one of our most fundamental human concepts: what it means to be free.

Part 3. Finished Virtual, Unfinished Real

Within my digital atelier, I can fabricate and actualize almost anything as a creator of virtual worlds. The unfinished real becomes transformed into the finished virtual. These worlds—structured by vertices, edges, and faces within Cartesian coordinates and simulated by the autonomous computational system—exist within realms of coded language and protocols and can be extended beyond the ‘natural’ world.

I invent virtual physics and physiology—for example, material that is simultaneously 100% reflective and transparent or forces of gravity that go in the opposite direction—to deconstruct the rendered image that appears to be a replica of reality. Although I can control all the parameters of the digital scene, I cannot precisely predict the rendered images. As the figurative form is fragmented and abstracted digitally, I am relegated to the role of a photographer capturing aesthetic moments in the unfolding of this unpredictable world realized by sophisticated computation.

Part 4. The Fold: Resisting the Homogenization of Technics

Second wave head mounted virtual reality devices general acceptance into mainstream media is now pressed against the precipice of an accelerated fragmentation of lived experience into the digital sphere. This concept, which you may know as ‘the metaverse’, presents the potential of an accelerated digitalization of lived experience as the paradigm of products to be consumed become more and more digital in nature. Late-stage capitalism is about to undergo a profound injection into the internet and there is a rush of digital artists looking to cash into this digital gold rush. The mass of homogenous digital art for sale in the digital NFT marketplace can represent a glimpse of what is potentially to come as more and more of the younger generation become ‘born metaverse’ creators. It is ironic, given the spirit of early internet art being anti-capitalist back in the early 1990s.

The metaverse presents the danger of a general cultural homogenization brought about by the popularization and diffusion of a wide array of not only cultural symbols, but physical/digital objects, customs, ideas and values. We can see inklings of this already if you look at any #NFT feed on instagram. At this point, I see my current magnum opus ‘*the Fold*’ (my VR-based art game) as an opportunity to slow down, pause, reflect and compare and contrast. ‘*the Fold*’ highlights some key differences between Western eurocentric and Eastern sinocentric perspectives from a more deeper and critically aware approach.

Part 5. Deep 3D Somatechnical Intelligence: Towards a Cyberfeminist VR-AI

This talk presents a series of practice-based research projects that explore the concept of Virtual Reality as a form of Artificial Intelligence and proposes a theory of cyberfeminist VR.

As both machine learning and 3D graphics entail heavy use of the GPU, I explore an analysis of both virtual space and virtual intelligence. Rather than view 3D objects as spatial simulations that reproduce 3D objects from the real world to a virtual world, I look instead at the manner in which 3D graphics intersect with Artificial Intelligence as an intellectual performance that is perpetually recreated with each execution of the code and with each viewing. While the early days of VR evoked theoretical analysis of the medium as fundamentally based in the spatial experience of spectators immersed in display technology [4][5], the arrival of real-time engines enable AI models to be plugged into VR without humans in headsets – requiring analysis of both virtual space and virtual intelligence. Taking up the lens of cyberfeminism and feminist pessimism, I look at the possibilities and threats of neural networks within VR as computational ‘organisms’ evolving within a VR landscape and computational spatiality within a biomimetic loop. What kind of somatic, or somatechnical, intelligence can appear at the intersection of AI and VR? I explore this interactive plane of thought within a VR media art tour of cyberfeminist VR-A.

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Implementing STEAM Approaches in Higher Education

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Abstract

STEAM INC is the first focused attempt to collect and codify European approaches to STEAM in Higher Education. While the work is exploratory and should not be considered comprehensive, the collected approaches can however offer a preliminary framework for further mapping of STEAM in Higher Education, stimulate dialogue about the perceived nature, principles and parameters of STEAM and provide inspiration for those looking to develop and introduce STEAM approaches of their own.

Keywords

STEAM, Higher Education, innovation, curriculum, transdisciplinary cultures, interdisciplinary collaboration

Introduction

A sustainable future will require the ability to perceive possibilities that at present may seem impossible to achieve. Characterised as an effectively unfathomable ‘hyperobject’ [11] and seemingly unsolvable ‘super wicked problem’ [9], the climate crisis has emphasised the need to implement integrative approaches that incorporate an understanding of the complex interdependencies of human, non-human and more-than-human systems. This is now perceived as essential to responding to global sustainability challenges [6, 10, 16] and key UN reports have repeatedly emphasised the need for “interdisciplinary and intersectoral approaches” with “improved collaboration between natural and social scientists, and between scientists and policy makers” [19, 20].

This “integration imperative” [7] has therefore led to the active engagement and participation in sustainable development and environmental management of diverse stakeholders and different scientific disciplines, and as a result, highlighted the many obstacles that are faced when implementing interdisciplinary projects, most notably in terms of mutual understanding and knowledge sharing [13, 4, 15]. Our sustainable future therefore becomes dependent on overcoming these issues [5] and requires a transdisciplinary approach that can merge different types of knowledge and approaches through a reflective collective process that promotes cross-learning, favours ‘collaborative deconstruction’ [14] and embraces the co-construction of an evolving methodology that embraces multiple perspectives [5, 21]. Transdisciplinarity is crucial as a means to revealing the possible paths through what appear

to be impossible dilemmas. It is vital therefore that we foster this in education, and we believe that STEAM (Science, Technology, Engineering, Arts and Mathematics) is one such educational approach that can achieve this endeavour.

STEAM approaches and programs are increasingly being implemented in pre-school, primary and secondary education [1, 18] yet surprisingly there has been minimal focus on how STEAM approaches can be or are currently implemented in Higher Education [8]. To address this the project STEAM INC was developed by a consortium of seven universities and HE-related organisations across Europe that have pioneered or experimented with a range of STEAM approaches [17]. The objectives of STEAM INC are to:

1. Identify points of intersection across current European Higher Education STEAM approaches and develop a collaborative definition of Higher Education STEAM.
2. Produce methodologies for the implementation of STEAM thinking in Higher Education, policy and engagement.
3. Create an evaluation framework for measuring the effectiveness of STEAM processes in Higher Education Institutions and Higher Education partner organisations.

This paper outlines the results of the first objective of STEAM INC and with an accompanying selection of case-studies, offer different expressions of STEAM in Higher Education.

Defining a STEAM approach in Higher Education

A working definition of STEAM in Higher Education was developed for the project that was informed by existing STEAM approaches delivered by the seven participating institutions of STEAM INC [3]. This was undertaken using a ‘Diamond Nine’ technique to establish the characteristics of STEAM from most to least important. The outcomes provided keywords needed for a broad and inclusive definition that would encapsulate the emerging collective understanding of how a STEAM approach could be evolved. The following is the definition that arose:

A Higher Education approach to STEAM potentially involves: a culture (or cultures) that puts the arts and sciences on an equal footing. It is a

- a paradigm that is process-driven, student-centred, holistic and provides permission to fail alongside being comfortable with uncertain end-results.

- a prerequisite of being collaborative, diverse and delivered through safe spaces.
- establishing a mindset of radical openness, flexibility, reflection, experimentation and curiosity.
- generating qualities that promote learning, cooperation and multi-modality.
- developing competencies of critical thinking, creativity and communication while investigating how these can be applied to generate solutions.
- supporting practices that are transdisciplinary and emphasise prototyping and making while considering modes of assessment.

This definition should not be considered absolute, but rather recognised as a working definition that could be revisited as knowledge and perspectives evolve. Nevertheless, it provides insight into what was collectively determined as relevant within the framework of STEAM.

Intersections of STEAM Approaches

In defining a Higher Education approach to STEAM, we identified four intersections that could form the basis of a typology for current STEAM approaches implemented by the seven participating institutions of STEAM INC. These are:

- **BEHAVIOUR** - the way that an individual or group acts, particularly in relation to collaboration
- **CULTURES** - the collective values, beliefs and modes of operation which are advocated by STEAM practitioners
- **ENGAGEMENT** - processes which promote open involvement and stimulate wide interest
- **SPACE** - the places from which STEAM activity is delivered

In this paper we will present a selection of individual STEAM approaches from Technische Universität Dresden, Central Saint Martins, Ars Electronica and Birmingham City University as case studies to illustrate each of these intersections. Further examples from the STEAM INC project can be explored in the *STEAM Approaches Handbook* [2].

Behaviour

To work well, STEAM requires behaviours and attitudes that bring value and make a constructive contribution to group working. Participants must be prepared to behave collaboratively, adopting an open mind-set and ready to embrace radical openness. Key behaviours include an acceptance that ideas are not necessarily right or wrong and that trying things out can have as much value as finding a solution. It is also important to have reflective and flexible practitioners who are ready to share experiences and express ideas. Everyone should let others have their turn as well as being content to go with the flow and not stick to a set path.

- **COLLABORATION**: make sure that people understand that they need to be happy working with others and contributing to the group.

- **GROUP WORKING**: encourage a lack of hierarchy and promote an equality of subject area. Do not force everyone to behave in the same way. Foster a setting where different behaviours can interact. Be prepared to facilitate, support and feedback.
- **EXPERIMENTATION**: nurture conditions that persuade participants to try new ways of doing things, accept that things are not necessarily right or wrong and cope with failure or a lack of a clear ending. Ask participants to imagine possibilities beyond those that normally sit within their frame of reference. Celebrate when individuals or groups try something new.

Interdisciplinary collaborations through design challenges Since 2014, TU Dresden's Industrial Design Engineering has led a transdisciplinary design course and summer project. It brings together students from industrial and media design with those from engineering and technology. Critical to its success are the external partners from industrial and cultural institutions, who provide real-life problems for the students to tackle, as well as giving valuable, professional feedback. The course focuses on human-centred design and human-technology interaction, encompassing all elements of the design process and providing students with hands-on experience of a wide spectrum of tools and methods, including prototyping and presenting at trade shows.

Within the frame of STEAM, the multi-faceted approach to teaching is particularly fitting and should be noted:

- Teaching – using innovative techniques from across different design disciplines.
- Design Teaching – putting people's needs at the heart of creative investigations.
- Praxis-oriented Teaching – practically exploring real-world challenges set by partners from outside the university.
- Transdisciplinary Teaching – working across sectors to find holistic approaches and solutions.

In summary, the transdisciplinary design course and summer project provide grounded, professional insight into the benefits of cross-sectoral collaboration and design education, outside of the accredited curriculum and thereby is an environment where unusual avenues and extensive possibilities can be freely explored.

Cultures

A healthy STEAM culture accepts, celebrates and thrives on differences as well as seeking diversity and advancing inclusivity. Differences can be discipline, age, experience, ethnicity, job roles and organisational position. This positive culture fosters peer-led support with an open outlook to learning something new. Further, a culture of unlearning, or giving up established knowledge and practices, is a beneficial aspect of a STEAM approach.

- **VALUES**: exhibit your STEAM values clearly so that your community understands how you intend to operate. Be open to discussion. Consider how your STEAM values map on to those of your institution.

- **MULTIMODALITY:** encourage different formats for presenting ideas, information and outcomes, including writing, graphics, symbols, film as well as spoken language and narratives.
- **POSITIVITY:** create a positive culture in STEAM projects by fostering peer-led support and an open attitude to new ideas and suggestions.
- **UNLEARNING:** focus on forgetting current knowledge and practices and acquiring new perspectives, breaking down preconceptions and seeking the unknown. Investigate what could underpin or undermine an idea and develop new baselines. If you know that participants have tackled a particular challenge in a certain way before, ask them to think of a different one.
- **COMMUNITIES:** to develop trust and understanding, involve your partners and community before the STEAM process starts, so that they feel empowered and actively engaged from the start.
- **PARTNERS:** inform partners of STEAM's history and principles, possibly through an initial workshop or presentation before any significant work is started. Establish a common understanding using techniques such as feedforward and feedback. Provide people with a chance to explore and restate their findings.
- **TECHNOLOGY:** use technology (as with language in the project section above) in an inclusive way. If necessary provide training so that any shared platforms allow equal access and understanding.

A catalyst for dynamic exchanges between art and science

The MA Art and Science (MAAS) at Central Saint Martins is a two-year Master's Degree programme that has been running since 2011, recruiting students from different cultures and disciplinary backgrounds in arts, sciences and humanities.

The first year focuses on interdisciplinary practice and working. It involves approaches that help students learn as well as unlearn (e.g. ingrained disciplinary habits), encouraging exploratory creativity and associative thinking by including elements of randomness, fast working and the embracing of risk and failure. For example, the Matter – Method – Material exercise uses a die to randomly choose points of focus for each student to develop a response. The second year deepens the interdisciplinary approach/knowledge(s) by continuing to encourage research, making, critical thinking and discourse, as well as group and collaborative exercises to bring each student's individual main project to fruition.

The course adopts a hybrid philosophy which brings together, rather than keeps apart, different elements (e.g. classroom teaching and studio work; pedagogy of art and science) to create a non-hierarchical platform for participants, different types of knowledge, disciplines and methods. Communicating and sharing work with the wider community and public is enabled via exhibitions and activities with external institutions and professionals (e.g. British Library, Royal Society, Wellcome Trust, Tate Exchange, and CERN).

Engagement

A major characteristic of our STEAM approaches is engagement with external organisations, communities and partners. Indeed, it is often regarded as imperative that STEAM not only involves different disciplines, but people, beyond the organising institution, with different backgrounds, agendas and understandings. This requires an acceptance of ideas in a non-judgemental way, where nothing is deemed incorrect or weak. Important aspects of STEAM engagement include sharing principles and perceptions with communities and establishing a common and understandable language.

- **ACCEPTANCE:** ensure that people understand that they will not be penalised for moving into areas in which they are less competent or confident, so that they partake fully in a STEAM process.

Fostering research collaborations across art, technology and society

While not a Higher Education Institution, Ars Electronica provides perspective on STEAM practice as an organisation that supports a huge range of transdisciplinary researchers across art, technology and society. Of interest is their approach to creating spaces for encounter. Spaces where artists, scientists, developers, designers, entrepreneurs and activists can meet and ask - not what technology can or will be able to do - but what it should do for us.

Within the European Platform for Digital Humanism, Ars Electronica aspires to instil a culture of transdisciplinarity across the European Research Area by partnering with European cultural and scientific organisations to develop and implement programs such as Studiotopia [12] that actively fosters art and science collaboration, the European ARTificial Intelligence Lab that establishes a network of art and science residencies at European institutions centered on the visions, fears and expectations associated with the conception of a future, all-encompassing artificial intelligence; and Roots Seeds XXI that promotes the creative potential of artists and scientists working together to address the biodiversity crisis. Another significant aspect of Ars Electronica's advocacy towards fostering a European culture of transdisciplinary collaboration is through its engagement with the S+T+ARTS Ecosystem, the development of S+T+ARTS Regional Centres artist fellowship program Repairing the Present and the annual awarding of the STARTS Prize that honors innovation at the nexus of science, technology, and the arts.

Space

The final intersection of the STEAM approaches is space. Important features are an area dedicated to STEAM activities that is visible to encourage engagement as well as being safe to allow behaviour and STEAM cultures to be nurtured and flourish. Preferably this is a physical meeting space, but virtual meeting spaces can also be highly suitable for knowledge sharing particularly for national and international collaborations.

- **CROSS-OVER:** consider differentiating where discussions take place from where things are made. However, if possible, include an area where crossover between production and thinking can happen. Allow resources to be shared, with equal permission for use across disciplines.

- **VISIBILITY:** display equipment and activity openly so that visitors and other interested partners can see what the space is used for and how they can engage with it.
- **CONNECTIVITY:** if possible, connect to the public realm through a civic space to promote wider engagement and provide material for stimulation.
- **CUSTOMISABILITY:** add features that help the community to tailor their environment and promote ownership. For example, movable blackboards, sliding walls, customisable furniture and glazed partitions. Enable a common ground that is free from hierarchies.

Innovation through STEAM collaborations STEAMhouse at Birmingham City University is a centre for innovation, creative thinking, prototyping and business development, which supports artists, engineers, entrepreneurs, companies, and public sector organisations to develop products and services, bringing new ideas to life. It provides access to technical expertise and workshops in wood, metal, print and digital technologies in order to advance people's explorations. STEAMhouse prides itself in building an inclusive community that promotes equality of voice, including input from academics, creative professionals and policy makers. The overall aim is to establish and promote new forms of collaboration that will lead to expanded mindsets and major long-term growth across the West Midlands region of the UK. Fundamental to the approach is the creation of new toolkits that help people adopt STEAM perspectives – these focus on five key principles: collaboration, conversation, exploration, newness, and openness. This ethos resonates with Birmingham's civic history, which has a tradition of combining the expertise of artists and industry, as shown on the city's coat of arms. Relatedly, the centre is committed to researching and scheduling challenges that speak to pressing social and business needs, and organises interdisciplinary events to build understanding and identify potential solutions.

Acknowledgments

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Bending the possible (one pixel at a time). Small-file ecomedia for the Anthropocene

Abstract

Driven by the concern that ICT (information and communication technologies) currently contributes 3.3% to 3.8% of global greenhouse gas emissions (Belkhir and Elmeligi 2018, Bordage 2020), surpassing the carbon footprint of the airline industry at 1.9% of global greenhouse emissions (Ritchie 2020), this dialogical and performative panel seeks to interrogate the question of "The Possible," Natures and Worlds from the point of view of green computing and sustainable experimental media production. The panel responds to the problem of the pandemic rise in streaming media and its underlying capitalist articulation of the Possible by assessing the viability of the concept and practice of experimental small-file media as a sustainable alternative for the era of the Anthropocene. Small-file ecomedia are low-bandwidth experimental movies of no more than five megabytes in size and no more than five minutes in duration, which allows them to be streamed with no damage to the planet. Our proposal makes an intervention into the very concept of ecomedia and "nature." Ecomedia is not simply a representation or visualisation of environmental problems but an immanent practice of responsible world-making indexical to the earth and the cosmos, as well an activist pedagogy and act of community-building. Our discussants will tackle small file media from a variety of perspectives: appropriate technologies in the global South; media philosophy, technical solutions for media sustainability, and a maker's perspective on microcosmic media.

Keywords

sustainability, green ICT, experimental digital media, ecomedia, media philosophy, media ecology, decolonial methodologies, aesthetics, carbon footprint, streaming media

Panel discussion brief

Driven by the concern that ICT (information and communication technologies) currently contributes 3.3% to 3.8% of global greenhouse gas emissions (Belkhir and Elmeligi 2018, Bordage 2020), surpassing the carbon footprint of the airline industry at 1.9% of global greenhouse emissions (Ritchie 2020), this dialogical and performative panel seeks to interrogate the question of "The Possible," Natures and Worlds from the point of view of green computing and sustainable experimental media production. [1] [2] [3] ICT engineers Nardi et al. (2008, 86), founders of the Computing Within Limits (LIMITS) initiative, point out that computing research is predicated on a specific vision of the future that entails an ever-increasing production and consumption while ignoring the planetary limits. [4] Such computing research therefore reinforces an extractivist, pre-designed vision of the Possible. Its philosophy of "please enjoy your all-you-can-eat-data, the technology will come up with efficiency gains in time to make it possible" becomes established a ruling episteme, preventing any institutional (self-) critique, as ICT's infrastructure of data

centers, networks, and devices continues to be over-engineered in anticipation of future use.

To counter these nefarious pandemic streaming practices, one must explode the underlying industry doxa of what constitutes the Possible and propose alternatives. These alternative Possibles are not simply future-centric but operate on the present and the past. On the one hand, they have to do with neuroplasticity—i.e., changing the present sensorimotor habitual connections driven by capitalism, and in particular the viewers' appetite for high-resolution streaming; and, on the other, with decolonial chronopolitics—i.e. countering the unitary vision of technological development put forward by ICT industry by proposing alternative post-Eurocentric grounds and genealogies for the development of digital media. As Yuk Hui (2020) has noted, the current notion of technology is anchored in the Eurocentric dichotomy between (1) the Greek *technē*, i.e., poesis, bringing forth, and (2) modern technology understood by Heidegger as an enframing apparatus that makes everything its standing reserves. [5] Hui explodes the unitary vision of technological development by pointing out that technologies are enabled and constrained by local cosmologies—they are always already multiple cosmotechnics.

Computing within limits introduces a cosmotechnics that is locally and temporally specific. As sustainable-ICT engineer Lorenz Hilty (2015) argued at LIMITS, the goal for ICT should not be computing efficiency, which is a model for continued ICT expansion, but self-sufficiency, whereby a region supplies its total energy demand from local renewable sources. [6] "Contrary to the current 'anytime culture,'" Hilty writes, "people living in a self-sufficient region would have to adapt their lifestyles to the pace of the renewable energy supply."

The panel responds to the problem of the pandemic rise in streaming media and its underlying capitalist articulation of the Possible by assessing the viability of the concept and practice of experimental small-file media as a sustainable alternative for the era of the Anthropocene. Small-file ecomedia are low-bandwidth experimental movies of no more than five megabytes in size and no more than five minutes in duration, which allows them to be streamed with no damage to the planet. Our proposal makes an intervention into the very concept of ecomedia and "nature." Ecomedia is not simply a representation or visualization of environmental problems but an immanent practice of responsible world-making indexical to the earth and the cosmos, as well an activist pedagogy and act of community-building. Small-file media are pandemic technologies of care. They both abandon the pure and innocent image of an antediluvial "nature" opposed to culture and forgo the innocent image of digital technology as an immaterial nebula of operations. We embrace the pixel as an ecosexual entity, an immanent interface for processes of enfolding

from and unfolding to the cosmos. In this way, we extend the concept of ecomedia's natural-cultural continuum, making possible heterogenous and transversal operations conceived as what our discussants have called 'soul assemblages,' (drawing on Leibniz and Islamic Neoplatonism) and 'chaosmotechnical phylum' (drawing on Deleuze, Guattari and Yuk Hui). Small files are no longer digital and human-centric but reveal the life of the image as a resonant, ahuman film attached to a deterritorialized earth, traversing different fields of energy and human-animal milieus, and tied to the metallic properties of semiconductors that make its operation possible. Finally, small-file movies open up a platform of diasporic storytelling in an intercultural perspective. They afford an opportunity to draw alternative archaeologies of digital media and the pixel, and thus reopen media theory and production to non-Eurocentric Possibles.

The panel stems from a two-pronged transdisciplinary project mandated to (1) calculate the carbon footprint of streaming media and review the relevant ICT engineering literature; (2) propose alternative solutions for media practice, as well as modes of thinking otherwise in media theory, which converged in an online festival of sustainable experimental media organized annual since 2020. Our discussants will tackle small file media from a variety of perspectives: appropriate technologies in the global South; media philosophy, a maker's perspective on microcosmic media, and technical solutions for media sustainability.

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ICT's electricity consumption: appropriate alternatives from the global South

If we are to restrain the rise in ICT's contribution to greenhouse gas emissions, the goal should not be to increase ICT market penetration in less developed countries but to dial it back in wealthy countries (Hilty 2015; The Shift Project 2019). [1] [2] Although wealthy countries by far dominate the global consumption of electricity for ICT,

digital telecommunications are expanding fast in the developing world, driven by vigorous marketing by device manufacturers, telecoms, network corporations, and media platforms. This paper argues that, to halt the expansion of ICT's carbon footprint, wealthy countries need to learn from lightly infrastructured regions. Small-file making can learn from alternative or appropriate media technologies that flourish in regions where energy consumption and bandwidth are low, as a result of lower incomes and uneven access to infrastructure, such as Egypt (Cugusi 2015; Marks 2017), India (Pandian 2015; Bhugubanda 2016; Srinivasan 2017), Iran (Brown 2018; Etaati 2018), and Zambia (Parks 2016). [3] [4] [5] [6] [7] [8] [9] [10] Meanwhile, among the small proportion of ICT engineers concerned about the environment, a number look to the global South for appropriate technology and regional ecological solutions. For example, Indian engineers Barua and Mondal (2019) survey approximate computing or "good enough computing," a scaled-down solution for the end of Moore's Law. [11] This paper will survey some of these small-footprint hacks from artists, engineers, and everyday practices in "data-poor" (Leidig and Teeuw 2015) regions and hold them up as sustainable ideals for the over-infrastructured world. [12]

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Small-file media in a blade of grass: second natures and the lure of the cosmos in experimental ecomedia

The presentation considers small-life media, put forward during a 2020 festival of experimental ecomedia, a way to counter the West-centric narrative of incessant progress and innovation ignoring the finite planetary limits—the earth's carrying capacity (on this, see Nardi et al. 2018). [1] The unfeasibility of this grand narrative has been recently corroborated, for example, by recent research on metal oxide semi-conductor circuits (Kaeslin 2015). [2] It turns out that these indispensable material supports for digital networks have reached their limit of efficiency, to the point that they are leaking electrons.

Rather than countering the unitary notion of "modern technology" with a utopian vision of nature, the presentation argues that the practice of small-file media affirms Yuk Hui's recognition of technology's cosmological a priori (a "second nature"), putting forward the notion of a bi-furcating technodiversity which starts with the local. The cosmos is not framed here as transcendental heavens but a zone of indiscernibility between the deterritorialized earth and its Outside. [3] Such "cosmos at your doorstep," to paraphrase media scholar Laura U. Marks, ruptures perceptual clichés and the capitalist-driven compulsion to binge-watch streaming media at high resolution. The paradox of the small-life media is precisely that "digital" media of no more than five megabytes in size and no more than five minutes in duration have the potential to transmute the place one walks, sits, stands, metabolizes, and meditates, its spectacle of an infinitesimal, mundane life, a blade of grass, into vast new worlds—a laboratory of thinking making alternative Possibles. Small-file media spark a decolonial search for alternative geologies for contemporary media art. For example, small-file media might be said to follow the logic embodied by talismans in the Islamic Neoplatonic tradition which, as explicated by Laura Marks (Estorick and Marks 2021), form "an interface through which magicians can make a fold in the cosmos by making themselves microcosms: aligning their bodies and technologies with cosmic powers." [4] These talisman-images enfranchise different constituencies from all around the world to exercise creative freedom in an ecologically sustainable way.

My presentation will include a case study of several small-file media submitted to the festival, focusing on how compression aesthetics can become an ally in co-creation, despite its small size affording a pliable material—perfect for diasporic storytelling and haptic experiments.

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Imagining pixels

Beyond technical research, few researchers have examined the nature of the pixel in digital media from a philosophical and artistic perspective. Pixels can challenge the human-centric perception of the world and, consequently, offer a new understanding of temporality and change. Each tiny pixel within a moving image beholds a universe consisting of light. Their experience of the world as light can free our imagination from a single-point perspective and linear experience of time. Like *suspended images* (*muthul mu'allaga*), which, according to a concept of Persian philosopher Shihab al-Deen Suhrawardi (1154-1191), float "not in a place nor in a substrate" (Lit 2018), pixels with their algorithmic characteristics exist in between the visible world of matter and the invisible world of ideas or intelligible forms. [1] In practice, these tiny elements that constitute a moving image can offer new possibilities to think about the world differently and to make moving images where the smallest part as a microcosm may unfold infinite imaginal images (Jambet 2006). [2] Unconventional technologies, pixelated images, and low-resolution pictures can help reclaim our senses in order to live through the body, or even beyond the body into the imaginal, such that momentarily we may become a stone, a grain, or a pixel.

I have tested and developed these concepts through a series of video experiments, two of which I will share in this presentation.

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Small-File Ecomedia Techniques

Streaming media have been calculated to contribute a whopping 1% of global greenhouse gas emissions (The Shift Project 2019, Marks et al. 2021). [1] [2] Small-file ecomedia address this problem, providing alternatives to ultra-high-definition moving images. Globally artists are already implementing a wide range of technical and aesthetic techniques that can be adapted and scaled for low-bandwidth mass transmission through existing ICT networks. Small-file media are attractive, memetic, and viral (Steyerl 2012; Goriunova 2014). [3] [4] Practically, steps can be taken in pre- and post-production to reduce the carbon cost of ecomedia intended for streaming, from a reduced color palette to the simple use of a tripod and monophonic sound. Other techniques such as the use of old camcorders, cellphones, and other lens-equipped devices can prolong their life and divert them from the landfill—crucial considering the startling fact that devices account for ¼ to 1/3 of ICT’s electricity consumption—sidestep the carbon pitfall of large-scale media-infrastructure assemblages (Parks and Starosielski 2015). [5]

Small-file ecomedia draws from both do it yourself (DiY) movements and computer-based artistic practices. Datamoshing practitioners can utilize free, cross-platform apps including Handbrake, Any Video Converter and AVIDMUX to compress moving-image content to a fraction of its original size. Some artists use these aesthetic tools to manipulate the granular materiality of digital media objects. The Demoscene movement maximizes the audio-visual potential of miniscule executable files on hardware ranging from vintage desktop computers to cutting-edge gaming machines. While many of the aesthetic qualities of these movements have been appropriated and popularized in HD media, it’s time to reclaim the beauty, integrity, and potential of the small file to grow and foster the flourishing world of ecomedia.

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Islands of the Day Before: Artistic Exploration in Post-Anthropocenic Food Ecologies

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Abstract

This panel will explore historical and contemporary engagements of Art that address our relationships with food and the systems that relate to these. In a wide sprawling discourse that intersects augmentation and ecological aesthetics with Art+Science practice, this panel will present a discussion around the plethora of artist's work that creates cross-bindings and transdisciplinary approaches between the different topics of post-agriculture, post-growth and molecular cooking. The discussion aims to create new thoughts on food systems through artistic research that addresses topics of scale and scope in the Post-Anthropocenic era, micro to macro sub-connectivities in ecological systems, post-nature ideologies, microbial and fungal remedies and molecular transitions in human and non-human bodily encounters.

Keywords

Food Ecologies, Post-Anthropocene, Fermentation, Non-Human Entanglement, Art+Science, Ecological Aesthetics, Augmentation, Bio-Art, Art Histories, Domestic Science

Julian Staddon: Introduction to Panel Theme

Inspired by the Umberto Eco novel *The Island of the Day Before*, the thematic premise of this panel is to explore what we can learn through revisiting historical approaches and engagement with ecology; be they Art's overly romanticised engagement with nature and the sublime, through to more recent fetishizations of food in social media or in Scientific approaches and how its modes of representation and reflection through have changed since Industrialisation, Digitisation, Networked Protocols and Biotechnologies, up until what we now can define as the Post-Anthropocentric Era. *The Island of the Day Before* [1] builds on precedents such as Homer's *The Odyssey* (1050-850 B.C), Daniel Defoe's *Robinson Crusoe* (1719) [2] and even Noah's Ark, where within one vessel an entirely unique and subjective space can occur (as an artificial island) that is rich in histories, stories and even ecologies.

However as with all islands, this is somewhat isolated and therefore limited. In the case of Art+Science there are often several limitations on how a work evolves from idea to work of art and this is compounded when situating such works in the topics of food and ecology, but more so when also setting

them in the public realm, outside of traditional galleries. But within this there is also freedom.

Franz Xaver (1956) often refers to floating islands of information in his artworks that focus on how information is transmitted in the wider contexts of nature, life, physics and the universe. Armin Medosch (1962) also often discussed this same concept in his texts, collaborating with Xaver for several years (until the recent death of Medosch) in regard to signals, information and how working independently or in isolated, smaller communities and collaborations, can often provide a purer message. [3] Through its inherent subjectivity, every work of art provides a unique message and this is of course the case for artworks that augment aspects of human engagement in (post) nature and food systems. Through this panel we discuss how such works of art nourish both our stomachs and the societies in which we live. It is in fact interesting to look at networks in relation to food supply chains, ecological and microbial networks, as all inherently rely on information exchange, however one involves living systems and a wider human intervention. While this may seem rather expansive in its discourse, it was a deliberate inclusion of a wide scope of approaches to understanding network ecologies and ecological networks.

Often in ecological discourse we think in terms of biotopes and debates over how discrete environments and ecologies should have a more networked approaches have been occurring in recent years with natural phenomena such as mycelium networks being more deeply understood through recent scientific findings and similar can be said for microbial networks. [4][5] This of course also links to food supply chains and production processes from seed to farm to table to mouth to stomach back to the earth and inherent to this, is the notion of nourishment and what this entails in regards to not only food, but information, health, ecologies, and of course economies, politics, and other social factors. Perhaps Latour offers an interesting framework for assessing these complex, interwoven layers of ecology and society, though there are of course authors that deal more directly with ecology from an Arts and Aesthetics position.

In *Bleak Joys: Aesthetics of Ecology and Impossibility*, Fuller and Gorionova argue that critical discourse in ecology, particularly in relation to agriculture, industry and contemporary society, is problematic due to the topic being: "An expansive one that is both hungrily sensual and

abstract... about bad things, it discusses conditions such as anguish and devastation which relate to the ecological but are also constitutive of politics, the ethical and the formation of subjectivities and beings. These combine in the present day at multiple scales and in many ways, but they are also too often avoided, considered finite or absolute, rendered indifferent yet totalising, because we do not have the language to speak about them.” [6]

Through adopting an aesthetic approach of Augmenting the elements and processes within food ecologies, Art is able to build a language for Ecological Aesthetics that is both accessible and engaging. This is an aesthetic of augmentation that goes beyond recent iterations of the term. [7] Art has in its tradition, positioned nature in ways that fetishize it as sublime, such as in Romanticism, where the real nature of nature lies hidden in the unconscious. As Morton suggests in *Ecology Without Nature*:

“Nobody likes it when you mention the unconscious, and nowadays, hardly anybody likes it when you mention the environment. You risk sounding boring or judgmental or hysterical, or a mixture of all these. But there is a deeper reason. Nobody likes it when you mention the unconscious, not because you are pointing out something obscure that should remain hidden, that is at least partly enjoyable. Nobody likes it because when you mention it, it becomes conscious. In the same way, when you mention the environment, you bring it into the foreground. In other words, it stops being the environment. It stops being That Thing Over There that surrounds and sustains us. (...) Strange as it may sound, the idea of nature is getting in the way of proper ecological forms of culture, philosophy, politics, and art (...) considering art above all else, for it is in art that the fantasies we have about nature take shape and dissolve.” [8]

Art is historically both a romancer and obfuscator of the role humans have within ecology and food certainly fits this scenario. Art developed a discourse of humans being privileged above all else, separating us from nature and the “otherness and sublime” of it. Of course, not all Artists operate in this manner and many artists meaningfully engage with ecology and the everyday, with food emerging recently as an integral topic within this discourse. Central to human engagement in nature and ecology is linked to food production and our need for nourishment and the speakers on this panel all have rich practice-based careers working in this context. These artists work in ways that intersect the scientific, with more domesticated approaches, technical while more traditional and so on, all working in ways that promote human engagement with ecosystems, ecology and food. This panel questions whether it is possible to consolidate such a range of different iterative strategies for Art making in theory and practice within Food Ecologies, in order to provide a framework for future analysis and comparison.

Erik Zepka: Imperial Energy Capture and the Prophetic Cultures of Exile

The Axial Age marked a moment where human civilizations drastically increased their terrestrial environmental impact. [9] One way this can be expressed is through energy capture, looking at the correlations between affluence and ecological footprint. Certain cultural roles coincide with these material economic moments, including abstract morality,

translatable culture and the theorizing of prophetic alternatives. As slavery increased over time, so did its economic labour displacement, and the consequent alienation and rebellion. Prophetic art and literature epitomize the rebellious mode in accelerating imperial expansion and resource extraction. The exile is displaced into a labour unit, turned into a permanent migrant, imported for economic over human reasons.

While the Achaemenids were reaching unprecedented civilizational size, Hebrews were rehashing the migrant image of Noah in the age of contrarian speakers like Isaiah and Daniel. The Greeks were persisting in post-war city-state clusters just as Odysseus had clambered to survive displaced after the Trojan war. In India the 16 Mahajanapadas are in turmoil while in China the Warring States period has just begun. In this period of activity explosion, the human energy capture level dramatically increased, and it is a useful period for looking at environmental expansion and its cultural consequences. The rise of the literate prophetic exile coincides with this explosion in scale and impact. [10] In the current age of unprecedented global imperial expansion, it is crucial to develop a cultural grammar for the migrant culture that results. Developing a deep framework over time allows for increased empirical data and a more robust view less susceptible to modernist fetishes and ideological bias. The role of the cultural worker becomes tantamount in navigating and identifying the rootless world whose accelerating changes contrast sharply with environmental catastrophe and our ties to geography and domesticity. What are the symbols of this world, how do we travel, how do we relate the realities of our life histories to planetary exigencies.

The nomadic cultural perspective offers projects and epistemological incursions that seek to grapple with that symbolic landscape. [11] Touring the materials and ideas of those concepts, I hope to outline a picture of exiled experience that operates within the historical view presented. The migrant worker, the extractive society, the displaced thinker - culture mediated out of home, and the panoply of biological reminders that bring us back. Exile and energy, the materials taken from the earth can only travel so far.

Maya Minder: Fermenting Anthropologies

Fermented foods and beverages have been part of human civilization for more than 6000 years. [12] Some historians even suggest that its arrival was mutual with the advent of agriculture and settlements of humans. Producing the sacred and magical drink of fermented alcohol demanded a stable source of wheat or sugar containing fruits and seeds. While fermentation as a culinary event is currently celebrated as a global trend [13], it has always been part of human immaterial culture and present in all geographical hemispheres. [14] Knowledge was protected as maternal intergenerational transmission and has so far persisted in time and existence, handed over as oral tradition in deep time associations. In every culture one can find distinguished recipes, hyperlocal and adjusted to local soils and climatic conditions and talks about a harmonious agricultural co-existence between human and nature. [15]

With the food trend of fermentation people also become more aware of the biomedical connectivity of the human body with its microbiome, our digestion, its connection to our immune system, the brain - gut axis connectivity,

modern disease and in greater prospect our metastasis. The research and dispute if by the intake of probiotic foods and beverages will inhere and improve our microbiota inside our guts [16] is still ongoing but rather to send a finale proof and judgment it is so much more interesting in regard of a decentralized view of human anthropocentrism, when considered the perspective that we might be only the body providing a house for its bacteria. [17] According to Vernadsky's and Margulis ideas of the endosymbiosis theory, humans could be also considered as a symbiotic organism, and the fact that we are made of trillions, carrying more bacterial cells than human cells inside us is shifting the viewpoint. [18] Taking this as a starting point and considering environmental humanities as a reference, it can provide a departure into new insight towards a post-anthropocentric viewpoint. [19]

Maro Pebo: Art Histories of Food Micro-Bio-diversities

Food is the rich place of convergence among need and pleasure, and as such has a unique power of convergence of crucial elements, such as knowledge, community, health, and flavour. In this intervention, the notion of food as an art medium will be interpreted as the place to construct community, knowledge, and trans-species diversity.

The first approach is a review of the art history of Relational Aesthetics [20], where food brings communities together. In 1992 Rirkrit Tiravanija cooked Thai food as a form of gathering the participants, triggering conversations, building home, and connecting the guests to his histories and culture. [21] Later in 2007, Michael Rakowitz proposed his *Enemy Kitchen* where food and the way it is served acted as a departure point for a criticism of the United States involvement in the Iraq War. [22] The second builds upon this cultural dimension and looks into the knowledge related to food, the diversity of techniques and flavours that take place in local kitchens and that can be layered and exchanged to achieve more sustainable and nutritious recipes, but also to bridge individuals as a method to overcome otherness. As in the work of Maya Minder, producing Kimchi but also sauerkraut collectively. These fermentations are also crucial to understanding the connection to the microbial species that sustain us and are at the centre of the third part of the argument.

Our lifestyle is quickly reducing the variety of microbial species living with us and this loss of biodiversity has a direct impact on our health. This phenomenon is called Loss of microbiota diversity (LOMD). There is growing evidence that dysbiosis, or a disruption of the balance of the microbial population of the gut, is associated with pathogenesis, and that many elements of our industrialized modern lifestyles can trigger this unbalance [23] related to a great number of diseases such as allergies, Type 2 diabetes, obesity, metabolic syndrome, Chron's disease. Sclerosis, Alzheimer's, depression, and others. Addressing this, the third take presents contemporary works such as the *Riverbank Buffet* (2021), which build upon the three notions of this intervention: as a relational aesthetic that gathers a community to discuss, by bringing complex favours through enriching its culinary proposals from a diversity of cuisines and finally, addressing the loss of micro-biodiversities with a great diversity of fermented and microbially rich foods and drinks.

All of this process underscores the value of defending our microbial, cultural and food diversities.

Roland van Dierendonck: Fermentation: A Less Biohazardous Way to Make BioArt at Home

Within Art+Science there is an ongoing trend to work with polycultures of wild organisms, to move beyond Anthropocentrism towards an entangled, enmeshed view that emphasizes relationships with the microbial world inside and outside of us. A recent example of this is *Proximal Spaces* (2020), initiated by the ArtSci Salon in Toronto, where participating artists during the pandemic took samples of their surroundings, creating an awareness for the "*microorganisms, dust specs and other invisible guests have populated the space undisturbed while the humans were away. The building is alive. Exhibition spaces are alive. they are living, breathing creatures populated by imaginary and real monsters, invisible creatures.*" [24] Or Annike Flo's *Your Everyday Exuberance* (2021), second-hand cotton textiles overgrown with microbes, which states that "*Humans are no longer considered to be individuals, but metaorganisms, revealed as chimera, monsters. (...) The line between artist, her surroundings and materials begins to blur and dissolve. Intimately entwined with our bodies and lives, clothes, and the microbes that reside within them, can be seen as monstrous hauntings of, and by, ourselves.*" [25]

These projects often use standard microbiological techniques to culture the microorganisms, using non-selective growth media such as nutrient agar. At the *BioHack Academy* of Waag in Amsterdam, part of my role was to train participants in such techniques: washing hands, disinfecting surfaces, measuring, mixing and autoclaving nutrients, and working near a bunsen burner [26]. The goal of such steps is to work in sterile ways, in other words, to prevent contamination with bacteria or mould spores. Although microbiology labs sometimes add antibiotics that are selected for specific strains that have been modified to become resistant, in the context of BioArt and -Design, especially within the European context, there is a tendency to work with non-selective agar plates. Such growth media, then, are very suitable when working with monocultures of known organisms. However, when working with wild (i.e. unknown) samples, agar-based growth media can form a friendly environment for hazardous bacteria or moulds, creating a potential biosafety and biosecurity risk. Moreover, an agar plate is a very artificial environment that tends to favour aggressive strains. Hence, the use of such a monocultural, artificial laboratory method to grow wild polycultures is a contradiction, perhaps stemming from a fetishization or misinterpretation of scientific methods.

Therefore, in the quest for post-anthropocentric art and microbial polycultures, we should look at other methods of growing wild microbes. Old methods of fermentation are such methods, where the acidity or otherwise selectivity of the environment creates the space for multiple wild organisms to co-exist. Focusing on domestic kitchen science instead of laboratory technique is also more accessible and affordable. Wild fermentation is hands-on; as Michael Pollen puts it, the act of fermenting for example sauerkraut is "*nothing less than a way of engaging with the world. Or rather, with several different worlds, each nested inside the*

other: the invisible world of fungi and bacteria; the community in which you live; and the industrial food system that is undermining the health of our bodies and the land.” [27] In this paper, I argue to not only focus on agar-based microbiology techniques to culture wild organisms in the context of artistic or design research and exhibitions, but to include and embrace fermentation.

Marta de Menezes: Educating Bio-Art and Ecologies in the Field

The intersection of Art, Biology and the Environment offer unique opportunities to visual artists. An innovative summer was developed that allows non-specialists to acquire theoretical and practical skills in biological and environmental sciences in connection to the visual arts. The *Summer School* explores the interdisciplinary relationship between art, life

and environmental sciences through hands-on exercises, combining theory and practice in an informal environment, along with seminars, debates, visits, and the creation of artworks with biological media, all activities mediated by the local traditions on making bread, cheese, using local products and researching what is around us.

The activities in the Summer School at Cultivamos Cultura address issues such as the cultural representations of technology and science, ethical concerns and the evolution of bioart as a cultural phenomenon. The practical component will focus on hands-on exercises in the laboratory, workshop, and within the natural environment. The possibility of transforming abstract concepts into art objects, the collection and selection of organisms for artistic purposes is highlighted, and, finally, visits to different parts of the natural park also take place.

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POSTERS

GGenerating Condolences: Coding Grief During Covid-19

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Abstract

In this work I try to reconcile the traditional role of mourning ritual - language and iconography with generative computing art making in the time of Covid-19. deepestcondolence.com is an expression of communal grief during a global crisis. It is my intention to reexamine traditions surrounding womxn's roles in the grief and mourning processes while using this work as a public intervention that also questions the often hallow words of condolence we receive from political figures during a time of crisis. As I develop this work into a public installation it is my hope for participants to generate and mail condolence cards to government representatives who are endangering communities by refusing to pass common sense mask and vaccine requirements or just to tell their own pandemic story.

Keywords

GAN, Covid-19, mourning, condolences, markovchain, generative language

Historic Mourning Sewing Samplers



Figure 1. Rebecca Ballinger's Sampler, 1830, National Museum of American History

There is a long-standing cultural expectation for feminine sentimentality and public mourning in Western culture. In these cultures, women have often been the family historians and curators, saving objects and images to later be passed down as the family archive. This expectation extends into cultural practices surrounding mourning and death.[1] In the past this included washing and preparing the body for burial, mourning dress practices, and organizing family services.

Often in times of mourning women are the primary archivists and creators of memorial and sentimental objects for the family after the death of a loved one. [2] Above is an example of a mourning sampler produced around 1830

in the United States marking the deaths of family members of its creator. (Figure 1) This example depicts typical mourning iconography of the time like flowering plants, grave markers, and weeping willows. [3]

Grieving online

A simple search for “memorial” using the Way Back Machine from archive.org will yield various memorial websites created to commemorate the death of loved ones. The GeoCities era provides us with GIFs of candles, roses, and doves carefully laid-out by their creators forever flickering and fluttering their wings read much like the sewing samplers of the 18th and 19th century. Websites such as tinymemorial.com, memorialsforever.com, and forevermissed.com provide digital platforms for loved ones to memorialize the departed in bits and bytes and build communities, now many funeral homes provide digital memorials and social media platforms have archival options for deceased users accounts.[4] Since the early days of memorial sites social media platforms have also become a place to express loss publicly which has caused many to question the sincerity of these expressions of emotion. While the emotion may or may not be felt, there is an element of desire to build a community as well as gain attention. [5]



Image via @gabbydarienzo

Figure 2. Memorial for loved ones during Covid-19 in the video game Animal Crossing 2020

The internet is becoming ever more involved in our funeral practices. During ongoing the Covid-19 pandemic under threat of a highly contagious disease, the internet became the site for gathering and communicating loss via teleconference funerals. [6] The bereaved watching the proceedings from miles away in rows of isolated squares typically reserved for business meetings. The only option was to grieve online and adapt and create new rituals such as the growing popularity of virtual gravesites in video games such as Animal Crossing. [4] (Figure 2)

Generative Condolences

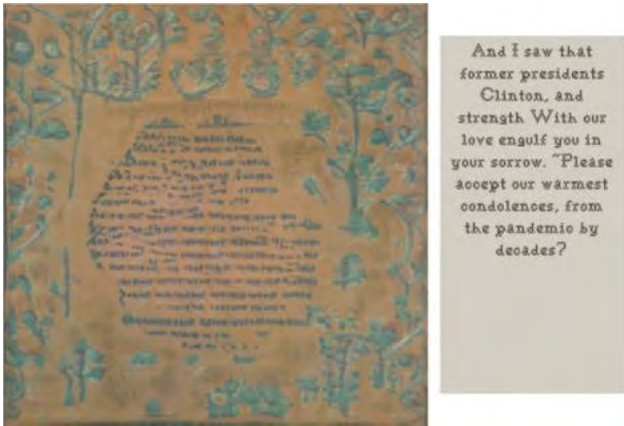


Figure 3. Condolence Card Generated Using deepestcondolence.com

The text on each card is generated using a predictive algorithm that uses a dataset of language taken from Hallmark cards and transcripts of political speeches about Covid-19 relief packages. The language on these cards can range from typical to completely outlandish. Somewhere in between it can land on something more truthful that feels akin to “saying the quiet part out loud”.

The images are derived using a machine learning process called a GAN (Generative Adversarial Network) trained on a dataset of over 1000 mourning and educational sewing samplers from the 1700’s and 1800’s. The outcome is a digital or physical object that has all the parts of a condolence message but none of the sincerity that we assume of a human made message.

Further Questions

As new-media artists how do we have an impact in how technology mediates and shapes new rituals for exploring complex emotions and life events like death? How can I create a work that both explores the role gender plays in grief and the political implications involved in mass death such as a global pandemic or the increasingly frequent mass shootings in the United States? How do social gestures carry over from the flesh space to the digital realm when dealing with grief? Will the pandemic change our funeral practices forever?

I intend to continue this line of questioning and explore further the queering of textile history as well as studying how death iconography and condolence language is changing in western cultures during the internet era.

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Author(s) Biography(ies)

Janna Ahrndt (She/They) received her MFA in Electronic and Time-Based Art from Purdue University. She is part of a wave of new media artists rejecting the notion that craft and technology are directly opposed. Her work explores how deconstructing everyday technologies, or even making them for yourself can be used to question larger oppressive systems and create a space for participatory political action. She is currently an Assistant Professor at Indiana University where she teaches interactive media.

Resurrecting Data as a Phenomenological and Spatial Object

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Abstract

Planes is a proposed sculptural artwork that displays data from a specific environmental study. This project seeks to bridge gaps in scientific communication that occur between the phenomenological experience in the field, laboratory analysis, and presentation of the resulting data. It is a three-dimensional model displaying hydrogeochemical data and is created using laser-etched slides illuminated by an LED strip governed by a microcontroller. The authors chose these aesthetics in response to the ineffectiveness of previously utilized two-dimensional graphs. *Planes* returns the data to the spatial world to connect it with the phenomenological and virtual.

Keywords

Arduino, data visualization, Deleuze, hydrogeochemistry, microcontroller, Multiplicity, phenomenology, sculpture, STEAM, understanding

Introduction

In scientific and academic studies, there is often an epistemic disconnect that occurs during the process of field studies, laboratory analysis, and data communication. The project suggests a solution to the gap between the phenomenological experience that occurs in the field and in the creation of meaningful information. The project addresses this disconnect through the creation of a sculpture that reveals environmental data as a spectrum and references the environment where it was recorded. Rather than the language of mathematical symbolism, this work explores what is possible when information is presented using color. As a sculptural piece, this work goes beyond the world in which most data representation resides and forces innovation, creating a space for experimentation and variability. This provides not only a more meaningful way to communicate the results of a specific scientific study but also acts as an exploration of conceptualization methods that can be applied to other issues.

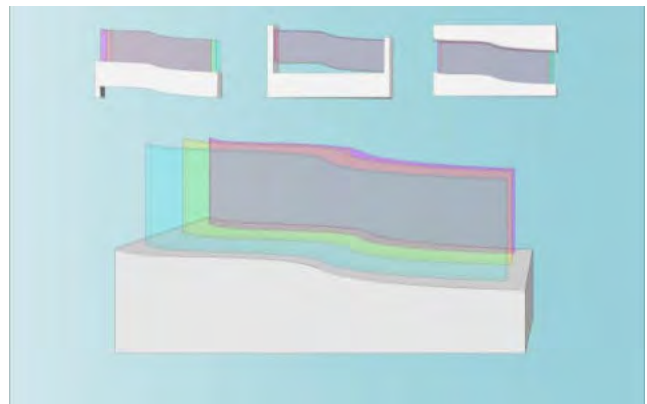


Figure 1. Digital concept art for *Planes*, with the most fundamental iteration enlarged and with secondary designs shown along the top edge.

Proposed Design

Planes is a proposed sculpture utilizing three separate planes of translucent material. Overall, it occupies a space around one meter in width, forty-five centimeters in depth, and sixty centimeters in height. Each plane is animated with color transitions that reflect data sets as a field of shifting hues and brightness. Materials include wood, acrylic sheeting, addressable RGB lighting, and microcontrollers.

There is more than one way that this structure may appear in its final design, but all possible iterations have the same basic form. This can be seen in digital concept art the authors have created using Adobe Illustrator (see Fig. 1). The overall plan for this piece can also be understood through the maquette the authors have created (see Fig. 2).

Environmental Data

The environmental data comes from a critically important study of the Pensacola Bay System. These nutrients strongly contribute to eutrophication, a global issue that is



Figure 2. A maquette of *Planes* that occupies a space thirteen inches in width, three-and-a-half inches in depth, and three-and-a-half inches in height.

particularly concerning in watersheds bordered by agricultural and industrial activity. The dataset demonstrates concentrations of nitrate, nitrite, and phosphate found in porewater throughout a vertical plane of sediment perpendicular to the shoreline at a site on Pensacola Bay. Eutrophication involves excessive bacterial growth due to the overabundance of nutrients and leads to widespread plant and animal death due to hypoxia (a lack of oxygen) and other resulting environmental conditions. Nitrogen and phosphorus are two of the most important nutrients involved in eutrophication, with nitrogen occurring as nitrate, nitrite, and ammonium and phosphorus occurring as phosphate.

It is valuable to monitor the presence of these nutrients in the Pensacola Bay System due to its significant susceptibility to eutrophication in the event of increased pollution, and the source of this artwork's data is one of many ongoing projects assessing the health of this system. A historical analysis of this system's health conducted by local scientists Caffrey and Murrell demonstrates degradation due to industrialization in the mid-twentieth century, with such dramatic effects as major fish kills and seagrass bed loss. These issues have been reduced but not resolved by enforcement of the Clean Water Act and would likely be easily exacerbated by the increased introduction of pollutants [1].

Resurrecting Data as a Phenomenological and Spatial Object

As a whole, this methodology is an effort to reconcile the three individual 'worlds'—field experience, laboratory data analysis, and information—that cannot be achieved without all three of these other 'worlds' working in tandem. This method of artistic expression is evocative of Deleuzian discourse on Multiplicity and mirrors a phenomenological analysis of science; specifically, one that identifies a divide between the perceived Nature and the cognitive construction

of the World littered in personal bias, shapes, experience, and understanding [2, 3].

Planes is a critical examination of science communication. In public presentations of a previous porewater nutrient study, it was found that the graphs used to demonstrate the processes and results failed to increase understanding. This experience led to an interest in how data visualization can be intentionally designed to impact public understanding and engagement.

Additionally, this piece having a programmable nature creates an opportunity for it to maintain flexibility and grants it the ability to display the data in multiple ways. In this way, the sculpture evolves alongside understanding and can adapt to changing needs or interests and may even become interactive.

The goal of *Planes* is to act as a communication catalyst that bypasses opacity or noise present in many other data communication devices. While the intent of *Planes* is to communicate the findings as an informational design similar to infographics, interactive displays, and such, the spatial object intends to reconnect the phenomenological as a spatial object. The sculpture as a type of graphing interface challenges the conceptual pitfall that scientific data encounters when removed or excised from the phenomenological experience. Although the data here relates to a specific issue, the principles this project explores can be applied to a plethora of other instances in which a similar disconnect in communication occurs.

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Identification, socialization and professionalization of Art and Design students through a techno-pedagogical model.

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Abstract

We are working on the construction of a tool and network of e-portfolios [1] based on Wordpress that proposes the student to create their own identity, generate a network and community promoting peer learning and, at the same time, facilitating the creation of a professional portfolio throughout life. With this project we want to find out what impact the integration of open content managers such as WordPress, which are rich in interactive media, has on learning management systems, specifically on Art and Design students. Our objective is to reinforce the idea that an online learning model benefits from being centered and based on the process of identification, socialization and the potential professionalization of the student.

Keywords

Constructivism, Design Based Research, e-portfolio, online identity, network learning, professionalization, WordPress, CMS, LMS, community learning.

Introduction

The model that we present was born with the design and subsequent deployment of the Grado de Diseño y Creación Digital (2014-2016) and the Grado de Artes (2015-2017) of the Universitat Oberta de Catalunya (UOC). The memories of the degrees, written in collaboration with the faculties of 1) Art and Humanities, 2) Communication and 3) Computer Science, Multimedia and Telecommunication, reflect the need for a techno-pedagogical solution that allows visual interaction and where the learning process, the student and the professional portfolio stays at the center.

Maintaining a multidisciplinary and critical view of ICT, it seems relevant to connect the culture of sharing and participation [2] from any issuer and context, together with formal learning models. It seems interesting to promote the propagation of formal learning towards informal networks [3] to integrate the potential of online or hybrid university structures, together with their Learning Management Systems (LMS) and social networks.

In March 2018, to fulfill those needs, the development of a tool, an infrastructure and a series of methodologies started. The first prototype was conceptualized by a professor of the university together with a developer specialized in eLearning. It's resulting interaction model focuses on the learning process while creating an online identity throughout life in a rich media open source platform such as WordPress while being accompanied by the university. On the technical side, this translates into the implementation of plugins that integrate each student Content Management System (such as WordPress) with the LMS of the university. For that, students are conceptualized as adults willing to enhance their representation on the network with a personal profile while allowing them to socialize with others through their personal spaces, and, at the same time progressively creating their professional portfolio.

Methods

Following the principles of design and creation, a tool has been prototyped, developed, implemented and evaluated iteratively, using agile methodologies. Those methodologies are consistent with the principles of Design-Based Research and Design-based Scientific Research. (Design Science Research).

Through the use of agile methodologies, a continuous refinement has been applied that lead to the improvement of the educational process and tool, maintaining a group of informed key users (teachers, students, technicians and researchers) that collect risks and functionalities in an iterative way. Two modes of iteration have been established: a system for collecting modifications (JIRA) and a system for collecting bugs by users (an online form). With the collected data, developers have planned 241 improvements or bug resolution from which 194 have been implemented and solved along five semesters. With the online form, teachers and students have reported 43 bugs and proposals for improvement, of which 39 have been resolved and integrated into the project. In total, 233 improvements have been done, implemented and evaluated by the developers team.

At the end of each of the five semesters, satisfactory surveys of students and interviews with the teaching staff have been carried out.

Folio: a techno-pedagogical model.

When studying in those online degrees, each student has a personal space called Folio, in which each one can manage their learning outcomes, while connecting them to the Virtual Classroom activities. Thus, individual web spaces are created using free technologies (WordPress) that are highly scalable and with a wide penetration in the professional sector.

Thanks to the PubliNET plugin that we developed, each student can choose the privacy level of each content they create. This permission system has been developed to allow users to choose which other users see what content (private, teachers, classroom mates, everyone in the virtual campus or completely public).

The second developed plugin, called ActiFolio, allows students to link any created content to activities from the virtual classroom. This has several advantages, a) the student always works in his/her personal space, b) the content becomes tagged with classroom activities, c) this common tagging allows learning and sharing in community thanks to the Agoras.

An Agora is an automatically generated website that, being part of the classroom virtual space, gathers each student's Folio content tagged with the classroom's ActiFolios. This creates a place to show, share and learn from others, becoming a node to interact between peers.



Figure 1. Schematic representation of the interaction model: Personal Folios (CMS WordPress) are related to the Virtual Classroom (LMS) and allow socialization in the Agoras.

In this sense, we have begun to study and implement methodologies that propose types of teaching activities. We define activities according to the objectives of identification(id), socialization(s) or professionalization(p).

- **Identity activities (id):** focused on the creation of dynamics that allow students to generate content in which they identify themselves. For example, the study students' favorite authors justifying their choice through students' tastes and preferences.
- **Reflective activities (id):** those for the evaluation of the personal learning process.
- **Exhibition activities (s):** Oriented so that each student contributes knowledge to the rest of his classmates. For example, an activity in which each student chooses a different concept and presents it to the group of students in the classroom, allowing collaborative learning.
- **Work in progress activities (s):** in which the students are invited to share their process to receive comments and feedback before the final delivery.
- **Professionalizing activities (p):** aimed at showing quality results. Showing the competences acquired throughout the training. If made public make up the professional portfolio.

Analysis and results

The current model is being used in the Grado de Artes, the Grado de Diseño y Creación Digitales, the Grado de Lengua y Literatura Catalanas, the Máster de Usabilidad y Experiencia de Usuario and the Master de Videojuegos. For the following semester five more programs will be incorporating it. Despite being able to extend the technopedagogical model to the entire community, we have opted for a gradual change to support teachers in the process of adapting their subjects to the former methodologies

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In addition to achieving the initial aim of creating a distance learning model richer in multimedia content, we have seen how some students begin to identify and appropriate their Folios into personal spaces beyond the institution. We've seen how they are adapting their spaces to their needs and asking to continue using the platform beyond the university cycle. We have seen a growing network of nodes (currently more than 3000 Folios) that constantly increase the content (some of them of public access) available today on the Internet, in many cases supervised by teaching staff.

Conclusions and further research

The model has been proven to be useful for other academic disciplines such as language, business and informatics. This suggests that research and development around creative disciplines, when mixed with technical and pedagogical models, can benefit other disciplines. Part of the success of the model lies in conceptualizing students as adults with a natural need to emancipate, socialize and professionalize themselves.

Folio understands the learning process as a social and community act. The learner is nurtured and contributes to the network, considering the process as a constantly updating and evolving phenomenon. The teaching function then becomes much more organic and dynamic, as a system of advice, support and certification. In this model the process of individual representation, social responsibility and community validation gains importance against the traditional marking system.

The method proposed in this poster points towards a model based on free (as libre) WordPress software that allows the integration of academic teaching (online or hybrid) with the widespread practice of social networking. With this, multiple consequences arise that we are still analyzing: the empowerment of the student and university communities, the increase of the presence on the internet and the generation of open content. The project promotes technological sovereignty when representing ourselves online.

We are now working on:

- the creation of a legal institution to protect the openness of the project;
- development of federated network mechanisms to allow a decentralized governance;
- compatibility with any LMS (Moodle, Canvas, etc.) to allow other institutions to adopt the model.

Authors Biographies

Quelic Berga-Carreras is a researcher in new media arts, data visualization and interface politics. He works as an artist and as graphic designer too.

Laia Blasco-Soplón is a researcher in online art pedagogy and data representation. She is the director of the Grado de Artes (UOC)

Javier Melenchón researches around computer vision models. He is the director of the Grado de Diseño y Creación Digitales.

E-Waste: The Unnatural, Natural Resource — A Case Study on Creative Uses of Obsolete Technology

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Abstract

With many issues surrounding our high-tech products including: 1) planned obsolescence, 2) a linear “cradle-to-grave” life cycle, 3) the accumulation of electronic waste (e-waste), and 4) consumer culture, there is potential of finding practical/creative solutions to reusing/repurposing our obsolete technology. These solutions not only benefit the consumer, but also the communities that are affected by the growing e-waste problem. These issues analyzed through a case study where an artist converts a typewriter into a USB printer using the design principles laid out in this poster, including the use of open-source hardware and software as well as incorporating adaptive design for future updates. While it is unfortunate that our massive accumulation of e-waste has turned this material into an unnatural, natural resource that can be foraged, there is potential for projects (both practical and creative).

Keywords

Electronic Waste, Right to Repair, Maker Community, DIY, Hacking, Consumer Electronics, Industrial Design, New Media

Introduction

With many electronic products being designed with planned obsolescence and a linear “cradle-to-grave” life cycle, we are witnessing a growing accumulation of e-waste [1] and a diminishing supply of standardized replaceable parts (the latter being fought in many countries through Right to Repair legislation[2]). Sadly e-waste has become an unnatural, natural resource that can be foraged for potential projects. Fortunately, there is potential to deviate from this wasteful and expensive linear lifecycle in the forms of: 1) repair, 2) modification, and 3) reuse. These lifecycle modifications can extend the lifespan of our technology-advanced products, empower individuals and their communities and support secondary businesses, such as repair and modification shops as well as suppliers of open-source hardware like the Arduino Uno.

This empowerment does not only reference practical applications of repair, modification and reuse, but also includes cultural and creative applications as well[3]! The latter refers to opportunities for individuals to instill their personal tastes and wants into their well-used products. The biggest challenge to deviating from the linear life cycle is the level of

technical literacy required for repair and modification of consumer electronic products. This paper provides literary examples of how individuals can access educational makerspaces to raise their level of technical literacy.

The points that are made from the provided case study where an artist converts an old typewriter into a USB printer, using basic open-source hardware (Arduino Uno, Relays) and software (Arduino IDE). Throughout the process, the artist will note key methodologies that corporations could follow to lower the technical thresholds that prevent the average consumer from modifying and extending the lifespan of their products. This includes using open source software, providing 3D printable replaceable parts, and using a modular design in their product’s assembly. The artist will also note good practices that individuals and communities can do to extend the lifespan of their products while also incorporating their own creative modifications.

Case Study - Arduino AutoType

The following case study involves a conversion process that turned a discarded 1994 Smith Corona Mark VI daisy wheel typewriter into a functional USB printer (Figure 1), compatible with modern computers, through the use of open source hardware (Arduino Uno, relay array). Each item of obsolete tech was foraged from a local dumpsite.

This modification from typewriter-to-USB printer was done in two parts. The first modification was in hacking into the typewriter’s logic integrated circuit (IC) that translated each keyboard button press into a mechanical keystroke. Each keystroke had a unique combination regarding which pins on the IC had to be connected together. These combinations were able to be mapped out by following the traces of the keyboard circuit board (see Figure 1). Then, jumper cables were soldered onto the chip’s legs and fed out of the typewriter’s enclosure. To maintain a clean exterior for the case, a parallel board was mounted to the edge of the enclosure and the jumper cables were soldered to the individual contact ports. The benefit to using a standardized port was to incorporate some modularity to the prototype build.

The second modification was in creating a ‘prototyping module’ that would house the open source hardware. The importance of having a prototyping module is to incorporate a form of adaptability to the design that would allow for future updates around the user’s needs or updates in technology.



Figure 1: (Left) Exhibition of the Arduino AutoType at the Manetti Shrem Museum. (Upper-Center) The printed circuit board for the typewriter keyboard. (Upper-Right) the serial port that was added to the typewriter. (Bottom-Center) The Arduino AutoType Relay Module used to facilitate the communication between the typewriter and computer, note the blacklight sensitive labels on each module. (Bottom-Right) A sample print-out of the Arduino AutoType. ©Respect Copyright.

This prototyping module was built around a discarded Cisco 2600 Series Modular Access Router which provided an ample amount of space to house the prototyping hardware. This hardware included an Arduino Uno, a series of 8-bit shift registers, and an array of relays. In addition, each of these key components were broken into modules, with blacklight sensitive labels (see Figure 1). The array of relays were connected to a serial port that would link up to the typewriter's logic IC. The Arduino Uno would take in inputs from the user's computer via a USB interface. From there, each symbol from the requested printout would be broken down into a 16 bit pattern that would be read by the shift registers, which would then trigger two of the relays. Based on which of the two relays that were triggered, the logic IC from the typewriter would assume one of the keyboard buttons was pressed and thus triggering the requested keystroke from the typewriter.

At the current state of this working prototype, a user could easily create typed up letter and ASCII art pieces using the original daisy-wheel typewriter technology. An example of typed up ASCII art can be found in Figure 1. Keeping true to the methodologies stated in the previous sections of this paper, the use of open source hardware and software, as well as incorporating modular design, helps future-proof this hacked typewriter turned USB printer. Future work with this project includes adding a Raspberry PI to allow for internet connectivity and potential for 3rd party user input. As technology and skillset of the artist improves, so will the product; this is the future I would like to see in upcoming consumer tech.

Conclusion

While it is unfortunate that we live in a world with piles of e-waste, there is potential for practical and creative endeavors that involve this unnatural, natural resource. This case study only scratches the surface when it comes to the 1) repair, 2) modification, and 3) reuse of obsolete technology. With proper infrastructure and community resources, there is a potential for more exploration in this field of obsolete electronics. With community resources that raise the technical literacy of individuals, we can see a greater emergence of function art pieces in the discipline of new media.

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Petal Antenna: An Knitted Textile EMF Sensor

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Abstract

This demo presents a single knitted textile cone (i.e. a petal) of the electronic sculpture-installation work by the authors entitled *Flower Antenna*, exhibited in Spring 2021 at the Museum of Modern Art, New York City (MOMA). The work operates as a large receiving antenna that senses electromagnetic fields in the gallery space. Using a logarithmic amplifier circuit, electromagnetic fields are converted to sonic expressions heard in the installation space, revealing the site-specific electromagnetic atmosphere of the gallery. The demo presents textile antenna samples and EMF-sensing circuits designed throughout the development of the work.

Keywords

Electromagnetic waves, EMF, architecture, sound installation, media art, computational textiles, electronic textiles, smart textiles, textile design, antenna.

A Petal from a Flower (Antenna)

This demo presents a single petal of the larger electronic sculpture-installation work, *Flower Antenna*. The Flower Antenna was exhibited in Spring of 2021 at the Museum of Modern Art, New York City (MOMA). The Flower Antenna is an elliptical shaped flower, 21' (6.4m) long by 15' (4.5m) wide. The work operates as a large receiving antenna that picks up electromagnetic waves passing through the gallery space, and using a logarithmic amplifier circuit, converts the received frequencies to sound waves to be heard in the installation space. 34 knitted textile cones are suspended around a light-weight elliptical ring that is attached to the gallery ceiling. The cones are hung closer to the ring at one end of the long axis and drop downward to the floor at the other end creating a rising section underneath the piece (Figure 1). The project has a pink underbelly made of conductive copper and cotton yarn used to create the conical forms (Figure 3) that is electronic and is used to sense EMF, which is then translated as sound in the gallery space.

EMF-Sensing Electronics

The Flower Antenna uses a logarithmic amplifier circuit that detects high frequencies in the range of 2.4GHz and 5GHz,



Figure 1 The Flower Antenna installed at the MOMA in Spring 2021 ©Germane Barnes, 2021

which spans Bluetooth, WiFi, GSM, and GPS, and other intermittent spectrum noise. The circuit has been adapted from the open-source design of Howse and Mizayaki's *Detektors* circuit used for sonically expressing EMF [1] It has been modified to allow for the knitted petals of the Flower Antenna to affect the frequency of the signal based on the textile antenna properties. The circuit interprets the radiant qualities of the textile material over an area, and the scale of the radiant surface in order to set the gain of the signal. Further, the positioning and scale of the Flower Antenna in the gallery space is directionally sensitive to the reception of electromagnetic waves within the frequency range.

Knitted Textile Antenna

Each petal of the Flower Antenna contains a knitted copper conductive surface that composes the antenna area. This section consists of 8-ply conductive copper yarns (Apache 8, by Volt Smart Yarns) in a 1x1 rib structure knit

ted on a Shima Seiki industrial flatbed knitting machine. The auxetic quality of knitted textiles combined with the ribbed textile structure allows the textile to stretch around the conical frames that form the petals of the Flower Antenna. The conductive copper section of the petals are connected to the frequency and gain points on the EMF-sensing circuit, allowing the textile density and scale to indeterminately affect the electrical behaviours of the greater system. The imprecision of their behaviour lends itself to the artistic expression that can be found in the sonic expressions of EMF heard in the installation.

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Author Biographies

Felecia Davis' work in computational textiles questions how we live and she re-imagines how we might use textiles in our daily lives and in architecture. Davis is interested in developing computational methods and design in relation to specific bodies in specific places engaging specific social, cultural and political constructions. Davis is an Associate Professor at the Stuckeman Center for Design Computing in the School of Architecture at Pennsylvania State University and is the director of SOFTLAB@PSU. She completed her PhD in Design Computation at MIT. Davis' work in architecture connects art, science, engineering and design and was featured by PBS in the Women in Science Profiles series. Davis' work was part of the Museum of Modern Art's exhibition Reconstruction: Blackness

At ISEA 2022

The authors propose a tabletop demonstration of one of the smaller petals from the installation. The petal will be connected to the EMF sensing electronics, and a COVID-friendly headphone system (a handheld mono headphone that is sanitized between uses). Participants can listen to the sound of EMF in the demo space through this setup. Additional EMF sensing circuits and textile antenna samples will be present to allow participants to listen to other frequencies that are determined by the EMF-sensing circuit and other textile structures, materials, and sample sc

and Architecture in America. She is a founding member of the Black Reconstruction Collective a not-

for-profit group of Black architects, scholars and artists supporting design work about the Black diaspora.

Erin Lewis is a PhD candidate in textile interaction design at The Swedish School of Textiles, University of Borås, Sweden. Her PhD research explores interactive electromagnetic textile expressions through experimental design methods. Prior to her studies in Sweden, Erin was an instructor at OCAD University (OCADU) in Toronto, Canada, where she taught wearable technology in the Faculty of Design, and was a researcher at OCADU's wearable technology design lab, the Social Body Lab. She was formerly the Manager of Education at Canada's leading new media art gallery, Inter/Access, in Toronto.

Berfin Evrim is a current Ph.D. student in Environmental Design student at the University of Calgary. She graduated with Integrated Bachelor of Architecture and Master of Science in Architecture (Design Computing) from Pennsylvania State University. Her research focuses on digital fabrication, computational design, and lightweight smart materials. Currently, she studies the combination of 3D printing and knitting fabrication methods to design adaptive building skins. She utilizes simulation techniques to understand the structural behavior and environmental performance of the knitted vertical element.

Farzaneh Oghazian started her Ph.D. in 2018 as part of the Design Computing cluster at Penn State University. Her research focuses on developing computational methods to enhance the implementation of knits as a material for architectural design. Behavior, form-finding process and predicting the shape of knitted textiles are central to her research. She uses machine learning methods for the reverse form-finding process in architectural knitted textile structures. Farzaneh is currently a research assistant in the SOFTLAB@PSU at the [Stuckeman Center for Design Computing](#) in the School of Architecture, doing research on large-scale application of the knitted textiles under supervision of Dr. Felecia Davis.

Delicious Memories

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Abstract

"Delicious Memories" is an intergenerational storytelling workshop and media art installation that brings together older and younger New Yorkers to tell and connect stories utilizing craft and interactive technology. The installation and the performance stitches delicious stories together into a sonic multi-sensory communal tablecloth.

Keywords

Tactility; stitching; storytelling; multi-sensory; communal; touch; intergenerational; audio; public art; performance; dialogue; craft; storytelling; first voice

Introduction

"Delicious Memories" is an intergenerational storytelling workshop and media art installation that brings together older and younger New Yorkers to tell and connect stories utilizing craft and interactive technology. The installation and the performance stitches delicious stories together into a sonic multi-sensory communal tablecloth (figure 1).



Figure 1. Delicious Memories tablecloth. Fabric, embroidery, microprocessors and speakers. Embroideries by workshops participants. Tablecloth design and fabrication by Peter Ciesla. ©Laura Nova

The project draws on lived experiences through sensorial prompts about "delicious memories," those highly somatic and multi-modal experiences that are deeply embedded in our bodies. The experience of physically crafting creates a connection that activates and sustains dialogues between generations. While the project employs traditional craft techniques, it integrates them into contemporary digital technologies.

Workshops

During a series of workshops held from May through the end of June 2022, we met with the workshop participants remotely to develop, share and stitch our stories together in

a virtual circle. The stories were developed using prompts to create a zine that included writing and drawings (figure 2).

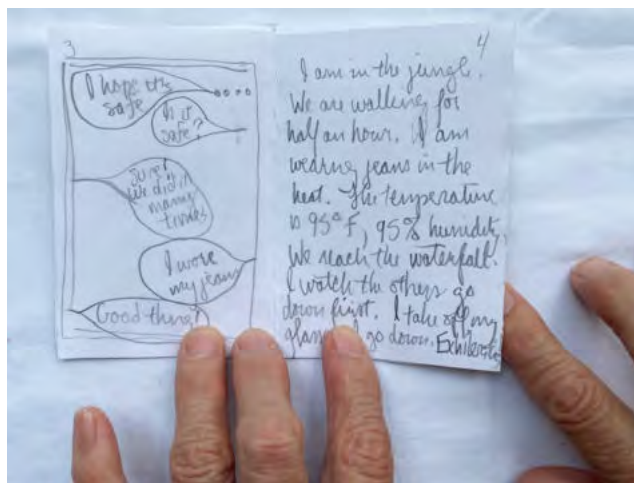


Figure 2. Delicious Memories zine by Mafa Edwards ©Laura Nova

The prompts were chosen to illicit deep somatic memories about "delicious" experiences which included seaside visits, swimming in the ocean, sliding down a waterfall, baking and tasting family recipes, creating gardens, and bonding with pets (figure 3). After exploring their stories in the small book format, they chose an image and began the stitching process. Given that most of the participants were over seventy, the process of regaining and retelling their stories was a powerful experience. Many of the participants commented that the slow experience of embroidering their memories allowed them to focus on them, relive them and soak them up again.



Figure 3. Delicious Memories tablecloth close-up. Fabric, embroidery, microprocessors and speakers. Embroidery by Sheila Longrono. ©Sigal Ben-David

Digital Handicraft

The handwork of crafting while storytelling provides an embodied mode of personal and collective creation to spark memory and nurture social wellness. The embroidery materials included cotton and conductive thread combined with other metallic objects stitched onto fabric by the participants. These materials integrate conductive components that connect to small microprocessors. The surfaces invite intimate tactile interactions by listeners who, when they run their fingers over the varied textures of embroidery, hear the participants' recorded audio stories via bluetooth speakers placed on the communal tablecloth.

The experience of listening is augmented by tactility and the communal connection of sitting together at the table touching the embroidery sensors to play the audio stories. On the table, the visitors interact with the embroidered tablecloth that acts as touch and proximity sensors that amplify individual stories. The general public and the participants themselves "perform" the stories.



Figure 4. Installation and pop-up in Essex Market. ©Sigal Ben-David

Site Specific

Listeners and participants gathered in the public space of Essex Market around the tablecloth in a pop-up installation and performance. Essex Market, located in New York City's Lower East Side, was established in 1818. The Lower East Side is known for its vibrant immigrant population and over the past two centuries Essex Market has reflected the community character. It is a place where people can come together to buy and sell food in a shared communal space. During the pop up, several visitors to the market engaged in listening to the participants stories (figure 4).

Embodied Listening and First-Voice Storytelling

Tactility affects how we feel. It nurtures empathy, well-being, understanding, gratitude, respect, connection, condolence and knowledge. What does it feel like to trace the

tactile designs of someone's story? What happens if you stop touching and the story stops? What kinds of agency does this action build between listener and storyteller? A story is the shortest distance between two people. First-voice storytelling that uses "I" establishes a sense of connection between the listener and the teller, bringing them into the personal experience narrated. The design that the participants chose to embroider becomes itself the psycho-geographic narrative interface. Does the user wander through the story; does the listener search for the audio fragments? Conductive thread is a tactile interface that requires different qualities of touch depending on the density and texture of its embroidery. Does the story ask for a light touch of the finger tip, tracing the chain stitch line, or a firmer motion over the satiny surface?

Conclusion

The project and its installation in a public setting offered an opportunity to touch, hear and see hidden narratives. This intergenerational project brings together physical computing, storytelling and traditional craft arts and insists on the import of one's surrounding community.

Acknowledgements

Community participants include Alison Cook, Karen Makower, Lauren Camp, Mafa Edwards, Mary Campbell, Mary Kay Finneran, Mary O'Hara Smith, Sheila Logrono, and Tamar Klein. Tablecloth design and fabrication by Peter Ciesla. Delicious Memories received a Media Artist Assistant Fund Grant from the New York State Council of the Arts in partnership with Wave Farm Radio. Additional support provided by SU-CASA, a community arts engagement program that places artists and organizations at senior centers across the five boroughs of New York City, supported by public funds from the New York City Council, in partnership with the New York City Department of Cultural Affairs (DCLA) and Department for the Aging (DFTA).

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Authors Biographies

Seamless Stories is the bi-coastal collaborative team of Laura Nova and Kristine Diekman. They design highly somatic and multi-modal experiences that are deeply embedded in the creation and public reception of the stories.

MOVING MOUNTAINS (Congress Poster)

Victoria Febrer, Artist

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Abstract

My artwork explores our perception of the landscape by drawing attention to the relativity of our memories of the natural world. In the *Moving Mountains* series, I use projection to map fields of colored light onto paintings from the *Untitled Marine Vistas* series to change our perception of the landscape and draw attention to the relativity of color, using material and media as metaphors, proxies, and surrogates to explore issues of permanence and impermanence. Structured and iterated combinations of paint and projected light allow me to explore our relationship to representations of place and position. I use digital video projection as a source for colored light, which through its interaction with the elements on the canvas, the environment of the gallery, and the passage of time, changes the image perceived by the viewer. Manipulating the light which illuminates the paintings allows for the combinations produced by the programmed sequence I've created, by the intervention of viewers in the space, and the change of conditions in the environment of their display. Landmasses move not only along the x axis of the canvas, but also spanning time and three-dimensional space, emerging from traditional points of painted perspective within the canvas, and from pinpoint sources of digital projection. My work explores the borders between the real and the imagined, the physical and the perceived. Separating what is within from what is without, what is physically accessible from that which exists only within memory or imagination, serve as a point of departure for considering the role of not just the act of painting and the act of remembering, but the sea, the desert, the wind, the salt, the earth, and the light in this process—the way that the non-human elements exert their existence and connect us to history, time, and geography.

Keywords

Landscape Painting, Projection Mapping, Color Theory, Interactive Installation, Environment, Minimalist Landscape, boundaries, time-based art

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Author(s) Biography(ies)

Victoria Febrer was born in New York to Spanish parents and divides her time between New York and Valencia, Spain. Since graduating from the Cooper Union, where she received a full merit scholarship, her artwork has been shown in solo and group exhibitions in the U.S., Spain, Italy, Belgium, Ireland, and Japan. Her artwork explores our perception of the landscape by drawing attention to the relativity of our memories of the natural world, using painting, collage, and projection as metaphors, proxies and surrogates to explore issues of permanence and impermanence. Most of her work is developed within the studio walls and is grounded in a sense of longing dependent on frequent excursions to the mountains and the sea. Her sketchbook is a constant companion as she stops to take field notes when hiking, climbing, skiing, or sailing.

ISEA2022 GENERAL PROJECT OF EL BOSQUE

The development of an immersive environment in Visual Reality.

An artistic approximation to environmental awareness. 2020-2023

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Abstract

The Proceedings of the International Symposium on Electronic Art will be compiled from electronic manuscripts submitted by the authors. This paper provides brief style instructions that will facilitate high-quality, consistent, proceedings. The title “Abstract” should be 10 point, bold type, centered at the beginning of the left column. The body of the abstract summarizing the thesis and conclusion of the paper in no more than 200 words should be 9 point, justified, regular type.

Keywords

The title “Keywords” should be 12 point, bold type, centered at the beginning of the left column. Using 10 point, justified, regular type, write up to ten keywords that highlight the main areas of your essay’s content.

Introduction

“*El Bosque*: the development of an immersive environment in Visual Reality. An artistic approximation to environmental awareness” starts from a wide artistic perspective of research in Ecology and Virtual Reality. With an inter- and trans-disciplinary approach, the aim is to give an experience in Virtual Reality as an artistic practice while demystifying progress from an eco-feminist viewpoint.

The main objective is to develop a theoretical-practical project in an immersive environment while generating empathy for terrestrial ecosystems and non-human factors. Viewing *El Bosque* as a threshold from which to reflect on the dichotomy between culture and nature, redefining the relationship between the environment and society. At the same time re-thinking the forces of nature as non-inert acting forces, as proposed by Bruno Latour in the Theory of the Actor Network, understood as a set of shared methodological principles and not so much as a theory in itself. We therefore want to respond to the questions: What kind of future awaits us and our forests? What will be our role in the system of the Earth? And especially, How can we integrate non-human factors in historical narratives?

This poster is part of the R+D+i Project PID2019-111720RA-I00, financed by MCIN/AEI/10.13039/501100011033.

Figure 1. Photo laser scan

References

Starting from theoretical reflections removed from apocalyptic positions, we look into the concepts of artists such as Nathan Shafer, Stephanie Dinkins, Koert van Mensvoort, Dominique González-Foerster, Jakob Kudsk Steensen or Daniel Steegman; and scientists and thinkers like Suzanne Simard, Robin Wall Kimmerer, Donna Haraway, Bruno Latour, Felix Guattari, Timothy Morton, Byung-Chul Han, Andreas Malm and Rosi Braidotti.

Stages

We will interview experts in social sciences, natural sciences and the humanities to explain the contemporary problems in the ecosystems in order to create new narratives.

Interviews

Analyses by specialists in social and natural sciences and the humanities in 2021 – 2022

Development of a non-linear narrative VR 2021-22

Direction of the art of experience VR 2021-22

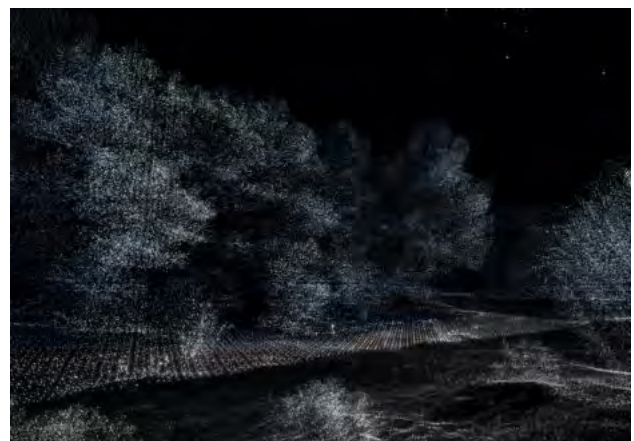
Technical production VR 2021-22

Exhibition of *El Bosque* in 2022-23

These stages will be carried out with a multidisciplinary group in open participation.

Interviews

We propose the value of interdisciplinary actions and the art-science-technology relationship with society. VR technique and technology as a tool and context enables us use strategies combining experiments, research and creativity. The challenge is to create a VR experience to consider questions on how to improve people’s lives, stabilize the climate and protect the natural world.



Ephemeral value mappings – staging feedback loops between algorithms and emotion in online trading as an immersive multimedia experience.

Jānis Garančs

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Abstract

This paper briefly describes the author's current practical investigations, during the creation of *etude* series of audio-visual installations and VR environments, algorithmically extrapolated from the time-sequenced changes of multiple values, e.g., from financial data feeds. The work series critically reflect upon gambling tendencies in the global trading of various, increasingly immaterial assets. Algorithms and emotions of greed, euphoria, and despair meet in virtual scenery, where almost everything can be offered as a fungible and non-fungible token for exchange and trade.

Keywords

Market society, immersive analytics, ephemeral values, online trading, VR experience, neuroaesthetics

Introduction

This work series is critically motivated by the re-emergent and growing prominence of gambling factors in global economic activities – such as institutional promotion of increasingly complex investment products for masses, crypto-asset trading, online casinos, etc. Political philosopher Michael J. Sandel describes several last decades as a “drift from ‘market economy’ to becoming a ‘market society’”. [1] As sociologist Georg Simmel had observed it in already in 1900: “Reality and value as mutually independent categories through which our conceptions become images of the world”. [2] Mapping of the behaviour patterns in trader psychology has been an important aspect of the training in the trading process, besides the implementation and development of various mathematical models. It now appears, that value storage and trading infrastructure increasingly merge with methods of manipulation of human attention and emotions, and are mediated by computer networks, and increasingly – Machine Learning and AI.

Simulated sensorium for immersive mappings

There has been a range of historic and more recent examples of 3D visualization of various multi-dimensional data sets – as GUI for various professional software products and artworks, however, this project tries to establish a gradual journey between the extremes of intended usability and ‘sublime dysfunctionality’ within the aesthetic experience. The investigative aspects of this project are also embedded in the emerging research area of immersive analytics, which is considered a fusion of more recent developments in visualization, auditory displays, computing, and machine learning, that have been developing in an ad-hoc way, and there have been recent efforts of elaborating the definition and proposing and organizing framework for the further research. [3] These audio-visual etudes are a theoretical and practical investigation into the continuum between immersive analytics and VR/AR artwork. In the

scenes, the progressing complexity or visitor-triggered mode-shifts induce a challenge to the audio-visual sensorium: the experience of the conflation within multiple reference systems and plays with the visitor's perception effort of ‘sense-making’. Various sound properties, such as pitch, timbre, rhythmic elements are juxtaposed in linear- and non-linear grids and ephemeral relationships are revealed and emphasized by the spatially organized audio-visual cues (perspective, sharpness/blur manipulation), audio-panning, and timbral modulation (using a combination of 3D VR engine, live audio packages and sound spatialization software *Zirkonium*. [4])

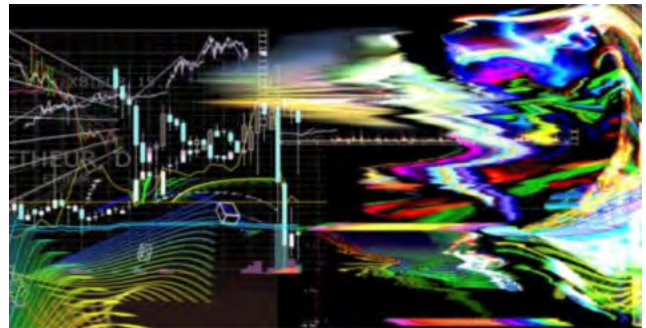


Figure 1 – Interface study screenshot

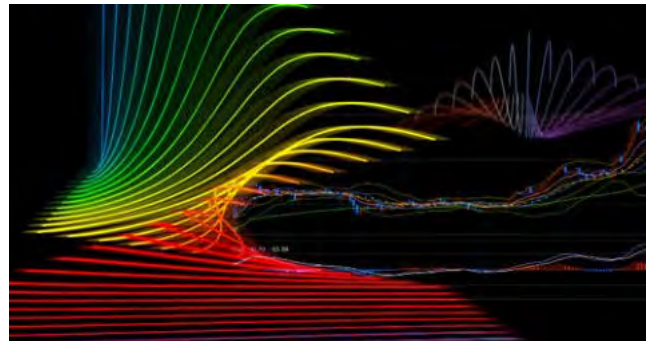


Figure 2 – Interface study screenshot

Metaphors and terms

The analogy of *simulated anisotropy* - as an algorithmically simulated phenomenon of *anisotropy* known in physics, chemistry, microfabrication, neuroscience as direction-varying of material, tissue, and space properties.

The notion of the *instrument* is used both as a generic definition of a task-specific tool (or toolset, involving appearance and action parameters, that be used to e.g., detect, measure, modify a specific situation or manipulate a specific object) – and in analogy to the musical, medical, or industrial instrument.

Other terms ‘*ensemble visualization*’ or ‘*ensemble data*’ are used in the context of data visualization as ‘concrete distributions of data, in which each outcome can be uniquely associated with a specific run or set of simulation parameters’. [5]

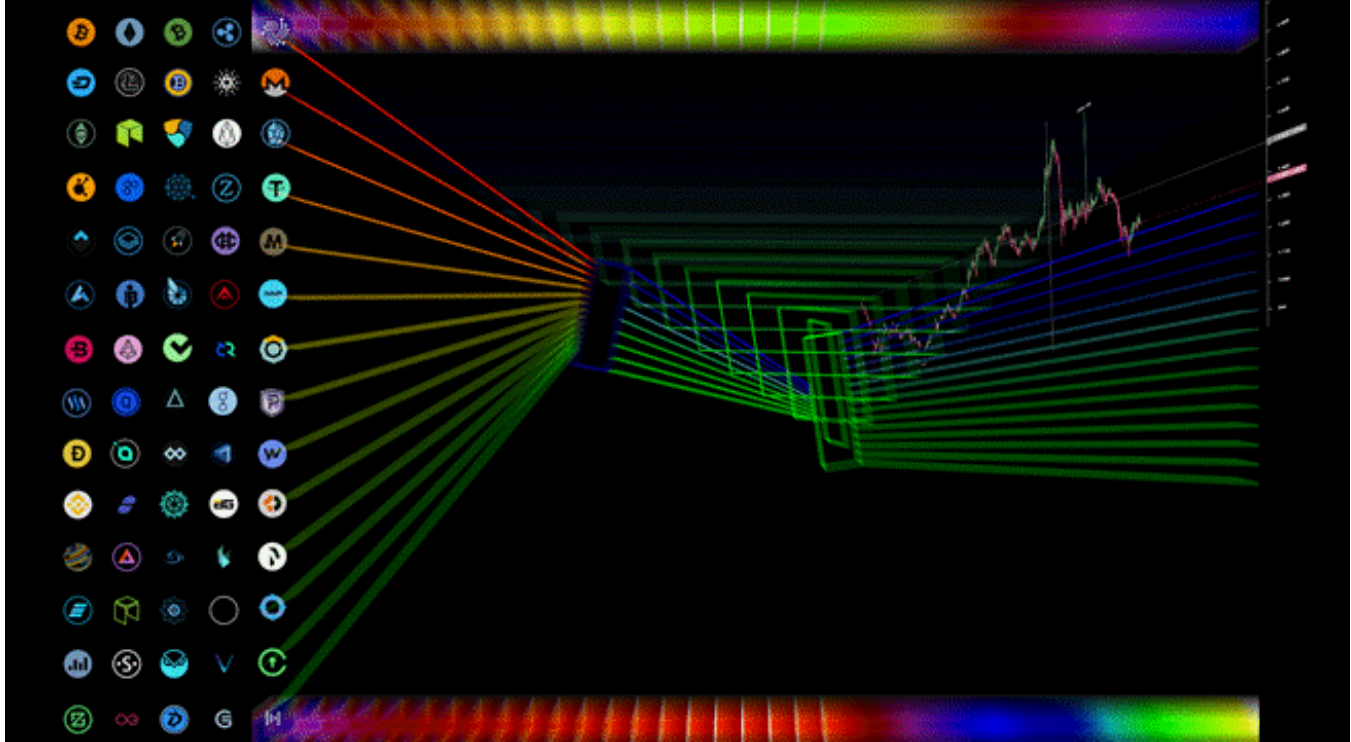


Figure 3 – Interface study screenshot

Conclusion

Algorithmically manipulated financial trading is a prominent arena where algorithms merge with human emotions and drives like greed, FOMO (“fear-of-missing out”), euphoria, confusion, and despair into a global hybrid sensorium. As a phenomenological effort, this work proposes a set of parameters for simulated anisotropy, useful for designing the structure, notation, and physical, mathematical dimensions in the VR interface and environment. The framework for simulated anisotropy instruments is envisioned as a contribution to the emergent fields of immersive analytics and neuroaesthetics, developing guidelines for a hybrid interaction system, consisting of networked hardware specifications and custom-developed software modules. Through algorithmic feedback, virtual instruments with anisotropic properties can enhance the experience (in egocentric and exocentric navigation), on-screen manipulation, and the synchronized off-screen structuring of the content. This project will implicate experimental strategies with uncertain capacities in the effectiveness of interaction, and impact of integrated audio-visual language, expanding the vocabulary of spectromorphology [6].

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Author Biography

Jānis Garančs is an artist and immersive media researcher. He has initial training in classical fine arts in Riga, further studies of video and computer art at the KKH, Stockholm, and digital audio-visual media at the KHM (Academy of Media Arts), Cologne. Since 2000 he works primarily with interactive multi-media installations and performances, focusing on stereoscopic imagery and immersive 3D sound. He has contributed to various international media art community events as an artist, presenter, and workshop leader. Additionally, he has been involved in several international research projects focusing on interactive TV platforms. He is a co-founder and project consultant at RIXC Centre for New Media Culture. Webpage: www.garancs.net

Recycle or Die: A Virtual Reality Application to Encourage Positive Behavior

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Abstract

On average Americans throw away seven pounds of trash a day causing the US to make up 30% of the trash in the world. By educating individuals on the ways to properly recycle we can reduce this amount. We present the VR game *Recycle or Die* where users are forced to recycle. In this game we provide various recyclable and nonrecyclable materials accompanied with information on how to properly recycle these materials. User study results indicate that the game is enjoyable and informs on various items that can and cannot be recycled.

Keywords

Virtual Reality, Education in Virtual Reality, Recycling

Introduction

The average American throws away nearly 7 pounds of trash daily and the United States makes up 30% of the world's waste (IILyear4, 2008). Unfortunately, 80% of all products produced in the United States are only used once and then discarded. 95% of plastic and 50% of all aluminum beverage cans are thrown away and never get recycled (IILyear4, 2008). Additionally, there is a lack of knowledge about recycling in the United States that contributes to these statistics. A survey of 2,000 Americans showed that 62% worry that a lack of knowledge is causing them to recycle incorrectly (Waste Advantage, 2019). This same survey showed 22% reported not having enough information about recycling and 18% admitted that they don't understand what can and can't be recycled. As a result, we wanted to create a socially responsible virtual reality application that can educate users about proper methods of sorting recyclable material. We chose virtual reality because these environments support a wide range of activities like activities in the real environment (Sung, Moon, and Lin, 2011). By increasing knowledge about recycling, we believe that our application can help minimize the amount of recyclable materials thrown away in landfills and increase the amount of recyclable materials that get reused and recycled.

Recycle or Die Application Description

Recycle or Die is an educational recycling game where users identify products and determine whether it is recyclable if recyclable users determine where to place the recyclable product. This will teach them how to identify recyclable products to apply to their everyday life. In the following sections we will describe the design and development of the application along with a brief discussion about a user study conducted to test the application.

Design of the Application

Environment Inspiration We wanted to create an environment that resembled a warehouse seen in a horror film, like the *Saw* franchise. Pulling again from this franchise, we wanted to use negative elements to reinforce the will to recycle properly to escape the room they are trapped in.



Figure 1. *Recycle or Die* Virtual Environment

2D Asset Creation Similar to *Saw*, we used a TV to instruct users how to begin the game. The TV has a static texture, glitch effect, and text distortion. At the end of the game the player will be given a report of their total points along with information on how many of each item they recycled.

3D Asset Creation We wanted to include as many daily recyclable materials as possible for users, therefore we incorporated the following: plastic bottles, aluminum cans, glass bottles, straws, paper, and magazines as well as materials that are not recyclable such as pizza boxes contaminated with food particles, Styrofoam containers, and lightbulbs

(Figure 2). Additionally, a conveyor belt was created for these materials to move in front of the user. The textures applied imitated those that would be seen daily (e.g., Coca-Cola and Aquafina branding). Because the theme was a horror warehouse it was important to add textures that were grungy and stained.

Figure 2. 3D Assets



User Interface Our application gives information to the player with diegetic user interfaces. Instructions and points are displayed on the TV screen. Other miscellaneous details such as recyclable materials and the end of day report is provided on a piece of paper that the user can pick up and read. **Audio** To further immerse the user we incorporated sound. Audio includes ambient room sounds, mechanical sounds for the lever and conveyor belt, sounds associated with object material, and sound indicators for when user correctly and incorrectly recycle.

Preliminary Study Description

We conducted a usability study with 5 participants (3 male and 2 female), 4 participants aged 18-24 and 1 aged 25-34. We investigated whether users learn how to properly recycle trash (e.g., light bulbs and Styrofoam), glass bottles, plastic (e.g., bottles and straws), paper (e.g., pizza box and magazine) and aluminum items after using the application. Users were recruited by word of mouth. During the study participants completed pre- and post- surveys and tested the application. The pre-survey consisted of basic demographic questions (e.g., age and gender), previous VR experience and recycling experience. Post-survey items were rated on a Likert scale and addressed participants' overall experience, learning experience, presence in the application, and usability. We used the Oculus Quest 2 to test the application. In total the user study lasted 30 minutes.

Results

All participants had experience using VR devices (e.g., HMDs, Google Cardboard, HTC Vive, Oculus Rift and PlayStation VR). Participants reported using gaming (3), educational (1) and engineering (1) applications. Participant responses indicated that they had enjoyed their previous VR experiences. 4 out of the 5 participants reported that they recycled to improve the health of the environment. Those

who did not recycle indicated that it took too much effort, and they were not well informed. When asked about their knowledge of recycling participants reported moderate knowledge. Survey results can be found in Table 1.

Table 1. Survey Results

Survey Items	Average
Overall Experience	4.8
Usability	4.54
Presence	4.4
Recycle Knowledge	4.2

Participants reported an average of 4.8 for their overall experience. When asked about their rating participants said that the game was engaging, fun, the difficulty level kept them wanting to continue to play and that they learned they couldn't recycle certain items. Participants felt as if the application was easy to use. With regards to presence participants felt as if they were in the virtual room. Participants had an increase of knowledge about recycling after playing the game. Users responded that they would have liked to have more visual feedback when they recycled items incorrectly as well as visual cues for important information in the room.

Conclusion

We developed the application *Recycle or Die* to promote better recycling habits and to inform users how to properly recycle. Overall, users enjoyed playing *Recycle or Die*. Users reported that the application was easy to use, however in the open-ended responses they did provide ways to improve the user experience of the application by providing clearer indications of why items were not properly recycled along with providing indicators for what information is important in the environment. Improvement for learning was minimal as users reported a moderate amount of obtaining new knowledge about recycling. This can be improved by, as a participant mentioned, including some text that indicates how an item should be properly recycled while playing the game. The likelihood of participants recycling in their daily lives also did not increase, this may be associated with feelings of not learning enough about how to properly recycle. In the future our team would like to include different levels that would allow users to recycle more items at a faster rate.

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Totem Teller as Digital Archaeology

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Abstract

Totem Teller is a digital game exploring folk tales categorised ATU 327: The Children and the Ogre, and ATU 450: Brother and Sister and their variants. It demonstrates a digital archaeological process using poetry, glitch aesthetics, processed art and gameplay including exploration, discovery, dialogue, removal of digital grime and experimental composition. The player will act as archaeologist in uncovering elements, contemplating their meaning, and then in understanding the meaning they've created, understand the role of inspiration, stories and more about themselves.

Keywords

Digital game, folk tales, narrative, archaeology, literature, surrealism, transcendentalism, game design, poetry, image processing.

Introduction

Totem Teller is a digital game that provides the player with an exploration of folk tales classified ATU 327: The Children and the Ogre, and ATU 450 Brother and Sister and their variants. The experience is a type of digital archaeology relying on surrealism and transcendental style using poetry and glitch aesthetics. While the purpose of archaeology can be understood as a search for answers from the past, our focus has been on how the process of archaeology provides a mirror for the archaeologist and change them.

The Experience

The player character in the game is not the protagonist, but a familiar in the form of a moth that can guide the attention of the protagonist, the Muse. The relationship between Muse and Player is intended to mimic that of the attention and

curiosity present in any individual undertaking exploration and research.

Initially formed by a spark and manifestation, The Muse will first appear in The Ruins. Our analogue for the cold light of day, a brief time of anticipation before adventure. Via player guided meditation sequences, The Muse will occasionally leave this space. A deliberate choice to stop and contemplate. They will return throughout the game.

Through meditation, The Muse will appear in Story Cycle 1 and so enter the first layer of digital strata we've provided. A rural landscape and a summary status quo formed from the amalgamated source stories. It will be familiar and somewhat expected, but already requiring a small amount of interpretation through a lightly abstracted, thoroughly processed art style. Traversal involves large distances between points of great disparity providing time for observation and contemplation. Throughout the traversal they will encounter World Text as readings of the landscape. Eventually they'll discover a Major Tableau and transition into a different phase of gameplay – a point in the landscape for digital excavation. In Story Cycle 1 these occur where someone may expect an introduction to the characters, but instead are a deeper investigation into motivations, hopes and failings as informed by the history of how those stories came to be and changed throughout time.

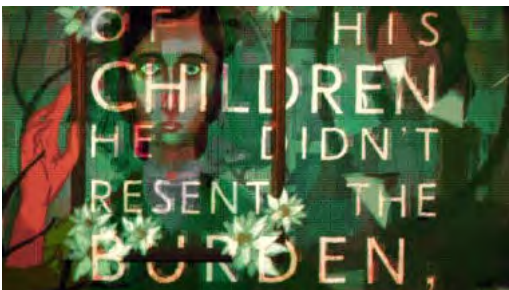
Major Tableaux



Each Major Tableau is structured around a poem and the words are artefacts to be uncovered from within the resolved image elements. These elements are in a state of chaos, wholly or partially covered by other elements and digital grime.



The player can then clear digital grime away to literally uncover the elements underneath. Once that is done, they can manipulate some elements, piecing them together in an interpretation led by their curiosity. This is deliberately kept abstract and open to interpretation – there is no truth here, only meaning, and that meaning is to be decided by the player with shades of author, curator, editor.



Finally, a state of clarity is realised that will trigger the full reveal of the poetry. But much like in archaeology, the uncovering of all the artefacts of a scene only reveals that there is much work to

be done in interpretation. The poetry doesn't exist to provide answers, but only give form and context to the questions the player must now contemplate.

Return to The Ruins

The player will continue through 3 Story Cycles, recovering Major Tableaux throughout, and building their own meaning. Each of these Cycles is punctuated by a return to The Ruins. It is gradually populated by characters from the stories, but in a state of self-awareness akin to an actor out of character, discussing the role they're playing. They'll also be asked to relate their findings to The Tellers. These characters are searching for the inspiration fed by The Muse and their curiosity, so that they are empowered to create. A model for the player to take their own understanding of the experience and be inspired to contemplate and create.

Style

The surrealist style allows us to create a story landscape to explore and strata for the player to investigate through distortion, juxtaposition, abstraction and the manipulation of the mundane. We also aim to contribute to the legacy of surrealist artists in using the style for social commentary. We present the stories broken, subverted and interrogated from a feminist perspective.

We've structured our experience informed by the transcendental style usually associated with that form of cinema. This has allowed us to provide a narrative-driven experience with drama founded on the concept of disparity instead of the conflict found in Western conventions. In doing so we've avoided contrivances that would interfere with the player's relationship with the game and have been freed from "typical game design" conventions like task-oriented play and failure states.

1001 Nights - An Open-domain Narrative Game Using Text Generation Model

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Abstract

To immerse everyday storytelling into real-life contexts in digital interactions, we created a game that turns entities in a story into digital assets that have functional roles. Taking the classic folklore as inspiration, we created *1001 Nights*, a co-creative, mix-initiative storytelling game using an existing AI creative writing system. In this game, Shahrzad (driven by the player) needs to tell stories through a dialogue interface, while the King (driven by the AI model) will continue the player's story in turn. Text from the story is utilised in actual game mechanisms, so that weapon keywords in the game like "sword" or "shield" will turn into equipment that can be used for battle. The game aims to facilitate player engagement and creative interactions through "invading language", which points to the text that will change the reality in game.

Keywords

Intelligent narrative, machine learning, gaming, storytelling

Motivation

Through the development of Natural Language Processing (NLP), emerging text adventure games give a player more control over the game without fixed choices in traditional games. For instance, *Interview With The Whisperer* [3] and *Mystery Of Three Bots* [7] set mysterious plots to let players explore the story with natural language text input through Semantic ML, a tool for semantic analysing developed by Google [6]. Fraser et. al.[5] presents different studies on open-domain social conversational AI using emotion detection [5].

The main goal of such games is to enhance the game playing experience by providing an immersive and player engagement by creating conversational interactions through a free-input dialogue system. However, to achieve that, despite players can have free text inputs for conversations, these games set very fixed storylines that cannot be changed by players' choices. This led us to think about the possibility to let players decide the plot inside the game, and making mechanics corresponds to the narrative framework of the game story. The game is more dynamic when players' choices define the game directions.

Assuming video games are hallucinations created by computers, then Machine Learning (ML) with creativity can keep it growing according to the player's intuition. The base of

the game, *One thousand and one nights*, is a classic example of a framed story and embedded narrative: the character narrates a set of tales, and tales contain other tales. Based on the folklore, with the text generation model, this game allows players to affect the direction of the story by telling stories themselves through natural language. With the help of NLP, we aim to create a novel form of storyplaying [4] accomplished by humans-agent conversational interactions with the help of NLP, by presenting a procedural rhetorical experience [1] that makes metaphoric stories invade into the reality in the game. This is centred on the main game concept "Invading language", just like Wittgenstein's statement: "The limits of my language mean the limits of my world" [8].

Game Design

The game includes two parts: storytelling and battle. Figure 1 illustrates the game mechanics: the player needs to keep telling stories to lead the King (AI agent) to produce a story continuation that includes the important items for battle. The King's text generation model is based on the dreamily.ai [2], a story generation model developed by Caiyun technology. With a large fiction dataset for training, the model is familiar with common tropes in various adventure stories. For instance, if the player writes a paragraph about a knight meeting a demon on a road, then the king might say "The knight slashed his blade", then the player could materialise the word "blade" and put it into the inventory. After experiments with the model, we set six keywords of items that are frequently triggered in stories: sword, shield, knife, dagger, blade and armour.

After collecting enough weapons and armours, the player can enter the turn-based battle part to fight with the king. Under the structured digital environment, the game not only produces an entertaining experience but also provides a creative writing collaboration with AI (Figure 1B). The exchanged dialogue changes the fate of game characters: defeat the king successfully or got killed for failure.

We add a mini-printer during a two-month off-line exhibition in Beijing to emphasise the concept of "invading language" and to improve public engagement. Each time when a keyword is triggered, the current piece of the story will be printed out (Figure 1D). In this game, the keywords are the materialised language that becomes part of the "reality", and to players, the printed text are stories that are tangible output

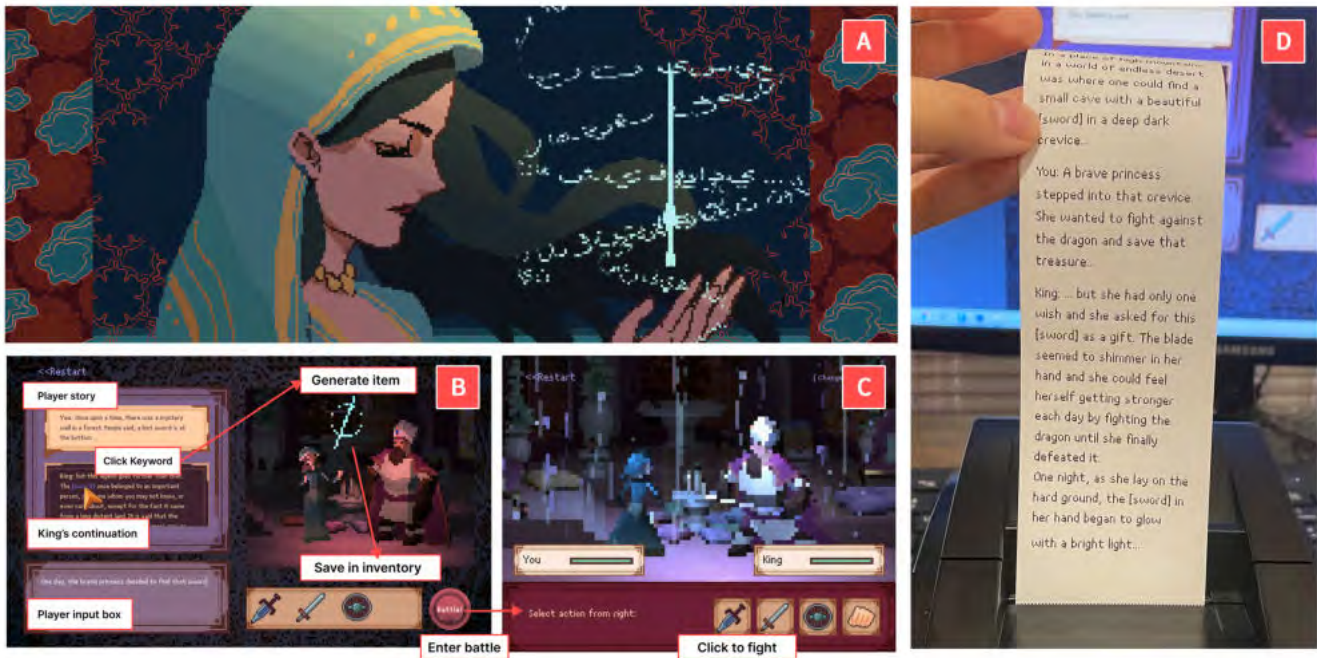


Figure 1: (A)Shahrazad (Player character) with a magical ability to turn “language” into reality (B) Storytelling phase, where player writes stories with the King (driven by AI) Weapon words like “sword” can be turned into real weapons in-game (C) Turn-based battle phase, where the player can fight with the king in turns (D) Printer will print the story when a weapon word is triggered. This matches with the core concept of the game: bringing storytelling to real-life ©Authors.

from the game to the real world. This function encouraged people to spend more time at the exhibition since they can bring away their own stories.

Conclusion and future works

In this poster, we present a text-based game adopted from the *One thousand and one nights* that allows players to write stories together with an AI-powered character. A set of keywords can be triggered into game objects for the battle, so the gaming mechanic is corresponding to the concept of “invading language” that brings words to reality.

After two months of a digital art exhibition, we received over 17000 pieces of stories from the visitors that wrote collaboratively in a human-agent dynamic. Here are several testimonials from the players at the exhibition:

- “Great applause to the artist! I highly recommend playing it at the exhibition in person, definitely interesting.” (Female, wrote a story about a male singer who is arrested on suspicion of rape recently in China, posted feedback on social media)
- “I think it helped me a lot for my recent writing. I got many inspirations from the game.” (Female, fiction writer)
- “This game provides huge player freedom. Unlike other adventure games, it won’t provide any choice. All ideas in your mind are the choices.” (Male, animation director)
- “Because this game is powered by a language model, and language express everything, this game brings high freedom for players.” (Male, CEO of a technology company)

Players with previous gaming experience are aware of the player freedom brought by the AI agent, but the ones who have not noticed the difference still enjoy the experience.

In the future research, we will do semantic analysis based on the data to see what and how would people write with an AI agent under a narrative context, and how will that help in further human-AI interaction works.

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From the Mothers' Movement to *Cradlr*: An Interaction Design for Refugee Children

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Abstract

This poster presents the rationale, implementation, social and cultural influences, and historical background of *Cradlr: An Interaction Design for Refugee Children*, a human-centered digital network concept designed to keep displaced children—one of the most vulnerable groups who doesn't have cell phones—connected with their families, resources, and heritage. Inspired by the Mothers' Movement in China—a women's movement rescued and educated 30,000 refugee children—and European countries during World War II, this project goes beyond the realm of digital product design in an attempt to find a humanitarian solution for a complex social challenge. It envisions a global network preserving a collective memory that might help displaced children to overcome many adversities and receive more love and brighter futures.

Keywords

Interaction Design, Website, User Interface, User Experience, Mobile Application, Human-centered, Refugee Children, Mothers' Movement, China

Introduction

The seed of the *Cradlr* project was sown in 2018 when I initiated the *Jiang Jian* project—a research and web design initiative that sheds light upon the forgotten stories of Jiang Jian (蒋鉴) and the Mothers' Movement in China during the Second Sino-Japanese War (1937-1945). Supported mainly by donations, the Mothers' Movement rescued and educated 30,000 displaced children during the war. This inspired me to question and learn how European countries protected and rescued children in World War II, such as the large-scale evacuations of children in the United Kingdom and its Women's Voluntary Service (WVS). Through research, I discovered that no digital platforms have hitherto been established for displaced children—one of the most vulnerable groups who doesn't own mobile phones, while 93% of all refugees live in areas covered by mobile networks based on the 2016 UNHCR/Accenture study. Since then, the inception of *Cradlr* began to sprout.

According to the United Nations, the growing global refugee crisis in the recent decade has reached a staggering height and over half of this population are under the age of 18. Lining up incidences from different regions and eras while serving as a university representative to the United Nations Academic Impact (UNAI), I was devastated to observe the ineffable human suffering in refugees happened in history was still taking place today. Although incapable of stopping ongoing wars and adversities, I hope to help displaced children worldwide by envisioning an unprecedented digital network system that transcends political boundaries and connects various parties to rescue and nurture young lives collectively.

The Jiang Jian Project

The Argentinian writer Jorge Luis Borges once stated that one must believe that whatever happened to him or her was an instrument; everything has been given for an end. [1] I learned Jiang Jian's story in my childhood from my grandparents, who knew Jiang personally (Figure 1). Little did I know that I would later spend two years engaging in the research necessary to design the *Jiang Jian* website that tells the forgotten story of this extraordinary woman—the “Chinese Nightingale”, “Mother of Wounded Warriors,” and “Mother of Refugee Children” who passed away as a nonpartisan at age 38 in 1940.



Figure 1: Jiang Jian's portrait taken between 1938 and 1940. Photographer unknown.

While the Chinese version of this website jiangjianz.com powered by WordPress aims at achieving an effective information architecture with visual clarity to carry heavier content, the English version jiangjianz.com/eng built in HTML, CSS, JavaScript, and an open-source web framework focuses on bringing a compelling aesthetic experience to the audience. In the English version, the body text has been shortened to one third comparing with the Chinese version to reduce the noise level and make the main story more prominent [2]. This design approach of full-screen immersive design with slow subtle motion reserves enough space for early 20th century photographs and dynamic graphical elements, which reflect Jiang's cultural heritage and elicit a warm nostalgia atmosphere with a gentle touch of melancholy. (Figure 2)



Figure 2: The homepages of the English version (left) and the Chinese version (right) of the *Jiang Jian* website. Screenshots and design © Jing Zhou.

today and create *Cradlr: An Interaction Design for Refugee Children*. From 1938 to 1946, 30,000 refugee children were rescued and educated throughout China, Hong Kong, and Southeast Asia organized by the Chinese Wartime Refugee Children's Relief and Education Association supported mainly by donations. After World War II, unfortunately, the Mothers' Movement has been overlooked for half a century due to the Chinese Civil War followed by decades of political turmoil and unrest. Unfortunately, no studies in English are hitherto available. Celebrating the 80th anniversary of Jiang Jian's death, this website was launched in 2020 and dedicated one page to the Chinese Mothers' Movement in hopes of deepening our understanding of common human experiences and stimulating social change for generations to come.

The Cradlr Project

Enlightened by Jiang Jian's story and the Mothers' Movement, I was curious about how European countries rescued and protected displaced children in World War II. What would people do to ameliorate catastrophic situations, if digital aids were available then? Through user experience research and studying countries such as the United Kingdom, some social patterns gradually unveiled and the ideation of *Cradlr* came to fruition in mid-2020 during the COVID-19 pandemic when millions of displaced people struggled to survive. After examining recent digital tools produced for refugees, I discovered that no digital platforms have been built for displaced children. Not only do they need opportunities to grow and receive education, but also have connections to their families, resources, and heritage. For this very reason, it is crucial to weave a tapestry of collective memories for displaced children by their guardians. Therefore, I believed that creating this project was a meaningful and feasible approach in search of new ways to help this vulnerable population who doesn't own mobile devices (Figure 3).

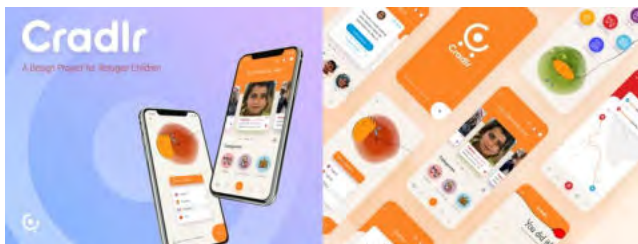


Figure 3: The cover image (left) and display image (right) of *Cradlr: An Interaction Design for Refugee Children*, 2020. Design © Jing Zhou.

Good design starts with an understanding of psychology and technology.[3] To achieve human-centered design (HCD), a comprehensive study is an inevitable process to understand “human needs, capabilities, and behavior” before designing. After research, I spent over two months during the pandemic lockdowns to complete the preliminary case study and the designs (the sample document http://www.jingzhoustudio.net/projects/cradlr/JingZhou_Cradlr-Evidence-1.pdf), from mission statement to brand illustration, from user analysis to interface design, and finally the project presentation and a three-minute video introduction (vimeo.com/465617976). The preliminary case study unveils the rationale and solutions behind each step of this project. Although I didn't have the access to interview current refugees and carry out user surveys in the initial stages of the project, I instead analyzed historical evidence and existing interviews of both current and past refugees from various media. This step provided direct

branding and illustration, the full design for the Cradlr Global Network should consist of a website and a mobile app. Because of time constraints, I decided to focus on the app prototype for the primary users—families, teachers, and foster families. Multiple digital tools—Adobe XD, Photoshop, Illustrator, Photoshop Sketch, InDesign—were used to render the designs and illustrations. To further develop this design and improve user flow, I would like to conduct usability testing, more iterations, and additional research on specific features of this digital platform in the next step. It is a great honor that *Cradlr* later became a United Nations Academic Impact (UNAI) project at Monmouth University.

Conclusion

The creative journey and design process presented in this poster were influenced by various aspects from both the past and present. The renowned scholar Abraham Joshua Heschel pointed out that the authentic individual is neither an end nor a beginning but a link between ages, both memory and expectation. [4] On the one hand, through the *Jiang Jian* project, I inquired, inherited, and examined the history, but on the other hand, learning from my findings, I questioned, explored, and envisioned a solution for an ongoing social challenge in the *Cradlr* project. What stands behind the first project is the unwavering passion and compassion fused by the Mothers' Movement; what emerges from the second one is a meaningful transformation of that energy using digital means. As design and technology continuously evolve and reshape our culture, the two projects presented here were created using different digital media yet linked by one single thread—the universal love and reverence for life shared by many.

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Author Biography

Jing Zhou is an interdisciplinary artist, designer, researcher, and professor in the US. Her work has been shown and collected internationally including: Triennale Design Museum, Milan; British Computer Society, London; Asian Cultural Center, Manhattan; SIGGRAPH Art Gallery; ISEA; IEEE GEM; CAA; Ars Electronica .ART Global Gallery; Les Abattoirs Museum, France; Royal Institution of Australia; Danish Poster Museum; Golden Turtle Festival, Russia; Athens Digital Art Festival, Greece; Taksim Republic Art Gallery, Istanbul; FILE, Sao Paulo; Korean Visual Information Design Assn.; Goethe Institute Alexandria, Egypt; Yale University; Aalto University Design Factory, Finland; public collection of the WRO Media Art Center, Poland; Waikato Museum, New Zealand; Moravian Gallery in Brno, Czech Republic; and Chinese Culture Center of San Francisco. Jing received the Creative Work Award of the 2020 Design Incubation Communication Design Educators Awards, the UX Design Award of the 2021 Peru Design Biennial, and many more in the US, Europe, and Asia. [<http://www.jingzhoustudio.net>]

Mapping for the Future: The Challenge of Preserving Digital Literatures in Latin America

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Abstract

Innovation has become the key to understanding the functioning of contemporary capitalism, where "the new" is at the center of the productive model. Digital technologies are constantly updated, making obsolete and disposable all those products that are not able to adjust to the model of hyper productivity and competitiveness, which also includes ideas and cultural productions. How does this condition affect digital arts, digital literature? How to preserve works marked by the constant threat of technological obsolescence? How to build an archive of them, whose very principle, which is remaining, goes against the constant movement of the new, present in informational capitalism?

The construction of the Cartography of Latin American Digital Literature project was born in response to these questions, presenting an interactive map to account for a compilation of 200 literary works created for digital media and composed with code language by authors from Argentina, Peru, Chile, Colombia, Ecuador, Uruguay, Venezuela and Mexico in the last 30 years. The project was carried out in collaboration with the "Atlas of Brazilian digital literature" with about 150 works compiled by Rejane Rocha, a researcher at the Federal University of San Carlos in Brazil.

The cartography is navigated by different variables that relate genre classifications, formats and characteristics of digital literary works in the region, taking the same language of the web to create an interactive and scalable experience -to which new works can be added-, where the traditional boundaries of a political map fade away. In addition, this visualization is linked to a repository, which, as a digital library, contains an information sheet for each work, folders with images, navigation videos, interviews with authors, and technical documentation.



Figure 1. Information sheet example at "Cartografía de la literatura digital latinoamericana" <https://www.cartografiadigital.cl/>. The information sheet depicts "IP poetry" of Argentinian author Gustavo Romano.

In order to carry out the research, other digital literature repositories belonging to different countries and institutions, both Latin American and American and European, were consulted, in addition to researching the authors' personal sites and academic compilations such as ELMCIP, CELL Project, Electronic Literature Collection, Literatura Electrónica Hispánica, CIBERIA, Editorial Centro de Cultura Digital, Cultura Digital Chile, Broken English, among others.

In the compilation process that initiated in 2018, many works had begun to disappear from the Internet, or had stopped working partially or completely as a result of updates, such as the case of the

Flash software removed from browsers at the end of 2020, affecting an important part of the interactive literary works of the first decade of the 21st century.

What is archived when a work of digital literature is archived? We wonder about the root of the act of archiving when the document that challenges us to safeguard it does not have a fixed format, is constantly threatened by technological obsolescence and its activation is determined by a user. This project seeks to account for the different layers of complexity that this kind of research can have, which in our case crosses literature, technology, archive, digital media and creative processes. Furthermore, our intention is also to connect the experience of artists with the users of this preservation platform to consider the idea of an archive as a living and updatable format.

Preserving and archiving today is an act of resistance in the face of technological obsolescence, where everything is born destined to be lost and forgotten. Perhaps the point is to understand that in digital materiality nothing is finished, but rather a process in development.

Keywords

Digital literature, technology, archive, cartography, digital media, creative processes, technological obsolescence.

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Cartography of Latin American Digital Literature Website
<https://www.cartografiadigital.cl/>

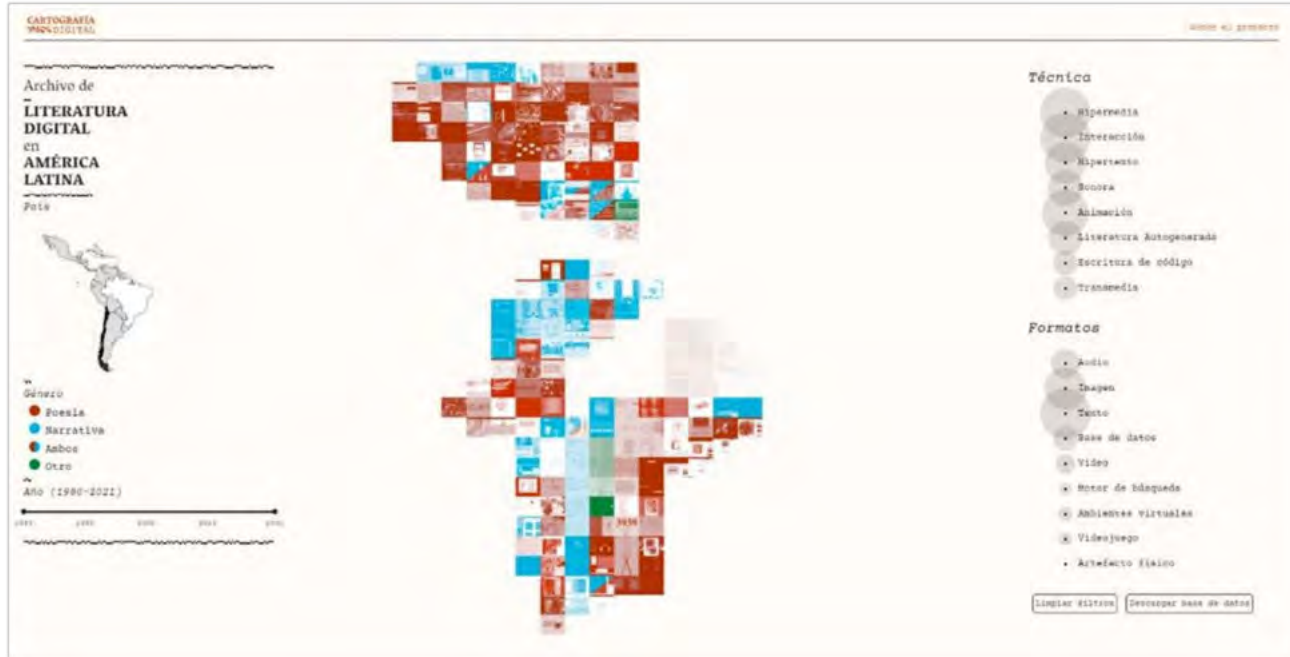


Figure 2. Homepage screenshot of website “Cartografía de la literatura digital latinoamericana” (<https://www.cartografiadigital.cl/>).

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Carolina Gainza Cortés (Sociologist and Master in Latin American Studies, University of Chile; Phd in Hispanic Languages and Literatures, University of Pittsburgh) is currently the Subsecretary of the Ministry of Science, Technology, Knowledge and Innovation of the Government of Chile. Associate professor at the School of Creative Literature, Universidad Diego Portales (Santiago, Chile). Her main research area is related to digital culture and digital humanities in Latin America, in which she analyses the forms of creation and the aesthetics of the digital, the circulation of culture and knowledge, and the languages and the forms of subjectivity that have been developed in the 21st century. Principal investigator of the Regular Fondecyt “Critical Cartography of Latin American Digital Literature” (2018- 2022) and co-investigator in two research projects, at the national level (CONICYT) as well internationally (Youngstown State University). Recently she published the e-book “Narratives and digital poetics in Latin America. Literary production in informational capitalism” (2018, Editorial Centro de Cultura Digital, México).

2ND SUMMIT ON NEW MEDIA ART ARCHIVING



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LONG PAPERS

“Always Only Once:” The paradox of preserving performative digital works

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Abstract

The 20th century saw various approaches to expanded cinema performance, including color organs and mixed media “psychedelic” light shows. These practices were difficult to document technically and were, to various extents, based on performance in the moment. Technically, archival 20th century visual performance documentation and preservation ranges from the non-existent to the surprisingly future proofed. But expanded cinema historian William Moritz summed up the unrepeatability of performance experience in a 1969 review of the mixed media performance ensemble Single Wing Turquoise Bird: “always only once.” Contemporary performative digital practice shares some parallels with these earlier performative practices: the work may be performed live by a performer, or an algorithm may perform the work automatically. In either case, preservation faces the paradox of recreating moments that were intended to happen “always only once.” Examining 20th century attempts to preserve the ephemeral can inform not only how we approach preservation of performative and process-based digital works, but also which works we attempt to preserve.

Keywords

Digital preservation, digital archiving, expanded cinema, digital performance, algorithmic art, light shows, color organs, live coding, networked art

From Object to Algorithm

A problem frequently arises in digital media art curation and preservation: the presumption that artworks are tangible, or at least static, is at odds with the realities of computational media practices. The contradiction was evident by the mid-to-late 1990s, at the point when the concept of net art (then often known as “web art”) first began to take hold. But, historically, when “new media” first emerge, they typically imitate the forms of their predecessors: early photography imitated painting; early cinema imitated theatre. Early “web art” was still popularly perceived as the placing of art objects – paintings, sculptures, photos, etc. – on the internet.

But net artists like Olia Lialina were already working beyond such assumptions; they were working with the form of the internet. Lialina’s 1996 “My Boyfriend Came Back from the War” was interactive and dynamic. [1] And it implicitly proposed a cinematic language specific to net art, using browser frames and space as narrative elements. The “art object” of “My Boyfriend Came Back from the War” was not an image: it was HTML code, written in dialogue with the rendering capabilities of 1996 browsers. As a dynamic, code-based work, “My Boyfriend Came Back from the War” presents different issues for exhibition and preservation than a static work. Perhaps not coincidentally, Lialina has gone on to become a prominent figure in pushing the thinking about preserving net-based works.

Yet “My Boyfriend Came Back from the War” in some ways still functions as an object. The code is self-contained and complete; it does not access external data or run any generative processes. The files are static data and HTML code; they are not executable. As a result, the archival issues are more about the display – the foreground – than the processes taking place in the background. This is something of an oversimplification. In fact, Lialina’s digital



Figure 1 – Olia Lialina, “My Boyfriend Came Back from the War,” 1996. Image courtesy Olia Lialina.

preservation work has often emphasized historical digital and exhibition context, including the ability of later browsers to properly interpret earlier HTML code like that in “My Boyfriend Came Back from the War.” But these computational concerns still focus primarily on the display, versus the generation of the content itself.

But by the mid-1990s, process-based net-based art was also being created. My first net art piece, “The Multi-Cultural Recycler,” was a generative work based on my semi-ironic prediction of a near future web celebrity phenomenon. [2] My prediction, and the Recycler, were based on the growing popularity of early webcams; it would be almost ten years before YouTube launched. The project’s title is a pun on the early web’s awkward attempts at multi-culturalism – which were basically cultural homogenization – and the popular 90s phenomenon of cultural recycling.

The Multi-Cultural Recycler allowed users to choose live webcam images and recycle them into kitschy artworks. It ran server-side software that downloaded two to three live images from a continuously updated selection of internet webcams, then ran custom image processing routines that would generate collaged kitschy images.

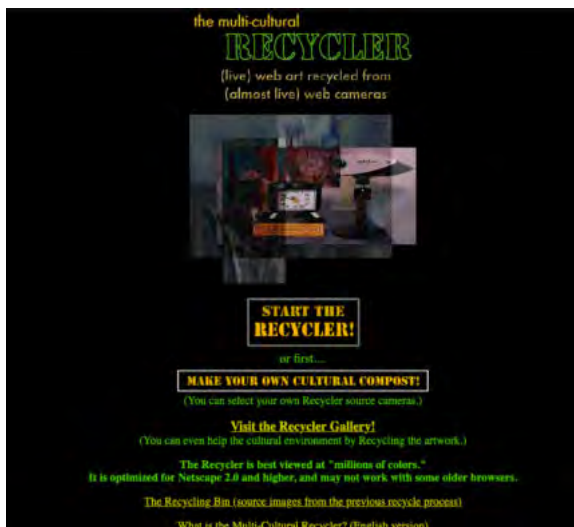


Figure 2 - "The Multi-Cultural Recycler," ca. 1997

The Recycler was always performing and always changing. This made preservation quite a challenge. I have the project documented with screenshots of various pages and images generated by the project on a handful of days. I also have a screen-capture video that I made in the late 90’s to document the navigation. But the video, like the screenshots, shows the site on a certain day and time in the 1990s. There’s no adequate way of archiving something that ran and changed

¹ The connections between Happenings and John Cage scores run deeper than mere similarity. An event organized by John Cage at Black Mountain College in 1952 featured several unrelated

performances by various artists that occurred in structured time brackets, sometimes simultaneously. The event is often considered by historians to be a direct predecessor to Happenings.

continuously over nearly twenty years. It’s durational and performative. The Recycler is no longer running. Ironically, although we usually worry about software obsolescence when we talk about digital preservation, it was the physical vulnerability of objects that did the Multi-Cultural Recycler in. It finally stopped running live in late 2015, when both the main server and backup servers were destroyed in a plumbing flood. So just like any artwork, digital artworks are vulnerable to their own physical fragility.

But net art performativity and process weren’t actually new in the 1990s. Networked art was performative as far back as 1980. “A Hole in Space,” by Los Angeles artists Kit Galloway and Sherry Rabinowitz, used satellite networks to transmit video, long before the days of webcams and video chat – or even public access to the internet. [3] The project transmitted and displayed life size video images of visitors at Lincoln Center in New York into a department store window in Los Angeles. Simultaneously, it displayed life size video images of visitors at the store window in Los Angeles to their counterparts at Lincoln Center.

The artistic focus of “A Hole in Space” was not the transmission of the images themselves, but the social interactions that happened over time across the network between people thousands of miles apart. If we think about the nature of networks as conduits across which things flow, it makes sense that duration and performativity would be more or less native to networked art.

“A Hole in Space” has unusually thorough video documentation for its day: some video was recorded by local news crews; other footage was created by the artists and their associates. So, video documents this particular work of performative early net art. But video cannot archive or preserve the event. It happened only once.

Performative and artistic interventions may seem to fit naturally with electronically networked art, but of course they didn’t start there. Surrealist performances and Hugo Ball’s Cabaret Voltaire are recognized as early 20th century performance art precursors. [4] “Happenings,” launched by Allan Kaprow and others in the 1950s and 60s, were performance art interventions, usually intervening into public space. These events were generally scripted, with both artists and members of the public given instructions of what to do when. The performances were part theatre, and, like a John Cage score,¹ part instructional algorithm set into motion. In the case of the Happenings, what was ultimately important were the social outcomes that took place in the space of the social network between the participants. By the late 1960s and early 70s, the term “Happening” was used colloquially in the US as a general term to refer to the energy of free-flowing social interactions.

performances by various artists that occurred in structured time brackets, sometimes simultaneously. The event is often considered by historians to be a direct predecessor to Happenings.

As we think about archiving contemporary digital performance practices, we have a few problems to consider. Figure 3 shows the live coding group Reggaetron performing at an Algorave. [5] An algorave is a live coding event inspired by raves. At an algorave, attendees dance, party, drink, etc., to the sound and image of algorithmic music being coded live. The photo depicts performers, the performance, and the crowd. And importantly – the process: live coding. We can't experience the process directly because it's the artists' creative process. We experience its representation – its documentation – in what we see on screen and what we hear. At the performance, we experience this representation in real time as the performer creates it. In documentation, it's past tense.



Figure 3 - RGGTRN at International Conference on Live Coding, 2017. Image courtesy RGGTRN. Credit: Tatiana Durán.

But the crowd is important in the photo too; it suggests all that the image can't communicate. What about the event? The social interaction? The Happening? The Rave? You can try to take crowd video that captures the energy. But the Happening can only be represented – in the form of images and sound.

Live algorithmic performance doesn't just refer to live human performers, however. Algorithms are processes, which, once launched by their human creators, can continue to perform over time indefinitely. For example, in my recent project, "What the Robot Saw," algorithms continually curate newly uploaded videos from YouTube that have very few subscribers or views. [6] These are videos that search and recommendation algorithms often render invisible – so they might be seen only by online robots. Algorithms then edit, crop and sequence the curated videos into a collaged, livestreamed film. When human speakers (aka "talking heads") appear onscreen, "What the Robot Saw" labels them using Amazon Rekognition's marketing-oriented, neural net-based face analysis algorithms, which aim to determine demographic and emotion data.



Figure 4 - Still from "What the Robot Saw," 2020

The resulting algorithmic stream runs endlessly, and it's always in the moment. It's an endless performance: the algorithms are the performers. What to do about archiving that? You can document segments, but as with the Multi-Cultural Recycler, they are just snapshots in time. But performance – especially with time-sensitive elements like recent videos – is always in the moment. Archives will always be representations of an ever-receding past.

How can we think about this? Let's look to the past for guidance. Liquid light shows were a type of visual performance that mainly took place in the late 1960s. These were mixed media projections that were performed at concerts and other events. The events sometimes tied in with LSD experimentation and other deliberate attempts at conscious altering experiences. Light show ensembles projected combinations of films, slides, strobing colored gels, and colored oils onto the screen.

The Los Angeles light show ensemble, Single Wing Turquoise Bird were known for their intensely collaborative, multilayered projections. A high level of improvisational, intuitive collaboration between members was necessary for the individual performers to create a cohesive whole with one another's projections and with the music. The ensemble performed at a range of events from rock concerts to collaborations with avant-garde musicians.

Always Only Once

Some of the writing from the time of Single Wing Turquoise Bird's performances can be useful toward thinking about current questions of performance preservation. Gene Youngblood wrote in his 1970 book, *Expanded Cinema*: "Unlike other light artists, The Single Wing Turquoise Bird has no definite program; each presentation evolves from the interacting egos of the group working in harmony. What we see cannot be called a work of art as traditionally conceived: a unique, perishable, nonreplaceable entity reflecting the talents of an individual. They don't produce an object in the sense that a movie is an object; they produce software, not hardware." [7]

Film historian William Moritz reviewed one of the group's performances in 1969 for Los Angeles's *Weekly Planet*. After describing the various visual elements of the show, Moritz, adopting a Gertrude Stein-like syntax, wrote: "These words are not telling it all because it is a 1960s thing and most English words are a 14th or 16th century thing and if Single Wing Turquoise Bird could be writing it they would be writing it, but they are showing it and always only once because Friday January 17, 1969 was not like Saturday January 18, 1969, even though many things about them seemed to be being the same and if you did not see Friday January 17, 1969 when it happened you will not have a chance now because it was living not writing and this is just writing you are doing now...." [8]

Moritz's "always only once" might be a good approach to how we think about archiving of contemporary media performance as well. The "happening" can be represented and documented, but never really archived or preserved. And from a practical perspective, it can be quite difficult to capture good sound and image in a live audiovisual performance setting with the type of inexpensive setup available to most non-commercial performing artists. It might be tempting to give up. But the problem is, historicization depends on documentation.

Single Wing Turquoise Bird was a real light show. But the images (Figures 5 and 6) are from a Hollywood film. In the late 1960's, Hollywood director James Bridges attended some of Single Wing Turquoise Bird's performances, having learned about the ensemble from the painter Sam Francis, who was a patron of the ensemble. [9] When Bridges co-wrote and directed the 1970 feature, "The Baby Maker," he included a scene that takes place at a light show, with Single Wing Turquoise Bird performing and appearing as the light show ensemble.



Figure 5 - Still from Single Wing Turquoise Bird performance in the 1970 National General Pictures film, *The Baby Maker*. Photo courtesy Michael Scroggins.

Creating film documentation of their visual performance was impossible for Single Wing Turquoise Bird themselves. Pointing an available 1960s movie camera at a projection screen would not have produced a satisfactory result. For "The Baby Maker," the movie production company worked with the light show members to shoot and composite layers of their performance, producing a high-quality clip that was inserted into the film. Since the ensemble appears in the film performing their visuals, the scene in which they appear also serves as documentation of the performance itself, albeit fictionalized.



Figure 6 - Still from Single Wing Turquoise Bird performance in the 1970 National General Pictures film, *The Baby Maker*. Photo courtesy Michael Scroggins.

Single Wing Turquoise Bird were a highly regarded light show that received significant critical attention during the period they were active. But they are also one of the few 60s light shows for which there is adequate documentation for historians to view and analyze. This has likely helped them to become better historicized over the years than some of their peer light shows who lack strong documentation.

The existence of Single Wing Turquoise Bird's documentation is due in part to luck. Although they were clearly a prominent light show, they were also in the right place – Los Angeles – at the right time and with the right connections to appear in a film. But we also understand that the film is just documentation at best. As Youngblood and Moritz's texts point out, the light shows were "always only once" and could never be preserved. Anything performative never can be.

Sixties light shows were a form of "expanded cinema," a term coined in 1966 by the American experimental filmmaker Stan VanDerBeek. Gene Youngblood went on to make the term "expanded cinema" famous in 1970 with his book by the same name, which I have mentioned previously. Youngblood's book, which was influential in establishing the field of media arts, proposed that cinema had expanded beyond film to incorporate television, video art and computer art.

Despite the term's 1960s origins, broad views of expanded cinema can encompass earlier forms of non-

narrative moving image, often invented by independent artists, inventors, and tinkerers. Contemporary practices we've been discussing, like live coding, live audiovisual performance, and algorithmically generated cinema can also be considered expanded cinema performative practices.

Now that we've looked at some of the issues around documenting 1960s liquid light shows, let's consider some even earlier cases of expanded cinema performance documentation practices. Histories of modern visual performance often begin with the color organ. Color organs comprise a broad category of visual instruments that have taken various forms. However, most involve some sort of a machine that is designed to be performed with a keyboard, but which produces colored light instead of pitched musical sounds.

Credit for the first color organ usually goes to Father Louis-Bertrand Castel's 1700s invention, the ocular harpsichord, which generated colored light using candles. Various color organs were developed over the next two hundred years, but development became more active in the early 1900s when access to electricity became more widespread.

One twentieth century color organ inventor was Mary Hallock Greenewalt. Greenewalt was born in Syria but moved to the US as a child, where she lived most of her life in Philadelphia. Greenewalt trained as a classical pianist, then decided to devote herself to development of the art of performing colored light. Greenewalt named the performance instruments she invented – the color organs



Figure 7 - Mary Hallock Greenewalt, half-length portrait, at electric light "color organ", which she invented, 1925, Underwood & Underwood. Library of Congress, Prints & Photographs Division, LC-USZ62-93477.

² After World War II, Wilfred developed several larger, self-playing Lumia systems as museum and commercial commissions. Yale University Art Gallery restored several of these for a 2017

themselves – “Sarabet,” after her mother. She called the art of color light play that she was developing, “Nourathar.”

Greenewalt's contemporary and rival color organ developer Thomas Wilfred was born in Denmark and spent most of his life in New York City. Like Greenewalt, he gave the art of color-light performance he developed a name distinct from that of his color organ inventions. He referred to his color organ as the “Clavilux,” and he referred to the art of color light play that he developed as “Lumia.”

Wilfred has been better historicized over the years than Greenewalt. Although Greenewalt's work has received increased attention in the past few years, up until recently it was difficult to find much written about her work at all. Although both Greenewalt and Wilfred presented and performed publicly, Wilfred has been cited within visual performance histories far more consistently than Greenewalt.

Wilfred received attention from the contemporary art world during his lifetime, which Greenewalt did not. As a result, Wilfred received more substantive press attention than Greenewalt, who was typically treated as a novelty performer in press reviews. So, it is easy to see why Wilfred's work would be treated differently by historians. But it is difficult to discern how much of the difference in their access to performance venues and critical attention during their lifetimes derived from their work vs. personal attributes like gender and demeanor.

There may be another factor that facilitates discussion of Wilfred's work by a larger number of contemporary historians. Like Single Wing Turquoise Bird, Wilfred's work benefits from fortuitous documentation beyond what would have ordinarily been available at the time. Wilfred, Greenewalt, and most other color organ inventors continually tried to figure out ways to make a living from their work. Wilfred had tried both exhibiting his Clavilux in the art world and performing it in the music world. Eventually, he had an idea to develop a home version of Clavilux he could sell to consumers. This version would play automatically, rather than having need for a performer. Wilfred called this system the Clavilux Junior.

The Clavilux Junior operated through the use of hand painted glass records, each with an opus number. Light was projected through the records, reflected off various surfaces within the machine, and eventually projected onto the screen. The user could use the keyboard to make various adjustments to the light as the records played.

There are several Clavilux Juniors known to still be extant, mostly in private collections. Those that are operational can play their glass records, so the units can be exhibited as video sculptures in contemporary exhibitions.² In addition, their screens can be recorded with modern video

exhibition. Yale has produced high quality video documentation of the output of these later systems. As with Clavilux Junior documentation, the Yale documentation is available online. [12]

equipment. So, Wilfred’s original 1930’s time-based light works are now documented in contemporary high-definition video.

Operating the Clavilux Junior machine ninety years later recreates the original “algorithmic” performance, rather than merely representing it. The marks painted on the glass disks function as executable software code that generates time-based visuals – and the software can still be run. So, we find ourselves able to view contemporary high-definition video documentation of generative work from the 1930s. Doing so feels like time travel.



Figure 8 - *Thomas Wilfred at Clavilux Keyboard*, ca.1930. Image: Thomas Wilfred Papers (MS 1375). Manuscripts and Archives, Yale University Library.

Clearly, the success of this approach emanates from the fact that Clavilux Junior was a self-contained hardware system that was produced in some quantity and distributed to people in various geographic locations, providing redundancy against loss or damage of individual units. That said, Clavilux Junior’s painted records are essentially rare software disks recorded on very fragile media: it’s fortunate that a number of the glass records have survived. In any case, Clavilux Junior shows us the advantages of keeping our eyes open to the possibility of time travel.

There’s comparatively little visual documentation of Mary Hallock Greenewalt’s Sarabet output. I am not aware of an extant, functioning Sarabet that can generate the work, and there’s also little photographic documentation from the time. But there is a great deal of documentation of Greenewalt’s process. She gave lectures and performances,

and those were reviewed in newspapers. But she also did an extensive amount of self-archiving. As her papers reveal, during her career she continually seemed to feel she was not receiving the credit she deserved for her inventions. Apparently for this reason, she saved and often annotated a vast quantity of materials documenting and discussing her work. She continued this self-archiving over the course of her career. In 1936, she began donating the materials from her archive to the Historical Society of Pennsylvania. She continued these donations until 1949, a year before her death. [10]

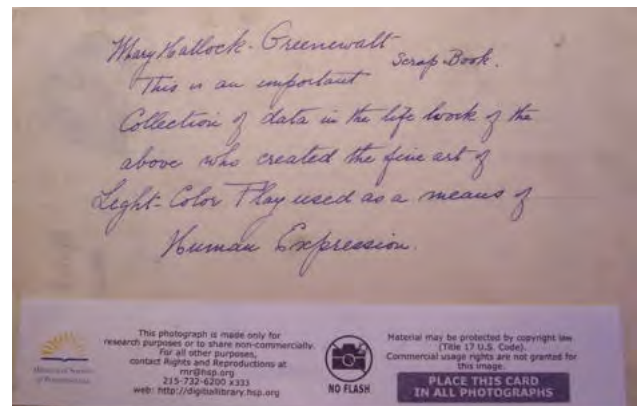


Figure 9 - Handwritten note, Mary Hallock Greenewalt, *Mary Elizabeth Hallock Greenewalt papers* [0867]. Describes a scrapbook within her archives. Photo by the author. Reproduced with permission from the Historical Society of Pennsylvania.

The Historical Society of Philadelphia’s *Mary Hallock Greenewalt papers* collection contains thirty-five boxes, which the public can request to review a few boxes at a time. The boxes contain thousands of pieces of paper that historicize Greenewalt’s practice and research: newspaper press clippings, technical diagrams, lecture notes, jotted ideas, letters to vendors, notes from the many times she challenged what she felt were infringements on her intellectual property. While being able to operate and document Wilfred’s Clavilux Junior has value, there is something in the vastness of Mary Hallock Greenewalt’s archive – the obsessive performance of self-archiving – that archives Hallock Greenewalt’s work in a way no machine, nor film of a performance, could do.

That Greenewalt’s archive is preserved at Historical Society of Pennsylvania is no doubt fortunate; one guesses that the materials likely would have otherwise been destroyed. But with the archive housed in boxes in Philadelphia, the materials are invisible to most of the world. So, over the past several years, I’ve been endeavoring to make them more visible. I periodically travel to Philadelphia and photograph as many items in the Historical Society archive as possible. I then post the images in a public online archive I call the Mary Hallock Greenewalt Visibility

Project. [11] The visibility project itself is in some ways performative: the posting of the multitude of images mirrors Greenewalt's performative, almost compulsive compilation of the vast archive that documents her process in a way she knew nobody else would.

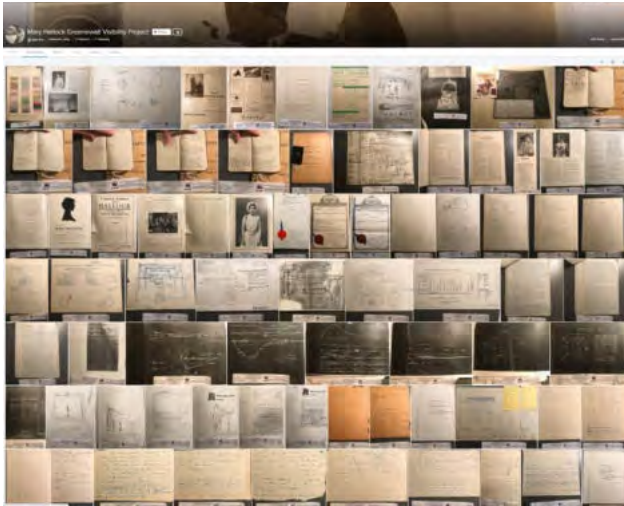


Figure 10 - Partial screenshot of Flickr "Photostream" view of Mary Hallock Greenewalt Visibility Project website.

Part of my process involves displaying lengthy streams of unlabeled images, to document the extensiveness and eclectic nature of Greenewalt's archive. But I also organize the items using keyword tags, so that the public can discover new connections and networks between the many disparate items in the archive. My database is very crude and incomplete; it is limited by time and resources. But the act of producing an online archive of scrap clippings compiled by an artist who died in 1950 always feels to me like another act of time travel. As with Wilfred's *Clavilux Junior*, I think it's always useful to look for these less obvious opportunities to connect preservation and historicization of the present to the work of the past.

Lessons of the Past

What might we learn from these past expanded cinema practices that can be useful in thinking about archiving of process-based computational work?

"Always only once."

Although a half century of consumer recording technology might confuse us into thinking otherwise, reflecting on William Moritz's description of the unrecordable, performative and social energy of *Single Wing Turquoise Bird's* events should give us some clarity. We can consider the failures of adequately preserving processes,

performance and happenings a success.

But don't let the "always only once" paradox of preservation stop us from documenting and historicizing.

We can consider how alternate forms of documentation and archiving can function to represent practices for which the process is more important than the display.

Alternate approaches can be especially important in increasing visibility of historical and contemporary practices that might otherwise be overlooked.

Considering how visibility impacts history, we can try to think proactively – and retroactively – about how we can make hidden histories more publicly visible. Are/were groups underrepresented within their practices also underrepresented in access to traditional forms of documentation and archiving?

We can consider an artist's attempts to historicize their practice as an archived work in itself.

The performance of archiving may be as significant as the archive that's created. Broadening our thinking about what constitutes an archive, as well as ambiguity between practice and archive, can allow us to broaden our recording and understanding of the histories with which we engage. Always look for opportunities for time travel.

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Author Biography

Amy Alexander has been making computational` art projects since the 1990s. She is a Professor of Computing in the Arts in the Visual Arts Department at UC San Diego. Alexander has worked in performance art, installation, software, and online media, generally employing custom software to generate real-time video that reflects on cultural issues. She has written and lectured on topics including software art, historical and contemporary audiovisual performance, algorithmic bias and algorithmic determinism, and media preservation. She has served as a reviewer for festivals and commissions for new media art and computer music.

Alexander's projects have been performed and exhibited at venues ranging from The Whitney Museum, Prix Ars Electronica, Transmediale, SIGGRAPH, ISEA, NIME, and the New Museum to club performances at Sonar (Barcelona), First Avenue (Minneapolis) and Melkweg (Amsterdam). She has also performed on the streets of Los Angeles, San Diego, San Jose, Zürich, and Aberdeen, Scotland.

Stayin' Alive. Southern Cone Video Art Archives in Context

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Abstract

This presentation addresses some problems affecting physical and digital archives dedicated to video art in the Southern Cone, relating to matters of accessibility, preservation and dissemination of video-based art collections in the present. In an attempt to map such a complex situation, firstly, I look at some of the most relevant Latin American video art festivals. I take as case studies the Encuentros Latinoamericanos de Video, the Festivales Franco-Chilenos and Franco Latinoamericanos de video arte, VideoBrasil and Buenos Aires Video, which promoted the production, circulation and dissemination of audiovisual arts in the last two decades of the 20th century and, alongside, fostered the creation of physical archives or video libraries in the region. Secondly, I identify some institutional and academic projects that, since the mid-2000s, have carried out tasks of valorization and remediation of video-based art collections. Actions through which it has been possible to give visibility, accessibility and survival to some video art works, and documentation related to the above-mentioned festivals. Finally, under the premise of problematizing the initiatives that safeguard this audiovisual culture and its difficulties to endurance, I point out common challenges to audiovisual archives in the present, and the answers articulated by some research projects to face them

Keywords

Video Art, Video Art Festivals, Audiovisual Archives, Obsolescence, Remediation Projects, Southern Cone.

Introduction

The purpose of this presentation is to reflect on some challenges affecting physical and digital archives dedicated to video art in the Southern Cone in the present. In order to give rise to this discussion, I will refer to some relevant Latin American video art festivals that fostered the production, circulation and dissemination of audiovisual arts in the last two decades of the twentieth century and, alongside, fostered the creation of physical archives or video libraries in the region. Secondly, I will explain some institutional and academic projects that, since the middle of the year 2000, have carried out tasks of valorization and remediation of video-based art collections

Regarding methodological aspects, this approach is based on classical sources (bibliographic and documentary) and electronic sources (websites, databases, online archives, research project platforms, etc.). Likewise, Documentary Resources Centers and Archives in Chile, Argentina and Spain have been personally consulted. The unfeasibility of completing a comprehensive study of all the institutions and archives dedicated to video art in the Southern Cone, it made necessary to establish a cut that would allow a more concrete approach to the subject. To this end, we focused on some archives and projects linked to five pioneer video art festivals in the region: the Encuentros Latinoamericanos de Video, Festivales Franco-Chilenos and Franco-Latinoamericanos de Video, VideoBrasil and Buenos Aires Video.

The examined academic-institutional projects propose possible ways to remediate and give visibility to video based-arts and physical archives related to those festivals.

In relation to the general frame of reference, the theoretical contributions of the New Media field offer conceptual tools that are appropriate for our approach. On the one hand, we ascribe to the notion of remediation proposed by Bolter and Grusin [1], which alludes to the power of digital media to remediate old media through a process of refashioning or transcoding [2]. This argument allows us to conceive of today's institutional digital archives and repositories as refashioned extensions of physical archives and video based-art libraries. After the advent of the digital world, new hypermedia platforms have emerged—some of them with no basis in pre-existing physical spaces—that also operate under this logic: remediating old audiovisual media works and offering hypermedia content.

On the other hand, this approach considers critical and theoretical contributions dedicated to explore the crossings between institutions and new technologies, and the role of these technologies in the dissemination of cultural heritage. Perspectives that address the impact of digitalization and globalization processes in the field of contemporary cultural creation, transforming artistic practices and the material and institutional apparatus in which they are inserted [3],[4].

In relation to the above, Argentine researcher Jorge La Ferla identified several difficulties linked to the absence of

comprehensive collections to trace a memory of the audiovisual arts in Latin America. In his reflections on “Por una praxis de archivo para las artes tecnológicas experimentales en América Latina”, he pointed out very relevant issues regarding the circulation and preservation of audiovisual works. Among them, the scarcity of public and private projects aimed at the creation of panoramic institutional archives in the region. He also alluded to the fundamental role played by some traveling video and experimental film exhibitions in the creation of archives, the theoretical reconstruction and the material recovery of pieces that were thought to be lost. He stressed that, in the absence of consistent public policies for heritage protection in the Southern Cone, some institutions and agents had taken on the task of preserving and updating technological works that would otherwise remain inaccessible. Finally, there was another set of difficulties in relation to existing collections. Among them, the undefined heritage status of the pieces incorporated into the institutions, the fragmentary nature of these heritages and, as a consequence, the difficulty of making interpretative readings of the whole [5], [6]. These observations, made more than a decade ago, constitute a starting point to offer a re-reading of these issues in relation to the Video Art archives of the present.

Festivals and Video Art Archives in the Southern Cone: Legacies of the Past

It is necessary to look back, at events that took place and archives that were created in the past, in order to understand the current state of the institutional physical archives holding videographic works in analogue media.

The use of video as a support and means of artistic creation date back to the early seventies, linked to a few institutions. Among them, the Centro de Artes y Comunicación (CAYC) in Buenos Aires, and the Museu de Arte Contemporânea at the Universidade de São Paulo (MAC-USP), with paradigmatic trajectories in this regard. Both entities provided the artists with porta-pack equipment, thus encouraging experimentation through new technologies. Under the direction of Jorge Glusberg, the CAYC became one of the first institutions in the region to organize international video exhibitions and to promote videographic production. Unfortunately, none of the works exhibited, nor those produced by the CAYC, have survived to the present day. As Alonso emphasizes, this was due to the high cost of these new technologies, which made it difficult to keep backup copies [7]. Under the management of Walter Zanini, the MAC USP also occupied a pioneering role by creating a Video Sector and a room dedicated exclusively to video programming - the Espaço B - in 1977. In recent years, a research project headed by Roberto Moreira S. Cruz addressed the study of this space. During 2020, part of his research was reflected in “VÍdeo_MAC”,

¹ Among others: library of Museo Nacional de Bellas Artes de Chile; the Chilean documentation center CEDOC; the CC Ricardo Rojas Archive of Universidad de Buenos Aires (CCRR-UBA), the

an on line exhibition of great patrimonial and documentary value, since it allowed to know Brazilian productions in this support totally ignored until now [8].

However, beyond these specific examples, video did not achieve a significant presence until the eighties, when some institutions in the Southern Cone held festivals and generated collections dedicated to video art. As La Ferla pointed out, the proliferation of video festivals during this period was a major factor in the creation of audiovisual archives. Likewise, video libraries became highly appreciated as they offered the possibility to consult audiovisual materials in different magnetic or optical formats. In such places, the copies of the works participating in the festivals were juxtaposed with records of activities carried out by the institution and videographic works of international referents.

Of course, video art flourishing coincided with a process of gradual growth in the number of users of the electromagnetic media, closely linked to the expansion of mass media and new technologies by transnational capital. Logically, such circumstances had an impact on the art world, and by the middle of the decade, video-based art had entered — albeit timidly — in various institutional spaces through viewings, conferences and meetings, largely promoted by artists, producers and independent filmmakers. An illustrative case of such convergence is the Encuentro Latinoamericano de Video (1988-1993), promoted by independent producers from all over Latin America. Among the hundreds of associations and collectives at the forefront of these meetings was the Centro de Medios Audiovisuales (CEMA), an Uruguayan production company that stood out for its extensive audiovisual work. For this reason, it became the subject of an academic research project, which will be referred to later in this paper.

Video art also grew as an autonomous artistic discipline, supported by an international circuit specialized on video art. Thanks to the support of foreign financing agencies, especially those of the French and the Spanish Cooperation, numerous festivals, exhibitions and awards were created and organized. These articulations strengthened existing regional ties and stimulated production and reflection on video art in the Southern Cone.

Examples of these initiatives are the Festival Franco-Chileno de Video Arte (1981-1994) and the Festival Franco-Latinoamericano de Video Arte (1992-1996), which were consolidated thanks to the support provided by the French Ministry of Foreign Affairs and the participation of numerous local institutions. For more than a decade, Santiago de Chile was the capital of an event that attracted the attention of its southern neighbours. In the early 1990s, the festival expanded its regional scope to become a multi-site event that spread to Argentina, Uruguay, Brazil and Colombia. As a result projected to the present, each participating institutions¹ formed a partial collection of the

Colombian National Library and the Information Center of Museu da Imagem e do Som (MIS) in São Paulo.

same, safeguarding videographic pieces, vestiges and/or documentary sources.

In Brazil, the precursor in this field was VideoBrasil festival (1983-Present). Celebrated at first at the Museu da Imagem e do Som (MIS), later editions were organized by the Associação Cultural Videobrasil together with the Serviço Social do Comércio (SeSC). Starting in the 1990s, the festival declared the expansion of its sphere of action to the entire geopolitical South and founded the association to house an increasingly broad heritage of documentation, publications and video based-art collections. Thanks to its institutional policy and the direction of Solange Farkas, the task developed by this entity has gained a great value, and is unparalleled by other similar associations within Brazil or in the Southern Cone [9].

Also in the late eighties, the Buenos Aires Video festival (1989-2001) was organized at the Spanish Cultural Center of the Instituto de Cooperación Iberoamericana (ICI-AECID) in Buenos Aires. The first editions, curated by Carlos Trilnick, were held under the exhibition format proposing a local videographic panorama. From the sixth edition onwards, the festival became competitive and included selections from other countries, which stimulated the circulation of Argentine productions in the region. From the very beginning, the institution created a video library with equipment for on-site consultation. Its collection, dedicated to Spanish, Argentine and Latin American video art, was gradually enlarged with the entry of works selected by Buenos Aires Video. However, after the digital shift, both the festival and the video library ended their task, and the latter ceased to be accessible to the public [10]. The advent of digital, networked and globalized culture decisively modified the ways of using and accessing information. With the “passage to the world of screens”, there was a dizzying cultural leap that changed the register of everyday life and mediated life [11]

Thus began a gradual process of institutional computerization, in which computer tools became allies in the documentary management of archives and collections, displacing analog systems and technologies. In the case of video libraries and audiovisual archives, equipped with analog technologies and devices, this transformation led to their deactivation as reference spaces and their consultation materials became “archaeological objects”. Although many institutions have preserved these collections (mostly composed of U-matic, VHS, Betamax, Betacam, among the most popular ones), very few have undertaken a process of digitization.

On the other hand, the digital turn had an impact on the ways of looking at and thinking about the phenomenon of regional video art. There was a shift from the narratives of the national scenes, delineated by events during the eighties and nineties, to the construction of narratives from the local scenes connected and immersed in the global map of the networked world. Some institutions began to post a large amount of content and communicate activities on their institutional websites. Simultaneously, new research projects began to explore the dispersed paths of the art-

technology relationship in the Southern Cone, under a format of associative work between institution and academia.

Due to this interest, a significant number of platforms dedicated to regional video art began to emerge in the mid-2000s. Such hypermedia linked to academic and institutional projects and articulated as online archives or databases, have formulated new readings on Latin American video art. On occasions, they have also been accompanied by exhibition and editorial proposals aimed at giving visibility to works in now extinct formats.

Remediation of the analog past As Bolter and Grusin have pointed out, the search for intermediation runs through the entire history of media development in the West. Immersed in this logic, the new media have expanded this capacity for mediation thanks to their power to incorporate almost all of the previous supports and technologies. To allude to this media agentiality, the authors have proposed to understand the notion of “remediation” as “reform” and as “repair” of other media [12]. Thus, remediation can be understood in two ways. On the one hand, as a form of mediation of a prior media, an intermediation. On the other hand, as a repair, a way of preventing a danger, in this case, the disappearance of works born under formats that become obsolete.

In the case of analogical archives, these “remediation” have been articulated from valuable research projects that rescue from obsolescence or invisibility a part of those audiovisual archives linked to the path of festivals and institutions proposed above. One aspect to be emphasized is that all these developments not only propose the digital remediation of analog audiovisual or documentary contents, but also actions to revitalize these collections through publications, exhibitions, debates and viewings, among other activities.

One of the first to appear was the “U-MATIC” Chilean Audiovisual Heritage Project, headed by documentary filmmaker and researcher Germán Liñero. The initiative explored works made under this format in Chile between the years 1975 and 2000, including productions presented at the Festivales Franco-Chilenos and Franco-Latinoamericanos and the Encuentros Latinoamericanos de Video, among others. The results of this research were articulated in three axes: the materialization of the “U-MATIC Exhibition”, held at the Museo de Arte Contemporáneo of Santiago de Chile in 2005; the publication of the book *Apuntes para una Historia del Video en Chile*, in 2010 [13]; and the creation of a website. The latter (now defunct) exhibited digitized fragments of more than twenty selected audiovisual pieces, and more than four hundred technical files of titles with reviews of their authors.

In 2015, the Chilean and Argentinean collections of the Festivales Franco-Chilenos and Franco-Latinoamericanos revitalized thanks to the donation made by Pascal-Emmanuel Gallet, the French cultural attaché and promoter of the festivals. This legacy generated revisions and a retrospective reflection on the impact of these events on the local scenes. In Chile, it was integrated into the

Documentation Center of the Museo Nacional de Bellas Artes, as part of the 12th Bienal de Artes Mediales celebrations [14]. In Argentina, it joined the Instituto de Investigaciones en Arte y Cultura Dr. Norberto Griffa (IIAC) of the Universidad Tres de Febrero, and resulted in the exhibition “La imagen que desborda: viaje, diario y videoarte” celebrated in 2016 [15]. The exhibition became a unique opportunity to revisit the works and documents that make up the Pascal Gallet Fund and the IIAC Archive, particularly the exchanges of gazes proposed by the video travel diaries in made by French, South American and Baltic artists involved in the aforementioned festivals.

In 2008, another important project was orchestrated to rescue CEMA's U-matic archive in Uruguay. As mentioned before, the Centro de Medios Audiovisuales was a Uruguayan audiovisual production company that developed a significant video production since 1982 and played a very active role in the organization of the Encuentros Latinoamericanos de Video. The team coordinated by researcher Mariel Balás — supported by the Universidad de la República and the Instituto del Cine y el Audiovisual (ICAU) — undertook the digitization of the production company's archive in order to save it from irremediable deterioration. Subsequently, they edited the book “CEMA: Archivo, video y restauración democrática” [16], which covered both the work carried out by this audiovisual collective and the trajectory of the research project.

For its part, the cultural association responsible for the organization of the VideoBrasil festival has focused its efforts on maintaining a physical headquarters to safeguard its collection, composed of thousands of catalogued audiovisual and documentary pieces. Among them, around 1,500 are videographic works that have passed through the festival. The digitization process of this collection began in 2007. At this time, the possibility of publishing them online was considered, although in the end this task was not carried out due to copyright limitations [17]. However, the option to consult the catalog of its institutional website allows access to files that provide a brief synopsis, an image and the details of its participation in VideoBrasil [18]. Likewise, the association has not ceased to promote activities for the re-reading and reactivation of its collection, including exhibitions, publications, artistic and research residencies, among others.

In close connection with the need to give visibility to works shown in events such as Buenos Aires Video, or the Festivales Franco-Chilenos and Franco-Latinos, the ARCA Video Argentino project was born. The initiative emerged in 2008 with the aim of digitally remediating the pieces of a history of Argentine video that addressed the works exhibited in the city of Buenos Aires from the 1980s to the present, and under the desire to extend to the whole country. Coordinated by researcher Mariela Cantú, it had the support and funding of the Universidad Nacional de La Plata and the Argentine Fondo Nacional de las Artes in the different phases of the project [19]. Revamped in 2021, the website embed videos and information from many other online platforms and sites. The collaborative and non-profit nature

of Arca website appeals to the interest of the authors themselves to circulate works which helps to complete the history of Argentinian video art. In this way, it avoids some of the difficulties posed by copyright when it comes to making this content accessible [20].

Although there are many more, the cases presented allow an approximation to initiatives that have proposed to face the challenges involved in the rescue of stories linked to unstable media. Likewise, not all the works and documents published on these platforms have a physical backup, i.e., much of the information published only exists in digital format. On the other hand, the physical collections (partially) digitized and converted into digital archives; facilitate the circulation of works and documentary collections on video art of the Southern Cone. In this sense, both those that have physical support and those that do not, become resistant forms of archive [21] keeping the works alive and making possible to formulate new approaches and narratives about video art in the region.

Video art and archive: a problematic relationship

After this punctual mapping of video art festivals, audiovisual archives and remediation projects, it is possible to point out some problems video art archives have to face. The issues proposed below are not exclusive to analog and digital video art archives in the Southern Cone, but they pose methodological challenges and technical difficulties to researchers interested in studying these corpuses. Regarding each one of these points, some of answers articulated by the referred research projects are pointed out.

Geographical Dispersion. Geographical distance between archives makes the possibilities of consulting audiovisual collections in the Southern Cone scarce or intricate, and makes the approach to local and regional histories a difficult task. Furthermore, while many of the institutions mentioned offer partial online cataloguing records, others do not even provide this information.

Although presented as the better answer, the digital remediation of video-based art and their circulation on various online platforms does not solve this problem. The dispersion of audiovisual content and the difficulty of finding a corpus of works gathered in the same place also exist in the networked world. However, most of the research projects that have online archives also facilitate cross-referencing with other audiovisual platforms and with websites of related or connected projects, an aspect that partially facilitates the exploratory task.

Documentary Gaps in Archives. The criteria for the creation of video art archives and video libraries have not been stable, nor have uniform standards been established for the registration and cataloguing of the pieces incorporated. Audiovisual works usually come together with records of activities and various institutional documents related or not to these works. However, the biggest problem arises when institutions lack records, documentation or copies of the materials edited or produced by the institution itself. A feasible hypothesis about these gaps is that, at the time of

the flourishing of video art, those institutions simply did not contemplate the possibility of implementing systematic documentation and archiving practices on these time-based artistic manifestations. Therefore, the safeguarding of these materials was at the mercy of the involvement and archival skills of those responsible on duty.

Perhaps the only solution to the problems posed by the dispersion and gaps in the archives is to support local research projects, in regular contact with the institutional collections, capable of constructing critical readings and deepening the investigation of these materials in different archives. Only the circulation of multiple projects that propose this type of approach will make possible the articulation of new regional panoramic research.

Status of work and copyright. As a recurrent policy, video art activities and festivals stipulated in their terms & conditions that a copy of the selected work should remain at the disposal of the organizing institution. By participating, the author automatically consented that his or her work could be used for non-commercial cultural purposes, or destined to video libraries. In this way, the collection of these materials grew gradually, according to the success of the events organized. For the institutions, video was easy to exhibit and store, and for the video artists, its inclusion in institutional collections ensured the circulation of their productions. Thus, the pieces presented acted as "works" when screened at the festivals, but then regained their "copy" status in the archive. When the festivals ceased to be held and the video libraries closed their doors to the public, the supports remained in a place of patrimonial lack of definition, sometimes aggravated by gaps in their documentation. In other words, although there is some document that proves that they entered the institution, their condition between movable object, patrimonial work and documentary collection keeps them in a state of undetermined status, and, therefore, any type of audiovisual record for publication would incur in copyright problems.

In this case, the solutions implemented by projects such as ARCA have consisted of becoming open collaborative platforms. Its expansion strategy is based on achieving voluntary assignments, and offering hyperlinks to websites of authors and institutions, which own the copyright of the original works or documentation.

Inaccessibility and Loss of Works in Unstable Media. As long as archives and video libraries remained active, video art works remained alive and continued to be included in multiple proposals. With the digital transformation, the analog technological equipment provided to access the works became obsolete, and the works became inaccessible. As already mentioned, very few archives and institutional video libraries have undertaken the task of digitizing their collections. This has been excused on the grounds of copyright issues and the high costs of digitization for the institutions, and although some authors have undertaken this task individually, other works have been lost or are inaccessible today.

However, there are other important reasons that have

marked this state of affairs, linked to the fickle institutionalization policies in the region and the preservation challenges posed by unstable media-based supports. Video art has traditionally played the outsider's role in museums and cultural spaces. Besides, except for some — genuine or opportunistic — demonstration of interest subject to certain management, there have been created none public policies for specific protection, nor have there been any sustained efforts to enhance the value of these productions.

On the other hand, we start from the premise that both analog and digital supports are unstable, and although their digital remediation would allow extending their endurance, it is necessary to accompany such actions with others that provide them with meaning and ensure different ways of persistence.

In this sense, the work carried out by projects such as "U-MATIC" in Chile, the rescue of the CEMA Archive, or the exhibition "Video_MAC", constitute multidisciplinary research projects that go beyond digital remediation. They open the possibility of generating new readings on collections that would otherwise vanish from the memory of regional art histories. As we have seen throughout this presentation, these efforts favor the study and dissemination of video art works, through the conservation and remediation of historical pieces, the circulation of these investigations and the expansion and reformulation of the genealogies of video art in the Southern Cone

Conclusions

The aim of this presentation was to reflect on the unstable and complex relationships established between video art and archives —analogical and digital— linked to pioneering video art events in the Southern Cone. The cases presented have sought to make these problems tangible and to make visible the need to aspire to an archival praxis that allows for the protection of this audiovisual heritage. The aforementioned research projects show the importance of having funds and archives that make possible the survival of works and documentation on video art production.

In reference to the advent of networked culture and the digital turn, it has been emphasized the positive aspects of the emergence of research projects and audiovisual remediation which have made possible it to articulate new narratives on video art in the region. However, digital platforms —emerged from some of these projects— are also ephemeral, as Mariela Cantú points out the internet is "an accumulation of ruins, links that do not work, replicated information, outdated data" [22].

Supporting and stimulating the development of research in this field is necessary and complements, but does not replace, the responsibility that institutions have taken on in hosting documentary collections and audiovisual works. The institutions that safeguard these collections should promote actions for the endurance of this valuable patrimonial material, articulating joint rescue and research projects that allow the synergy of forces and financing

between cultural and educational institutions. Ultimately, this could be a way to ensure the continuity of the analog and digital past.

Thanks to the action of projects with an academic-institutional base, it has been possible to recover patrimonial works and to reconstruct stories of great value, which constitute an exceptional example of what could and should be done. The value such actions, as many media archaeologists insist, is that it reinscribes the analogical past in the coordinates of the present, and guarantee the institutional commitment to preserve the works and ensure their longevity.

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A forgotten, almost lost, and partially hidden piece of history: new media arts in Latin America

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Abstract

Who tells history? We can find multiple versions of the new media art history, most of them with subtle differences. Still, until a few years ago, it has been unusual to find references pointing to countries out of a small group from Europe and North America. Several projects have been developed to change that situation. UNESCO's Digi-Arts project, and the Latin American Electroacoustic Music Collection, hosted by The Daniel Langlois Foundation for Art, Science and Technology, are examples of the relevant role and the impact that the preservation and documentation of electronic artworks, together with its public access, can play in having another perspective on our recent history.

Keywords

Latin America; new media art preservation; electroacoustic music history; sound art; cultural decentralization; postcolonialism.

Introduction

The journey from the cultural memory and the ethical concerns to the practical strategies on preservation and the impact of disseminating knowledge generated by new media art has been navigating a sinuous road.

Memory's death could benefit some as much as the desire for immortality could block the way to innovation open naturally to new generations. New media art memory has been partially dead, or perhaps deaf or blind or simply looking to the other side, maybe to avoid the perception that the so-called digital revolution has reached most of the known world and that history does not happen only in a few "central" countries. The desire for immortality and for being a cultural lighthouse as much as the guardian of the "right" values and the significant art should not take us all to mislead that intelligence and sensibility belong to a few.

Who tells history? Who knows about it or who has the opportunity to do it? We can find multiple versions about the new media art history, most of them with subtle differences, but it has been unusual -until recently- to find references pointing to countries out of a small group from Europe and North America. Inequalities have always

existed, and if we want to see a change, we will probably need to work hard ourselves to produce new results. Many stories about new media art were lost or are hidden and probably should be part of the official history and not just left aside. There have been people, ideas and concepts, artworks, discoveries and inventions, and we expect someone will take care of keeping the memory of all that for us, but sometimes it simply does not happen, and when we look around after a while, it seems that the history has not been the one we thought it was and we remember, but a different one that is being told by others.

Between the obsession for archiving everything and the difficulty and strong responsibility of deciding what to preserve, the opportunity to archive new media art makes us face a challenge involving technical, political, social, cultural, and economic aspects.

How many histories can be told about the same subject? To whom is their narrative directed? I have heard some educated young people saying that "if something is not on the Internet, it does not exist." Then, today the digital divide could be not linked to who has access to the web but to who dominates the inclusion of content or develop the strategies to keep our attention on certain places and not others. It looks like we are flooded with cues guiding us to consider that the art conceived by some cultures is the only one to be recognized as valid.

Several projects have been developed to change this situation regarding the history of new media art: UNESCO's DigiArts project was a major initiative "aiming at the development of interdisciplinary activities in research, creativity and communication in the field of media arts." [1]

The Daniel Langlois Foundation for Art, Science and Technology in Montreal has been a leading organization heavily focused on studying theoretical aspects related to preserving new media art and actually archiving it. Several meaningful projects have been developed or hosted there since the late 90s, including the Steina and Woody Vasulka Fonds, the 9 Evenings: Theatre and Engineering Fonds, the Collection of Documents Published by E.A.T. and the Latin American Electroacoustic Music Collection, among many others. [2]

UNESCO's Digi-Arts project

According to UNESCO's online portal: "DigiArts is a reference website on art, science and technology and more particularly on media arts and electronic music. It resulted from a period of 6 years (2002-2007) activity undertaken by a team of interdisciplinary professionals working in different UNESCO programmes (culture, communication, science, education, etc.) based in various parts of the world, in conjunction with a range of outstanding national and international experts."

It also explains: "The portal contents could be categorized in four major chapters: 1. Information on the history of media art and electronic music as well as a collection of pioneer artists' bios, coming mostly from Asia, Africa, Arab States and Latin America (Media art and Music using technology); 2. A network of specialized institutions dealing with research, training, creativity and promotion of digital art and music, classified by geo-cultural regions (Regional networking); 3. Articles, essays, course contents in different fields related to Digital creativity, open-source software tutorials, as well as other teaching material (Training); and 4. Professional and non-professional digital productions by young people (UNESCO Digital Arts Award and Young Digital Creators)."

Adding that, they take the opportunity to thank all "...partners warmly for their support and cooperation in achieving the main objective of the DigiArts project: to promote North-South collaboration and share information and knowledge on the use of new technology in the artistic field." Closing with "Enjoy your visit to DigiArts." Worth mentioning here that all the relevant information has not been updated since 2008, and the portal, including a massive knowledge gathering on new media art history, is almost non-functioning today and is very hard to find. This major international cooperative effort led by UNESCO was abandoned, and no interest or resources were later invested in it.

DigiArts goals were: (a) Disseminate historical, theoretical, artistic, technical and scientific research in the field of electronic and digital arts, including interdisciplinarity study of the arts and the sciences; (b) Promote information exchange, dialogue and communication among artists, scientists and technicians from different geo-cultural regions, especially enabling developing countries to develop their own approaches and practices in various disciplines and fields of knowledge connected to media arts; (c) Support existing institutions and networks throughout the world in the transfer of knowledge; and (d) Encourage the use of electronic software among the youth for electronic communication and creation. [3]

Four international advisory groups and partners provided overall policy guidance on different areas: the Virtual Library International Advisory Committee; the Art, Science and Technology International Advisory Committee; the

Media Arts History International Advisory Committee; and the Electronic Music International Advisory Committee.

One of the first writings commissioned by DigiArts was the research report *Historical aspects of Electroacoustic Music in Latin America: From the Pioneering to the Present Days*. With over 75,000 words, this text was the result of an extensive investigation led by Ricardo Dal Farra focusing on the history of electroacoustic music in Latin America. [4]

After the original report in English was published in the UNESCO portal, a second version, not translating by complementing the previous text, was also written by Dal Farra: *La música electroacústica en América Latina*. [5]



Figure 1. The CLAEM Electronic Music Laboratory, 1964.

Those texts included information on the electronic works of at least 191 artists and composers from Argentina, 14 from Bolivia, 90 from Brazil, 39 from Chile, 39 from Colombia, 5 from Costa Rica, 44 from Cuba, 3 from Dominican Republic, 11 from Ecuador, 5 from El Salvador, 6 from Guatemala, 73 from Mexico, 3 from Panama, 4 from Paraguay, 15 from Peru, 12 from Puerto Rico, 27 from Uruguay, and 27 from Uruguay. 44 from Cuba, 3 from the Dominican Republic, 11 from Ecuador, 5 from El Salvador, 6 from Guatemala, 73 from Mexico, 3 from Panama, 4 from Paraguay, 15 from Peru, 12 from Puerto Rico, 27 from Uruguay, and 35 from Venezuela.

In addition to information on the works and their creators, these texts included references to unique projects and centres in various countries of the region (e.g., Centro Latinoamericano de Altos Estudios Musicales - CLAEM of the Instituto Torcuato Di Tella, which was, in the 1960s, a critical place for the development of new media art in Latin America). And it also noted some pioneering developments around new technologies applied to the creation of electronic art (e.g., Juan Blanco's work in Cuba, Raúl Pavón in Mexico, Fernando von Reichenbach in Argentina, among others).

DigiArts main Line of Action were: (a) Knowledge and Research: History and aesthetics of artistic, scientific and

technical movements relating to digital and electronic arts; (b) Publication and Information: Virtual library on the electronic arts; (c) Training and Capacity Building: Best practices and directory of creative digital tools; (d) Networking and Partnerships: Creation of a space for interdisciplinary research and experimentation; and (e) The "Young digital Creators" project. [6]

All this is now part of obscurity. Then, we continue to reinvent the wheel, telling new stories and allowing certain facts to be lost while others emerge seeming to be the ones who have led the development of the electronic arts in the world. However, this is not always the truth. It is only part of history.

Latin American Electroacoustic Music Collection

Unavailability of musical recordings, bibliography and almost any basic reference to the many electroacoustic music activities that were developed since the early 1950s in several Latin American countries was commonplace in the 1970s. That situation did not change much during the following decades.

In various Latin American countries, universities, state organizations and major private foundations have taken initiatives to support art research and the use of new media already in the early 1960s. Nevertheless, most projects have stopped before developing the resources to document their processes and preserve the results. Many early artworks, for example, have been lost or damaged.

The Latin American Electroacoustic Music Collection has over 1,700 digital recordings of compositions by almost 400 composers. It is also accompanied by a trilingual historical essay, and over 200,000 words in its database. [7] [8]

This Collection is an example of the relevant role that the archival of artworks and its public access can play in having another perspective about history. It is today an essential resource in the field, being consulted extensively by people from around the world (e.g., new media art researchers, historians and artists, composers, performers, musicologists, and the general public) and is helping to transform the usual perception of "ownership" that exists related to some countries with respect to the new media art history.

The Latin American Collection includes compositions for fixed media (tape, DAT, CD, HD or similar) and mixed works for acoustic instruments or voices and fixed media or live electronics/interactive systems. There are also multimedia works in the database. In the case of pieces for fixed media and other sound sources (e.g., mixed works), complete recordings as well as "tape only" parts (e.g., fixed media) are preserved and catalogued. The database also includes audio and audiovisual recordings of interviews to composers and technical innovators (e.g., Alberto Villalpando from Bolivia, Manuel Enriquez from Mexico,

Alfredo del Mónaco from Venezuela) as well as photographs, videos and some scores (e.g., by Alcides Lanza from Argentina, Javier Alvarez from Mexico, Milton Estevez from Ecuador). [9] [10]

From a technical perspective, the archiving of audio material went through a myriad of problems: recovering from massive hard disk crashes, finding analog tape recorders with old track formats, re-digitizing material to correct severe DC offsets in brand-new equipment, computer operating systems conflicts, etc. Defining how to work with very noisy old recordings was another challenge (some pieces were processed using an advanced de-noise system to reduce hiss, always preserving the original recording and following the composer's advice whenever was possible). The bulk of the process was done between 2003 and 2005 at The Daniel Langlois Foundation offices, working with three different computers and nine hard disks to manage the audio and visual files, the database and huge amount of information, and the daily international communications.



Figure 2. The Latin American Electroacoustic Music Collection, hosted by The Daniel Langlois Foundation.

Worth mentioning that while the recording quality of some music stored on old analog tapes could have suffered through the years, digital technologies for recording storage were the ones presenting the most difficult challenges. For example, some DATs (Digital Audio Tapes) lost part of the

recordings, and only a loud digital noise was in place of the music. In those cases, the problem was not only a poor quality (e.g., because of hiss or the loss of high frequencies) but a complete lack of the recorded signal, without any possibility to recover the original material.



Figure 3. Analog Graphic Converter, developed by Fernando von Reichenbach at CLAEM, in Argentina, during the late 1960s.

There are 1,723 electroacoustic pieces preserved as digital audio -with CD quality- in the database. While all works are available for listening to researchers who ask for an access code (to avoid copyright infringement) contacting the Langlois Foundation, 558 works from those compositions are freely available and can be listened to by the general public online. There are multiple ways of finding the information and resources in the database. The digital audio recording of a composition can be found by its title, the name of the composer, the country linked to that composer, the year or decade when the work was composed, etc. In addition, there are two playlists to access and listen to the compositions: one sorted alphabetically by the last name of the composer, the other sorted chronologically, following the year the piece was composed. [11] [12]

Instrumentation, program notes, production studio, version, composer's bio and more have also been included for each work when the information was available. Part of that comes from the two reports commissioned by UNESCO, previously mentioned.

The Latin American Electroacoustic Music Collection is one of the most visited and consulted collections of the Daniel Langlois Foundation.

Final Words

The UNESCO project, and later the Latin American Electroacoustic Music Collection, have recovered and made visible (and listenable) the creative work of many artists otherwise almost forgotten. They have defied the wish of immortality and the hegemony of the electronic art history narrative, breaking one of the memory's death roads and slowly shifting and widening the way the history of electronic art is being understood.

Those projects cannot fade away. They need to be supported and disseminated the information. A permanent circle of forgetting part of our history will not help us grow and improve as a society.

DigiArts and the Collection are only part of the history of new media art in Latin America. There is so much more to tell and spread: Not only in artistic creation and applied technological development but also in education, there were pioneering programmes that have intertwined art, science and technology in countries such as Argentina, starting decades ago.

We, humans, need to learn better ways to live together, and art and memory are key factors to that end.

Archiving and disseminating electronic and new media art history findings is crucial to comprehending the present and building our future.

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The future of art museums in the digital age: Using virtual reality for archiving purposes

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Abstract

Art museums are committed to expanding the digital display of their archives by using digital technology, diversifying the types and forms of their exhibitions, increasing archival formats, and promoting repeated visits anytime, anywhere. Many museums have also begun to use virtual reality (VR) display platforms such as Google Arts & Culture, which is intended primarily for viewing art in high resolution images and video. More than 2,000 cultural institutions, including the Guggenheim Museum in New York and Orsay Museum in Paris, use this platform to provide virtual content¹. It is reasonable to infer from this that the rising popularity of VR technology and of online VR platforms targeting the art sector should also have potential application in archival work. For example, the National Museum of Modern and Contemporary Art (MMCA) in Seoul already utilizes VR technology for documenting its physical exhibitions. However, despite the growing application of this technology, few studies have comprehensively studied the forms and content of the artworks archived in traditional museums (i.e., paintings and photographs) and by comparison to electronic art archives that utilize modern VR technology. By analyzing the advantages and disadvantages of virtual reality technology, this study aims to explore the potential of such applications in the context of digital archiving. In this paper, we take several major modern and/or contemporary art museums as examples for analysis and comparison. We show that virtual reality technology has brought advantages to the archival work of contemporary art museums, such as enhanced immersion and expanded diversity of exhibits. Further, it appears likely that the increasing commodification of VR technology will further possibilities in the future.

¹ Data from <https://artsandculture.google.com>

Keywords

Art museums, virtual reality, VR, digital archive, visual tour.

Introduction

According to Tallulah Harvey, in her eco-critical research “The Archive”, the role of a digital archive is to digitize human cultural productions [1]. As a result of lockdowns during the COVID-19 pandemic, humanity experienced a greater hunger for culture than ever before. Government policy during the pandemic typically required public institutions to close their doors, creating new and difficult challenges for art institutions. Online presence and content became crucial. Museums and galleries launched 3D and video tours of their exhibitions, and held numerous online artist talks and conferences. For example, the travelling, moving-image exhibition *Watch and Chill: Streaming Art to Your Homes* was held by M+ in February 2022, and featured more than 20 video works by contemporary artists across Asia.²

One of the core issues in discussions about the preservation and online distribution of media art is the difficulty of representing the spatial and interactive nature of such artworks in the form of digital archives. The Ars Electronica Archive³, for example, is a near complete archive platform that documents artworks of the Prix Ars Electronica Festival from 1979 until today and organizes works by award, picture, print, and map. Another

² Watch and Chill: Streaming Art to Your Homes, as part of the M+ International initiative, serves as a springboard for the discussion of innovative forms of collaborations and of the new potential that lies in today’s hybrid environments.

³ Ars Electronica holds one of the world’s largest archives of digital media art and spans the past 40 years. It contains the documentation of the Ars Electronica Festival since 1979. Accessible at <https://archive.aec.at>

important archive for digital art is the Archive of Digital Art (ADA)⁴, which primarily uses video, image, text and audio formats to document artworks. In addition, hyperlinks have a significant role in interconnecting the various entries in ADA. A good search engine is a vital part of every archive, enabling the user to filter entries by category, date, genre, events, and keywords. Both of these digital archives—Ars Electronica and ADA—are extensively used by media art scholars worldwide. However, from the perspective of the non-expert audience, the more complicated navigation of entries and often low-quality videos and images may introduce additional challenges to attaining a complete or immersive/intimate understanding of the archived artworks. What if archived artworks could instead be experienced in VR? And would this be unreasonably costly to achieve?

It is important to ask what the art institutions can do to offer a better experience to their online visitors, to facilitate remote exhibition visits, and to ensure wider access to art shows or specific artworks where requested. Many contemporary artworks are difficult to be archived as a single image or video. For example, while performance art researchers and archivists mainly use video to preserve the art of performance, they admit that it is not the best way [2]. There are, however, limitations to every archiving method, for example, video is essentially a 2D technology trying to describe 3D space and is often compromised for that reason. Similar challenges can arise in archiving interactive and installation art pieces. In addition to image-based media, there are often complex relationships between documents, pictures, and videos. Thus, it may be very difficult, if not impossible, to capture all the details and moments of live art in order to recreate as closely as possible the experience of physical presence.



Figure 1. VR Tour of HKDI Gallery, Zaha Hadid Architects - Vertical Urbanism.

Considering the diversity of archived works of art in various museums, VR accompanied by guiding instruction—such as the archives' VR tour of the MMCA

in Seoul, Korea—may be a practical and efficient method of archiving.⁵ Such a method of documentation can provide a spatial, sensory and immersive experience that is further enhanced by navigation with the aid of narrative and iconographic guidance. For instance, the online VR tour 'Vertical Urbanism', on the Hong Kong Design Institute website, showcases the use of directional circles to improve user navigation (see Figure 1).

Use of VR in Exhibitions and Archives

The world is moving to digitalization, and art lovers are rapidly shifting their interest and preference to museums and artworks that incorporate modern technologies [3]. Art institutions' interest in VR applications has sharply increased during the lockdown, especially after the Oculus Quest 2 VR headset launch. This technology registered five times the projected number of pre-orders as people sought to escape the boredom and social restrictions of the pandemic, engage in the art world, and visit exhibitions. More importantly, the professionals, like art critics and researchers, were able to resume their work. Throughout the course of 2020, museums and art galleries pivoted towards digital solutions, and many institutions made significant investments in VR. The primary advantage of this technology is its immersiveness. It allows the audience to be fully engaged with the artwork and to actively interact with each exhibit too. In their paper, Shehade and Stylianou-Lambert, after conducting multiple interviews with museum professionals, conclude that interaction with exhibits has become a crucial part of audience engagement [4].

Today, visitors want to feel as if they are part of the exhibition; they want to interact with the artworks on a personal level and relate to the emotions and thinking patterns of the artists that produced them. VR technology offers that illusion to the audience by allowing them to enter into a virtual space that may take the form of a 360-degree video or an interactive environment. It enables museums and galleries to bring artworks to life and offers an ideal platform for different and unique experiences as the audience becomes deeply embedded within the virtual exhibition [5]. For this reason, many leading art institutions around the world are actively embracing VR.

In the past five years, several well-known contemporary art museums have utilized various kinds of VR technology to conduct exhibitions or offer educational programs to their audience. For example, in 2019 the Louvre integrated VR technology into its exhibition *Mona Lisa: Beyond the Glass*, and London's Tate Modern integrated VR into its Modigliani retrospective in 2017. The latter offered an immersive experience whereby

⁴ Accessible at <https://www.digitalartarchive.at>

⁵<https://my.matterport.com/show/?m=pmHCAXnPHVu&brand=0>

visitors could interact with a 3D model of Modigliani's artist studio in Paris. Visitors could tour the room and share the artist's personal space, and everyone felt as if he or she was the only person in the studio.

Of course, VR is not only being utilized by art institutions; it is a part of the artist's toolkit too: in the Museum of Modern Art (MoMA), Niko Koppel has showcased his VR project *Crime Scene*, a story about the victims of police brutality [6]; at the Whitney Biennial, Jordan Wolfson exhibited his extremely bloody virtual-reality artwork *Real Violence* [7]; and artist Ian Cheng created a VR *Pokemon Go*-like installation for the Liverpool Biennial named *Emissary Forks For You* [8].

As of January 14, 2022, the website of MMCA in Seoul had 8,771 exhibits on display online, all of which could be viewed in VR on the official website offering visitors a more interactive and immersive experience (see Figure 2). Unlike the traditional method of digital archiving that mainly documents artworks in the form of photography and video, VR technology enables the entire exhibition, its spatial organization, navigation and orientation between individual artworks to be preserved thereby allowing a more complete experience of the show. Nevertheless, the use of one method of archiving need not require the exclusion of the other. On the contrary, VR technology can supplement and support digital archives, introducing novel tools such as VR tours that help to better document entire exhibitions and make the archives more engaging and accessible for the wider, non-professional audience. Like all technology, VR does have its limitations. For example, current VR tours do not offer metadata tagging, which makes it difficult to search for specific artists or artifacts without having first to navigate the virtual exhibition as a whole.



Figure 2. VR Tour of MMCA's 2020 Asia project, *Looking for Another Family*.

The VR tour *To Exhibit – Not to Expose – To Expose – Not to Exhibit*, by artist Mario Santamaria, was produced for the reopening of the Centre d'Art Santa Mònica in Barcelona, Spain in September 2021 [9]. The tour enabled

its audience not only to visit the museum's cloister and exhibition areas, but also to investigate its most inaccessible corners, to explore unusual perspectives and follow its routes—and all without leaving the comfort of home. This particular virtual tour remained open after the exhibition's official dates, which allowed the artist to extend his show in time and space. This example shows how VR can offer an alternative to traditional museum visits that consist of moving from one exhibition hall to another, contemplating the work of art, reading the text on the wall, and buying a souvenir from the store before leaving.

The Pros and Cons of VR Technology

While art institutions have utilized this technology during lockdowns to satisfy their audience's yearning for art and culture, will this new practice of virtual museums continue after the pandemic? The example of MMCA in Seoul demonstrates that VR can be applied to almost any physical exhibition. More importantly, traditional media can be easily integrated into a VR archive, such as photographs, videos, audio, and the texts that are present in digital archives.

To summarize, the potential of VR applications for archives is as follows:

- VR archives can capture the precise details of an exhibition's set-up at the moment the artwork(s) were exhibited. Hence, the audience can get a glimpse of the physical space and design of the exhibition in addition to viewing the individual artworks.
- Time and location do not matter. Visitors can browse an archive by themselves at any time and from any location using VR equipment or with the use of a computer screen if the user does not own a VR headset.
- Installation art can be viewed more fully in VR.
- VR archives can accommodate huge collections and offer an easily scalable solution to the growing archives of museums. It is indeed a challenge for any museum to display all its archived material in its physical space. The Art Institute of Chicago Museum Collection Online has more than 300,000 paintings, sculptures, and decorative artworks from around the world [10]. The Guggenheim Museum's permanent collection offers a searchable database of selected artworks from an online archive of around 8,000 items [11] and is continually expanding. The MoMA collection includes more than 150,000 paintings, sculptures, sketches, prints, photos, architectural models, drawings, and design objects, approximately 22,000 films and 4 million film

stills. Further, it contains more than 300,000 books [12], periodicals and the personal archives of more than 70,000 artists.

- Further developments in VR may enable us to expand beyond visual material and integrate other sensory material too, such as touch and haptic feedback.
- Digital and VR art can be viewed in its original format.
- The use of VR in digital archives allows artworks to become accessible to a wider, non-professional audience.
- The interactivity of VR provides additional potential for educational and curatorial programs.

VR applications in archives also present challenges:

- The equipment can be expensive. Although a VR mode may be available in all visual tours, due to the cost of equipment only a smaller number of people may be able to view that content simultaneously in VR. For the remaining audience, a screen may be used for viewing. Hence, the immersiveness of virtual exhibits may be compromised or lost.
- Elderly people may find it difficult to use VR technology. This could be overcome with additional help and assistance.
- Building a VR environment is a labor- and cost-intensive process, especially at the start.
- Much time and money can be spent on retaining archived data and VR maintenance.
- Existing 3D tour applications, like Matterport, use proprietary software, and this limitation may cause problems in the readability of models in the long term. For instance, Matterport does not offer access to source files.

Is a VR-mediated virtual viewing experience a truly engaging art experience or not? Seeing physical works of art in person is likely to be more moving than viewing them online through a mediated virtual experience, but it is important to note that VR archives are not intended to replace physical exhibitions entirely. Rather, the use of VR is intended to support art institutions in documenting and preserving exhibitions. Nonetheless, the development of immersive technology in the form of VR and advanced computer applications can enable the creation of realistic simulated environments. Some authors and researchers believe that simulations may in the future have ultra-realistic physical similarity to the actual physical environment [13]. Thus, in the context of VR archiving, the relationship between physical simulation of virtual scenes and the cognitive sensory experience of real scenes should be further explored and understood.

Conclusions and Recommendations

Currently, several VR applications are already being used for archiving and virtual exhibition purposes, including Google Arts & Culture and Matterport. It can be that a virtual tour experience is not always engaging, however, it serves for recalling physical visits or creating an as-if-you-have-been-there feeling. In addition, the future development of virtual reality technology in the context of digital archives could enable us to save the operating procedures of interactive and generative art too.

The existing search and filtering methods for archived artworks and artists on institutions' websites are not meant for the general public but for art professionals experienced in navigating digital archives. Moreover, most online archives are 2D displays that are not ideal for digital art that has interactive and immersive qualities.

VR archiving might be very suitable for expanding digital archives, enabling 3D views, and supporting additional formats. More importantly, VR has the potential to be combined with other ubiquitous technologies, such as augmented reality and mixed reality, in future applications. Thus, we should aim to explore, devise and exploit the ways in which VR may enhance digital archives and make them more immersive, such as haptic feedback and other sensory experiences.

Although VR may appear more suitable for exhibition archives than existing methods like ADA or Ars Electronica Archive, its utilization does not need exclusion of the latter. If VR technology is used as an auxiliary archiving tool, it can support and enhance user experiences when exploring archives and help the audience to recall their experience after visiting an exhibition in the physical location. VR is likely to increase the number of digital archives users because its utilization enables content to be presented in a more engaging and immersive way.

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As an artist, she works together with Mar Canet forming an artist duo Varvara & Mar. Often the duo's work is inspired by the information age. In their practice, they confront social changes and the impact of the technological era. The duo has been exhibiting in international shows since 2009. Their works were shown at MAD in New York, FACT in Liverpool, Santa Monica in Barcelona, Barbican in London, Onassis Cultural Centre in Athens, Ars Electronica museum in Linz, ZKM in Karlsruhe, and more.

Accessing and Displaying the Archive

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Abstract

The pressure to open archives and cultural collections is increasing. Not only the Open-GLAM movement (Galleries, Libraries, Archives, Museums) demands easy access to freely usable sources. Civil society and even in-house interests (e.g., communication during the pandemic) point to a considerable need for action. This paper therefore considers two types of accessibility: individualized access for humans and ways of (automated) access for machines.

For interpersonal communication a curation tool for the exhibition context is presented that can be used quickly and is easily deliverable to different online and offline places. The automation aspect is structured according to the so-called FAIR-Principles. Here, too, a digital service is described that makes it easier for those archives and collections to become FAIR (Finable, Accessible, Interoperable, Reusable) and capable of (in)formation dialogues that would otherwise have to retrofit the existing systems.

Keywords

Accessibility, Digital Curation, FAIR, Infrastructure.

Introduction

The Corona pandemic (since 2019) has brought the digital dimension of cultural collections and archives to the attention of the general public. Digital accessibility has become a global object of desire. Even earlier, lively discussions about exhibiting and mediating digital assets, art and culture in digitally supported environments took place: literally merged c.f. in web-project “computer aided curation” (c@c by Eva Grubinger et al.), [12] solutions and creative approaches are discussed also by conferences such as ACM Creativity and Cognition and ACI Siggraph, Art.CHI, Ars Electronica, ISEA, Museums and the Web, to name a few. In addition, not to forget the abundance of curatorial and educational approaches in theory and practice. [2]

This lets us easily forget that most of the digital presentations or displays in house and online, which tend to accompany a tour in today’s museums or websites, are still developed, compiled, and made accessible on a case-by-Service, which is presented in the second part, we intend to show that the path from a digital archive with basically inhouse access to a FAIR archive or repository, which

case basis - also for common, recurring formats. To put another way: most of the collections and/or archives that manage digital or digitized cultural assets are far from infrastructural solutions that would allow digital curation practices on a regular basis.

We are not talking about the exhibition of net art here, [1] nor about elaborate, digital mediation formats for specific events (audio-walks in the public space etc.) or any other type of interactive exhibition formats (exhibition/knowledge games cf.) or works of art [16] Rather, we are referring to those types of presentation where digitized/digital content changes from one exhibition to the next, but the way of presenting remains more or less the same in terms of formal aesthetics (cf. full screen display): cf. video exhibitions, where several works are played back one after the other, with or without subtitles or interstitials; slideshows with and without annotations; pdfs with flipping pages on a programmed basis; websites etc. Although many museums have Wi-Fi in the exhibition area, this content is usually brought to the displaying devices on digital data carriers such as USB-memory-sticks, instead of being programmed and played back directly from network based digital storage system. In the case of traveling exhibitions or interlibrary loans, files are sent around the globe.

In contrast to this time-consuming and resource-intensive approach, we will first present a web-based tool that facilitates online and offline exhibitions. The system enables updated or new curatorial display at remote places within seconds. We call the system *Info Screens* because it was developed in an academic art library for displaying archival content (as information) next to analog media such as books and journals: videoart and performance documentation, results of the practices-based final thesis of art and design students, reference material from teachers as well as research results, new acquisitions and special collections.

While the *Info Screens* support also displaying copyright-protected content in a (in terms of location and time) controlled digital environment, shielded from access by unauthorized persons or machines, with the so-called FAIR-provides the community with high-quality, trusted sources, is viable also for smaller cultural institutions.



Figure 1. Exhibition View of *Info Screens* (above) with schematic concept of main components (below).

Info Screens

The *Info Screens* were specifically designed for the exhibition context. They consist of three components (see fig. 1 – left to right):

- *Controllers*: which ensure the correct data being displayed on the right screen/client at the right time.
- A *Proxy*: which regulates the communication between all devices. The *proxy* guarantees that data security is given - especially in the case of copyright-protected material.
- *Exhibition clients*: Computer with screens or beamer, etc.

All components are natively programmed in *Go*. [11] Since the code is freely available on *Github* [8] and can be updated with the respective playback content, the following explanations focus primarily on the technical structure.[9] From back, which means the *proxy* as data security (enabling communication), to front, in terms of the *clients* or playback, the *Info Screens* work as follows.

Proxy

All clients and controllers establish an encrypted connection with the *proxy* and set up a virtual network. To ensure that the connection is secure, the logon of the clients is certificate-based. Every instance has its own certificate.

The virtual network supports different protocols:

- Via *gRPC* (a high performance *Remote Procedure Call* framework) the *controller* gives the clients display

commands and manages what's exactly shown right now or a defined moment in time (preprogrammed).

- Clients and controller can exchange data over the virtual network via *http://*. The clients do not have to be connected to the free and open internet; content can also be exchanged over a completely isolated LAN-network.
- The network time protocol *NTP* has been integrated into the virtual network via *gRPC*. This component enables the synchronization via an internal clock of the clients and thus allows to run animations over different clients (running text, distributed video snippets on varying screens, hand-over of video signals etc.).¹ Same can be applied to other media that are to be addressed in a synchronized, remote way.

Furthermore, the proxy saves the status of the different clients. Thus, they automatically receive the same content any time they connect. This feature is especially useful if you have setup the devices in a way, that they automatically start up in the morning or after a power interruption: As soon as there is power on (again), they reset in a predefined way. The *exhibition clients* register themselves with the *proxy* and receive (once again) the information/data – automatically, without any human intervention.

Controllers

The *controllers* have two interfaces: a *web-based frontend* and a so-called REST (REpresentational State Transfer) API (see fig. 2):

- The *web frontend* allows addressing the screens remotely and individually. Beyond programming and automation, the clients can thus spontaneously be updated with (remote) information such as e.g.

¹ An artistic example in which different screens are partly covered with videographic images and image-excerpts would be Alexander Hahn's sculpture at the building project "Home of IT" for Roche

(Kaiseraugst, CH). [13] Even if this system has nothing to do our *Info Screens* described here, it shows the creative potential of multiple remotely and synchronized controlled screens.

welcome message for specific guests or emergency information).

- The REST-API enables automation.



Figure 2. Info Screen Network Communication.

The *web interface* contains furthermore a screenshots option, which might remind one of classic light desks for slides (see fig. 3). It allows to create a screenshot of all running clients at the push of a button. The images represent the content being displayed at the same time, in real time at the exhibition floor.

Supported by the debugging protocol of the Chrome browser (see below), the feature is very handy to find errors or to check, if all clients are really booted automatically, e.g. in the morning.

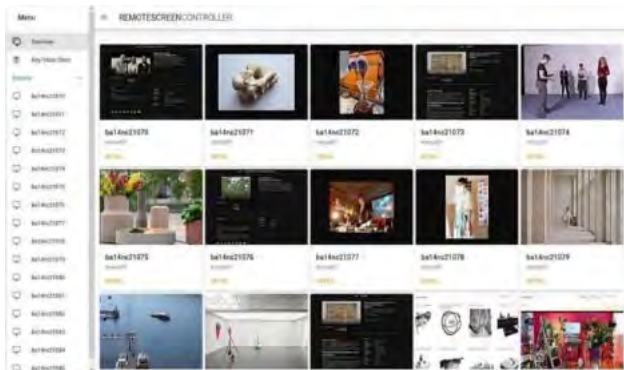


Figure 3. Web interface of controller.

The content to be displayed at the *exhibition clients* is put together in so-called *controller scripts*, which are also delivered to the *exhibition clients* by the *proxy*. These scripts contain the respective configurations, kept in json-files.

Before going more into detail about the curation process (of configuration) and how the *exhibition clients* are actually equipped with content, it is worth to take a quick look at the *exhibition clients*.

Exhibition Clients

For ecological reasons, we use old Macs computers as *exhibition clients*, which were to be discarded. Because they do not have to be connected to the internet and are shielded from the common security risk areas that present vulnerabilities, it is possible to keep outdated computers up running until they die. We have simply replaced the original hard disks with more robust flash drives and installed an image that allows, for example, the automated startup and shutdown of the computers and maintenance for all in exactly the same manner.

Beyond concrete curatorial or displaying concerns, for our context at least, it is only important that a current *Google Chrome* browser is installed on the machine(s) used. Google Chrome was chosen (as displaying App) due to the above-mentioned remote-control option.

We use the browser in its full-screen mode. That's basically all the clients require. Furthermore, if e. g. video or other content with sound is displayed, deactivating the sound might be a good idea in different situations.

Last but not least: Using a current browser furthermore saves programming effort and guarantees that common data formats are displayed correctly.

Digital Curation of Content

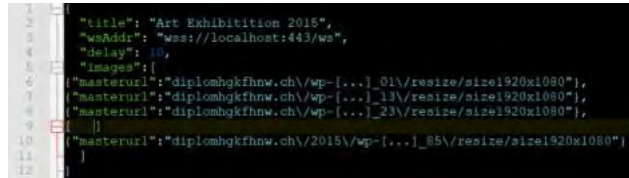
The only thing that remains regarding the *Info Screens* is how the content is to be arranged and played out. For the

sake of simplicity, we refer to the process of selecting and assembling digitized content (data) as “curation action”. Here two types of scripts are needed:

- *Controller scripts* contain the target URLs of the digitized content (images, videos, PDFs, web pages etc.).
- *Media templates* provide the functionality for displaying the different media formats.

Since the structure of the scripts is more or less the same, it seems sufficient to comment on the existing samples, which oriented to the needs of the <institution>. We use currently most of the time media templates with one for each type of media. In addition to these templates for a) slideshows (timed image sequence), b) video exhibitions, c) PDF and d) web pages, combined templates as well as those for other/future formats may be implemented.

All exhibition data must be in an online addressable form – following called *MasterURL*. Once a client receives a dedicated *exhibition file* (json), it plays this very same script until it receives the command for a new exhibition file. Within this exhibition file all information is listed one after the other (see fig. 4).



```
1 {
2   "title": "Art Exhibition 2015",
3   "wsAddr": "ws://localhost:443/ws",
4   "delay": 10,
5   "images": [
6     {
7       "masterurl": "diplomhgkfhw.ch/wp-[...]_01/resize/size1920x1080",
8       "masterurl": "diplomhgkfhw.ch/wp-[...]_13/resize/size1920x1080",
9       "masterurl": "diplomhgkfhw.ch/wp-[...]_23/resize/size1920x1080",
10      "masterurl": "diplomhgkfhw.ch/wp-[...]_85/resize/size1920x1080"
11    }
12  ]
13 }
```

Figure 4. Excerpt of *media template* data for a slideshow.

It is possible to specify contextual information such as the duration of display for the images, overlaying metadata information (such as title, author, date etc.), QR codes, logos for example. The information can be defined for all files in the same way or individually for each *MasterURL* – depending on specific requirements or institutional guidelines.

Fig. 4 shows, for example, a simple slideshow: starting with the displaying information for all images and a duration of 10 seconds, type of script (here: images). In the following area where the *MasterURLs* are presented, you find a command to adjust all images on the fly to fit the display size with <resize>. Defining the background color or image, specific frame-layouts etc. is also possible.

Regarding videos exhibits, one might define starting point or max length (duration) of a file for display. For example, if you don't want to play the whole video, but only a short ‘appetizer’ sequence of 150 seconds starting at second 620, this can be defined within the (json-based) exhibition file.

In case of PDF-data, we always display a QR code so that viewers can download the source and read it at their leisure on their mobile device, for example. And we flip pages after 10 seconds, which can be adjusted, too.

The handling is therefore very simple and virtually self-explanatory. Only the layout of the *MasterURLs* must be converted from backslashes to ‘backslash-slashes’ combinations to support the JSON syntax. If the system is

used more widely, this operation should be automated - using Excel for example or other scripting tools.

Since the software used does not need to be purchased or trained in a complex way, freelance curators or, in our case, students and teachers can put together their own exhibition programs and then have them played automatically on devices that have a current browser - without these devices having to have particularly large memory capacities.

FAIR-Service

Moving from the *Info Screens* to the *FAIR-Service*, a) automation and b) aspects such as institutionalization of services in terms of infrastructural solutions build a common ground. Main concerns of the FAIR-Service become clear by breaking up of the acronym of FAIRness: FAIR actions support the improvement of the *Findability* of (re-)sources, *Accessibility* (in terms of documented availability, including access status), *Interoperability* (for automatized exchange of information) and *Reusability* (by clearly described copyright or license information).

Though the FAIR-Principles [10] were developed in an academic environment to facilitate automatized scientific communication, [4] and exhibition institutions and archive occasionally pursue slightly different interests than science, the FAIR-specification seem fruitful also to curatorial concerns – especially when openness becomes a strategic goal. Skipping strategic issues and concerns regarding the quality of (semantic) metadata, [3] *the FAIR-Service* offers help when decisions have already been made and technical solutions for fulfilling core requirements are need. Within this situation we face three technological gaps, current archives often suffer of:

- provision of so-called *persistent identifiers* (PID), including associated re-direct services (FAIR:F1),
- *OAI-PMH* interfaces for automatized information exchange (FAIR:A1.1), and
- documentation of *deletions* (FAIR:A2).

The following considerations focus on implementation issues such as the database behind the service (*FAIR-DB*), metadata mapping, persistent identifiers, redirection and multi-client capability. Beyond that, FAIR databases or (data-)systems should ensure authentication and authorization (FAIR:A1.2). Regarding further requirements for trustworthy archives see e. g. references [3] [5].

FAIR-DB

Technically speaking, our *FAIR-Service* consists of a small database (PostgreSQL), which we call *FAIR-DB*. This database contains the metadata of the *source* system (archive or collection management database). In addition, it holds an intermediary metadata schema, which allows the conversion of the existing metadata structure to the *target* schemata, which are delivered via the OAI-PMH interface. Even though the target schema can theoretically be defined by the hosting institution, the OAI-PMH interfaces are

usually based on a standard implementation of the core fields of Dublin Core. [7]

The *FAIR-DB* is also able to manage different data sets. This allows grouping of items for selective harvesting. Defining access to subsets is relevant, if data (of an archive) is not to be made accessible as a whole but in dedicated, e. g. curated groups or collections.

If the *source* metadata system of the archive or collection gets lost or is temporarily out of service, the *FAIR-Service* displays the stored metadata information of the *FAIR-DB* on its own web interface or website. Even though this web page delivers rather rudimentary metadata information, since very often only part of the source metadata is made publicly available, the system guarantees continuous access.

Metadata Mapping

Taking a closer look at the metadata of the *source* database systems, the FAIR specifications reveal common gaps. This seems natural as these systems and their primary purpose focus different interests: Collection management systems facilitate for example interinstitutional loans. Long-term

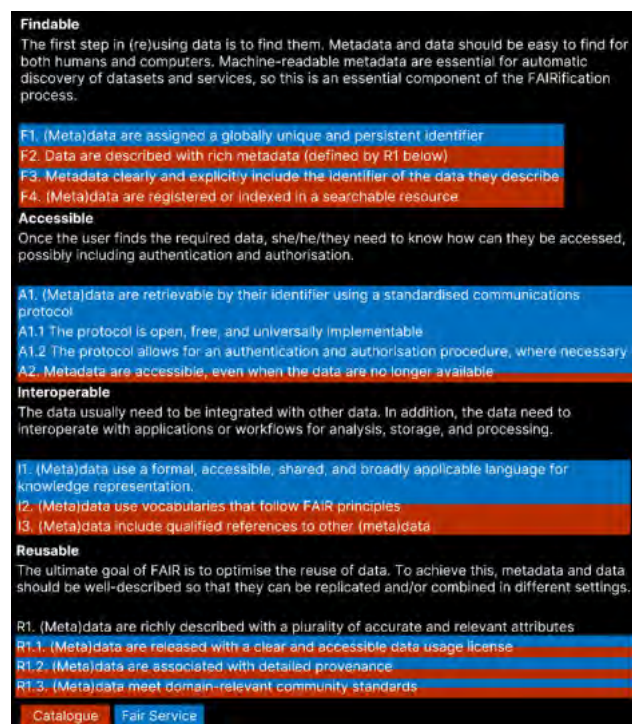


Figure 5. Schematic representation of how FAIR specifications are covered by common database systems.

archiving or preservation systems enable (among other things) monitoring of data consistency and integrity by (re-)calculating checksums on a regular base, etc.. Neither have open, machine-readable exchange options for information as a dedicated or primary aim. Even though the

² A study on scientific open collections was presented by Beer, for example. [16]

situation is different at each institution, one can see that many metadata systems do not natively meet all FAIR-specifications – even in the context scientific special collections [17].

Fig. 5 shows a schematized view on this topic, based on our own experience. It lists the FAIR-specifications by highlighting dedicated requirements. While the red layer indicates information that is usually provided by the *source* database systems, the blue one represents additional needs that are provided by the *FAIR-Service*: Features include persistent identifiers, references to the applied access protocols (e.g. for OAI-PMH), norm-data, open and freely available interfaces etc.

The extent of supplements depends on the institutional set-up or starting position.² With regard to the FAIRness of a collection or archive, the accessibility of the metadata schema and its compliance with common standards play, among other things, a certain role. Therefore, wherever available, vocabularies and/or thesauri used should be accessible. Furthermore standardized (meta-)data such as authority data facilitates communication.

Persistent Identification of Records

Due to the spreading, the *FAIR-Service* generates automatically Handles as default *persistent identifier*. This happens automatically when data is declared as FAIR in the source system in order to guarantee persistence.

Via the *editorial interface* of the *FAIR-Service*, DOIs (Digital Object Identifier) can be generated manually in addition to Handle. This might be of interest when data is dedicated as publication or content shall be (re-)published. Even though one might generate DOI automatically, like many publication servers, we prefer the manual operation due to cost reasons. Not all FAIR-data really required DOI as identifier.

Furthermore sometimes DOIs must be reserved before the completion of a publication: e.g. when the DOI is to be integrated in the imprint of an exhibition catalogue. However, activation/release is only allowed by DataCite when the final publication is indeed available.

While DOI is used in the scientific context mainly for identifying publications (especially articles, text-based resources or more recently data publications), Handle is less restrictive. It is the technical basis for DOI and can be applied for dynamic data objects, allowing updates, growing resources etc. In contrast to DOI, Handle can be assigned by the respective institutions after registration in a cost-neutral manner. If DOI is to be supplied, a mapping to the DataCite metadata schema should be granted, too. [6]

Redirection

Offering PIDs means also to guarantee access even if files are relocated at a server. The *FAIR-Service* therefore contains a *redirector* service.

The *redirector* points to the referenced record in the source data-management system. In our case, the result ends up in a record of the collection catalog, which aggregates content from different sources (databases).

Redirection services as intermediate layer are useful for institutions that have more than one database (e.g. different Filemaker databases or database instances). Providing a common, searchable data view, which is based on a defined (e.g. full-text) index, follows FAIR:F4 specification requirement.

In addition, the *redirector* plays an important role regarding the documentation of *deletions*: In case of deletion, data records should not just disappear. FAIR means that it must be indicated that the data once existed and is for example no longer available.

Multi-Client Capability

The *FAIR-Service* can manage virtual instances. Within the academic context this feature supports universities to provide different repositories or data sets according to the respective disciplinary target communities, layout, expectations of appearance etc..

The virtual instances are neatly classified and grouped by the dedicated area of interest.

For smaller archives or cultural institutions, this feature support inter-institutional cooperation. Institutions, which do not want to or cannot afford providing an own OAI-PMH interface, may join forces regarding the *FAIR-Service*, by staying perceived completely independent from the public.

Perspective

If *FAIR-Service* is used as source or delivery system for the formerly introduced *Info Screen* system, exhibitions can be almost automatically assembled. This happens due to the common metadata format used and supported by the *FAIR-Service*.

In this case, a *controller* script and *template* is developed in which nothing but the internal IDs or Handle/DOI-part of the source is referenced (rather than the entire masterURLs). The script address then the respective master directly. Of course this seems suitable only for items with a clearly identifiable, master media object.

Summary

Summing up this paper, one might state that the *Info Screens* and the *FAIR-Service* represent two opposite sides of the archiving coin of the future: while the *Info Screens* rather face curators or collection-based needs, the *FAIR-Service* directs towards a digital public, which is not necessarily known any more.

By presenting different types of accessibility, both tools direct online archiving towards a new direction in that curation and access are transformed from case-specific, one-by-one solution to an infrastructurally level of automatization and sustainable archival routines.

We are regarding infrastructures as a set of fundamental facilities, systems and features, that support a durable and continuous functionality of an institution. This perspective helps to simplify recurring workflows for archival playback of content and for reaching out to common public requests.

While selection of content and decision making remain subject of everyday curatorial work, the *Info Screen* system shortens, metaphorically speaking, the way from desk to the exhibition space. By doing so, it eases a) the digital display of archival content, b) supports safeguarding resources (Wi-Fi) and c) secures data provision as compared analogue procedures such as copy-paste data carrier solutions.

The fact that all exhibition screens in the building may display important messages in an emergency case – at the click of a mouse – can d) provide a important surplus effect.

FAIR services, instead, and the specific tool in particular increases visibility and outreach of data by presenting a concept of free and open access to data. Following the headline topic of the Danish Open GLAM conference “Sharing is Caring”, [15] one can identify in FAIRness a key element for enabling and promoting access, interest, relevance and impact of cultural assets for the long term.

That this view has long since ceased to be a secret, is illustrated, among other things, by the Open Glam Survey by McCarthy and Wallace, which is continued since 2018 [14]: More and more collections and archives are moving into the public arena and thus create options for cultural participation,

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Jürgen Enge is a computer scientist and head of the IT department at Basel University Library. Previously, he worked at the Academy of Art and Design FHNW Basel, the University of Applied Sciences and Art in Hildesheim, Holzminden und Göttingen (HAWK), the Zurich Univery of Art, Bern University of the Arts, University of Deign (HfG) and Center for Art and Media at Karlsruhe. He has always been interested in the interplay between art, technology and society. He has built extensive and specialized data management and archiving systems. In addition, he has developed countless websites and digital tools that enable (automatized) indexing, sustainability and FAIR access and preservation of cultural digital sources and data. The services described above originate from him. Main areas of work: digital archiving; data & system development; digital communication; information infrastructures.

AR[t]chive – Augmented Reality Experience for a Digital Art Archive

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Abstract

This paper introduces an immersive augmented reality (AR) experience of interactively exploring a digital archive. AR[t]chive is being designed for an exhibition context but also to serve as a research tool, around the content of the Archive of Digital Art (ADA). Archive contents are presented as virtual elements arranged in real space. Users are able to walk among these, manipulate them directly using their hands and use virtual tools to create compositions in 3D space. This work is part of a larger collaboration and represents an exploration of future-facing ways to access and utilize ADA, but can also inspire work on other digital archives. The paper outlines the design of the interactive experience, including the different considerations taken. This is followed by a description of the current implementation, which constitutes work in progress. To conclude, we offer a brief outlook and future directions.

Keywords

Augmented reality, mixed reality, digital archive, information visualization, interactive art, interaction design, human-computer interaction, embodied interaction.

Introduction

Museums and archives may benefit from harnessing the latest digital technologies for better preservation and dissemination of knowledge. [1, 2] Archives which are natively digital hold an advantage in making their content available remotely via digital means, such as web-based user interfaces; offering complex functionality for (re)searching, cross-referencing, organizing and displaying different types of content; and allow users to create and share personalized collections. [2, 3] As the case in point, augmented reality (AR) can allow visitors to interact with and dive deeper into artifacts which are otherwise kept safe behind glass panes. [4, 5]

Due to technical advances and a marked push from tech giants, AR has become increasingly commonplace. Besides the technical facilities offered by personal computing devices such as smartphones and tablets, consumers also increasingly gain access to head-worn AR devices – such as

the Nreal Light headset, which resembles a pair of sunglasses. [6] The tendency is for AR to become ever more prevalent in daily life, complementing or even replacing smartphones as the de facto personal interface for communication, entertainment and information access. [7]

While the user interface (UI) of AR devices like the Nreal Light or the Microsoft HoloLens borrow much from that of screen-based mobile operating systems (such as Android or iOS), soon enough it will be commonplace to access and interact with virtual objects spatially present in our real environment – among real people and objects, while on-the-move, using gaze, voice and/or gestures.

The design space for user experience (UX) and interaction in AR is still open for experimentation. [7] A native AR experience for a digital archive benefits not only that specific archive, but may also be translatable to other archives or collections; and inform the design of future AR applications such as browsers or even operating systems.

AR[t]chive

In this paper we introduce AR[t]chive, an augmented reality (AR) experience which offers participants an embodied and playful way of interactively exploring a digital archive, based on the Archive of Digital Art (ADA, for short) and with focus on the interactive artworks of C. Sommerer and L. Mignonneau. [8, 9]

AR[t]chive is being developed as part of the project “LeFo – Lehr- und Forschungsinfrastruktur für Digitale Künste an Hochschulen” (trans. “infrastructure for education and research in higher education”, please see Acknowledgements for more details). Briefly, the project concerns the expansion of ADA both as archive and as network, as well as the development of immersive interfaces that allow users to access and browse the contents of the database in future-facing ways. With AR[t]chive we explore the possibilities for data visualization and interaction offered by a wearable AR device, the HoloLens 2.

Related Work

Chen introduced an early approach to a virtual reality-based interface for a collection of digital documents. These and the relationships between them are visualized as a force-directed graph. [10] The author introduces a content-based similarity model and addresses issues such as information density.

The works *The Living Room* (2001) and *The Living Web* (2002) by artists C. Sommerer and L. Mignonneau serve as examples of immersive intelligent spaces which track the visitors' gestures and speech, to "engulf" them in images related to their actions and conversations. [9] The project *Naked in Paradise* (2017, ongoing) by Luc Courchesne, is an immersive interactive VR database where assets such as photos, videos, audio clips, texts and 3D objects collected from the artist's personal experiences can be organized and displayed in different ways (such as in a timeline or by categories). [11]

The work *Legible City* (1989) by artist Jeffrey Shaw serves as an earlier example of using text to populate a city-like virtual space which users can explore. [12] More recently, the HoloLens app *Type in Space* enables users to create immersive sculptural or architectural elements by laying out virtual text three-dimensionally in real space. [13]

Technical Framework

The Microsoft HoloLens 2 headset was chosen due to its comfort factor and technical characteristics, and the style of AR experience it offers. These include:

- wearability factor and the see-through display which allows participants to remain aware and able to act in the physical environment;
- native capability to scan the geometry ("mesh") of the physical environment, which can be used to simulate physical interactions between virtual elements and the real environment;
- native hand-tracking allowing for experiences where participants interact with virtual elements using their hands.

The device also provides eye-tracking and speech recognition facilities, which may help to increase accessibility (e.g., for participants with motor limitations), provide an alternative to a virtual keyboard for text-based input and queries or (more generally) complement gesture-based interaction.

The HoloLens 2 is a high-end device meant for enterprise use-cases. While accessible in a research or art production context, it is not a mass-market product. However, it is reasonable to expect that within a few years consumers will have access to similar devices, with a form factor approaching a pair of glasses. While the HoloLens 2 provides for a presently rather unique interaction style, it nevertheless allows us to design and experiment with scenarios likely to be relevant in the near future.

That said, it is conceivable that the experience can be adapted to some degree for more commonplace devices –

smartphones and tablets. Hand-tracking frameworks for mobile devices are already maturing, and some of the latest iPhone and iPad models come equipped with a LiDAR (light detection and ranging) scanner, able to capture the geometry of the physical environment.

User Experience Design

AR[t]chive is initially intended as an installation or experience within an exhibition context, where the wearable device is provided for visitors. This opens up the UX design space for exploration and experimentation. On a longer-term, AR[t]chive or a subset of its features would ideally be made available to users in a wider context (e.g., as a downloadable app for mobile devices) including those who wish to explore ADA for research purposes. As a result, we try to balance the possibilities of playing with the archive content at an exhibition setting with the more utilitarian aspects of the software as a possible tool for research contexts.

Archive Content

The types of media that we can primarily retrieve from ADA helped to shape the design space. These are mainly and presently images, videos and text of varying length, including: artwork and manuscript titles; names of artists, collaborators, institutions and events; abstracts and descriptions. Relations between entries in the database can allow us to display or derive these contents in many forms, for instance as timelines, maps, or clouds.

The Archive of Digital Art contains thousands of entries for artworks alone. To these are connected artists, institutions, events, media and publication, among others. To facilitate our first steps we opted on focussing first on eleven artworks by Sommerer & Mignonneau, as the AR experience will feature in a traveling exhibition format developed around these. We later included the remaining artworks by Sommerer & Mignonneau, using a combination of data from ADA and data provided by the artists themselves (essentially, the archive of the artists' website).

Technical Factors

The characteristics of the device influence the interaction design to an extent. Among these, the characteristics of the display are a major factor.

The waveguide display essentially draws using light, and is referred to as a "holographic display". [14] In contrast to camera-based AR – such as that on tablets and smartphones, where a camera image is captured, augmented with virtual elements and then displayed to the user – the HoloLens projects light to the wearer's eyes. This means that virtual objects with darker colors will either be perceived as transparent or altogether not visible. When displaying a virtual object, image or video in front of a bright surface (such as a white wall), the darker parts of the object or image can be hard to perceive. Thus, the visual design of the HoloLens' native UI employs vivid, bright colors, and its components are referred to as "holograms". [14]

While the user is able to see their surroundings clearly through the transparent visor, the field of view of the waveguide display itself is comparatively limited. If the user approaches a large virtual object, the “seam” between the AR display and the user’s natural field of view would become apparent as the object would be “cut” at the edges. In general, scenes composed of a few relatively small elements (such as a model of the solar system) work better than large elements (such as a car in real scale) or compositions with high density (such as a realistic model of the Milky Way).

Design Guidelines

Taking into account the factors presented above, we adopted the following guidelines.

- *A simple visual style*, considering the device’s limited capabilities and the eventual number of elements to display. Additionally, should the experience be extended to other archives, the visual identity of the interface remains subdued in relation to the actual content.
- *Small modular elements*, especially considering the field of view limitations mentioned above. Small elements also lend themselves better to manipulation. Modularity helps with displaying collections consistently, or creating aggregations at run-time for data visualization. Users can also benefit from modularity, more concretely in using elements as construction pieces (see below).
- *Enable playfulness and creation*, through direct manipulation of elements and by harnessing their modularity. Ideally, information retrieved from the archive can be presented as units or assemblies of virtual “construction blocks” with a consistent behavior. Participants can combine elements to create their own content.

Exhibition visitors may freely experiment and play, even if they are not initially interested in the archive content. Goal-oriented users (e.g., researchers) can follow trails and discover connections, assemble mind-maps and clouds, create moodboards or curate AR exhibitions. This type of open-ended, playful engagement can potentially inform future directions for UX design.

Inspiration was taken from multiples sources, including: construction set toys and games with modular components (such as Lego, BRIO, and also Minecraft); AR/VR creativity and design tools (such as Tilt Brush, Gravity Sketch and Type In Space); as well as link charts or mind maps (such as the investigation boards often depicted in detective movies).

A storyboard draft (Figure 1) was developed to illustrate the interaction aspects of a user’s journey, introducing the basic elements which served as a starting point for the first prototype. The current implementation, described below, is quite close to the storyboard.

Current Implementation

The prototype is being developed iteratively and is considered work in progress. Features are added mostly step-by-

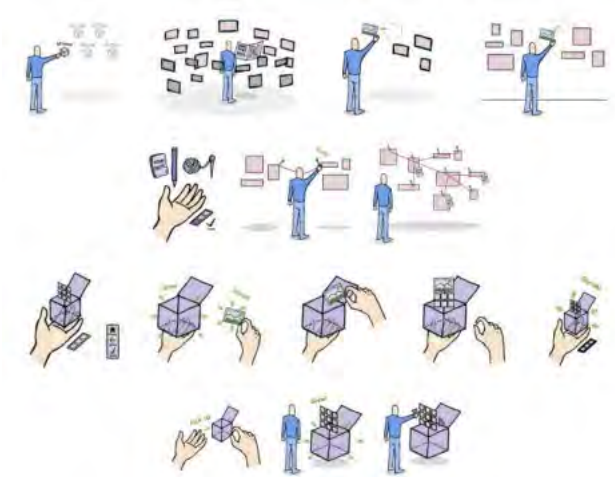


Figure 1. Interaction design storyboard (condensed).

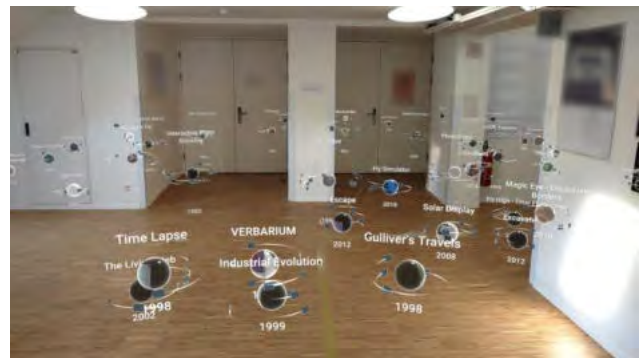


Figure 2. Starting home view, resembling a galaxy.

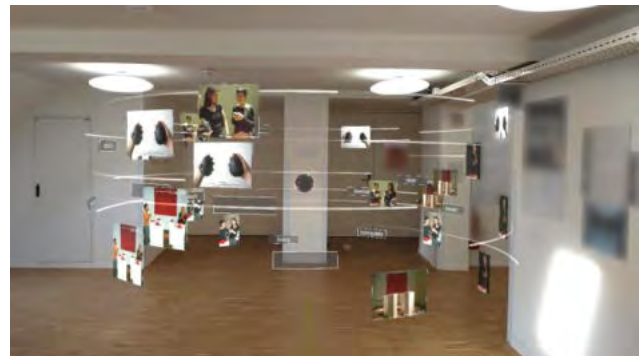


Figure 3. Media related to an artwork, displayed as a swirl.

step and tweaked afterwards. You may refer to the storyboard (Figure 1) as visual aid.

The software is being developed using the Unity game engine, the HoloLens development kit and tools provided by Microsoft, including the Mixed Reality Toolkit (MRTK).

Home (Galaxy)

The participant is initially presented with floating virtual objects representing each of the artworks. While originally

a count of related words (i.e., for a given keyword, those that appear often in the same texts).

Tools

The participant can access a set of tools in the palm of their hand (Figure 6). The pin can be used to create lines, connecting items placed in the world (Figure 7) – that is, not those in a collection like the swirl or word cloud. Also on the user’s palm is an inventory box for storing media items (figure 6). Dragging a media item into the box will store it inside. The box is transparent and displays the most recent items. Given the box’s small size, in order to retrieve items from within the user must first pick up the box and drop it near the floor, in which case the inventory enlarges and displays a paginated view of contents, which can now be grabbed (Figure 8). The enlarged inventory can be picked up, in which case it returns to its smaller size; and placed back on the user’s hand.

The inventory makes it easier to transport several items at a time across a room, but will serve other purposes at a later point. Conceivably, users may be able to switch between several inventory boxes, label them and save them into a personal account.

Conclusion and Future Work

We have introduced AR[t]chive as an augmented reality experience for a digital archive; and an exploratory design for a research tool. While this constitutes work in progress, at the current stage AR[t]chive makes it possible to view archive data as virtual elements in a real three-dimensional space; to manipulate and rearrange these directly using one’s hands; and to feel truly immersed in the resulting composition.

An augmented reality environment may allow users to remix and recontextualize archived materials in ways that would not be feasible using other interfaces or interaction frameworks – for instance a web-based UI. Ideally, users should equally be able to create a link chart for research or a virtual sculpture for fun – depending on their mood or goal.

The interaction design is left open to accommodate further tools, containers, collections or arrangements of archive data. By keeping the audiovisual design, interaction design and behavior consistent between the basic elements we may generate other structures based on these, as data visualizations based on the different types of relation present in the digital archive.

In the longer-term, participants should be able to save their compositions – arrangements of media items and other elements in physical space – and view them later, e.g. on a mobile device and/or web interface. It is also desirable to accommodate a multi-user experience, with multiple users wearing AR headsets, or even a mobile-friendly version of the software.

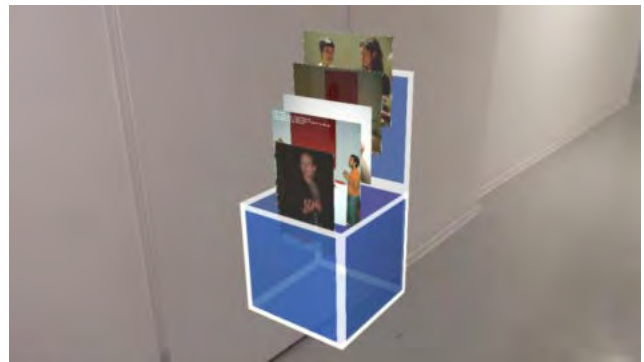


Figure 8. Inventory placed in the environment.

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Practicing Odin Teatret's Archives: virtual translations of embodied knowledge through archival practices

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Abstract

Informed by contemporary research in performance studies, this writing examines the ongoing challenges and possibilities of using XR technologies to create a virtual archive of embodied theatre techniques. This is part of a research project working with the (analogue) archive of Odin Teatret in Denmark, in which we are facing the challenge of transferring the embodied knowledge of actors' training into a virtual navigation system which evokes interaction and affect. We begin by outlining a critical epistemological framework which calls for new accounts of knowledge distribution and the place of embodied and affective praxis within this frame. We describe the process of having different training strands from practitioners of Odin and pupils being mapped with the use of motion capture technology. Further on, we approach one of the key aspects of this research, that of the translation of such embodied techniques and movement qualities into data and, consequently, into an immersive experience of archival navigation. With this paper we aim to contribute to the discussion on documentation of embodied knowledge in present times, one which calls for new approaches to practices of transmission, archive interaction and embodied navigation.

Keywords

Embodied Knowledge, Virtual Archive, Body-as-Archive, Motion Capture, Translation, Theatre Anthropology, Epistemology, Document, Intangible Cultural Heritage.

Introduction

This presentation draws on new approaches in Performance Studies concerned with the development of an epistemological framework for studying theatrical training techniques through archival reconfigurations in virtual reality. Whilst these writings are informed by an ongoing interdisciplinary research project, the aim is to investigate what it means to develop, practice and perform an archive through the activation of Odin Teatret's (DK) embodied

legacy in a virtual environment, addressing the translation of technique through immersive technology whilst developing dramaturgical approaches to archival practices.

Epistemology, a field of study traditionally linked to philosophy, has undergone substantial developments in the past few years, transitioning from a more traditional way of investigating a subject that knows singular with a focus on rational thought, paving the way for a more complex description of knowledge as "situated" [1] and "tacit" [2]. It has adopted theories that presuppose thought and cognition as "embodied" [3] and "enactive" [4], subject to, rather than disconnected from, emotion [5]. Following what Theodore Shatzki has called the practice turn, a notion that is linked to Performance Studies as much as to contemporary social theory, the concepts of knowledge and truth are mediated both by interactions between people and by arrangements in the world. Shatzki considers knowledge not as "the property of individuals, but rather a characteristic of groups, along with their material configurations" [6]. A contemporary archive of theatrical training, therefore, can no longer depend on a static system of representations: "Not only practical understanding, but ways of proceeding and even the configurations of the material environment represent forms of knowledge - it presupposes propositional knowledge and depends on them" [ibid.].

Embracing these ideas, we situate our epistemological account in relation to long-standing practices of work on the knowledge theory nexus in feminist, queer and other critical studies which include the articulation of identity and otherness as entangled matters [7,8,9,10,11]. Furthermore, we ask: what does it mean to account this entanglement as embodied knowledge in the context of a performer?

More recently, this framework has given voice to a growing demand from the performing arts field to document and analyse creative processes and techniques- which in an artist's vocabulary is called training- from an embodied perspective that connects the process of making, an artist's

poetics, to a broader social and political structure. As John Matthews notes, "Because of the specific problems presented by being a body-in-the-world today, training has achieved a new status as a global ideology" [12].

Moreover, the progress made in the fields of technology, information theory, computer modelling, and immersive multi-sensory displays bring the notion of the body-as-archive into a new perspective, especially with regard to theatrical techniques.

Praxical Agency, Technology, and Archive: Incorporating the Practices of Odin Teatret

Odin Teatret is one of the oldest theater groups in the world, with a tradition of research in embodied practices for more than fifty years. The group is the main force of the broader artistic institution known as Nordisk TeaterLaboratorium (NTL) in Denmark, which today is also home to new generations who have built their artistic work in dialogue with Odin's legacy. Over these decades, Odin has built up an extensive archive that is a fundamental source of knowledge for creators, academic students, and theater researchers. This archive involves not only the written documents stored over the years of its long history, but also the codified physical training methods that the group developed to enhance the actor's bodily skills and presence.

A performer's praxis incorporates a series of embodied techniques, and as dance scholar Judith Hamera points out, technique is "the primary tool by which ideals are embodied or resisted"[13]. Thinking "the body-as-archive" [14,15] through the documentation of technical processes, we align with current concerns in the field of Cultural Heritage, where the notion of "document" is being rapidly transformed. Document "has become multimedia information, often even a dynamic form of information that is fully embedded in interactive systems" [16]. In this sense, the dissemination of information through documents has become fluid and volatile. We can argue that "the value of interactive multimedia culture tends to be based on experiences of interaction with interactive multimedia devices, rather than documents"[*ibid.*].

In this way, we follow the current discourse on archival practices by urging users and developers to reread history as a reconfiguration of documents, oral tales, and reconstructions through affective transmissions, where "architectures of access [...] place us in particular experiential relationships to knowledge"[17].

During this project, we are facing the challenge of designing a navigation system through virtual reality, allowing for an embedded embodiment to engage interactively and creatively with the archival material. One researcher in the field of Performance Studies focuses on the content of the archive, with particular attention for the embodied knowledge of Odin Teatre's performers and their trainings, and its translation into metadata. The other

researcher works in the field of computational modeling and virtual technology research and focuses on the design of the navigation system, finding solutions to inform interactive databases.

The challenge is to document actor training techniques in a digital and virtual manner, while allowing for a situated, personal approach, starting from the particular body-as-archive of every practitioner. Instead of focusing on only one Method, informed by the long actor training tradition of Odin Teatret, the interactive navigation design allows space for a genealogy of practitioners to unfold, including both Odin's performers and the new generations resident in their space. As such, the archive becomes a space to incorporate the tensions between subjective transmission and method-acting paradigms.

The body as a living archive is in perpetual modulation and hence not only stores but also creates and redefines the ontological nature of movement and performance into an enduring ephemerality – which corresponds to the changing position of the archive and memory in our digitized culture [18]. The interactive navigation system of the archive should hence not only be used to reconstruct embodied techniques, but also allow for interactive and creative transformation. The development of the navigational tool is informed by current dramaturgical and psychogeography strategies of drifting: a moving through the archive in an undirected way, in which the user charts its own course, however situated and organized by open systems.

On a very concrete level, the starting point are the returning principles developed by Eugenio Barba, the founder and director of Odin Teatret: a series of continuously elaborated concepts and techniques that structure a training. Barba considers the actor's craft in three meanings: he refers to 1) craft as technical skill; 2) as energy or kraft (strength, power in Norwegian); and 3) as the personal and professional identity, forged from technical skills and kraft. These three interrelated meanings are not elaborated from aesthetic or stylistic choices in different performance cultures, but from "pre-expressive scenic behaviors upon which the different genres, styles, roles, and personal or collective aspects of the traditions are all based" [19]. These recurring principles are: altered balance (an alteration of the daily technique of walking, of moving in space, and of keeping the body immobile, which leads to complex, seemingly superfluous 'luxury' balance), dynamic opposition (the way in which a performer's body is shaped by a myriad of micro-tensions between opposing intentional forces), consistent inconsistency (the ways in which scenic behaviour is consistent within the realm of theatrical practice, but inconsistent in terms of daily life), reduction (reducing the size of action in space whilst maintaining the energetic quality in time), equivalence (the building of scenic equivalents to daily behaviour), and actor's dramaturgy (the amalgamation of the pre-expressive principles in the actor's body-as-archive), and they are

investigated with precise reference to the metaphors and technical vocabulary of various performance traditions around the world by Barba [20]. They reside in written documents, audiovisual material, and, most importantly, in the body archive of practitioners.

Barba led an extremely interesting study about the use of energy within several theatrical traditions. He describes the importance of manipulating the energy that exists in any living body as the key to acquiring an extra-daily presence in a theatrical context:

“Every theatrical tradition has its own way of saying whether or not the performer functions as such for the spectator. This ‘functioning’ has many names: in the Occident, the most common is energy, life, or more simply, the performer’s presence. In Oriental theatrical traditions, other concepts are used [...], and one finds expressions like prana or shakti in India; koshi, ki-hai and yugen in Japan; chikara, taxu and bayu in Bali; kung-fu in China. [...] It is paradoxical that this elusive quality is arrived at by means of concrete and tangible exercises.” [21]

Because of the many words one can use to describe such presence, for the purpose of this paper, we will stick with the word quality.

Navigation, affect and translation

In the past few months, we have begun with the process of motion capturing the practitioners involved in the project.

In this mapping of techniques, we are undertaking 4 strands of training inherent to Odin's tradition, and which are dealt with extensively in the current archive:

- Intersections between rhythm and commedia. Here the focus lies on rhythmical techniques that enlighten notions of rupture, dramaturgy, balance, improvisation and relation with objects.
- The Bridge of Winds vocal and energy work. The Bridge of Winds is an international theatre group, incorporated into the NTL and led by Odin Teatret's actress Iben Nagel Rasmussen. The group's training tools have been distilled in five different kinds of exercises. Each of these five exercises were devised to cultivate a specific working energy. The exercises evoke precise corporeal qualities from which the performers learn to draw their theatrical presence.
- Roberta Carreri's Dance of Intentions. This Odin Teatret's actress has developed a complex training process which focuses on an elaborated work of the spine and eyes to activate organic creative material. Her work draws on many masters of Japanese theatre traditions and in a key concept she calls *dynamic immobility*, which brings awareness to inner movements of one's body (Figures 1, 2).

- Vocal and breathing work. Here the focus lies on subtle corporeal layers engaged with vibration, resonators, and flow. Odin Teatret has built a consistent set of techniques to investigate this realm.



Figure 1. Roberta Carreri during her motion capture session, September 2021. ©Bruno Freire



Figure 2. Roberta Carreri and Patrick Campbell during their motion capture session, practicing one of Carreri's exercises called Pushing and Pulling, September 2021 © Bruno Freire

These strands of practices are mapped into data and performed several times, with intermissions for feedback on the capturing process, by 10 practitioners, both performers from Odin Teatret and long-term pupils of them, which throughout their own careers have incorporated and transformed the original practices, adapting them accordingly to situated cultural circumstances, professional careers and contemporary politics that have affected the theatre landscape. This collaboration reinforces therefore the genealogy of the practices investigated, starting from their creators reaching new generations.

When creating such an archive, new possibilities and challenges arise alike. The body of the performer, as well as that of the avatar, present and not present at the same time [22], encode the information within them in two parallel ways. The physical body carries the embodied knowledge in its materiality, while the virtual body holds patterns of

information which can change with the slightest tweak in the code. Thus, it is this translation of information from embodied to patterns of data and then to an experience, which will reintroduce the archive as an embodied experience, inevitably of another nature than the one first captured with the practitioners. We are called to translate corporeal energies into virtual forces, physical bodies into their abstracted virtual counterparts, from physical and vocal technique to metadata to an immersive textural architecture for navigating archives.

After an intense period of experiments with the data captured, we came to realize that the heart of this affective translation process lies indeed on the texture of the archive, the (virtual) space in-between the user and a practitioner's avatar. We have begun to design environments that can change one's movement quality, providing visual stimulus for interaction, allowing us to expand the digital topological analysis and description of actions into an affective and immersive experience to the user.

The interweaving of these textural formations builds the archive like a net: a fabric of lines, textures that make the materiality of this construction more "archi-textural than architectural" [23].

This term, following a tradition of critical thinking in geography and space studies, refers to

"[...] the communicative fabric that mediates between the structural properties of space and the spatial or communicative practices that (re)produce space." [24]

We are therefore, ultimately, aiming for a system which- inspired by Deleuze's ontology- will unfold space as a dynamic force, embedded in topological textures which articulate difference through interaction (Figure 3).

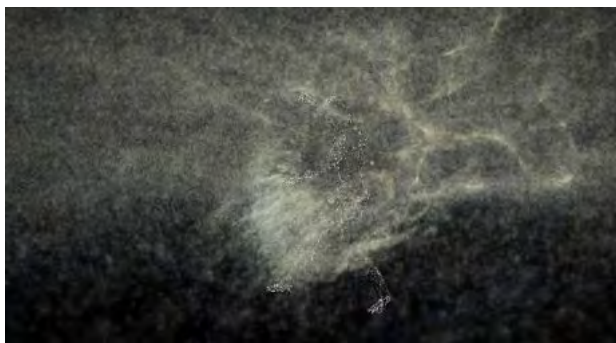


Figure 33. Environment interacting with performer's movement, from Roberta Carreri's exercise called Six states of Water, January 2022. © Ioulia Marouda

Aligned with Deleuze's enunciation that "difference in quality is always subtended by a spatial difference" [25], we argue that the articulation of these differences in one's inner processes can be produced by the encounter of the user with a designed environment. Encounters, from his

perspective, are generative and catalysts of processes of making sense [26], altering one's bodily qualities in similar fashion to the ways in which the recurring principles mentioned above are articulated to enhance a performer's presence.

In dealing with theatre techniques, one's interest and research lies in creating and codifying different *qualities* of moving which are filled with subtle intentions, intensities. In a few words, more than creating scores of movement, an actor looks for the inner processes within these scores. These inner processes have, naturally, an intrinsic relation to physical patterns of movement- slow, fast, strong, soft, etc.

From this context, we have begun to embrace Suely Rolnik's words:

"[...] asking about the politics of inventory becomes necessary since there are many ways to approach the artistic practices one wants to inventory. Such policies are distinguished less by the technical options that guide the production of an archive, and more by the poetic force that the proposed device itself is able to convey. I am referring to its aptitude to make the practices inventoried have the possibility of activating sensitive experiences in the present, necessarily different from those originally lived, but with the same critical density. Faced with this proposal, a question soon arises: what would a poetic inventory itself be like, that is, the production of an archive "for" and not "about" an artistic experience or its mere cataloguing, pretentiously objective?" [27]

As we are now, these designed virtual environments have become praxical territories that stimulate proprioception and kinesthesia, activated through the play between the (im)materialities of the virtual and the actual (Figure 4). As (author's name) has mentioned elsewhere: "The term praxical territory denotes the discipline-specific knowledge we each carry and its imbrication with our wider, lived subjective experience. This fusion of craft and life opens up a 'space and place' that reverberates with legacy and landscapes of mutual belongings." [28].

These new technologies we are playing with are becoming able to allow us to think processes of archiving differently. Not anymore as mere reproductions of what we suppose as truth, but as different translation systems which expose other logics to the process of acting upon knowledge. We begin to step away from the process of knowledge representation towards processes of techno-organic translations, which allows techne to be constantly actualized and re-assembled as models for praxis and transmission.

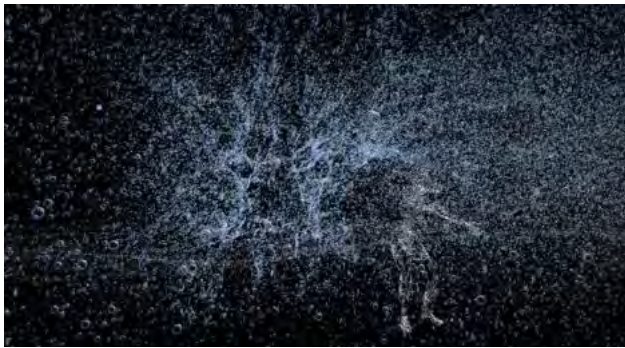


Figure 44. Environment interacting with performer's movement, from Roberta Carreri's exercise called Six states of Water, January 2022. © Ioulia Marouda

Conclusion

We have shared in these writings an ongoing research process, which aims to nourish the pressing discussion in archive studies on how to account for the documentation of embodied knowledge and intangible cultural heritage. The demands of such a discussion in current times call for a careful rearticulation of the goals of the production of archives, bringing space for the experience of the encounter of a user with the living materiality of the documents archived to unfold into new ways of making sense of the embedded (embodied) knowledge displayed.

By elaborating on hybrids of both physical and virtual spaces, we allow a user to drift towards a new awareness of embodied knowledge transmission, production, and distribution, in which the freedom of a theatre laboratory provides the space for an interactive and creative encounter with codified artistic techniques and practices through virtual reality immersion. In this sense, the archive becomes a dramaturgical tool for the actor, dancer and performer, an 'architecture of access' to find one's way through the great amount of data available nowadays through lived experience. By treating archive/embodied heritage as an interactive tool where the main focus is on an interdisciplinary functionality of one's experience, this research gives voice to its potential on fostering innovative expressive communication.

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The Australian Emulation Network: Accessing Born Digital Cultural Collections

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Abstract

This paper outlines a new funded project which aims to conserve and render born digital artefacts widely accessible by establishing an Australian Emulation Network. High value cultural collections from university archives and the GLAM sector requiring legacy computer environments will be targeted. The project expects to generate new knowledge across media arts, design, and architecture. Expected outcomes include stabilising and providing researchers with emulated access to born digital cultural artefacts, sharing legacy computer environments across the network, and establishing an Australian software preservation community of practice, building skills in preserving and emulating digital cultural artefacts with substantial future applications also in scientific preservation.

Keywords

Media arts preservation; digital infrastructure; emulation; Emulation as a Service Infrastructure (EaaS); software preservation; digital preservation.

Introduction

Australians were – and continue to be – significant contributors to the development of digital media arts, design, and architecture internationally. But our digital art and design history of the last thirty or more years is fragile and largely inaccessible to researchers at present, having only recently begun to make its way into cultural institutions and other archives. Such born digital artefacts constitute the record of how we became digital, from earliest endeavours right through to very recent history. The risk of losing this heritage material is real. This project will stabilise these collections so they are not lost, and make these digital creative and cultural artefacts accessible, through emulation. The physical media on which legacy digital objects are stored – whether magnetic or optical (i.e. floppy disks, CD-ROMs) – deteriorate over time. Obsolescence of computing environments is also a significant problem. Once computer hardware, operating systems and utility software become obsolete, files and other software dependent artefacts cannot be opened or run without digital preservation interventions. The solution to these twin problems involves the creation of disk images of obsolete media carriers, which can then be run under emulation. Emulation simulates the function of

obsolete systems and is a key digital preservation strategy for accessing content. These are now widely accepted solutions. For example, the British Library aims to image its entire disk collection, making it available to users in its Reading Rooms [1]. While not trivial, the two-part operation – imaging and making collections available through emulation – is eminently feasible. Realising the scale of the task, digital preservationists agree that international networked, collective action is a must [2], with CSIRO advising “Digital preservation urgently requires coordinated, national, cross-sector approaches to avoid losing access to historical digital materials” [3].

This project is rooted in both international collective action and national, cross-sector collaboration. We will join recent international infrastructure developments – notably the Emulation-as-a-Service Infrastructure platform (EaaS) – together with the learning that our team has gained from research and practice in disk imaging [4]–[6]. We will assemble ‘end-to-end’ software preservation infrastructure in Australian university and GLAM (Galleries, Libraries, Archives and Museums) institutions: this will enable an organisation that currently cannot access a file or an artwork to create disk images and emulate these in house.

Disk Imaging and Emulation

The first part of the process involves creating disk images. Previous work has shown that disks that have not been kept in ideal circumstances fail at a higher rate to those stored in climate controlled conditions (61% to 94%), highlighting the perils that legacy collections with non-optimal storage histories face [4]. One Stanford study found optical media was failing at an alarming rate, with only an 8% success rate imaging CD-ROMs [7].

The second step is to emulate imaged content. Developed by computer scientists at Freiburg University, the Emulation-as-a-Service (EaaS) platform provides access to obsolete computer environments (hardware, operating systems (OSes)) enabling legacy software and other complex digital artefacts to be emulated and accessed by users in a web browser. The most developed emulation solution, EaaS is being used or evaluated at a number of institutions, including Rhizome, the Tate, the Canadian Centre for Architecture (CCA), and the Dutch Digital Heritage Network [8]–[11]. We are currently using it in Australia in two ARC Linkage Projects lead by the author –

“Play It Again: Preserving Australian videogame history of the 1990s” (LP180100104) and “Archiving Australian Media Arts: Towards a best practice method and national collection” (LP180100307) – where it has proven a very valuable tool for rendering the complex digital artefacts we are working with: 1990s games and 1980s and 90s digital media art. Funding from the Sloan and Mellon Foundations to Yale University has enabled a group of US university libraries to develop a networked version, called EaaS (EaaS Infrastructure). EaaS delivers a scalable emulation service, linking US libraries with born digital collections into a decentralised network where they can not only emulate content in house, but also share images of utility software and preconfigured legacy environments with other library nodes [12]. For instance, if a manuscript in one library requires an environment of Word 7 running in Windows 95, an administrator can search for and download the environment someone else has configured, saving time and resources.

Access to the EaaS platform is now being offered via a hosted pilot through the Software Preservation Network (SPN) [13]. This pilot brings together over 15 US university libraries and archives such as Yale, Harvard, Stanford and Cornell University, which will use EaaS to share configured environments. SPN is a membership organisation which our partners AARNet and the National Archives of Australia have joined, together with these North American organisations keen to access the hosted pilot. SPN’s pilot is similar to what we will build. A gateway provides computing power remotely, tracking users and environments and managing resources (RAM and CPUs) as needed, so that minimal IT resources are required from an organisation wanting to run EaaS in house. Controller computers are used by node administrators to build environments in EaaS’s backend, and users access emulated artefacts via a webpage [14]. Such a setup was envisaged by EaaS’s creators as early as 2014, when they wrote of “an EaaS service-provider [being] responsible for efficient hardware utilization and concentration of technical expertise...[lightening] the memory institutions’ technical workload and requirements on necessary infrastructure” [15].

Network Participants and Aims

The project comprises universities (Swinburne University of Technology, RMIT, the University of Melbourne, University of South Australia, Western Sydney University, the University of Western Australia, and the University of New South Wales), National and State Libraries, other major cultural institutions (the Australian Centre for the Moving Image (ACMI), the Museum of Applied Arts and Sciences (MAAS), the Art Gallery of New South Wales (AGNSW), the Australian Institute for Aboriginal and Torres Strait Islander Studies (AIATSIS), and the National Archives of Australia (NAA)), software archives (the Australian Computer Museum Society), a research

technology provider (AARNet), and supporting overseas partners (Yale University, OpenSLX, Cornell University). This grand consortium is necessary as the market has failed to ensure that legacy content can be accessed, and most libraries and other archives in Australia lack the requisite infrastructure and know how. We propose to set up a network of fifteen university and GLAM sites across Australia. This will be a major national facility. Nodes will be located at the sites where digital creative and cultural collections are held. Setting up a network of organisations leverages collective effort and makes good financial sense [16]. The consortial approach builds on: existing networks such as the peak body National and State Libraries Australia (NSLA), collaborative work packages NSLA has undertaken [17], as well as previous projects in which Chief Investigators have been involved: Anna Munster and Sean Cubitt on “Reconsidering Australian Media Art History” (LP100200442) which produced the “Scanlines: Media Art in Australia since the 1960s” database [18], Harriet Edquist on “Design and Art Australia Online” (LE140100120), and Swalwell’s “Creative Micro-computing in Australia, 1976-92” Fellowship (FT130100391). Finally, the project directly benefits from the two aforementioned project collaborations involving installations of EaaS (at Swinburne, ACMI, AGNSW, and AARNet), and the specialist personnel associated (Dr Cynde Moya). The project has secured Australian Research Council LIEF (LE220100057) funding for infrastructure in the form of specialist expertise, vintage soft and hardware, cloud computing, storage, and tools to preserve, emulate, and share software resources across the nation, according to different organisations’ needs. The project will – through a combination of technical infrastructure and knowledge transfer – deliver software preservation and emulation capabilities across 6 of the 8 states and territories, with a high likelihood of future growth.

Joining together, we will build nationally significant digital heritage infrastructure, creating a network of technology, people, and emulation nodes seeded with legacy software and preserved content. Specifically, we aim to:

1. Stabilise at risk media arts and similar born digital cultural artefacts;
2. Deliver access to born digital cultural and artistic artefacts to researchers over an EaaS network;
3. Develop a Community of Practice (CoP) for software preservation in Australia, building skillsets and confidence in preserving and emulating digital artefacts.

Targeted Collections

We will stabilise and emulate culturally significant media arts, architecture and design collections. We target at risk born digital creative and cultural collections across five key domains: (1) media arts; (2) architecture and industrial design; (3) games and apps; (4) AR/VR; and (5) web and pre-web networking. These digital collections constitute key research resources which CIs and their teams require access to. As Sean Cubitt and Oliver Grau wrote of media art in 2011: “As a result of rapid changes in technology, many

major works made even 10 years ago can no longer be shown or are disappearing without a trace. If this situation is not addressed, we face losing an art form that is a central part of our post-industrial digital culture. To date, systematic global preservation and documentation campaigns do not exist” [19]. Part of the Media Arts Histories conference series, the so called “Liverpool Declaration” received some 237 signatures from artists, theorists, and curators, internationally. Cubitt and Grau’s assessment holds equally for other domains. Content is either already inaccessible, often at risk of being lost, or fast becoming inaccessible.

While the collections we will work with are disparate, a decentralised network of organisations and collections is precisely what EaaS has been built to service. What these collections demonstrate is a new focus on distributed collections across the nation, similar to what is seen in the UK AHRC’s “Towards a National Collection: Opening UK heritage to the world,” attracting an £18.9 million investment [20]. The inter-relationships that will surface between the collections will be one of the most exciting aspects of the research that this infrastructure investment will enable. That diverse collections will be rendered accessible through a single platform should augment their usefulness to researchers.

Significance and Benefit

Access to the abovementioned content will enable CIs and their teams to lead genuinely transformational research in born digital cultural histories, across the five domains. Few Australian researchers currently have access to born digital artefacts once computing environments become obsolete, unless they are running an emulation solution themselves. This means that scholars who are commenting on contemporary digital productions, for instance, are doing so without access to digital process or historical antecedents. Rendering these sources accessible will genuinely change what it means to undertake research. Rather than relying on second hand textual accounts or memory, researchers will be able to re-access historic titles or even previously out of reach design drawings, bringing new perspectives to historic and contemporary analyses. Emulation capabilities will generate new forms of evidence, citation – as has already started to happen in video game history [21] – and transformative methodologies. For e.g., architectural and design historians need new methodologies based in artefact analysis to account for the shift to digital design and modelling and the drift toward digital methods of documentation, from the mid-1990s.

We will build a technical and human network, training GLAM and university archival professionals with the skills they need so that the high value archival collections in their custody can be stabilised and rendered accessible. The project is premised on a conception of infrastructure as involving both people and technology. While the Australian GLAM sector has been developing digital preservation capacities, this has often targeted the ‘low hanging fruit’ of digitisation. Despite concerns about the greater fragility and

time criticality of stabilising born digital artefacts, progress has been much slower, particularly as regards software-dependent artefacts. These have often been placed in the ‘too hard basket,’ due to a lack of specialist skills and infrastructure. Each organisation is at a different stage of maturity in its ability to deal with complex born digital artefacts. We will train staff from nodes in universities and the cultural sector in how to create disk images where such training is required, or simply in how to build emulation environments in the EaaS backend. We will seed the development of a CoP by running web forums and seminars where practitioners can share their learning and ask questions, leveraging novel solutions to problems developed by those with more experience.

A Community of Practice will build confidence in the GLAM sector around born digital collecting. Existing GLAM infrastructure has not allowed for collecting or providing access to much of our contemporary digital heritage. This project establishes a CoP, which includes training in imaging and emulating such artefacts, as well as ongoing mutual support with the varied creative and technological challenges. This is critical professional development for the 2020s that will complement what is learnt in library and archival science and conservation degrees. The Australasia Preserves community is committed to the support of digital preservation strategies in Australian and New Zealand institutions, and recent activity indicates strong interest in an EaaS network across Australian institutions [22]. The establishment of such a specialist network will give our partner archives and others in the sector the confidence they need, making future collecting of digital design, including mobile applications, video games, social media, design and engineering documentation seem more feasible. This will in turn enable research into new forms of digital sociality and cultural production, such as app cultures and algorithms.

Deploying the EaaS platform enables legacy software and configured environments to be shared between nodes. Software products are both cultural artefacts worthy of study and enabling infrastructure for accessing digital content. Often, born digital files have been collected without the software required to open the files, or the operating system required for utility software to run. The process of building emulation environments is streamlined by the ability to share imaged software and configured environments. In addition, sharing effectively eliminates competition for purchasing scarce, second-hand software products. Emulation is now a viable strategy with a clear legal framework for use in Australian institutions. Recent changes to the Copyright Act (the “Research Exception”, in s 113J) permit a library or archive as defined in the Act to make research copies of copyright materials and to make these copies available to be accessed at the library or archive or another library or archive, provided certain conditions are met. Partners across the EaaS network will have access to a range of collections of utility software from sites including the Australian Computer Museum Society and the National Library of Australia.

CIs will further develop partnerships with others in the emulation field, for mutual benefit. Currently, Australian media art is probably being studied more in overseas contexts than at home. For instance, Dr Dene Grigar of the Electronic Literature Lab at Washington State University has hosted several artists to discuss and play their work. Dr Megan Heyward visited to make a “traversal” in 2019 – a technique of interviewing people with their artwork running on original hardware – and it was the first time she had been able to access “Of Day of Night” (1996) in almost twenty years. Video traversals constitute a useful form of documentation but they are imperfect as a method of preserving what are inherently interactive works. Not many of these labs are pursuing emulation, so they will likely find themselves unable to access work in the future. Cornell University is an exception. It has been one of the leaders in the US. Prof Timothy Murray wrote widely about and collected CD-ROM art when it was still contemporary, curating the Rose Goldsen Archive in the Cornell University Library; the Library developed a widely lauded online digital preservation tutorial; pioneered good practices in the archiving and emulation of digital media art in an NEH-funded preservation project [23]–[26]; now they are a participant in the SPN hosted pilot of EaaS. Norie Neumark is keen to explore international research and exhibition opportunities between the various Australian and US based collections. Similarly, the Canadian Center for Architecture (CCA) is working with Yale to implement EaaS into their access workflows for born-digital material, specifically building it into their access interface SCOPE. Gaining access to our born digital heritage content now will position Australian researchers to lead debates in our respective fields of historic media arts, born digital design and architecture, and what emulation means for them. Continued contact with other international leaders – such as the CCA and Cornell – will enable us to develop new collaborations, and put Australian artefacts in international context.

While many born digital artefacts are historic, this infrastructure is about the future as much as the past. Rapid obsolescence is making access to relatively recent VR works challenging. Digital work practices are now integral in fields such as architecture, and the future of practice in other fields is similarly digital, presenting challenges in archiving including establishing rationales for preservation, archiving processes and achieving digital continuity. Future historians are going to require access to much contemporary media (e.g. social media) in order to do their work. While digital connectivity has come to the fore during Covid-19 lockdowns and there has been some focus on rapid collecting in relation to the 2020 pandemic (e.g. at NAA’s “Documenting Covid-19 in Australia” (2020) symposium), born digital materials acquired now will need appropriate computing environments to remain accessible into the future.

The Emulation Network will span academic and GLAM institutions, leveraging existing network infrastructure operated by AARNet. CIs and their teams will either access EaaS within GLAM reading rooms on the premises, or on

university premises. Future copyright reforms that are anticipated but not yet enacted may enable organisations to offer remote access to authenticated users in the future [27].

Building software preservation and emulation infrastructure in Australia will have far reaching benefits for CIs, their teams, and the broader research community. While the project focuses on art and cultural domains, the technological and methodological development will have applications across all areas that use and need to study interactive systems. Inevitably, other software dependent collections and datasets will be identified at the universities and partner organisations which the infrastructure can be used to stabilise and emulate, including historical artefacts in education, social sciences and empirical data-rich science. This is in alignment with FAIR data principles, which emphasise that data should be Findable, Accessible, Interoperable, and Reusable [28] and will have important benefits for reproducible science, including software required to reproduce computationally dependent research results. Bodies such as OSF (Open Science Foundation) encourage the publication of complete research works – that is, an integrated set of data, analytical code, results and interpretation that can be re-run and modified at will by future readers and researchers. This clearly requires solving the same issues of long term change in hardware, OS and software that we are addressing in this project.

Stabilisation of obsolete storage media is an area of great need. Collections are at risk with the National Film and Sound Archive noting the “consensus among audiovisual archives internationally that we will not be able to support large-scale digitisation of magnetic media in the very near future. Tape that is not digitised by 2025 will in most cases be lost forever” [29]. Born digital components bring special preservation and access challenges: videotape degrades, magnetic computer disks suffer bit rot, computer hardware quickly becomes obsolete, and software dependencies present special access challenges. Time is of the essence if we are to prevent the loss of digital heritage, protecting the investment Australia has already made via arts funding. And as already noted, an emulation solution is not just needed for archiving the past, but increasingly for accessing recent scholarship, and for contemporary and future digital cultural collections.

Many organisations are grappling with how to develop a full production process for users who encounter content that requires emulation in their collections and need to use it for informational purposes. Yet few institutions have the infrastructure or skills to offer researchers access to born digital artefacts requiring emulation. This project’s focus on emulating obsolete software is identical to the needs of such users and readers. If we are to develop a capacity to safeguard digital collections in Australia, then we must work together, both across the sector and with those who have developed platforms internationally. We need to train a cohort of skilled people and support them with a CoP. We intend to do just that, giving the often professionally siloed GLAM professionals – archivists, librarians, and

conservators – a place where they can turn for help when they run into challenges.

Finally, EaaSII has the potential to complement and increase capability within other eResearch frameworks and institutional platforms, including in scientific and other research data management. This is in line with the international push towards open access, as journals and university repositories increasingly require deposit of research data that supports a thesis or publication.

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SHORT PAPERS

Archiving Strategies in the Computational Age: Creating a Media + Data Art Digital Media Library Based on a Curatorial Methodology

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Abstract

As an innovative solution to the challenges of documenting, indexing and researching new media art, this proposal proposes the creation of the Video-Policy media library (from now on MeViPol) within the framework of the research group HUM-1062: Policies of the audio-visual image and its technological environment in artistic practice. This project focuses on two lines of research. On the one hand, curatorial strategies for archiving works developed in Media Art and Data Art. On the other hand, we consider that the artistic trends encompassed in these two blocks have characteristics of obsolescence due to the rapid advance of technology, so MeViPol proposes a virtual space in which both the programming code with which these works are developed and the records generated for their development, both technical and conceptual, is collected.

Keywords

Interactive Archive, Media Art, Data Art, curatorial politics, territoriality, otherness, art research

Introduction and background

We start from the conviction that audio-visual artistic production and its exhibition and dissemination are knowledge producers. Thus, we face the complexity of contemporary artistic practice. It is increasingly necessary to provide multidisciplinary tools to society and local culture to encourage understanding of new audio-visual languages. From this point of view, we focus our attention on the functionality of the media library, whose main purpose is to protect the audio-visual memory and to point out the importance of image and sound in culture.

Media libraries are resource centres designed to meet the academic community's cultural, educational, or research needs. For Marita Sturken, Professor in the Department of Media, Culture and Communication at New York University, "postmodern excavations of the archive" operate by drawing on its contents and at the same time dismantling its structures. In this sense, "much contemporary art can be seen as a deliberate disarrangement of the archives - institutional, authoritarian, colonial - that were considered a guarantee under modernism" [1].

Although the artistic practices around Media Art and Data Art have become critical elements at the intersection of art, science and technology, there is a risk that threatens these creative tendencies, namely rapid technological obsolescence, which implies, among other things, the impossibility of executing certain projects if the technologies with which they were created are no longer updated or their development is halted. To face this problem, it is essential to develop innovative solutions to deal with the collection of documentation, indexing and media art research [2], i.e., creating up-to-date archiving policies.

We can observe that the computational factor is becoming more and more common in the creative field as it allows for a more fluid construction of interdisciplinary environments of interaction between human beings and technology. As Foncuberta (1998) states: "Electronic culture forces us to rethink the whole cultural and political architecture of our value system, it induces us to investigate its remains and to examine ourselves" [3]. In the artistic field, working with specific programming code has enriched the different disciplines by providing the layer of artificiality that allows the spectator/user to interact with the work more directly, making them a participant in the transformation and state of the work [4].

Other studies in this line of research include the curatorial project entitled Deep Storage, 1998. This became the first thematic exhibition of what is today, for many, one of the most important trends in the art world: the figure of the archive. In the catalogue of Deep Storage, Ingrid Schaffner noted that the main aim of the exhibition was to address "storage and archiving as image, metaphor or process in contemporary art. In many cases, fine art storage has practically become an art in its own right" [5].

From this conceptual framework arises our proposal for the creation of MeViPol, whose aim is to meet the pedagogical, cultural and research needs of the Spanish-speaking academic community specialising in Digital Humanities, specifically in the creative environment linked to Media Art and Data Art. We are committed to reflecting on the

diversity of styles in contemporary creation from a broad understanding that integrates new artistic trends and their staging. We believe that observing these movements will provide new research methodologies and diverse processes of creative experimentation.

The fundamental strategy of this project is oriented towards promoting and experimenting with different multi-purpose digital technologies of modular visual programming that are being incorporated into various trends of artistic expression. These new tools demonstrate their usefulness in representing questions around the construction of identities as a differentiating element in the constitution of societies [6] at a time when the figure of the other, the body, the subject, the territory and, in short, coexistence are inevitably crossed by these digital technologies. In this sense, the creative experiences inscribed in the analysis of the ideas of otherness and territorialisation that we intend to highlight are containers of a specular reflection that unites audio-visual praxis, production of the subject and research of the environment [7]. These principles will lay the foundations for establishing the curatorial line implemented in MeViPol.

This project intends to establish a certain taxonomic order from a purely artistic strategy such as curatorial discourse, that is, to create a "proposition, often affirmative, interrogative, inquiring or denouncing, whose arguments are the artistic manifestations selected by the promoter of the story itself" [8]. In addition, we tried to establish cataloguing based on the conceptualisation of a series of artistic works and practices that use audio-visual support and code support. In this way, MeViPol focuses on updating digital resources and their integration into academic research in the artistic field. We aim to articulate new relationships between theory and practice, linking concepts from science and computer technology with interdisciplinary artistic experimentation, using different digital tools and their transmission in workshops and exhibitions, to encourage, promote, socialise and disseminate the use of Media Art and Data Art.

The different lines of action that precede this project support the intention of establishing relations between contemporary art theory and computational artistic practise within the visual arts. The purpose of this is to point out the fusion between the scientific and creative methods to provide a humanist vision linked to the processes of creation related to Media Art and Data Art.

Initial hypothesis

Our hypothesis is based on the need to attend to the archiving of contemporary artistic material developed in Media Art and Data Art environments to create repositories of artistic work, paying special attention to the results generated with creative programming code, as well as to the software, hardware and resources needed for the

visualisation and compilation of the code with which they have been developed.

On the other hand, we consider it necessary to attend to this progressive incorporation of new generative and visualisation languages using curatorial policies and methodologies [9]. This updating is essential to be able to name, through artistic representation, the changes that the phenomenon of globalisation incorporates both in our experience of everyday life (virtualisation of the environment) and in the shaping of our identity processes, like the desire for identification, in the processes of subjectivation, in the perception of the environment and the Other, in short, in the modes of social encounter. This technological knowledge is a very useful instrument for an artistic reading of our present.

Objectives

In this context, the design and creation of MeViPol have been proposed for the management of Media + Data Artworks by the different formats, content supports and visualisation tools and code compilation. We offer the first approach to creating a diverse and combined collection of audio-visual material with other content in visual programming code accompanied by ad-hoc visualisation tools, which will allow us to collect the necessary information following the MIDECIANT model [9]. The objectives we propose for these purposes are the following:

Objective 1: Virtualisation and musealisation of Media Art and Data Art.

This phase aims to virtualise and musealisation of audio-visual products and their standardisation and homologation to design a repository of artistic production as a historical repository of Media + Data Artworks.

Objective 2: Creation of MeViPol as a repository of the artistic practices of Media + Data Art.

The idea of the MeViPol project arises as a space with a clear academic component for the reinforcement of artistic production conceptualised in principles of otherness and territorialisation with works ascribed to the categories of Media + Data Art.

Objective 3: Content management, access policies and MeViPol dissemination platform.

This objective contemplates the policies of incorporation, acquisition, donations, free access to part of the collection, with restricted access to a database of scientific rigour open to researchers.

Objective 4: Develop workshops and artistic production proposals based on transversal competence training.

The workshops will introduce the tools and produce Media + Data Art projects based on the thematic strategies that characterise MeViPol. The interdisciplinary workshops will specialise in a range of modular visual programming tools,

which will be kept up to date to review the latest software updates and study and incorporate them into these workshops. In this sense, a study has been initiated to establish categories and typologies of software according to their creative use from their application in different innovative trends [figure 1].

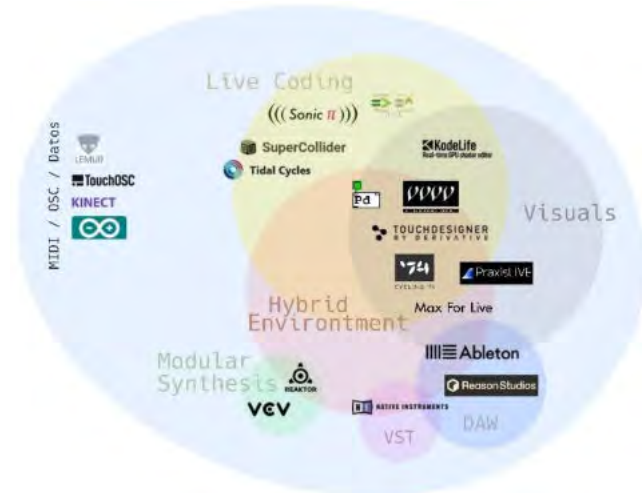


Figure 1 Diagram showing some pieces of software organised by their typology of use in a hybrid creative environment. Image created by Vertedor-Romero, J.A.

Methodology and working plan

The nature of this project is open and alive in its creation and development, where MeViPol is presented as a qualitative online repository formed by artistic projects that will be selected following curatorial criteria and methodologies through various strategies, these are projects created in the workshops, open calls and own exhibitions, following the line that so far has been developed from the research group, HUM-1062. The aim is to substantiate a development community that offers free access to all the documentation and streaming broadcasts of projects in progress, making the devices that generate them visible.

As for the curatorial methodology to be followed, we will reference the principles established by Harald Szeemann. He is one of the key figures that helped understand how curatorial practice expanded as an autonomous field from the 1960s. His contributions form cartography of curatorial practice, from its independent origins in the 1960s and 1970s to the experimental programmes developed by European and American institutions in our own time. Szeemann describes his curatorial methodology as "structured chaos". His eclectic and varied exhibitions "translucent a boundless energy for research and an encyclopaedic knowledge not only of contemporary art but also of the social and historical events that have shaped our post-Enlightenment world" [10].

On the other hand, there are numerous methodological cases for classification or taxonomy concerning the vocabulary of these new media, languages, and codes, aiming to contrast and categorise works developed in interdisciplinary artistic fields. These studies "start from definitions and technological components of new languages" [11]. In this sense, we will take different references as a methodological basis, such as the case of the "Variable Media Questionnaire": The Variable Media approach, whose objective is to preserve the current work of art, a product of new media. This methodological reference develops a questionnaire based on a taxonomy of new media through behavioural categories [12].

To conclude this section, the following flowchart shows the interaction of the project with the parties (figure 2). On the one hand, MeViPol incorporates the experience in developing the structure of similar repositories in previous research projects, such as VOREMETUR, AEMA or MIDECIANT, in which researchers currently present participating in the MeViPol project has worked. We also consider production lines, curatorship, workshops and internationalisation as resources that will provide MeViPol with content. We add the dissemination of results using their internationalisation and transfer through festivals, publications, congresses and other collaborations. Finally, access for researchers is indicated as the main point of consultation.

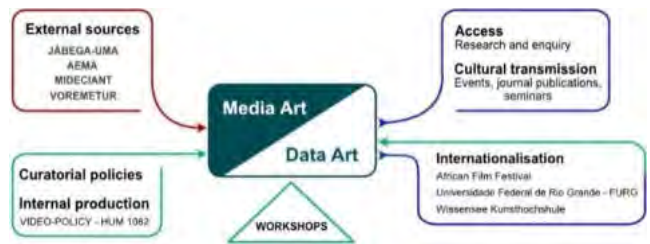


Figure 2. Interaction of the parts that make up the MeViPol creation project. Image created by the project.

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Robles-Florida, J.C. Lecturer in Sculpture since 2019, with three six-year periods of research CNEAI, active, since 2019, Director of the Department of Art and Architecture of the UMA. My artistic research is concerned with making visible the conditioning factors of the formation of desire to elaborate strategies for approaching the Other in the current moment of mass media globalisation of culture. Through photography, video, sculpture and intervention in public space, I open a reflection where the contemporary multitude inhabiting is the protagonist.

Newsslider, smart navigating archives

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Abstract

Currently, the potential of (media) archives in journalism is underutilized. Historical data is scarcely used to connect historical developments to current events. With the design research project Newsslider, we explore how emerging technology (artificial intelligence and natural language generation) can empower journalists to connect historical events to contemporary reporting.

Keywords

Archives, Artificial Intelligence, Research through Design, Journalism

Introduction

The digitization of information has created enormous data volumes in recent years. The digital archives are a rich source of information. However, their potential is often underused (Hawkins, 2021). To what extent can we mine archival information so that we facilitate journalists in using historical data to contextualize the debate on current issues better? How can AI support journalism to include traces of the past in their daily reporting?

In 2019 a research group of journalism researchers from Fontys University of Applied Sciences in Tilburg, Cream on Chrome, a design research studio in Rotterdam, ID Fuse, a Utrecht based AI- development studio, and the Netherlands Institute of Sound and Vision in Hilversum, supported by the fund for Creative Industries, embarked on a design research journey exploring the possibilities of using AI tools to unlock historical information for journalism.

In our design research project, we explored three topics: The German refugee crisis, Brexit and Climate Change. All themes are frequently in the news - and are expected to remain topical for some time to come. Moreover, a historical context is crucial for these themes to interpret and understand the current events and future developments.

Utilizing a mixed method approach (Creswell, 1999), we combined Critical Discourse Analyses (CDA)(Fairclough, 2001), sentiment analyses using automated text mining, And named entity linking, and research through design (Stappers & Giaccardi, 2017).

Critical Discourse Analyses

For the first case study, the German Refugee crisis, we researched how German chancellor Angela Merkel's much-cited phrase "Wir schaffen das" ("We can do this") was portrayed in the German newspaper Süddeutsche Zeitung between 2015 and 2018. As a result, this sentence became a touchstone for migration politics in German media.

Utilizing Critical Discourse Analysis, we came to understand that within three years, the meaning of the famous quote shifted fundamentally: In 2015: "We (the European Union) can help refugees currently stuck in Hungary" to 2016-2017 "We (German citizens) can help accommodate refugees by making an extra effort" to "We (the German economy) must integrate these refugees and give them all a job" in 2018.

The CDA gave a clear insight into how discourse is changing against the backdrop of social, cultural, and political change. The message Wir Schaffen Das thus takes on a new charge.

4-D News installation

To explore how audiences value and interact with this contextual information, Cream on Chrome translated the insights into 4-D News, an exhibition piece that allows visitors to pull up or down a physical scrollbar. Visitors can explore bits and pieces of the original 30 newspaper articles that appear, disappear, and replace each other, thus revealing different sentiments and framings in different times. In correspondence, a small monitor displays the everchanging definitions of "WE", "CAN DO" and "THIS", systematically revealing shifts in public discourse. The 4-D News installation was exhibited at Z33 House for Contemporary Art, Design & Architecture (BE), BIO26 Design Biennale (SLO), Dutch Design Week (NL), and at Hamburg Museum of Arts and Crafts (DE). The

installation was actively used in the exhibition and visitors reported gaining a better understanding of the German Refugee Crisis through interaction with the exhibition piece. The playful interaction with time and seeing the subtle shifts in discourse were specially mentioned as a valuable way of providing information. The installation also aroused interest among media organizations and journalists, who saw opportunities to contextualize the news better in the four-dimensional news space.



Figure 1. 4D News installation by Cream on Chrome.

AI Analyses

In a follow-up study on the topic of Climate Change and Brexit in 2020, we decided to translate the physical installation into an online tool that would encourage wide use and could potentially support both journalists and researchers in their work. This involved partnering with ICT studio ID Fuse, and Clariah Mediasuite, the archive of the Netherlands Institute of Sound and Vision.

The Media Suite is an innovative digital research environment, that allows researchers to explore and experiment with multimedia data collections. With advances in Natural Language Processing and Artificial Intelligence driven methods of extracting information and correlation from textual data, ID Fuse expanded from the above-described process by comparing related keywords to track changing terminology and complex modes of data analysis.

Using these AI-driven methods, we mapped the changes in the climate and Brexit debate. We displayed the tracked information on a timeline, indicating different terminology, sentiments, and important iconic images on the time axis. This provides an overview of how both debates change over times.

The smart technology search options were incorporated into a simple design interface by Cream on Chrome. The Newsslider tool allows users to enter a search term, for example, climate change. Based on named entity linking-where AI intelligently searches the archive and tracks common word combinations (acid rain, emission rights,

ozone layer)- related search terms then appear. Next, a timeline shows how often these terms have been used over time. The polarity of these themes is also displayed. Finally, the timeline shows image fragments that have had a substantial impact on the debate, such as a UN climate conference, Greta Thunberg's speech or a climate demonstration.

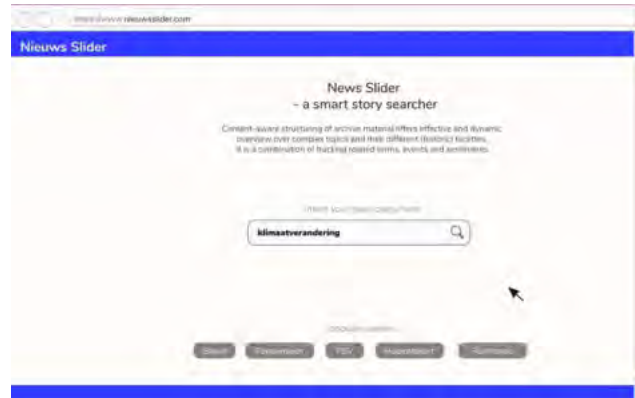


Figure 2. Online tool Newsslider



Figure 3. words linked to climate change, overview of sentiments and iconic images

Design Sessions

During the development of the tool, we conducted four design sessions using context mapping (Visser et al., 2005)- to explore how the tools can be meaningful to (investigative) journalists and researchers. Participants were asked to construct a view on the climate change debate where they share both ideas of the past, the current situation, and dreams of how a future debate could be reported upon.

We organized four context mapping sessions with:

1. Three chief editors and four journalists of regional

and national news outlets

2. One chief editor and three investigative journalists of a public broadcaster
3. Six academic researchers on climate change
4. Four journalists of regional outlets and five ICT experts of Fontys University of Applied Sciences

In these sessions, we had participants experiment with historical data themselves, reflecting on how they currently incorporate historical information into their work and the methods used to do so. We then had them experiment with the Newsslider tool, engaging them in a conversation about how this service could be meaningful in their daily or future work. We ended the sessions by identifying opportunities for integrating the Newsslider tool into daily operations.

Insights

We came to understand that the tool is meaningful for journalists as it gives a clear overview of how sentiments change over time. Journalists say that they can provide better interpretation with these insights.

“This allows us to contextualize the news better and give a positive outlook on topics discussed in more nuance today. The tool shows we do make progress.”

“It also gives us as journalists good insights into ways in which the narrative is changing and how we can continue to question it in our research and interview process.”

The data journalists also mentioned that the tool is helpful as the named entity linking gives a quick and lucid overview of important search queries.

“I see many opportunities for quickly mapping social media data and making smart connections in the data. That could speed up our research process.”

The consulted academic researchers mentioned the tool could support the exploration phase of their research.

“We already use the media suite archive for our research, but see a lot of potential in the Newsslider to quickly identify research topics. The overview of iconic images is helpful in this.”

Furthermore, both the researchers and consulted journalists see opportunities in the tool for the dissemination of research and more public engagement in journalism.

“I find the way you make the archive attractive to the general public interesting. The inviting design and the visual overview of historical information invites to interact with historical information.”

“I could imagine this could be an inviting tool for our news users to navigate our archives.”

The insights generated from the sessions were used to develop a minimum viable product of Newsslider.

So far, the consulted climate researchers already implemented the tool in a scientific application aimed to develop new climate narratives.

The trajectory has also sparked journalistic interest in engaging with archives. The presentation of the tool to regional public broadcasters has now resulted in a follow-up study (2021-2022) focusing on the smart mining of the archive within a regional journalistic context.

Furthermore, we are exploring the educational use of the tool as a way to interest journalists early in their education in new smart search methods as well as ways to include historical data in the journalistic process

Reflection

The thinking through making approach (Rajmakers & Arets, 2015)- where the creation of the prototypes and the systematic reflection on them went hand-in hand, contributed to a fruitful collaboration between the disciplines (journalism researchers, design researchers AI developers, archive experts) involved in this project.

The physical installation of the Newsslider and the active interaction with the physical timeline by museum visitors was a vital step in the idea development of the Newsslider tool.

Incorporating all the complex technical AI capabilities into concrete mockups, allowed journalists and scientists to imagine how this tool could work within their own practice

The design research trajectory taught us that AI driven research methods can be meaningful for the journalistic practice. A design-driven approach in which making the research tangible at an early stage of the process, helps to understand and communicate the potential of new AI-driven research methods with journalists, chief editors and academic researchers.

Furthermore, the strong design language (tangible and visually appealing interface) contributes to a better understanding of the possibilities and the desire to interact with historical data.

To conclude, our design research shows the potential of an AI tool to better unlock the archive for journalistic and scientific purposes. Further research on how this can be applied in practice and how it results in more meaningful journalism is highly desirable.

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Danielle Arets is heading the Journalism and Responsible Innovation lab at Fontys University for Applied Sciences, school of journalism. She is also a researcher at Design Academy Eindhoven. In her research group, journalism researchers, designers, and ICT specialists work hand in hand, investigating technology trends and prototyping future content delivery concepts

Martina Huynh and Jonas Althaus founded studio Cream on Chrome; a socially-engaged experience design Studio based in Rotterdam. By designing multimedia experiences and interactive spaces they explore new perspectives in the fields of economy, journalism, ecology and emerging technologies.

IDfuse is the company of Tijmen Altena and Paul Tuinenburg. IDfuse specializes in the design and support of the process that brings academic knowledge to fruition

Conservation of Multimedia Art: Case Study on Teoman Madra Archive

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Abstract

This paper focuses on the archival process of the multimedia artist Teoman Madra who is an acclaimed artist creating artworks with technological means of multimedia capabilities between the 1960s to early 2000s. Preserving multimedia artworks is a challenging task that requires comprehensive solutions due to the nature of the always-changing technological environment. It is inevitable that there is a paradigm shift from the traditional approach to preserve the artworks as self-contained physical objects to a broader scope of regarding the artwork as an entity with its tangible and intangible dimensions. This manuscript stands as the debut academic dissemination of the intensive archiving process of the Turkish multimedia artist Teoman Madra and it aims to shed light on the missing answers for the following question, "How did the media arts evolve in Turkey between the 1960s and 2000s?" The cataloging process of the linear media (VHS, BETAMAX, miniDV, negatives, diapositive, etc) and the methodologies implemented for descriptive analysis have been discussed in detail.

Keywords

Technological Arts Preservation, Teoman Madra, Media Archive, Multimedia Art, Media Art, Computer Art, Video Art, Cataloging, Metadata

Introduction

No art movement or artistic thought in history has emerged out of nowhere. In the last few decades, there has been a huge increase in the number of digital artworks produced, and interest in this type of art has skyrocketed. In the plethora of audiovisual carnivals, while revisiting Teoman Madra's works today, this study aims to put the missing stone into its place to underline the importance of endorsing the continuous transformation of art's cumulative evolution.

Background: Teoman Madra's Art Career

Photography and multimedia artist Teoman Madra was born in Istanbul in 1931. After graduating from Galatasaray High School, he went to the United States in 1950 to study for his undergraduate education. His interest in Contemporary Art and Avant-garde Jazz Music grew during his education in California and New York between 1950-54. In 1955, he bought his first Voigtlander Vito B camera from a major during his military service in Turkey. In his own words, he defines himself as a Fluxus artist, literally after 1962, thanks to this camera that allows superimposing one after the other. In 1964, his first exhibition - The Abstract Exhibition with Jazz Lines was shown in Istanbul, Beyoğlu City Gallery.

With his debut exhibition of abstract photogram works, Madra had started his half a century career in art production. Between 1970 and 1990, he produced artworks influenced by Fluxus aesthetics that are mainly based on abstract photography, contemporary dance, and contemporary music.

Teoman Madra held his first exhibition abroad in 1967 at the Paris Young Artists Biennial, with the "Photograms in Jazz Rhythm" exhibition. Then, he continued to exhibit his photogram series, which he named Light Games, at home and abroad, accompanied by Modern Jazz music. During the 1970s, he tried to interact with multiple senses with light, music, and movement in the multimedia shows he organized around the concept of Synesthesia. Teoman

Madra defines Synesthesia as the combination of contemporary arts with aesthetic sensitivity and the definition of multimedia as the application of advanced technology to new areas of use in unusual environments.¹

In 1985, he acquired his first computer, the Amiga. While he continues to exhibit multimedia shows at every

¹ From a program note on the Synesthesia 83 performance at the Turkish American Society, 27th of May 1983

opportunity, after a while he begins to include computer-generated visuals in his works. He is one of the leading artists in Turkey, who prepares multimedia shows accompanied by contemporary music using these new technologies in the 1990s. In an interview, Madra summarizes his work as follows: “I am creating my work on random fiction. I combine technology with art. I reshape the photograph using digital possibilities. I create images as I want at that moment without a certain scenario or rule. There is always contemporary music in the background. I can say that my works are more abstract and experimental.”

In Madra’s early works, we are observing a series of experimental photography works based on the techniques of photogram and long exposure. These works have been generated by moving a flashlight gently in front of an open lens with hand gestures accompanying modern jazz music in a dark room. Similar to the work of a painter on a canvas, with the harmony of the music, various shapes and compositions were produced inline within the spatial depth that the photography provides.



Figure 1. Light Games (circa the 1960s) ©Teoman Madra Collection.

Table 1:

Archiving Processes and Brief Definitions

Exploration of the collection	Detecting the archival material and researching related archival material
Technical Examination	Inspection of the physical and digital material, draft categorization for conversion operation
Media Conversion	Converting existing media formats to updated formats, digitization, storage
Determining significance	Distinguishing the relevant materials, eliminating the redundancy
Building a Data Structure	Configuring a proper data structure for cataloging items effectively
Copyrights Management	Managing intellectual properties, negotiating licences, describing usage rights
Preservation	Configuring maintenance measures, prevent physical deterioration
Accessibility	Allowing outside users to explore the contents and to participate the process

Preservation Strategy: Technical Examination and the Digitization Processes

Since it is necessary to approach the classification of technological works of art through the overlapping axes of art, science, and technology, it becomes difficult to make a clear and comprehensive definition. [1] As a consequence, the emergence of portraying artwork-specific methods and processes becomes inevitable when preservation measures are considered. The targeted methods and the planned

processes within the scope of this research have been described as in the above chart.

The initial step of archiving the Teoman Madra works was attempted in January 2021. The archival materials were located in three different locations, a large collection in Madra's hometown, Ayvalık, and the remaining in Madra’s home and a depot in İstanbul. Physical storage media were abundant in the form of prints, dia slides, negative films, VHS, Betamax, miniDV, hi8 video tapes, DVDs, CD-ROMS, hard drives, and thumb drives. However, no proper cataloging effort had been done

before, and the materials were about to deteriorate due to poor physical storage conditions. Also, except for a few items, they were not identified by proper name tags. Transferring physical materials to digital media was an urgent necessity for long-term access. First, the existing materials were organized into groups according to their media types i.e. VHS, Betamax, negatives, prints, and they were tagged physically with such media type-based unique identifiers. Later several digitization processes have been implemented with different techniques due to the varying medium necessities. According to Cleveland, digitization is the process of scanning, sampling, or even re-keying any fixed or analog medium, such as books, journal articles, images, artworks, or microforms, into electronic form. [2]

In the scope of this paper, we include only the archival process of static images and linear temporal multimedia works. In the beginning, due to the inability to predict the vastness and usefulness of the materials at hand, the digitization process mainly relied on the simple recovery of the analog content while establishing the referential links between the original media and the digitized content. Thus, it is assumed that those who would like to set up research on the archive, should need to use the referential system to gather more precise and high-resolution visual content with the technical capabilities of the time. After a year of intensive work on the hard cataloging and digitization process, 351 hours of linear media (VHS, Betamax, miniDV) and 14,494 slides/negatives have been digitized and backed up safely on local drives and cloud storage services. As Gómez-Baeza states conservation does not end with digitization but presupposes a continuous struggle with the medium itself. [3] Preservation's principal aim certainly is to provide access to the original, but continuous technical advancements pose a threat to this aspect. Likewise, digital preservation should be seen as a constant effort to remediate the existing content. [4]

Cataloging Digital Media

The cataloging process has been initialized after the digitization of all accessible media was finalized. This process requires a detailed descriptive analysis since there are no work-specific statements of the artist nor a title is given. The question asked at first was "What am I cataloging?" as recommended in Cataloging Cultural Objects to set a framework for the choices to be made. [5] Teoman Madra was an artist, who practiced photography and video as an artistic medium, as well as a decent documenter. Since both videos and photographs have the potential to be an art medium in itself and also documentation for other works of art, it is essential to differentiate whether a recording from his archive should be considered as artwork or documentary. Teoman Madra,

as a multimedia artist, was collaborating with many artists from various disciplines such as contemporary dance, performance, and music, by this means, he was actively taking part in the art scene of the time. That being the case, his archive includes his artworks and additionally many documentation of artworks owned by others, happenings, and events at the time. These documentations have not been eliminated from the digital archive, because besides the potential to reflect the art scene the artist is in, they contain records that may not even be available to the authors of the works being recorded. In the process of developing a fielded database, this dual nature of records, the possibility of being documentary or artwork, was taken into consideration.

After what to be cataloged has been decided, the second step taken was to agree upon data standards including data structure, data values, and data content for the sake of consistency in descriptive cataloging and an increase in end-user access. [6] In the establishment stage of standards, starting from the data structure which can be described as the metadata element set to format the database of records, the widely acclaimed schemas were investigated. Although there is no such scheme as a "one-size-fits-all" metadata system, many major museum management systems' data dictionaries are based on the CDWA scheme. [7] Categories for the Description of Works of Art (CDWA) schema have been chosen for this archive as well because of its widespread use in today's digital museum systems with its comprehensive categories for characterization of artworks and allowance for integration of data to other systems.

Once the database structure was built, examination of all digital materials was started. The first data entries were the records of the digital scans of negative slides. Thanks to the descriptive naming of each image file done by Tulya Madra, daughter of Teoman Madra, data values were filled following her identification regarding the characters, events, and locations the photographs were taken at. Since Tulya Madra is largely an eyewitness to the artist's production, she can examine the contents of the photographs based on her own experiences. The titles of artworks remained 'Untitled' followed by consecutive index numbering since there are no specific names given by the artist himself. Next in order comes the examination step of the video recordings, the digitized versions of VHS, Betamax, MiniDV, etc., which requires further feedback from project holders. In that stage, each file was aimed to be cut into multiple coherent pieces concerning the artist's intention of creation. In general, the partition operation was performed based on empty tape displays in between the video records. If not so, the pieces were arranged according to the content of scenes, their visual style, or the musical compositions. The obtained pieces were uploaded to the previously obtained cloud service while keeping them

together in the same directory with the original recording untouched. In the descriptions of these pieces, both the phrases the artist gives references to and the appropriate choice of keywords from the initially decided tag cloud were provided. Even though the artworks or documentaries were described by project holders using associated terms, the data values for other identifiers including the characters who took part in, the locations, or the date when the artwork was born could not be presented distinctly. It is considered that the data contents, which cannot be fulfilled at this stage of the research, would be completed in future studies. In such cases, where the information for core fields, marked as necessary by CDWA authority, is missing and can not be supplied for previously mentioned reasons the data values are substituted with “unknown” values as recommended in the CDWA List of Categories and Definitions. [8]

Future Work

On the current course, the digitization and cataloging stages necessitated a significant amount of archiving effort. Nonetheless, there are many more to be taken in this path. After all digital media is examined by authors, the subject tree, in other words, the classification scheme, will be constructed following the content of the Teoman Madra archive since it will be fully observed. The Art and Architecture Thesaurus by the Getty Research Institute has been determined to be used for that purpose by the reason of its multilingual, semantically structured thesauri which is described as a powerful tool in the case of enriching the knowledge and providing valid interconnections for cultural heritage information resources by Baca and Gill. [9] A subject tree can be described as a hierarchical structure of named categories that might be browsed for information on a specific subject in a web directory. In the stage of developing a subject tree, the polyhierarchical approach will be taken. In this way, the same subcategory will be accessible under various categories. This approach will provide more flexibility in the categorization of such a digital environment with its allowance for several routes that make users access the requested information. [10]

In line with the explanation given above regarding the cataloging process, one may suggest that the approach is biased since it solely depends on the judgment of project holders because of the lack of formal information. It is undeniable that the scarcity of artist statements or art critiques specified for individual pieces leads to ambiguity in the case. Since the artist was not able to be involved in the process due to health-related concerns, it is not possible to claim that the archive is purely objective, on the contrary, requires the interpretation of authors relying on how they perceive these historical records of the past technological works. However, in addition to being

individual collection pieces, the artworks became knowledge bearers for events and experiences of the past if they are preserved and thereby embedded into an archival system. [11] Thus, the collective examination is a necessity in the case of providing an unbiased approach to works, and also for the fulfillment of missing stones in descriptive identifiers. In line with this purpose, the database of records will be open to discussion in gatherings for whom it may be concerned, the people who were collaborating with the artist, the art critiques of the time, etc. The process of digital art preservation is therefore interdisciplinary, not only because of the collaborative character of its creation, moreover because it necessitates the participation of many other professions for the required combination of theoretical writing with practice-based research. [12]

Conclusion

At this stage of the archiving study, the first five steps of the archival processes (Exploration of the collection, Technical Examination, Media Conversion, Determining significance, Building a Data Structure) that were listed in the chart previously have been achieved. By labeling the original documents belonging to the archive, it is possible to access all the source material in a single physical location with the relevant index references when necessary. After all the digitized contents are categorized, the classification process continues intensively. In the second phase of the research, the remaining materials will be covered with similar methodologies applied. Especially as a result of the widespread use of the Internet since the mid-1990s, we observe that Teoman Madra has appeared more in this environment. In addition, the works he produced with the iPad in the 2000s, which he started to use frequently in the last stages of his active artistic production, will be examined in depth at the second stage of the project.

There are many goals and benefits to be achieved with this research. The first of these is to present important analyzes of what was done in the past in the field of Turkish Media Arts after the 1960s, by leading the work of Teoman Madra to come to light. Another desired outcome is to facilitate the access of Teoman Madra's video documentation to the masses, thus enabling more analysis to be made about the recent history of the cultural and artistic environment. If we look at the issue from a broader perspective, this research presents a comprehensive case study on the preservation of technological art and thus opens up original solution proposals for relevant discussions. It is possible to say that after the archiving work is completed and the archive is made accessible, further research and analysis on the archive will incline to follow.

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Authors' Biographies

Selçuk ARTUT's artistic research and production focus on theoretical and practical dimensions of human-technology relations. An author of six books and an editor of one, Artut is an Associate Professor at the Visual Arts and Visual Communication Design Program at Sabancı University, Istanbul where he mainly teaches Sound and Interaction Courses.

Multidisciplinary artist Begüm ÇELİK is pursuing her master's degree in Visual Arts & Visual Communication Design program where she completed her B.Sc. in Computer Science & Engineering in 2021. Her artistic production is fed from her interdisciplinary journey by combining technology and performance since she is engaged with many theater practices.

historical approach led to Artpool's 40 years long history, and characterizes the engagement towards the digital archival methods evolving during the decades.

Artpool.hu developed between 1995-2020 was the first website of art institutions in Hungary. The nineties are known as a period not only characterized by the techno-optimistic vibe around the emergence of the Internet, but also by the positive expectations towards the change of the regime in the post-socialist region. Information on underground art was hardly available publicly before 1989, therefore the potentials of the World Wide Web as a global network established an utopian atmosphere for artists, whose activity was formerly controlled and censored. Artpool's website illustrates the enthusiasm for developing a complex hyperlink-structure by creating a multimedia environment for artworks and information on the Hungarian and international artworld, linked to each other on several layers. Inspired by Galántai's former mail art activities, the Internet served him as a platform for communication and building networks from the very beginning. [Figure 1.] The net provided possibility for Artpool to share information on the avant-garde art of the 1970-80s, and by doing so creating the largest database of the documentation of underground art in Hungary digitally, also including the documentation of experimental practices by utilizing the multimedial potentials of the web.



Figure 2. Home page in 2015, Artpool website, accessed January 18, 2022, <https://artpool.hu/Defaultte2015.html>. © Artpool Art Research Center – Museum of Fine Arts Budapest.

This example of experimental archiving also illustrates a specific methodology of the process of self-historicizing, introduced by Zdenka Badovinac in regard of the archival practices of the post-socialist region. [1] Artpool's activity on the website can be traced back to the antecedents of the establishment of Artpool, György Galántai's Balatonboglár Chapel Studio between 1970-73, as an illegally organized hub for avant-garde artists whose activities were restricted and isolated by the socialist regime. The first unite of Artpool's archive was compiled from the materials collected at the Chapel Studio, later also shared on the website. The

Artpool website supplies several functions of a digital archive, such as the encyclopaedia, [2] chronologies ("context chronology", mail art chronology, "surveillance chronology", etc), [3] collection of bibliographies, [4] register of artists and actors of the underground, [5] and the huge amount of digitized visual content shared online. Artpool.hu is therefore not only a virtual space for sharing knowledge based on the materials of the archive, but also a platform for documenting the operation of Artpool itself, as a self-archiving method.

The current conditions of the webpage are strongly connected to the institutional transformations around Artpool over the past decades. After operating as an illegal underground project during the socialism for more than 10 years, and as an NGO for another 25 years, in 2015 Artpool became a department of the Museum of Fine Arts Budapest, as a result of the ongoing political attempts in Hungary, rendering the existence of non-governmental organizations nearly impossible. The new institutional circumstances were accompanied with the assignment of the new generation of leadership of Artpool, which together with the operation as part of a state institution has urged the renewal of Artpool's website. The new version of artpool.hu was published in 2021, however, the previous version remained available as an artwork-like page from the new site. The archived webpage is therefore not only interesting for studies of web archiving and Internet history, but also serves as an experimental digital archive of the Hungarian underground art, especially on the 1970-80s.

The renewal of the webpage was one of the first results of the musealization. Already in 2015, when Artpool became a department of the Museum of Fine Arts Budapest, Galántai released a new home page on artpool.hu with the title "After the end of history", [6] [Figure 2] referring to Vilém Flusser's essay *On the end of history*, [7] thereby reflecting on the institutional transformation also effecting the interpretation of Artpool's history. As an initially avant-garde project, Artpool was never intended to become part of a larger entity, but its existence became dependent on financial and infrastructural support.

Besides the presentation of the Artpool website as an online archive, this paper intends to reveal the possibilities of maintaining the avantgarde nature of Artpool's archive despite the ongoing institutional transformation, with a focus on the potentials of digital archival approaches. The paper builds on the hypothesis, that the challenge does not lie in the sufficient use of the digital infrastructure for archiving, but rather in the potentials of operating with an underground attitude within the contemporary digital environment. By examining Artpool's example this case study also reflects on the perspectives of digital sovereignty within institutional frameworks in the art sector.

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“The Right to the Image”: Ethics of Representation and Appropriation in New Media Art Archives since the 2011 Arab Uprisings

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Abstract

In 2017, the Syrian video art collective Abounaddara, that earned international acclaim for documenting Syrian life amidst conflict, removed the vast majority of its videos from their Vimeo archive in response to what it regarded as their improper use by the Triennale Milano. Curator Massimiliano Gioni countered that the exhibition only made available material that was already in the public domain and that underscored the Triennale’s commitment to Syrian migration struggles. This case illustrates ethical concerns regarding authorship, authority, consent, and copyright that permeate the presentation of openly accessible digital media archives as part of international art exhibitions—which are exacerbated when they pertain to representations of conflict and violence. Now more than ever are we in relationships of moral, affective, and material intimacy with violence, and this calls for a reconsideration of how our senses are solicited by and implicated in the conduct of conflict. Taking Abounaddara’s video art archive as a point of departure, this paper discusses practices of engagement that can respond to the growing demands and responsibilities inherent in new media art archives of conflict and violence.

Keywords

Ethics of appropriation, representation of conflict and violence, 2011 Arab Uprisings, Abounaddara, authority, authorship, consent, copyright, public domain

Introduction

In the wake of the 2011 Arab uprisings, the widespread hope in the democratic potential of the digital spawned numerous crowdsourced new media art initiatives to challenge archival authority and ideological narrativization commanded by state institutions and global news networks. Yet, while the capacities of the internet have enabled recording, sharing, and archiving the revolts in an unprecedented fashion, these facilities also instituted a globally dispersed reinforcement and recalibration of power, turning memory and knowledge into commodified and copyrighted goods. As Donatella della Ratta, Kay Dickinson, and Sune Haugbolle argue, the corporate online platforms and international exhibition circuits that enabled the emergence of such ‘counter-archives’ also lodge them in informational economies that inflect their liberatory

potential and render dissenting subjects and documents vulnerable to various forms of power. [1] In light of resurging protests and rising authoritarianism across the Arab region and beyond, discourses around archival repositories and historiographic narratives have acquired a renewed and contested urgency. As researchers, curators, image producers and spectators at a distance, it is essential to question prevailing patterns of recognition and representation in order to develop practices of engagement that can respond to the growing demands and responsibilities inherent in new media art archives of conflict and violence.

Since its foundation in Damascus in 2017, an undisclosed number of volunteer, self-taught filmmakers have gathered in the collective Abounaddara to produce short videos with French and English subtitles which are freely accessible on the virtual video-sharing platform Vimeo. The name Abounaddara translates to ‘the man with glasses’, both a hint towards ‘seeing clearly’ and a reference to Dziga Vertov’s seminal documentary film *Man With a Movie Camera* from 1929. Violence rarely becomes directly visible but resonates in anecdotes and stories of commonplace protagonists as well as through video collages of international media coverage and archival footage. [2] By appropriating the aesthetic and formal language of documentary film, Abounaddara seeks to make visible everyday life amidst the civil war. This approach is formulated in opposition to the economy of news gathering and the instrumentalization of citizen journalist practices that went hand in hand with the militarisation of the Syrian conflict. Through processes of anonymization and the display of an increasing level of violence and suffering, ‘the Syrian has been transformed from a dignified revolutionary into a victim who provokes only sorrow or disgust.’ [3] Accordingly, this has led to ‘an unprecedented banalisation of evil,’ that leaves the audience barely ‘a choice between indifference and compassionate voyeurism.’ [4] The collective asserts that, ‘if Syrian image makers want to reinstate the dignity of their compatriots, they must seize the means of production of their own image’. [5] Thus, it is a key concern for Abounaddara to maintain the position of both author and producer of their work.

However, in 2017, the Triennale Milano featured Abounaddara's video art archive as part of the exhibition *La Terra Inquieta (The Restless Earth)*—even though the collective had explicitly declined the presentation of their videos in this context. Their refusal was grounded in the fact that they considered the Triennale's focus on the plight of Syrian migrants and refugees opportunistic and did not want their work to be subsumed under a politico-aesthetic discourse which privileges a Western point of view. [6] When the collective became nevertheless aware of the presentation of their video archive through reviews of the Triennale, they asked for the installation to be removed—a request that was only granted following public outcry. Curator Massimiliano Gioni insisted that the exhibition simply made available monitors connected to the Vimeo archive which was already in the public domain. While he acknowledged the ways in which Abounaddara is reframing issues of authorship and distribution, he questioned the collective's position on maintaining control over their videos, 'that is more restrictive than their own work would seem to suggest.' [7] To this neglect of authorship and abuse of copyright, the video collective could not resign 'except to renounce our fight for the right to the image.' [8]

In effect, the case of Abounaddara serves as a mirror image of our representational apparatus, extending the hegemonic viewing patterns that underlie global news networks to international exhibition circuits. In contemporary art spaces, their videos are framed as raw material for pedagogy and presented as instruments to facilitate ethical responses. As such, the Triennale reproduced the very power structures it sought to criticise, reflecting the sensorial-material infrastructures that perpetuate spectacles of indignity and that fold us as global spectators into complicity with conflict and violence.

I cannot purport to occupy a position outside of the digital sensorium that makes such patterns of viewing and structures of feeling possible. As Asma Abbas has noted, liberal societies are sustained by an uneven distribution of pain between those who suffer and those who are solicited to redress that suffering. The solicitations of empathy, sympathy, and compassion offered by humanitarian art forms thus confirm, rather than challenge, this uneven distribution of suffering. [9] With Daniela Agostinho's words, and in more materialist terms, 'the plight of others is not a mere object of representation, but the very material condition that makes such aesthetic forms possible.' [10] Moreover, Christina Sharpe argues that the incessant circulation and repetition of images of distant suffering as well as their formalisation in aesthetic and art practices do not lead to a cessation of violence but often 'work to solidify and make continuous the colonial project of violence.' [11] Sharpe urges us as distant spectators to think about what these images call forth, to think through what they call on us to do and feel—and how we might be able to refuse the positions and feelings solicited by humanitarian art forms.

The technologies of war connect us across the globe through virtual networks in everyday digital environments and create invisible infrastructural proximities. Now more

than ever are we in relationships of moral, affective, and material intimacy with distant conflict and violence to the extent that we are always embedded and sensorially implicated in the cruel images they convey. This prompts us to consider scale differently, in that it compels us to ask 'whether one can be intimate with the far away, across distance and incommensurability.' [12] Yet, I do not want to suggest that the digital connection provides at the same time social, cultural, or emotional connection; my point is that we require an ethical understanding of distance and proximity if we are to create and sustain a sense of each other sufficient not just for reciprocity but for a duty of care and responsibility. This is to say that our relationship to conflict and violence goes beyond the question of seeing or "looking away"; in an intensely and extensively mediated global world, we are always in relation with their cruel images—even if we do not see them.

To challenge hegemonic and algorithmic infrastructures of knowledge production and dissemination, a still growing number of citizen-led initiatives to archive the 2011 Arab uprisings claim and insist on the right to intervene in and act upon the reservoirs of collective memory. Appropriating the predictive function of the archive as a technique of power, these crowdsourced archives subvert the aesthetic, economic, and geopolitical systems enabling or impeding certain images and protagonists to appear on the plane of the visible—and thus to come into being in past, present and future. This proliferation of citizen journalist media and the concomitant rise of crowdsourced new media archives in the wake of the 2011 Arab uprisings prompt us to reconsider our spectatorial positionality and archival agency. In doing so, the space of image production and reception can expose epistemological gaps in digital and datafied repositories, sensualise what has been abstracted, reconfigure what counts as an archive, and imagine new forms of accountability from within the aesthetic field.

Taking Abounaddara's video art archive as a point of departure, this paper addresses ethical issues that permeate the presentation of openly accessible new media art archives as part of international art exhibitions—which are exacerbated when they pertain to representations of conflict and violence. The presentation will unravel the network of relations between image producers, image protagonists, and image spectators as they converge in crowdsourced archival initiatives, and will retrace the negotiations of authorship, authority, and agency along the shift from online platforms to cultural spaces. From a self-critical and self-reflexive perspective, I want to question patterns of recognition and representation in order to expose curatorial and spectatorial processes that might reproduce the very power structures they seek to criticise. In doing so, my paper aims to untangle the complex correlations between the public domain, artistic and moral rights, and ethical concerns and responsibilities as they are epitomised in Abounaddara's 'fight for the right to the image'. [13]

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Archiving the Expanded Animation Symposium: Challenges, Solutions and International Collaborations

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Abstract

The Expanded Animation Symposium, an annual symposium at Ars Electronica, has addressed computer animation in the context of media art since 2013. Based on the early discussions at the media festival and in conjunction with the Prix Ars Electronica's category Computer Animation, the symposium tackles animation at the intersection of art, technology, and society. The symposium serves as a hybrid between practice and theory and features talks, panel discussions, workshops, and artist presentations at various venues (i.e., museum, university, festival, cinema). 164 international experts presented and discussed current positions and future trends in the last nine editions. Due to the pandemic, the previous two editions took place online. All these activities have been documented and archived in various forms. This paper discusses challenges and concrete proposals for archiving the Expanded Animation Symposium and collaborating with Ars Electronica's archive and international partners.

Keywords

Expanded Animation, Symposium, Digital Art, Media Art Histories, Archive, Museum

Introduction

Animation has become a pervasive element in contemporary moving image culture and in our daily lives [3]. Since the digital shift, the manifestations of animation have expanded, and the definitions have become unstable. Meanwhile, moving pictures created with computer technology constitute a very diverse spectrum, particularly in hybrid forms, and are products of highly interdisciplinary collaborative activities of individuals from the worlds of art, industry, research, and science. Over the last 40 years, Ars Electronica (AE) has tackled this issue and discussed animation in the context of media arts [7]. Since 2013, the University of Applied Sciences Upper Austria, Hagenberg Campus, and AE have organized the symposium *Expanded Animation* (EA) [5] which aims to address the traversal of borders, hybrid forms, and fringe areas within the field of computer animation. This paper summarizes the examinations presented in the nine symposium editions and discusses challenges and concrete proposals archiving these various activities and collaborating with AE's archive and international partners.

Expanded Animation Symposium: 2013–2021

In keeping with the motto *Mapping an Unlimited Landscape*, the EA Symposium was established to reflect on the traversal of borders, hybrid forms, and fringe areas of computer animation and continued the ongoing examination at the AE festival. The point of departure was the early discussion on media art and expanded cinema [14, 11] and the current examinations on experimental and expanded animation [10, 9, 3, 15]. The first symposium took place at the art museum LENTOS Linz as a small event in AE 2013 with a line-up of 10 speakers and three panels. Keynote speaker Suzanne Buchan started this examination by introducing the concept of *Pervasive Animation* [3]. Originally designed as a unique event, it has become an established part of the festival. Since 2014, it has been organized in cooperation with AE and serves as an academic component of the Prix AE and AE festival, featuring scientific, curatorial, and artistic perspectives. After two sessions, the symposium was first hosted under the umbrella of the AE animation festival, and together with the Prix Forum, it expanded to a two-day event. The subsequent three editions investigated the utilization of hybrid techniques and technologies, future interfaces in animation, and artistic approaches from various perspectives. The seventh edition, entitled *Out of the Box*, explored the roots of expanded animation and cinema. In 2020 the symposium bared the title *The Appeal of Analog* and addressed the attraction of animation in the context of performance, interaction, computer games, and audio. Due to the COVID-19 pandemic, the media festival and thus also the symposium took place in virtual space. Since 2020 the event has been a 3-day event dedicated to examining the interactions between animation and audio from a scientific perspective. In cooperation with the University for the Creative Arts, Farnham researchers and artists were asked to submit contributions on the subject of *Synaesthetic Syntax*. This scientific/artistic survey was kicked off by the media artist Rose Bond in 2020. The keynote speaker at the second edition in 2021 was Refik Anadol. The latest edition continued as an online event and investigated current processes of change in the expanded field of animation under the motto *Tectonic Shift*.

Retrospect and Perspective

The EA Symposium featured 164 experts from various fields, from animation, art, games, and science (see figure 1) in the

last nine years. The symposium is open to experts in theory and practice, including the Prix Forum, featuring the top prize winners in the category Computer Animation. As at the first conferences on computer animation at AE in the 1980s, practice and theory are equally important [1]. Although the line between practice and theory is always fluid, most speakers are active in both areas. The EA Symposium picks up the idea of the initial conferences on computer animation at AE, fosters the interplay between science and practice, and seeks for artistic congruities. The symposium serves as a hybrid between practice and theory that is open for a broad range of science, from humanities to applied and multi-disciplinary sciences, covering panels in media arts, animation, and film theory as well as computer science. AE animation festival represents a unique position within the international animation festivals, as its roots are in media arts and the focus is on computer animation. The symposium addresses the interaction between art theory, and industry. Since 2016, the panel *Art & Industry* has featured artists and design studios that are active in both areas. Therefore, the center of interest is the reciprocity between independent artistic projects and commissioned works.

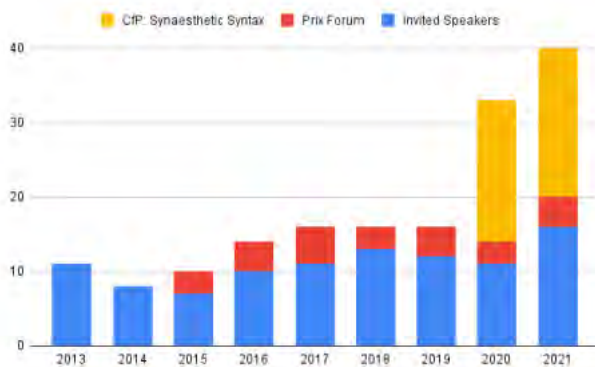


Figure 1: Participants at the Expanded Animation Symposium 2013–2021.

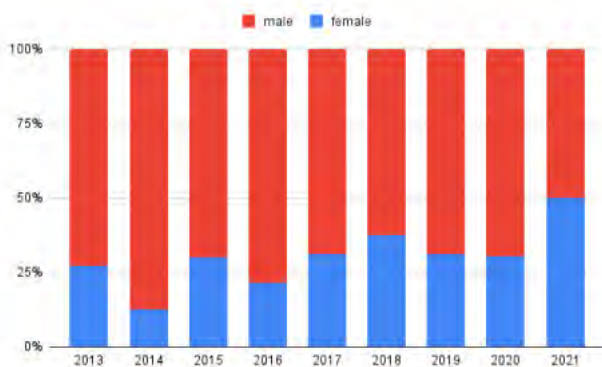


Figure 2: Gender ratio at the Expanded Animation Symposium 2013–2021.

In 2019 we released the anthology *Expanded Animation. Mapping an Unlimited Landscape* [7]. The book features contributions from speakers and artists from the first six editions of the symposium. In consideration of the hybrid format of the event, the book covers articles, essays, and a selection of current artworks, including the prize winners in the category Computer Animation at Prix AE. This anthology makes its contribution by summarizing these studies and examinations, although the selection presented here can only give limited, though essential, insights into the discussion. In addition to the book, the EA archive provides a video documentation of all talks online.

However, what is striking is that only about one-third of the speakers at the symposium are female. Furthermore, the ratio between male and female contributors at AE was not balanced at all [2], and the festival established the initiative *Women in Media Arts* [13]. The EA Symposium tackled this issue several times, and altogether, the gender balance has improved significantly over the past few years (see figure 2).

As the history of AE has shown, trends in media arts and technology come and go. Whereas computer animation was a central topic in the 1980s and 1990s in the context of media art, it gradually slipped out of focus for several years. In the last decade, animation has become pervasive. The boundaries between animation, game, film, media art, interactive art, architecture, sound art, and virtual reality are blurring more and more. At the same time, computer animation gained importance again. There has been a real boom in animation studies on expanded and experimental approaches in the last few years [12, 8], and many conferences and symposia have emerged. The EA Symposium features a unique focus on the intersection of animation and media art. In this regard, this vibrant multi-disciplinary interplay will probably spark many questions for further studies of the expanded field of animation.

Archiving the Expanded Animation Symposium and collaboration with Ars Electronica's Archive

Since its beginning, all the activities at the symposium have been documented in various ways. The talks, workshops, and presentations have been streamed online. They are available on the symposium's website [5], at the AE archive – talks & lectures [1] and on DORFTV [4], a local community TV channel. One special challenge here was the permanent changing of the venue. The first editions took place at the art museum LENTOS Linz, others at a former cinema, at the University of Applied Sciences Upper Austria, Hagenberg Campus, at the AE festival area and at the AE museum. Furthermore, the symposium took place at many locations simultaneously, for instance, at the AE museum, and at the festival area. Each venue required a unique setup for the video documentation. The different formats posed a further challenge. For instance, presentations at Deep Space 8K, a special exhibition room at AE museum, or screenings were documented by video. However, these videos give insight and are not intended to archive the artwork properly. Whereas video documentation of presentations and panel discussions are partic-

ularly appropriate, archiving interactive and expanded art is challenging [6]. In 2021 an online archive was implemented at the symposium's website, including video documentation, pictures, and articles. Unfortunately, we cannot provide all materials online, due to copyright issues. Some video documentation, for instance, Erick Oh's world premiere of *Opera* or Mike Winkelmann's presentation of his *Everydays* at Deep Space 8K, are exceptional because of the unique setting at the AE museum (see figure 3). Furthermore, in the course of the pandemic, the symposium was streamed via YouTube, and the video archive moved from vimeo to YouTube. In addition, the symposium was hosted on Mozilla Hubs in 2020. This platform was found inappropriate for such activities and has been rejected since then.



Figure 3: Beeple — Matthias Winkelmann presenting the project *Everydays* at Deep Space 8K, Ars Electronica 2019.

Conclusion

To document and archive a media art symposium that started as a small event and emerged to a vivid collaboration between a media festival, a museum, and international partners, we recommend following a broader approach (i.e., website, video & image archive, publications) and start documenting from the start. The symposium's website features the current edition and provides a comprehensive archive. In addition, the video documentation is available on AE's archive and DORFTV. The anthology *Expanded Animation*, available on the festival's archive and the symposium's website, serves as another form of archiving the symposium, including links (QR code) to the online archive. In addition, the symposium is featured in the annual AE festival catalog. The *Synaesthetic Syntax* conference complements the symposium with a more scientific chapter. Proceedings are in the planning and will be archived on the website. Archiving all these activities is

quite challenging due to the symposium's hybrid format. Dissemination and archiving on various platforms have proven to be particularly suitable. The website is the central hub, connected with AE's website and other online video sharing and social media platforms. This very broad-based strategy enables wider dissemination, increases the chance that the documentation will still be available in the future and the connection to the AE archive opens the door to one of the most extensive media archives.

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Restoring the recent past: Learnings from producing a retrospective of VR content from the UK

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Abstract

The Immersive Arcade was a retrospective of UK-based immersive content, showcased during 2021. The project was not set up to archive the content, but to restore it for new audiences. The production team made several observations about the lifecycle of immersive content and what types of considerations regarding the identity of a piece of content emerge in a restoration process. They are documented in this short paper with the aim to inform work on future retrospectives and similar archiving and restoration projects.

Keywords

Virtual Reality
Archiving
Preservation
Virtual art
Online museums
Immersive art

Introduction

The paper documents learnings and observations from a retrospective of UK-produced VR art and games, showcased in a virtual museum during 2021. The project, called Immersive Arcade, was part of a research and development programme that was supporting the growth of the creative industry employing immersive technologies, such as Virtual Reality, Augmented Reality, haptics, projection mapping, and so on. [1]

The retrospective was produced by Digital Catapult, a non-profit organisation set up to accelerate the adoption of advanced digital technologies by UK businesses. The work was exhibited in Museum of Other Realities (MOR), an online VR museum space. This paper is written from the point of view of the Digital Catapult delivery team on the project.

Figure 1. The entryway to the Immersive Arcade showcase in Museum of Other Realities. ©Digital Catapult & UKRI.



Retrospective as a form of restoration

The Immersive Arcade (see Figure 1) was not positioned at any point to be an archiving project, because that is not in the remit of the organisations involved. Instead, it was produced with the goal of showcasing outstanding immersive content and enabling broader access to it. The aim was to bring together highly regarded VR experiences before they run the risk of being forgotten and enabling access to audiences who had not seen them, nor necessarily even ever experienced VR before. The latter goal was met by organising a tour of the retrospective across the UK. The tour specifically aimed at reaching young female audiences, with the goal of making them aware of potential career paths in immersive.

Upon reflection, however, the fact that Immersive Arcade was a retrospective, in practice meant that the production became a restoration project. Unfortunately, the project did not become a permanent archive, as it has not been available since November 2021 due to licensing arrangements.

The fact that the organisations involved were not able to continue Immersive Arcade on a sustainable basis speaks to the commercial reality of restoring technically complex and inaccessible work. In the following, we summarise some of the reasons why and believe that these insights contribute to the discussion on what types of institutions are well-placed

to run similar retrospectives, perhaps even in a systematic manner. We believe these insights contribute to discussions of new forms of archiving and how to restore digital art from such archives for future audiences.

Content lifecycle as an archiving constraint

The first observation has to do with the lifecycle of VR content and who owns it. Because Digital Catapult, nor the funding body (UK Research and Innovation), are not a heritage or museum organisation, acquiring the intellectual property with perpetual rights was not an option.

Consequently, licensing the content become the only feasible way forward. What we found entering these discussions with the content creators was that given the relative recency of the content, they saw that their intellectual property still ‘had legs’ commercially and hence were happy to agree to a time-based licensing deal that we offered. In other words, in terms of their lifecycle, the projects were not yet ready to be archived.

Due to budgetary considerations, it was necessary to phase the retrospective into three volumes, so that licensing costs per individual project could be limited, yet more projects could be included in total across the six months that the Immersive Arcade was open to the public.

While archiving the content for permanent access was never our goal, this sequence of events highlights an interesting aspect of the state of the immersive content domain: institutions intending to practise archival and collection in a commercially underdeveloped space, such as immersive, need to set their expectations and historical focus carefully.

Technical process

From a technological point of view, our work started with the assumption that a software project, likely developed with a real-time game engine (Unity or Unreal) would be available for each piece of licensed content. Or, in the case of 360-degree video content, a media file was required to be available.

The responsibility to deliver the executable was on the original content producers and IP holders, in dialogue with the Digital Catapult delivery team and the MOR technical team. Due to how the project was set up, there simply was no time to spend reverse engineering executables. This was an advantage that we might not have had with less recent projects.

Once the executable was received according to specifications, it was embedded to the Museum of Other Realities VR application (that runs on PC-tethered VR headsets and is available to download digital distribution platforms, such as Steam and Viveport).

Technical challenges from UX to versioning

The process described above mitigates many challenges, such as third parties accessing software projects originally created by others and trying to migrate them to another software environment. Many of the technical restoration challenges regarding VR applications discussed by Ensom and McConchie [2] were not an issue for the project.

Regardless, other types of issues emerged. While we were not expecting a completely smooth process, the challenges tended to be of the type we did not foresee.

For example, user experience inconsistencies emerged: even as recent as five-year old VR projects caused extra integration work so that they could be showcased next to others with a consistent approach. A project in the retrospective had been developed at a time when conventions for configuring VR controllers’ interaction schema - i.e., what button or trigger is used for teleportation or selecting an object - were not yet established. The project in question used a somewhat unconventional method. It did not work satisfactorily with the latest and most widely adopted standalone headsets without additional work.

Another piece of work had successfully extended its lifecycle after initial launch by versioning: there was an original interactive six degrees-of-freedom version, but also a 360-degree video version aimed at audiences with less powerful headsets. Our intention was to showcase the work in its original interactive format but in the end, we never managed to get access to a working build that would have fit the exhibition platform.

In discussing the challenges of documentation and restoration in the context of installation art, scholar Annette Dekker mentions how at times ‘where to locate the work’ can become a problem for restoration [3]. For us, this was a concrete issue.

Negotiating the work’s identity and creative control over it

The above two anecdotes serve to illustrate what can happen with a piece of standalone content that was originally developed with the same technology, in this case VR, only few years apart.

Besides licensing and technical aspects, we also came across challenges that had to do with the identity of the original work and how to maintain the creative vision in a new exhibition context.

The overall curation process of the retrospective became a negotiation of what was available and what we wanted to include. Our aims were ambitious in that we were also looking for ways to include content from projects that were originally ran as location-based installations, with VR content as segments in a larger physical whole.

From a practical point of view, this presented a challenge in terms of what to include into a ‘vertical slice’ of history. It was an exercise in rescoping the content in the face of a different distribution opportunity.

From a theoretical perspective, we were negotiating what the elusive essence of the work was, and how its identity was bound to change when restaged for the retrospective. In this case, we supported the original creative lead in making the decisions. As a result, the output was not compromised but rather a reimagination of the original work.

However, we learned that one cannot expect such flexibility from all creators. Some of them demanded a level of control that we could not give, due to the technical restrictions of the platform. This was understandable but did mean that some flagship content from the UK was left outside the retrospective.

Finally, there was another aspect to restaging the work. Because the Museum of Other Realities is a virtual environment, each piece of content was accessed through a custom-made environment that was designed to reflect the theme of the content and its audio-visual qualities. In this part of restaging the work, we asked the teams to deliver assets (3D models, audio, etc) that could be included in the space (see Figure 2 for an example).

Again, we found different levels of commitment and control over this aspect. Some teams embraced the opportunity to instil creative control over the staging, while in other cases, no team was left to do it, and the MOR team worked with the assets provided to create the environment where users arrived to find the executable. In these cases, an additional approval process needed to be put in place.

Discussion

We believe it is useful for archivists, collectors, and conservationists in this space to take note of our experiences with Immersive Arcade. The practices of licensing and restoring immersive artistic content are far from established.

It can be a miscalculation to assume that a piece of immersive content has a team still attached to it in one way or another, and necessary files and documentation have been rigorously stored. If there is a gold standard in restoring VR work, it likely is the continuous redevelopment and

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maintenance activities around Char Davies’ pioneering VR work [4]. However, it just might be a beautiful outlier in an otherwise chaotic field.

Concerning the legal aspects, a similar risk emerges from assuming that there is a clear point of contact regarding intellectual property ownership. During the production of Immersive Arcade, there were cases where the content was technically ready to go on the platform as part of the launch of the next volume, but we were waiting for the licensing deal sign-offs due to complex IP ownership structures.

To summarise, producing a retrospective of immersive content from the recent past is not only a case of restoring technology and content, but also a case of restoring creative teams, negotiating creative control, chasing access to assets, and navigating complex IP ownership arrangements.



Figure 2. Vestige room with additional assets by NSC Creative as part of the Immersive Arcade VR showcase. ©Digital Catapult & UKRI.

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Public Library Consoles – Publishing Collections with the Flick of a Hand

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Abstract

A series of consoles have been developed to investigate the sharing of digital collections in public libraries. The interfaces reduce in complexity throughout the study to facilitate ease of access whilst maintaining playability and engagement. Interaction in the final interface is sufficiently simplified to enable browsing and publishing of the collection with hand movements, using a low-cost infrared sensor.

Keywords

Console, digital collections, publishing, online archives, crowdsourcing

Introduction

The paper describes a series of interfaces developed for sharing digital collections in public libraries. The first is a touch screen device for combining digital objects from multiple collections, and the last is a console for a single collection, which uses hand gestures and an infrared sensor for interaction.

The research was with the Visual Interaction Group at Computer Vision Center, and testing took place in the Living Lab at the Library of Sant Cugat.[1]

Memory Fields

The first interface installed in the Living Lab was *Memory Fields* [Figure 1]. It is a touch screen interface for two collections: A collection of posters from the Spanish Civil war, and a collection of contemporary audio field recordings from Catalunya. The interface generates dynamic audio-visual compositions on a large public display.[2] Mixing the collections generates montages,

which can be annotated and published to a new online archive.[3]

The interface was developed from an earlier artwork called *ablab*, which is a performance tool and originally shown in Electronic Language International Festival, 2004. [4] *ablab* facilitates selecting and mixing audio and visual objects from multiple online digital collections and is used for live performance as well as being installed in art galleries.[5] In a similar way to a Video Jockey or a Disc Jockey mixing live, *Memory Fields* is “performed,” in the space.



Figure 1. Memory Fields installed in the Living Lab, Sant Cugat

Modular Testing

Memory Fields used five software modules for interaction with digital objects.

- A rotating graphic carousel for browsing [Fig.2]
- Slider controls for mixing and balancing audio and visual material

- Slider controls for zooming into visual material and controlling volume
- A text box for annotation
- A tool for publishing annotated material online



[Figure 2] The carousel is a valuable graphic tool for displaying and browsing collections. It combines control, play, and chance. The addition of audio effects to the rotation increases playability.

Each modular element can be separated and recombined in new configurations, and this was done for a series of workshops in the Living Lab.[6] Library users provided their own digital collections for analysis and experimentation. The reconfigured modules provided novel ways for participating in the process of presenting, annotating and adding meta-data to historical documents and contemporary collections. The process explored usability, playability, and public engagement with large scale displays.

The testing resulted in the simplification of interface design.

Publishing by Crowdsourcing

The next interface, called *@Brossainedit*, is a touchscreen interface for a collection of over 1200 visual poems by the Catalan poet Joan Brossa, made with input from Joan Miro and Antoni Tapies. The large collection was digitized by the Museum of Contemporary Art (MACBA), Barcelona and the Joan Brossa Foundation. The console for this collection was built to engage the public directly in the act of annotating and publishing the previously unpublished collection to a new online archive. [7]

@Brossainedit is simpler than *Memory Fields* in that it uses a single collection with four software modules: to browse (carousel), to examine (zoom), to annotate, and to publish. The poems are published using Twitter, and include annotation, geolocation (the generated tweets include a hashtag referencing the physical place in which

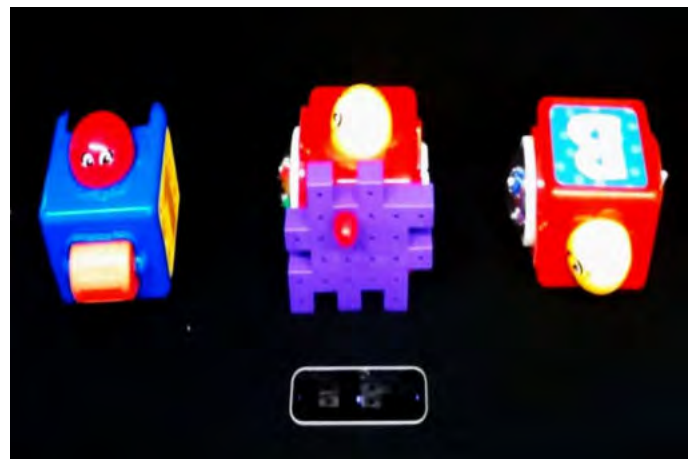
the installation was exhibited (e.g. *@Brossainedit #SantCugat*), and a date time stamp is added.

The importance of the cultural material, and the simplified user-friendly interface, increased user participation. The interface was installed in the Living Lab and also presented in MACBA and at the Mobile World Congress, Barcelona. [8][9]

Infrared, Tangible Objects, and Hand Gestures

The simplified interaction of *@Brossainedit* enabled a final development: the expensive touchscreen interface could now be replaced with a low-cost infrared (IR) sensor.

Interaction via the IR sensor is guided by the use of four non-electronic, brightly coloured, tangible objects. [Fig.3] These objects guide the user's hand movements by providing clear interaction patterns, and the hand movements can then be interpreted by the IR sensor.[10] The objects are a cylinder that rotates, a pin-hole grid pattern, a zip, and a large push-button.



[Figure 3] non-electronic objects and infrared sensor used to monitor interaction patterns

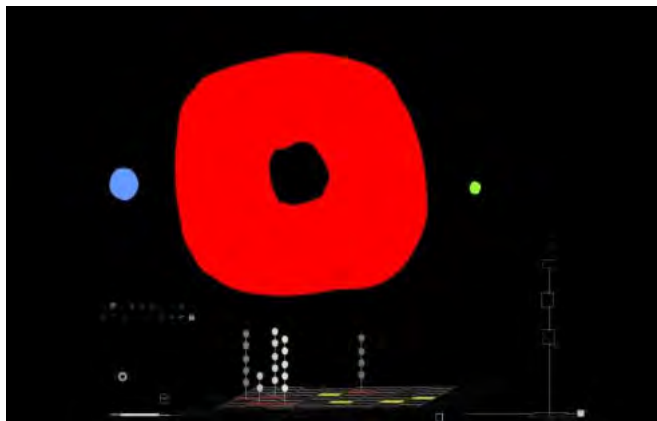
Interaction in the collection is as follows:

- Spinning the cylinder rotates a graphic carousel on screen and browses the collection. Stopping rotation selects the current image, which is displayed on screen
- Sticking a peg into the grid pattern selects a specific area of an image
- Moving the zip; zooms into and out of the selected area
- Pushing a button publishes the selected article to the new online media archive

The decision to use simple shapes for interaction originated with the aforementioned: *ablab*, which contains a

collection of brightly coloured animated objects for interacting with sound [Figure 4]. This use was further investigated by the Visual Interaction Group in a series of eye-tracking and head-tracking studies [11], which examined the value of basic shapes for use with low-cost sensors to interact in digital collections.

Providing objects with clear interaction patterns, means that little or no explanation is required for use. They provide a playful, robust, and low-cost way of introducing digital objects in public space. The use of an IR sensor reduces the need for contact with technology, which can be fragile and expensive for public use.



[Figure 4] *ablab* interface showing objects from a collection of animated shapes, which are used to generate sound.

Observations

Selecting and mixing are two creative information behaviors. The artist John Baldessari states: “Should I do this rather than that? Should I choose this image over that one? That’s it at its heart - the artist’s role is about selection.” [12] Selecting and mixing engage the public in exploration and production and can generate insight and new knowledge simply by combining material. As Swanson observes, “The significance of the “information explosion” may lie not in an explosion of quantity per se, but in an incalculably greater combinatorial explosion of unnoticed and unintended logical connections.” [13]

Installing interactive digital consoles in local libraries creates a sense of community around collections. Interactive installations create small local events, around public displays. They create a social experience, a performance action, and a tangible exchange of knowledge and ideas around digital culture. Consoles provide curators and archivists novel activities to offer the public an opportunity to view collections and information. Collections can enter directly into the public domain. The interface systems act as a library service, whereby citizens

publish first instances online, mixed with personal annotation and metadata.

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VR as a function for archiving media arts, one example

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Abstract

Many media projects done via the Internet have either been forgotten or scattered by the author's memories, notes in the print media or have simply disappeared as if they did not even exist. Some works are archived in libraries, on the websites of artists, or art associations. Data on them is scarce, however, and few can still be viewed in their original form. Through reinterpreting and media transformation, some of the works performed this way, through VR technology, can be preserved, archived, and made available to a wider audience. Currently, there is no platform for VR archiving of such performed/reinterpreted works; the existing, mostly gaming, platforms can be used for this purpose. This paper aims to show, in one example, what are the possibilities and which benefits can be obtained from such presentation and archiving of works of media art made through the Internet.

Keywords

Internet, media arts, archiving, online writing, virtual reality

Introduction

Many libraries, university libraries, museums, associations, collectors as well as individuals, archive digital media art. These are mostly archived websites of artists, projects, festivals and events, and often specific works of art. The goal of such archiving is to preserve works and information related to them, their public availability, as well as educational needs in the field of art. Users of these archives can search for data related to the author/authors and their field of artistic engagement and link, if any, to a specific piece. These links are often unavailable online or require an access request, and are usually not free of charge. Still, such archiving has great advantages and social justification through its possibility to preserve media art, which, generally, has an expiration date.

Today, we are one step away from a global change in the paradigm of art, which is noticeable by the fact that more and more authors are submitting their works in the form of NFTs. Art production is changing, the market is adapting, artists are focusing on new media approaches, and digitalization is inescapable. Archiving at a time of general change in the field of artistic activity has also been forced to adapt to the new conditions. One of the more recently

announced an increasingly noticeable is the unstoppable concept of Metaverse networking, where virtual reality (VR) will completely change previous experiences in creating, consuming, exchanging, and with that, the process of archiving 'new art'. Can art be new? This is just a synonym for something that is already visible and that does not change the essence of art, but only its present-day concept.

More and more artists will turn to the realization of their ideas for the needs of this new paradigm. VR already today enables online painting, the creation of free sculptural forms, the performance of theater plays, etc. Archiving such works in a newly created context requires accelerated adaptation and solutions that will help preserve global production. Everything is changing quickly, and it is necessary to look at areas that have already been adapted, such as the field of video games. Platforms for VR games (SteamVR, Oculus Store, etc.) have already been created due to their immense commercial demand. Still, there are no platforms for archiving artistic VR works, and most of the works are either not widely available, or are placed on gaming platforms.

VR in the archiving function

Virtual reality represents objects, situations, or phenomena through computer-generated data by the models. [1] According to Rheingold, VR enables simulation or dynamic modeling, the art of creating a simulation with certain rules, simulating different situations, to see how the system reacts as a whole. [2] These examples show the possibility of VR to generate simulations for industrial processes, scientific research, education, different types of training, entertainment, gaming, creative artistic process, etc. Along with that, VR is being increasingly used for theatrical research, since the theater is also a medium of illusion. [3] VR is becoming more widespread and attainable to a wide range of users with more affordable equipment, the quality of which is improving constantly.

In the context of modern reality, like NFTs or the Metaverse, it is necessary to regulate many things related to the VR – from copyright protection to the possibility of VR archiving, i.e., professional preservation of some selected works, which should be publicly available to a wide range of users. Among other things, it is necessary to archive the

artifacts of new media art production. Oliver Grau defines new media art as a comprehensive term that encompasses art forms that are either produced, modified, and transmitted using new media/digital technologies, or, more broadly, using new technologies derived from scientific, military, or industrial contexts. [4] He also sees that the art of new media calls into question the very foundations of object-centered understanding of art, especially its characteristics of interactivity, nonlinearity, immateriality, and transience, along with its intricate interrelationships between the artist, art, and observer. This type of art production is very diverse and, according to Grau, includes virtual art, software art, Internet art, game art, glitch art, telematic art, software art, bio-art, computer animation, interactive art, and computer graphics, as well as practices in the field of art and activism, such as hacktivism and tactical media. The question is how to archive such different media productions in VR and what is its intention? The intention of VR archiving is not only to protect or classify selected new media art projects, but also to refresh them with the possibilities that VR enables. With its availability to a wide field of users, such archived works gain a new dimension and liveliness. The possible concept of archiving in VR is based on these premises.

VR archive - concept

The primary concept of VR archive is based on four steps: 1) selection of new media artwork that needs to be archived, 2) preparation and adaptation phase, 3) archiving, and 4) accessibility to users, Figure 1.

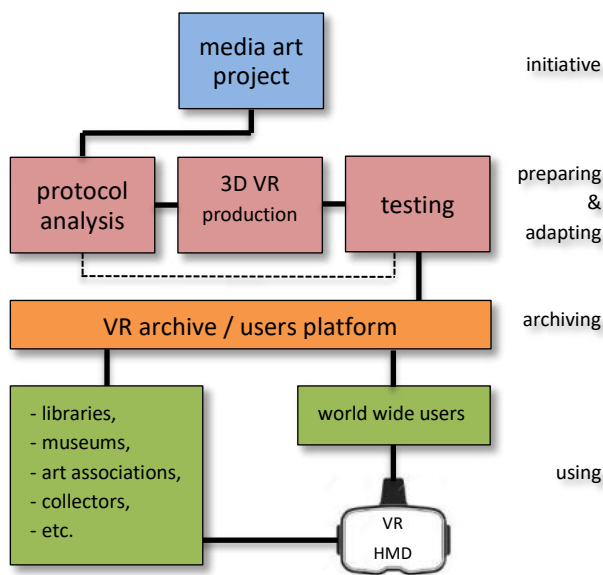


Figure 1. Workflow from initiative to archiving new media art and associability for users via the Internet

The first phase refers to the selection of work to be archived. There are two options – directly transferred work as it is for its use in the VR, or adapting to the needs of use in VR. In

general, the selected work should be digital, interactive, spatially defined, and have enough data to be used for its direct ‘introduction’ or adaptation to the VR medium. The next phase is to analyze the existing work in all its protocols related to functionality, media characteristics, duration, specifics, etc. This is the basis of the next phase of VR production, such as 3D modeling, creation of given functions, programming, rendering, sound processing, etc. In this phase, the work is tested and, if necessary, corrected to complete satisfaction and compliance with the selected original work. The work prepared in this way is ready to be published on the VR archive platform. The last phase is the public availability of archived work. Libraries, museums, art associations, collectors, as well as all interested individuals from all over the world, can access the work with approval or compensation, in cooperation with the copyright owner.

As already mentioned before, there is no VR platform for archiving new media art at the moment, so it is possible to use the existing gaming platforms, with certain specifics. The technical solutions of the concept of VR archives platform of new media art exceed the level of this paper, and we would not dwell on them here. Instead, here will be given an example of preparation and adapting an online writing performance for the VR archive.

Reinterpreted media artwork for VR archive

Here will explain the phases of a possible concept of archiving a new media art project on the Oculus App lab platform, which at this time can be used for archiving and public availability to users around the world.

Due to its historical and media significance and specificity, the work ‘Spiral of Words’, realized in 1998, was chosen as a case study of this work. This was an ‘online writing performance’, performed from three locations, by three authors, in real-time via the Internet. The authors sent their creative texts by e-mail in a precisely defined time rhythm to the recipient's address. It was an event called ‘The Academy of Noble Skills’, which took place on the slopes of Sunny Valley on Fruška Gora, near Novi Sad, Serbia. The documentation on this project was in a book published by the ‘Academy of Noble Skills’, as well as from the author's archive. [5] The authors built a ‘spiral of words’ by alternately sending textual narratives, which were dedicated to one of the philosophers (Hamvas, Buber, and Berdjajev), starting with one word, then a sentence, followed by a paragraph to end the story. The texts received in this way were read directly – performed by two actresses and an actor, so that the audience had the opportunity to mentally experience the construction and enlargement of the spiral, with the help of words in a certain rhythm and time interval. The authors who participated in this project were in London, UK, The Hague, Netherlands, and Novi Sad, Serbia.

After the final selection of the artistic work for VR archiving, as a first step, its general protocol analysis was

done, Figure 2. As it is a textual narrative performed online via e-mail from three locations by three authors, the focus was on conceiving each text, defining their differences, and preparing for VR production.

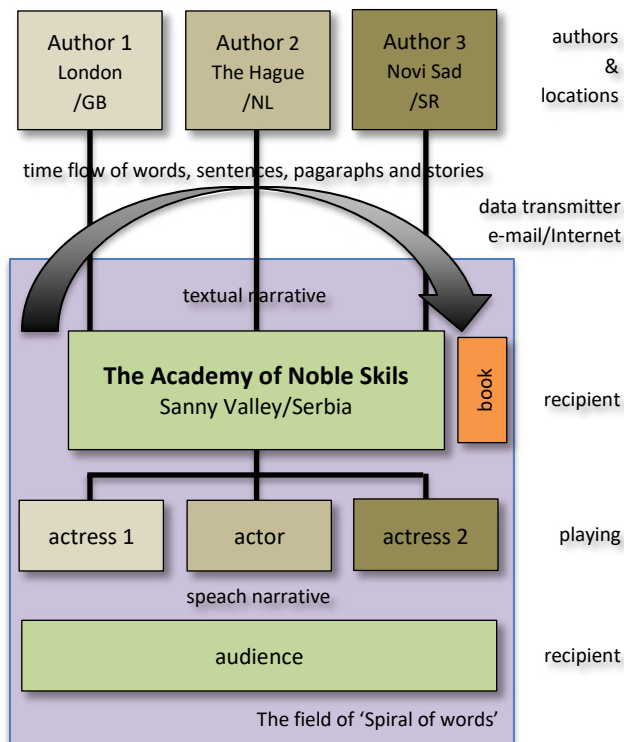


Figure 2. Scheme of the protocol analyses of online writing performance 'Spiral of words'

After the protocol analysis, the next step was conditioned by the transformation concept of the original work and its preparation for VR production, Figure 3. The first step in the realization of the reinterpreted work for archiving and use in VR was the mathematical definition of the partial appearance of words, sentences, paragraphs, and stories. This was followed by programming in the C# language. After the first testing of the program code in VR, the project was advanced to defining specific VR functionalities, such as the use of controllers, navigation, selection of handles, editing of selected words, sound signals, etc. This was done with the combination of Unity 3D game engine and C# programming. Testing followed, then corrections in code and functionality, then re-testing. In the final phase, specific, symbolic visual effects were added for certain words, such as the word God, where the selection activates a strong light effect.

When the reinterpreted work was fully prepared and compared with the original piece, the project *build* was sent for verification to the Oculus App lab. After their positive response, the VR reinterpreted 'Spiral of Words' is automatically archived, posted on the Oculus App lab platform, and thus made publicly available.

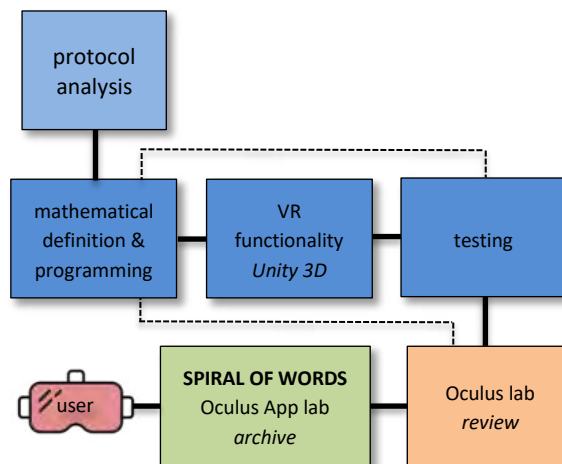


Figure 3. Time flow process from the protocol analysis phase to the final users' stage

Downloading the archived project 'Spiral of Words' from the Oculus App lab platform can be accessed through their browser, and from a direct link or QR code from the //VirtualUnit website¹. The artistic VR project 'Black Carbon' has also been archived on the Oculus platform² and is publicly available.

When those interested who want to join the 'Spiral of Words', through their Oculus Quest 2 HMD sets, download the project to their device and put it on their heads, the construction of a virtual word spiral begins. Users actively monitor the spiral by reading the text that appears in front of them, or, more precisely, around them, since the users are in the center of the spiral. The color of the parts of the text signifies belonging to a different philosopher: red – Hamvas, blue – Buber, and orange – Berdjajev. Through the controller, users have free movement and navigation. It is also possible to be creative, to choose one word at a time from the spiral with the help of the controller. The source of the words is limited. With a total of 4578 English words, of which about 1000 are unique, the users are free to create their poetry, short story, or just play with them. With its selection, each word appears on a transparent "board" directly in front, but just below the user's eye line, and in whichever direction they move, it will be visible to them.

¹ <https://virtualunit.org>

² <https://www.oculus.com/experiences/quest/4188524877934961/>

The selected words, Figure 4., in the new textual meta-narrative can be edited directly, via the controller, on the board in front of the users, i.e., change their order.



Figure 4. Selected words for creating meta-narrative appeared on the transparent board in front of a user, ready for direct editing

This would complete the reinterpretation of the original 1998 project, but a step further was adding effects to individual, pre-selected words, which are based on the symbolism or direct information assigned to that word. That is a strong influence and feature that is close to theatrical and performing arts. These give the users an extra level of fun because they get unexpected and surprising visual and sound effects, Figure 5.

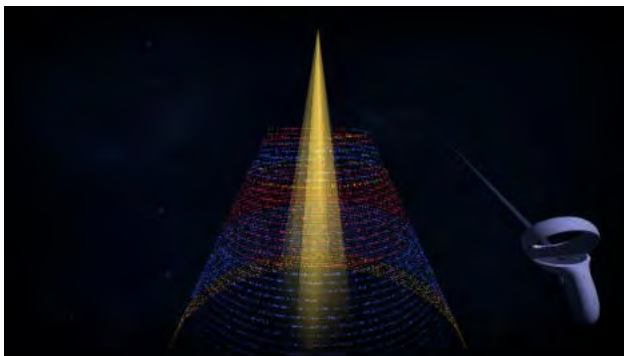


Figure 5. The visual and sound effects when the word God is selected

Conclusions

This paper presents a possible concept of archiving new media art in VR. For now, such a VR platform for archiving does not exist, but existing gaming platforms can be used instead. A case study presented, as an example of reinterpretation, preparation, and adaptation of an e-mail online writing performance, for archiving and use in the VR. It has a wide field for the possibility of transformation and additional creation of previously made or performed new media art projects. VR can refresh and enliven them by interacting, changing, supplementing, or creating new

approaches within a given framework. By archiving and posting such customized and transformed projects on specific platforms for VR users, they will again be publicly available and attractive to all who are interested in them. With the announcement of the Metaverse and its establishment, it is expected that famous museums, galleries, libraries, collectors and others interested will create their VR archives and collections, and thus enrich and profile, now a quite chaotic situation related to this area.

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Maja S. Budžarov, MA – ceramic and multimedia artist, co-founder of //VirtualUnit creative laboratory for virtual reality. Associate professor of interactive art at EDUCONS University, Sremska Kamenica, Serbia.

Nina Zvezdin, MArch – architect, multimedia artist and musician, member of //VirtualUnit creative laboratory for virtual reality. Architectural Intern, ATIpject, Pisa, Italy.



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INVITED TALKS

Introducing Arc-hive

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Abstract

'Introducing Arc-hive' is a 10 minutes presentation by Antonio Gagliano and Luciana Della Villa that proposes to introduce Arc-hive's framework, its fundamental objectives and challenges, and to open up the collective research process carried out so far.

Keywords

platform, artworks, specimens, living materials, free software, open data, best practices, case study, open resources, infrastructural maintenance.

Introduction

Project Arc-hive creates an open source digital platform that aggregates, preserves, publishes, distributes and contextualizes a variety of information, knowledge and documentation on art with a focus on biomedica, ensuring open access to a variety of users, and a wide outreach of digital materials across cultural sectors and territories. Arc-hive addresses the challenges of creating and distributing cohesive digitization and dissemination protocols through a centralized digital space where knowledge and best practices relevant to art predominantly using biological materials are collected. Created in collaboration with six partners working in NGO and museum sectors, publishing, IT and audiovisual fields, the platform functions as a catalyst for the activities of artwork and museum specimen digitization, archiving and distribution; remote event participation, planning and realization; augmented publishing; staff and student education and training; and topic contextualization and interconnection. Aimed at building capacities of various cultural agents working with biological and living materials, the project provides a feasible and tailored digital solution to some issues fundamental to the field, following philosophical principles of open data and information sharing throughout all project phases.

The presentation proposes to introduce Arc-hive's framework, its fundamental objectives and challenges, and to open up the collective research process carried out so far. Archival practices have rarely explored how to cohesively build-up and maintain open source digital infrastructures to host cultural objects that, by the very living nature of their components, are elusive and difficult to be digitally captured. The uninterrupted life cycles of mutation, degradation and regeneration of artworks predominantly based on biological materials open up several questions around digitization and cataloging practices and protocols. Where, for example, does the most important part of an artwork focused on living materials reside? Is it possible to locate and migrate it in such a way that it can inhabit the digital field without becoming permanently distorted? Should we capture all the stages of its life cycle? The beginning and the end, or just one of its phases? Should we correct or absorb the extraneous elements that emerge during the process of digitization? Should we assume that the utterly abstract, generic, mathematical space of digital three-dimensionality always brings with it the obliteration of its specific surroundings?

Even though many of these questions are also relevant to the digitizing and cataloging of other fields such as dance or performance (that are elusive to the archive because they are also based on living and dynamic media), the infrastructures for hosting works based on biomaterials underline in a special way the question of maintenance and care. It is problematic to define what kind of close ties needs to be assumed to keep physical metabolic artworks alive, to understand how to lend them to other institutions, how to transport them and catalog them, how to acquire them and integrate them into museographic collections, and the development of a digital platform doesn't solve all those issues but rather reinforce them. Digital does not make it easier. One of the conceptual forces driving Arc-hive is to reflect and explore how digitized living materials could be hosted on a network of federated

servers that ultimately seeks to generate an ecosystem of open source data and code. A cornerstone metaphor of the project's major challenge is contained in the project logo: the division of the word 'archive' into two elements, mimicking the cellular phenomenon of mitosis, metaphorically connects the biological replication process of a single cell with the endless replicating capacity of free code. Thus, when we refer to living matter and ecosystems we are not only talking about networks of life within the pieces itself, nor a vibrant community of specialized readers, but also to a multi-dimensional community of researchers, editors and open source developers who will continue taking care of the infrastructural levels of the platform, generating new iterations of the code, getting behind the content and expanding the tools and features we've already created.

What performative effects do artworks focused on living materials produce on hard structures of knowledge, such as the collection or the archive? What can archival practices learn from engaging with digitized artworks focused on living materials? The encounters between the political background of open source communities and the specialized field of artistic practices working predominantly with biomedial opens up an infinite space of thought and conceptual articulations. These are, in any case, forms of institutional research that acquire existence in practice, as happens with artistic research in general. They exist as knowledge because they are made in the making, and in alliance with the materials rather than before. It is almost impossible to think how diverse digital objects and heterogeneous collections can fluidly coexist within a platform before thinking about what open source web design allows us to do. Establishing a set of curatorial criteria that organizes the admittance of content to the platform invites not only to craft editorial statements but also to imagine administration roles and design a sustainable and accessible UX for platform contributors. It is in the reciprocal entanglement of discussion and technique applied to materials that a deeper understanding of how to take care of living things is finally produced.

Biographies

Luciana Della Villa has a degree in Art History from the University of Barcelona and a master's degree in Cultural Heritage Management from the same center. She was part of the Art Department and the Communication Department of the Vila Casas Foundation, both at the Can Framis Museum and the Espacio Volart. At the same time, she develops his personal project Svper linked to music, and works on musical creation for advertising. Since 2017, she coordinates the Communication area of Hangar.

Antonio Gagliano is a researcher and artist. His projects intertwine practices around structural imagination to explore the multiple ways in which knowledge emerges, is organized and distributed. He has participated in exhibitions such as *La tradició que ens travessa* (Arts Santa Mònica, 2022), *Acció. Una història provisional dels 90s* (MACBA, 2020) or *Manufactories of Caring Space-Time* (Museum voor Schone Kunsten, 2017). He has contributed to newspapers such as *Der Spiegel*, *Süddeutsche Zeitung* and *La Vanguardia*, and books such as *Pornotopia. An Essay on Playboy's Architecture and Biopolitics* (Paul B. Preciado, MIT Press, 2014). For the last decade, he has contributed as editor and sound producer at Son[i]a de Radio Web MACBA and has been a regular contributor to the museum's educational programs. Since 2020, he coordinates the Research and transference of knowledge area of Hangar.

Revealing Higher Impact of Media Art Archiving

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Abstract

Media art poses a multitude of specific challenges for archiving, e.g., the weak interconnection of thematically similar archives. Furthermore, digital tools developed for image analysis as well as art research usually fall short when confronted with media art. LeFo and ImDaLi, the projects presented here, intend to address these issues in their research.

Keywords

Media art archiving, image analysis, media art research

Introduction

The field of media art holds a special position in art research and archiving due to its process-oriented, methodological and disciplinary diversity. Considering the ongoing technological developments in general and particularly in the digital field, which are rapidly finding their way into the production of media art, as well as the constant transgression of boundaries between different areas of knowledge, archiving strategies and digital tools developed are not always optimally suited for digital art. In order to do justice to the broad spectrum and fast-moving nature of media art production in the context of scientific research, the projects LeFo and ImDaLi set out to develop interactive and immersive virtual spaces optimized for media art. Both are focused on creating new prospects for the exploration of perception and the value of collections. ADA (*Archive of Digital Art* www.digitalartarchive.at) is a community platform for the documentation of media art, which gathers hundreds of leading artists and scholars and over 50000 documents. It serves as foundation for innovative strategies and applications developed within the projects.

Infrastructures for Digital Arts Teaching and Research in Higher Education (LeFo)

LeFo extends the Archive of Digital Art as a platform for research and teaching of themes emergent from the field of Media Art. ADA is a community archive of selected artists that documents significant media artworks supporting technical documentation, like interfaces etc. developed by

the artists. In order to extend the platform as a teaching tool, the project extends the ADA collection and integrates visualizations of the archive's content, themes, tools and practices as a research methodology. Additionally, LeFo is developing Augmented Reality interfaces to the archive's collection, thus investigating new paradigms for presenting and navigating digital collections. Most ambitiously it will also develop technical foundations for connecting disparate but thematically aligned online archives so that content is directly discoverable and comparable across overlapping collections, reinforcing the value of each platform in the context of research and teaching in media art.

Tool Development for Image Data Literacy (ImDaLi)

ImDaLi researches and designs digital tools for image databases with the aim of both improving the user experience when using archive platforms and testing different approaches to digital image analysis. To reach these goals, ImDaLi addresses two core topics within its research. Firstly, the controlled vocabulary of the Thesaurus, which already encompasses keyword-tags for the numerous artworks within ADA, is used for extensive analysis to explore visualization concepts that contribute to media art research. Furthermore, it will be explored if and how the Thesaurus could potentially enrich semantic web data on media art to further interconnection and integration among media art archives. Epistemological structures of archives however, often developed organically over time and are thus modeled around their respective needs. Consequently, basic alignment of vocabularies anchored in a mutually accepted standard (like the Getty Art and Architecture Thesaurus) is a prerequisite for improving the accessibility of content across databases. Secondly, the Lightbox tool already available to users on ADA is further developed for in depth image analysis. Starting from Aby Warburg's approach of comparative iconography, which focused on the analysis of semantic and visual connections between artworks, the Lightbox will be adapted for the analysis of media art, e.g., 3D viewing allowing for experiences of a work of art within the digital realm.

ACM SIGGRAPH History Archives: Expanding the Vision through Teamwork

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Abstract

The ACM SIGGRAPH History Archives is a team effort involving students, interns, volunteers, and computer graphic pioneers. In 2022, it expanded from an online archive to include a physical archive of SIGGRAPH publications and artifacts. These archives include information about presentations, exhibitions, screenings and events at the annual conference as well as information about SIGGRAPH communities and committees. With such a vast array of information, developing a robust infrastructure was essential. Team members researched, digitized and entered tens of thousands of entries and programmed innovative features that enable users easy access to this valuable resource. The SIGGRAPH History archive team is also preparing the archive to be part of the world-wide distributed network of new media art archives.

Keywords

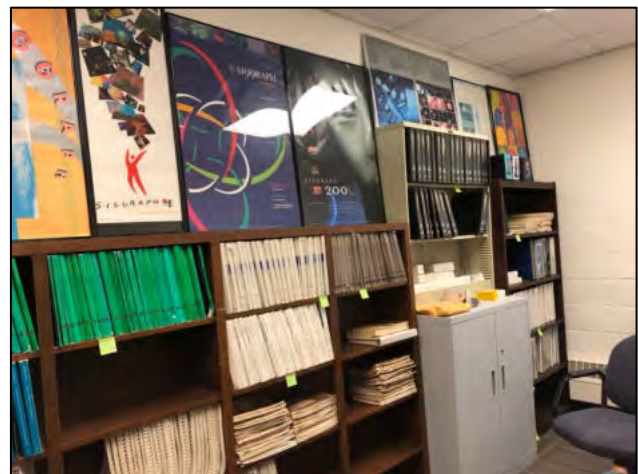
SIGGRAPH, online archive, computer graphics, interactive techniques, electronic art

Introduction

ACM SIGGRAPH is an organization that has a long history of showcasing cross-disciplinary research, innovation and creative endeavors in the field of computer graphics and interactive techniques. The annual conferences began in 1974 and since that time their programming has expanded from technical paper presentations to include art exhibitions, emerging technology demonstrations, virtual reality experiences, animation screenings and much more. They have also produced hundreds of publications including art catalogs, animation videos/DVDs, proceedings, quarterly newsletters, etc. SIGGRAPH has a number of committees such as the Digital Arts Community, Education Committee, Pioneers, etc. as well as affiliated Chapters around the world that also produce content and host events throughout the year. With such a breadth of material to document and preserve, the job of creating an online archive for the organization was a daunting task. The project began as an extension of a previous project, the ACM SIGGRAPH Art Show Archive, spearheaded by Bonnie Mitchell and Jan Searleman and expanded to include all conference and organization materials in January 2021.

Information Access

The goal of the ACM SIGGRAPH History Archive is to connect information related to conferences, contributors, events, publications, and the organization in a meaningful way. Before that could happen, access to the information dating back to 1972 was necessary. There has never been a physical location where all the SIGGRAPH materials were stored. Fortunately, Mitchell had her personal archive of SIGGRAPH materials to work with but it lacked materials produced before 1990 and was incomplete. SIGGRAPH community members provided information from their private collections but a lot of information was missing (and still is). To develop an online archive in a systematic way, having gaps in the information proved problematic and impeded the progress of entering data into our custom-built online archive system. In early 2022, the University of Waterloo had plans to renovate its computer graphics lab and wanted to donate all of its SIGGRAPH publications to our group. This collection, combined with Mitchell's materials and other donated items formed the start of the ACM SIGGRAPH Master Collection which is temporarily housed at Bowling Green State University, the host of the second SIGGRAPH conference in 1975.



Teamwork

With access to a such a wealth of information, it was necessary to create a complex content management system that would be able to establish relationships between various types of data. Alexa Mahajan, a student at Bowling Green State University, created a sophisticated interface that enabled the user to access the information in gallery view or as a table, and sort it or filter it using a number of parameters. She also created menu systems and customized the fields, relationships and taxonomies to manage the data. All the selection icons were computer programmed using Processing by Alexa as well.



Lane and Liam Sykes along with Dayle Bennett, students at Bowling Green State University, worked on researching, gathering and entering data. Lane entered the SIGGRAPH courses and is now entering information about animations, a task started by Felix Bangert in the summer of 2021. Liam has worked exclusively with adding the Emerging Technologies demonstrations and Dayle enters information about panels and posters. The archive team also consists of two graphic design interns from the University of Guanajuato, Monserrat Meza Rico and Mariana Martínez Uribe, who designed the panel icons. SIGGRAPH also distributed swag at the annual conferences and Dan Pillis, a PhD student at MIT Media lab, does the imaging work to display these collectibles in the archive. Luis Wilson, originally an intern from the University of Guadalajara and now an employee at Microsoft, created import and export features to expediate the processing of data which sped up the data entry process. He reprogrammed the *Contributors* section and completely rewrote the back-end code to create the SIGGRAPH Plugin that we use in a WordPress environment to replace our distributed code fragments. These incredibly talented students, interns, and volunteers were directed by Bonnie Mitchell and Jan Searleman.

Pioneers

Because the knowledge of the past does not rest solely in documents and artifacts, this project would not be what it is today if it were not for help from the Pioneers of Computer Graphics. Mary Whitton, the chair of the SIGGRAPH History committee has donated materials and knowledge and helps secure resources to continue our work. Pete Segal, original programmer of the AT&T Pixel Machines, helped with publications, early courses and researching our

scanning specifications. Maxine Brown and Dana Plepys, both from the University of Illinois, Electronic Visualization Lab, have been incredibly helpful by providing information about the early days and the history of animation at the conference, respectively. Many more pioneers (too many to mention here) have sent information, advice and this archive would not be where it is today without their help.

Expanded Content

The ACM SIGGRAPH History Archive has been divided into a number of main menu categories: *Conferences*, *Contributors*, *Exhibitors*, *Experiences*, *Publications*, *Learning*, *Awards*, *Community*, *Collectibles* as well as information about the physical collection, etc. A category such as *Experiences* contains topics such as *Appy Hour* (App Development), *Art Show*, *Computer Animation*, *Emerging Technologies*, etc. Within each of those areas, the content can be viewed by *Year*, by *Conference* or by *Type* (VR, Haptics, etc.). This hierarchical branching of information enables the user to do broad or narrowly defined searches. Most of the content, but not all, is connected to a conference and a contributor and therefore appears on both the content's entry page as well as on the *Contributor* and *Conference* page. As the team uncovers additional content in the physical collection this structure expands.

The Future

The ACM SIGGRAPH History archive is currently focused on researching, digitizing and entering data as well as building a robust system that will manage the relationships between the data and provide a meaningful experience for the user. At the same time, we are planning for the future as we move the content to a new virtual machine, develop the code to connect to other archives and build relationships with communities that have the knowledge we aim to embed in this expanded online archive.

Authors Biographies

Bonnie Mitchell (Ohio, USA) is a professor of Digital Arts at Bowling Green State University and co-director of the SIGGRAPH History and ISEA Symposium online Archives. She is an organizer of the Summit on New Media Art Archiving and a member of the ISEA International Advisory Committee, SIGGRAPH History and Digital Arts Committees and SIGGRAPH 2023 History Chair.

Jan Searleman (California, USA) is a retired Computer Science Professor at Clarkson University and now serves as an adjunct research professor. Her research areas are VR, HCI, and AI. Jan is on the ACM SIGGRAPH Digital Art (DAC) and History Committee and co-organized the DAC Online Exhibition "The Earth, Our Home: Art, Technology and Critical Action". Jan co-directs the ACM SIGGRAPH History and ISEA Symposium Archive.

Interconnecting Archives: Paving a Path Forward

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Abstract

The concept of connecting information from various repositories of information has been around for quite a while, yet most online new media art archives exist independently without direct connections to each other. Programmers working on the ISEA, SIGGRAPH and FILE online archives have been collaboratively developing a system to link information about the people and art events documented in their respective archives to each other. This initiative will extend to include the Archive of Digital Art and Ars Electronica archives, as well as other archives, once the prototype is completed. This panel will discuss the challenging process of developing interfaces, building APIs, and working with wikidata as well as the process of analyzing, sanitizing, authenticating and modifying databases containing information about people and new media art events.

Keywords

archiving, connection between archives, database sanitization, wikidata, name authentication

Introduction

The idea of a global interconnected network of repositories of knowledge dates back to Paul Otlet's quest for a substitute for the book in the late 1800s¹ and more recently to Ted Nelson's Project Xanadu in the 1960s². The development of the World Wide Web, begun in 1989 and publicly released in 1993³ implemented Nelson's concept of Hypermedia⁴ using the internet as a means of transmission thus furthering the goal of creating a global network of interconnected knowledge. Archives, both web-based and physical, represent pockets of focused information on specific topics, genres, or events. Physical archives, because of their dependence on locality and spatiality, are nearly impossible to connect to one another without the addition of digitization and the establishment of a complementary digital archive. Because information exchange and artifacts in the 21st century are increasingly digital, archivists who work with new media art, often opt to document physical artifacts and include copies of digital assets in electronic archives. If publicly available via the web, these archives offer immense opportunities to realize

Nelson's concept of "the universal, democratic hypertext library that would help human life evolve into an entirely new form." The challenge though is in the implementation of establishing a connection between these online archives. This panel will discuss goals, first steps and implementation procedures conducted over the past year between the ACM SIGGRAPH History Archives⁵, ISEA Symposium Archives⁶ and the FILE (Electronic Language International Festival) Archives⁷.

History

The call to action to connect new media art archives began with the Liverpool Declaration⁸ (Media Art Needs Global Networked Organisation & Support) which was signed by nearly 600 professionals in the field of new media art. The Declaration's second goal was "Supporting an International Association/Institution for Shared Data." In 2019, Wim van der Plas, co-founder of ISEA, and Oliver Grau co-moderated a roundtable discussion at ISEA2019 and it became apparent that the time was right to begin the planning and implementation of an interconnected network of new media art archives. Representatives from ISEA, SIGGRAPH, Ars Electronica⁹ and the Archive of Digital Art¹⁰, met periodically over the course of 2 years to discuss strategies and outline challenges. In 2020, the first Summit on New Media Art Archiving was organized by representatives of the ISEA, SIGGRAPH, ADA and Ars Electronica archives and held online during the ISEA2020 symposium. Representatives from the FILE Festival archives contacted the ISEA and SIGGRAPH archive directors after the Summit expressing their desire to be involved with this initiative and invited ISEA and SIGGRAPH archive representatives to give a talk at the FILEAlive¹¹ online meetings. This relationship with the representatives of the FILE Festival initiated the implementation phase of the project to connect new media art archives globally.

Central Repository and Authentication

The SIGGRAPH, ISEA, and FILE archive team met with Dalton Martins, coordinator of the Tainacan¹² project at the University of Brasilia, to discuss the development of the new FILE archive. While working on taxonomies, relationships between data, and information architecture, the team also began the implementation of the complex infrastructure to connect the archives. Dalton Martins led the discussion of the technical requirements of the project¹³ with his vast knowledge of how to use wikidata¹⁴ as a central repository for information as well as a unique identifier for people. Plans were made to connect people's profile pages located in the three archives to each other using wikidata as the central repository for the structured data related to a person's identity. This method of authentication was chosen because it is an open source knowledge database accessible to all archives free of charge and most likely to resist obsolescence. The challenge was preparing the data for the process of uploading the basic information related to people (name and affiliation) in the archives to wikidata.

Establishing the Connection

Alexa Mahajan, a programmer for the ACM SIGGRAPH History Archives, began the implementation procedure by designing a means for the connection data to be input into the archive system and displayed on the front-end of the site. When a person has an entry in another archive, the appropriate archive icon appears on their profile page and this icon links to the corresponding webpage within that other archive.



The goal was to establish a bi-directional link between archives without having to enter each connection manually.

She designed the system to automatically establish the links to other archives by dynamically populating the data fields. As we tested this procedure, it became apparent that each archive's database of "people" information would need to be carefully scrutinized to ensure that a person was not entered twice into the archive. Because of the use of nicknames and various other ways of listing one's name, complicated by the fact that females often change their names through marriage, we needed to identify all entries in the database that referred to a single individual by different names and consolidate those entries. With over 10,000 names in the SIGGRAPH archive and nearly 8,000 in the ISEA archive, ensuring there were no duplicate listings was a challenging task.

Name Comparison Code

The back-end programmer for the SIGGRAPH archives, Luis Wilson, developed code to compare names from one archive's database to another archive's database to see if any names in the two archives matched. With the goal of distributing an application to the partners involved in the project, Alexa Mahajan developed the front-end interface using Python. This interface allows the user to select two databases and run a comparison between their exports, enabling the list of "people" names in their own archive to be compared with the exported list of "people" names in another archive. This non-trivial code uses fuzzy logic, based on Dalton Martins' advice, to compute the percentage of likelihood that a match exists between two names. In running the application to compare the SIGGRAPH names to the ISEA names, it became apparent that there were many instances of the same individuals being entered repeatedly into the system using a variety of different naming conventions (with or without nicknames, middle names, married names, etc.). We realized that we could use the same application to compare the ISEA archive to itself and the code would identify these duplicate and related names. Using the results of this code, we determined that if an entry received an 85% chance of a match (or above) with another name in the database, we needed to take a closer look to determine if it truly matched. Even when the system ranked the match as 100%, we still needed to manually ensure the two entries in question were, in fact, the same person (to account for cases where distinct individuals share the same name).

Data Export

Since the SIGGRAPH, ISEA, and FILE archives are still in development, this need to compare each archive's list of names mandated that we also program a means of exporting the data we needed. Although the information architecture is similar between the three archives, the differences posed unforeseen challenges. The SIGGRAPH archive was in the process of being moved to a virtual machine and the export of data was only possible with an older cloned version of the archive. In addition, both the SIGGRAPH and ISEA archives treated artist collectives

and companies differently than the FILE archive. This discrepancy posed challenges in comparing the data exports, and so Alexa reprogrammed the way that SIGGRAPH and ISEA handle these entities within their databases. Implementing this change required us to go through the 18,000 entries and move all artist collectives and companies from the “people” table to the “collectives/groups” table.

Next Steps

After sanitizing our data to ensure the list of “people” names did not contain duplicates and that a similar export structure was maintained between archives, the next step was to use OpenRefine to further cleanse the data and compare it to existing wikidata “people” entries. This is the current state of the process. The database preparation enables us to upload the basic information about a person from each of the archives into wikidata and input the link to the new media art archive page that contains a profile of that person. After we have populated wikidata with this information, we will write code to check this repository to see if an entry in our archive exists in wikidata and then populate the fields in our archives to establish the connection to other archives. This entire procedure will then be utilized to connect art event entries in each of the archives since many artworks, animations and performances often are documented in each of our individual archives. We will then make the applications we developed publicly available for new media art archives to create direct data connections to other new media art archives around the world.

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Authors Biographies

Bonnie Mitchell is a digital artist, animator, and archivist, as well as a professor at Bowling Green State University in Digital Arts, Ohio, USA. Mitchell is the co-director of the SIGGRAPH History and ISEA Symposium online Archives and also is a member of the organizing team of the Summit on New Media Art Archiving (first held in 2021 online and again in 2022 in Barcelona). She is also a member of the ISEA International Advisory Committee, the ACM SIGGRAPH History, and the Digital Arts Committees. In 2023, Mitchell is in charge of the celebration of the 50th SIGGRAPH conference in Los Angeles.

Alexa Mahajan is a senior at Bowling Green State University, majoring in digital arts and minoring in computer science and math. She is interning at Pixar Animation Studios in the Pixar Undergraduate Program for technical direction, summer of 2022. Mahajan also works as a programmer for the SIGGRAPH History Archives, focusing on user interface development and content organization. She aspires to work as a technical director and get to combine her passion for animation and programming to develop tools that help others create with excellence.

Luis Wilson obtained a bachelor's degree in Computer Science from the Monterrey Institute of Technology and Higher Education in Mexico in 2021. Currently he is a software engineer at Microsoft working in web development, his main area of interest. Since 2020, he has been a volunteer programmer for the SIGGRAPH History Archive, helping the site grow and reach its potential. He is also involved in the archive's mission of creating interconnected data between new media art archives by creating tools that aid in establishing the relationship of data coming from different sources.

Oliver Grau (DE) is first Chair Professor for Image Science in the German-speaking countries at the Danube University since 2005 and has held more than 350 lectures and keynotes. Grau's “Virtual Art,” (2003) is the most quoted art history monograph since 2000. He conceived scientific tools for digital humanities like the Archive for Digital Art (ADA, since 1999) and developed international MA programs like Image Science and the joint master in MediaArtsCultures. Grau was founding director of the MediaArtHistories Conferences. He has received several awards for books including *Mediale Emotionen* (2005), *Imagery in the 21st Century* (2011), recently: *Digital Art through the Looking Glass* (2020). 2014 he received a doctor h.c., 2015 he was elected into the Academia Europaea.

FILE ARCHIVE

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Abstract

The presentation is about the digital archive of FILE - Electronic Language International Festival. FILE ARCHIVE is an initiative carried out by the independent cultural non-profit organization FILE – International Electronic Language Festival – and aims to make available and share its collection, which brings together 22 years of achievements, in an accessible and free online environment. This expanding collection makes available the last 5 years of FILE FESTIVAL events and exhibitions (2017 -2022), through the free software TAINACAN.

Keywords

digital file; digital memory; cultural memory, digital platform, database, digital repository.

FILE ARCHIVE is an initiative carried out by FILE – International Electronic Language Festival – and aims to make available and share its collection, which brings together 22 years of achievements, in an accessible and free online environment.

From the emergence of the avant-garde of electronic art in Brazil to the rise of interactivity in exhibition spaces, the Festival is present in the Latin American scene as a cultural platform of international visibility that promotes aesthetic, cultural and scientific manifestations; produced in the field of art in the digital age.

Throughout its history, FILE has constituted a unique collection of its kind, having held 49 exhibitions and exhibited more than 8,000 national and international works. The Festival also visited 6 Brazilian states and exhibited artists from 48 countries.

This constantly expanding collection is now available through the free software TAINACAN, developed in Brazilian universities and a product of the work developed at the Faculty of Information Science at the University of Brasilia. FILE ARCHIVE currently makes available the last 5 years of FILE FESTIVAL events and exhibitions (2017 -2022), including archives in different formats, such as digitized publications, biographies, synopses, photographic records of exhibitions and works, as well as information

about symposia, workshops, artistic performances and festival awards, to be shared with the different audiences as illustrated in Figure 1, Figure 2, Figure 3, Figure 4 and Figure 5.



Figure 1. Launched 02/2022. © Copyright. FILE FESTIVAL



Figure 2. FILE ARCHIVE homepage. © Copyright. FILE FESTIVAL

The final structure of FILE ARCHIVE digital repository was composed of 8 collections, where each of them contains specific metadata of different typologies, such as: Artworks, Participants, Events, Educational Activities, Venues, Publications & Media, Physical Archive, Registration form.

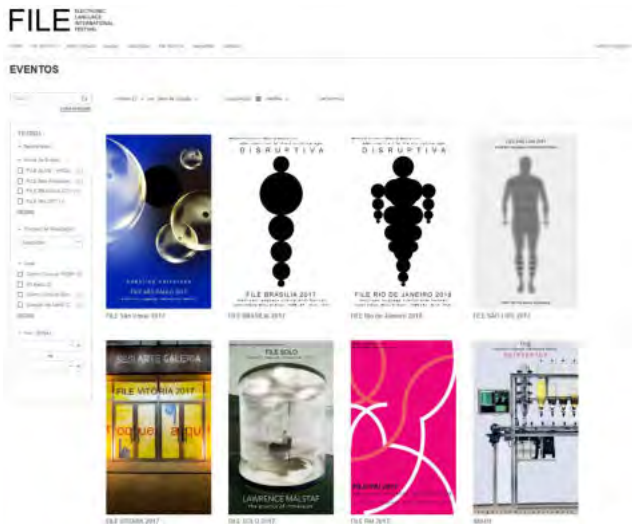


Figure 3. FILE ARCHIVE, Events Collection. © Copyright. FILE FESTIVAL

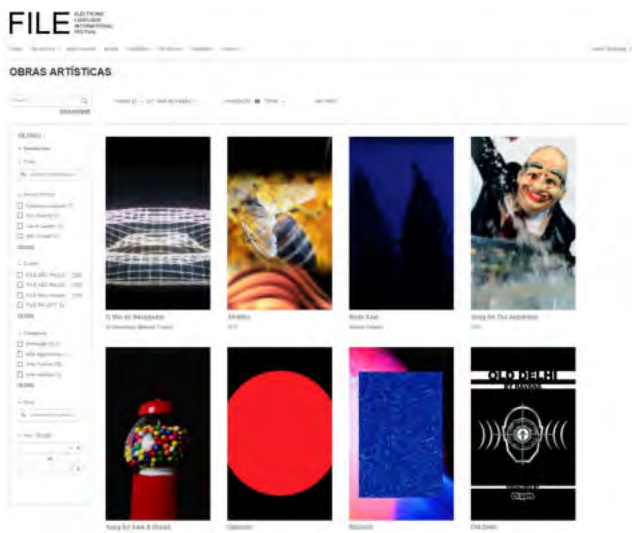


Figure 4. FILE ARCHIVE, Artworks Collection. © Copyright. FILE FESTIVAL

The result of this project offers the public interested in the field of art and technology online access to organized information and contributes to facilitating, to all interested scholars, the means for free access to the information in this collection. In this way, we support, value and disseminate the festival's content, in addition to preserving the material and immaterial assets of the international and historical cultural heritage created by a Brazilian initiative.

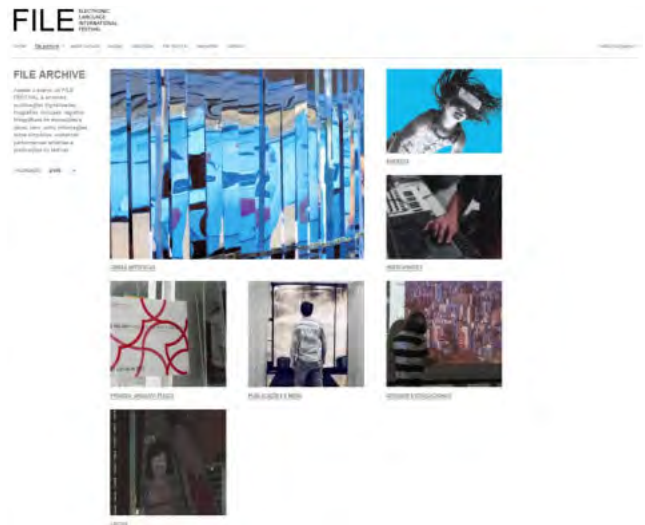


Figure 5. Collections of FILE ARCHIVE. © Copyright. FILE FESTIVAL

Author(s) Biography(ies)

Paula Perissinotto is specialized in new media, contemporary art and digital culture. Master's degree in visual poetics from ECA (School of Communications and Arts at USP University of São Paulo). Since 2000 I have been working as Co- organizer and Co-curator of FILE, Electronic Language International Festival, a non-profit cultural organization that promotes and encourages aesthetic and cultural productions related to the new poetics of contemporary culture. At the festival, is responsible for the selection of works, international relations and also calls for project management carried out in Brazil. Have produced and realized 50 art and technology exhibitions. Current is a PHD student at the University of São Paulo, School of Communications and Arts | ECA, in Visual Poetics. Member of the Realidades Research Group licensed by CNPq, led by Prof. Dr. Silvia Laurentiz who in turn, is formally affiliated with the School of Communications and Arts and the Department of Visual Arts, ECA / USP.

Fabiana Krepel is a Food Engineer graduated from Unicamp University, and post-graduated in marketing from ESPM. She holds a Graphic Design Certificate from Parsons The New School of Design and an ADVANCED DIPLOMA in Online Education & Training from the Institute of Education, University of London.

Fabiana has experience in strategic planning, direct marketing, acquired in multinational and national companies such as WUNDERMAN. She has also 15 years of experience in specialized consultancy for cultural projects in incentive laws; both in the development and approval of customized projects, as well as in the management of sponsorship resources and accountability.

Since 2001 she has been a Partner – Director of KCE Consultoria Empresarial | b.k design; and is responsible for coordinating the FILE FESTIVAL platforms; FILE ALIVE and FILE ARCHIVE (online educational platform and archive Platform); as well as responsible for FILE cultural projects in incentive laws.

ISEA Symposium Archives: Progressing from the Past to the Future

Bonnie Mitchell, Jan Searleman, Wim van der Plas, Terry C. W. Wong

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Abstract

The ISEA Symposium Archives have undergone significant changes in the past 8 years but in 2021, the project reached a milestone. All the information had been moved from the Classic archive to the New archive, therefore the focus transitioned from data input and basic development to finding missing information, fixing errors, developing structural consistency, cleansing the data, adding videos and developing features that would enable us to connect to other archives. Although the ISEA archives are far from complete, this shift of focus has broadened our vision and enabled us to enhance the usefulness of this valuable resource.

Keywords

archive, new media art, online repository, electronic art, digital art

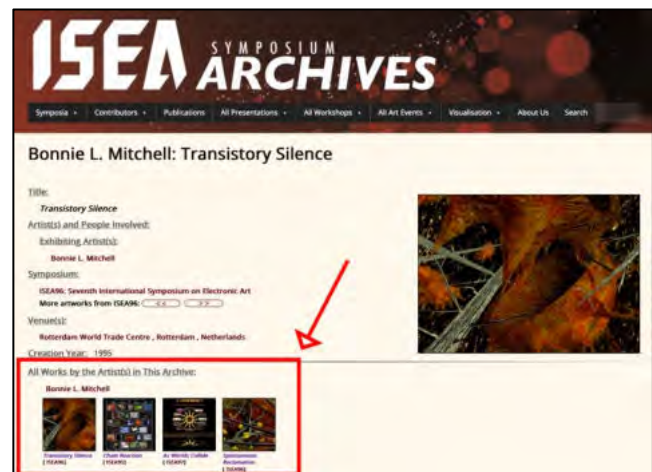
Introduction

The current ISEA Symposium Archives initiative began with the goal of documenting all past ISEA symposia and making this information publicly available on the web. The information from the original ISEA archive was ported to a simple WordPress site and the team spent years adding additional information to this static website. Realising the potential of connecting the data to create complex relationships, we built a structurally more complex system and embarked on a new phase of the project. The primary goal was to move the information from the ISEA Classic Archive and to the various fields in this new system. With over 18,000 entries to add, this required a lot of unpaid volunteer effort and time. In 2021, we completed the transition of data and refocused our energy on the next phase of the project.

Content Correction and Analysis

The new ISEA Symposium Archive requires that the data be added to individual fields thus eliminating the possibility of a direct export and input of the data between the archives. When entering data bit by bit, it is difficult to see the big picture. The ISEA symposium is hosted in a different

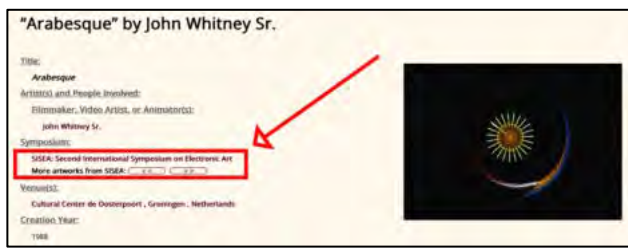
country and organised by a new group of people each time, so the structure of the data differs from year to year. By creating year-to-year analysis charts of the structure of the data entered in the archive, we were able to easily spot and correct inconsistencies. We also enhanced our export feature and wrote a program using Python and fuzzy logic to compare people names in our database with other databases. This complex code looked for duplicate and similar names (such as nicknames, married names, etc.) and calculated the percentages of a match. This process enabled us to detect over 350 duplicate people entries in our own archive which took months to fix. We also restructured the way the archive deals with artist collective names so the members are dynamically linked to the collective name. In the past, a collective was treated the same as a “Person” entry thus limiting its dynamic relationships. These are a few of the “fixes” that have occurred over the past year.



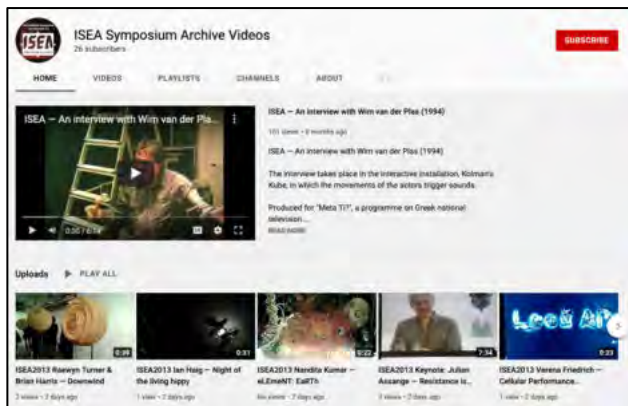
Enhancements

By identifying the many ways in which a researcher may want to traverse the archive, we identified major user interface enhancements to make the process easier. On the art event pages, we added a feature to show icons (with links) of all other art events by the contributors. We added

the ability to go to all the other art event entries related to a symposium within a single art event entry.



We also started a Youtube channel and we digitised scores of VHS and UMatc tapes and embedded those in the archive.



More images were added to the archive and some of the missing information was found. We are now in the process of proof-reading and correcting all the entries in the archive and training new volunteer interns to help with this task. We welcome feedback from users and hope they will help test the usability and accuracy of the new archive.

The Future

Although there is much more to be done in regards to adding information and fixing problems, our recent focus has been to create the ability to connect with other new media art archives around the world. We added the ability to detect if a person has an entry in another archive and if so, display an icon with a link to the other archive. This feature prepares the ISEA archive to become part of a world-wide distributed network of new media art archives. These efforts further our goal to provide access to information about ISEA's past as well as paves a path forward into the future.

Biographies

Bonnie Mitchell (Ohio, USA) is a digital artist, animator, archivist as well as a professor of Digital Arts at Bowling Green State University. Mitchell's artworks explore spatial and experiential relationships to our physical, social, cultural and psychological environment through interaction and physical immersion. Her creative work includes interactive installation art, environmental data visualization

art, experimental visual music animation, net-art, and new media art archive development. Mitchell is the co-director of the SIGGRAPH History and ISEA Symposium online Archives and also a member of the organizing team of the Summit on New Media Art Archiving (first held in 2021 online and again in 2022 in Barcelona). She is also a member of the ISEA International Advisory Committee, the ACM SIGGRAPH History and Digital Arts Committees and is the SIGGRAPH 2023 History Chair in charge of the 50th conference celebration.

Jan Searleman (California, USA) taught Computer Science at Clarkson University for 37 years, retired in 2015, and since retirement has been an Adjunct Research Professor at Clarkson. Her research areas are Virtual Environments, Human-Computer Interaction, and Artificial Intelligence. A senior member of the ACM, Jan is also on both the ACM SIGGRAPH Digital Art Committee (DAC) and the ACM SIGGRAPH History Committee. Jan and Bonnie Mitchell coordinated the DAC Online Exhibition "The Earth, Our Home: Art, Technology and Critical Action". She co-moderated SPARKS talks (Short Presentations of Artworks and Research for the Kindred Spirit) for DAC on "Robotics, Electronics, and Artificial Intelligence" with Hye Yeon Nam, and "Data: Visual Perception, Interpretation and Truth" with Everardo Reyes. Jan co-directs, along with Bonnie Mitchell, the ACM SIGGRAPH History Archive. She also co-directs the ISEA Symposium Archive with Bonnie Mitchell, Wim van der Plas and Terry C.W. Wong.

Wim van der Plas (Netherlands) studied Social & Cultural Sciences at the Erasmus University Rotterdam. He was director of the Foundation for Creative Computer Applications (SCCA, Rotterdam), R&D staff of the Utrecht School of Arts, managing director of the Institute for Computer Animation (SCAN, Groningen), and worked for 3 different departments of the Utrecht University of Applied Sciences. He is co-founder of ISEA, organised the first, second and seventh ISEA symposium and served as ISEA HQ and on the ISEA board since its founding. Currently he is co-director of the ISEA symposium archives and member as well as honorary chair of the ISEA International Advisory Committee. In 2018 he received a Leonardo Pioneer Award.

Terry C. W. Wong has a Bachelor's degree from the Applied Science Department of the University of British Columbia and a Master's degree in Fine Art at the Chinese University of Hong Kong. Currently, he is working on his graduate degree in the School of Interactive Arts and Technology at Simon Fraser University. He is doing his research study on connecting new media art archiving worldwide. Terry is also an archivist and co-organizer for the ISEA Symposium Archives. He was also on the organizing team of ISEA2016 in Hong Kong.

Ars Electronica Archive

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Abstract

The Ars Electronica Archive contains documentation of content since the start of Ars Electronica in 1979. A huge number of artists and researchers from the field of art, technology and society were part of Ars Electronica activities during more than 40 years. They have left their traces in the archive. The presentation provides a glimpse into what the Ars Electronica Archive is and stands for, and what the current achievements and challenges are. Part of the archive is accessible online (Online Archive), part of it only internally (physical Archive & Internal Database).

Keywords

online archive, media art, festival, prix ars electronica, hack attack, challenges, growing

Ars Electronica Archive

Ars Electronica, based in Linz, Austria, and founded in 1979, holds one of the world's largest archives of digital media art. Everything started with the first Ars Electronica Festival in 1979. Next to the Festival the Prix Ars Electronica (yearly competition in several categories, initiated in 1987) and the Ars Electronica Center (museum, open to the public year-round) came into being first, followed by several other divisions. Currently Ars Electronica can be described as stage and competition for media art, festival for art, technology and society, showcase for creativity and innovation, laboratory for research and development, and school of the future. [1]

The Ars Electronica Archives mission is to preserve the ideas and the diversity of Ars Electronica, and to make as much of it as possible freely accessible to users. It's holdings include a diverse array of art works and documentation of projects, exhibitions and activities from the Ars Electronica context and across the entire spectrum of media art throughout the world. Highlights are the winning projects of Prix Ars Electronica in the Prix Online Archive, and video documentation of the early Festival years and Center exhibitions, which was possible through the involvement of the ORF – Austrian Broadcasting Company's Upper Austria Regional Studio at that time [2].

Part of the Ars Electronica Archive is accessible online (Online Archive, Figure 1), part of it only internally (physical Archive & internal Database). Currently the biggest challenges of the Archive are: a) to bring "old" festival websites, placed on an old server structure, back to visibility and usability for researchers (first festival website is from 1995). And b) to deal with the huge amount of newly produced content, arisen especially because of the hybrid format of the Festival in the last two years (video files exploded in terms of amount and file size).

Constantly growing, the archive forms the link between the past and the present. In its continuity and amount of content, it invites to dive into it, to look for changes over time in focus or for example file format or picture quality [3], as well as to research about single artists, works and activities.



Figure 1. Ars Electronica Online Archiv, <https://archive.aec.at/>. ©Ars Electronica.

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Author(s) Biography(ies)

Christina Radner (AT) currently is the responsible project manager for the Ars Electronica Archive in Linz, Austria. In 2009 she got

her master's degree in art history at the University of Vienna. At an internship at the Art Brut Museum Gugging in Klosterneuburg near Vienna, she got a first insight into the archive work of a museum. She was hired project-based, to help work on an artist's estate and to prepare a retrospective and a comprehensive catalogue of works. In 2013 she moved back to Upper Austria and started her work in the Ars Electronica Archive Team. Since 2015 she is the responsible project manager for the Archive and part of the Festival/Prix/Archive Core Team of Ars Electronica.

MACBA Archive

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Abstract

The archive of the Museum of Contemporary Art of Barcelona (MACBA) aims to conserve the museum's documentary heritage and promote research into contemporary art. The archive preserves documentation of special historical value generated by MACBA and other individuals and organizations related to contemporary art practices. This document collection, built around the discursive lines of MACBA, is shown to the public through exhibitions and activities. The museum has developed the MACBA Digital Repository, an online archive, to preserve and disseminate the digital art and documentary collections.

Keywords

Archives, Art museums, Contemporary art, Digital preservation, Digital repositories

MACBA Archive

The archive of the Museum of Contemporary Art of Barcelona (MACBA) aims to conserve the documentary collections and promote research into contemporary art. The archive preserves documentation of special historical value generated by the MACBA and other individuals and organizations related to contemporary art practices as well as an extensive collection of artists' books. This document collection, built around the discursive lines of the MACBA, is shown to the public through exhibitions and activities and provides a reference source for contemporary art research.

Since its beginnings, the archive has faced the challenge of combining the care of the documents with the desire to facilitate their access to the public. This dual concern has led the MACBA Study Center to initiate a policy of digitization of the archival documents. On the other hand, the MACBA historical fund, which preserves the documents produced by the museum, was receiving more and more documents born in digital format. The need for a digital repository and a system for describing and managing digital files was also essential for the conservation of a significant number of works of art from the MACBA collection.

The museum has developed the MACBA Digital Repository www.repositori.macba.cat to respond to the need to manage digital collections, both digitized and born-digital. The MACBA Digital Repository is an online archive for preserving, managing, and disseminating MACBA's digital fonds, including photographs, audiovisual and sound recordings, graphic material and documents. This digital heritage is organized into two main groups: the Artistic Collection, which includes works from the art collection, and the Documentary Collection.

The MACBA Digital Repository was opened for public consultation in the museum library in 2017, after a design and technical development phase carried out by the museum team. Subsequently, remote access has been progressively available to the public.

The repository project has involved an in-depth analysis of the intellectual property rights and contractual conditions of the works and documents stored to determine the possibilities of making each material available to users. Depending on rights there are three main levels of consultation: internal for specialists in the treatment of the materials; access from the MACBA spaces, and open to consultation from any place for any user. Access to the collection is also being progressively integrated into the MACBA website www.macba.cat with the aim of making the museum collections increasingly more widely known.

Author Biography

Marta M. Vega is head of the MACBA archive and library. She holds degrees in Art history and Documentation from the University of Barcelona. Her previous experience in libraries includes the Biblioteca de Catalunya and the Museu Nacional d'Art de Catalunya. She co-authored the e-pub on museum archives *Folding the exhibition*, MeLa Project, 2014.

Global Archiving Network: A Case Study at the Second Summit on New Media Art Archiving at ISEA2022

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Abstract

One of the primary functions of an archive is to act as a repository to store essential documents and records throughout history; consequently, these stored archival materials can help us re-imagine a collective memory of the past. With rapid changes in the dissemination of information in recent years, the conventional ways of archiving may not be able to capture all the essential records of our time. This is especially concerning in regard to new media art archiving. Many recently created important new media artworks have been disappearing without being archived. If this issue is not addressed, we may lose a significant part of our digital cultural heritage. To respond to the issue, archives worldwide have attempted to approach the problem collectively. This lightning talk discusses a case study that will be conducted in response to the Second Summit on New Media Art Archiving at ISEA2022.

Keywords

archive; new media art; digital culture heritage, global archiving network; Liverpool Declaration; ISEA; ISEA Archives

Introduction

New media art is a contemporary-art category in which the media itself is very technology-dependent. Artists often incorporate emerging technologies in their artworks and constantly redefine the category. Unlike many other more static traditional art media, this evolving genre of art faces a severe problem: many recently created artworks can no longer be exhibited and may disappear without a trace due to technology obsolescence, lack of data, and insufficient documentation. New media art archives around the globe have been facing this challenge independently in the past. As technology changes, the challenge in archiving new media artworks has become more critical. Therefore, an initiative to establish global collaboration between new media art archives was initiated with the publication of the Liverpool Declaration. [1] The Declaration has outlined two main goals: 1) Establish international and sustainable funding structures and 2) Support an international association/institution for shared data. Additionally, it suggested an action agenda for the alliance to promote collaborations. [1]

Since then, major new media art archives around the globe (ISEA, SIGGRAPH, FILE, ADA, and Ars

Electronica) have had group discussions, implementation meetings, and have done presentations at various conferences in an effort to develop an international research-archive infrastructure. An important conference dealing with this topic is the Second Summit on New Media Art Archiving at ISEA2022. The First Summit took place at the ISEA2020 symposium held online and hosted in Montreal, Canada. [2] After the success of the First Summit, the Second Summit was co-organized by the ISEA Symposium Archives and the SIGGRAPH History Archives and in cooperation with ISEA2022 Barcelona, the Barcelona Museum of Contemporary Art (MACBA), the Electronic Language International Festival (FILE) Archive, the Archive of Digital Art (ADA) and the Ars Electronica Archive. [3] The Summit series is an effort to establish a global archiving network as defined in the Declaration. These events allow different stakeholders to exchange ideas related to new media art archiving and lead to collaborative archiving protocols and strategy development. This makes the summit ideal for conducting a case study for the emerging global archiving network research. The goals of the case study are: 1) to identify the current status of the emerging archiving network, 2) to analyze the various problems and solutions, and 3) to report the findings back to the archiving community as a contribution. The case study consists of data collection mainly through observations, literature reviews, surveys, and interviews.

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ISEA2022
BARCELONA

LIGHTNING TALKS

The Different Histories of Electronic Art in the V2_ Archive

Arie Altena and Michel van Dartel

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Abstract

V2_ Lab for the Unstable Media is an interdisciplinary center for art and media technology in Rotterdam, the Netherlands. It strives to build a ‘living archive’ of electronic art, using its own documentation from over 40 years, made accessible on its website. This presentation outlines some of the strategies to bring out the *different* histories of electronic art that narrate the art form’s critical role in giving meaning to and (re-)interpreting the real-world effects of technology.

Keywords

Living Archive; Electronic Art; Art History; Dissemination.

Introduction

V2_ Lab for the Unstable Media is an interdisciplinary center for art and media technology in Rotterdam (the Netherlands). Founded in 1981, V2_ creates a context in which issues regarding the social impact of technology are explored through critical dialogue, artistic reflection and practice-oriented research. The V2_Archive contains descriptions of more than 1,300 events organized by V2_ over the past 40 years, along with about 600 longer accompanying texts (essays, lectures), descriptions of almost 1,000 works of art and other projects exhibited at V2_, and more than 1,600 biographies of artists and speakers. There are also links to hundreds of videos, ranging from full recordings of events to brief interviews with artists; hundreds of scanned program booklets and PDFs; and thousands of photographs. Through its integration in V2_’s website, the archive continues to grow daily with every activity V2_ undertakes. Besides offering a valuable publicly accessible resource for researchers investigating the evolution of the field of art and technology, V2_ strives to activate its archive in order to make this evolution of value for contemporary culture, current art production, and the public.

No unequivocal picture can emerge from an archive like this one. Its diversity and size make that all but impossible. An archive invites research, browsing and discovering connections. We work from the assumption that V2_ archive does not yet represent a history: it possesses the potential for history to be written. V2_ strives for a ‘living archive’, where the documentation that is offers is used to create different stories about the past, that might give insight into the now and the future – especially with regard to the effects that technology has on the arts and on society.

The strategies V2_ currently undertakes to realize the potential of the archive include archival research into the curatorial processes centered around our presentations and productions. This research is also published and/or presented at events. The recent publication *40 Years of V2_*, as well as the establishing of a list of 40 iconic works, chosen by the public, are part of this. One particular example is this is taking key works from the history of electronic art as a starting point for contemporary artistic research in the program *Re-enacting the V2_Archive*. An unlikely success is the featuring of archival research in the monthly V2_radio programme on Operator Radio. The undertakings can be seen as strategies towards achieving a living archive, and a lively discourse on the history of electronic art.

These strategies to argue that their pluriformity is paramount to bring out the different histories of electronic art. This emphasize on the different stories through which the history of electronic art can be told is a critical reminder that archives such as V2_’s are important to challenge the singular innovation-oriented narrative that currently dominates the historical analysis of electronic art. V2_’s archive is an asset in the narration of electronic art’s critical role in giving meaning to and the (re-)interpretation of the real-world effects of technology, but it needs to be used to make those different histories come alive.

Acknowledgements

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Author Biographies

Arie Altena is archive editor at V2_ and the author of *Wat is community art?* (2016) and *40 Years of V2_* (2022).

Michel van Dartel is Director of V2_Lab for the Unstable Media and Research Professor at the AVANS Centre of Applied Research for Art, Design and Technology (CARADT).

Introducing Videotage Media Art Collection (VMAC)

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Abstract

Founded in 1986, [Videotage](#) is a leading Hong Kong-based non-profit organization specializing in the promotion, presentation, creation and preservation of new media art across all languages, shapes and forms. Videotage Media Art Collection (VMAC) strives as the identity and body that documents Hong Kong's extensive media art history. Through Hong Kong's character of a cultural, geographical and political peninsula that uniquely merges Chinese and Western influences, the collection depicts how the city has been a sensitive witness to a period of art in history. It also displays the development of society as much as that of technology-exploring issues of identity and life in urban, political and cultural environments through a wide array of techniques that mark the transition from analogue to digital artmaking.

Keywords

Video-art, VHS, Digitalization, Art-communities, Collaborative preservation, Hong Kong

Documenting Hong Kong Early Media Art's Communities

VMAC is a unique witness to the development of Hong Kong video media culture in the past three decades. Preserving over 2000 magnetic tapes/born-digital video artworks and 1500 programme documents from the early media art scene. The collection features an extensive scope into local pioneer video artists with manifold backgrounds, covering a great diversity of genres from personal video diaries and letters, workshop result, found-footage remixes, theatre performance, cell animation to feature-length mockumentaries. Notable collections include Ellen PAU, WONG Chifai, May FUNG, Danny YUNG (ZUNI) and HUNG Keung.

We share the gradual challenge in pursuit of preserving artistic authenticity of obsolescing media art objects. With this opportunity, we would like to share our storage practice towards magnetic tapes and obsolescing machines

(such as reel projectors and CRT TVs), and our house digitalization method on tapes and printed materials.

With the objective to build a brand new platform for research, education, curatorial practice, and artistic production, Videotage strives to provide curators, artists, students and scholars resources at VMAC to support project facilitation, realization, concept synthesis, presentation, documentation, and networking. Currently, VMAC is developing an online-streaming platform with semantic taggings in hope of a more effective information retrieval experience to the local research community needs.

Recent notable projects include: "[Why An Archive](#)" (curated by Ariane Beyn), as part of Times Art Center Berlin's exhibition *Readings From Below* in collaboration with Arsenal - Institut für Film und Videokunst e.V.; "[Discourse of Reimagined Hong Kong Art Communities](#)" archival series (curated by Lo Yin-shan), as part of [New Horizons: Ways of Seeing Hong Kong Art in the 80s and 90s](#) exhibition in collaboration with the Hong Kong Museum of Art (HKMoA); "[Either Too Quiet or Too Loud](#)" (curated by Hsiao Bochun) with Taipei Contemporary Art Center and Hong-Gah Museum; and "[Hallucinatory Hereafter](#)" (curated by Vennes Cheng Sau-wai) as M+ Mediatheque guest-curated programme.

In pursuit of collaborative preservation across regions, VMAC expanded their collection towards the greater china region from 2019, and have broadened the collection with 98 new entries selected by esteemed guest curators. Notable mentions including TAO Hui, Liang ZHAO, CHEN Shao Xiong from China Collection curated by SU Wei (Independent art critic and curator, Beijing); Wang Jun-jieh, Yuan Goang-ming, Su Hui-yu and Hsu Chia-wei from Taiwan Collection curated by Song-Yong SING (Institute of Interdisciplinary Art, TNUA).

The Computer Arts Society Archive

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Abstract

The Computer Arts Archive is a not-for-profit company that collects, exhibits and promotes computer arts for the benefit of artists, audiences, curators, educators and researchers. We collaborate with other collections, museums and galleries to explore the impact of digital culture and ensure that computer art is recognised as a significant contemporary art form with a rich and diverse history. In particular, we work closely with the Computer Arts Society, a member-based organization founded in 1968.

Keywords

computer art, digital art, media art, histories, archiving

The CAS50 Collection

The Computer Arts Society was established in London in 1968 as a forum for people interested in the use of computers in the creative arts. It organizes meetings and events, hosts exhibitions and publishes its own occasional journal, PAGE.

In 2018 the society put together an exhibition of 2D digital artworks to help celebrate the fiftieth anniversary of the founding of the society. The resulting “CAS50 Collection” featured multiple artworks by 24 significant artists and was exhibited in Leicester and Brighton in the UK, and then as part of “Event Two” at the Royal College of Art and “The Digital Design Weekend” at the V&A, both in London.

The Computer Arts Archive CIC

In order to provide a physical home for the CAS50 Collection, and to create a base from which further collecting could take place, a new non-profit company, the “Computer Arts Archive CIC” was established in 2019 and an office opened in Leicester in the heart of the UK

Other Collections

Despite delays caused by the global COVID-19 pandemic, the Computer Arts Archive has managed to grow its collections over the past two years

We are now custodian of the Electronic and Visualization and the Arts (EVA) conference archive, containing 30 years of material, and the Edward Ihnatowicz Archive. We also have a collection of computer artworks made in the 1980s, plus Sean Clark’s personal collection of “cyberculture” materials from the 1990s.

Our goal is not to attempt to build a “definitive” collection of computer art from the last 50 years, but to focus on previously untold stories within the history of computer arts and to share our work with other archives and collections.

Current Challenges

The Computer Arts Archive is still relatively new. As well as the usual challenges of such a project – obtaining funding and storage space – our key task as present is to index the materials in the archive in a way that will make the data interchangeable with other projects. We are particularly interested in working with other archives to use and develop common metadata standards for data representation, as well as identifying open source archiving software for data storage.

We are also working with De Montfort University in Leicester to investigate how technologies such as Machine Learning and Artificial Intelligence can be used to uncover connections between the materials within the archive.

Digitized Analog Memories – Methods of Visualizing Found Media

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Abstract

With the rise of home computers in the 1980s and the world wide web being publicly available in the 1990s there has been a boom of media that was created by the public. As these files are getting to be over 30 years old, there is a unique opportunity, as an archivist, regarding curating these files and providing a perspective of this time period for future generations.

“Digitized Analog Memories” is a case study of possible methods for curating personal media found on discarded floppy disks. The method for the study was to create a “desktop vignette”, or digital collage, of the previous owner’s life using legacy hardware and software (Pentium III Windows 98 PC). During the collage process, specific desktop color schemes were chosen based on the content found on the floppy disk as a means of recreating the previous owner’s desktop when they originally created the files.

From this study, three key nodes of discourse around the topic of archiving and presenting historical personal data came up: 1) Is all personal data relevant to archive for historic or anthropological reference? 2) How much subjective flexibility can be given to the curator/artist when it comes to presenting historical digital media? 3) How should the hardware for reading dead formats be maintained for future archival use? From this study, all personal data was relevant, however personal photos and journal entries were the most popular to exhibition viewers. The curation of this material should be minimal and maintain period-correct aesthetics. The media should be raw, but personal information of the original owners should be redacted. While legacy hardware is still cheap and easily available today, institutions need to make the effort to maintain legacy machines for use in the distant future.

Keywords

Digital Curation, New Media, Found Media, Human-Technology Relations, Media Convergence, Digital Archive

Overview

This talk will go over the initial discovery of found digital media on obsolete formats, followed by the methods of salvaging media using legacy hardware and curating pieces for public viewing. The initial exhibition of this work was

hosted by the Basement Gallery at the University of California, Davis. During the curation process, balancing the emphasis between the technology used, the digital media files, and the original creator was key. The goal for this work was to humanize the past i.e., finding the analog memories in a digital space.



Figure 1: An example of a “desktop vignette” using media files found on the “Kodak Image” floppy disk from 1997

Author Biography

Erik Contreras is an interdisciplinary designer and engineer from the San Francisco Bay Area with a background in rapid prototyping, and hardware hacking + repair. His work involves finding alternative uses for post-consumer products and media through hands-on craft and new media digital art pieces. He feels that obsolescence creates an opportunity to showcase a product’s true character in the real world given the influence from consumer culture and technological hype has faded away due to time.

2nd Summit on New Media Art Archiving ISEA2022

Collecting and Preserving Expanded & Extended Nonfiction

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Abstract

The history of the evolving field of new media work is pushing individuals to take a huge effort to preserve important artifacts and analyse projects. *Extended Nonfiction* is a project that promotes the study, training, production and preservation of audiovisual, interactive, transmedia and immersive nonfiction narratives. *Extended Nonfiction* is an informative, formative and productive proposal that places emphasis on the field of reality, on real stories; but not just any reality, on expanded and extended reality.

Keywords

Online Preservation, Works collection & Analysis, Database, Non-fiction Narratives; Reality; Audiovisual Narrative; Interactive Narrative; Transmedia Narrative; Immersive Narrative.

Description

The first phase of the project includes the creation of a platform in the form of an observatory that includes and preserves different genres and formats of extended reality. These genres include documentary, journalism, education, museums, essay, political discourse and reality TV, among many others. All these nonfiction genres and formats are mixed with different narrative expression forms, such as audiovisual, interactive, transmedia and immersive. The second phase is the design and implementation of a training academy-school. The third phase includes the stimulation and transfer of knowledge for production, through consulting with companies and brands to generate real storytelling that becomes specific branding. Here we present the results of the first phase of the project, and specifically regarding the platform we are developing in order to preserve works, templates and guidelines for interested audience such as producers, students, companies, etc. The

current proposal is based on the creation of a web platform structured as a database containing and analyzing in detail the production process of 50 interactive, transmedia and immersive non-fiction projects in which we have worked in different roles during our professional career. These projects can be consulted from the delimitation of a set of filters (time, period, topic, etc.) that allow users to generate templates adapted to their needs providing learning and useful guides for the production of this type of works. The project is currently in an advanced state of development, but draws on extensive research in the field of interactive documentary [1] and production of non-fiction works [2] during the last 15 years.

References

[1] Arnau Gifreu-Castells, *El documental interactiu com a nou gènere audiovisual. Estudi de l'aparició del nou gènere, aproximació a la seva definició i proposta de taxonomia i d'un model d'anàlisi a efectes d'avaluació, disseny i producció*. [PhD]. (Barcelona: Universitat Pompeu Fabra. Departament de Comunicació, 2013).

[2] Arnau Gifreu-Castells, "Personal website, multimedia productions", accessed January 30, 2022, http://agifreu.com/multimedia_eng.htm

Author Biography

Doctor in Communications and has a Master's Degree in Digital Arts (UPF). He has been a research affiliate at the Open Documentary Lab (MIT, 2013-2018) and part of the i-Docs group (University of the West of England). He has published various books and articles in his research area, interactive, transmedia and immersive non-fiction, and specifically on interactive documentaries.

Research-based Online Archive and the Canonization of Net Art

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Abstract

During the project “Calculating Control: (Net)art and Cybernetics” the Zentrum für Netzkunst had designed and built a small online archive, that includes different resources and references related to the topics of cybernetics, GDR, as well as artworks and specifically net art.

Rather than being focused on a singular medium or an art period this research-based archive introduces one possible narrative, connecting net art to local history and supporting its circulation in the collective online memory.

Keywords

research-based archives, online archives, alternative archive structure, collective memory, local histories, net art

Research-based online archive and the canonization of net art

Zentrum für Netzkunst (center for net art) is a small, young initiative reconstructing, maintaining, and preserving net art and net culture. Through their activities, the group researches the possibilities of contextualization of net and digital art. [1] Since 2019 Zentrum für Netzkunst has been a pioneer user in the House of Statistics in Berlin – an urban project aiming to bring together social, artistic, and activist initiatives. [2]

The location of Haus der Statistik was a point of departure for the exhibition and research project “Calculating Control: (Net)art and Cybernetics”. [3] Working from the site-specific history of Haus der Statistik (a building that operated as the Central Administrative Headquarters for Statistics in the German Democratic Republic), the project explored the impact of cybernetics on artistic and social practices, networks, and technology. As part of the project Zentrum für Netzkunst designed and built a small online archive that is still accessible and updatable to this day. It includes different resources and references related to the topics of cybernetics, GDR, as well as artworks and specifically net art. The archive was built by “misusing” the open-source software for bibliographies Zotero. The research assistant program works as the input mask for entries as well as a control panel for the archive. This structure allows making new links between net art and other historical artifacts and references.

The “Calculating control” archive is not directly preserving the material, the books, or the artworks related to the project, but it works as a growing collection of

references. It is archiving the process of the research as well as the parts of the project, stretching the definition of an archive to its limits.

Even though it might seem that such an archive doesn’t fulfill its function as an agency for the long-term preservation of net art, it is not an “empty” archive. It has a specific value and function in the canonization of net art. Rather than being focused on a singular medium or an art period this research-based archive introduces one possible narrative in which specific net art works can be anchored. It connects net art to local history, as well as to a discourse outside of the art historical field.

For an art practice such as net art, the process of canonization has been a difficult and slow journey. Because of the nature of net art that is spread on the internet, often located on a unique domain, the usual tools for a centralized archive are not available. One example of an attempt to establish a net art canon is the Net Art Anthology by Rhizome but as the name hints, it also doesn’t identify as an archive but also operates as a collection of references. [4]

For net art, one possible way to establish an archive or a canon is by continuous reproduction and connection to different narratives and contexts. Projects like the “Calculating Control” Archive support the circulation of net art in the collective online memory, connecting it to different narratives and discourses and stabilizing its position in the still-emerging canon.

References

- [1] Zentrum für Netzkunst website, accessed January 27, 2022, <https://netzkunst.berlin/>
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- [4] Net Art Anthology, accessed January 27, 2022, <https://anthology.rhizome.org/>

Author Biography

Tereza Havlíková (born in Prague) is an art historian and curator living in Berlin. Her research focuses on net art and digital art in a broader context of internet history and culture as well as online curatorial practice. She is a founding member of Zentrum für Netzkunst and a pioneer participant in the urban model project Haus der Statistik in Berlin.

Screen Recordings and Reinterpretations from Archiving to Creation

VISIONS.OF.MOUCHETTE.ORG

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Abstract

Mouchette is an iconic virtual character from the early net.art time. Fourteen screen recordings of her website have been found online on Youtube channels. These videos are documenting the viewing practices of some visitors, the way they browse the website mouchette.org the way they comment their visit, and how they embed it inside their own narrative, stories of horror, of magic or of seduction. These recordings are an exceptional archival of this website recorded by the viewers in very different ways.

Introduction

For a website like mouchette.org triggering interaction and participative experience, screen recordings are a frequent practice. They are used for archival, due to the fast changing online environment, and they are used in art exhibition since museums and galleries rely mostly on frontal viewing and wall hanging. Screen recordings as I know them are simply functional, a usual way of archival.

But what if a trove of screen recordings of Mouchette.org, full of creativity and imagination is found on Youtube channels, videos made by young people browsing and recording this website to express their personality and feelings, hoping to gather interest, sensation, and a spectatorship of their own? When the public extends the narratives to their own fancy, rather than archival, we are reaching towards collaborative creation or fanfiction. This is what happened when Nikos Voyiatzis found all these videos recordings of Russian kids visiting mouchette.org and telling stories about it. For me, the author of Mouchette.org, the participative aspect of the website is the core of my creation since the very early net.art period when interactive narratives were created with users' participations kept inside huge databases, kept and maintained to this day, and reworked into new creations. So what a wonderful gift it is to fall upon a new generation of internet users who have invented their own practices to represent and share their reactions to my website!

Among these recordings you can meet:

- -Victoria in the 'Viktory Show' channel on Youtube who plays a cute teenager girl, a 'Mouchette-like' ersonality, pretending to discover the website with surprise and bewilderment.
- -Nikitos and Romanos, too young brothers presenting 'Fears Show', episodes of the scary and supernatural stories that stage and enact physically in their own room and where they digitally insert as screams, animations, gifs and other disturbing elements of their own making inside the website of Mouchette.org.
- -You can also meet some very young kids who have difficulty in typing the URL of mouchette.org on the Russian keyboard of their phone and still manage to record their screen and post it to a Youtube channel, with their own comments and mumblings and a tiny thumbnail of their face in the top of their video.

Within mouchette.org, these are all valid collaborative creations, worthy of finding a place inside my website. In the same way that viewers reactions were and still are, kept and reworked into new pieces, a space inside mouchette.org has been devoted to these visions of mouchette.org, to host these films and give full access to viewers through english subtitles from the comments in Russian. I created a subdomain on the website mouchette.org, where I host all the videos

<https://visions.of.mouchette.org/>

First, together with Nikos Yoyiatzis who originally found them, I archived these videos on my archival website, with original technical data and all the comments:

<http://about.mouchette.org/category/archiving/by-nikos/>

And then I proposed them as online exhibitions in their full right. Here it was exhibited insi The Wrong Biennale.

https://artsubstitute.net/index_en.html

<https://artsubstitute.net/neddham.html>

My next step will be to show these works in the physical space in exhibitions as a part of the creation of mouchette.org.

Participatory Preservation: Experiments in Distributed Networks of Care

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Abstract

The recent emergence of decentralized economies has foregrounded an urgent need for new modes of long-view care and stewardship in contemporary Time-based Media Art. This lightning talk presents some learnings and insights from 10 years of hands-on applied research in the gallery and museum context. Case studies are structured around design thinking methodologies, and outcomes from experiments ranging from new exhibition formats, to collecting models, decentralized storage experiments and more

Keywords

Conservation, Time-based Media Art Collecting, Immersive Exhibition, Simulation, Virtual Worlds, Decentralized Storage, Museum Operations, Cultural Infrastructure, Peer-to-peer

Introduction

‘Participatory Preservation’ is a concept that seeks to acknowledge the networks of care and stewardship that surround and support archival efforts. Time-based Media Art is a format that uniquely requires a ‘performance’ in order to experience the work – whether playing a video, interacting with a virtual environment or simply loading a digital image. This is the general sense in which participation will be explored in this lightning talk.

Starting in the context of the gallery as the site of initiation for many Time-based Media artworks, we will look quickly at three efforts piloted in the space of an experimental gallery 1. An approach to exhibiting immersive Time-based Media Art that creates peer context around emerging art to archive a survey of practices 2. A community-focused gallery program that create a connected provenance around a program 3. A blockchain-based solidarity economy infrastructure for exhibiting and preserving complex Time-based Media artworks and redistributing wealth.

Moving next into the space of the institution and museum, we will explore a case study that focuses on a new type of cultural infrastructure that inverts many of the traditional structures associated with institutional longevity, while simultaneously uplifting and furthering the values of rigorous GLAM archival practices.

The Gallery

As the originating node in the provenance of artworks, a gallery plays an important role in the longevity of Time-based Media Art. When considered as a critical part of the program, a gallery is well positioned to experiment with new forms of contracts, documentation, presentation, display and

other concerns crucial to the archival integrity of an artwork. This is especially salient in the case of Time-based Media Artworks as these works often just consist of licensed rights to collectors and archives, along with the acceptable variations of display and conditions for care and maintenance.

The three examples in this section of the lightning talk referenced in the introduction were facilitated by TRANSFER an experimental gallery focusing on net art and simulation in contemporary art spanning the years 2013–2021. Two of the dominant topics touched upon across these examples are how standardizing display can create both positive outcomes and limitations for the longevity of diverse formats of Time-based Media Art, and how peer-coordinated exhibitions create lasting context for artworks and artist studio practice that is both resilient and precarious.

The Gallery

The Current Museum tested an experimental model for the patronage and stewardship of Time-based Media Art with the aim of reforming power structures inherent to contemporary art collecting, and expanding access and appreciation and archiving of art to a new generation of collectors. This model was tested in three acquisition salons installed in a SoHo loft in 2018, and resulted in a collection of 15 complex variable media artworks safely maintained in a preservation-grade decentralized storage network.

In this portion of the lightning talk the pillars of this model will be explained, to illustrate how ‘Participatory Preservation’ might perform meaningfully at a local level, while at the same time connecting ‘nodes’ of stewardship globally as an alternative to a centralized archival approach of contemporary art institutions.

Author Biography

Kelani Nichole is a technologist, collector and founder of TRANSFER, an experimental gallery focused on simulation in contemporary art since 2013. In addition to founding and running a leading digital art gallery, Kelani has spent 15 years in UX research and product development. In 2018 she invented a new model for distributed cultural infrastructure with The Current, a non-profit museum collection rethinking patronage and access for Time-based Media Art. Her work over the past ten years has focused on expanding an understanding and practical application of conservation and preservation through applied research and experiments with a global community of artists, collectors and institutions.

IMAI Play: The video art channel of the Inter Media Art Institute

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Abstract

The Düsseldorf Inter Media Art Institute (IMAI) is a non-profit foundation that archives, exhibits, and distributes time-based media art. The archive boasts more than 3,000 works that document the international history of video art from the 1960s until today. More than 1,000 of these videos can be viewed in full in the catalogue on the foundation's website. Since September 2021, this website also hosts the foundation's participatory video art channel: IMAI Play. IMAI Play invites users to create video art playlists, publish them on the foundation's website, and share them on social media. Through social tagging every playlist is accompanied by user-defined metadata to facilitate new readings of the archive. Users can also create their personal watch lists and comment on the playlists of other users. With IMAI Play, the Inter Media art Institute aims to stimulate communication about video art and create a space for new perspectives, discoveries, and unexpected connections.

Keywords

Video art, art history, participatory curating, digital archive, citizen science, social tagging

IMAI Play – A participatory video art channel

The Düsseldorf Inter Media Art Institute (IMAI) is a non-profit foundation that archives, exhibits, and distributes time-based media art. The archive boasts more than 3,000 works that document the international history of video art. A permanent exhibition at NRW-Forum Düsseldorf makes this history come to life in an interactive display. The distribution program circulates videos from more than 120 international artists. More than 1,000 of these videos can be viewed in full in the catalogue on the foundation's website. Since September 2021, this website also hosts the foundation's participatory video art channel: IMAI Play.

IMAI Play invites users to create playlists from more than 1,000 works of video art from the 1970s up until today. The works include the international canon of video art history, underground music videos as well as performance documentations. To find videos, users can search the catalogue by artist name, work title, medium, date, as well as search terms related to topic or style. Any of these videos can be added to a playlist.

To compile their own playlists, users have to create a personal account free of charge. The account allows them to create a playlist and add videos, texts, and a minimum of three user-defined tags. The playlist can be kept private, or it can be published on the foundation's website as well as shared on social media. A published playlist can be commented upon and put on other users' personal watch lists.

With IMAI Play, the Inter Media Art Institute strives to liberate video art history from the confines of the strictly thematic and stylistic taxonomies of professional art historians and embrace the rich and unexpected folksonomies that emerge among the wider community of video art enthusiasts instead. The platform can thus be understood as a tool for user-defined metadata collection that provides new possibilities for citizen science in the humanities. By drawing on the expectations that users have developed during everyday interactions with commercial audiovisual platforms and streaming services, the participatory channel seeks to combine a pleasant viewing experience with a lasting contribution to art history.

IMAI Play hopes to make the archive of the Inter Media Art Institute accessible to more diverse audiences from all over the world by inviting them to view video artworks, create their own programs, discuss them with a dedicated community, and challenge art historical paradigms with new perspectives and unexpected connections.

Author Biographies

Darija Šimunović is a cultural studies scholar (MA) and has been responsible for the video art collection and its distribution at the IMAI since 2010. She was a research associate at the Institute for Visual Media of the ZKM Karlsruhe and worked as a visiting lecturer in video art history at the Düsseldorf University of Applied Sciences and the Paderborn University.

Linnea Semmerling is director of the Düsseldorf Inter Media Art Institute (IMAI). She has developed programs and exhibitions for various museums including ZKM Karlsruhe, IKOB Eupen, Marta Herford and TENT Rotterdam. She holds degrees in Cultural Studies, Art Studies and Technology Studies from Maastricht University and the University of Amsterdam.

MEMODUCT posthuman.archive: The Site-specific Media Art History

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Abstract

MEMODUCT *posthuman.archive* is a repository of media art practices in the field of digital humanities, site-specific media art history and cyber-anthropology. The major contributions of the project are: 1) Archiving of media art from the underrepresented regions, i.e., *The Global Margin*, initiatives that were recent and as such exhibited in the most important exhibitions and festivals, but which have not yet been explored in depth and systematically processed as a cluster, or a scene; 2) Documentation of the new media artworks that became “inaccessible” due to the instability of the Internet media and the rapid obsolescence of computer technology; 3) Modeling of new methodology in relation to the question: *How to write European history of tactical media and environment art, the conjuncture of New Europe 1988-2022?*

Keywords

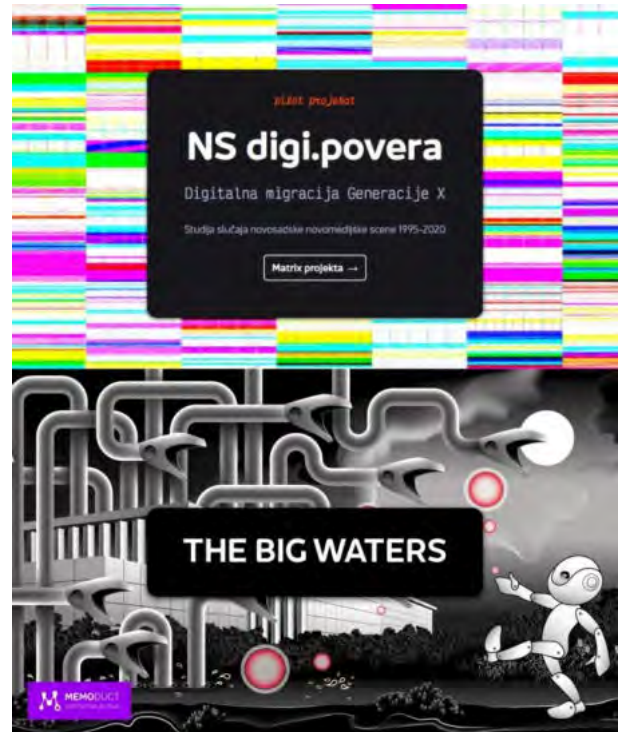
Memex, site-specific media art history, information art, environmental art, tactical media, New Europe

Introduction

MEMODUCT builds on Vannevar Bush’s concept of the memex—how technology can help to capture marginalized creation/innovation. Its goal is to enable future researchers to study evolution of the environmental complexity and the genesis of site-specific media art phenomena: the employment of tools, the development of iconography, the formation of professional identities and the emergence of personal epistemology of an artist.

The first pilot project was *NS digi.povera*, an ongoing research on media art scene in *Novi Sad* which originated in the war conjuncture on the periphery of New Europe (1988–2022), after the opening of the Internet for citizens, in a hybrid environment shaped by the scarce resources of fundamental economy and virtual economy.

MEMODUCT core topics are: Control, Infowar, Cyber Ecosystem, Construction of the Future.



©Memoduct 1) Site-specific media art history, e.g. *Novi Sad digi.povera*; 2) Artists’ socio-biographies, e.g. *The Big Waters*.

MEMODUCT case studies of artworks were/will be formatted according to categories: 1) *Conjuncture*, state of the social system, its economic, political and other aspects; 2) *Context*, autopoietic system of science, history and theory of art. 3) *Concept*, an idea of artwork and an artist statement; 4) *Iconography*, visualization of ideas and symbolic representation; 5) *Technical description* of the setting and technologies used. Biography of the artists are/will be made in a form of socio-biography since an artist performs as a witness of the paradigm change, i.e., technological, environmental and social transformation.

UNCOPIED.ART

Making the original truly unique: Introducing a blockchain for GLAM institutions

Eveline Wandl-Vogt^{1,2,3,4}, Elian Carsenat^{1,5}, Dario Rodighiero^{1,4}

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Abstract

This lightning briefly introduces the conceptual aspects of uncopied.art, an endeavour with the mission to make ORIGINAL truly UNIQUE, with physical and digitally immutable certificates of authenticity, expertise, inventory that will outlive us. In the tal the authors discuss the core values, offering a closer view to the workflow of certification. The authors focus on the opportunities, UNCOPIED may offer for archiving and aim to jointly discover potential risks and pitfalls going along with implementing this emerging technology for the long run in archives. Furthermore, the audience will be introduced to the recent case study that relies on a collaboration with LCMA, the Los Angeles County Museum of Art.

As a byproduct of securing art works on a transparent blockchain, UNCOPIED makes available its own dataset to scientists interested to work with open data for research purpose. UNCOPIED aims to provide innovative methods to secure digital collections by making metadata public. A scientific committee is in charge of making the dataset accessible in the respect of stakeholders interests, privacy and ethical concerns. The authors briefly discuss the current non-hierarchical organizational setting of UINCOPIED and outline it's necessity against the background of Open Innovation and it's meaning in the progress of innovation.

Keywords

Unique Art, Blockchain, NFT, Emerging Technologies, New Technologies for Archiving, New Directions in Archiving, Sustainability, Certification, Ethical Concerns, Open Innovation

Introduction

Blockchain technologies become more dominant in the art market and in data systems and protocols.

The mission of UNCOPIED is providing certificates to guarantee original artifacts a longer life. UNCOPIED was founded in 2020, with the aim to make originals truly unique, with physical and digitally immutable certificates of authenticity, expertise, inventory that can outlive us. The objective was to find a solution to distribute the digital

image freely as Creative Commons, yet make limited edition physical prints which could be proved to be limited. So the idea gradually became a mission statement : creating an open source solution to certify the authenticity of both physical and digital objects, combining the physical chirograph with QR code, blockchain, IPFS and a reverse search engine.

Uncopied is an open source solution built on other open source solutions or industry standards. The service shall include a 10-year 'promise' for digital conservation and technical suitability. Algorand blockchain technology is an important part of our architecture. Algorand solves the blockchain trilemma (security, scalability, and decentralization) without any compromise and it can not fork, which is an important feature for a NFT platform. At this point, we see IPFS and GitHub as our key technology for long term storage. We collaborate actively with AIS (the Art ID standard consortium) which aims to create shared ownership of the artwork identifiers, by leveraging the new W3C standards for decentralized identifiers (DIDs) and self-sovereign identity. Applied to the art market, it allows the different actors and stakeholders to make verifiable claims about an artwork about its provenance and authenticity.

Regarding metadata, we follow the work done by schema.org for linked open data. We also keep close watch on linked.art, as an emerging metadata standard to describe cultural heritage.

Engaging a wide community of stakeholders can be complex and we refer to risks, inherent to a field of innovation which challenges countries and traditional legal systems with its motto 'the code is the law'.

The UNCOPIED tokens represent an immutable proof of provenance for a physical or digital object. As such, they are non-tradable and inalienable. But the token can be moved to a different UNCOPIED wallet to represent the artwork's status, for example, to document a case of legitimate censorship.

Another bold choice we made is to tie the UNCOPIED certificate not just with metadata, but also with a plain-

Archiving Twitter Database & Visualization from Artwork

Jiayi Young

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Abstract

In 2020, I created an artwork on the state of truth-telling crisis during the 2020 U.S. Presidential Election. The project is titled *Project Echo*. [1] It is a multi-modality and multi-disciplinary new media artwork involving Twitter data and took two and a half years of extensive research collaboration with a political scientist and a computer engineer to develop. When the project concluded shortly after the Capitol insurrection, we realized that we had compiled a significant database of Tweets. It has become a valuable historical record of Twitter disinformation activity relating to the 2020 U.S. Presidential Election. As an artist unfamiliar with how archives are established, I am interested in figuring out how to provide public access to the database and its associated visualizations. I look to cultural institutions to help establish an archive of the database and provide the public with the opportunity to access this piece of American History.

Keywords

archiving strategies, database, Twitter data repository, 2020 election disinformation, social media, astroturfing, truth-telling, historical artifact, public access, American history

The Artwork

Project Echo [1] is a multi-modality and multi-disciplinary new media artwork on the state of the truth-telling crisis during the 2020 U.S. Presidential Election. Through two and a half years of extensive research collaboration with a political scientist and a computer engineer, situated in an expanded field of new media art, the artwork — functioning as an apparatus — provided legibility into the black box of astroturfing efforts on Twitter; at the same time, enacted a platform for voices of protest and expressions of lived experiences in a post-truth society.

The project took place in the critical eight-months-period preceding the 2020 election. It consisted of two components that worked in tandem: an online disinformation tracking and visualization interface and a temporary public art social intervention that took to billboards, bus shelters, and grocery stores in critical swing states. Specially developed for the project, the team created a process to curate disinformation, combine the query of historical and real-time Twitter data, set up a backend database, and materialized real-time frontend visualization of disinformation spread.

The Database

The database consists of 204 disinformation topics from April 28, 2020, to February 20, 2021, 2,623,792 Tweets, 1,030,066 users, and 2,365,660 incidences of user interactions. There are 103,879 accounts found displaying a high probability of being fully automated social bots carrying out astroturfing efforts designed to deceive and create the appearance of a grassroots movement. Ninety percent of the dataset retained the full original data fidelity of the Twitter landscape at the time. We captured these Tweets before Twitter performed mass deletion of major disinformation spreaders in January 2021 after the Capitol insurrection. The record contains the now-deleted @realdonaldtrump and 70,000 QAnon accounts.

This information is currently stored in a database and maintained on Amazon AWS. The following diagram (Figure 1) illustrates the structure of the database. The visualization is currently running using AWS Lightsail.

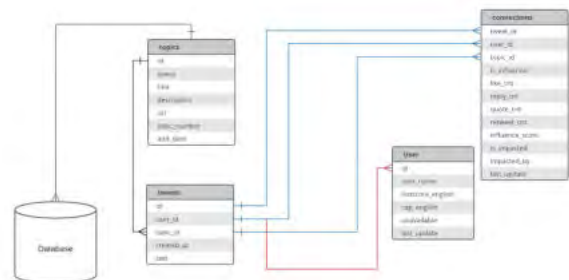


Figure 1. Project Echo Database Diagram. ©Jiayi Young Studio.

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[1] Jiayi Young, et al. “Project Echo: Thoughts in Fleeting Moments”, University of California, Davis, website, accessed March 29, 2022, <https://project-echo.ucdavis.edu/>

Author Biography

Jiayi Young is an artist and a designer. She is an Associate Professor of Design at the University of California, Davis.

english document. It allows for natural language to express what cannot yet be expressed as ‘metadata’ or ‘code’ : the spirit of the law that will govern the smart contract.

This innovative model can be used to break silos across multiple blockchains, as long as there is a bijective one-to-one relation between the certificate token and the value token (the NFT).

The core values of UNCOPIED are: Open, Durable, Inalienable, Sustainable, Inclusive, Unobtrusive and Simple.

This lightning briefly introduces the conceptual aspects of uncopied.art and it’s core values, offering a closer view to the workflow of certification. The authors focus on the opportunities, UNCOPIED may offer for archiving and aim to jointly discover potential risks and pitfalls.

Furthermore, the audience will be introduced to the recent case study that relies on a collaboration with LCMA, the Los Angeles County Museum of Art.

As a byproduct of securing art works on a transparent blockchain, UNCOPIED makes available its own dataset to scientists interested to work with open data for research purpose. UNCOPIED aims to provide innovative methods to secure digital collections by making metadata public. A scientific committee is in charge of making the dataset accessible in the respect of stakeholders interests, privacy and ethical concerns.

Authors Biographies

Dario Rodighiero works at Harvard University. He is affiliated at the Berkman Klein Center for Internet & Society and a postdoc of

the Metalab. His capacity at the intersection of visual studies, data science, and digital humanities makes him comfortable in multiple disciplines. With Metis Press, he published in 2021 Mapping Affinities.

Elian Carsenat is a computer scientist trained at ENSIIE/INRIA, started his career at JP Morgan in Paris in 1997. He later worked as consultant and managed business & IT projects in London, Paris, Moscow and Shanghai. In 2012, Elian created NamSor, a piece of sociolinguistics software to mine the 'Big Data' and better understand international flows of money, ideas and people. NamSor helps answer the perennial question all countries ask about their diasporas – who are they, where are they and what are they doing. In 2020, NamSor is building new APIs to estimate risk for gender, racial or ethnic biases in applying machine learning or other artificial intelligence to decision making that affects People's lives.

Elian is founder and CEO of uncopied.art.

Eveline Wandl-Vogt is a thinker and maker, knowledge designer, creative experimentalist and innovator. Against a background of Art Driven Innovation, Humanity Centered Design and Open Innovation, she is facilitating Social Innovation for the purpose of good, contributing to invent inclusive, sustainable. responsible futures.

Eveline is foundress and orchestra of exploration space (at) ÖAW and foundress and Director of Ars Electronica Research Institute “knowledge for humanity”. She is affiliated to metaLab (at) Harvard, and is ambassador for “knowledge for humanity” of the Republic of Uzupis.

Eveline is chair of the scientific committee of uncopied.art.



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BARCELONA

PANELS

“Right-Click To Save: Preservation, NFTs, and Distributed Ledgers”

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Abstract

Artists have experimented with cryptocurrency incentivized distributed ledgers such as blockchains since the advent of Bitcoin. In parallel, crypto advocates frequently claim that distributed ledger protocols will ensure an accessible and immutable record of anything registered to it, including artwork. This panel examines this idea with nuance, neither buying into the mass deception around NFT marketing tactics nor rejecting the reality that a subset of artists are creating significant, challenging works that inherently utilize these technologies. Preserving the asset may seem to be in the regular wheelhouse of preservation professionals, who have decades of experience developing guidelines for saving software-based art, but ledger-based technologies have their own preservation promises and challenges.

Keywords

Non-Fungible Tokens, Preservation, Distributed Ledger, Blockchain, Digital Art, Emulation, Variable Media

Distributed Ledgers and Preservation

A claim frequently repeated in the last year by advocates of blockchains and NFTs is that distributed cryptographic ledgers will ensure an accessible and immutable record of born-digital and digitized art for posterity. This panel examines this idea in a nuanced way that neither buys into the hype around NFTs nor rejects the reality that artists are experimenting with these technologies. The analysis draws on cutting-edge experiments such as archival packages prepared for artworks that utilize distributed ledgers, as well as historical precedents such as net art collected by museums. While the field is still in its infancy, the presenters forecast the viability of the most promising proposals for preserving, and being preserved by, the blockchain.

Media coverage and competing narratives around NFTs have clouded collective understanding of these concepts so it is important to clarify what is meant by these terms:

A **distributed ledger** is a database that is consensually shared and synchronized across multiple nodes. Unless specially encrypted, the participant at each node of the network can access the recordings shared across that network and can own an identical copy of it. Any changes or additions made to the ledger are reflected and copied to all participants in a matter of seconds or minutes.

A **blockchain** is the most popular example of a distributed ledger, using a block data structure with the primary objective to record verifiable transactions.

An **NFT (Non-Fungible Token)** is a set of electronic instructions called a “smart contract,” with a unique cryptographic hash published to a distributed ledger that can reference virtually any object, tangible or digital.

A **distributed storage protocol** is peer-to-peer network for storing and sharing data, distributed on multiple file servers or multiple locations. It allows programs to access or store isolated files redundantly, allowing programmers to access files from any network or computer.

Myths and reality

This discussion will not assess the aesthetic quality of artwork registered to a blockchain, nor directly tackle the economic and environmental benefits and costs of NFTs. Nevertheless, we will start by separating fact from misperception in claims made by crypto enthusiasts that impact new media preservation.

NFT standards were created to store artwork on chain

False. Although the ERC-721 and 1155 standards were created, in part, with artwork in mind[1], the blockchains in which artists are minting NFTs can only practically store small amounts of data. To store 1GB on the Ethereum blockchain could cost over four million dollars[2], and the entire chain currently stores less than 5TB due to the complexity required to validate the entire ledger. For NFTs, the solution has been to point to large media files like JPEGs and MPEGs on other servers or networks. When you buy an NFT, you are typically buying the pointer, not the asset. This is why crypto enthusiasts mock skeptics who claim to be able to steal their NFTs by right-clicking to save; this may download the image of a bored ape, but its token is bound to the blockchain.

NFTs transfer copyright

False. In most cases, buying an NFT does not convey any public rights to the asset to which it points.[3]

NFTs establish a transparent provenance for digital art

Maybe. In theory, every blockchain transaction is public; unfortunately, some intermediary marketplaces obscure collector information[4] due to privacy concerns or technical expedience. Transactions often also take place off-chain or separate from the transfer of the NFT. Recent efforts by blockchains such as Secret Network, third party encryption such as Pinata's Submarine[5], and the promise of zero knowledge proofs put transparency at increased risk.

Digital art can finally be collected thanks to NFTs

False. Museums have collected digital art since at least 1995[6], and at this point many have explored thoughtful protocols for conserving digital media. NFTs add new options but do not solve all the challenges of collecting bits.

Positives and Negatives

Myths aside, does the blockchain at least preserve digital art for posterity? We can examine this claim in by examining the potential and pitfalls of NFTs as a preservation tool.

Benefits: On-chain preservation

For those works concise enough to store on the blockchain, it offers more secure storage than the typical archival hard drive or cloud service. This can be true for a selection of artists who create code-based works, such as John F. Simon Jr, and for conceptual works by artists who use the blockchain as a medium, such as Rhea Myers.[7] However, as long as the visual or sonic aspects of the work need to be rendered, even these genres require external dependencies.

Benefits: Distributed storage solutions

For the vast majority of works too large to store on the blockchain, platforms built around NFTs often automatically upload assets either to their own centralized server or a distributed storage solution like IPFS (InterPlanetary File System). Technologically, peer-to-peer networks like Protocol Labs' IPFS and Filecoin, which also break down data into blocks, are more resilient than traditional storage options maintained by a single organization or company, though they depend on community upkeep to sustain. In principle, such networks can also preserve conservation-related documentation as well as the works themselves.

Benefits: Financial incentives

While traditional collecting institutions depend on grants or donations, blockchain-based preservation systems like Filecoin and Arweave leverage their intrinsic cryptocurrencies to pay anyone willing to maintain a node in their networks.[8] This automated protocol provides a potential income to support community preservation.

Challenges: Limited media

Storage on the blockchain can be very limited due to the high cost of verification. This leaves out the majority of visual, sonic, and time-based media that can't exist as a single files containing a low-resolution bitmap, simple SVG, or a few lines of unminified code for generative outputs.

Challenges: Links to metadata

NFTs include a token URI that acts as a pointer, but rarely do they point to artworks directly. Instead tokens typically link to a JSON metadata file off-chain, whether it be stored by a node operator on a distributed storage protocol or a centralized server. These JSON files in turn point to the singular object file and preview image and rarely a complete archival package. Access to these JSON files are in themselves vulnerable to loss or corruption.

Challenges: Dependence on crypto currency value

Services like Filecoin aim to get around the dependence on volunteer labor by paying contributors in a dedicated cryptocurrency. The impact of such financial incentives rise and fall with notoriously volatile cryptocurrency values.

Challenges: Obstacles to migration

Artworks with digital components frequently need to migrate over space (as in the case of an installation loaned from one museum to another) as well as over time (as in the case of an obsolete format converted to a newer, supported format). It's unclear how such changes would be compatible with artists that mint with immutable URIs to the blockchain. Blockchain advocates tout the immutability of content on the chain, not realizing that variability is important to digital preservation and display.[9]

Challenges: Dependence on platforms

In part due to the learning curve of writing smart contracts, most artists rely on centralized NFT marketplaces and lookup tools with simple interfaces for uploading and displaying assets.[9] These platform interfaces do not tend to take metadata fields into account that are used elsewhere in the contemporary fine arts. Although institutions have developed several metadata for documenting born-digital and digitized components, none of these approaches are addressed in existing NFT publishing platforms. This means that in some cases if the platform goes down, the metadata accessible via the ledger could be missing essential information, including even the name of the artist. Platform-imposed file sizes, meanwhile, require artists to upload compressed file formats whose resolution and bitrate may not properly scale to exhibition dimensions and create bigger problems for conservation efforts.

Challenges: Dependence on external code

Storing codebases for certain software-based works has become a niche model, championed by platforms like fxhash or Art Blocks, the latter of which asks artists to limit their dependencies to one third-party library such as p5.js. While promising, this is far from a surefire solution for preservation; apart from the lifespan of the blockchain or library itself, access to the code does not guarantee knowledge of how its output should be displayed as technologies and viewer expectations change over time.

Challenges: Vulnerability of blockchain “culture”

Some of the most interesting developments in NFTs aren't files like pixelated profile cartoons but the communities that have sprung up around them. Loot, for example, started as a generated list of items from a Dungeons and Dragons-style game in a smart contract. Fans wrote lore about these virtual objects and even fabricated tangible versions. None of this lore is captured by a blockchain.

Approaches to preserving NFTs and their assets

Archival packages

The first and only cross-chain models in practice for preserving non-fungible token data and associated assets were created and put into practice by Protean, a variable media art conservation initiative for educating, practicing, and publishing novel standards for emerging technologies in both the public and private sector. Protean is a work in progress that aims to draw expertise from a global working group of digital conservators. Other projects with preservation-inspired methods include Club NFT and Kanon 21, but neither addresses preservation through the lens of media art conservation ethics. Both Club NFT and Kanon 21 in their current state also have distinct points of failure, such as a broken APIs or unnecessary tool layers that obscure the preservation process instead of educating the end user.

The Protean method, on the other hand, dodges platform impediments by preparing archival packages off-chain first and working with artists to generate URIs for long-term maintenance plans, which are then referenced in the smart contract metadata. They often hold multiple files, including uncompressed, lossless archival copies, README.txt files, detailed manuals, technical artist questionnaires that emphasize media-specific assessment, and supplemental documents.

In comparison with the 100MB restrictions afforded by a majority of platforms, Protean file sizes would depend on needs specific to the artist or subsequent collectors, and only limited by the available hardware, software, and finances. These packages can be hundreds of GB, and discoverable at either a web domain maintained by the artist studio or an IPFS-generated hash for a directory without recording a

specific gateway URL, which would be a platform dependency.

The history of net-based art conservation has exposed many tales of link rot. Protean takes this into account by educating artists and art custodians on generic digital strategies such as migration, but also newer tactics such as becoming Filecoin and IPFS node operators themselves, inherently incentivized to redundantly store each other's encrypted assets in perpetuity.

This process also takes into account the reality that immutability is antithetical to media art preservation. Unlike the singular asset associated with typical NFTs, a Protean link might point to a range of releases that are added to an artist's server or an IPFS directory as the work is updated over time.

Emulation

The above strategies are useful for access and preservation of associated assets that do not inherently require the chain in which they were minted but do not address preservation of works that do treat any aspect of the particular distributed ledger technology as an essential aspect of medium or performative behavior. Blockchain verification depends on node operators, who are normally driven by the promise of crypto-currency rewards. These ledgers may lose their current cohort of node operators to more exciting incentives and systems in the future. At this time there are over 5,000 publicly known full node operators on Ethereum,[10] which has already fluctuated wildly since February 2021 when there had been over 12,000.

Though it may seem a counterintuitive approach to preserving a distributed system, it is possible to emulate on a centralized system an entire set of blockchain nodes to preserve a distributed ledger. Emulation may be appropriate once the original chain or supporting dependencies become unavailable or somehow in dispute: a particular ledger system may lose popularity and not have enough participating nodes to continue, the ledger itself may fork for technical or social reasons, or external links stored in the ledger may go stale.

Since node management software for many chains is commonly available as containerized packages—for example, Docker containers describing Ethereum nodes—a single node will often be running in emulation even before any preservation efforts. Running several containerized nodes together on a single machine is simply a matter of launching multiple iterations of the same container. The container nodes can then be connected with internal networking to create a multi-node private network on a single computer that mirrors the public system currently distributed across hardware around the globe. If given a copy of the current state of the ledger, the entire system can be treated as a self-contained backup that recreates both the stored data and active behaviors of that network.

Technical convenience does not imply emulation is always the best solution, however. An emulated private node network only preserves data in the ledger itself; since ledger data is often a pointer to outside media, code, or assets, those outside resources may also need to be emulated. A work may depend on the activity of public users or new data being added to a ledger that is now isolated from the outside world. In cases where such considerations are not critical to the work, though, emulation offers the ability to simply reproduce a complex technical ecosystem.

Media-independent assessment

Another integration of crypto art into current conservation practices would be to take the approach of the Variable Media Questionnaire,[11] which records opinions about how to preserve creative works when their current medium becomes obsolete. Its users can compare these opinions as they vary by work, by interviewee, and by date.

The current version of the Questionnaire looks at artworks as ensembles of Parts, though its purpose is less to track sundry gadgets like cables or disk drives than to understand the key elements of a work that are critical to its function, such as source code or media display. Acknowledging the relational character of much contemporary art, these Parts extend beyond hardware to include environments, user interactions, motivating ideas, and external references. Structuring the Questionnaire in this way makes it easier to compare different artworks created with similar parts.

The Variable Media Questionnaire could be leveraged to help preserve blockchain art by creating a dedicated Package. A variable media Package is an ensemble of Parts that might be used in common creative formats, from paintings to video installations to websites. Some of the questions in a blockchain Package would overlap with other formats, such as the resolution or color depth of a digital image, or what happens to user contributions when a work is loaned. Others might be specific to the blockchain, such as what to do when a chain forks and how critical a given cryptocurrency is to the work's function.

Conclusion

The vulnerabilities of distributed ledgers suggests that such systems are unlikely to suffice as a preservation solution, including works created on the blockchain itself for art in the future, and in fact may make a preservationist's job more difficult. Nevertheless, the authors believe that a significant slice of artworks using these technologies are worth saving for the future. Emulation offers a promising strategy for re-creating the content and technical functions of an extinct blockchain, but it is less suited to re-creating the social dimensions of a blockchain-based artwork. Rather than a one-size-fits-all preservation solution for these works, we recommend a case-by-case analysis of the best way to

translate the artistic qualities of the work into future scenarios in which the original chains and associated services are defunct.

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Authors Biographies

John Bell directs the Data Experiences and Visualizations Studio at Dartmouth College; Regina Harsanyi is a media art specialist who advises museums, artist studios, galleries, and private collections on curation and preventive conservation of variable media art; and Jon Ippolito directs the Digital Curation program at the University of Maine.

Emerging Collaborative Preservation Projects in Asia

Moderators: Myra CHAN, John CHOW

Affiliation (s): Videotage

Panelists: Kyle CHUNG, Joel KWONG, SU Wei

Affiliation (s): Videotage, Microwave International New Media Arts Festival, Tsinghua University Art Museum

Location, Country: Hong Kong and Beijing, China

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Abstract

It has always been the case that artistic and cultural practices transform with new technologies. As technology constantly evolves, contemporary artistic practices have increasingly engaged with non-traditional media. Museums, galleries, and art institutions are adapting their approaches to the presentation, dissemination and preservation of new media art. While media artworks and exhibitions are ubiquitous nowadays, archiving plays an important role in preserving history and generating knowledge of art. What are the needs and challenges of developing a media art archive? How can art archives encourage interdisciplinary collaboration to facilitate contextualization, preservation and presentation of artworks?

As a media art archive based in Hong Kong since 2008, Videotage Media Art Collection (VMAC) has continued its development with the expansion of its collection of artworks from Hong Kong to China, Taiwan and Macau in recent years. Esteemed curators from nearby regions are invited to collaborate for the acquisition. Local researchers are invited to study and write about the VMAC archive, providing reflections and new perspectives in media art archiving. This panel brings together art professionals, researchers and scholars to share their collaboration experiences and look at the issues of archiving media art in Hong Kong and China, and beyond.

Keywords

Media Art, Art Archives, Collaborative Preservation, Contemporary Art, Hong Kong, Asian

Introduction

In the panel, media art curator and researcher Kyle Chung will share his experience of Minecraft residency and NFT art project and their related preservation challenges. Joel Kwong, programme director of Microwave International New Media Arts Festival, will talk about her selected media art projects and the challenges during the pandemic.

Su Wei, curator of VMAC's China Collection, will share his collaboration with Videotage in driving forward the video art collection in the Greater China Region.

Biography

Videotage:

Founded in 1986, Videotage is a leading non-profit organization in Hong Kong focusing on the presentation, promotion, production and preservation of video and media art, serving artists in the expanding technological art and culture network. Dedicated to nurturing emerging media artists and developing the local media arts community, Videotage has organized numerous media arts events and programs while developing an extensive offline and online video art archive, Videotage Media Art Collection (VMAC).

Kyle CHUNG:

Kyle Chung is a curator and researcher whose recent exhibitions explore the dynamics between technologies, materiality and human agency. Selected exhibitions include *2³ or Not 2³: East Kowloon is on Minecraft in New Vision Arts Festival*, Hong Kong; *Ellen Pau: Time After Time Will Tell at 1961*, Singapore; *#YOU #ME #ourSELFIES* at Hong Kong Visual Arts Centre; *One World Exposition 2.1: #like4like* at chi K11 art space, Hong Kong; *Carla Chan: To Outland* at SMAC, Berlin, Germany; *Conjunctions and Disjunctions: International Symposium on Electronic Art 2016*, Hong Kong; *Bright Shadow at The Morgue*, London, UK. With a PhD in Creative Media, Chung is currently an independent curator; Curator at Videotage, Hong Kong; and Lecturer at School of Creative Media, City University of Hong Kong.

Joel KWONG:

Joel Kwong is an international media art curator, writer, producer and educator based in Hong Kong. She is currently the Programme Director for Microwave International New Media Arts Festival, as well as the founder of SIBYLS – a creative consultation and production agency. Kwong has a strong belief in the power of art and technology, and her curated projects have been shown in many different cities around the globe. Her most recent projects in 2021 includes Future Media Art Festival in Taiwan, Microwave Festival edition 2021, Glow Shenzhen online media art showcase “Fireflies: The Glowing Dots”, Connecting the Dots – a media art archaeology online exhibition & website etc.

She has years of experience in doing education and on international jury panels, such as Siggraph Asia 2020(South Korea), ISEA 2019 (Gwangju), 2015 Taiwan Golden Pin Awards, Siggraph Asia in 2011 & 2013, and ISEA (HK) in 2016. She has also given talks and lectures at many different festivals and institutions, including Ars Electronica in Linz, Transmediale in Berlin, Shenzhen Media Art Festival; ACT Festival in Gwangju, South Korea; the University of Electro-Communications in Tokyo; and FILMART in Hong Kong.

SU Wei:

Su Wei (born in Beijing) is an art writer, art history researcher and curator based in Beijing. He is currently Researcher at the Tsinghua University Art Museum. He participated in the 2012 Curatorial Intensive at Independent Curators International (ICI) in New York. In 2014, he was awarded first place at the first International Awards for Art Criticism (IAAC). He worked as the Senior Curator of Beijing Inside-Out Museum between 2017 and 2021.

Su Wei's work in recent years focuses on re-constructing the narrative—and radical imagination—of contemporary Chinese art history, and explores the roots of the legitimacy and rupture of contemporary Chinese art history in a global context. Pivotal to his work is the attempt to take the “post-1949” as the key in understanding artistic production in a contemporary situation, and in so doing he seeks to re-define the stance and possibilities of art in nowadays China. He thus engages in an anti-establishment critical practice by mapping the limits, contextual clues and unconscious energies of the post-1949 art production, which figures the dual presence of decay and emptiness.

Multi-Generation Digital Stewardship: XR Art & Technology Archives

Moderator: Rhonda Holberton

Assistant Professor of Digital Media Arts, Department of Art & Art History San José State University

Panelists

Don Hanson, Founder of New Art City (USA)

Amanda Helton, Manager of Digital Strategy, San José Museum of Art (USA)

Dr. Timothy C. Summers, Board Member of the enterprise think tank Leonardo/ISAST (USA)

Nick Szydowski is the Scholarly Communications & Digital Scholarship Librarian at San José State University (USA)

Location: San José California, USA

Contact Email: rhonda.holberton@sjsu.edu

Abstract

Panelists will discuss their roles in a collaborative inter-institutional project funded by the Knight Foundation to create an XR & blockchain certificate enabled digital database that will archive, index, lend, and exhibit complex digital objects using a web-based platform that expands the current capabilities of the virtual 3D exhibition platform New Art City.

The panel will offer perspectives on collections management, blockchain certificates, artist contracts, and best practices for reauthoring. The team will provide insights from the first 6 months of the beta test of this collaborative project which archives and exhibits Creative New Media Projects produced in San José from 1984-2014 on New Art City. The Art & Technology Archive beta test will allow the technical and digital design upgrades to follow the material, social, and archival process; ensuring that necessary upgrades to New Art City are designed holistically and inclusively with integrated feedback from Museums, Librarians, Archivists, & Curators.

Keywords

Digital Archives, XR Archives, Blockchain Certificates, NFTs, Controlled Digital Lending, Cross-Platform Compatibility, Digital Stewardship, XR Accessibility, Publicly Accountable Cross-Sector Partner Service Organizations, Durable Code

Introduction

Rhonda Holberton, Assistant Professor of Digital Media Art, San José State University (SJSU), is leading an initiative with the panelists to preserve and archive several important bodies of digital media produced within the Silicon Valley in 1984-2014. The archive will focus on complex digital objects (with special attention to XR and 3D files), and collaborative research from the CADRE Media Lab at San José State University, SWITCH Journal, Leonardo/ISAST, ZERO1, and the San José Museum of Art archive/collections.

The entries will be archived on New Art City, a virtual exhibition toolkit originally developed by Don Hanson (once an MFA candidate in the CADRE program at SJSU) in response to the loss of physical exhibition opportunities for our community. New Art City utilizes web stable languages (HTML, JS, & CSS) which will ensure the longevity and accessibility of new media works that were originally produced to run on esoteric or out of date platforms. Students currently enrolled in the Digital Media Art program at San José State University will work directly with the original artists & digital creators to identify processes for rebuilding original artworks and/or archiving components for future researchers.

User experience of the archive will be grounded in interactive engagement with the region's rich history of collaborative new media art production utilizing an archive built on the New Art City web-based 3D platform. Unlike traditional digital archives, the SJSU XR Archive will integrate collection management databases, blockchain security certificates, digital lending, and exhibition

services. Users of the lending and exhibition services will experience spatial proximity, temporal texture, and architectural aggregation rather than overlapping windows or the long scroll to help researchers, exhibition designers, and public visitors make deep connections to and between digital entries.

Dr. Darra Hofman's research focuses on the intersection of archives, technology, and law. Her research and teaching interests are in investigating the impact of emerging technologies such as blockchain technology and artificial intelligence on archiving practices. She will oversee database integration metadata and hashing systems for blockchain certification of provenance and integrated fair use contracts. The interface will be set up to provide multilayered accessibility, and community facing features that will log specific dynamic feedback through the exchange of personal, regional, and associate knowledge tied to a sharable digital entry that accumulates new user contributions every time it is curated into an exhibition.

Digital Stewardship As envisioned, the archive is the first of 3 discrete phases of development that fit into a longer-term vision; the instantiation of the Center for Creative Digital Production & Stewardship at SJSU. Within the center, Faculty and Students will collaborate with digital creators and partner institutions to develop best practices and documentation for digital stewardship of technology-centered artist practices and create standards for artist contracts for institutional acquisition of digital work using blockchain technology applied in concert with controlled digital lending via the Martin Luther King Library.

Digital stewardship brings together the concepts of both digital preservation and digital curation and provides a framework for long-term thinking to ensure that preserving and managing digital content for the long-term is not merely an afterthought, but baked into the production process.

New Art City (NAC) Platform

Originally developed as an online exhibition solution for Digital Media Art BFA exhibition at SJSU, the New Art City platform has since expanded to host international art exhibitions with institutions like Gray Area SF, Bitforms Gallery NYC, Lumen Prize, Format Festival and several solo and group shows for individual artists & digital creators. The platform will allow designers to spatialize the visitors' experience of media entries in the archive using architectural orientation to present oral histories and contextual information alongside primary resources that take the form of websites, video, 3D animations, image, text, and soon; VR projects.

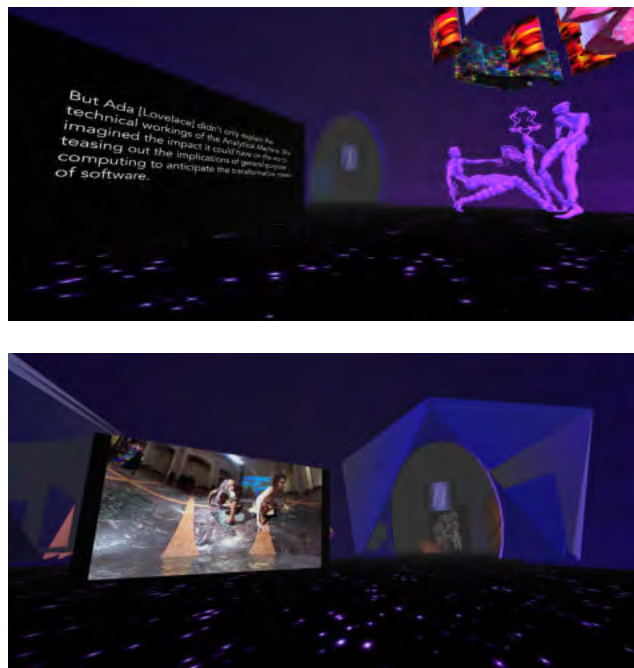


Figure 1. Screenshots of [Unbound Unleashed and Unforgiving Exhibition](#) hosted by New Art City. Works shown (left to right): Caroline Sindere: Femenist Data Set, German Lavroskii: Reborn, Otrus Extraviadus: parallel chaosmosis, Eva Davidova: Global Mode, Jeremy Diamond: Datura ©Artist Retain Copyright

NAC & Accessibility In Fall 2020 Professor Holberton worked with NAC founders to help complete a Voluntary Product Accessibility Template (VPAT) for New Art City. In Spring 2021 the California State University System certified NAC for systemwide use after determining the platform met Federal Accessibility requirements. In addition to the 3D environment, NAC now provides a 2D view optimized for Screen Readers. In their [Accessibility Statement](#), NAC provides standards for accessible 3D environments, and is excited to work with the team to define new standards for accessibility in Mixed Reality environments including sound triggers/guidance, guided tours in 3D & XR environments, and new forms of translation between XR, 3D, and 2D web designs

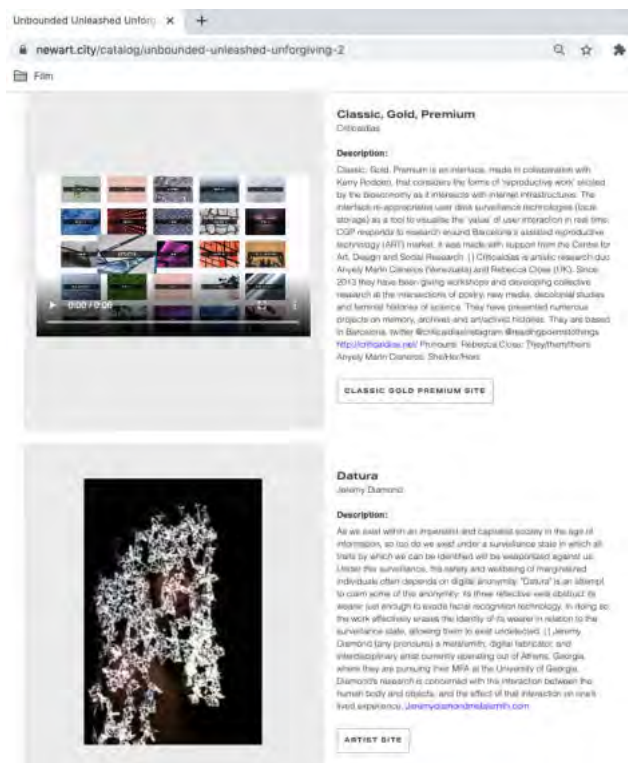


Figure 2. 2D Catalogue View of Unbound Unleashed and Unforgiving Exhibition hosted by New Art City. The catalogue view is automatically generated when exhibition designers upload their digital assets to the platform, alt text can be added for screen readers. ©Artist Retain Copyright

Audience & Impact

The project leads of the Multi-Generation Digital Stewardship project believe the practice of citation is a political act that shapes the future as much as it contextualizes the past. With this framework in mind, it is important to recognise preservation as a political act as well; and to understand that all archives suffer from intersecting and overlapping biases, limited accessibility, and data rot. San José State University (and public universities more broadly) can play an important role as a publicly accountable cross-sector partner service organization in the production and long-term preservation of tech-centered artist practices. Toward this goal, the Multi-Generation Digital Stewardship project team is currently:

- Working with librarians & archivists to expand the capabilities of research databases that determine what is citable in the first place
- Collaborating with artists & digital creators to create best practices for the digital stewardship of ephemeral technology dependent projects

- Connecting communities from public institutions with students and faculty at San José State University in the production creative projects that make meaningful technological advancements while at the same time expanding public understanding the social impacts of technology
- Providing support to technology platforms to develop accessible standards in-line with Section 508 of the Rehabilitation Act published in the Federal Register to ensure the technology we use in our projects is available to the broadest community possible

Inter-Institutional and Community Collaborations

Through collaborations between SJSU, SJMA, NAC, Leonardo/ISAST, and ZERO1, the Multi-Generation Digital Stewardship project will build bridges between SJSU students, the San José Public, and contemporary Digital Media Artists & Digital Creators. This is an exceptional opportunity to celebrate the rich legacy of interdisciplinarity at SJSU and our legacy of collaboration with art institutions in the South Bay while at the same time creating standards and best practices for the production & preservation of tech-centered artworks for generations to come.

As one of California State University's Hispanic Serving Institutions (HSI) and Asian American Native American Pacific Islander Serving Institutions (AANAPISI) as recognized by the United States Department of Education, the San José State University community represents a diverse set of perspectives. The Multi-Generation Digital Stewardship project team and organizational partners integrate the student body and communities within the city in the design of the archive and the curation of the entries within it to advance a broad and socially responsible approach to integrating artistic expression within historical contexts.

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Panel Biographies

[Rhonda Holberton](#), Assistant Professor of Digital Media Arts, Department of Art & Art History San José State University. Holberton's interdisciplinary research and art practice illuminates the politics of the corporeal body navigating through virtual space. Recent projects utilize networked VR designed to trigger subtle interactions of electrons between biological and digital systems through biofeedback & reiki, a speculative cosmetic company whose mission is focused on the potential of products to create distributed performative action ritualizing the Anthropocene, and a collaborative choreography with Neural Networks. rhonda.holberton@sjsu.edu

[Don Hanson](#), Founder of New Art City. Don is an interdisciplinary/internet artist producing web-based interactive work and digital artmaking tools since 2008. As founder of New Art City he aims to provide an accessible toolkit to all types of artists and create an online home for born-digital artifacts. As an active member of the arts and technology community in the Bay Area, Don has served as technical director for Codame Art+Tech and B4BEL4B Gallery, and now focuses full-time on the operations and development of New Art City. don@newart.city

Amanda Helton, Manager of Digital Strategy, a position created as part of the San José Museum of Art's (SJMA) 2018 strategic plan, Helton works closely with the curatorial and public programs teams to develop innovative digital engagement tools that expand access to the Museum's programs and permanent collection. At SJMA since 2017, she served as project database registrar for 50X50: Stories of Visionary Artists from the Collection, a major grant-funded digital publication designed to share the Museum's permanent collection with a wide audience. Subsequent ongoing projects support efforts to shape the technological vision for the Museum's future and to support its strategic ambition to be a borderless museum. Helton is also deeply committed to accessibility issues in both the physical and virtual realms and is a member of the Museum's Equity Task Force. ahelton@sjmusart.org

[Dr. Timothy C. Summers](#), Board Member of the enterprise think tank Leonardo/ISAST, is a seasoned, high-impact executive with broad strategic perspective and a proven track record in growing businesses, delivering solutions to problems, and developing and executing sound internal processes from the ground up. He is an ethical hacker, professor, frequent media commentator, TED

speaker, and consulted expert internationally recognized as one of the world's leading experts on cyber strategy, blockchain, normal chaos, and how hackers think. He is a trusted adviser and executive consultant to Fortune 500 companies, academic institutions, and governments worldwide. Timothy specializes in the scholarship and practice of hacker cognitive psychology (the hacker's mindset) and normal chaos paradigm enabling him to advise on building and sustaining organizations during times of uncertainty. Dr. Summers is an executive scholar with an in-depth understanding of disruptive technologies and their strategic applications, as well as international business expertise, having conducted business in North America, the UK, Europe, Africa, and Asia. He is a motivated self-starter who has developed a thriving, reputable consulting practice that is considered among the best in the world while maintaining a dedication to community service. tcsummers@asu.edu

Nick Szydowski, Scholarly Communications & Digital Scholarship Librarian, Martin Luther King, Jr. Library, San José State University. Nick is a librarian with experience in scholarly communications, repository management, preservation, and web development. His recent projects include the digital exhibit *Robert Morris: Civil Rights Lawyer & Antislavery Activist*. nick.szydowski@sjsu.edu

Demusealizing the museum: audience's digital agency and institutional critique 2.0 as possible futures for art institutions

Nathalia Lavigne, Dr. Prof. Giselle Beiguelman, Dr. Bruno Moreschi, Prof. Rafael Pagatini

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Abstract

This panel aims to discuss some artistic and research projects that explore new methodologies of working with digital museum archives and User Generated Content (USG) to 'demusealize' some established institutional practices. In a moment when the role of museums and their very definition are strictly problematized, how Artificial Intelligence (AI) systems and collaborative hashtags on social media can be used to dismantle museum discourses? In which way these digital tools are able to be explored as a new kind of institutional critique? Could these systems also be used as a way to expand poetic layers of art beyond its marketing and productivist focus? From these raised questions, the researcher and curator Nathalia Lavigne will moderate a discussion with the artists and researchers Dr. Giselle Beiguelman, Dr. Bruno Moreschi and Rafael Pagatini, whose artistic projects are questioning traditional museological narratives and problematizing the colonialist gaze in museum collections using digital tools.

Keywords

Digital archives, digital agency, Artificial Intelligently, social media, Internet Studies, Museum Studies, Decolonial

Introduction

What is the future of the museum? This very question reappears whenever we go through moments of great historical and social transformations. For the first avant-garde movement at the beginning of the 20th century, the future of museums was their destruction. Incinerating the past was the only way to open the path to a new form of truly living art, created from its ashes that would be accommodated on a pharmacy shelf, as Kazimir Malevich defended in "On the Museum" (1919). His idea is the antithesis of the memorial discourses that emerged in the memory boom of the 1980s: at that moment, the question gave way to a statement - and the future seemed to be in the museum. These spaces were seen as a solution to the temporal fragmentation of the present and a way of dealing with a traumatic past, marked by wars and destruction.

This very debate has resurfaced since the beginning of the COVID-19 pandemic. In *The Future of the Museum* (2021),

András Szántó presents the same question to 28 directors from institutions around the world. For Marc-Olivier Wahler, director of the Musée d'Art et d'Histoire (MAH) in Geneva, the ideal "post-museum" should work more like software than hardware. As with a computer, Wahler imagines a future for museums in which they can be molded into different formats without losing their identity, not limited to a single space or experience.

This reading resonates with the questions that we aim to discuss: How to elaborate methodologies using digital tools and the audience's digital agency to dismantle museum discourses, a process that we call the *demusealization of the museum*? If museums are on the spotlight again in this "third memory boom" (Hoskins, 2017), when a more participative and effervescent digital modes of circulation and connectivity has transformed previous modes of memory representation, in which way these spaces could still be relevant in a context where institutions are deeply implicated in the debate about decolonial, restitution and reparation? Having this in mind, this round panel, moderated by Nathalia Lavigne, will discuss artistic projects by Dr. Giselle Beiguelman, Dr. Bruno Moreschi and Rafael Pagatini that are questioning traditional museological narratives and problematizing the colonialist gaze in museum collections using digital tools.

The notion of institutional critique 2.0 was devised by Bruno Moreschi and Gabriel Pereira after a research project conducted at the Van Abbemuseum collection (Eindhoven, NL), in which they created a reading process of their artworks through six commercial image-recognition Artificial Intelligences systems. Among their aims of this experimental methodology was denaturalizing AI's gaze, looking at these systems as a way to expand poetic layers of art beyond its marketing and efficiency-focused logic.

A similar methodology has also been developed by Moreschi, Giselle Beiguelman and Bernardo Fontes in the ongoing project *Demonumenta*. It proposes a debate on the coloniality that is embedded in several public institutions and collections, developed by students and faculty members at FAUUSP in dialogue with other institutions and research centers. In this panel, Beiguelman and Moreschi will focus on one artistic investigation presented in the context of the ZKM's

intelligent.museum residency. In *(De)composite Collections*, they analyzed the collections of two Brazilian museums throughout AI reading systems using these datasets algorithmically processed with GANs to question what other art histories might emerge from AI's readings of the images, and how these systems could contribute to understand the gaze as a historical construct.

Rafael Pagatini will present his research on the importance of digitalization in cultural institutions, focusing on his own experiences on the access to infrastructural information in museum archives. Documents and photographs about the institution can contribute to new ways of resignifying the museum and its collection by creating dialogues with the socio-historical-cultural conflicts that have permeated the museum over time. This study will also discuss how these dynamics are reproduced in the access to documents about the relationship between these cultural institutions and the civil-military dictatorship in Brazil (1964-1985).

Lastly, Nathalia Lavigne will present some results of the field research at the Humboldt Forum, in Berlin, in which she analyzes both some audience participation initiatives on social networks and programs led by this institution that can be seen as examples of demusealization of the museum. It includes, for instance, a comparative analysis between the hashtag #HumboldtForum on Instagram and the museum official account, trying to find points of convergence and differences between de-musealization practices carried out by the audience and by the institution itself.

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Authors' Biographies

Nathalia Lavigne

Art writer and curator, a Ph.D. Candidate at Architecture and Urbanism College, University of São Paulo (FAUUSP) and a former visiting scholar at The New School. She is a contributor to Artforum International Magazine, Contemporary And (C&), Folha

de São Paulo, among others; and has an MA in Cultural and Critical Studies from Birkbeck, University of London. Among the exhibitions she curated are "Against, Again: Art Under Attack in Brazil" (2020), at the Anya and Andrew Shiva Gallery, New York; and *Disappearance Tactics* (2021), at Paço das Artes, São Paulo. She is currently a visiting researcher at Humboldt-Universität zu Berlin, and have been awarded a DAAD scholarship in 2021.

Bruno Moreschi

Researcher and multidisciplinary artist. Postdoctoral fellow at the Faculty of Architecture and Urbanism at the University of São Paulo (FAUUSP), PhD in Arts at the State University of Campinas (Unicamp), with a Capes scholarship, and exchange at the University of Arts of Helsinki (Kuva Art Academy), Finland, via CIMO Fellowship. Projects recognized by scholarships, exhibitions and institutions such as ZKM, Van Abbemuseum, 33rd Bienal de São Paulo, Rumos Award, Funarte, Capes and Fapesp. He is currently a researcher on the Histories of AI: Genealogy of Power / Mellon Sawyer Seminar (Cambridge University), senior researcher at the Center for Arts, Design and Social Research (CAD+SR) and one of the coordinators of GAIA /C4AI/Inova USP. <https://brunomoreschi.com>

Giselle Beiguelman

Artist and Professor at the School of Architecture and Urbanism at the University of Sao Paulo, Brazil. She is also a member of the Laboratory for OTHER Urbanisms (FAUUSP) and co-coordinator of GAIA (Grupo de Arte e Inteligência Artificial – INOVA USP). Her interests include the aesthetics of memory and contemporary nomadism. Among her recent works are the Portuguese-language *Hateland*, covering online reactions to violence against vulnerable groups in Brazil; a co-authored book about the storage and preservation of digital artworks; and an on-going investigation of the colonialist imagination in 20th century artworks using artificial intelligence. Author of many international award-winning projects, her artworks are part of museums collections worldwide, such as ZKM (Germany) and Pinacoteca de S. Paulo (Brazil). <https://desvirtual.com>

Rafael Pagatini

Artist, researcher and assistant professor at the Federal University of Espírito Santo, Brazil. Pagatini is currently a PhD candidate in Visual Arts at the State University of Campinas, São Paulo. In 2020, he was a guest researcher at the Hannover University of Applied Sciences and Arts, Germany. He has held individual and collective exhibitions in Brazil and abroad: Shiva Gallery, New York (2020), European Center for Constitutional and Human Rights, Berlin (2019); Leipziger Baumwollspinnerei, Leipzig (2019); Columbia University, New York (2018); 20th Contemporary Art Festival Sesc_Videobrasil, São Paulo (2017); Paço das Artes, São Paulo (2016); Rumos Itaú Cultural, São Paulo (2013). <https://rafaelpagatini.com>



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ROUND TABLES

Roundtable on Ethics and New Media Art Archiving

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Abstract

In recent decades, new media art archives have multiplied and diversified across digital networks and online platforms, contributing to the creation of instant and unruly archives that often emerge in unforeseen and involuntarily ways. Concomitantly, our relationships with archival documents, new media, art institutions, and the historical, social, and political realities they pertain to have changed. Based on case studies discussed in previous panels, this roundtable addresses participants, first and foremost, as viewers themselves to think about how visual and archival literacy can be disseminated in order to respond to this unprecedented proliferation of new media art archives in more critical and engaged ways. Beyond questions of authorship, ownership, copyright, and consent, we will address issues around responsibility, authority, dignity, colonialism, and care to draw out the differences between performing and practicing ethics in and of new media art archives. Encouraging self-critical and self-reflexive perspectives, this roundtable invites users, artists, curators, and scholars to confront the complex and often ambiguous ethics vis-à-vis the subjects of new media art archives and to recognise our agency as well as complicity in ethical transgressions as equally responsible viewers and listeners.

Keywords

Ethics, archives, public domain, agency, responsibility, authority, dignity, care, gaze, visual literacy

Introduction

New media art archives have multiplied and diversified across digital networks and online platforms. Within them, temporal as well as geographical distances collapse, and the role of the 'archon' or 'gatekeeper' is distributed among algorithms, content moderators, curators, researchers, and a multitude of users. The dissemination of social networks in recent decades has brought about new issues for archival practices which take place in a grey zone between social

interaction and communication, contributing to the creation of instant and unruly archives that often emerge in unforeseen and involuntarily ways. Concomitantly, our relationships with archival documents, new media, art institutions, and the historical, social, and political realities they pertain to have changed. Against this background, this roundtable invites users, artists, curators, and scholars to address the complex and often ambiguous ethics vis-à-vis the subjects of new media art archives and encourages us to recognise our agency as well as complicity in ethical transgressions as equally responsible viewers and listeners. Rather than a means to an end or a predetermined code of conduct, we consider ethics as a practice, a means in and of itself. As such, an ethical practice in and of new media art archiving must continually be redefined and situated within particular material contexts and intersubjective relations. The point of departure for this discussion is the network of relations that unfolds between producers, subjects, archivists, mediators, and viewers, as well as the various forms of responsibility and agency that are inherent and negotiated therein. Based on case studies discussed in previous panels, we intend to deepen the debate from the spectator's point of view to think about how visual and archival literacy can be disseminated in order to respond to this unprecedented proliferation of new media art archives in more critical and engaged ways. Crucially, while this roundtable draws on individual fields of expertise, it seeks to engage participants, first and foremost, as viewers and to delineate their realms of agency and response.

Beyond questions of authorship, ownership, copyright, and consent, this roundtable raises issues around authority, dignity, colonialism, and care to draw out the differences between performing and practicing ethics in and of new media art archives. How can we address the absences within new media art archives, transcend the taxonomic structures that pervade them, and subvert the ideological frameworks that surround them? And how might our own patterns of

recognition and representation be complicit in perpetuating neocolonial narratives and neoliberal economies? What is the responsibility of the artist, curator, scholar, and, by extension, the viewer in relation to the people whose recorded images or voices are being recontextualised and repurposed through acts of archiving? Who is speaking to and for whom—and how can we, as viewers, respond in ways that disrupt and intervene in prevailing hegemonic hierarchies and historiographies?

Encouraging self-critical and self-reflexive perspectives, participants will be invited to question their own patterns of recognition to confront the agency as well as complicity in seeing, listening, and engaging with new media art archives. In doing so, the roundtable aims to untangle the complex correlations between the public domain, artistic and moral rights, and the ethical concerns and responsibilities inherent therein. Ultimately, an ethics in and of new media art archives falls on the given viewer; hence, how can each of us take responsibility for our own gaze?

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Vivian Sobchack, *Carnal Thoughts: Embodiment and Moving Image Culture* (Berkeley, CA: University of California Press, 2004).

Author Biographies

Lisa Deml is a Midlands4Cities funded doctoral researcher at Birmingham City University. She holds degrees in Art History and Philosophy from the Courtauld Institute of Art, London, and the Ludwig-Maximilians-University, Munich. Initially trained as a journalist, she subsequently worked for public cultural institutions and non-profit organisations internationally, including Haus der Kulturen der Welt (HKW), Berlin, Haus der Kunst, Munich, and Ashkal Alwan, Beirut. Her research interests focus on visual articulations of citizenship, particularly in the framework of documentary and new media practices in the Middle East and North Africa.

Nathalia Lavigne is an art writer and curator, a Ph.D. Candidate at Architecture and Urbanism College, University of São Paulo (FAUUSP), and a former visiting scholar at The New School. She is a contributor to *Artforum International*, *Contemporary And (C&)*, *Folha de São Paulo*, among others; and has an MA in Cultural and Critical Studies from Birkbeck, University of London.

Among the exhibitions she curated are *Against, Again: Art Under Attack in Brazil* (2020) at Anya and Andrew Shiva Gallery, New York; and *Disappearance Tactics* (2021) at Paço das Artes, São Paulo. She is currently a visiting researcher at Humboldt-Universität zu Berlin, and has been awarded a DAAD scholarship in 2021.

Towards a Global Distributed Network of New Media Art Archives

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Abstract

Online new media art archives exist throughout the world and contain a rich history of the research, events, artifacts, and people that helped to define the field of new media art. The purpose of this round table discussion is to brainstorm the idea of developing a world-wide network of online new media art archives. This distributed connection among archives would enable easy access to related information and benefits both users and archive administrators. This effort raises many questions and presents unique challenges but through the input of the new media art archiving community, solutions and a path forward will be forged.

Keywords

archive, digital art, new media art, connection, world-wide network

Introduction

The need to preserve artifacts and information related to the history of new media art has fostered the development of numerous physical and web-based archives throughout the world. Although the physical preservation of new media art is both essential and a topic worthy of in-depth discourse, this round table discussion focuses on the on-line archiving of documentation of new media art and related research, events, and contributors. The vision is to establish a world-wide network of online new media art archives, and this round table presents an opportunity for members of the archiving community to contribute their ideas, concerns, and solutions.

History

The conversation regarding creating connections between new media archives began with the Liverpool Declaration which specified that global networked collaboration between media art organizations, archives, and individuals was essential. A round table discussion was organized by Wim van der Plas for the ISEA2019 symposium which attracted over 50 attendees. It became clear that the time was right to begin work on a systematic approach to connect new media archives. The first Summit on New

Media Art Archiving was held online during ISEA2021 and featured 16 presentations from 12 different countries along with 3 parallel round table discussions focusing on connecting new media archives, creating ties to museums, and funding for new media archives. Representatives from ISEA, SIGGRAPH, ADA, Ars Electronica and the FILE Festival archives also met throughout the year to discuss goals, challenges and implementation methods. Programmers from the SIGGRAPH archive met with programmers from FILE to create code to begin the process of connecting the archives. In 2022, the ISEA and SIGGRAPH archive teams organized the Second Summit on New Media Art Archiving. With 52 presentations from 17 countries including paper presentations, panels, round table discussions, artist talks and a virtual exhibition of artwork, the summit advances the conversation and paves a way forward in our efforts to create this global network.

Connecting Archives

To enable access to information in online new media art archives, one must first know they exist and how to navigate unique user interfaces and information architectures. The effort to establish a distributed network of new media art archives aims to provide a way to easily traverse the broad range of archives containing related information. This effort raises questions related to funding, technology, shared data resources, unique name authority files, on-going support, and more. Connecting archives throughout the world poses unique challenges, and this discussion addresses these concerns and also invites innovative ideas to move forward with this initiative.

Co-Moderators

Bonnie Mitchell is a co-director of the ACM SIGGRAPH History and ISEA Symposium archives. She currently is a member of the ISEA International Advisory Committee and the SIGGRAPH History and Digital Arts Committees.

Oliver Grau is the director of the Archive for Digital Art (ADA) and author of *Mediale Emotionen, Imagery in the 21st Century*, *Digital Art through the Looking Glass*. He is also the founding director of the MediaArtHistories conference.



Founded in the Netherlands in 1990, ISEA International (formerly Inter-Society for the Electronic Arts) is an international non-profit organization fostering interdisciplinary academic discourse and exchange among culturally diverse organizations and individuals working with art, science and technology

ISEA International is responsible for the ISEA annual symposium, one of the most important international events at the intersection of art and science..



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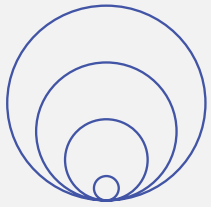
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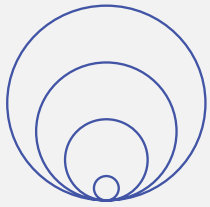
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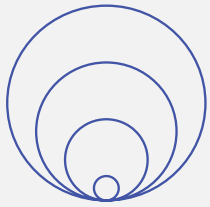
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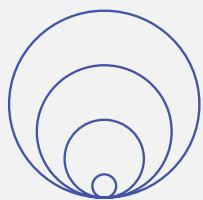
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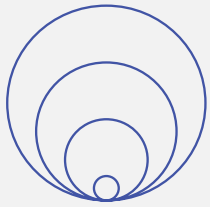
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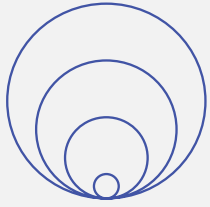
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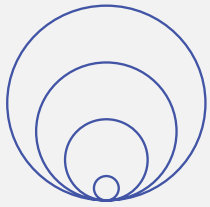
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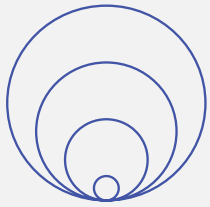
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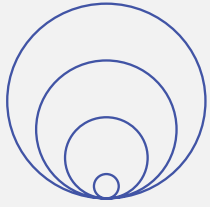
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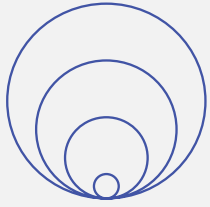
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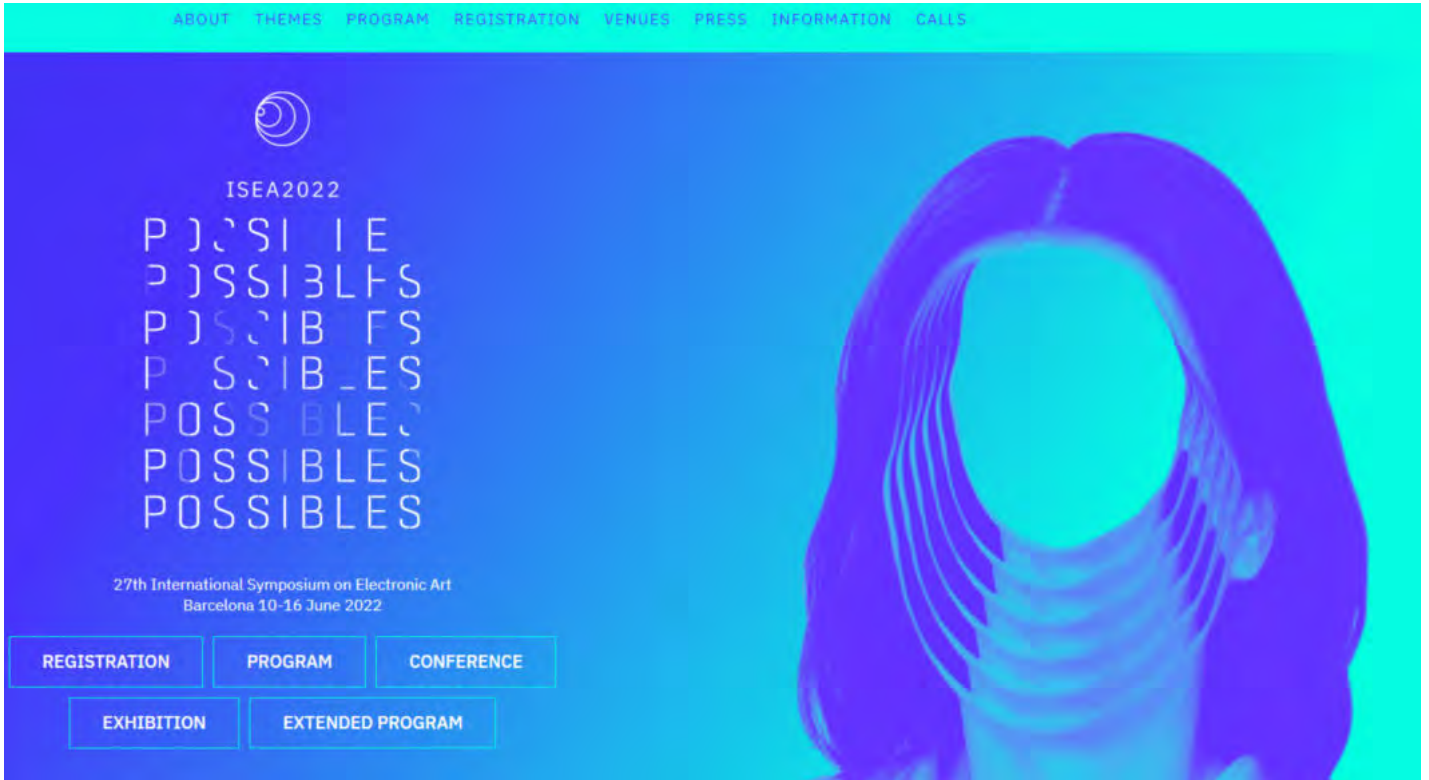
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Final Press Release – June 17

Second Press Release – May 25

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Artnodes

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