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# Investigating the atmosphere of pervasive and ubiquitous computing mediated spatial experiences: a post-phenomenological approach

Dimitris CHARITOS<sup>1</sup>, Iouliani THEONA<sup>2</sup>

1. Faculty of Communication and Media Studies, National and Kapodistrian University of Athens, Greece, vedesign@otenet.gr

2. School of Architecture, National Technical University of Athens, Greece, iouliani@gmail.com

**Abstract.** *The aim of this paper is to discuss the process of creating atmospheres in the context of pervasive computing-mediated spatial experiences. Firstly the concept of an atmosphere is defined and the process of creating atmospheres is discussed. Secondly, the paper considers the embedment of pervasive and ubiquitous computation and the Internet of Things technological infrastructure onto physical environments as spatial interfaces. Then post-phenomenology is put forward as an appropriate theoretical framework for approaching the experiential impact of technologically mediated spatial experiences. Finally, the paper uses an interactive audio installation artwork as an example to further the discussion presented in the paper.*

**Keywords:** *atmosphere, ambience, pervasive and ubiquitous computing, internet of things, spatial interfaces*

## On ambience, atmosphere and the embodied, emotional nature of the spatial experience

*'An ambience is defined as an atmosphere, or a surrounding influence: a tint.'*

Liner notes from Brian Eno's 'Music for Airports'<sup>1</sup>

In his liner notes for the 'Music for Airports' album, Brian Eno (1978) defined the term 'ambient music' as a form of 'environmental music suited to a wide variety of moods and atmospheres'. He related the objective of creating such a musical composition to the creation of an environmental situation, which induces certain emotional responses to the listeners experiencing this situation.

The concept of 'ambience' is closely related but not identical to the concept of 'atmosphere'. Spanou (2014) defines an 'atmosphere' as a first impression, or even a kind of prediction or as emotive reaction towards the environment directly connected with the world of feelings. The literal sense of the word relates to the science of meteorology and is associated with the properties of environment that

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1. Brian Eno "Music for Airports", the initial American release of musical recording in CD format: Ambient 1", PVC 7908 (AMB 001)

directly bear on the possibility of life and on the comfort of organisms. The metaphorical sense of the term describes the resonance between the properties of the environment and patterns of feeling or emotion and could be the result of being in any kind of environment, man-made or natural. Spanou (2014) links the metaphorical conception of the atmosphere to the phenomenological perspective that develops notions of space and time as directly derived from experience. She suggests that most existing theoretical discourses on the concept of atmosphere approach it through an essentially phenomenological perspective that is through embodied experience and certainly not through anything close to a measurable, fixed or controllable property.

The concept of atmosphere brings together different levels of spatial intelligibility. At the most generic level, atmosphere bears on orientation, the attribution of importance that underlies our embodied perception of environment. (Spanou & Charitos, 2005: 146) At another level, embodied experiences acquire metaphorical projections and extensions into abstract meanings (Johnson, 1987, Lakoff & Johnson, 1999) which function as fundamental metaphors we think with, rather than as metaphors, we consciously construct or think of. (Spanou & Charitos, 2005: 146) At a third level, embodied experiences arise as a consequence of intentional design and as responses to relational patterns that are interpreted as an outcome of design. At this level atmosphere is understood reflexively and implies a conscious awareness of environment as symbolic form. (Spanou & Charitos, 2005: 146)

The concept of an atmosphere (Spanou, 2014) and the process of creating atmospheres are discussed here, from the perspective of designing the physical structures, situations and generators that may support the generation of a certain atmosphere. The process of making atmospheres is mostly related to creating the conditions through which the atmosphere appears and Bohme uses the concept of generators in correspondence to these conditions. Thus creating an atmosphere does not only imply the production of a series of artifacts and things, which bind space and determine the spatial experience as such (Charitos, 1998), but mostly the process of making possible the appearance of a phenomenon by establishing the conditions which may generate it.

## **Pervasive computation, Internet of Things and spatial interfaces**

In this subsection, the paper discusses pervasive and ubiquitous computation and the Internet of Things (IoT) as technologies, which mediate the spatial experience of humans using them, ultimately aiming at inquiring the atmospheric aspect of these types of computer-mediated spatial experiences. The rapid evolution of embedded and pervasive computing, wireless networking, mobile and wearable computing, sensor networks and intelligent environments as well as the convergence of these technologies has led to the gradual transformation of the internet, from a network of networks to a network that may connect any computers with other computers, as well as with any other human artifacts or physical objects. In recent literature, this emergent phenomenon has been called: the Internet of Things (IoT) (Gershenfeld 1999, Pfister, 2011) signifies the expansion of internet onto the physical world, including and connecting things, physical objects of everyday life and artifacts (Mattern & Floerkemeier). These technological advancements bring forward a new

condition whereby human-machine communication becomes spatialised and implicit<sup>2</sup>, persistent and invisible. Additionally, computation extends beyond the limits of the desktop and expands physically and conceptually out towards the world and onto any physical, symbolic, material and immaterial objects and the environments that these constitute.

Mark (1999) has stressed the significance of physical space as a characteristic of pervasive computational interfaces. As computation gradually becomes part of everyday physical space, the spatial context within which interaction between humans and computation takes place radically changes from a fairly static single-user, location-independent world to a dynamic multi-user situated environment.

From a phenomenological perspective, our world consists of phenomena and the most permanent relations between phenomena constitute an object. We survive in our environment by orienting ourselves to objects, which are being manifested to us through the psychological and cognitive processes involved in the perception of phenomena. Space is, therefore, defined by objects, or elements of form, which bind it (Charitos, 1998). Therefore, the spatial context within which human-machine communication takes place, in the era of pervasive computation, comprises of both computational elements and all the physical environmental stimuli that may be involved in the process of interaction. This context is a kind of 'spatial interface', where the physical location of the interface to the computation becomes relevant.

Bohme (2013) discusses the process of making atmospheres as relating to the manipulation of material conditions, of things, apparatus, sound and light. But a atmosphere itself is not a thing; it is rather a floating in-between, something between things and the perceiving subjects. The making of atmospheres (Bohme, 2013) is therefore confined to setting the conditions in which the atmosphere appears. He refers to these conditions as generators. The true character of making, does not really consist in producing a thing, but in making possible the appearance of a phenomenon by establishing the conditions which allow for it.

We could then suggest that when we design interactive spatial experiences, which take place within such interfaces, we need to design both the physical setting as well as the digital aspect of the experience afforded by the use of computation. Ultimately, when we want a computer-mediated spatial experience to generate a certain atmosphere, we need to design the artifacts of the physical setting as well as the embedded elements of computation in a manner that determines the conditions which will afford the emergence of the atmosphere, as the outcome of the interaction between the human and the hybrid environment. It is, however, important to stress that in such hybrid environmental settings, human-computer interaction is not necessarily only an anthropocentric process but can largely be the outcome of material agency of non-human living actors, non-living things and objects.

## **A post-phenomenological approach into the design of spatial interfaces**

As earlier suggested, phenomenology is an important theoretical basis for the concept of the 'atmosphere', which is under discussion here. It is, however, questionable whether phenomenology could offer an inclusive theoretical

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2. For a further discussion of the term implicit interaction see Rizopoulos & Charitos (2006).

framework for interpreting the relations of humans to spaces and places, which is mediated through the latest advents of technology. Heidegger (Verbeek (2005), in his early works, sought to investigate 'the role that actual technologies play in the way in which reality acquires meaning for human beings'. Progressively though, phenomenology distanced itself from the prospect of a philosophy of technology, reducing technological artifacts to conditions of alienation from meaningful encounters with the world.

Verbeek (2005), building on the work of Ihde (1993a, 1993b), suggests that a reinterpretation of phenomenology is necessary, in order to address certain valuable questions on the role of technology in shaping human experience, while at the same time taking into account contemporary technological circumstances like the emergence of pervasive computing and the IoT. Both Verbeek and Ihde agree on the need for a post-phenomenological paradigm that is dedicated to exploring the relations between human beings and the world, which is shaped by technological mediation, as opposed to only describing the world in itself. Retaining the triad: Human – Artifact – World (Ihde, 1979) – or as Verbeek (2005) puts it: I – Technology – World [25] at the core of its inquiry, post-phenomenology presents valuable insights into the process of using and experiencing interactive spatial experiences supported by pervasive and IoT technologies, ultimately aiming at informing the design of these systems for evoking certain atmospheres.

In his attempt to identify different ways in which technological artifacts mediate human encounters of the world, Ihde traced a continuum of object/subject relations (Ihde, 1979, Verbeek, 2005). On one extreme, he set what he described as embodiment relations, where objects expand the body and its capacity to experience its surroundings. Hence, a subject relates to the world via an object. On the other end, he proposed the concept of alterity relations. In this case, technological artefacts are regarded as the other, appear to have a certain independence, hence the focus shifts to the interaction between subject and object. Between the two above mentioned categories, Ihde identifies hermeneutic relations. Again, the object mediates the experience of the world, the difference though lies in the fact that it is not perceived as part of the subject, as an extension of the body, but is regarded as separate. Hence, the technological artifact 'provides a representation of the world, which requires interpretation in order to impart something to us about it' (Verbeek, 2005). Finally, Ihde identifies a distinct set of relations between humans and technology that unfold mostly in the background of human experience. In this instance, technological artifacts do not explicitly manifest themselves as means to encounter the world, or objects to interact with, rather they influence the context while seemingly absent. Ihde's taxonomy demonstrates that a post-phenomenological framework of analysis is relational and context-sensitive.

Following Ihde's analysis, we could also suggest that, in the context of spatial interfaces supported by pervasive computation, information escapes the confines of the representational context afforded by the limiting two-dimensional space of the desktop computer screen and is projected onto and manifested via the activity of the technological artifacts located in the physical world. Particularly in the case of IoT systems though, the technological artifacts shape the context of human beings in a rather implicit manner, which may largely be attributed to machine-to-machine communication, rather than only to human-machine communication (background relations).

## Pollen

'Pollen' is an interactive audio installation that was created by Coti K. and Dimitris Charitos (2009) and was presented during the Expanded Ecologies exhibition at the National Museum of Contemporary Art, in Athens, Greece. 'Pollen' was conceptualised as a site-specific artwork that was set up at the garden outside the museum from mid June 2009 till October 2009. It is used here as a means of exemplifying some of the arguments put forward by the paper so far.

The installation captured data from the environment, like light levels, sound and atmospheric pollution and transformed it into an auditory ecosystem that functioned adversely towards these environmental conditions, in an attempt to counterbalance them at a symbolic level. The visual form of the installation was a network of beehives, which were positioned at the exterior of the museum in such a way that they defined a micro-environment, by virtue of their arrangement and the evolving sound composition they transmitted. The beehives contained the input devices that captured environmental information (sensors, microphones, etc.), the information-processing part of the system as well as the devices (amplifiers and speakers) for supporting the 10-channel audio presentation system. By making use of microphones and sensors, the (usually disturbing) sound levels and other factors of environmental pollution were digitised in real-time and used as input for the system, consequently producing the auditory environment, which comprised of synthesised audio, representing natural sounds of insects and birds, in an abstract manner. The beehives interacted with and emitted sound as a response to the constantly changing environmental conditions of their physical surroundings thus immersing the visitor in an atmosphere generated by this interaction with the system's parameters, in an attempt to 'protect' her from the negative stimuli of the urban context. Hence, the beehives shaped the atmosphere not only through their visual presence, but also through their inter-activity.

From a post-phenomenological point of view, although the outcome of this interaction was clearly manifested in the auditory environment that was produced, the problematic, the internal logic as well as the manners in which this interaction took place were largely concealed (background relations). Additionally, this public space installation was intended as a very subtle intervention to the existing environmental setting. In other words, the experience of being within the generated atmosphere existed at a threshold, fluctuating between manifesting itself as a public space artwork and hiding in the background of the noisy environmental setting. Taking into account the taxonomy of the three different levels of spatial intelligibility relating to the concept of an atmosphere, mentioned earlier (Spanou & Charitos, 2005:146), Pollen evokes an embodied experience which lies in the common ground between a conscious awareness of being surrounded by an intentionally designed environmental composition as a symbolic form and the acquisition of metaphorical projections and extensions into abstract meanings functioning as metaphors we think with.

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## Authors

Dimitrios Charitos is an Assistant Professor at the Faculty of Communication and Media Studies of the National and Kapodistrian University of Athens. He is an interactive designer and architect. He has coordinated or worked as a researcher in more than 12 research projects funded by Greek or European funding bodies on areas such as: interactive design, locative media, virtual environment design, interactive art, environmental behaviour. His artistic work involves electronic music, audiovisual, non-interactive or interactive, site-specific installations and virtual environments. He has authored or co-authored more than 80 publications in books, journals or conference proceedings.

Iouliani Theona is an Architect Engineer, having graduated from the School of Architecture, Faculty of Engineering of the Aristotle University of Thessaloniki. Currently, she is a PhD candidate in the School of Architecture, National and Technical University of Athens and she also collaborates as a researcher at the the Faculty of Communication and Media Studies, University of Athens. Her research interests include pervasive games, locative media and hybrid spatial experiences.