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Building Bridges: HCI, Visualization, and Non-formal Modeling

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Building Bridges – From Non-formal Modeling to HCI and Visualization

In 2011, two HCIV workshops took place at renowned conferences. HCIV is a new major program in Human–Computer Interaction and Visualization. The aim of this initiative is to establish a study and research program that will combine the knowledge of both the science and the practice in the fields of human–computer interaction and visualization. From 2009, HCIV [1] is an official working group of the IFIP Technical Committee on Human–Computer Interaction (TC13). The first workshop at ECCE 2011 [2] focused on "Non-formal Modeling for Interaction Design." The second one was held at INTERACT 2011 [3] with the main topic "Building Bridges—HCI and Visualization." Proposals for both workshops were successfully submitted to the two conferences. After acceptance, the workshops were advertised on academic email lists and on a special website. The submissions to our workshops were made in the form of extended abstracts and carefully reviewed by the organizers. During the workshops the authors presented their work in short talks followed by intense discussions. Furthermore, two very inspiring keynote talks were given by Mary Czerwinski (Microsoft Research, Redmond, USA) and Bob Spence (Imperial College London, UK). In a final discussion, all participants agreed that the topics definitely deserve a visible platform for presenting the single ideas and contributions to the research communities involved in this field. The idea to publish two books based on the outcomes was born. However, after the two fruitful workshops took place, we – the organizers – found that both workshops, despite their contrasting research topics, were very similar in their results and take-away messages. Thus, it seems that (non-formal) modeling, HCI, and visualization are more tightly connected than the literature and conferences imply. Clearly missing are the bridges connecting these important research fields. We hope that this book will help build some of these bridges, allowing us to explore new horizons.

Non-formal Modeling

If modeling is included in the requirements analysis phase of a systematic interaction design method, it mostly focuses on some kind of formalism, e.g., task modeling and requirements specification. However, when designing in collaboration with nonexpert stakeholders this will not work. On the other hand, it is exactly this creative collaboration between stakeholders and designers in a very early design phase which allows us to explore and consider new solutions before these need to be prototyped or implemented.

Non-formal modeling tools and techniques for early collaboration with stakeholders [like sketching, (paper) prototyping, and storytelling] are relatively cheap and, on the other hand, uniquely stimulating techniques for identifying both the boundaries and the opportunities of the design space for interactive systems.

Using visuals, however, is not without pitfalls. Designers who communicate with stakeholders should be aware of how humans perceive and understand. The human visual system, the "mind's eye," relies in large part on the eye and on the processing and the interpretation of the information processed by the brain. Visual design utilizes both. Additional care must be taken to present and highlight important information. Thus, at least a basic knowledge of perceptual and cognitive issues is needed to avoid a poor usage of different features in visual design.

One of the main issues is drawing a user's attention to where it is needed. Here, the so-called preattentive processing, the step that occurs before the attention of the user is concentrated on the visual image, plays an important role. Preattentive processing is performed automatically on the entire visual field detecting basic features of objects in the display. It is done quickly, effortlessly, and in parallel and can therefore greatly improve the intuitiveness of representations. It is a strong instrument for enabling a fast and natural way of acquiring information.

One of the key elements of preattentive processing is the theory of visual or retinal variables, which can be compared effortlessly [4]. Bertin identified eight visual variables: form, orientation, color, texture, value, size, and position (position counted twice). In addition, he divides the characteristics of perception of visual variables into four groups: associative, selective, ordered, and quantitative perception. The knowledge of visual variables and their perception criteria is essential for an intuitive, user-centered interaction design.

All the above-described techniques have in fact been elaborated, and sources as well as resources are available. Teaching design students how to locate and apply them in a creative way strengthens their ability to develop user-centered solutions from the start.

A key problem of visual design in public services and applications is the lack of time and money. The lack of time means stakeholders cannot invest enough time to develop a formal model to define the design process because they are stuck in their principal tasks. The lack of money leads to short-term design processes without having enough time for evaluation. On the other hand, stakeholders mostly cannot really outline their needs because they are often non-professional users, and thus are not able to clearly define their requirements. In fact the design is done based on rare information about requirements followed by the implementation of a rough model as end result. The non-professional users need intuitive, self-explaining systems. If we do not meet this interest, users will not accept a system. Therefore, an important and crucial step is to identify their special needs by involving the users in design decisions. This results in the need of non-formal modeling processes to achieve reasonable results.

Therefore, we need a way to reach an optimized model in interactive design based on the specified needs of the stakeholders. One possible solution might be a more or less "online" evaluation. Once the implementation of different methods has started, the stakeholders have to be involved in the design process by evaluating the current results. This means the implementation has to be based on perceptual and cognitive issues following the steps of the well-known evaluation cycle [5] in a very condensed way. This kind of evaluation tailored for the stakeholders leads to a faster correction of possible faults within the development phase. Implementing a new design method with an immediate evaluation and response by the stakeholders themselves yields an

"online" evaluation to reach the users' desires. While evaluating one method, the next method can be implemented. This leads to a user-specified and convenient visual design.

This way is less time consuming because in the beginning some coarse requirements are sufficient to get started. During the design process, it always takes a few minutes to define the next steps because the users get a visual impression of their ideas. Another advantage is to get a visual result of what might be the final result in an early project stage.

Visualization and HCI

Whenever discussing the relationship between HCI and visualization in general or when presenting research results in these areas, questions arise about the differences between these research fields. Are not both fields just the same? And if not, where is the common ground? Can we combine the separate viewpoints and paradigms in a unified and complementary approach, or are we forced to choose one or the other? How can we give the general public (the developers and users of visualization and HCI and the engineers implementing our designs) a precise and practical enough idea about what is happening in these fields and what is not? What are the consequences of the answers on the previous questions: how and what should we teach? What will be the future? This dilemma is a topic of frequent discussion around the water cooler, lecture halls, as well as in the boardroom.

One of the major issues is that it is not easy to precisely define the terms visualization and HCI and there are many interpretations of these two fields that appear to be distinct.

ACM SIGCHI tries to give people a working definition for HCI: "Human–computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them" [6]. However, at the same time the applicability of this definition is significantly limited by adding that it "at least permits us to get down to the practical work of deciding what is to be taught."

Similar imprecise descriptions can be found for visualization. One possibility is the classic definition given by ACM SIGGRAPH: "visualization is […] the formation of mental visual images, the act or process of interpreting in visual terms or of putting into visual form" [7], although the visualization subcommittee of the SIGGRAPH Education Committee in 1997 provided an alternative: "A computer generated image or collection of images, possibly ordered, using a computer representation of data as its primary source and a human as its primary target" [8]. Foley [9], in 1994, states: "A useful definition of visualization might be the binding (or mapping) of data to a representation that can be perceived. The types of binding could be visual, auditory, tactile, etc. or a combination of these." Kosara [10] tries to better conceptualize the term visualization by defining some criteria forming a minimal set of requirements for any visualization: "Visualization is based on (non-visual) data, produces an image, and results in a readable and recognizable output." Finally, some definitions approach

the concept from the point of view of computing: "Visualization is a method of computing. It transforms the symbolic into the geometric, enabling researchers to observe their simulations and computations. Visualization offers a method for seeing the unseen. It enriches the process of scientific discovery and fosters profound and unexpected insights. In many fields it is already revolutionizing the way scientists do science" [11].

As mentioned, questioning similarities, differences, and correlations of HCI and visualization forms an important part of our daily work life. In order to better (or at all) answer these questions, questions like the ones listed below need to be discussed and – if possible – answered:

- What is HCI? What is visualization? What is a working description that is practical for highlighting the special features of each of the fields as well as supporting mutual understanding between them?
- Are there other disciplines involved in this struggle (e.g., visual analytics)?
- How can we take advantage of the two fields and how can we find ways for people with different inclinations to collaborate and take advantage of the strengths of each other?
- What are the similarities of the disciplines? What are the major differences?
- Do we need to really split the domains? Or do we need to join them and provide a joint curriculum for studying and practicing them?
- Can we give definitions that are better applicable in real situations?

Does one need to further research ways of making people take advantage of both disciplines in designing interactive visual systems? In that case, what are the research agenda(s) and what are the top 10 research challenges?

In the current volume, we provide some visions from scholars in these fields, working at – or across – the borders between these fields. Their work may point to possible directions to answer our questions, and will help in the understanding and developing of a holistic cross-discipline.

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