Beyond the Reality Syndrome

Designing Presence in Virtual Environments

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Recent explorations of the concepts of form and content in virtual worlds open a new understanding of the development of novel design paradigms that can promote the sense of presence in virtual worlds. This paper presents current research in the design of presence in virtual worlds and investigates the impact of design paradigms that integrate the components of form and content.

Keywords: *Virtual environments, presence, virtual reality, virtual design, task-based design, scenario-based design, performance-based design*

Introduction

Virtual environments (VE) are currently being designed and implemented to accommodate diverse functions such as shopping, banking, travel planning, etc. These information-based environments are generally not sufficient to simulate the experience of real life. There is a need to establish new conceptual approaches to the design of virtual environments in order to enhance the richness and complexity of our experience in virtual worlds in order to make it more similar to real-life experience. Among the challenging problems today is the achievement of a sense of presence in the virtual environment which might duplicate, replace, or improve the human sense of 'being there'.

Current research in the experience and evaluation of virtual environment is investigating significant concepts that can be applied, due to technological developments, in the design of virtual worlds. Among them are the concepts of presence (Slater, 2000) and place (Mitchell, 1995; Kalay, 2001).

Given the centrality of these issues for the future of VE's development, research into presence is becoming a multi-disciplinary field of some importance. The role of architecture and design has particular significance in this emerging field. This paper reports on research to define, model and evaluate the architectural and design contributions to the strengthening of presence and, particularly, the role of human behavior in these environments.

Being there - the experience of presence in mediated environments is associated with multidimensional perception and various cognitive processes. These subjects and research related to them are of great significance to the field of virtual design, since they provide a theoretical basis for understanding and developing novel design paradigms for the design of presence-rich virtual

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Being there - the experience of presence in mediated environments is associated with multidimensional perception and various cognitive processes. These subjects and research related to them are of great significance to the field of virtual design, since they provide a theoretical basis for understanding and developing novel design paradigms for the design of presence-rich virtual environments. Novel design paradigms should include and integrate both traditional design experience and the cognitive understanding of space, function and structure with emerging new concepts related to mediated environments.

This paper reports on on-going research which attempts to define, model and evaluate novel design paradigms for the creation of a better sense of presence in virtual environments.

2. Background

Current approaches in the design of virtual environments for everyday functions such as e-business and e-culture are frequently based on the common and prevalent document metaphor (Kalay, 2001, Oxman, 2003) Other design concepts were imported from the field of Virtual Reality in order to deal with the modeling of space. Simulation of spatial reality has a key role in order to duplicate the experience of real space.

The domination of a virtual environment is related to immersion. In the most technically advanced applications of virtual reality, known as „immersive" VR, the user is essentially isolated from the outside world and fully enveloped within the computer-generated environment. Virtual reality (VR) entails the use of advanced technologies, to produce a simulated (i.e., virtual) environment that users perceive as comparable to real world objects and events (Schultheis and Rizzo, 2001). Users may be provided with visual, audio and, in some instances, haptic and olfactory feedback of their performance. Indeed, one of the cardinal features of virtual reality is the provision of a sense of actual presence in, and control over, the simulated environment (Weiss and Jessel, 1998).

There are various factors that are important in order to achieve immersion. For example there are aspects related to form such as simulations of lighting, resolution, speed, and level of reality; aspects related to content that are related to the task that the user is required to perform in a virtual environment. Under certain conditions such as occur when a task is more meaningful, interesting or competitive to the user, the level of presence is

generally improved, even in the absence of high immersion (Nash et al., 2001).

The design of architectural building types, as well as the design of urban spaces has usually been employed to support visual experience. In contrast to reality, the content of an architectural space and the typological qualities of virtual spaces are defined as symbolic rather than functional (Oxman, 2003). For example, in virtual worlds there is no need for structural elements, since structure has lost all but it's visual and symbolic meaning. Arcades and other urban typologies are used in the design of virtual architecture in order to replicate the experience of recognized spaces. Structure symbolizes the analogical realm of space and time in digital space and acts as an interface for movement. This is particularly relevant with respect to the definition of movement space that acts as a medium for transcending the scrolling facility of document-based environments. Such investigations of temporal space experienced through movement and scene transitions can be regarded as among the conceptual foundations of the user's experience of presence in virtual space (Oxman, 2003).

However, even this kind of Virtual Reality which simulates spatial and visual experience, well known from gaming environments, often reduces the cognitive space in which people can be active and creative in a way similar to everyday life. In order to go beyond this concept, current research is looking for a richer set of concepts.

3. The conceptualization of presence

Form and content are basic concepts in understanding presence (Slater, 2000). Both are known to have a significant impact on the sense of presence. Various types of presence can be achieved in virtual environments according to the application of different types of the media-form and the media-content in the design of mediated environ-ments. These will be explained below.

Media-form is defined by the physical and spatial properties of the display that enable the activation of the virtual environment. The physical environment is responsive to the creation of multisensory stimuli that activate perception, cognition and emotion. For example, the following three categories that are associated with media form according to Sheridan (2000) are: sensory information, the level of control over the sensory mechanism and the ability to modify the environment.

Media-content refers to objects, actors and other aspects of the environment that are represented by the medium and which allow a flow of events known as the „narrative" or the „story". Factors of media content are responsible for keeping the user interested and involved.

Slater (1999) provides good examples of the achievement of interesting and engaging context in different settings by mixing principles of content and form. According to Slater „being there" or „being present" means activating the perceptual, cognitive and mental systems in a way similar to real situations where the human behaves as if he is there experiencing similar thoughts and actions.

The sense of presence can be achieved even when the level of immersion is not high. What is important is the creation of rich and complex environments that induce the human feeling of „being there". For example, in the design of a music hall, content can be conveyed by sensory and visual effects of place such as sound, and the spatial experience can be achieved by visual and immersive effects (Slater, 2000). Both of these, the form and content can create mediated environments for having a sense of presence. Furthermore, such a virtual environment can offer the social sense of place by providing opportunities to meet, recognize a face, to be surprised by meeting, or other forms of social content.

This approach to the dual concepts of form and content opens new directions for experimentation and development of novel design paradigms

that can induce an enhanced sense of presence in virtual worlds. In the following section we illustrate the exploitation of the concepts of form and content as a basis for the development of design paradigms for virtual worlds.

4. Design paradigms that induce presence

Designing a place in virtual worlds should be rich enough to activate all the components of human perception, cognition and emotion. The characteristic of presence may be defined as the multisensory experience of reality that supports interacting in a virtual environment „as if you were there". The simulation of the quality of realism, or verisimilitude, is a function of numerous factors in virtual environments including, among others, visual realism, movement transitions, gravity, haptic sensations, etc. The enhancement of these multisensory experiences is currently assumed to contribute to the sense of presence in all types of VE including various technologies of VR as well as mixed technologies of interaction.

The goal of all presence and interaction technologies is to achieve a high level of presence coupled with a seamless functionality of interaction. There exists a base-line of important definitions in presence research that attempts to generalize the research issues above the level of specific technological applications.

Architectural design has a particular significance in this emerging design field, since it is a field that has been traditionally engaged with the creation of rich human experiences through the design of the physical environment. Furthermore, architectural design has historically developed a rich conceptual vocabulary for dealing with the description and evaluation of environmental form (Oxman, 2003).

In our own research we have found the dual concepts of form and content extremely useful. Presence appears to be affected by perceptual and cognitive factors related to the spatial-temporal-physical aspects of scenes that characterize both of these concepts.

This diverse and complex body of influences constitutes one pole of presence research related to architecture and design. We are currently exploring types of paradigms that integrate the two components of form and content. We are now experimenting with various design paradigms in developmental and empirical situations in various research projects. The first is termed task-based design, the second, scenario-based design and the third, performance-based design.

4.1 Task-based Design (research: performing task in virtual environment)

Slater (1999) suggests that presence in virtual environments includes the following three aspects: a sense of "being there", domination of the virtual environment over the real world, and activation of the participant's memory as if he is in an actual location rather than a compilation of computer-generated images and sounds.

Task involvement, the „control" of visual scene and scene transitions by the participant (usually the participant's movements) are important issues in the design of such task-based environments. The way users can interact with displayed images, move and manipulate virtual objects, and perform other actions in a way that engenders a feeling of actual presence, and immersion of their visual sense, in the simulated scene is one of them (Wijnand and Riva, 2003).

In our current research, „task-based design" is employed for the development of virtual living environments. We intend to construct and evaluate a tool termed „LES" (Living Environment System) for use with people who have disabilities. Its main purpose is to test whether the environment is an accessible environment, meaning that it is that is designed in a way that doesn't „interfere" with performance. The LES will allow us to test the environment and to see where the barriers are.

The virtual environment is being developed for

testing various everyday activities within a context of a domestic spatial environment. The assumption that we can test the accessibility of a real environment through the performance of humans in a virtual one is based upon the approach that the process of „place understanding" that occurs within a virtual environment may be similar to that which takes place in real environments and thus, humans perform in VRs in a similar way to the way they perform in real environments. For example, it was found (Darken and Silbert, 1996) that the same principles of environmental design that are implemented to assist way-finding in the physical world (e.g., directional cues) help way-finding in virtual worlds.

The LES enables the development of an interactive environment that can be used to tests users' abilities to identify and modify accessibility barriers while navigating within it. The construction and simulation of these environments is carried out using EON Reality's (www.eonreality.com) tools. These tools enable a rapid development of interactive 3-D environments that are easy to navigate in real time while performing accurate collision detection. Accurate collision detection (which was until recently available primarily in mechanical, non-interactive simulations) enhances our ability to gather relevant data from the simulation process. In previous generations of

VR tools, the collision detection was limited to a bounding box. This bounding box was a rough approximation of the user's body contours and left out many of the fine details (such as curves, gaps and protrusions) which are needed to accurately represent the body. With the EON Reality platform we can not only identify each collision, but can also record the occurrences into a database, as well as give auditory, visual and haptic feedback to the user in order to prevent positions that are physically invalid. This means that a user cannot navigate to a position where the wheelchair or a part of his or her body overlaps another object (a wall, a door, a table or its legs, etc). Figure 1 presents an illustration of an application of the EON Reality environment to the LES task-based design

The ecological validity of this simulation allows the user to navigate in the virtual reality in a way that is as similar as can be to the navigation in the real environment. The user can not only identify barriers in his/her way but even identify corners or narrow passages that, although passable, would be difficult and inconvenient to navigate on a daily basis due to the number of moves and collisions they would necessitate.

In general, the task-based design approach is related to both form and content. Form is achieved by simulating a specific environment and the con-
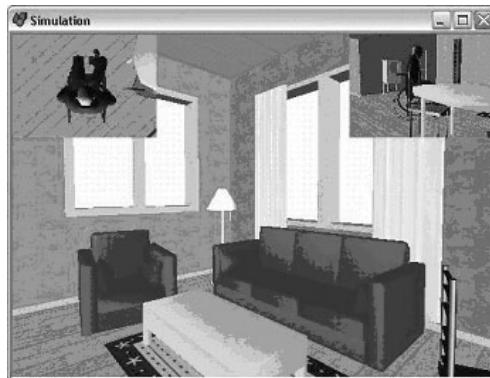
Figure 1
Application of EON Reality environment to the LES task-based design (Orit Palmon and Meir Shahar).

*Figure 2*
Scenario-based design (Rina Kolomiski).

4.2 Scenario-based design (illustration project: co-presence in virtual environments)

Our approach to „scenario-based design" attempts to achieve a sense of spatial reality in virtual worlds through the materiality, and the mobility of the subject(s). One of the most interesting challenges of VE's is achievement of the complex characteristics of *real-time interaction in social situations.* This represents another level of presence enhancement in VE's involving various aspects of socialization. These include real-time social action-reaction phenomena in visual-temporal space, communication-response, etc.

In the following particular application, the utilization of the concepts of „content" and „form" are elaborated and tested in a situation of virtual co-presence. „Co-presence" (Lombard and Ditton, 2000) is created by the integration and the interaction of the two types of presence, physical presence (form) and the social presence (content). Scenario-based design creates choice and opportunities for social interaction simultaneously in various virtual places. Figure 1 illustrates an example of a meeting between a visitor and a painter in a virtual museum. The unique quality of this environment is that the painter can meet the
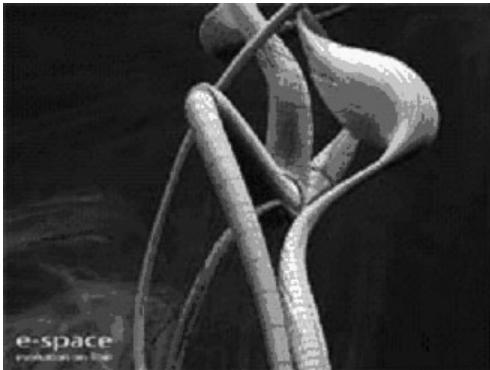
visitor in the museum upon her/his request, or alternatively invite the visitor to his/her studio. This paradigm supports a real or imaginary scenario that can be associated with places such as museums, schools etc. The meeting creates the quality of co-presence. In addition, the sense of presence is enhanced by the unique experience provided by the virtual, an experience possible, but usually beyond, that of real environmental experience in such environments.

This application characterizes a *user-centered augmented service environment* which attempts to enhance the real-time accessibility and control of a range of functions that are integrated with the visual scenes. In such expanded service augmented reality environments the role of architecture and design factors satisfies a range of important cognitive requirements.

4.3 Performance-based design (illustration project: performance in imaginary worlds)

In virtual environments there is no need to respond to climate, gravity or weight. Therefore the concept of „performance-based design" is free to simulate any defined relationships. In our experiments, performance-based design simulates behaviors according to physical and temporal variables and parameters and integrates them in the design. This can be also relevant to the issue of social presence. For example, figure 2 illustrates an „Internet Café" that can grow or become smaller in direct response to the number of its current participants at any time and the existing potential for social interaction that is represented symbolically. Thus in performance-based design of virtual place the environment is responsive. Such performance functions of virtual place are the activation and change of dimensions and shape according to the number of users who „occupy" the space.

Volume and shape can become visual cues to simulate habitability even in an imaginary environment. In our work we have demonstrated how such information and data constructs can

Figure 3
Performance based design (Shachaf Zait, Inbar Idan and Lior Rozenfeld).

be translated to, and implemented by, dynamic physical simulations. For example, in many chatroom applications we can read information such as the participant's list, the number of active participants, the participants that have joined and left the forum, etc. Usually this information is handled and presented by techniques of listing (information-based design). In contrast, we have demonstrated a flexible 3-d space that is responsive to the number and the presence of its virtual participants and will represent them symbolically and visually.

5. Evaluation Criteria in Presence Research

How we can determine the extent to which a user feels present in a virtual environment is a significant issue in the evaluation of how successful is the design of a virtual environment. What is the link between the presence measures and achieving good design?

Currently there are various methods commonly used for measuring „presence" such as self assessment, behavioral measures and physiological variable that examine actions and manners exhibited by the users in response to objects or events, etc. (Insko, 2003). However, in order to address the complexity of the interpretation of presence as it relates to the design of virtual places, evaluation issues that are associated with the design and creation of virtual worlds are of research priority. In the design domain of large scale architectural virtual environments, Knight et. al.,(2003) in their work on the construction of a virtual university campus discuss and present issues related to the usage of naturalistic interface in testing the experience of presence in VR environments.

Since there are various design paradigms for virtual environments that have different objectives, as we have presented and demonstrated in this paper (task-based design, scenario-based design, performance-based , etc.) and since a good design can add to the success of achieving the sense of presence that users sense, there should be a particular way to evaluate presence in each approach. Good design is a design that allows users the type of interactions of a specific environment.

6. Conclusions

In exploring the suitability of novel design paradigms for the construction of virtual environments we have found that the concepts of form and content stimulate insightful innovation with respect to the potential of the design of virtual worlds. In design they offer a good point of departure for more experimentally-driven design approaches for virtual places as well as for imaginative exploitation of the virtual in order to create a sense of the hyper-real. In order to advance such developmental hypotheses of novel paradigms of design, the evaluation and measurement of the sense of presence in designed mediated environments has become essential.

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going research on design and presence in virtual environments.

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