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nAVRgate: GATEWAYS TO ARCHITECTURAL VIRTUAL REALITY

A review and thoughts on future directions

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Abstract: A core element in the success of a virtual environment is the ease and appropriateness of the navigation process. Navigation is a two part process which consists of a facility for enabling movement [Locomotion] and sensory input to aid the navigator in finding they way around [Cognition]. Our work has focussed on Navigation in Virtual Environments for Architecture and that work is summarised here.

1. Introduction

To aid navigation and representation in Virtual Environments many disciplines have chosen an architectural metaphor, such as buildings or urban settings. But what are the appropriate metaphors and associated devices for Architectural navigation and representation? This is a question that we have been addressing through the nAVRgate project in which AVR is a sub-acronym for Architectural Virtual Reality.

One aim of the nAVRgate project, which is now in phase two, is the development of a generic navigational metaphor, that incorporates a variety of natural locomotion methods. We initially developed an architectural VE using a commercially available and computationally efficient gaming engine and, began by using a bike for navigation. As an interface this was direct and effective and follows from the Legible Cities idea suggested by Jeffrey Shaw (1994).

nAVRgate-2 extends ideas developed in nAVRgate-1 (Knight and Brown, 1999) and brings together three strands of refinement:

1. New techniques for low-cost, natural and appropriate interaction devices have been developed.
2. Proposals on how the shortcomings of the software in nAVRgate-1, without the loss of computational efficiency, might be addressed have been investigated.

3. Ideas that have arisen from parallel work in the authors research group on the nature and differences in perception of architectural images in a computer mediated environment are being drawn in and added.

The work described here emphasises the Navigation aspect of our Virtual environment and in this respect Darken et. al (1998) note that:

> *Navigation must be seen as a process. We often make the mistake of seeing it as its end result – locomotion- navigations most visible attribute. However, the cognitive subtasks that drive locomotion…are an integral part of the overall task*

Inextricably tied to the requirements of navigation is the mental representation, the cognitive map, of our understanding of the environment. In architecture there is a legacy of visual representation in the real world that we should take into account in designing new virtual environments. Maher et. al. (2000) make the point:

> *Although architectural design is noted for the forms and places created, the semantics of these places lies also in their function. The functional aspects of physical architecture can influence the design of virtual worlds*

The initial intention in the nAVRgate project was to develop a low cost Virtual Environment where navigation was driven through natural and familiar forms of locomotion. The aim is to focus on experiencing the VE rather than learning the navigation method. To do this the interface must, very quickly become transparent. An initial desire was to open up the possibility of experiencing large-scale urban environments to an audience; that is with a large display area and wide angle of view. We have re-appraised some key research in this area and are now in the process of expanding the interface toolkit. Just as importantly, the sense of presence and connection with the VE should be strong. (Davies, 1998). The aim of the nAVRgate project is to achieve rapid transparency and sense of presence as suggested by Regenbrecht et.al. (2000).

Figure 1. nAVRgate bike in use

It is, though, easy to fall into the trap of assuming that natural locomotion is best most appropriate for virtual environments. So far we have found it to be very effective, but we need to be aware of "questionable assumptions concerning distance and direction estimation and maneuverability" (Darken et.al. 1998). In addition there are several pieces of work that show that spatial skills are not completely innate, (Carpenter and Just, 1986) and this has particular consequences when we consider designing virtual architectural environments; for architects and non-architects. There are other issues too. The importance of retaining a sense of orientation in a VE has been noted **(**Bridges and Charitos, 1997**)**. Furthermore, the problems of scaling and scalelessness in the locomotion through, and perception of, the virtual space need consideration; Loomis et. al. (1992) have shown that distance and direction estimation in virtual space were improved by adding proprioceptive information aids.

2. Controlling and Understanding Movement Though Space

There are particular spatial skills that aid us in navigation through three-dimensional virtual environments. Evidence shows that there is difference in spatial ability between individuals and genders (McGee, 1979), and this has broad implications. More specifically, research shows that skill in spatial manipulation and understanding can improve with practice and training (Carpenter and Just, 1986). Architecture is a very particular discipline; one where spatial abilities are developed and nurtured. Brown and Ryong (2000) have described and accounted for the particular cognitive skills that are developed throughout and architects training; and the consequences, in terms of appropriate representations and interfaces are expounded.

Secondly, related to this work, and in particular to consideration of the architectural image Brown and Nahab (1996) have shown that the value and perceived quality of an architectural scene is very dependent on the nature of the representation. Issues such as sketchiness, degree of photorealism and colour-monochrome rendering play a fundamental role in determining that perceived quality. In Virtual Environments, as with more conventional static representations, the nature of the rendered image (representation) surely plays a key role in generating an appropriate and successful ambience.

Conclusion

The nAVRgate system aims to respond to the higher expectations of users today brought about by the ubiquitous application of computer mediated interaction. Bill Mitchell (1995) described cyberspace "the new architectural promenade", but architectural representation in three dimensions has a history

that we can learn from and build on. Added to that, architects have particular needs and skills that developments, like the nAVRgate project, should seek to satisfy.

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