Working in Virtual Environments through appropriate Physical Interfaces

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The work described here is aimed at contributing towards the debate and development relating to the construction of interfaces to explore buildings and their environs through virtual worlds. We describe a particular hardware and software configuration which is derived by the use of low cost games software to create the Virtual Environment. The Physical Interface responds to the work of other researchers, in this area, in particular Shaw (1994) and Vasquez de Velasco & Trigo (1997).

Virtual Evironments might have the potential to be "a magical window into other worlds, from molecules to minds" (Rheingold, 1992), but what is the nature of that window? Currently it is often a translucent opening which gives a hazy and distorted (disembodied) view. And many versions of such openings are relatively expensive. We consider ways towards clearing the haze without too much expense, adapting techniques proposed by developers of low cost virtual reality systems (Hollands, 1995) for use in an architectural setting.

Keywords*: Virtual Environments, Games software.*

Introduction

The work described here involves the development of a system to investigate and interact with an Architectural Cyberplace. The idea of Cyberplace was proposed by Szalapaj and Filho (1997). In a Cyberplace implicit meanings associated with architectural design can be expressed at either "pragmatic or emotive" levels. The act of creating and working in such environments creates a range of contentious issues for debate. The nature of such systems generates a range of social, cultural, philosophical, practical and technical matters that have been, and continue to be, discussed in the contexts of environments for architectural investigation and exploration.

The social and cultural aspects involve the consideration of Nesses [otherness, groundedness, thereness (presence)]. In short Otherness is concerned with the absence, in virtual worlds, of (sometimes incongruent) aspects of reality and being a human in a real world. Matters relating to Groundedness are to do with balance, between, say the physical and the imagination. Thereness relates to how the human has a presence in the Virtual World; and that presence relates to both bodily and linguistic presence.

Our aim is to address and investigate a limited range of these issues by creating an environment which, put bluntly, might be cheap but effective. The environment involves the physical and the virtual. We describe how we created each of these aspects.

The virtual

It is a frequent criticism of conventional CAAD and rendering software that the time taken both for the creation and rendering of models is both overly complicated and time consuming. It is recognised by many [for instance, Brown and Horton (1990), Kurmann (1994), Brown and Simpson (1998) and Stellinwerff (1999)] that there is a need for better computer based conceptual sketchers and modelers. However this kind of tool is yet to become widely available.

Large-scale urban environments have been successfully modeled (e.g. Bourdakis, 1997) largely using VRML or proprietary software, but there are limitations to the range of applications suitable to this software approach. Most VR commercial systems concentrate on a personal immersion experience through the use of head mounted display. Whilst this has advantages in the concentration of both display and position tracking hardware in one unit, it is not conducive to a shared experience. So what do we want from an alternative means of creating a virtual world?

Some goals

The requirements for a Virtual Environment system for studio use could be summarised as:

- *Ease of group participation*
  In a presentation situation, it is vital that largest number of people can participate/ engage with the VE, a form of what Gibson described as a "consensual hallucination". This leads to the use of a large-scale projection system rather than other alternatives such as a head-mounted display or conventional monitor. The form of the projection could vary from the simple data projector to more complex three projector curved screen type.

- *Easy assimilation of the navigation method*
  Complex and confusing methods of moving about the model are counter-productive as the user will spend more time thinking about the controls than the experience of the model.
- *Rapid interaction and system response*
  A system that has a tardy response either in the method of control or in the display can cause frustration for the user. Whilst this can be the result of a system with inadequate power for the task in hand, it may also be the result of the expectation of the user used to the current standard of commercial games.
- *Communication.* In an ideal situation, the ability to be able to share the ideas or the experience of using a space in real time, not just to a group, but to a remote use or group of users is a distinct advantage.

Software

It has long been recognised that the area which is both the most demanding of software, and the area which has the greatest expectation from its users is that of games software design. Manufacturers spend large amounts on developing both hardware and software to satisfy this burgeoning market for first person view 3D games that run (in current terms) on a standard PC.

Several of these games now come with 'level editors' to assist the avid gamer in creating yet more fanciful scenarios in which to shoot ever more grotesque creatures. For student use, games such as these have distinct advantages over conventional CAAD software. Firstly, the gaming environment is in the majority of cases the software that they are most familiar and comfortable with, most likely having spent more hours with them than any other software. Secondly, this familiarity and realisation of what can be achieved can overcome the fear of using a more conventional CAAD program. We have looked at one of these games and its associated level editor to evaluate its use in a studio situation.

Figure 1 (right). Worldcraft editing environment
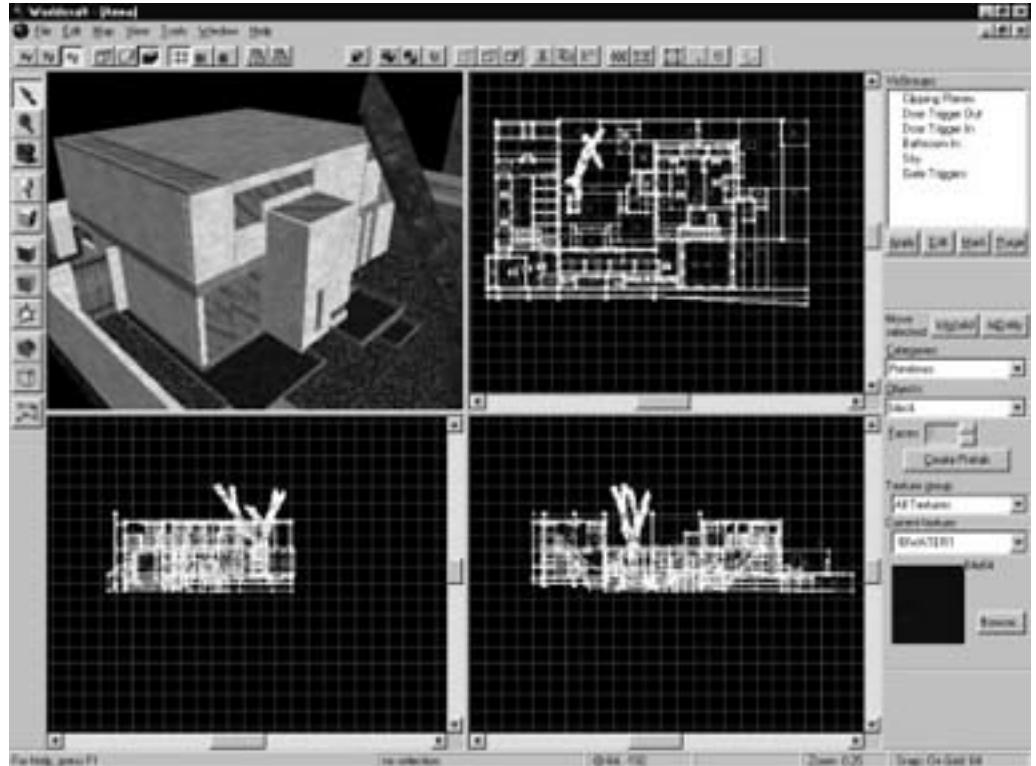
Many such games fulfil the requirements that are required for an architectural VE system, particularly of interiors. The navigation systems are designed solely with rapid response and, on an initial level, ease of learning. Games such as Quake and Half-life have dubious story lines and even more questionable morals, but from a technological viewpoint are very interesting. The main thrust of the advertising and development of these games is in the ever increasing 'realism' of the worlds (a dubious claim given that they are portraying alien worlds) they are portraying and the speed with which the user can interact with them.

Half-Life by ID software has been recognised as a game which has both good graphics (with a high frame rate and smooth movement) and atmosphere generated by good lighting effects and textures. It also has the advantage of being networkable and multi-player. Lighting effects are created by a separate radiosity program when the game is compiled. Games can be played across the internet with the networking being optimised for multiple users. Each copy of the software is a game server. These features have great potential for architectural use.

The method of moving around the VE is very simple, user definable and easily learnt. Moving in the X-Y plane is achieved (as you may expect) by moving the mouse forward and back, or side to side. Mouse buttons can be assigned to looking up or down. Many of the controls are not immediately applicable for architectural use, although they can be used to give a heightened sense of interaction. Controls for changing weapons are of more use when they are

reassigned to open a door or crouch down. With the most obvious relic of the game removed (the first person view of the forearm and hand holding a gun or other implement), Half-Life becomes a convincing architectural environment.

A further area which makes Half-Life stand out is the potential for the pseudo-intelligence of the creatures within the game. We have not investigated this yet fully, but there is the possibility for the use of 'intelligent' guides or assistants

Creating worlds in Worldcraft

The creation of is carried out in a method familiar to anyone who has used a 'conventional' modeling program such as 3D Studio Max. Objects are created by dragging out to the required size; textures are applied by dragging. There are some omissions from WorldCraft, some of these coming from the limitations of the game itself, rather than the editor. The most serious of these is the lack of any Boolean operations and true curves, which results in rather rectilinear or apparently pixelated environments. The gaming world is eagerly awaiting the latest version of Quake, Half-Lifes marketing rival, which is being toted as handling Boolean operations to give more variety to its worlds. Probably the most noticeable, and serious, omission for users familiar with other software is the lack of any import facilities which means that there is no option but to create the whole model from scratch in WorldCraft. This would be less of a problem if there was an easily understood scale, but the program uses an arbitrary unit unique to the game based on the grid unit visible in all the windows. In fairness, the modeler is only designed to be used with Half-Life, and once used is relatively easy to adapt to. As the model quickly become quite large, slowing the display, judicious use must be made of the facility to hide entities as there is no equivalent of layers. These factors may seem to describe an overly restrictive environment in which to work. With the exception of the lack of import facilities, these are soon forgotten. Half-life can link an unlimited number of worlds

together by means of 'portals' (similar to Quicktime VRs hotspots) which usually take the form of a door. Each world is only loaded when required. The loading results in a slight pause, but does enable apparently endless worlds to be created.

Once the world has been created, it can be viewed in the Half-Life after it has been compiled. This process is scripted by Worldcraft, the time taken dependant on the level of rendering required (i.e. draft for model checking or final for game playing). The time for compiling will obviously vary depending on the machine specification and model size, but one hour is not uncommon on a mid-specification PC.

Using HalfLife

Once compiled, the virtual world that has been created can be loaded into Half-life and viewed .The method of navigating the game is by default, mouse or joystick. For a screen-based presentation this is adequate, but for a projection system, a more naturalistic metaphor is required. A metaphor that links the user within the virtual environment will heighten the immersion experience.

The exercise bike was used as an initial attempt to provide both the experienced user and beginner with an object that was easy to relate to. The aim was to investigate both the efficacy of introducing a virtual environment into the studio, and the design of an easily learnt navigation tool. The bike, whilst not a new idea [A] is very well suited to an architectural use. By adapting more conventional hardware control devices such as a mouse, the bike can be used in any Windows application rather than requiring explicit joystick support from the target program.

With the control mechanism transferred to the bike the user can control movement in the virtual world, and the user regains some of the loss of "self-presence" that Shaw (1994) refers to. But then there is the nature of the image that the bike controls. This could be viewed through some kind of head set or could be screen based. But the work of Vasquez de Velasco and Trigo (1997) and Brown *et al.* (1996)

*Figure 2 (a) and (b) (right).
Views of the design modelled
in Half-Life*
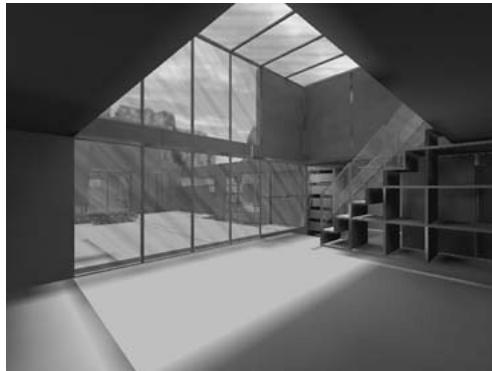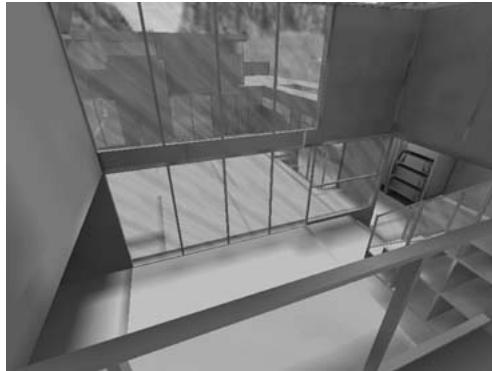
shows that, in an architectural setting, understanding and engagement with an architectural environment is enhanced by large image projection. Not only does this give the possibility of a shared experience but, perhaps more importantly, the senses of engagement and presence are improved. We feel that these are areas which merit more work in the future.

Feedback

We have used the configuration described above with a group of architectural students, all of whom had prior CAD experience. The scheme adopted was for a small house, the client of which was another student in the group. Each of the houses was to form part of a terraced street. It involved each student in being not just a designer, but also a client. Each of the students produced a final presentation that was a Half-life world with varying degrees of success.

The response from the observing architectural critics was largely positive when discussing the real-time interaction with the designs. It was also interesting to note the effect that it had upon their design processes. Two used the software to test their design expectations and developed them according to their experiences. It was the opinion of the students that the use of Worldcraft and Half-Life had predictably led them in directions which they would not have taken them in a 'conventional' design process. The reaction from the students concerned was that they had a greatly heightened sense and perception of the spaces that they were creating.

One of the interesting outcomes was that one student used the software only for the presentation. This particular student initially developed the design conventionally, but then built his completed design in Worldcraft, in the end using this as both the design development and design presentation environment.

The anecdotal feedback from others who saw the presentations was also as they felt that it gave a heightened spatial experience, even though at this point, the presentations were on a conventional computer monitor.

Conclusion

The use of low cost gaming software proved to be successful within this albeit limited application and the limitations, primarily caused by its gaming origins, did not prove an insurmountable barrier. On a more ambitious scale of design scheme (or with students of a more free-form persuasion) the result might have been different with the Worldcraft editor proving to be to be restrictive and confining. On the other hand the same students would have found similar problems with most other conventional CAD or modelling applications. The interactivity that the designers found with the virtual environment helped their design process, but it would have been considerably more

useful if there had been a more rapid updating of the VE with the design in progress.

It is in this area that we are now steering our research. With the use of more powerful creation and viewing software, we will be able to update the VE directly from the modelling program without any intermediate compilation. We are continuing to develop interface metaphors in a number of areas that will allow particular and more focussed investigations to take place.

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Notes

[A] Jeffrey Shaw used the bike as an interface to the installation, "Legible City".

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