Computer Game Technology as a Tool for Participatory Design

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This paper reviews existing research into real-time visualization in architecture, urban design and landscape architecture and describes a University of Lincoln project exploring the application of this technology to participatory design. Staff at the School of Architecture have used 'Virtools Development', a computer game prototyping package, to help residents in Hull, UK, to visualize and interact with a design proposal for a 'home zone' in their neighbourhood, arrived at as part of a wider participatory process. This paper evaluates computer game technology in relation to more conventional participatory tools. It is difficult to justify using the technology to create simple 'walk-through' simulations of design proposals, it argues. In such cases, the benefits real-time visualization offers over non-interactive video are largely outweighed by the technical difficulties involved in the production and use of real-time environments.

Keywords: *Computer games; real-time visualization; landscape architecture; public participation*

Introduction

The technology behind the 3D game engine has been in existence for well over a decade and the computer games industry itself is now well established and highly successful. While the industry is often praised for its successes, more often than not, computer games are seen in a negative light – a form of entertainment that glorifies violence and encourages anti-social behaviour. Today's computer games offer a level of detail and realism that leaves little to the imagination. 'Soldier of Fortune', a popular 'first-person-shooter' game, allows the player to target individual body parts and graphically depicts the dismemberment of unfortunate virtual characters. This kind of violence is not exclusive to computer games, it can equally be found in other forms of entertainment, from children's cartoons to major motion pictures. So why do games provoke such public outrage? It is the interactivity within the virtual world of the game that sets it apart from film and television and has made the industry a particular focus of attack – the power computer games have to engage the player as active participants in the narrative rather than as passive observers. The body count rises as players learn to apply skills of hand-eye coordination, logic, memory, visualization and problem solving.

Ironically, this skill-testing character of the game environment, developed to engage players in acts of creative destruction, means that the technology is also highly effective when put to more constructive uses. The fact that the US military used 'Doom' – an early first-person-shooter game – to train soldiers to kill is often repeated in the popular press (Wood, 2002; Radford, 2000). Increasingly, however, people outside the games industry have begun to see how games technology might be applied in fields with more obvious social benefits. Education is one area where businesses have sought to exploit the potential of computer games. For example, Immersive Education, a UK new-media company, has created a learning tool called MediaStage with a game engine at its core. Students can bring classic texts and historical narratives to life using the software to create role-plays, performances and scenarios in a real-time, virtual environment (www.mediastage.net: June 2004). Real-time graphics engines are also being used to train medical practitioners in surgical procedures (Sakas, 2002). Errors are less of a problem when virtual models are used instead of live patients. The growing interest in digital media and real-time visualization within the heritage industry has given rise to a whole new field of activity known as 'virtual heritage'. Here game engines are being used to reconstruct archaeological sites, ancient settlements and even whole cities (www.virtualheri tage.net: June 2004).

This paper describes a University of Lincoln research project exploring applications of computer game technology to participatory design. Staff at the School of Architecture have used 'Virtools Development', a computer game prototyping package, to help residents in Hull, UK, to visualize and interact with a design proposal for a 'home zone' in their neighbourhood, arrived at as part of a wider participatory process. In order to set the aims of this project in context, the paper begins with a brief review of the concept and practice of participatory design and then moves on to examine existing research into applications of games computing to visualization in architecture, urban design and landscape architecture.

The theory and practice of participatory design is well established in the architecture and planning professions, dating back to the 1960s and 70s when pioneers like John Turner, Lucien Kroll, Rod Hackney and Ralph Erskine first began to extol the benefits of user involvement in the design process (Towers, 1995). In the UK, after a period of decline in the late 1980s and early 90s, the field has been given new impetus by changes in urban policy endorsing the notion of community involvement in the physical renewal of cities. Many architecture and planning practices have capitalised upon this new trend and are offering a range of community consultation services to public and voluntary sector clients alongside more standard planning and design services. In addition, there is a growing body of literature examining tools and techniques that can be used to promote public participation in architecture, urban design and planning (Wates, 2000; New Economics Foundation, 1998; The Architecture Foundation, 2000; Driskell, 2002; Sanoff, 2000; Gibson, 1995).

Most of this literature is concerned with practical strategies for employing manual tools, like drawing, physical modelling or interactive displays, to be used in 'face-to-face' situations such as design workshops and public exhibitions. However, recently, academics have begun to explore applications of digital media to participatory design. There are several published examples of interactive websites and geographic information systems (GIS) being used to support urban design and planning initiatives (Kingston et al, 2000; Batty, 2001). The application of virtual reality and games computing to participatory design is an interesting and very recent development. Virtual models based upon computer game technology can be used to help non-professionals visualize potentially confusing paper-based plans and drawings, literally allowing them to 'walk through' and interact with designs in three dimensions and in real time. However, exciting as these new developments may be, research into applications of digital media in participatory design is still quite limited. There are very few practical studies looking at applications of real-time visualization to user participation in any of the built-environment professions. In architecture, established theory and practice still does not address everyday digital media, such as digital video, internet polls and web-based discussion forums. Current debates about digital media and public participation are focused primarily on urban design and planning.

Architecture is an area where one might expect to see widespread experimentation with computer game technology. There is a clear overlap between the skills of the architect and the games designer. Game designers and modellers spend much of their time imagining and constructing architectural environments, while today's architects must gain extensive skills in computer-aided design and 3D visualization. It is widely acknowledged that the games industry draws upon the architectural profession for expertise. However, there has been very little movement of people or knowledge in the opposite direction. It is surprising how few published studies there are of real-time visualization in architecture. Most of the literature on this subject is found in the trade press rather than in peer-reviewed, academic journals, it is anecdotal and full of large claims based on little real evidence.

Paul Richens, a lecturer at Cambridge University's Department of Architecture, has used the Unreal game engine, a commercial, first-person-shooter game, to construct a real-time virtual model of RMJM Architects' design for the University's new computer laboratory. He sees games software as "a highly effective architectural tool" pointing to multiplayer online interaction as a particularly useful way to involve clients and potential building users in the evaluation of design proposals (Richens, 2000; Weaver, 2000). Yet he provides little or no information about how the architects, the clients or the building users engaged with the software. Murray Fraser, Professor of Architecture at the University of Westminster, has collaborated with Halli Bjornsson in the development of Cadai, a real-time modelling and visualization package aimed at architects. Fraser represents real-time visualization as an "open, democratic technology", arguing that it has the potential to empower architects, building users and clients alike (Littlefield, 2003). But again there are no related studies of users' engagement with the software to support this claim. In fact, a recent article in Building Design seems to contradict the claim that Cadai is empowering for architects. It describes how the architecture and planning firm RTKL felt it necessary to hire a team of games designers to construct its Cadai model of a business park proposed for Warrington, primarily to avoid "the architect's temptation for photorealism" which would have made the model unworkable (Littlefield, 2004).

Games engines tend to operate more effectively when used to visualize building interiors as opposed to urban landscapes. Notwithstanding this fact, there seems to be more experimentation with games computing in urban design and landscape architecture than in architecture itself. RTKL's model was constructed to illustrate a masterplan rather than an individual building. Arup Associates has developed its own city modelling software based on game technology to allow planners, developers and local people to evaluate proposals for the redevelopment of Ancoats urban village in Manchester. They believe this kind of city modelling will be used more widely in the future to speed up the planning approvals process (Mabey, 2004). The Teesside Virtual Reality Centre in the UK has produced real-time visualizations of several urban projects using Multigen-Paradigm's Vega software. Projects include a housing refurbishment and urban landscaping scheme in South Bank, Middlesbrough, as well as a proposal for new housing and shopping facilities in the Drumchapel area of Glasgow (www.vr-centre.com: June 2004). The Centre maintains that virtual reality offers a highly effective means of engaging communities in urban regeneration initiatives. But, as with most of the projects already mentioned, it is difficult to find any published studies supporting such claims.

Some studies have been published in this area by researchers outside the UK, most notably at Osaka University. Professor Tsuyoshi Sasada has experimented with virtual reality systems in environmental design, exploring different hardware and software solutions to support collaboration between professionals and city inhabitants concerned with the revitalisation of a retail district in U city Japan, and between academic researchers and environmental designers involved in the redevelopment of parkland sports facilities in Taiwan (Lou, et al., 2003; Fukuda, et al., 2003). While most other researchers have built simple 'walk-through' simulations, Sasada has constructed software that allows users to compare multiple design options and to make design changes interactively. Unfortunately, he provides very little information about how users responded to the software, concentrating instead on describing the interactive features his team created and the different steps involved in producing the software. While Sasada's work does answer some practical questions about how real-time environments can be constructed and configured to engage non-professionals more directly in design decisions, it says nothing about how the technology should be employed within a more broad-based, structured process of participatory design.

Building and landscape design is a complex, creative practice with many different dimensions, aesthetic, environmental, social and economic, and many different stages, from brief formulation and concept development to detailed design and construction. Consequently, successful strategies for user participation in building projects are also necessarily complex and dynamic. As Nick Wates points out, there is rarely a single "quick fix" tool or technique that can address all dimensions of the design process or meet everyone's needs. Considerable care must be given to the planning of participation strategies in every situation, with different tools being combined, sequenced and adapted to meet the varied interests and abilities of users and to build momentum in user involvement throughout the life of the project (Wates, 2000).

Looking at the full range of digital media used to promote public participation in architecture, planning and urban design, it is apparent that investigations have not been sufficiently grounded in participatory design practice to determine how such tools should work in combination with more conventional participatory techniques. For the most part, studies have been carried out by IT professionals or by designers whose primary interests lie in the application of IT within their own disciplines, rather than in the practice of participatory design. The result is that digital tools have not been tested in the context of realistic, structured processes of user participation. They are usually examined in isolation from other manual tools and techniques or simple comparisons are drawn between one digital tool and a supposed manual counterpart (Kingston et al, 2000) or complementary technique (Al-Kodmany, 2000).

Imagine a situation where your own neighbourhood is to be redeveloped, new buildings erected and some homes to be demolished, perhaps your own home. Imagine a process of community participation where your only opportunity to influence decisions being made about this redevelopment is to engage with a computer game. Clearly it makes very little sense to claim that games computing has a useful role to play in participatory design without considering how this technology supports and is supported by more conventional participatory tools, like drawing and physical modelling, and by events like design workshops, public meetings and exhibitions where professionals and non-professionals can negotiate decisions through dialogue. It is in this light of these considerations about the wider context in which participatory design initiatives take place that staff at the Lincoln School of Architecture have structured the following questions about the use of digital media.

At what stages and in what aspects of the design process are digital tools best employed to enhance user awareness and understanding of design problems and user involvement in decision-making?
How effectively can digital tools enhance user participation when employed in different settings, such as public exhibitions, dedicated public-access computer terminals, and the world wide web?
What are the benefits of combining digital media with more conventional, manual, participatory tools and techniques?
What benefits can digital media contribute to user participation in design that cannot be provided by traditional tools and techniques?
To what extent is participant control over the production and use of a tool a factor in its success and how does the technical complexity of a digital tool impact upon user participation?
How are different social groups empowered or disempowered through the use of digital media in the context of participatory design?
How do different graphical and representational approaches in the design of digital tools impact upon their legibility and utility for non-professionals?
Can effective interactive, digital tools be constructed using commercially available equipment and software that is accessible to participatory design practitioners?
How easily can participatory tools based on digital media be replicated?

These questions form part of a long-term research agenda at the University of Lincoln and underpin ongoing investigations into a wide range of digital media, including interactive websites, web-based GIS and digital video, as well as computer game technology. The University is uniquely placed to progress this research agenda. It has one of the few postgraduate architecture programmes in ‘Participatory Design’ in the UK, considerable expertise in new media and games computing and an established track record in participatory design consultancy.

The Albany Street home zone project

In 2002 the Lincoln School of Architecture was commissioned to design the Albany Street Home Zone, a £450,000 urban landscaping and traffic-calming scheme in a residential area of Hull in the UK. Home Zones are residential streets where pedestrians and cyclists take priority over motor vehicles and physical obstructions like planting and seating are used to slow traffic to walking pace. They are quite common in other European countries, but are relatively new to the UK. The Albany Street Home Zone was a demonstration project, part of a larger central-government programme to promote the uptake of home zones by local authorities across the country. The government identified public participation as a high priority in this initiative, and required local authorities to demonstrate active involvement of community members at all stages of the project, from the compilation of the original bid for funding, through to the design and evaluation of the project. Albany Street was selected for inclusion in the home zone programme primarily because it had a highly active residents’ association and a low level of car ownership.

Methodology

The Albany Street Home Zone was managed by a partnership group, which included representatives from the local residents’ association, local landlords and City Council officials. The partnership group compiled a project brief, which allowed one year for the production of the design and related community participation. The University proposed a three-phased approach to participation in the project. The first phase was concerned with awareness raising, familiarizing residents with the home zone concept, design problems they must deal with and relevant design precedents. The aim was to provide people with as many choices as possible and build a consensus around a limited number of options for different elements of the Home Zone before work began on a unifying design. The techniques employed during this phase of the project included a public exhibition, door-to-door interviews with residents, a children's photography workshop and community trips to view similar projects elsewhere in the country. An interactive website was also created. This was an important digital tool; it not only provided general information about the project, but also included a discussion forum and an online 'digital catalogue' where residents could 'vote' for different design features. Local people who did not have access to the internet could use a dedicated public access computer terminal that was set up in a temporary office on the street. The office also served as drop-in facility for residents and a base for project meetings and events.

The second phase of the project saw the creation of a preliminary design for the scheme as whole. Most of the creative activity took place in design workshops. However, some additional supporting events were organised around the workshops. In particular, visiting experts were invited to deliver seminars on key themes previously identified as priorities by residents during the house-to-house interviews. Topics included ‚design against crime', parking, planting and artwork. In the first design workshop, small groups of participants collaborated with the project architect to develop some very basic design ideas. They sketched and modelled their ideas in clay on a large-scale plan of the street. The architect worked up an initial design proposal based on these ideas and the results of earlier consultations. This proposal was gradually refined in response to suggestions made by participants in subsequent workshops. The second phase of the project culminated in a street party and interactive exhibition where residents responded to the preliminary design in greater numbers. During the last phase of the project final modifications were made to the design using information gathered during the exhibition and the results of further consultations with the emergency services and other public service providers.

Computer game software was employed during phase two of the project. Two postgraduate design students began working on a real-time model of Albany Street at the beginning of this phase, constructing the individual houses that would form the backdrop to the landscape design. One had a background in interior design and the other in civil engineering. Both were highly proficient in the use of AutoCAD and 3D Studio Viz/Max. In fact, the civil engineer worked as a university lecturer in her one country and was responsible for teaching CAD modules using both software packages. Since the University of Lincoln runs an undergraduate course in Games Computing, students with training in real-time modelling could have been used instead. But one of the aims of the research was to discover how easy or difficult it would be for built-environment professionals to construct an effective, real-time environment using skills they already have in high resolution modelling. Very few architects have any experience of real-time modelling, but many have extensive experience of 3D Studio Viz/Max, which is the software most widely used by games designers to construct real-time models. The students also had to learn to use the computer game prototyping package, Virtools Development. Virtools was chosen because it allows designers to assemble models and add the interactive features necessary to the virtual environment without any programming or scripting skills. Complete models can be imported from 3D Studio Max with textures and lighting already set up and interactivity can be added through a simple drag-and-drop interface. University staff with experience of games computing monitored the students' progress in creating the real-time environment. The fact that the students were paid by the hour also introduced some real budget restrictions, alongside the time constraints given by the project schedule.

The intention was to use the virtual environment created by the students as a working model, adapting and changing it between design workshops as participants developed their ideas. It was hoped that the model would provide a basis for collaborative experimentation in the workshop setting and gradually be worked up into a final design. A first-person-perspective camera was chosen as the model viewpoint so that participants could get an impression of what it would be like to 'walk through' the scheme. A laptop computer was considered the best means to view the model since participants could easily access a mobile computer alongside other media to be used in the workshops, like large-scale plans, photographs, modelling clay and paper and pens for sketching. A USB mouse attached to the laptop acted as the controller for camera movement. The availability and cost of the hardware used was another important research consideration. Laptop computers are relatively cheap and are now a standard accessory for most design practitioners.

The virtual model was also intended for use in two other settings, in the public exhibition at the end of phase two of the project, and in the everyday office context, for viewing on the public-access computer terminal. The phase-two exhibition took place outdoors on the street itself, allowing the office to be given over entirely to displaying the model. The office windows were blacked out, a data projector was attached to the laptop and one wall of the room was filled with a projection of the virtual environment. Ambient sound effects were also added to the software at this point. The fact that the entire office was used as a display space meant that large groups, up to about twenty people at any one time, could view the virtual model simultaneously. Again all of the equipment used was relatively cheap, widely available and likely to form part of the toolkit of many design practitioners.

It was expected that some flexibility would be required in the application of the proposed research methodology. The virtual model was to be employed in the context of a live project, structured by a broader participatory process that was intended to be dynamic. Consequently the methods used were necessarily qualitative, context bound, and subject to change. The most significant change in approach concerned the use of the virtual environment as a working model. The learning curve for the students was very steep and they found it difficult to produce successive iterations of the model to coincide with the schedule of design workshops. The problems they encountered were primarily due to the technical complexity of the real-time modelling process. At this point it is worth explaining the some of the key differences between 3D modelling as normally practiced by architects and other designers and modelling for real-time visualization.

Production of the virtual environment

High-resolution models generally rely on geometry for detail and are normally constructed using hundreds if not thousands of separate geometric objects. Textures are used primarily to communicate materials and colour. A single high-resolution model of a building might contain hundreds of textures of different sizes, proportions and colour depths. The computational load involved in this form of visualization means that rendering a single image of such a model could take several minutes. Real-time game engines must produce at least twenty-four separate rendered images of the virtual environment every second in order to maintain the illusion of movement. This means that the geometry cannot be very complex, individual objects must be constructed using a very simple mesh of polygons and scenes should be composed from as few objects as possible. The level of perfection in geometry is also important as errors such as open meshes or coincident surfaces can lead to instability in the game engine. Textures are used to simulate detail which cannot be portrayed using geometry. However, textures used must be few in number and conform to some very strict rules regarding sizes, proportions and colour depth. Most game engines share common restrictions based upon the specifications of hardware manufacturers. Generally speaking, textures must be of sixteen or twenty-four bit colour depth, they should be square and the pixel dimensions should be to the power of two, for example 512 by 512 pixels. Models are usually constructed by editing object meshes at polygon level. The UVW coordinates of each piece of geometry must also be manipulated manually to ensure that two-dimensional textures wrap precisely around corresponding three-dimensional objects. To conserve the amount of memory the game engine uses when rendering a scene, textures and geometry should be repeated within the scene wherever possible.

The real-time visualization of Albany Street was assembled from only fifteen separate models of different house types found on the street. These were then repeated within the virtual environment to give a convincing, although not entirely accurate street scene consisting of approximately one hundred houses in all. Each house was constructed as a single geometric object in 3D Studio Max and all of the different materials that form part of the house were combined within a single square texture. The textures were created from photographs of actual houses on the Street. The UVW coordinates of each house modelled were unwrapped in 3D Studio, a process akin to flattening a rather complicated cardboard box. The unwrapped model coordinates were used as templates to create the textures in Adobe Photoshop and these textures were then mapped onto the geometry in 3D Studio. It was originally intended that the students would use AutoCAD drawings produced by the architect after each design workshop as a base from which to create a continually changing real-time model of the landscape design. However, even before the first workshop took place, it became clear that this approach was not possible.

University staff constructed a single model of a house and its associated texture to demonstrate the real-time modelling process to the students. When they first saw the model the students were extremely confident that they could replicate the process and complete all of the models necessary to construct the first virtual environment in less than three weeks. After three weeks of constant work the interior design student had completed one house correctly and the CAD tutor had given up in sheer frustration. Real-time modelling is a very disciplined skill and requires a tremendous amount of patience. The procedures followed are also very different from those involved in creating high-resolution models. Editing meshes at polygon level, manipulating UVW coordinates point-by-point, creating complex textures in Photoshop, these were entirely new skills for both students, and they found that their existing knowledge of high-resolution modelling was of little

Figure 1
The modeling process. A low polygon mesh of an Albany Street house, the related texture and the final model.

advantage in the learning process. In fact sometimes it was more of a hindrance. For example, both students kept building overly complicated models, using multiple objects and more geometry than strictly necessary. Modelling errors were another serious problem. University staff used an STL testing routine to check completed models for errors, open meshes or coincident surfaces. In the first three weeks the students would present models that looked perfect but when tested would show multiple errors. Often, low polygon models of no more than four hundred polygons would be found to have over one hundred errors. Students would then be asked to reconstruct the model from the beginning. It was in the face of repeated failures like this that the CAD tutor eventually gave up.

Even when the interior design student had eventually mastered all of the procedures necessary to create real-time models, it still took him more than one and a half days to build each of the houses used in the virtual environment. The student's difficulties were further compounded by the nature of the design that emerged from the first workshop. The road surface was defined by a highly complicated organic pattern of different materials. A decision was made to construct the pattern using a series of separate but interlocking geometries. This meant the virtual environment was very efficient in terms of the computer memory it required, but it made it very difficult to change. Given the difficulties the students experienced in constructing real-time models and the likely time and costs involved in continually updating the virtual environment, University staff decided to abandon the idea of a working model. Instead, output was restricted to a single model of the home zone scheme reflecting the design as it existed just prior to the last workshop. This meant that participants would still be able to view the virtual environment as a 'design in progress' within the workshop setting and residents in general could still respond to the visualization during the public exhibition.

Application of the virtual environment

The virtual model of the street was well received by participants attending the last design workshop. Initially it was treated as an occasion for 'play', as residents took turns to 'walk through' the virtual environment using the mouse. However, several workshop participants chose not to engage with the software, preferring to watch others manipulate the model instead. Interestingly, after the model was introduced and work began on solving specific design problems, none of the residents chose to interact directly with the software, but encouraged university staff to manipulate the controls instead. It is difficult to say how much this problem reflected participants' reticence in regard computer technology in general and how much it was caused by the specific controller used. The camera-mouse control function was a default feature available in Virtools. It was not particularly intuitive, and generally required some prior explanation and one or two minutes of practice before participants were able to manipulate the model effectively. It is worth noting that individual residents who viewed the virtual environment on the public access computer in the office subsequent to the workshop were equally reluctant to operate the controls.

Notwithstanding participants' reluctance to use the software directly, it still proved useful in addressing many of the questions they had about the design proposal. It was evident from earlier workshops that participants had problems understanding the plans produced by the architect. Often, they were unable to distinguish between lines indicating changes in surface pattern and those indicating changes in level. They also found it difficult to interpret dimensions. Previously the architect had to work hard to explain aspects of the drawing verbally or by improvising sketches. In comparison, participants had no difficulty interpreting the virtual environment. Variations in level and pattern were easily perceived. One resident commented that she had never really understood what the pattern on the road would look like until she saw the virtual model. Participants also had little difficulty interpreting relative dimensions. For example, the width of the footpath did not arise as a potential problem when participants were shown plans of the street. But when they were shown the virtual model for the first time several participants commented that the footpath looked far too narrow and suggested that it should be widened. The software also proved helpful when used in conjunction with the plans. Often, participants made enquiries about a particular point on the plan and then asked the university staff to locate this spot in the virtual model. The plan was a more precise representation of the design proposal than the model and could be used as a basis for accurate measurements. However, the model enabled participants to visualize the plan in three dimensions.

In the workshop setting, the virtual environment was viewed by no more than ten participants at any one time. These were all adults in their thirties or older and all of them had some experience with computers, in their work environment if not at home. When the model was displayed during the exhibition it attracted a much larger and more diverse audience, children, teenagers and adults, some with considerable experience of computers and some with little or no experience. Once more, the residents were clearly impressed by the virtual environment. Large groups of residents, sometimes up to twenty people at a time, stood in the darkened room in total silence, apparently transfixed by the projected image. Individual residents had to be encouraged to speak and to manipulate the virtual model using the mouse. While the assembled audience was happy to view and ultimately to comment on the visualization, none of the adults present were willing to control the software. Again, it is difficult to say how much this was caused by the specific controller used. Onlookers could not discern how to operate the control functions merely by watching others manipulate the model. Users had to be instructed and had to practice for one or two minutes while the rest of the audience watched, a potentially embarrassing situation that was clearly off-putting. Children and teenagers were the only ones who did not seem to mind engaging directly with the software. However, they tended to look upon the virtual environment solely as an opportunity for 'play' and quickly became bored when they discovered all they could do was walk up and down the virtual street. When pressurised to use the controls, several of the adults asked if we could 'let the programme run by itself' instead. In the end a member of the University staff manipulated the model randomly as well as responding to specific directions from onlookers.

Interestingly, people frequently asked for the model to be reoriented so that they could see their own houses, but they had to be told this was not possible. The repetition of house models within the virtual environment meant that it was not an entirely accurate representation of the street. However, Virtools allowed for the creation of models of extraordinarily high quality, which meant that the street scene as a whole was very realistic, a somewhat paradoxical situation which was clearly significant in how users ultimately interpreted the software. Another difficulty encountered during the exhibition was in the relationship between the setting for displaying the virtual environment and the other participatory tools used. The exhibition itself was a freestanding wall six-metres long and two metres high. This wall consisted of several presentation panels many of which required interaction from users. For example, residents could record their views about different features of the design by writing comments on 'post-it notes' and placing them next to an image of the feature in question. The images were prints of captured screenshots from the virtual model. The fact that the virtual environment was displayed in the office and the interactive exhibition was located outside on the street meant that comments made by residents when viewing the display could not easily be recorded. This is symptomatic of a deeper problem with the virtual environment as it was originally conceived. Unlike many of the other manual tools used in participatory design initiatives, the virtual model offered a largely one-way system of information exchange. It was set up primarily to provide information to participants, not to accept and store information given by them.

Conclusion

It is clear that the real-time visualization of Albany Street made a useful contribution to the participatory process, enhancing participants' understanding of design problems in all three settings where it was tested. The benefits derived from the software could not easily have been replicated by manual participatory tools. Static perspective drawings cannot communicate space as a sequence of events in time. However, it is not clear that the software offered any obvious benefits over digital video, particularly when the time and expense involved in constructing the real-time environment are taken into account. The one key difference between real-time visualisation and the high-resolution video 'fly-throughs' that many architects produce is the element of interactivity. The user decides the pathway the camera will take as opposed to the route being predefined by the architect. But in the case of the Albany Street Home Zone, users were generally reluctant to take control of the virtual environment. It may be that future experimentation with the control device will improve upon this situation. If nothing else, however, this project should encourage researchers to question applications of game technology designed merely to facilitate simple 'walk-through' simulations of design proposals. Simulations of this kind actually

Figure 2
A screenshot from the real-time visualization of the design proposal for the Albany Street Home Zone.

offer a very low level of user interaction compared to many traditional participatory tools and, aside from the basic directional input from the user, do not allow for two-way exchanges of information. Given the flexibility of packages like Virtools, the game environment could be set up to receive as well as provide information, such as sound, text or images. But, this would require some programming ability, a skill beyond the average design practitioner. In this respect at least, a simple participatory tool like the 'post-it-note board' offers some clear lessons; it can both receive and give information, in as much as participants can read notes left by others as well as placing notes themselves, and it can be built and used by anyone with relative ease.

References

Al-Kodmany, Kheir: 2000, 'Public Participation: Technology and Democracy', Journal of Architectural Education, 53/4 (May): 220-228.

Batty, Michael (2001) 'Models in Planning: Technological Imperatives and Changing Roles', Journal of Applied Earth Observation and Geoinformation, 3 (3): 252-266.

Driskell, David: 2002, Creating Better Cities with Children and Youth: A Manual for Participation, Earthscan, London.

Fukuda, Tomohiro, Ryuichiro Nagahama, Atsuko Kaga and Tsuyoshi Sasada: 2003, 'Collaborative Support System for City Plans or Community Designs Based on VR/CG Technology', International Journal of Architectural Computing, 4 (1): 461-469.

Gibson, Tony: 1995, 'The Real Planning for Real', Town and Country Planning, (July) 187-189.

Kingston, R., S.Carver, A.Evans & I.Turton: 2000, 'Web-Based Public Participation Geographical Information Sustems: An Aid to Local Environmental Decision-Making', Computers, Environment and Urban Systems, 24: 109-125.

Mabey, Simon: 2004, Making Virtual a Reality, Sustain, 5 (3), p. 28.

Radford, Tim: 2000, Computer Games Linked to Violence, The Guardian, April 24, p.8.

Wood, Gaby: 2002, The Comfort of Joysticks, The Observer, May 19, p.6.

Towers, Graham: 1995, Building Democracy: Community Architecture in the Inner Cities,UCL Press, London.

Littlefield, David: 2003, Playing with Games, Building Design, May 23, pp. 20-21.

Littlefield, David: 2004, Game Plans, Building Design, June 18, p. 26.

Lou, Cheongwai, Atsuko Taga, Tsuyoshi Sasada: 2003, 'Environmental Design with Hugh Landscape in Real-Time Simulation System', Automation in Construction, 12: 481-485.

New Economics Foundation: 1998, Participation Works: 21 Techniques of Community Participation for the 21st Century, New Economics Foundation, London.

Richens, Paul: 2000, Playing Games, Digital Creativity, 11 (3), pp. 156-60.

Sakas, George: 2002, Trends in Medical Imaging: From 2D to 3D, Computers & Graphics, 26 (4), pp. 577–587

Sanoff, Henry: 2000, Community Participation Methods in Design and Planning, John Wiley, London.

The Architecture Foundation: 2000, Creative Spaces: A Toolkit for Participatory Urban Designers, The Architecture Foundation, London.

Wates, Nick: 2000, The Community Planning Handbook, Earthscan, London.

Weaver, Matt: 2000, Cad Plays with Game Technology, Building Design, Oct 27, p. 8.