Implementation of Real-Time Landscape Visualisation for Planning Process

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1 Introduction

Recently, there has been a great deal of interest in new communication technology in planning processes. Particularly, the popularity of three-dimensional visualisation media is increasing in many countries with the benefits of extensive participation capabilities, enhancement of communication and efficiency of data management. The fashion of the adaptation is due to the reaction to traditional two dimensional communication methods; maps and plans, which possesses fundamental deficiencies for a three/four-dimensional world.

So far, a number of studies refer to the attempts of the planning implementation of three-dimensional visualisation within the planning process (Appleton et al., 2001, Orland, 1992, Sheppard, 2001). Particularly, some researchers amongst them employ real-time rendering technology and they have drawn attention to the great potentials of interactivity of public engagement.

Contrasting those advantages, some disadvantages of acclimatising this technology in planning have been identified; Lange claimed (2001) that three-dimensional visualisation was not properly implemented with the planning process, it is used just as an expensive supplement to sell the final planning project; it also pointed out (Sheppard, 2001) that there was a risk of using three-dimensional visualisation; potential manipulation, which could misleading.

There is no exception to implementing the new communication media in the planning process in the UK; however, the few have considered the potential role of the technology in conjunction with the planning context.

The paper aims to identify the implementation of real-time visualisation in the planning procedure and decision-making process under the discretionary planning system. Moreover, it discusses the further possibility of the fast growing but ambiguous use of the visualisation media as decision-making and public communication tools in the planning process.

In order to testify this usage of real-time visualisation within planning, a case study was carried out in conjunction with a local planning authority in North East England. The area used in the case study is Windlestone Hall School, County Durham and the interactive visualisation of the relocated school is implemented in the community consultation process. The experimental process involved the following:

1. the development of a real-time three-dimensional model of the school and the area,

2. the development of an interactive interface of the visualisation for users,
3. the interviews with planners and visualisation preparers,
4. the observation of decision making process of the new school location, and
5. the observation of level of influence of the used media on the process.

2 Identifying Issues

There are several issues that must be addressed to determine the suitability of using real-time technology as a communication medium in planning decision-making process including: the potential risk of biased or misleading into level of detail; cost; and the various planning stages to be used. These issues have been identified in literature review and prior interviews with planners and visualisation preparers.

2.1 Potential Risk of Biased or Misleading Information

A recent survey (Appleton, 2001) suggested that value judgement would always be present, and parts of the image would be selected and set up to show the scheme to ITS best effect. While this could be presumed artistic licence, there are further questions of intentional incorrectness in visualisations, for example to reduce the apparent impact of a proposal.

In the UK, visualisation guidelines for other similar techniques can be often found. For example, using 50mm focal lens is standard in picture presenting and photomontage illustrations. The Landscape Institute has also published the 2nd version of Visual Impact Assessment Guidelines in 2004, which gives recommendations and requirements on usage of computer-based techniques such as visibility mapping, GIS, photomontages (Landscape Institute and Institute of Environmental Management and Assessment, 2002). However, in case of three-dimensional visualisation in planning, there is little framework and guidelines to safeguard agaist technical and ethical misuse of technology in planning and consultation in the UK neither in government bodies nor by professionals.

On the contrary, it was claimed that virtual realities might be exceeding the expansion of the knowledge base of research needed to prevent situations where unintentionally or intentionally misleading virtual environments are used to make significant environmental planning decisions. If such misleading situations arise, there must be processes and solutions for assessing the role of the visualisation technique versus the visualisation developer (Orland et al., 2001).

2.2 Virtual Reality

Since V.R.'s definition is generally agreed on (Hall, 1990) as ‘creating an experience that is indistinguishable from the real experience; generating the same stimulus as the real environment; generating the same perceptual response as a real scene; creating the impression of a real space’, *realism* is always an issue in three-dimensional landscape visualisation.

However, in light of affordability, high level of detail of the real world aren't be always the prime target for landscape visualisation in planning. Visualisation preparers and planners generally compromise to find an appropriate balance between level of detail and production cost. This fact was supported by research (Appleton, 2001) pointing out that a high degree of realism might actually prove distracting in some ways. In addition, the level of detail could be decided by the purpose and use of the model, which can be focused on certain elements in visualisation (Appleton and Lovett, 2003, Lange, 1999).

Even though visualisation technology has always aimed to approach the real world, it is often claimed (Vince, 1998, Whyte, 2002) that virtual model might never reach the real world because of substance beyond the technology. For instance, a real-time model would not reflect atmospheric circumstances in the real world such as clear, cloudy, rainy, and windy. Moreover, causality in every action and reaction, and physics in real world cannot be replaced with computer-generated models (Cavazza, 2004).

2.3 Production Cost

So far, little research has been carried out on the cost of real-time visualisation. One of the reasons is that because contemporary technology is being developed constantly, measuring costs would be very elusive. Software such as three-dimensional authorising, GIS could be key elements as well as data availability and labour costs.

Moreover, the cost of visualisation models is very dependent on types of models (mainly degree of LOD[1]) and services provided. Therefore, it is difficult to illustrate a specific figure of cost; however, it was suggested (Martin et al., 2002) that it generally ranges between £500 to £20,000, typically £5,000 in normal circumstances in planning in the UK.

GIS applications are normally used in academic areas and large organisations, which costs much more than CAD-based authorising software in terms of data acquisition and its management. Unlike such large bodies who have availability of GIS-based applications, most real-time models in planning are prepared by individual consultants. Therefore, it is considered that CAD-based approaches have been predominantly used for landscape visualisation by landscape consultants because of the cost of GIS applications and data availability.

2.4 Planning Stages

Even though, there is great potential for technology in planning implementation, one criticism is that the employment of the real-time visualisation in the planning stage could become supplementary. It was claimed that without integrated connection with planning, three-dimensional visualisation could be just an expensive supplement to sell the final planning project (Lange, 1999).

[1] Level of Detail

This Stage to Use issue also plays a key role in deciding LOD of models. For example, in early and middle phases, it can be used in various degrees of LOD; whereas, in final phase including marketing, much higher detail is required.

For example, Al-Kodmony (1999) identified three different media to use in various planning stages, particularly community participation cases. It was found that freehand sketching and the GIS were the most effective for problem identification and brainstorming, while photo-manipulation using computer imaging was most useful for exploring solutions to previously identified design issues.

3 Using Real-time Visualisation Techniques in a Planning Process: Windlestone Hall School Relocation

3.1 Background of the School Relocation

The study area is the Windlestone Hall School, County Durham in the Northeast of England. The School is for students with special needs, particularly emotional and behavioural difficulties. Windlestone Hall, built in 1835 and listed as being of Grade 2 architectural and historic importance, was first developed as a school in 1958 and currently teaches around 60 pupils aged between 11 and 16 with emotional and behavioural difficulties (EBD). The basic problem was that,even after considerable adaptations and improvements, the 19th century county house was just not designed for providing facilities for a 21st century education.

The County Council had decided to replace the building as part of a wider review of EBD education. Another school for EBD pupils is in the north east of the county; therefore, Windlestone's replacement needs to be in the southwest and the preferred site is amongst the 90 acre Childton Blue House Farm, the Chilton Reclamation Site and Denebridge Row.

Fig. 1: Stakeholder Meeting in 2004

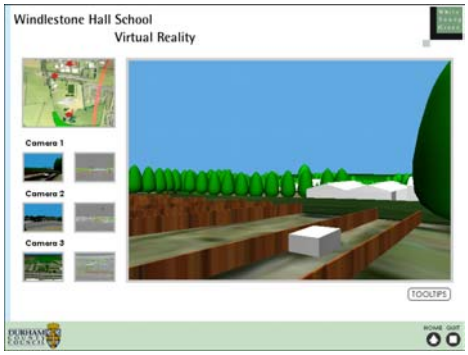

Fig.2: Interface of the Model for the Consultation

Initial consultations have already been held with teachers and governors at the school, who are in favour of the relocation proposals. More detailed plans were shown in a public

exhibition during May, 2004 in Town Council Offices, where stakeholders including members of the public, had the opportunity to review the proposals and share their opinions with representatives from both local authorities and from the school.

3.2 Data Availability

A DTM[2] covers the area within which the contours are placed in every metre[3] was available for the ground model and the context adjacent. A high resolution, true colour, digital aerial photograph was also available for the area which was draped across the DTM surface. Photographs, history and uses information had been collected with local archive research and site visiting.

3.3 Real-Time Modelling

As identified in the previous section, production costs is one of the issues in the paper. Therefore, software has been chosen on the basis of cost feasibility and flexibility for geometry, texturing and human interfacing. Scripting-based Shockwave technology has been employed for production rather than data-driven GIS applications. Scripting language, Lingo[4], is used for creating basic geometry, texturing, camera controller and atmosphere effects. Moreover, interactive interface in the publishing stage is also prepared by the Macromedia Shockwave technology.

Models of selected features were added to the basic topographic and textural framework of the study area. These models initially contain trees or shrubs of diverse types and built-in structures. The tree features were represented by basic geometry.

The software used the DTM and the land cover data as inputs to separate land cover types into different groups within '.w3d' format. Moreover, it creates separate 'Shockwave' files in which trees were located within polygons for appropriate land cover types. New school buildings were included in the virtual environment, the dimensions and layout of which were specified using CAD software and with textures taken from architect's and images of the proposed plan. The sky was constructed using a script of Lingo.

The full model includes approximately 5 textures, 748 shaders, 977 model resources, and 3 cameras (approximately 5 Mbytes). In the daytime simulation, there were three light resources positioned to correspond to a sunny day of Northeast England.

When the separate '.w3d' files were developed for each of the elements, the vegetation groups and the buildings, they were merged into a single file in the Director software for the user-friendly interface, which creates cross-platform Autorun CD media for Windows running PCs and Mac OS X running MacIntosh computers.

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[2] Digital Terrain Model

[3] In the UK, Ordnance Survey provides 5 meters digital terrain model; however, DTM and a high resolution '.tiff' aerial image for this case study were provided by a private surveyor who uses airplane survey system.

[4] Scripting language of Macromedia Director

As an alternative, '.dcr' file format was provided embedded in 'html' files for the survey using the Internet streaming. It is accessible through the Web and contains full features of interactive flythrough and walkthrough models as well as the stand-alone CD title above.

3.4 Case Study Procedure & Method

A real-time visualisation was presented during a public exhibition on May 2004. An interview was made with 20 participants who live adjacent to the proposed site; they have much knowledge of the area and have been aware of the nature and context of the project. Other stakeholders participating were planning officers from local planning authority, people from the school and architects.

All participants viewed through a 4x3 ratio projector on one side of the room after brief introduction of the proposal and visualisation exercise. All participants were given opportunity to control views with their own hands through the camera controlled by keyboard and mouse. Then, an open discussion followed regarding to the school relocation project as well as real-time visualisation. After the discussion, they were given formal questions during and after presentation. The questions included;

- understanding of the project,
- difference between 'with' and 'without' the real-time model,
- realism (level of detail), and
- cost effectiveness of the technology

The consultation process and participants' choices were observed and all data collected was analysed. Prior interviews with the visualisation developer and planning officers were added to the analysis process.

4 Analysis and Discussions

The information provided of the siting options of the school is the most apparent, but not the only difference to the traditional communication media based on drawings, two-dimensional images. In the experiment carried out here, there was much appreciation of the technology by stakeholders and general public appreciation for the interactive walkthrough and flythrough simulations, where residents were able to measure the new proposals exactly from their bedroom windows.

Other valid concerns about planning implication of virtual reality technology were raised after the completion of the experiment. These issues include;

- the fact that realism doesn't offer a great deal to users who know the site already,
- in the case, geometry is more concerned matter than other elements,
- during the modelling process, there is no guideline or professional reference of visualisation under UK planning procedure, which could result in possible biased reference.

Some of these issues can be addressed by more focused and detailed modelling of the virtual environment in the near future. This might include specific features for each different case of project, for example, more geometry details such as height information and more accurate texturing. Although there was little remark on the quality of the visual illustration during the experiment, it was not photo-realistic, and improvements in this aspect of the model of the virtual environment would also be beneficial, supporting subjects in a virtual environment access to a key map - and capable of running movement using the virtual map.

Computer based visualisation and virtual reality are becoming popular in planning processes in the UK. Despite the limits[5] of real-time technology, research indicates (Martin et al., 2002) that four out of twenty local authorities and eight out of thirty housing associations that had used virtual reality or something similar. In those cases, virtual reality and computer animations are being used in 'scenarios' on various developments such as ZVI[6], Visual Impact Assessment within Environment Impact Assessment, and Landscape Character Assessment.

In the UK planning policy, there are no restraints nor does it have a codified constitution of the type common to most other countries (Yadley, 1995). Such a lack of constraints allows for a wide degree of discretion in the UK planning system. In determining applications for planning permission, a local authority is guided by the development plan, but is not bound by it: other 'material considerations' are taken into account (Cullingworth and Nadin, 1997).

Under such discretionary planning structures, the most decision to be made in planning application are open to be decided; therefore, it is considered that communication media and similiar reference take bigger parts than in other countries. On the other hand, it could adversely affect a decision significantly when visualisation contains technical/ethical mistakes, biased information or any prior reservation.

During the case study, real-time models were prepared on the basis of surveyed information. However, from surveyed information, it has been found that there was much room for artistic licence for creating real-time landscape models. Although it starts from physical data including ordnance surveys, virtual reality models in planning use provides these options for preparers to consider;

1. Texture – type, variety, accuracy, resolution
2. Camera – type, angle, position, focal length, movement
3. Movement – speed, height, collision handling, terrain following

As previous research suggested (Orland et al., 2001, Sheppard, 2001), it needs some standard forms of the new technology to avoid any misjudgement or minimise the limits and errors. Particularly, policy constraints, professional guidance and training, monitoring and enforcement, and practical benefits of a support infrastructure for visualisation have been identified.

[5] See the last paragraph of Section 2.2
[6] Zone of Visual Influence

1. General principles and responsibilities laid down in a code of ethics
2. Best practice guidelines, standards, and specific procedures to assist preparers directly in their visualisation work
3. Professional support networks and institutions

The author also recognises that establishing such guidelines is eminent in Britain. Even during this investigation, it was witnessed that a local authority rejected a presentation of a virtual model in the planning application process meeting because of the concerns of a potential of favouring a particular proposal. Therefore, *policy-based* and professional body -involved guidelines could be necessary to safeguard the use of the technology and to provide an efficient discretionary planning system.

In the experiment, the subjects were present in a room with monitors and data projectors and their peripherals, and were therefore, certainly not *immersed* in the virtual environment. The impact of these conditions on the decision made by the subjects cannot be quantified, but it can be considered that it is reflected in the answers to questions about similarities to the real environment.

However, the subjects are not particularly concerned about realism in the visualisation. With prior knowledge of the site and proposal through the whole process of the planning application, most of them were more concerned about physical geometry including height and the degree of tree screening in the model.

Therefore, it could be considered that visualisation models do not necessarily have to have a full degree of realism in planning circumstances. As illustrated in the previous section, it could vary in planning proposals and purposes of the implementation.

In terms of cost, the experiment has been carried out with a scripting-based software. Similar to *Shockwave Lingo*, there are numbers of commercial and non-commercial tools to create real-time visualisation including VRML[7]. Unlike Geographic Information System based software, those are free or relatively affordable to bodies who actually prepare visualisation such as landscape consultants. Those solutions are compatible with commonly used Computer Aided Design and drafting applications as well as supporting additional features through scripting process.

Finally, in this paper, a real-time model was used in the stage of public consultation. During the experiment, it was also suggested to employ the technology in early stage of planning application where people can see the existing problems and have more options to choose. With traditional methods, the materials of the proposals were drawings and written documents, which the public had difficulty of understanding, compared with the real-time media used in later stage of the planning process.

[7] Virtual Reality Modelling Language

5 Conclusion

This paper described a real-time visualisation technique employed at a phase of participatory planning process. It illustrated as follows,

- a local planning authority prepared a real-time landscape model for a consultation,
- a visualisation preparer created a real-time model with Shockwave technology,
- with the model created, members of general public and other stakeholders were participated in the school relocation project, and
- during planning process, public consultation and a stakeholder meeting with the visualisation were observed.

The case study and its planning implementation exercise do not cover all aspect of real-time technology, but it allows analysis of the process of consultation with new communication media within the planning context.

The findings have important implications for consultation using real-time rendering technology. The realism of the model wasn't a critical issue as far as it illustrates an appropriate degree of realism. Consultees and participants accepted the apposite level of details of the School buildings and vegetation as far as they are geometrically correct such as height and tree transparency because mostly they were concerned about physical features including view screening and roads accessibility.

Another finding was that there was not any framework for creating real-time models for planning use during the case study process. There is no guideline and standard for visualisation preparers to follow this could result in giving too much artistic licence to preparers. Therefore, the author envisages that the potential biased information could be illustrated in favour of particular interest group(s).

During the investigation, the author identified a great deal about real-time visualisation technology with other media such as the Internet streaming. Within the experiment process, the final product was also published for the Internet streaming with full interactive features. Without physical limitations such as meetings and interviews, people could access to the proposals extensively, particularly, pupils of the school has access to the information of new school. From this attempt, mainly identified issues were size of monitor (screen) and resolution, available Internet bandwidth.

As the planning application process is encouraged to be more transparent and inclusive, the use of the Web is becoming more popular. The UK government prepares E-government campaigns (Johnson, 2004) and promotes local governments to establish the infrastructure of information sharing to the public in a more accessible way. However, this area hasn't been researched much. Only a handful of researchers refer to potential planning aid using the Internet (Wherrett, 1999, Wherrett, 2000, Bishop, 1997). Further research about remote survey on planning aid needs to be carried out to explore more options, including the Internet and digital broadcasting, in the near future.

In further research later this year, comprehensive survey and data collection will be included. It will be added the identification of main issues on the technology implementation in planning, predominantly, focused on real-time tools. Moreover, the enhanced research will analyse the necessity of guidelines in employing the technology in planning procedure and help the formation of framework under the discretionary UK planning context as well as potential Internet employment.

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