Using virtual reality as information tool in spatial planning

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Abstract

Public participation is becoming an increasingly important issue when it concerns spatial planning. New spatial plans are expected to be available to citizens and open for discussion. The Internet has proved to be a very useful tool for sharing information with a large number of people, however a picture or map of an area will not be very useful for everyone trying to get a good idea about the future situation. It is quite difficult to get a good impression of the changes to an area by using a 2D image or map representation.

Geo-visualisation is seen as a new way to present spatial issues to the public and improve the interaction and communication. Virtual environments are very useful to show the current and future situation on a very realistic level. The user can interact with the environment by navigating through the virtual world and see what impact the spatial plans have on the area. A three-dimensional representation of the plans will give a more realistic idea about the impact the changes will have on the present situation. But not only the internet is a new way of bringing information to the citizens. Display technology is also improving, like the development of the ICWall and the CAVE^{tm}. The ICWall is a large screen capable of processing large data sets and on which therefore a 3D stereo projection can be achieved. Such a large display makes it possible to present the spatial plans in a large room to a large number of people at the same time without the loss of resolution. The visitors can view the spatial plans in 3D with the use of glasses and can respond to the plans at the same time to the responsible people like the project planners and landscape architects.

These new techniques raises a lot of new research questions such as, do people respond differently when spatial plans are presented by using virtual reality? And do tools like the CAVE^{tm} and the ICWall prove to be useful as a communication device?

Key words: Geo-visualisation, Public participation, 3D and4D planning,

Introduction

Public participation is becoming a very common method for designing and finalizing spatial plans. Getting the citizens involved will lead to a better acceptance and a more positive attitude towards the changes in the public space. As technology is improving the tools for PP are becoming more advanced and numerous as well. Geographical Information Systems are already a widely accepted tool to present the spatial plans to the public. But now Virtual Reality is becoming increasingly important to visualize the future situation. This article will describe the current situation of the use of virtual reality in public participation. Some research questions about this matter will be discussed in more detail. After that a comparison is made between two visualization aids to see how useful these tools can be in the process of public participation and spatial planning.

The current state of public participation

Public participation is a fast growing item in the spatial planning process nowadays. The term Participatory GIS was created in 1990 [Obermeyer, 1998] and has since then become increasingly popular. As the term got more widely used, the processes for which the term was used became more numerous as well. This trend raised the questions such as, how much interactivity will be needed before a process be considered as participatory? Can a citizen listening to building plans during the planning process be considered as participatory or is further involvement such as bringing in new ideas required for participation. In the Virtual Landscape position paper [Lammeren, 2003] the various levels of participation have been set out per author. Each definition of participation embraces various levels of participation depending on the role of the citizens and the authority. In most cases this participation level varies from informing the public to the level of full control of the planning process to the citizens. Several of these participation levels can occur within one project. The levels of participation which may occur will be defined by the planners. They will decide beforehand how much influence the citizens may have on the plans and how much may be changed. For example, nobody wants a factory in their backyard, but is allowed to have an opinion on what it is going to look like. That is why the level of participation needs to be defined individually for each planning process.

The Current state of Visualisation

Currently, when spatial plans are presented to the public this usually happens with the use of a maquette. This maquette is easy to comprehend and gives a good overview of the plans. However, the Maquette also has a lot of disadvantages. The Maquette is a large rigid solid thing that can only be kept at a specific location. In the field of spatial planning this location is usually the project bureau or information centre. Citizens willing to participate have to travel to the location of the Maquette to get a good overview and make some remarks on the design of the plans. One can not interact with the Maquette and new ideas can not be visualised instantly.
Apart from maquettes Geographic information systems have become a useful tool in visualising spatial plans. Geographic information systems have already been widely used in participatory planning activities in third world countries [Harris and Weiner,2003] as well as in the developed world [Harrison and hacklay, 2002]. In both cases the GIS proved to be a good tool support an interactive planning process. The GIS allows instant interactivity, can visualise the plans at various locations and can be instantly altered to process the comments and suggestions from the public. But a GIS is a sophisticated tool and a lot more difficult to comprehend than maquettes. Inexperienced participants might find it difficult to visualise the plans as they are only represented in 2D.
A combination of the Maquette and the GIS seems to be ideal situation for presenting and interacting with spatial plans. It is best to have the 3D effect of the maquette for visualising the future situation and to have the interactivity and ability to change from the GIS component. This combination is called Virtual reality or VRGIS [Hacklay, 2001]. It means that a 3D computer model is generated showing the current or future situation [Dias et al, 2003] [Antunes et al, 2002]. The model can be explored by simply navigating through the virtual world. As current visualisation techniques are becoming more advanced by the day, the possibilities for public participation are increasing as well. The Virtual world can be presented to a large group of people by using a large screen, It can be visualised on a high end system such as a cave amongst an expert group, but it can also be distributed on the internet to get a large number of people involved. The Cave and the large display will be closely described later in this article.

Research questions

Having all these new techniques and tools for display, that cause a change in public participation, also raises a lot of new questions.
One of these questions is whether citizens really get a better understanding of spatial plans when these are presented with the use of virtual reality. This depends on several factors including the quality of the 3D display and the realism of the virtual environment. GIS might be difficult to understand because of the complexity of the system [obermeyer, 1998], but virtual reality on the other hand will be a lot easier to comprehend to an inexperienced participant.
A second question is whether the viewer has sufficient knowledge to navigate through the virtual environment on the internet without getting lost? An experienced flyer will recognise the environment and will have a good orientation, but an inexperienced flyer might not be able to recognise the area from the air. The houses, for example, will have to have a certain amount of realism to be recognised.
The third question is, will public participation be improved when people can respond directly to the plans with the use of internet, e-mail or directly respond to the plans when presented on a big screen in a large room?
Another question is how realistic the scene has to be to serve the purpose of the visualisation. Too much realism will frighten the audience and decrease the will to participate, but on the other hand, a small amount of realism will confuse the participants and decrease the ability to orientate. Obviously the level of realism depends also on the purpose of the visualisation. The appearance of a new building will require more detail than the overview of a whole area.

Another interesting topic is the occurring NIMBY-effect in pp planning, especially with 3D visualization [Loidold, 2003]. As soon as people are allowed to fly by themselves and look at the spatial plans, they will try to find their own house in the future situation. This person might then see that the plans are going to affect the view from his or her house and therefore not agree with the plans. This would not have happened if this person hadn't been allowed to fly home, but instead only on a certain area. Virtual reality gets people involved, but sometimes a bit too much.

Visualisation tools

As mentioned earlier, new tools for visualizing spatial plans and interacting with the audience are becoming available as computer technology is improving. 2D GIS can be simply visualized on a computer screen or even have the produced maps printed out and handed out as leaflets. 3D environments on the other hand will have to be visualised in an interactive manner. One has to be able to navigate through the 3D environment to look around and look at the scene from different perspectives. There is obviously no need to look at a 3D scene from just one point of view.
There are various display devices available, to share information and have a certain level of participation with either a large group or a small expert group. In this paper two visualisation aids will be described and compared. The decision for discussing these two devises is based on the availability of these systems to the researchers from the Vrije Universiteit. The ICWall is located at the VU Amsterdam and is therefore very easy to access and use as test system. The CAVE^{tm} is not located of the VU, but is situated at SARA computing & networking services Amsterdam which works is close contact with the VU and was originally founded by the VU.

ICWall

ICWall stands for Interactive and collaborative wall. The wall is a 8 tiled display with a size of approximately 5,5 X 2m and has rear projection. The setup of the system at the VU is shown in figure 1.
The whole system was designed to be a low cost system [Germans et al, 2003] and therefore it runs on normal pc's with a Linux operating system. Each tile is made up of one pc attached to a normal projector. Some of the tiles have two projectors so a passive stereo projection can be achieved. The passive stereo effect can be experienced because the light from the projectors is polarised. One projector creates the image for the left eye and the other projector creates the image for the right eye. When the observer wears glasses with polarisation filters, the left eye receives the image from one projector and the right eye only sees the image from the other projector. The observer gets the feeling there is depth in the displayed image. Fortunately also the polarisation glasses are very low cost. In total there are 9 pc's 8 of which are to render the individual images for the projectors and the 9th computer is used as a master to control the communication towards the other 8. The computers are connected though a normal Fast Ethernet network which can also be connected to the internet.

Fig 1: Setup of the ICWall with on the left a smart-board to control the wall from the room.

Situated in the room in front of the screen is a smart-board. This is a large flatscreen panel with a touch screen in front of it. The visualisations on the Wall can be controlled from the smart-board which can be seen in figure 1. Drawings can be made on the touch screen and directly visualised on the wall making it possible to interact with the wall real time.

CAVE^{tm}

The term CAVE stands for CAVE Automatic Virtual Environment and is in fact a product developed by the Electronic visualisation lab (EVL). The system is commercially sold by Fakespace systems. There are several other institutes or companies creating similar display devices. They call it differently like Reality cube because CAVE is a registered trade name. The systems have the same setup of components and operate in a similar way, so the term CAVE in this document refers to the system rather than the product itself.
A CAVE is a full immersive display device using stereographic projection. The size of the CAVE is approximately 3X3m and can have projections on all six sides of the cube. The CAVE at Sara has projection on four sides of the cube excluding the back and the ceiling.

Figure 2 shows a schematic drawing of the CAVE setup at Sara. To reduce the space the system needs mirrors are used to divert the light from the projectors on to the walls of the CAVE. All faces have rear projection except for the floor where the image is projected on through a mirror on top of the cube. The CAVE uses active stereo projection. This means that the projector has a resonance showing alternatively the image for the left eye and the image for the right eye. The user standing inside the cube has to wear shutter glasses which block alternatively the right and left eye so the viewer sees depth in the picture. The user will see depth in all directions giving him the ultimate immersed feeling. The user becomes part of the virtual world and can literally walk through the spatial plans

Inside the CAVE are various interactive devices such as a 3D pointer which is used at a mouse. This device can be pointed at object to select them or interact with it in another way. The CAVE also supports the use of VR-glove with which the touch sensation can be simulated. For Spatial plans this glove is of less important. A devise that is important on the other hand is the tracking device. One of the shutter glasses has the device mount to it so that the computer can calculate the position of the user in the virtual environment. When the person with the tracker moves, the displayed image will change according to the new field of view.

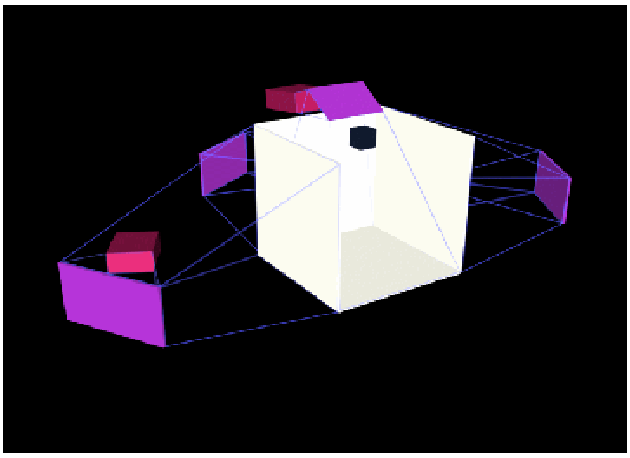

Fig 2 : Setup of the CAVE^{tm} system at SARA. The white box is the area where the observer will stand in. The pink boxes are the projectors and the purple squares are the mirrors.

ICWall vs. CAVE^{tm}

The main similarity between the ICWall and the CAVE is that both systems are capable of handling large datasets and are capable of stereoscopic display. A third similarity is the inflexibility of the system. It is practically impossible to move either the CAVE or the ICWall to another location. Apart from those three similarities the systems are very different indeed.

One of the major differences in setting up the system is the cost. The ICWall is a low cost system and is made of off-the-shelf equipment [Germans et al,2003]. Both systems run on a Linux operating system, and both systems are capable of running under Windows as well. This choice depends on the demand of the programmers. The CAVE on the other hand is very expensive. The projectors capable of creating a stereoscopic view are a lot more expensive than the projectors attached to a normal graphics card. Both systems are very immobile. Not only the size limits the transportation but also the complexity of the system. It takes time to set up and calibrate the whole system before it can be used.

Another difference is the Immersive value of the system. Both systems are capable of stereo projection, but the CAVE clearly gives a more immersed sensation than the ICWall. This because of the multiple projection surfaces of the CAVE.

A final difference is the target group. The ICWall is meant to communicate to a large number of people at the same time whereas the CAVE is more suitable for smaller expert groups.

How public participation can be improved

Having the advanced technologies such as the ICWall and the CAVE already improves public participation, but there is still a lot to be done. For example the transportability of the two systems mentioned earlier. It would be useful to take such a system to the location of for example a stakeholders meeting. At present the stakeholders will have to go to the CAVE or a projection wall. Now the same problem occurs as before. Citizens willing to participate will have to travel to have a look at the plans. This is the same as it was before, having to go to the project bureau to take a glance at the Maquette. A much more portable and widely available option is to use the internet to bring the visualisation to the people. Everybody can then look at the plans and respond via e-mail or join a discussion on-line. At present the visualisations are not suitable for most computers and require more advanced hardware, but in the near future the internet will be the ideal tool for getting the public involved.

One disadvantage of the internet visualisation is that it will not be possible for most people to view the plans in actual 3D. The immersive feeling is therefore not present, but maybe in the future more people will have shutter-glasses at home and are therefore able to create their own stereo effect.
A final tool for improving public participation is the use of mobile devices. The idea is to get the visualised information of the spatial plans in 3D to a mobile device in the field. The person in the field will be able to look at the present situation and the future situation at the same time and will have no difficulty in getting a good feeling about what is going to happen to the environment [Bishop, 2002]. The key to public participation is to get the public involved. People will much easier get involved when they become enthusiastic after seeing a good 3D visualisation and are able to get a good understanding of what is going on.

Conclusions

The development of new technologies has a very positive influence on public participation. The quality of visualisation leads to better insights and better understanding of the spatial plans. This will lead to more interactive participation of the people from the affected areas. Tools such as the CAVE and the ICWall have proven to be capable of displaying large datasets using stereo projection and creating an interactive virtual environment, but the immobility of these systems is still a limiting factor. But, as technology is advancing rapidly, new technologies will become available soon and more citizens can be reached and will become enthusiastic to participate.
It is still necessary to think about the amount of detail that is necessary for different applications, different phases and different target groups to be used in a 3D representation of the spatial plans. It is not very well researched yet what level of detail is suitable for which purpose.

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