Modelling for Virtual Reality in Architecture

Jonas af Klercker

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CAAD, VR, modelling, spatial experience

Abstract

CAAD systems are using object modelling methods for building databases to make information available. Object data must then be made useful for many different purposes in the design process.

Even if the capacity of the computer will allow an almost unlimited amount of information to be transformed, the eye does not make the transformations in the same "simple" mathematical way. Trained architects have to involve in an inventive process of finding ways to "harmonize" this new medium with the human eye and the architect's professional experience.

This paper will be an interimistic report from a surveying course. During the spring semester 2000 the CAAD division of TU-Lund is giving a course "Modelling for VR in Architecture". The students are practising architects with experience from using object modelling CAAD. The aims are to survey different ways to use available hard- and software to create VR-models of pieces of architecture and evaluate them in desktop and CAVE environments1[1].

The architect is to do as much preparation work as possible with his CAAD program and only the final adjustments with the special VR tool.

Background

Virtual reality in computers is now becoming financially realistic to building designers. The technique though is developed within industry with sufficient economic strength to use the most sophisticated solutions.

In this paper we focus on virtual reality for supporting laymen's experiences of building space and use of the built environment. The difficulties for anybody to correctly interpret a drawing is a common experience and the power of computer rendered perspective views is respected. So far memory saving techniques like the animated "Walk through" and "Quicktime VR simulates VR in almost any CAAD software. All this has been discussed and demonstrated at eCAADe conferences through the years.

In this paper we focus on the Virtual Reality which simulates also "real time". The freedome to explore a computer model spontaniously and the possibilities to change the behaviour of the scene create new possibilities to increase experience and support engagement and understanding.

Anyone who has tried to model a house from the information of a set of drawings knows that there will be a need for complementary details. These will help increasing the experience but they also stresses the need of computer models becoming more and more detailed. This may be even more obvious as the demands for a wider use in fact for the whole lifteime of a building are imposed.

With the ambition to create experience of spatial qualities, the computer screen has serious limitations. The "normal" perspective view is limited to around 60° sight angle and this is also the problem with the manual draft. In film and video industy a widening of the screen is introduced, and in video games stereoscoping spectacles are being merchandised to a resonable cost. Different projection methodes are under development and testing at uinversities and industry.

Experimental course

In order to explore the possibilities to integrate VR-technology with CAAD to improve communication and problem solving, an "external course" is organised by the CAAD division. Half of the participants are practising architects and half are diploma working students with skills in computer use and modelling. We are using the facilities at LTH and the CAVE-installation in Helsingborg.

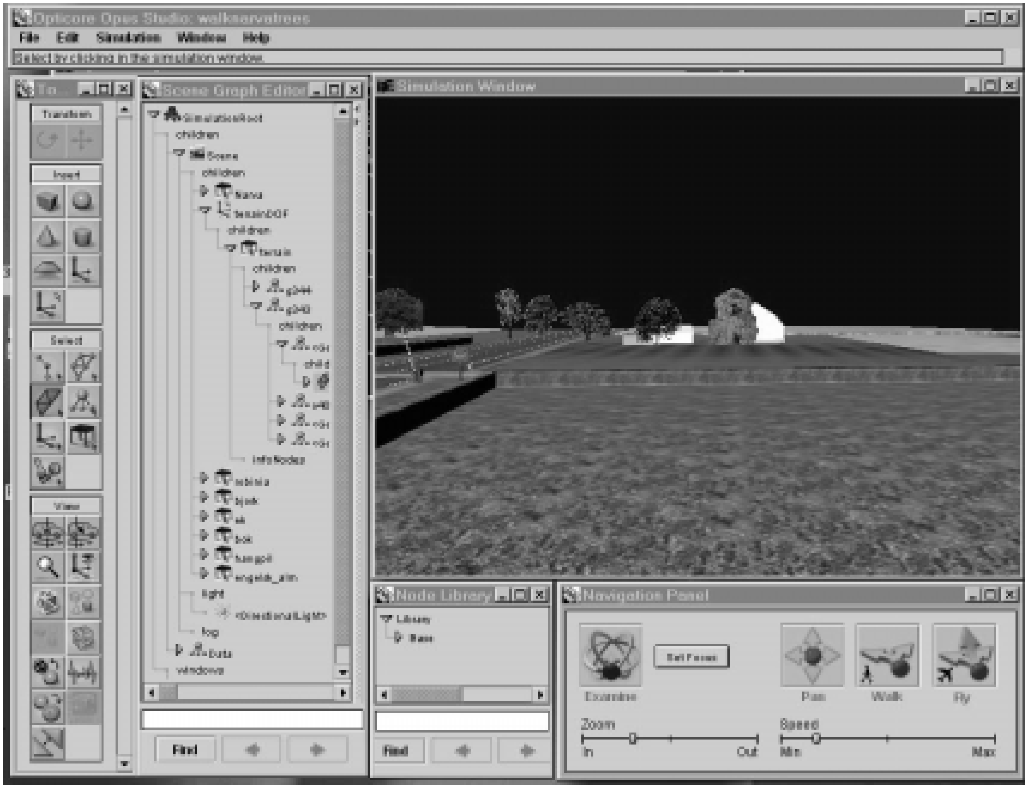

Image 1.
Opus VR-software default interface.

In the course AutoCad/3D-Studio Viz and Archicad software are utilised in modelling and Opus (by Opticore) for VR. All software runs on the same NT-system so file transportation is simple although the translation of the conventions of the WRML2 format differs a little. The developing companies are helping to overcome these problems and so far it has worked nicely. The Opus also runs on the Sillicon Graphics Onyx in the CAVE, which makes it possible to compare different presentation media.

The situation when this paper is written is that the course is half through and the participants have found out that making a model Virtually interactive in the VR software is not such a big problem as it might have been imagined. The rest of the time is going to be spent testing different aspects to get more practical experiences.

The notations beneath are reflections made so far (middle of March 2000).

What is VR-software about?

Simulation of virtual environment in real time demands a lot of computer power. The start has been at an economically high level and VR was developed by those who needed it so much that it was worth the costs. The costs of a VR software so far has been unrealistically high and one interesting issue is how the merchandisers now will act to broaden their market.

With the introduction of the WRML format VR for computer games was made possible. Just lately the VR-software NeMo was introduced, which is aimed to game making. One of the Swedish software developers, Opticore, now make their UNIX-software also run on NT plattforms. This opens up for user groups like architects, who already work with computer models. With some modifications they could use VR in their normal design process.

There is no real intellectual description with a reasonable metaphor to explain what it all is about. To what we can see the VR functions are based on very sofisticated calculations and there must have been a lot of time and creativity put to invent the operations and because of the exclusiveness the students have been tutored more or less individually.

Simplifying the geometry by minimizing the amount of polygones.

To minimize the demand of computer power, VR-programming so far has been working on limiting the amount of polygones to be calculated by simplifying the geometry and extraction of objects in sight. Very caracteristic is the use of textures substituting geometric forms.

The representation of the building etc. will then be simplified, which ought to be a familiar task to architects working with manual techniques. Any architect would agree that it could be done in many ways, good or bad, often mixed with artistery. So there might be a point in finding inspiration in the new possibilities of simplification and abstraction suggested by the VR technology.

Textures and texture mapping

Textures in most VR productions so far are photos which are manipulated in an image processing software like Photoshop. As the texture handling in a VR software is based on rational mathematical processes they have to be a square with the side size with the multiple factor of 2. This means that you cannot just use any image. The use of textures has to be planed carefully.

Texture mapping is used in CAAD programs also, and one simple solution could be to adjust them to the VR formats. On the other hand representation by the geometrical form is natural in the CAAD environment and in some cases a substituting image mapped on for instance a facade could be sufficient.

Level of detail related to distance

The observation that less details are visible with increasing distance has made the VR-programmers to use the "LOD", Level Of Details. It means that the choise between geometrical respectively texture representation can be related to the distance at which the object is positioned. But there is more to it!

The sight of a normal human eye and the interpretation by the brain is so far not succesfully imitated by any technical method. For instance the computer, which is calculating a geometrical scene, makes a numerical scaling of the objects linear to the distance from the eyepoint. The representation of the object at a distance is then a result of a calculation. The human eye is more selective. We imagin that the further away the less detailes are visible, but all the same we can sort out and recognise characteristics.

"Behaviors"

In VR software "behaviors" are used to make the real time experience feel alive. Behaviors have been invented as the areas of applications have developed. VR so far has not focused on spatial experience of the built environment, so we have to pick ideas from other areas.

For example, we find that opening doors or moving objects in a predefined way is the most obvious behavior to add to avoid the feeling of a static physical environment. Walking through shut doors is just as bad as all doors being wide open.

Making simple changes or togle between different colors, materials, positions of objects like furniture, sights etc are also easy to imagin. Change between night and day, movement of the sun, different weather conditions and seassons could be wanted.

Simulating human activities in the building etc. is still mostly used in advanced computer games which show the possibilities, but has no real serious use in built environment simulations so far.

Light and shadows

Have we got so trapped as CAAD operators by the "shading" technique that we do not appreciate the impression of shadows to create an atmosphere in our visualisations? Shading might be all right for a "sketch-like" model at an early stage of design, but if you claim to do something realistic we have some doubts.

In some VR scenes as well as ordinary shaded views surfaces with the same color make them float together and make the environment uncomprehendable. This is where shadows are absolutely necessary and by default the camera is equiped with a "headlight.

Interaction with the envirorонment.

The most elementary interaction with the virtual room is to move your "eyes" around and maneouvere in a naturalistic way. In a one screen view the curser seems to be a good alternativ, but in a more complex projection set some kind of gadget like a joystick has to be used. In our CAVE installation a glove is used for controls which is relevant for grabbing things but quite inadequate when it comes to moving yourself around.

Very useful for an experience of reality is that the program can keep track of where you are and act accordingly. When you are about to collide with an object it can indicate it or even make it impossible. It can also activate "gravity", that is, put your eye on the correct distance obove the floor or the steps of a flight of stairs.

Conclusions so far.

The conceptual idea of the course is that it is possible to use ordinary CAAD software to prepare models for VR in a way that it will be easy to import and arrange for VR presentations. There should be no need for a "filtering" VR-expert between the architect's intentions and the laymen's experiences.

The tests at the course so far has been quite successful and indicates that the concept is realistic.

Notes

1 af Klercker, J. *A CAVE-interface in CAAD-education*, proceedings at the 16th European conference of eCAADe, september 1998, Paris, Ecole dÁrchitecture de Paris Val de Marne

Jonas af Klercker
CAAD
Lund University, Sweden
jonas.af_klercker@caad.lth.se