Computer Graphics as a Communication Medium in the Design Process

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During the last ten years at the Sasada Lab of Osaka University, we have been using computer graphics for presentation, design review, and design for practical architectural design projects. Computer graphics, including computer generated animation, is a powerful communication medium, and makes collaborative work easy. Nowadays, computer graphics technology is melting with networking technology, and many hot new technologies are being created. Among these new technologies, we find technologies such as VRML and 3-D browsers that should be the key to progress for 3-D design in an architectural design process. This paper demonstrates how these new technologies solve problems of 3-D design in the architectural design process.

Keywords: Computer graphics, 3-D design, VRML, 3-D browsing, collaborative work

1. Computer graphics and the architectural design process

We have been using computer graphics and computer generated animation as a communication medium in the architectural design process for more than ten years. The traditional way of communication in the architectural design process is not easy to understand especially for non-professional participants of the design project. Visual information created using computer graphics and 3-D model is a very powerful medium because it is easy to understand for both professional and non-professional participants of design projects.

Architectural design is a kind of a social activity. In the architectural design process, architects must communicate with other participants a great deal for collaboration. These other participants include professionals of architectural design, namely structural, mechanical, and electrical engineers, governmental people, and so on. However, to make the design process much more open and to make the design richer, we need to communicate with other participants who are not professionals, such as clients, users, neighbors, citizens, and so on. To communicate with these non-professionals, one of the most important aspects is the kind of medium that should be used. This is the reason why we started the research to use computer graphics in the architectural design process.

2. Presentation with computer graphics and its problems

In the early 80's, we started to use computer graphics and computer generated animation for presentation of design projects. Computer graphics is easy to understand, and carries much more information compared to perspectives and other traditional media. Now, using computer graphics animation is a popular way to present design projects in Japan. Numerous architectural design firms and design teams in construction companies have their own teams for this task. However, after we started to use computer graphics in practical design projects, we found that there are two major problems to be solved in the presentations with computer graphics to ensure good and smooth communication.
The first problem is a problem of initiatives. Because designers write an animation scenario and create the animation under their initiatives, the animation strongly reflects the designers point of view. Sometimes this makes other participants such as clients become irritated because they feel that they are looking at what designers want to show and not what they want to see.

The second problem is a problem of timing. Making 3-D models from traditional drawings is cumbersome and time consuming, so designers want to avoid having to rebuild models according to the changes of the design alternatives. This makes designers have the tendency to make 3-D models at the end of their design process, after the alternatives are almost fixed. In this circumstance, other participants such as clients, feel that if they find some problems in design during the presentation, designers do not have enough time to fix them and designers don’t want to change them.

3 Solutions - design review and design with computer graphics

To solve the problem of initiatives, we proposed the design review system with computer graphics for clients. Using this system, clients can create their own animation their own way. After clients receive drawings of the design alternatives from designers, they can start to create the animation from the part that they have most interest. If clients find some problems in the design alternatives, they can pass information to designers, and this gives designers more time to consider their alternatives.

To solve the problem of timing, we proposed the design system with computer graphics and 3-D models. With this system, designers start their design by treating 3-D models from the very early stage of their design process. Because all design alternatives are in the form of 3-D models, it is easy to make representations at any time of the design process by using some appropriate rendering systems (Figure 1).

![Figure 1](image_url)

We organized concepts of these three systems and established concepts of Open Design Environment (ODE) in 1991. Then we developed a system according to this concept. We are using ODE in practical design projects, and we distributed the system to other design firms, design teams in construction companies, and clients in the form of free ware. Now, ODE is used by many organizations, and members of the ODE user group are eager to participate in collaborative works in architectural design using ODE.

4. Limits of problem solving in design process by ODE

We proposed the design review system and design system to solve problems of the presentation system, as. ODE. However, compared to the presentation with computer graphics, the design review and the design with computer graphics are not so popular in practical design projects in Japan. We are sure that we made some mistakes in the process of solving the problems.

We tried to solve two problems in two ways independent of the other. In the case of design review, clients are able to take the initiative in making computer graphics outputs and animation. It allows clients to review the design alternatives from their own point of
view, but clients must still wait until the end of the design process. The problem of timing is not yet solved in this case.

On the other hand, in case of the design, clients can review design alternatives at any stage of the design process, however clients should ask designers to make renderings and animation for their review. The problem of initiative is not yet solved in this case. The fact that the part of the design review and the design of ODE are not accepted widely in the field of practical design projects, shows that we should find some new approach to solve these problems. We should try to solve the two problems together, not independently.

5 New technologies

Recent progress in hyper medium and network technology gave us a new solution to solve the two problems at the same time. Using the newest technology VRML (Virtual Reality Modeling Language), we can treat 3-D objects as hyper media, the same as texts, images, sounds, and movies. This means that we can make hyper links between a 3-D object and a text, an image, a movie, and other 3-D objects. This feature makes computer graphics output much more understandable and a more powerful design medium in the design process.

There is no need that all these resources exist on a same site, but if these resources exist on the network, we can use them by making hyperlinks to them. In this circumstance, we have no need to make all models of 3-D components that consist of our design alternatives. We will be able to find many 3-D models of furniture, equipment, street furniture and so on, in the manufacturers site. Corresponding to the VRML, new 3-D object browsers are coming out one after another. New browsers are very light and powerful, so we have no need to use high performance graphic machines to browse 3-D objects. With these browsers, we can walk through 3-D space in real time.

6 New solutions - Network ODE (NODE)

With the new technologies of hyper medium and networking, we can form a new design system that has no problem of initiatives and timing. Designers proceed with their design using 3-D models from very early stages of the design process. These models are open to the participants of the design project through the network. The problem of this design system for clients was that clients need to ask designers to make computer graphics output for their design review under the initiative of designers. However, with the new development in technology, clients can browse at design alternatives on their own via the network, and they can review design alternatives from their own point of view (Figure 2).

![Figure 2](image)

Clients can select 3-D browsers from several ones, and they have no need for high performance machines and professional teams. Moreover, clients can stay at their own comfortable place when browsing. The network brings them all 3-D models of design alternatives which they need, and if they need related detailed information, VRML takes them to other sites where links have been made by designers. In NODE environment, participants can browse at design alternatives from anywhere at anytime. The seams of space and time between designers and other participants no longer exist.

7 References
