THE MULTI-USER WORKSPACE AS THE MEDIUM FOR COMMUNICATION IN COLLABORATIVE DESIGN

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Abstract. The design process requires collaboration between organizations and individuals. This paper considers recent research in collaborative design system, it is called the multi-user workspace. The group-oriented multi-user workspace is a design environment where the collaborative work progresses smoothly between participants in the architecture design process. This paper describes the research project concerning the multi-user work space with inter-university collaboration. The design in the multi-user work space is processed while participants interact with each other. This paper shows the possibility of the multi-user workspace and investigates its problems.

1. Introduction

The architectural design requires collaborative work among various participants such as architects, clients, engineers and various agencies in stages of the design process. The Sasada laboratory has conducted the collaborative architectural design through various projects. In the process of those projects, several important issues are found. The face-to-face meetings are periodically held in a real space (for example, conferencing room) and the presentation of the project is carried out in the design process. The participants fixed the date for presentation using e-mail, telephone and fax. It's very difficult for all participants to be present in the same place at the same time. Therefore the projects are performed in an asynchronous fashion.

Sometimes the participants need to synchronously access the virtual space, where they review the design to solve the encountered problems.
quickly in the design process. In the multi-user work space, the presentation data exist in multi-media format, as a combination of text files, images, movies and 3D objects. The participants can access the multi-user work space, review the design while communicating with another participants, and solve the problems by collaborating each other.

This paper describes the recent research on multi-user work space with inter-university collaboration, participating Osaka university in Japan and Kyung Hee university in Korea. The design process is evolving in the multi-user work space where participants interact with each other. This paper aims to show the possibility of the multi-user workspace and understand its problems.

2. Multi-user work space

The Sasada laboratory has carried out various collaboration projects. According to those projects a design system was developed to assist designers as a tool of the design review while solving various specialized problems. These projects recently carried out let us to know the necessity of new media.

2.1. SOME MODELS OF THE COLLABORATIVE WORK

The WWW mediated projects can be classified into three types as follows:

- Collaborative design between designers and public
- Collaborative design between designers
- Collaborative design between designers and clients

2.1.1. Collaborative design between designers and public (Maruyama Project)

On the Island of Awaji in Osaka Bay in Japan, the Maruyama fishery harbor is located. In accordance with the master plan, the facilities of the harbor are designed one by one. The design process is opened to the public from the early stage using its home page. The home page for this project is composed of texts, 2D images (including sketches, CG generated still images and photos), and 3D objects. To manipulate the 3D objects at high speed on the Internet, the model data of the plan does not have the surroundings data. Therefore, the public could not review the design completely under these conditions. An e-mail is the only communication tool between designers and public, and the information flow is unidirectional.

2.1.2. Collaborative design between designers (Ayuyagawa Project)

The Sumoto City planned to build a big bridge over the Ayuya river, and
requested the Sasada laboratory to design the bridge. In this case, the design process between building experts who have various specialties, and the feedback among the participants is normally very quick. The BBS records the comments and questions with image automatically, so the bi-directional communication has been accomplished.

2.1.3. Collaborative design between designers and clients (Mikata Project)
The Mikata-cho in Fukui Prefecture is famous for the vestiges of Jomon Age. The Mikata-cho planed to make Jomon Park including the museum, recreation facilities and research center. The clients could review the design with 2D image of the project home page and operate the VRML of the plan from all viewpoints.

In this project the interactive bulletin board is used for bi-directional communication. The clients download the image of project home page, and write his/her opinion on it and attach the image with an e-mail. The agent program automatically separate the text and the image, and upload it to the project home page. In this project, all attach files are 2D image.

2.1.4. Lessons from these projects
Through these projects, we have found the necessity of new media for smooth design review, that is synchronous, real and interactive media. We have begun to develop a new collaboration system in a 3D virtual space. If this 3D virtual space is the same as a space in reality, the participants, who are maybe clients, specialists, or designers, can perceive the things in the virtual space as their own way.

2.2. CONCEPT OF MULTI-USER WORK SPACE
Like any place in reality, the street is easy of development in the multi-user work space. Users can build their own small streets feeding off of the main one. They can build buildings, parks, signs as well as things that do not exist in reality, such as special neighborhoods where the rules of three dimensional space and time are ignored. The events happen in a virtual three-dimensional world as a computer-driven alternate universe where people assume avatars, travel, plan, and build.

The multi-user work space consists of the shared virtual space and the private virtual space. The shared virtual space allows multi-users to interact on the Internet. On the other hand, the private virtual space is not shared for private work. The shared virtual space allows many kinds of tools in multi-user work space to be shared. Also the changes in a multi-user work space such as motion, data modifications and sound are transmitted to the users immediately. In this case, the problem of having a seamless environment in
time and space is resolved. The private virtual space has a function in a separate space (not shared). The design process needs to set limits to the public, and needs to progress in the private space until the design is partially completed. Thereafter, the shared multi-user work space accommodates changes. In addition, the people concerned in the design process are free from the restraints of being present at the same time and place. As a result, in the design process the asynchronous function improves the quality of communication or design.

It's very important how to represent of multi-user in the virtual space. An avatar is the embodiment of a user's awareness and identity within a multi-user computing environment. In the virtual worlds, an avatar is an audiovisual representation of a human user that facilitates communication with other users in a cyber-space. The purpose of an avatar is to give other users in a multi-user distributed VR simulation, a proxy or surrogate for the purposes of simplifying and facilitating multi-user interactions on a social level. The representation of many human traits are important in the avatar representation of the user. For example, emotion and gesture may be vital in creating user's optimal virtual conversation interfaces.

Virtual space is built by a project server. A project server consists of a property server, an avatar server and a web server. The property server manages all the data related to the building and objects in the world. The avatar server communicates avatar traffic through the world. In addition, a web server is required for storing the art work for the world. This web server can be anywhere on the Internet. The client which have their own browsers can access the project server.

3. Inter-University Project (Kyung Hee Project)

Kyung Hee university in Korea is trying to establish a graduate school of design for training the design professionals. As the current education system is given too much on logical reasoning, they are going to build a new curriculum and new building for the graduate students who want to have practical experience. The building is composed of CAD rooms, design critics rooms, lecture room with slide, audio and video facilities and so on. For the design of the building, an Inter-University project between Kyung Hee university in Korea and Osaka University in Japan has been established.

In the early stage of the project, both of the universities set up their project home pages and shared the data. Kyung Hee university is in charge of the topographical map, the picture of the building around the site, and the drawings in their home page. Osaka university is in charge of providing various tools such as groupware calendar, bulletin board and web robots database to support multi-user workspace.
3.1. OBJECTS MAKING WITH DATA BASE

Kyung Hee university produced 3D models of the buildings around the site, and added those images and DXF files to their home page. Osaka university downloaded the DXF files from Kyung Hee home page, converted it into VRML for design review at any time on the Internet, and represented it to Osaka university home page. The multi-user work space is made by arranging the 3D objects after the 3D model is produced. Therefore, the participants can review and refine the design in the multi-user workspace.

3.1.1. Standard format for sharing 3D model data
As different modeler (ArchiCAD, formZ, AutoCAD) have been used, the 3D model data is shared by using DXF and VRML format. In an early stage of the project, Kyung Hee university made 3D model and Osaka university made it into VRML. As time goes by, Kyung Hee university have accumulated the know-how and techniques of making VRML and QTVR objects. In this process the participants have communicated by slowly learning various Internet technologies.

3.1.2. Data arrangement with web robots database

A Web Robots Database for data arrangement on the virtual space has been utilized for the collaborative design. The Web Robots Database is used to manage and effectively search the distributed data on the Internet.
format of the List of Active Robots has been changed to a new format which allows more information to be stored, faster updates, and information to be more clearly presented.

The Web Robots Database is composed of a robot, intelligent agents and a search engine: A robot is a program that automatically traverses the Web's hypertext structure by retrieving a document, and recursively retrieving all documents that are referenced; Intelligent agents are programs that help users with things, such as choosing a product, or guiding a user to fill forms, or even helping users find things; A search engine is a program that searches the necessary data through databases of HTML documents gathered by a robot. (Figure 1).

3.1.3. communication with BBS

![Figure 2. Bulletin Board System.](image)

BBS communicates between participants, and record the problems, questions and answers with multi-media data including text, image, VRML and movie. User post a message with a attached file, such as image, VRML and movie. BBS represents the contents which posted with inlined multi-media data (Figure 2).

The representative communication tools have their pros and cons. The characteristic is as follow (Table 1). Comparing these communication tools, BBS is most useful in this project.
3.2. DESIGN REVIEW IN MULTI-USER WORKSPACE

The server of the multi-user workspace has been setup after the background image of the site is completed. The server of multi-user workspace has been composed of a property server, an avatar server and a web server on the Osaka University web site. Both of the universities made 3D models the buildings around the site, and located the models in multi-user workspace. The 3D model data produced by various modeler made by DXF or VRML format are finally converted into RWX format (renderware format). These RWX data is saved in the project server, so that the participants can use it via their own browser. The available data is buildings, facilities, 2D images of human figure or tree, texture materials, 3D vehicles and street furniture.

The participants can review the design using their own browsers whenever they want. They could re-arrange, move, and transform the objects in the multi-user workspace. Also the participants could recognize avatar as a remote representation of human identity and existence, and express the emotion through avatar because it is possible to communicate precisely through these synchronous communication.

After the environmental data is located in a multi-user workspace, the participants can review each of the design alternatives while communicating with each other. The communication tool is BBS and "chat", and the contents of the communication was recorded. As the result of the design review, 3 design alternatives is selected (Figure 3).
4. Conclusion

An architecture design is the result of the teamwork of multi-disciplinary groups such as designer, client and other actors. The design process includes the exchange of information between individual and organizations, and discussions among professionals of the team.

In this research project, professors and students could enter into a shared virtual space which they built, and could review the design interactively. Each participant can see what he/she wants using the interactive functions, such as walk-through and examiners (a review tool which can rotate the object) and non-interactive functions, such as still images and animation, while he/she communicates with another participant.

Each student can review the design in the virtual space made by the professors and students. It is easy to use an authoring tool for making data, gathering opinions of participants on the bulletin board, VRML viewing and application analysis of the shadows from a distributed area. All of them are composed as a modular basis. This design environment makes the design review possible at any stage of design in multi-user work space on the web.
In this study, the possibility of the multi-user work spaces with progressive communication between various actors who are located geographically remotely has been investigated and the realization of the open architecture is partially accomplished.

References


http://206.79.196.34/avata/Avitechn.html
http://sct.mit.edu/dsof/research/design.html
http://www.worlds.net/80/alphaworld/aw-about.html


John S Gero, Mary Lou Maher, “Current CAAD Research At The Key Center Of Design Computing University Of Sydney”, In Thomas K., editor, The Introduction of Technology, CAADRIA96, Hong Kong, April, 1996, p.35-52


Milad Saad, Mary Lou Maher, “Exploring the Possibilities for Computer Support for Collaborative Designing”, In Milton T., Robert T.


Sungho Woo, Yoshihide Takenaka, Tsuyoshi Sasada, “Architectural Virtual Space in Design Education”, In Thomas K., editor, The Introduction of Technology, CAADRIA96, Hong Kong, April, 1996, p.27-34


Tsuyoshi Sasada, “Open Design Environment”, Proceedings of the 4th International