Abstract. The digital tools are most convenient technologies to realize distributed collaborative design environment on the web. A lot of practical design systems have been already developed with researches in the world. On these systems, the digital bulletin board and web-map technologies are generally used to support for group-discussing and exchanging design proposals via the web. But some of them are only possible to store design materials apart on the web and the peculiar interface is not well-optimized for architectural design activities. In this paper, we discuss to develop the collaborative design system simulated of our practical group-work methods. The APEX/VPB & MAP will realize the easy information management with interactive digital bulletin board and map-based interface. Finally, we will report the results of our experimental design studio using with APEX/VPB & MAP.

Keywords: Dynamic Interface; Distributed Collaboration; Geographical Map Navigation; Design Management; Web Archive.

Introduction

In general design projects, architects usually gather and share a lot of documents, photo-images, sketches, drawings, physical and digital models among the design team. They have to deal with a lot of design materials to evaluate fundamental issues of their project and solve them with creative ideas and proposals. In these processes, it is possible to record a huge number of design materials as digital files and make it easy to share them among distributed people on the web. But the amount of digital files tends to be increasing step by step in recent projects. So practically, the web-based distributed collaboration would be difficult ever. There are several reasons. First, each digitalized design materials and information would be recorded apart without adding any relation with each other. In order to get digital material what we
need, we have to seek from numerous stocked files’ repository. Second, these digital repository could not be well-structured for architectural design activities. It is quite difficult to understand the global relationship of fragmented design materials in each project. Third, the technical interface and computerized procedures are too complicated and unfamiliar to traditional architects. It is necessary for us to be provided more graphical interface and accustomed procedures for primary design management.

In traditional architectural designing, we usually use the pinup board and graphical mapping method to discuss a various design issues in the team. These tools are very popular and make it possible to share prior design materials and share the current topics and proposals in the team. Therefore we consider that it is necessary to develop the web-based archives to manage a lot of design resources in the distributed design environments. Then we will offer the graphical and interactive interface and navigation methods simulated by conventional pinup board and geographical mapping method.

**Analysis of Design Activities with Pinup Board and Map**

In order to develop the graphical design interface and information archive to support the efficient collaboration, we observed our experimental design projects and recorded all of our sketches, graphical images, ideas and proposals to describe our design procedures. Then we analyzed and classified them as several procedure models.

**Design Materials of Collaborative Designing**

We have executed three design projects in our students’ design studio. All design materials and updated proposals throughout those projects had been preserved as our team’s collaborative design activities. Then we tried to arrange them as the graphical oblong flowchart to understand what materials and information are needed in each stage of projects. The some part of flowchart is shown in figure 1.

From this flowchart, we could define the procedures how we imagine our design concepts and represent them to others throughout the projects. We found the several types of design materials and classified them into seven categories:

1. Texts of primary keywords,
2. Texts and diagrams for concept making,
3. Photos and 2D graphical images,
4. Hand-drawing sketches,
5. 2D-CAD drawings or 3D models,
6. Animation Movies and Multimedia data,
7. Presentation Board and Drawings.
The Role of Conventional Pinup Board
A graphical pinup board is generally used to discuss the various materials and proposals within the design team. Any participants are able to present their own recent ideas on the pinup board simultaneously. The other participants are able to refer them to know which proposals have been current issues to be considered in their team. We think that the pinup board is very useful to support both of synchronous and asynchronous design collaboration. And it is possible for us to understand the overview of current teams’ activities. The major advantages of the pinup board method for collaborative design are listed below.
1. The current activities of the team are presented graphically on it.
2. It’s easy to browse the recent materials without complicated operations.
3. The materials are handled dynamically and arranged to understand their relationship.
4. The expired and unnecessary materials are covered naturally behind new one.
5. It’s useful to present graphical ideas in synchronous design meeting.
6. It’s easy to add new materials and proposals asynchronously among the team members.

Geographical mapping of Design Materials
We also use the geographical mapping method to understand the local circumstance for site planning. We always make a lot of small pieces of photograph images where to describe the characteristic view and location of the site and put them on the geographical map. It will make it easy to evaluate local issues and review the graphical site situation. We consider that geographical mapping of design materials is very useful and efficient for design collaboration.

APEX/VPB & MAP System
Then we have developed the Architectural Proposal EXchange (APEX) system environment. The APEX/Visual Pinup Board (VPB) will provide the graphical interface to mediate the web-based collaborative discussion alike using by conventional pinup board. The APEX/MAP is geographical archive to browse a lot of digital photos and images and locate them on interactive web map.

System Development
The APEX/VPB & MAP system was composed as online services with current web technologies. We developed it with Dynamic HTML, PHP, JavaScript and Flash ActionScript. We also adopted the Ajax and Google Map API to browse interactive web map. On the server side, the system works on the Apache WWW server and MySQL, free relational database on Linux PC. On the client side, the system is accessible to all network members only with the standard web browser, such as MS IE and Mozilla Firefox equipped with flash player. (figure 2)
Collaborative Working on the APEX/VPB System

The APEX system supports three typical stages in architectural collaboration on the web. It is possible to record various design materials into integrated design information archive. The illustrated flowchart is shown in Figure 3. First, using the ‘Resource Board’, designers can save and share all private design materials as Design Resources with graphical thumbnails icons. They can refer to them at any time in order to reflect on design ideas. Second, using the ‘Personal Pinup Board’, designers can make their own design proposals only by selecting some necessary materials registered on the APEX system. Finally, using the ‘Group Pinup Board’, designers can offer their own proposals to others via the Internet. A set of these design materials and proposals are registered in APEX to review the design process graphically.

Features of APEX/VPB Interface

The Visual Pinup Board interface is integrated entirely to the APEX system and it’s available to manipulate dynamically proposals and materials on web browser. The major screenshots of APEX/VPB system are shown in figure 4. Our implemented functions of Visual Pinup Board are listed below.

1. Navigation method is similar to conventional pinup board and the way of using it is easy to understand.
2. Resources and proposals of design project are displayed as the graphical and suggestive thumbnail icons’ layouts on the web.
3. It’s available to arrange thumbnail icons freely with simple drag & drop operation.
4. Sets of icons’ layouts are preserved as the course of design progress to evaluate design procedure after project.
5. The recorded layouts are reviewed as dynamic animation view on the web.
6. It’s available to add comments graphically with small ‘post-it’ icons to any proposals.

Features of APEX/MAP Interface

The APEX/MAP will realize the geographical map navigation of design materials on the web. All digital images are classified with keywords, media type, direction, user defined tags, geographic position, the time and date taken photo. It’s easy to select the necessary photo images from digital archive and show the results on map based interface. The major screenshots of APEX/MAP system are shown in figure 5 and 6.
Practical Design Studio enhanced with the APEX System

We have already tried a couple of experimental design studios with the APEX/VPB & MAP system in our research group. In these projects, we evaluated the functions of the APEX/VPB & MAP system environment for synchronous design discussion, asynchronous group working and analysis of design procedures.

Synchronous Collaboration: Face to Face Design Discussion

The APEX/VPB system could support the graphical design discussion on a face to face environment. It’s easy to take out the stored proposals and digital images from the APEX’s digital archive. The participants could select a lot of digital photos on the web map interface to examine the site situation and indicate the detail of them in wide projected computer screen on white board. In this environment, we could use the VPB for creative face-to-face group activities. (See figure 7)

Asynchronous Collaboration: Exchanging Proposals among Distributed Team

In distributed group environment, we could exchange design proposals via the web and examine them by asynchronous procedures on the APEX/VPB system. The designer could register his own proposals to the APEX/VPB system as a set of several CG images, drawings and CAD models asynchronously. The other team members and critics could refer them and add remarks to them at any time. These asynchronous design procedures are recorded to the APEX’s archive with time stamp. We could reproduce and review all concurrent and asynchronous team’s activities displayed with the graphical arrangement of the VPB. The screenshots of asynchronous discussion and list view of recorded comments are shown in figure 8.
Figure 8
Registered proposals and critiques are arranged dynamically on the APEX/VPB.

Figure 9
Dynamic animation reviewing and statistical analysis of design project.
Analysis of Design Activities with APEX/VPB
There are some functions to review the historical activities of design procedures in the team. It's available to display the animation and visual chart of the amount of registered materials, classifications, time-stamp and member's name. (figure 9)

Results and Conclusion
In this paper, we discussed to develop the graphical and map based interface simulated of conventional pinup board and map discussing method. It was optimized for collaborative architectural design and management. After our design experiments, we asked the participants about the design procedure in the APEX/VPB system environment. Almost all of them answered that it was efficient for virtual group design on the web and the APEX/VPB made it easy to deal with great amount of design materials. In the future, we will improve this system environment and apply it for more practical design project.

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References