MAKING THE COLLABORATIVE DESIGN PROCESS OBSERVABLE

Visualization of collaborative process in a VDS Project

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Abstract. In collaborative design studio via computer networks, the whole communication could be logged in database. Design Pinup Board is a virtual wall to pin up design ideas and developments, and it plays a roll to provide a user interface to DPB database. The more active collaboration is, the more information is stored in DPB database. This leads to the difficulty of a glance of the process, and time-consuming searching of pinup precedents. This study describes multiple visualization methods as flat and intuitive interfaces to DPB database, instead of a deep hierarchical DBP structure, followed by a short discussion of a case study in a VDS project.

1. Introduction

Many institutions run VDS projects recently, and reveal technical and also behavior issues (Chiu, 1998) (Cheng, 1998) (Morozumi, 1999). From our experiences of the past four VDS projects, DPB which is a only user interface to the communication-recorded database, sometimes disorients students due to the deep hierarchical structure. The more active collaboration, the more information recorded into the database. The hierarchical depth is getting deeper, and users should take time to browse the entire pinups including heavy pictures and movies. Our students really feel uneasy to access to the information they wanted, and feel difficulty of observing and grasping what is going on in the team.

In fact, the entire communication recorded in the database of VDS'99 (10 weeks, 6 groups of three members each) counts up to 4648 pieces of text (281327 characters), 239 pinups of pictures, and 210 comments to the pinup proposals.

Collaborative design works via computer networks became increasingly important to the architectural design and building industry, too. It is easily imagined that larger scale projects have the same problem of user interface to a huge logged data during the collaboration, thus the compilation of a large amount

of pinup design ideas and design developments with comments, chat records, TV-meeting records, e-mails, and so on, can easily make DPB structure complicated.

2. Problems

Through three projects of VDS'96 (Kumamoto University, MIT, and KIT), VDS'97 , and VDS'98 (KIT and Tokyo Denki University), which have been carried out in our research group by 1998, we found many problems left to be solved, based on the analysis of the data logged and experiences. Among them, we feel especially the necessity of a good interface to DPB database, where a large amount of information logged for collaboration.

Figure 1. DPB of VDS'98

Figure 1 is a typical DPB screen, which we used until 1998. This shows just a table of contents within the database stacked on time basis. A user can see just one page at a time, needs to scroll to browse all the pinups and comments. The purpose of this study is to construct a prototype of more effective user interface to DPB database; visualizing methods of DPB database.

3. Team Page and DPB

The team page is a virtual space for each team to collaborate and contains Notice board, Chat utility, and Design Pinup Board (DPB).
Notice board functions as an asynchronous communication media to announce something to all the team members.

Chat utility provides a synchronous communication media like MS Chat module. DPB is used for showing individual design ideas and design developments with a title and comments, adding opinions or discussions onto the previous pinups.

Through this team page, members communicate each other synchronously or asynchronously and collaborate together.

Logs of Notice board and Chat are stored in each database of the system through the whole process for further analysis.

4. Design of Design Pinup Board

Design Pinup Board is a bulletin board system to pin up and to present design proposals and related comments which contains multi-media information, and to argue about design ideas. On DPB, usually a lot of design proposals and related comments are "pin-upped" and it is not easy to browse the whole proposal, neither to select one which a member wants to see.

4.1 REGISTRATION OF DESIGN PROPOSAL AND COMMENT (PINUP)

The registration of a design proposal needs registrant's name, title, URL of thumbnail image, and URL of the design proposal with comments. Users are asked whether it is a new proposal or a "related" proposal to the precedents.
"Related" means improvement, addition, deformation, question, related materials, opposite opinion, and counter-proposal to the precedent design proposal.

Meanwhile during browsing DPB pages, users can register their opinion or idea at any page within the DPB.

These data is stored into the DPB Database of this system, from which the system creates multiple types of visual representations of registered proposals with relationships with each other.

4.2 DESIGN PROPOSAL CARD

The basic format of each design proposal card is indicated as in Figure2. This is a basic representation of a set of registered information, which is created from DPB Database.

The bottom frame has registrant's name, registration date, title, comment,

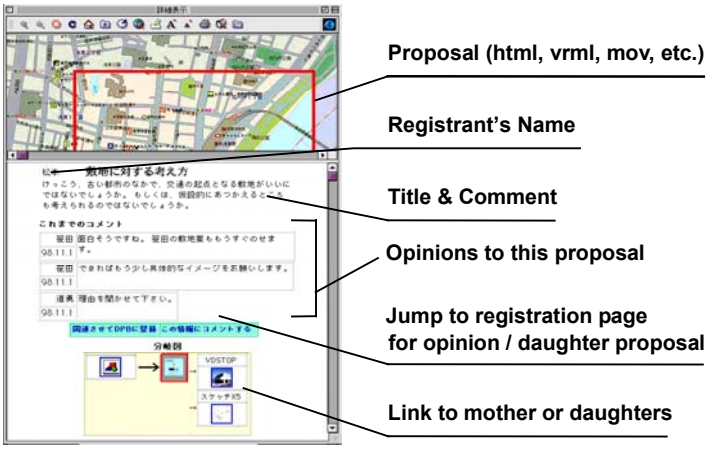

Figure 2. Design proposal card format

opinions toward the proposal, and links to mother proposal and daughter proposals.

A design proposal is indicated in the upper frame of the page. This picture is called up here via Internet from the original file which are located on somewhere in the designer's private web site. Designers can register design proposals with any format adapted to WWW-Browser (html, jpg, mov, vrml, etc), only typing URL of the design proposal file, which is managed by DPB Database of this system.

4.3 METHODS OF VISUALIZATION

In this system, multiple visualizing methods are provided on DPB to facilitate to browse the proposals, to grasp the design process, to find where the team is, and to pick up a specified design proposal and comments. The methods provided on DPB are;

1. Relational chart of design proposals (tree)
2. Relational chart of design proposals ("tug of war")
3. Calendar of the project
4. Time series table of design proposals

These pages are created from DPB Database respectively to represent multiple aspects of the collaboration process (*Figure3*).

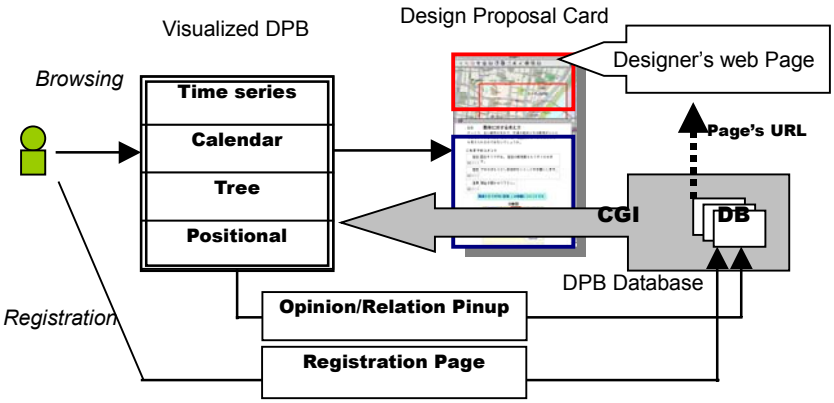

Figure 3. Structure of Design Pinup Board

In order to represent the registrant and registration date implicitly, we adapted the following rules;

A. Each member are assigned a specific color
B. Recent registration is darker in gray scale

Each member is assigned a color at the point of even-divided hue ring, resulting white in the fully mixed-up case. For example, three members are assigned red, green, blue, and six members are assigned red, magenta, blue, cyan, green, yellow, and when each member contributes equally to a resulted proposal, the color of the proposal comes out to be white.
Colors appeared on DPB are the result of interaction between each member.

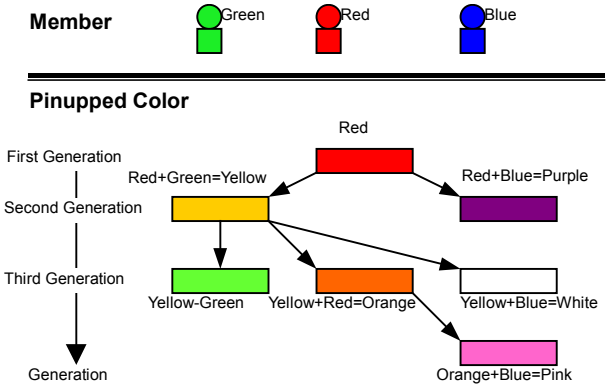

Figure 4. Color mixing on DPB

When a

member assigned green registers a proposal which is related to the existing red colored proposal, the proposal becomes yellow (= red + green).
Figure 4 shows how color is mixed as a result of interaction, and the resulted color seems to represent the degree of cooperation. In other words, it can be judged that vivid color means the individuality, light color means the interdependency. This expression is used throughout DPB.
More design proposals pin-upped, it becomes more difficult to identify which registration is recent or older on DPB without an explicit date record shown. In addition to color segment, another gray scale segment is attached to the color

Figure 5. Color and Gray scale segment

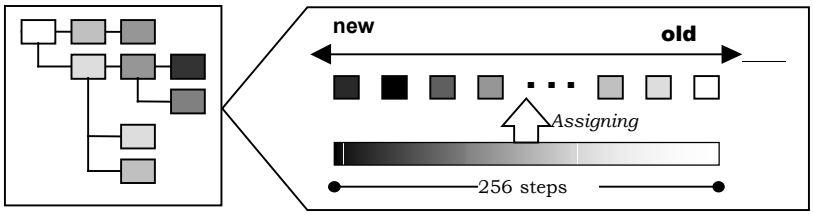

Figure 6. Gray scale of 256 steps

segment to represent the freshness of the registration (*Figure 5* and *Figure 6*). This expression is used in the hierarchical representation and positional representation as follows.

4.4 TREE REPRESENTATION

The tree chart of all the design proposals is indicated in the left frame. When mouse is on the small rectangle which represent a design proposal in the left frame, an accurate registration date is indicated in a pop-up window. And when it is clicked, more detailed information of it's daughter design proposals are indicated in the right frame (*Figure 7*).

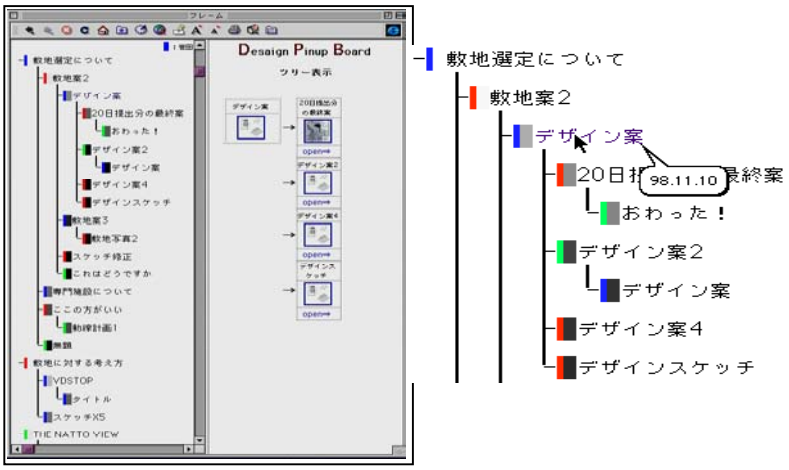

Figure 7. DPB- Tree Representation

4.5 "TUG OF WAR" REPRESENTATION

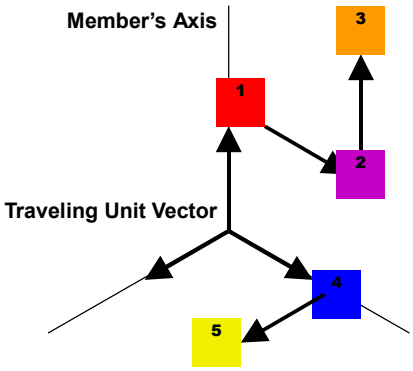

Figure 8. Positional Representation in case of three

Each member is assigned an axis in a planar positional chart. When a daughter design proposal is registered, it is allocated at the point one unit vector apart from mother parallel to the registrant's axis. In other words, "tug of war" of the collaboration can be observed (*Figure 8*).

And we can also observe each member's behavior by checking where proposals allocated (*Figure 9*).

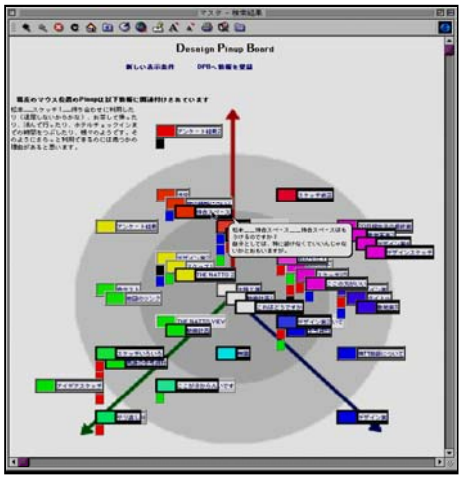

Figure 9. Positional Representation

For example, design proposals around the center could be the result of cooperative work. A lot of proposals distributed between two axis means dense design idea exchanges of the two members, and proposals allocated outer area between the two means only two members densely exchanges ideas each other. Proposals allocated along each axis means each member works independently.

Furthermore, we can guess the tendency and style of collaboration of the team by observing the distribution of the whole design proposals of the page.

4.6 CALENDAR REPRESENTATION

Calendar representation is an another method to show the project schedule and resulted color day by day.

Design proposals registered are attached beneath the schedule bar, of which color indicates the last result of the day (*Figure 10*). It can be observed, by this page, which day design proposals were registered actively and who was most active on that day.

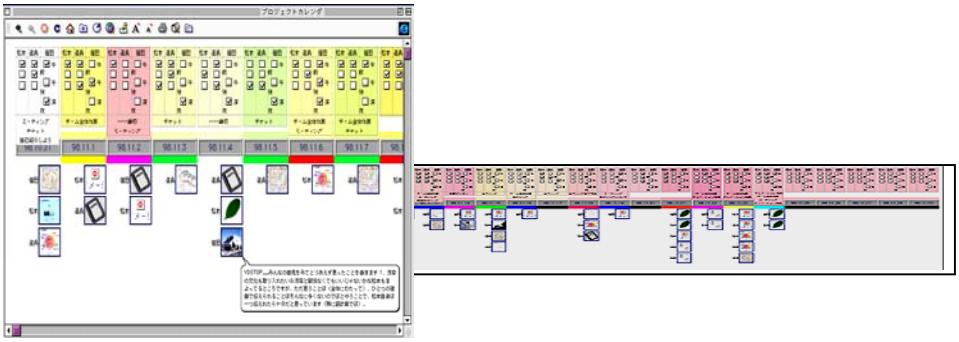

Figure 10. DPB-Calendar page

4.7 TIME SERIES REPRESENTATION

The time series chart has the nearest appearance to the conventional DPB page. Each pinup proposal is stacked to upwards with the date and time of registration.

However, each pinup proposal has a thumbnail picture of design proposal with comment, a color bar calculated according to the mixing rule, and colored squares which show someone's comment to this proposal (*Figure 11*).

Figure 11. DPB-Time Series Representati

5. Discussion and Conclusion

We adapted these visualization methods to VDS99, the project carried out from May to July in 1999. 18 undergraduate students participated to form 6 teams of three students each; two from Tokyo Denki University and one from Kyoto Institute of Technology. They are all novice to the network collaboration, however they are familiar with WEB.

The survey conducted after the project shows that;

- 58% of the students prefer the tree method,
- 58% of the students prefer the "tug of war" method,
- 88% of the students prefer the time series method.

The followings are the opinions of students to each method;

- The registration of the design proposal is complicated and irritating.
- Tree method was used frequently when students wanted to review the process, to find where the student is, and to check the proposal relationship. Students evaluated the convenience to look at a glance of the whole process.

- Tug of war method was used to see the partner's and own contribution, to see just for fun, and to check the hottest topic. However, some students say that the chart is hard to understand, and some can not understand the objectives of the chart.
- Time series method is the nearest to the conventional DPB appearance, and easy to understand. Students say that the chart image is simple and easy to use, and easy to find the newest proposal.

Although some problems are identified through the project and the post-project survey, this study indicates that the real time visualization of collaboration process is useful both to the students and advisors.

The prototype of visual user interface to DPB database improves greatly the difficulties of students for easy navigation and better understanding the situation.

Acknowledgment

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