

# Web-based Communication System for Studio-Centered Design Education

## *An approach for enhancing interactions among students and teaching staff*

*Mitsuo Morozumi, Yuji Murakami, Riken Homma, Yasunobu Onishi, Ryuya Kotani, and Shinya Oda*

*Kumamoto University; Kyushu Tokai University; Ishimoto Architectural Firm Inc., Japan  
<http://morolab.arch.kumamoto-u.ac.jp/>*

**Abstract.** *There have been many successful examples of Virtual Design Studio projects that have used a variety of network communication technologies, showing that interaction among participants enhances performance of the design team. However, the application of VDS techniques to a design studio program conventionally conducted in a studio space still seems to be limited, even though there is a clear need to improve interactions among students and teaching staff. The authors developed web-based groupware, GW-Notebook, and application techniques for a design studio program to enhance interaction in class hours in a studio space and also in off-studio hours, in which members work in separate locations. This paper discusses a model of communication and interaction in a collaborative design studio program conducted in a studio space. It also considers the major features of the developed system, the environment, and method of system usage in different teaching styles, and finally reviews performances of the latest system tested at junior collaborative design studio.*

**Keywords.** *Studio teaching; communication; collaboration; groupware.*

### **1. Background and objective**

With the recent development of network communication technology, the methods and procedures of architectural design have been rapidly changing. There have been many successful examples of Virtual Design Studio using various forms of network communication technology such as web-based groupware and video conferencing systems, and this shows that interaction be-

tween participants enhances the performance of the design team (Wojtowicz, 1995, Kolarevic1998, Hirschberg 1999, Maher 1999, etc.). Moreover, many schools have installed network facilities in studio spaces to facilitate the sharing of various digital design tools in the studio by students and to help them communicate with others through the internet.

However, the application of VDS techniques to a design studio program conventionally conduct-

ed in a studio space still seems to be limited, even though there is a clear need to improve interactions among students and teaching staff. A conventional design studio consists of asynchronous works of students or student groups, and individual consulting with advisers in regard to their projects. Though there are class critiques, such asynchronous working styles have prevented the mutual stimulation of design activities and the students' imagination that would normally occur through daily communication. Since an increasing number of students have started to work with a PC at home or elsewhere, the chances of interaction have become fewer, and even advisors face difficulties following the progress of students' activities.

As it is assumed that programs in a studio space will remain important in design education, the authors developed, in 1998, the first version of web-based groupware for a design studio, GW-Notebook (Morozumi, 1999), and started experimenting with it in a junior design studio program every year (Morozumi, 2001). The early version had been designed to take advantage of the web system mainly as an asynchronous design communication and design information-sharing tool, but the latest version has also furnished various utilities to support on-site design presentation, discussion and critique, so that the system can totally support a studio program conducted in a studio space<sup>1</sup>.

It is the objective of this paper to discuss a model of design communication in the studio; the major features of the old and the latest system; the environment and method of system usage in different teaching styles; and finally to review performance of the latest system in junior collaborative design studio.

## 2. Major features of the early version of GW-Notebook<sup>2</sup>

1) The GW-Notebook is written with VB script as a special web working in an ASP environment linked to Microsoft Access. It applies a simple web structure with a minimum number of pages of fixed format selected for design communication. The system provides three different types of notebook to handle design communication of different levels: a Project-Notebook, a Team-Notebook, and a Personal Notebook<sup>3</sup>.

2) There are four different types of format for these web pages, namely a Data Page format (Figure 1), a Bulletin Board Page format, a Link-list Page format and a Team Minutes page format.

3) Students have their personal notebook as the start point of their work. They archive sketches, models and survey data, classifying all information in folders. When they need to discuss designs for the purpose of organizing a presentation as a team or to share collected data in a team, they transfer documents from the Personal Notebook to a Team Design Page or to other pages as needed.

4) There are utilities to help upload files to a web page and also to link those files to other pages. A directory utility assists the user to archive files to folders defined according to their classification system. It handles document files, spreadsheet files, graphic files, or CAD files of all types.

5) Each page has utilities to display graphic files as both thumbnail images and display size images. With the help of a plug-in, users can display DWG, DWF and DXF formatted 2D and 3D files, and can even manipulate several CAD utilities on a web page<sup>4</sup>.

6) To encourage synchronous design discus-

<sup>1</sup> Chen (2004) discussed similar needs for the conventional design studio.

<sup>2</sup> There were reviews of the early version in Morozumi (2001).

<sup>3</sup> Once a project name, a team name or a member name is registered, the system automatically generates the pages or indexes necessary for each. It is possible to register as many notebooks as needed.

<sup>4</sup> In some cases, such as document files, spreadsheet files, or presentation files, only the file name appears in the graphic area. Clicking the file name will start up the corresponding application if it is installed in the working PC.

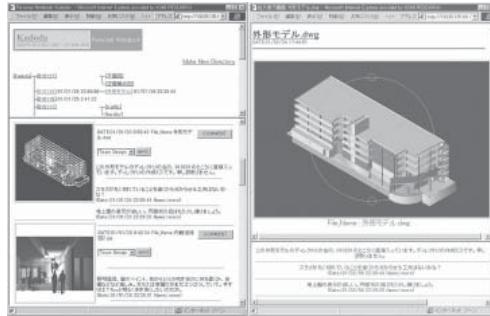


Figure 1 Example of Data Page (early version)<sup>5</sup>

sion, students or instructors use the comment section located beside each visually displayed design document, as well as Bulletin Board pages provided for the project level and team level.

### 3. Major process of communication in class

The authors conducted a fifteen-week collaborative design studio program in the last 5 years. Twenty-five to thirty-five students took the course every year. A remote adviser and several TAs also participated in the studio. Though the studio program included a weekly meeting in a studio space, the GW-Notebook, in different versions, was used as the core of communication among the studio members. The theme was to revitalize a 200m x 200m area of the mixed residential-commercial area that lies behind a downtown shopping street in Kumamoto City. The authors asked students, in teams of three or four, to design a building on some vacant sites or to replace buildings they thought unsuitable for the area after careful site studies and discussion within the team.

Table 1 presents the scenes and activities assumed in the studio program, which were classi-

fied into four groups, according to whether they were synchronous or asynchronous activities and whether they were on-studio space or off-studio activities. It also indicates the participants in each activity and the version of GW-Notebook<sup>6</sup> that was used for each group. The major processes of communication when the early version was used were as follows:

1) A GW-Notebook handles all data produced in the studio on one web server, allowing studio members to upload and share information from network PCs just by accessing the designated URL with any popular web browser<sup>7</sup>.

2) It is used as a pin-up board for asynchronous communication, firstly to present and share design documents among studio members, and secondly to exchange comments, questions and answers among studio members.

3) It is also used as a media of presentation and a reference for synchronous discussions during class hours by projecting its pages with dual PC-projectors.

4) Students access the system through the internet, some from the studio space, and some from home at the asynchronous works stages. The instructors, teaching assistants and remote advisers work from computers in each office when they have time during off-studio hours.

5) When a browser is shared with application software among distant sites and a video conferencing system is used simultaneously, the GW-Notebook will also become a base of synchronous remote communication<sup>8</sup>.

<sup>5</sup> The left section of a Data-Page format shows a directory of user-defined folders. The right part shows a list of data that the user has uploaded to a current folder; with thumbnail images of data and comments and memos typed in for each group of data. Once a user touch the comment button located at each thumbnail image, display size image window appears.

<sup>6</sup> There were revisions nearly every year. This paper calls the system developed in 2000 the early version and the one revised in 2004 the latest version.

<sup>7</sup> Some of the plug-ins, such as AutoDesk-VoloView express may not be supported by the Mac OS.

<sup>8</sup> In the activities that used a video conferencing system, an asterisk is added to the right end column of the Table.

List of Scen and Activiteis	members	GWN	List of Scen and Activiteis	members	GWN
GWN: GW-Notebookotebook	Instructors, TA Students	Early version Latest version	GWN: GW-Notebookotebook	Remt. Advisor Instructors, TA Students	Early version Latest version VideoConference.
<b>SYNCHRONOUS &amp; ON-STUDIO SPACE</b>			<b>SYNCHRONOUS &amp; OFF-STUDIO</b>		
<b>studio lecture</b>			<b>participation to studio lecture via net.</b>		
presentation of reference materials	• ○ X X		presentation of reference materials	•	X X X
presentation of past studio works	• ○ X X				
distribute hand-out reference materials	• ○ X		print out reference materials	•	X
Q&A sessions	• • X X		participation to Q&A sessions through the net	•	X X X
<b>ad-hoc meeting in small group</b>					
presentation, discussion	• X X				
presentation, discussion with mark up	• X				
surveying reference material through the net	• X X				
print out list of reduced graphics on the spot	• X				
<b>design clinic in a small group</b>			<b>participation to design clinic via net</b>		
presentation, discussion, advise	• • X X		discussion, advise	•	X X X
surveying reference material through net	• • X X		surveying reference material through net	○	X X
discussion, advice with mark up	• • X		discussion, advice with mark up	○	X
print out a list of reduced graphics	• ○ X		print out a list of reduced graphics	•	X
<b>design jury with large audience</b>			<b>participation to design jury via net</b>		
presentation, discussion	• • X X		presentation, discussion	•	X X X
presentation, discussion, advice with mark up	• • X		presentation, discussion, advice with mark up	○	X
hand-out printed list of reduced graphics	• ○ X		print out a list of reduced graphics	•	X
<b>ASYNCHRONOUS &amp; ON-STUDIO SPACE</b>			<b>ASYNCHRONOUS &amp; OFF-STUDIO</b>		
<b>individual studio work at desk</b>			<b>individual studio work at home or else</b>		
download files, work with applications	• X X		download files, work with applications	•	X X
building physical models and taking photos	•		building physical models and taking photos	•	
up-pload files of sketch, presentation, report	• X X		up-pload files of sketch, presentation, report	•	X X
writing team minutes	• X X		writing team minutes	•	X X
review of other's work, comments, Q&A	• X X		review of other's work, comments, Q&A	• •	X X
review of reference materials, past studio works	• X X		review of reference materials, past studio works	•	X X
asynchronous Q&A on the work, schedules etc.	• X X		asynchronous Q&A on the work, schedule s etc.	○	• X X
			notice, additional instruction on the work, schedule	○	• ○ X X
asynchronous Q&A on the tool usage	• X X		asynchronous Q&A on the tool usage	○	• ○ X X
			<b>site studies with digital camera</b>	•	
			<b>library or internet survey for refe. materials</b>	•	X X
<b>scheduled meeting among team members</b>	• X X		<b>asynchronous meeting in team</b>	•	X X
<b>ad-hoc meeting among team members</b>	• X X		<b>synchronous meeting in team (celulerphone)</b>	•	X X
data exchange, through the net	• X X		data exchange, through the net	•	X X
<b>submission of report, sketch, proposal</b>	• X X		<b>submission of report, sketch, proposal</b>	•	X X
			<b>preparation for refernce materials</b>		
			up-pload files of reference material	• •	X X
			<b>preparation for the studio (scheduled meet)</b>	• •	
			<b>preparation for the studio (adhoc meet)</b>	• •	
			<b>individual work on system maintnance</b>	•	X X
			<b>announcement on system maintenance</b>	•	X X

members taking major roles • subordinate roles ○ used media media for communication X activities performed in group\_

Table 1 Scenes and activities of design studio program observed at on- studio and off- studio hours

#### 4. Additional features of the latest version and their application to the class

The early version was designed to take advantage of the web system mainly as an asynchronous design communication and design information sharing system. After reviewing the three-year practical experiment with the early version, the author decided to enrich utilities to support on-site design presentation, discussion, and critique so that the system could totally support communication and interaction among studio members.

1) At a presentation or critique, students often want to present many different documents one after another, flexibly changing their order of presentation. To respond to this need, the author designed the presentation mode. Once users put the cursor in the lower part of the window after entering this mode, the system displays thumbnail images of all documents in a selected folder, laying them out in linear fashion in the lower part of the window<sup>9</sup>. When the list becomes long, users can scroll through it using the mouse. Simply by touching one of the images with the cursor, users can display the image of the corresponding document, fitted to the frame. At that time, the thumbnail images are hidden until the cursor is moved to the lower part of the window again. There are also utilities to zoom in and out at the ratio selected in the pull-down menu at the upper left corner of image (Figure 2, lower image).

2) Students frequently wish to present different documents juxtaposed on a display or on a screen. It is also common to present a juxtaposed overall view of presentation documents and their zoomed up image. The latest version has a utility to display two different documents in a juxtaposed position. After entering juxtaposed display mode, selecting one of the thumbnail images with the right mouse

button displays a frame-fitted image of the corresponding document on the right side of the display, and the left mouse button displays an image on the left side. The authors normally use a dual display PC that has dual PC projector output.

3) Mark-up in documents commonly enhances design discussion (Morozumi, 2004). The author tested two different mark-up utilities in a team design clinic. These were software that has a mark-up utility for a PC, mimeo mouse, and a utility furnished in a PDP display device (Figure 3). The former required a user to capture the image of an application window and paste it into the system before the mark-up operation. This process was complicated and disjointed for users. As this software lacked a utility for zooming up on part of a captured image, it prevented discussions on details of the document. The latter utility allowed a user to easily capture the displayed image for mark-up and zooming operations. However, because the system used a mechanism of digitally zooming up a captured image at the display resolution, the zoomed-up image failed in providing the resolution necessary for discussing detail. Use of the expensive PDP display was another barrier.

4) The latest version introduces a utility that allows a user to place markup on a transparent window at the same resolution as the displayed data. As this window is overlaid on a designated window of the GW-Notebook, the user can easily zoom in to discuss detail and zoom out to discuss the total image. It has utilities to draw or erase freehand lines, to draw simple geometric figures with mouse action, and even to save 10 different marked-up images as a temporary file for each window in one sequential operation (Figure 4).

5) Learning places is an integral part of design studio. The digital camera has become quite a useful tool for recording place features but studios still face difficulties in smoothly sharing place informa-

<sup>9</sup> In order to display the list of thumbnail images instantaneously in many parts of the system, the authors developed a utility to generate a reduced size image of documents that use the major formats.

tion, or even effectively archiving it in relation to spatial organization, especially when the collected data size is large. To support site analysis in the studio, the authors developed a utility to archive and display digital photos or sheet form documents on a map or drawing image on a web (Onishi, 2005). These documents can also be used from normal pages for different stages of the work.

6) Taking memos in a design jury or a small group design clinic is a difficult task for studio members, especially when many documents are presented. To support audiences or reviewers when taking memos or making comments, the system furnished a utility to print out reduced images of the documents registered in any folder of the GW-Notebook. It provides several formats in A4- and A3-sized sheets.

7) Finding methods for developing the class awareness of students is an important task in online education (Naka 2004). A design studio program faces similar problems when students prefer to work with a PC at home or other places away from the studio design studio. The system introduced a utility that displays small photos of the students who are working with the system.

## 5. Observation and discussions

In the studio of 2004, thirty-five students, forming 9 groups of 3 to 4, uploaded 1396 data files to the Personal Notebook. The total file size reached 978 MB. The system has almost eliminated busy web maintenance work, and students could concentrate on their design projects. As the system used thumbnail images, it allowed smooth operation even when 30 to 50 documents were displayed in one data page at the same time.

The authors conducted a questionnaire on system use after the studio, and 22 students submitted their answers. Major findings were as follows:

1) They positively evaluated the environment of the design jury that used dual projectors for presenting student work uploaded to the GW-Note-



Figure 2 Design Jury that Used Dual PC Projectors and a Display Image on the PC Used

book. Seventeen respondents said that design documents projected onto large screens helped them understand the presentation better in comparison to a presentation in a conventional studio using paper drawings and physical models. Eighteen respondents said that GW-Notebook utilities in the presentation mode helped them make a smooth presentation. Features that were evaluated as helpful were selection and switching of presented documents by pointing at the thumbnail image list, juxtaposition of two different documents on a dual screen, and use of the zooming utility during explanations.

2) In the small group clinic, the author used a PDP display with mark-up and zooming utilities. Fifteen respondents said that the presentation using the mark-up utility was helpful for discussion, and fourteen said that they reviewed the marked-up images uploaded to the system in the later works. When students brought physical models or hardcopy sketches, they frequently captured the



Figure 3 Use of Mark-up Utility in PDP Display and that of Mimeo Mouse

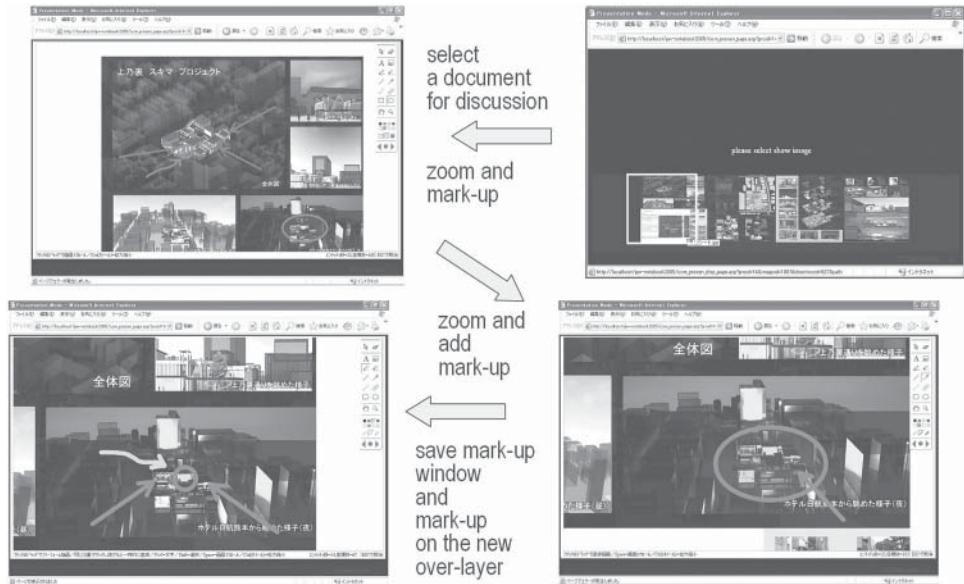


Figure 4 Use of Zoom and Mark-up Utilities Developed for the Latest Version

images with a digital camera and shared discussion using mark-up utilities over those digital images uploaded to the system. But many felt that the resolution of the zoomed up images lacked the resolution necessary to discuss detail. Though the author did not have a chance to test the mark-up and zooming utility of GW-Notebook in a class, the authors intend to test their operation in a practical situation soon.

3) In the off-studio hours, all respondents said that they reviewed the work of others using the system, and that this helped their own work very much. Twenty-one out of twenty-two students also said that the comments uploaded to the work of others, as well as the comments on their own work, was quite helpful in exploring ideas. But there were negative reactions to the size of PC display they used. Twelve students said that the PC display was too narrow to observe design documents properly, especially to observe a pair of juxtaposed documents. Considering the positive evaluation of the design jury that used a dual screen, juxtaposition

and comparison of documents are quite important operations that the digital environment needs to be improved. A few hesitated to see their photos appeared on the window, but thirteen out of twenty-two respondents answered that they felt encouraged or could recover calmness when they could recognize that many other classmates also had been working at that time.

## 6. Future works

As the mark-up and zooming utilities cannot provide workable operation when shared between remote designers, the authors intend to redevelop the utility using a flash server system.

This paper dealt with interaction in a studio program among studio members. However, it is also believed that a design studio could provide an environment for learning various subjects taught in different classes as an integrated knowledge or technology through cases. Oxman discussed the need for a requisite pedagogic framework for de-

sign education before developing a virtual design university that must put the design studio at the center of the program. Another challenge for the authors is therefore to design a process of interaction and the necessary utilities with which an instructor of other classes could communicate with studio members using cases dealt with in the studio, and with which studio members could review the content of other classes.

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