THE PROJECT OF VIRTUAL LABORATORY FOR INFORMAL COMMUNICATION ON GIGABIT NETWORK

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Abstract: As the computer network technology has evolved, the Internet has spread out to include variety of users. They get together and create communities on the network, so that virtual relations between people have been emerging. Many such virtual communities use chat rooms, mailing lists and message boards making use of the existing applications. On the other hand, informal communication such as a chat and private conversation during a break at a conference, has been recognized important. We often come across a good idea when having relaxing conversations. In a daily life, we have various environments for informal communications which are necessary for keeping relations with the others even for having better formal communications. However, it is not so easy to have an environment for informal communications in a cyber space on the Internet when only relying on the existing applications. In this research, we try and use some new experimental informal communication tools in our virtual laboratory environment in which several universities are interconnected with Japan Gigabit Networks (JGN) /ATM. First, We have set up a CCD camera at each laboratory and deliver streaming live video to share the environment. Then, we constructed a meeting system using Microsoft Netmeeting and OpenMCU. In addition, we implemented on-door communication systems using the metaphor of a door on WWW as a media for novel types of informal communications. In this paper, We explain the summaries of experimental environment and the supporting applications for informal communications. We also let students to take the main role of communications so that they use tools for their informal communications in a realistic way.

1 INTRODUCTION

As the computer network technology has evolved, the Internet has spread out to include variety of users. It is no more only for researchers and the company employees but for individuals, as well. Those individual users have access to the network from their home. They get together and create communities on the network, so that virtual relations between people have been emerging. Many such virtual communities use chat rooms, mailing lists and message boards making use of the existing applications.

On the other hand, informal communication such as a chat and private conversation during a break at a conference, has been recognized important (Kraut et al., 1990; Whittaker et al., 1994; Isaacs et al., 1996). We often come across a good idea when having relaxing conversations. It is more likely for researchers to create new ideas through informal communications rather than through the formal communication such as the ones at a laboratory seminar and a conference. In a daily life, we have various environments for informal communications which are necessary for keeping relations with the others even

for having better formal communications. However, it is not so easy to have an environment for informal communications in a cyber space on the Internet when only relying on the existing applications.

In this research, we try and use some new experimental informal communication tools in our virtual laboratory environment in which several universities are interconnected with gigabit networks. We let students to take the main role of communications so that they use tools for their informal communications in a realistic way This paper reports our experiment.

The paper organization is as follows. The next section describes about the concept of informal communication. Section 3 reports on our gigabit network environment in which we use our tools. Section 4 presents our informal communication tools for virtual laboratory environment. Section 5 discuss applications of those tools in our virtual laboratory, and Section 6 gives some conclusions.

2 INFORMAL COMMUNICATION ON THE INTERNET

The informal communication is generated by an encounter and a conversation without any deliberate plan but by chance (Fish et al., 1990; Matsuura et al., 1993). Generally, the nature of conversation during a coffee break in a work place or interaction with people after work is impromptu. Conversations are real-time. Facial expressions are of a great help to know what the partner has meant by his/her words.

In order to achieve a real-time conversation on the network, people often use a chat system instead of e-mail. However, the chat system is not able to give us people's facial expression because it is a character-oriented communication tool. Therefore, in order to implement informal communications via computer network, a method that can easily tell what you think and feel is necessary.

In order to tell your present state of mind, emoticons are used in the communications using characters such as chat and e-mail. An emoticon is a combination of characters that resembles the facial expression of people to express sadness, happiness and anger, etc. Indeed, it is a simple way to express our feelings, however, multimedia data such as audio or video may offer better opportunities to transmit them.

Supporting the informal communications using multimedia data, has been researched in the area of Computer-Supported Cooperative Work (CSCW) and Groupware (Fish et al., 1992; Nakanishi et al., 1996; Obata and Sasaki, 1998). As the bandwidth of networking became popular, TV conference systems were used extensively, and the multimedia environment was created with the virtual multiple connections. However, such systems were basically used for formal communications such as a conference and a lecture because the systems were constructed on the infrastructures that were not widely available and expensive to install.

Moreover, they were not built on an universal infrastructure that was easy for a user to operate (Isaacs et al., 2002). That is why only a few of them are now in practical use currently.

In this research, we verify our tools for informal communications on the Internet in terms of usability and operability on the network. In the experimental work, firstly we interconnect the universities in remote locations by network to construct an informal communication environment. Secondly we develop several applications and perform examinations for verification.

3 EXPERIMENTAL NETWORK

We have built a research network, called VL (Virtual Laboratory) Network to connect the geographically distant universities by gigabit networks.

VL Network makes use of ATM link of the Japan Gigabit Network (JGN). JGN is a governmental network designed for research and development of very high-speed networking and high-performance application technologies. JGN consists of nationwide high-speed optical-fiber networks with ATM switches. The ATM switches are located in ten places and are connected to each other by very high-speed optical-fiber links. Fifty four nodes are connected to the ATM switches presumably to let researchers have an access to the network from anywhere in Japan. VL Network interconnects five universities, Iwate Prefectural University, Kyoto University, Kyushu University, Kyushu Sangyo University, and Saga University.

Figure 1 shows the configuration of the VL Network. In this figure, the connections of Kyushu Sangyo University and Saga University are presented by a dotted line, because they are yet to be connected. Figure 1 shows the IP layer. The universities are interconnected in full-mesh on ATM layer. Therefore, we can change network topology easily.

The VL Network is connected to the global Internet via the QGPOP network. QGPOP, Kyushu GigaPOP Project, aims to build a dedicated R&D Internet in the Kyushu region with commodity Internet, focusing on the Internet's end-to-end principle and new features such as IPv6, multicasting, and Mobile IP. QGPOP is connected to Korean Research Network at 1Gbps via KJCN, the Korea-Japan Cable Network. In this way VL is connected now to Korean Research Network with very high speed. We are planning an experiment for the international informal communication using multi-languages.
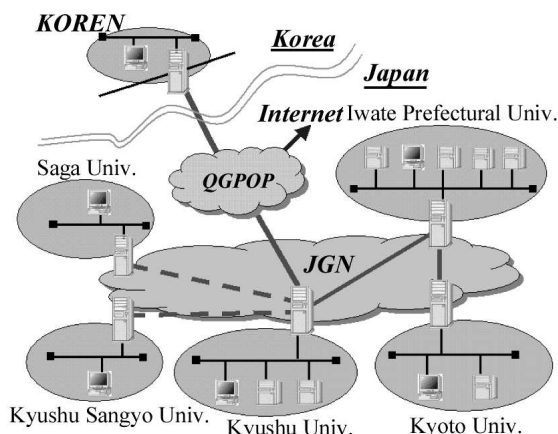
Figure 1: Configuration of the VL Network.

Figure 2: Environment sharing by using RealSytem.

4 STUDY ON THE SUPPORT FOR INFORMAL COMMUNICATION

In this section, we introduce some of our tools to share the VL environment. We had some experiments using those tools to have a chat or making contact with users of other universities on the VL Network.

In addition, we explain the outline of each experiment conducted on the VL Network.

4.1 Environment Sharing by using Streaming Application

We have set up a CCD camera at each laboratory and deliver streaming live video for 24 hours using the RealSystem (freeware version) to share the environment. When using RealPlayer, only one video of a laboratory is available. In this experiment, however, we use SMIL (Synchronized Multimedia Integration Language) file so that the videos of all laboratories interconnected can be seen simultaneously. Each live video which is delivered by using RealSystem is shown in Figure 2. We set the bandwidth of the live video to be delivered between 250 Kbps and 450 Kbps so that high quality video can be obtained to share the environment visually.

Although the above method is effective for sharing a visual environment, we found that interactive communication did not go so well because of the large delay in the delivery of the live video information.

4.2 Informal Netmeeting by using OpenMCU

As interactive communications using RealSystem did not go so well that we constructed a meeting system using Microsoft Netmeeting and OpenMCU (Open Multi Control Unit). OpenMCU is a freeware application which is equipped with ITU H.323 teleconferencing protocol. In the meeting system with OpenMCU, 4 users can be displayed at the same time.

The experimental result shows that both video and audio could be transmitted and received all right when the number of users were less than five. However, noise was generated in the video and audio because some hardware systems at laboratories were not compatible with one another.

Even in the case of five users or more, only four of them appear on the display in the order of receiving audio information; the system shows only four parties at most on a display. If the fifth user who is not currently on the display, starts to speak, he/she will appear on the display taking a place for one of the four users. This way the conversation is suddenly interrupted. To solve this problem, we need some control on who speaks next so that all users can join the conversation smoothly. However, such a control does not fit with the nature of informal communication which should be impromptu and unplanned.

We conclude that the conversation using OpenMCU allows only less than five users to join. Regarding the conversation including five or more users, we need to develop a new application. However, the communication system which can deal with an unlimited number of users may cost much. It is important to determine up to how many users can join the conversation when designing a system for interactive communication using video and audio. The result of evaluation is shown in Table 1.

In the communication using Netmeeting, users

Table 1: Evaluation results.

Number of users	Evaluation
4 or less	Transmission/reception of video and audio was completed all right. Noise was generated due to the incompatibility of hardware
5 or more	The conversation was interrupted because the display switched quickly upon speech of the user. Someone had to control the conversation, so that the request of the informal communication was not satisfied.

sometimes could not hear each other well because of the low quality of audio. In addition, we found that it was more useful that users would be able to input character information including URL and file names. To comply with this situation, we added a chat system so that the communication would go on smoothly. The chat system also contributed to enhance smooth informal communication; it enabled all users to share specific information such as network addresses which would be understood better by writing. Figure 3 shows an actual informal communication using Netmeeting and a chat system.

4.3 On Door Communication

We try and implement communication systems using the metaphor of a door on WWW as a media for novel types of informal communications. We call those communications through a door "on-door communications", and presume two types of systems. The first one is a system for a chat at a net door, and the second one is an on-door message board.
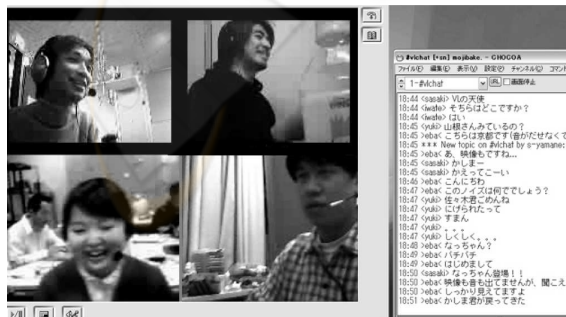

Figure 3: Informal communication by using Netmeeting and chat system.

4.3.1 The On-Door Chat System

To realize informal communications, we apply chat system as a method for supporting communication with video and audio. In addition to the conventional chat system which uses only characters, we add the metaphor of a door so that the on-door chat system is implemented to realize a chat in front of the door virtually (Suzumura et al., 2002).

Our on-door chat system provides two awareness tools, viz. knock and shadow. A knock on the door is used to let the others notice the arrival of a visitor at the door with an auditory signal.

A shadow indicates the existence of visitors as well as that of the door owner. When the owner is in the room, the light can be seen through the door window as well as the owner's shadow. A visitor gives a knock on the door and starts chat with the door owner. If the owner is not available but any other visitors are out there, their figures can be seen outside the door, so that the new visitor can join the others in chat. If no one is around, the visitor can leave a message on the chat board. When a visitor comes across at the door, his/her shadow is generated outside the door so that the owner and the other visitors would notice the new comer.

A door is implemented as a web page. A server system for generating a door web page functions as a door dealer. A user (i.e. an owner) gets a door page from the door dealer. A chat system is presented on each door page so that the visitors can have a chat. A knock on the door is used to let the others notice the arrival of a new visitor at the door with an auditory signal. When an owner has connected with a door, his/her shadow appears on the door window, whereas the shadow of visitors appears in the foreground of a door. We added a feature so that we could have some more sounds, which show users' emotion as well as their associated texts (i.e. emoticons) than merely a knock sound. For example, clicking "LAUGH" button gives an icon, ":-)". A knock produces a text "Knock!" on a chat line. Figure 4 shows an example of our chat board.

4.3.2 The On-door Message Board

We discuss the message board for supporting the system of informal communication. The message board system which is used on VL Network is called "on-door message board" (Segawa et al., 1999; Murayama et al., 2001; Segawa et al., 2002).

The idea of our on-door message board is to bring a message board on the door of a room in a student hall of residence into the WWW environment. We have developed a message board system on WWW for asynchronous communication, which provides users with simple tools for drawing (Murayama et al., 2001;
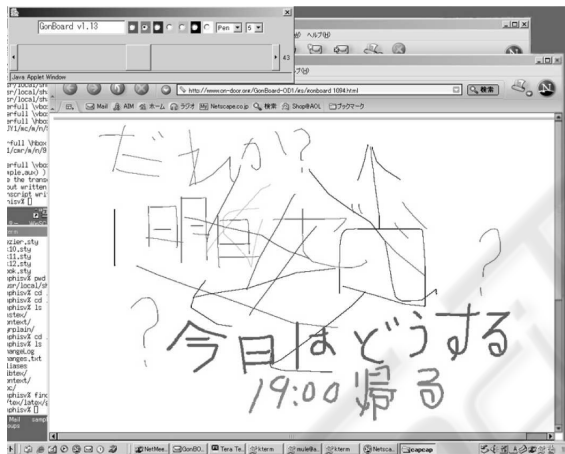
Figure 4: On-door chat system.

Figure 5: On-door message board.

Segawa et al., 2002). Letters are coded as a collection of lines. On this board, any message can be written by hand making use of a mouse and a tablet. We add the time visualization function so that messages in past will be fading out gradually.

We find the system useful specifically when we are having a discussion using Netmeeting within the virtual laboratory, one can express his/her idea in an image in a cooperative manner; that is one can add image objects such as lines and letters onto the figure image drawn by some others. Figure 5 shows the message board.

We have not tried the extensive use of the time visualization function yet, and shall try and use this function in fugue experiments to figure out in what occasion the function is most useful.

4.4 Access from External Network by VPN

We have an access control on applications on the VL Network so that they are permitted to use only by the authorized users inside the VL Network. Those outside the VL Network are not allowed to access the experimental environment of VL Network. However, we consider it very important that authorized users can join the community from anywhere without restrictions to implement informal communications. For this reason, we use a Virtual Private Network (VPN) so that those authorized ones outside the VL network can also access VL Network and join the community. For example, in Kyushu University, the Faculty of Economics, which is outside VL network, is connected to VL network of a graduate school of Information Science Electrical Engineering by using VPN technique. (See Figure 6.)

As an extension of the VPN technique, we implemented Dynamic VPN (DVPN) (Kashima et al., 2003). DVPN allows a connection to VL Network from a user's home which is connected to a commercial provider where the IP address changes dynamically. As a result, all the authorized users who are registered with VL Network can access the VL Network from anywhere to join informal communications on the Internet (Figure 6).
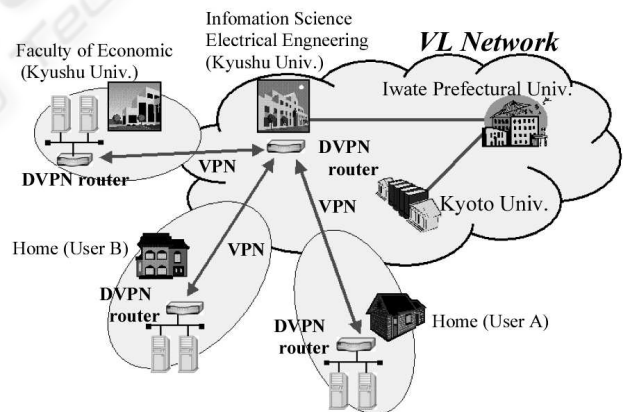

Figure 6: VL Network with DVPN system.

5 APPLICATION FOR VIRTUAL LABORATORY

We have performed several experiments. We constructed a virtual community on the Internet in order

to promote communications among students. Thorough our experiments, we found that the academic knowledge exchange of students in remote places was promoted by means of virtual laboratory environment. In future, we shall look into how the education based on informal communications would work by organizing voluntary seminars so that students have more opportunities to learn from each other.

In the future, we will also consider how to enjoy the Internet when making evaluations of the communication system. As the first step, for discussing the environment sharing, we have already conducted experiments of an e-party in which users could join from remote places via network. The experiments were performed by broadcasting a party at a laboratory in real time. After several e-party experiments, we found that the followings, with which a new system should be realized, were necessary for supporting informal communications.

- a method to transmit video and audio smoothly (for a place connected to low-bandwidth network)
- sharing the display by multiple users
- the development of easy-to-use user interface

6 CONCLUSION

In this paper, in order to clarify the problems for realizing informal communications on the Internet, we reported our VL project to construct a virtual laboratory environment in which several universities were interconnected with gigabit networks. We then explained the summaries of experimental environment and the supporting applications for informal communications.

In the future, we will evaluate these applications in detail and look into the problems. We will then develop new applications and systems. Moreover, we will perform network construction and experimental operation with the next generation protocol, IPv6 on the VL Network. Finally, we would like to let those applications work with IPv6.

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