DEVELOPMENT OF WEB-BASED COLLABORATIVE CONFERENCING FOR DISTANT LEARNING

RESEARCH PROJECT FIRST-TERM REPORT

SUPERVISOR

PROFESSOR MICHAEL RUNG-TSONG LYU

PREPARED BY

MA KA PO (98080150)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
THE CHINESE UNIVERSITY OF HONG KONG

Abstract

Advances in multimedia technologies and high-speed networks and Internet technologies lead to new types of teaching and learning. Various digital media may be integrated and distributed via networks, such that they are available in arbitrary places and at arbitrary times (independence of space and time). It allows the geographical distribution of teachers and students who are connected via fast networks and who two-way communicated synchronously. Compared to traditional distance learning this allows for a higher degree of interactivity and usage of new instructional media such as digital animations or simulations. A major goal in developing synchronous collaborative works environments are desktop video-conferencing systems, which mostly audio, video, and joint editing of documents is supported.

Contents

1 Introduction

The World Wide Web (WWW) is being used as a strong educational technology undoubtedly.

Nowadays, using computer networks has become part of students' life. Students can easily connect to Internet with their personal computers or using the computer laboratory facilities. Since the WWW technology provides the transparent access to anywhere for information ignoring the geographical distribution. Everyday students login to obtain new information, to do their homework or just to talk with others. On the other hand, instructors try to convert the traditional course material for use on the Web. Also assignments, problem sets, quizzes and tests are available too [6].

The Web provides a platform for delivering not only the text materials that a class might need, but also the multimedia requirements as well, including audio and video streams of instructor lectures. Students can view the on-live presentation from the instructor by the web browser in real-time. However, responses from students are always restricted to text-based chat or e-mail.

This text-medium feedback path has shown moderately effective for supplementing self-study in subjects which do not require audio or manipulation of visual aids (e.g. a whiteboard), but it does not come close to approximating the auditory and visual interaction which characterizes the traditional classroom. It is unsuitable for subjects like spoken languages, mathematics, and many science courses.

Through advancements in compression technology and conference server bandwidth management it is now possible to exchange audio, whiteboard, and video information via a computer network, including the Internet. To date, however, there has been little exploitation of low bandwidth (i.e. analog modem) Internet conferencing for on-line instruction.

In this paper, we purpose to implement a desktop conferencing system for effective communication between instructor and students distributed geographically. There are totally five sections including Introduction, Web-based education, and Multimedia conferencing system, Design of web-based collaborative system and Conclusion.

2 Web-based Education

Up to date, many classes use to conduct in classroom where teacher/lecture present her materials through speech, motion, slides or writing notes on blackboard. These classes mainly are dominated by the teacher, either on the covered materials or on the pace of the course.

Because of the rapidly grown WWW, classes can be existing over the networks. The major difference between the web-based and existing education flow is students/learners can choose their own paces for learning. They can skip those materials that they have already learned or known and they can replay the course that they were not thoroughly understood. Thus web-based learning removes the constraints of restricted schedules and encourages intuitive motivation of students.

Besides, there are many advantages of web-based education:

- ✓ Interactive;
- ✓ Multimedia;
- ✓ Just-in-time delivery;
- ✓ Multi-platform;
- ✓ Easy updates;
- ✓ Efficient distribution of information;
- ✓ Available on demand, when needed;
- ✓ Ignoring time differences;
- ✓ Available from any locations;
- ✓ Flexible presentation formats;
- ✓ Flexible (network) delivery systems.

On the other hand, the web-based education system needs to overcome the deficiency of face-to-face feedback from students to instructors. Instructors always scanning the audience and looking for tiredness, lack of interest, understanding and distractions. He may alter the pace and vary the contents in accordance with the feedback [7].

Many universities and private organizations offering on-line courses attest the value of the Internet in enhancing distance learning. However, most of these programs lack the real-time interactivity of a classroom, being essentially correspondence courses, which use email and web pages in place of printed material. In recent years a few interactive on-line programs have appeared. One of example is MWPS, which discussed in the next section.

2.1 MWPS

MWPS is a Chinese version of NCSU Web Lecture System (WLS, see http://renoir.csc.ncsu.edu/WLS), that supports construction, editing, and management of Web-based presentations, and synchronous and asynchronous capture and delivery of classes and lessons. The presentations consist of HTML documents with streaming synchronized audio and video. The video can be of the low-bandwidth variety or it can be MPEG-2. Low-bandwidth MWPS lesson can be received over ordinary modems and telephone lines. MWPS contains an on-line editor that allows instructors to prepare slides for delivery. The system captures audio and timing data during live presentations and automatically creates a web-deliverable version of the presentation. All of the details of the underlying system are hidden from the users, both instructors and students. MWPS allows users view a presentation using a standard Web browser, such as Netscape, and listen/watch to the accompanying streams via a RealSystem player. The system also has the ability to deliver live presentations with student interaction. Its home page (http://www.cse.cuhk.edu.hk/~lyn9804) is shown in Fig 1.

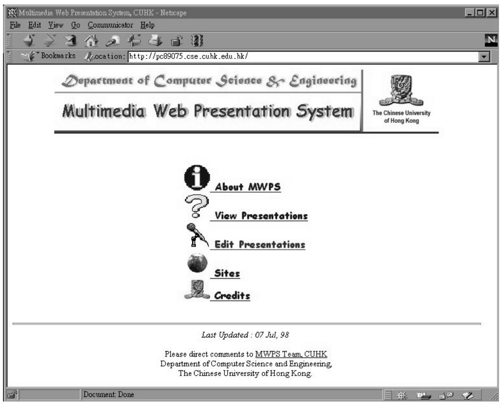

Fig 1: Multimedia Web Presentation System Home Page

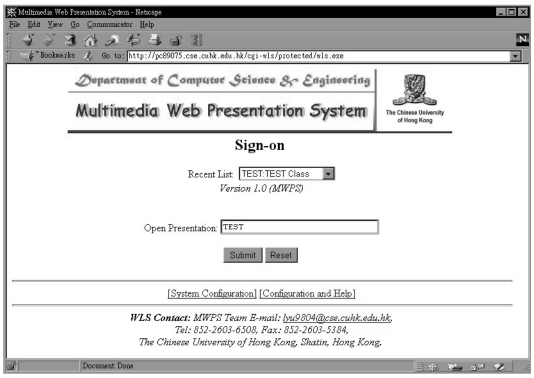

Fig2: The Sign-on page for the lecturer

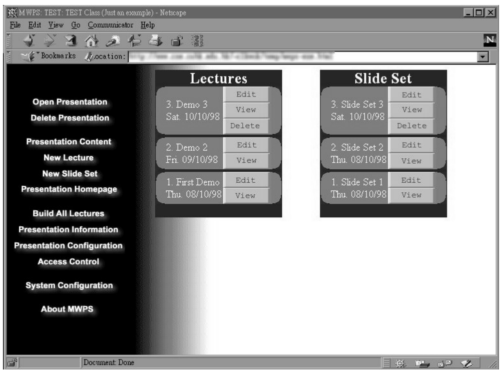

Fig 3: MWPS Lecturer Editing Main Menu

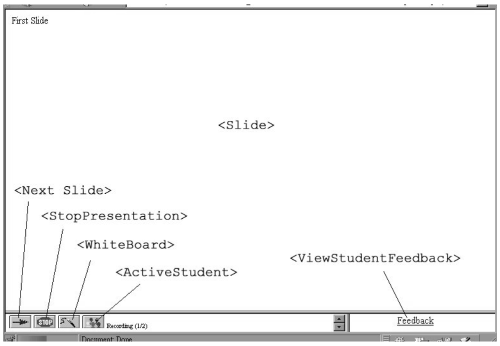

Fig 4: Presenting Screen

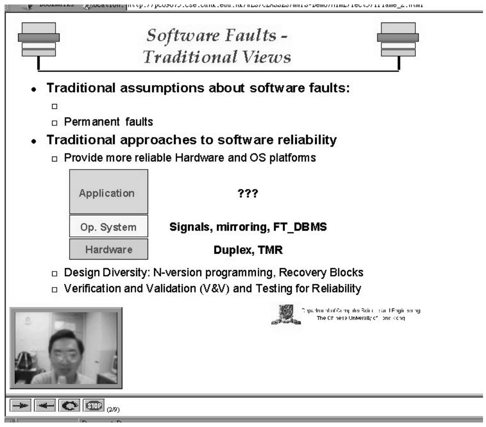

Fig 5:Review presentation in playback mode

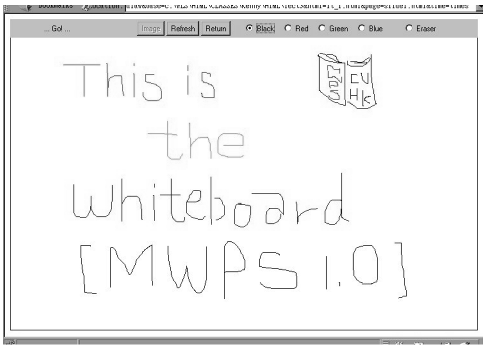

Fig 6: whiteboard

3 Multimedia Conferencing System

A multimedia conferencing system is an on-line real-time system where the multimedia information is generated, transmitted, and presented in real-time. As the number of participants and locations of the conference increase, the resource demands will also increase. The system primarily deals with creating digitized video, digitized voice, data, images, and graphics and transmitting such information across a communication network so that it reaches the destination(s) in real-time.

3.1 Basic Concept related to Multimedia

3.1.1. Definition

Multimedia denotes the property of handling a variety of representation media in an integrated manner, where representation media is related to how information is described (represented) in an abstract form, for user within an electronic system.

It is necessary for a multimedia system to support a variety of representation media types including text, graphics, animation, audio and video.

3.1.2. Characteristics of multimedia

Those audio, video and animation are defined to be continuous media. Continuous media types are those with an implied temporal dimension: items of data must be presented according to particular real-time constraints for a particular length of time. In contrast, discrete media types have no temporal dimension. Examples of discrete media types include text and graphics.

3.1.3. Assessment of the demands of digital media

Calculation of basic data requirements for storage or transmissions of continuous media types are presented in Table 1.

Media type	**Average bandwidth (Mbits/s)**
Voice	0.064
High-fidelity audio	1.0
Slow scan video	80
High-quality video	200

Table 1 Demands of digital continuous media

The above table just shows general illustration only, as bandwidth requirements can vary dramatically depending on the precise parameters associated with the encoding (such as the frame rate or resolution for video). These figures can be reduced considerably by the use of appropriate compression techniques.

The key objective of compression is to reduce the quantity of data by removing redundancy. The success of this process can be measured by the compression ratio achieved. However, executing a compression algorithm takes time. The better the compression ratio, the longer the calculation takes.

The compression technique for image and video, MPEG, is used in the proposed system. MPEG (Motion Pictures Expert Group) has developed a compression standard within ISO specifically designed for the compression of video and its associated audio track.

3.2 The challenge of multimedia for video conferencing

Support for continuous media

The use of continuous media, such as voice, video, in distributed systems implies the need for continuous data transfers over relatively long periods of time; for example, playout of video from a remote conferencing camera. Furthermore, the timeliness of such media transmissions must be maintained as an ongoing commitment for the duration of the continuous media presentation.

Real-time synchronization

Synchronization refers to the maintenance of real-time constraints across the continuous media connection. Usually in video conferencing, more than one media type needs to be maintained. Examples of inter-media constraints include lip synchronization between audio and video channels or synchronization of text subtitles and video sequences. Synchronization mechanisms must operate correctly in a distributed environment, potentially involving both local and wide area networks.

Multiparty communications

There are several aspects to group support for multimedia. Firstly, it is necessary to provide a programming model for multiparty communications (supporting both discrete and continuous media types). Facilities should also be provided to enable management of such groups: for example, providing support for joining and leaving of groups at run-time. Secondly, it is important to ensure that the underlying system provides the right level of support for such communications, particularly for continuous media types. Thirdly, with multimedia, it is necessary to cater for multicast communications where receivers may require different qualities of service. This adds some complexity to quality of service management. Fourthly, it is important to be able to support a variety of policies for ordering and reliability of data delivery.

3.3 Internet Technology for conferencing

3.3.1. Bandwidth requirement

Bandwidth is the major bottleneck associated with conferencing system over network. Conferencing is a form of communication, which is the transfer of information from one place to another. The connection between the two remote sites through which the information flows is called a communications channel.

Sending video through a communications channel requires a lot of bandwidth. The picture on the monitor is made up of very small dots called pixels. Suppose we wanted to send video that used a 300x200-pixel picture. For each of the pixels in the picture there is a corresponding byte of information that describes the pixel's color. Thus there are 300 times 200 pixels in the picture. That's 60,000 pixels or 60 kilobytes of information for just one frame of video.

Video is made up of many frames. A TV picture for instance displays about 30 frames every second. Since the human eye is relatively slow, compared with electricity at least, it perceives 30 sequential still pictures as continuous movement.

This means that we would like to send 30 pictures through the communications channel each second. That's 60 kilobytes times 30 pictures per second or 1.8 million bytes per second. If we are using the most ubiquitous communications channel in the world, a telephone line, it will take around 30 minutes to transmit 1 second worth of video [8].

3.3.2. MBone

The MBone is a virtual network implemented as a subset of the Internet. It uses the IP-multicast protocols to provide multicast video, audio and shared whiteboard facilities across the Internet. MBone provides multi-point connections, either one-to-many or few-to-few, while preserving Internet bandwidth by making use of multicasting [8].

Multicast is the process of sending packets to a group of distinctions. MBone is comprised of two things:

- a physical network, made of IP multicast nodes spread over the globe and running over the globe and running over the standard Internet;
- a set of tools to announce audio and video programs broadcast over the networks and to assist users in automatically joining such groups and automatically launching necessary applications on their systems.

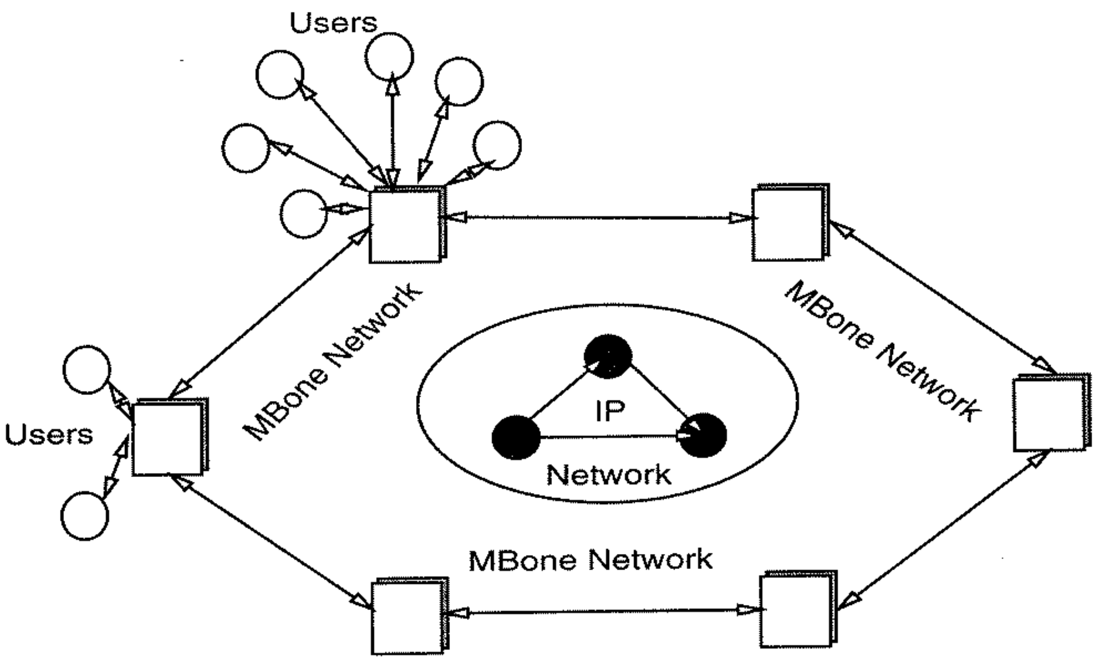

Fig. 1.14. MBone Example

4 Design of Web-based collaborative system

4.1 Requirements for Collaborative Environments

We would like to specify the basis of the proposed system [9]:

- ✓ Create customized collaborative environment (user interface) with the appropriate access;
- ✓ Add collaborative features to specialized applications;
- ✓ Incorporate distributed multimedia functions;
- ✓ Exploit the state-of-the-art audio, video and network technologies;
- ✓ Enable open collaborative applications (sharing documents, images);
- ✓ Set of separate modules (audio, video, whiteboard, etc).

This system will make use of the existing operational system, the Multimedia Web Presentation System (MWPS), which mentioned before.

4.2 Architecture of Collaborative Environments

4.2.1. Layout of Synchronous mode of MWPS

As mentioned before, MWPS is an Internet Application built on top of the web environment. It allows instructors/lecturers conducting presentation/lectures to those students through the Internet using web browser.

We focus on the synchronous mode of MWPS, which the "classmates" attend the class in real-time. The students can interact with the presenter directly giving instantaneous feedback.

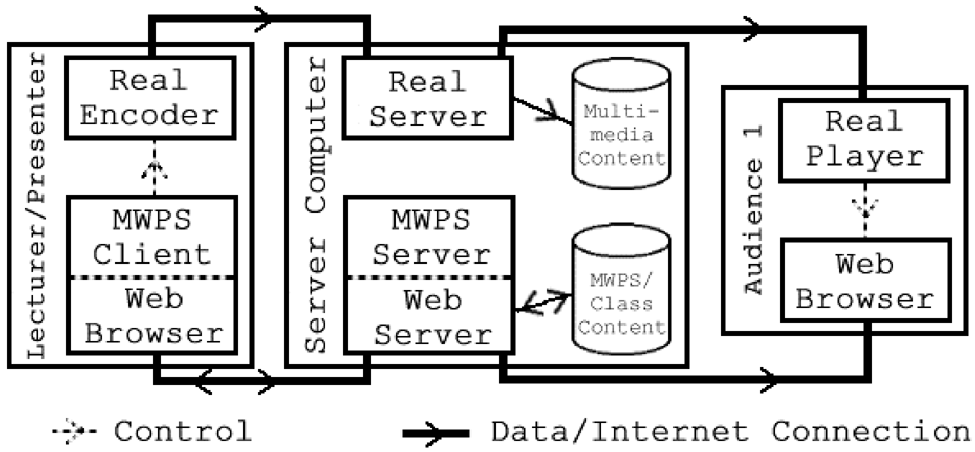

Fig. 8 MWPS live presentation in synchronous mode

The above figure illustrates the connection of MWPS System during synchronous mode public presentation. On the left-hand side is the presenter's MWPS client machine and MWPS server is in the middle. Students are placed in the right-hand side as audiences.

The server is comprised of three parts: Real Server, MWPS Server and Web Server. The Real Server handles all aspects of multi-media contents, says audio and video. The Web Server provides access of slide of course materials, which containing mainly images and text, to Internet. It also uses to prove the authentication to access and sets the environment of web browser for running CGI and JAVA programs. The MWPS Server coordinates the other two servers and functions the whiteboard application.

Once the lecturer starts the presentation, signals will be sent to the MWPS Server through the Internet connection, MWPS Server will then retrieve corresponding lecturing material (HTML view graphs) back to the client machine and coordinates it to control the Real Encoder in order to start recording. This multimedia content is directly transferred to the student/audience machine through the Real Server and the view graph sequence is also transferred from the MWPS Server. Afterward, Real Server will store the multimedia content captured from the Real Encoder, while MWPS Server will capture the sequence of view graphs and generate the presentation.

4.2.2. Layout of Collaborative Environment

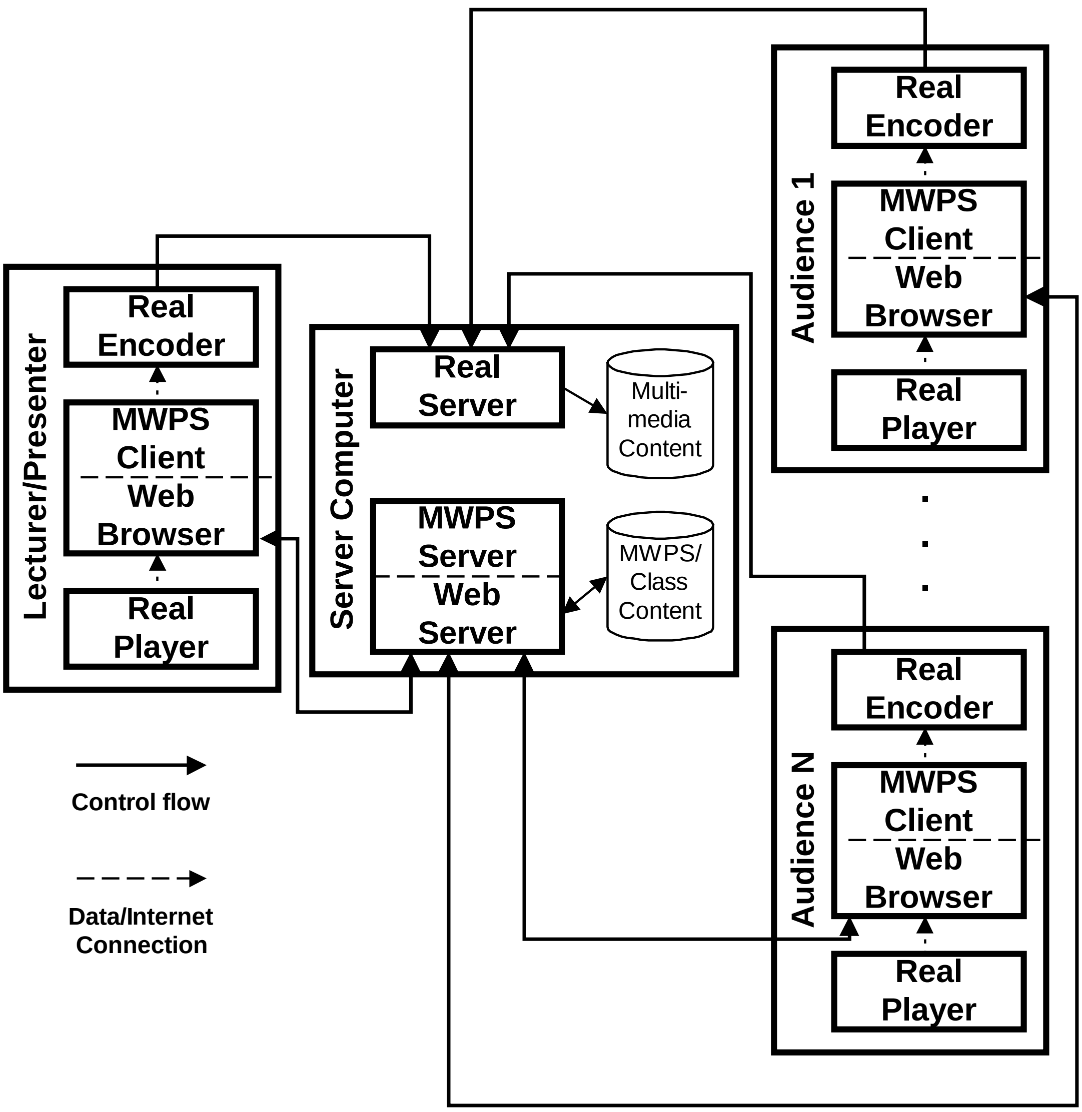

Fig. 9 Collaborative Conferencing architecture

The above figure purposes the outline of the collaborative conferencing architecture. On the left-hand side is the presenter's MWPS client machine and MWPS server is in the middle. Students with their client machines are placed in the right-hand side as audiences.

Basically, the components of client machine and server have changed. But the passive audiences gain the opportunities to join the presentation and express opinions.

This time, the lecturer starts the presentation, signals will be sent to the MWPS Server through the Internet connection, MWPS Server will then retrieve corresponding lecturing material (HTML view graphs) back to the client machine and coordinates it to control the Real Encoder in order to start recording. This multimedia content is directly transferred to the student/audience machine through the Real Server and the view graph sequence is also transferred from the MWPS Server. On the other hand, students can give feedback and follow the same procedures to broadcast to others.

4.3 Problems encountered

We can forecast the following problems existing in this purposed system:

- Dramatically increasing transferred materials over the limit of the bandwidth;
- Difficult to maintain synchronous transmission manner;
- Individual computing power may not support co-existing real-encoder and real-player in the same time;
- Much more equipment are needed in students' side;
- Students with little experiences operating computer may find difficulties to use the system, as a result, losing the studying interest;
- Lack of facilities to support for joining and leaving of groups at run-time.

Also this system may not support collaborative applications likes sharing documents.

4.4 Future Plan

In order to make a collaborative environments, the above problems must be solved or try to minimize to an acceptable level.

To provide a good policy for activating the client machine can minimize the first problem. Those idling machines should be ignored until any responses are triggered. Facilities will be added to achieve the collaborative environments. Extra training is needed to provide to students in the installation and debugging his computing environments.

In the coming semester, workable program should be generated and related evaluation will be conducted to test the program. Hopefully, the above problems can be solved at that time.

5 Conclusions

Effective collaboration between the instructor and students is crucial. This essential factor determines the fate of future web-based education. However, the existing campus wide educational environment on top WWW is basically a weak “two-way” interaction between teachers and students. Moreover, the instructors must be familiar with the related Internet technologies that support effective communication and collaboration [4].

On the other hand, collaborative conferencing is a new paradigm for communications. Eventually the camera sitting on top of the monitor might be as prevalent as the mouse sitting next to the keyboard. Although the quality of the service provided by conferencing is limited by the amount of bandwidth available in the chosen communications channel, quality can be improved by utilizing data compression techniques, which effectively increase the bandwidth of the communications channel [8].

Combining these two things, collaborative conferencing environments try to improve the communication flow between instructor and students. As a result, the lecture seems held on a virtual classroom over the network and instructor can see the face of students, in the same time, replies the question raised by them.

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