

Implementing a Desktop Video Conferencing Technology for Effective Teaching and Learning.

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ABSTRACT

The traditional teaching method has brought about a lot of inconveniences on the part of students and lecturers in our tertiary institutions. These inconveniences include travel costs on the part of students to reach lecture venues, inadequate and congested lecture rooms, and so on. The necessity for the modification of this teaching method brought about video conferencing technology, which is a means whereby a live connection among groups of people or individuals in separate locations is made possible for the purpose of communication and sharing of computer application for collaboration in real time.

This paper examines the objective of designing software that would anchor desktop video conferencing effectively and efficiently. The features of the software include transmission of video signals, audio signals, data properties and coordination of the conferencing session. The software would be integrated on the hardware which includes a camera (visual capture device), microphone (audio input device), speakers (audio output device), video board (visual interface on system), network card (network interface on system) and the computer system. The technology is web-based and implemented on a network. This would enable people participating in the video conferencing session to see, hear, and collaborate effectively.

(Keywords: video conferencing, networking, workstations, LAN, Mbone software, controller, processor)

INTRODUCTION

The rapid growth of computers in the modern world has been brought about by one unique aspect, which is networking. Networking is the

interconnection of two or more autonomous workstations or nodes together for the purpose of data sharing, resource sharing, communication sharing, and process reliability. The increasing advancements in networking technology brought about the development of video conferencing, which has been a very important technology development in the learning environment.

It is a means whereby a live connection among groups of people or individuals in separate locations is made possible for the purpose of communication and sharing of computer applications for collaboration in real time (Callum, 2000). This is more or less a typical synchronous conference. By synchronous, we mean the students and lecturer are engaged in the class simultaneously in such a way that the classic teaching synergy of question asking with immediate response is a fundamental part of the educational process. An audio, video, and text is used in video conferencing environment enabling both parties to see, hear, and present materials as if they are in the same room. The growth of network technology and in particular, the internet, has led to a greater awareness of the potential of conferencing system for teaching, collaborative work, assessment, and student support (Burns et al., 1996).

The traditional teaching methods in which lectures are delivered face to face and with physical presence of both parties (lead teacher and students) is quite different from video conferencing. So using video conferencing technology does change the normal teaching environment and this can cause concern for tutors and students alike. Although video conferencing is trying to adopt the traditional teaching way expect for the technology involved and the physical presence of both parties which is not required. Lectures are seen on screens and visual display. However by approaching the

possibilities offered by video conferencing in a positive manner, the learning experience can turn out to be successful for all concerned (Burns et al, 1996).

Video conferencing involves the use of hardware and software for its full architecture. A complete simulation will enable both parties, which are the students, and lectures to see, here, and present materials just as if they are same room (Callum, 2000). Organizations like banks, oil companies (to communicate between onshore and offshore personnel), manufacturing companies, and television stations are also using video conferencing these days to carry out some specific task.

OVERVIEW OF VIDEO CONFERENCING

Video conferencing is more or less bringing lectures to one's doorstep. As earlier stated it is quite similar to the traditional classroom. The instructional options available to a teacher in a videoconference classroom are similar to those used in a traditional classroom. Small and large group work, demonstration laboratories, and lectures are just a few ways that teachers deliver content and students engage the material (Mason and Davis, 2000).

Video conferencing is a vital tool used for personal communication, which include informal and formal meetings, collaborative work between researchers using shared applications, presentations and education.

Delivering a lecture on the day's subject is appealing because a teacher can get through the entire lesson and eliminate the time-consuming work of facilitating numerous groups or demonstrations. Lectures are an effective means of delivering information to students at all sites during a one-time-only video conference or in combination with more engaging activities. However, lectures can be counterproductive for both teachers and students if they are used as the primary mode of instruction throughout a videoconference course.

An interactive model of instruction allows students to actively participate in the lesson through demonstrations, small-group discussions, laboratories, writing, and presentations. Activities can be done "live" during the videoconference or after the videoconference.

Preparation considerations and production time increase when a class is more interactive. Coordination with teaching with teaching partners and students at receiving sites is the key to managing class time effectively and delivering the essential parts of the lesson.

Combining lectures with activities ensures that important material is covered while engaging students and giving them hands-on experience with concepts. The production needs of a combined lecture/interactive approach vary based on the kinds of materials and participation activities required. It is important to balance flexibility with the lesson's priorities (Mason and Davis, 2000).

According to Hazel (1998), the types of video conferencing that are practiced include:

- Person to person (class to class / one to one meeting): this is the simplest form of conferencing where two computers connect directly with each other using conference software. The connection might be base on the usage of the usage of the Internet protocol (IP) address of the person or the users address information as configured on the software package. The two parties can then communicate over the network in real time.
- Group conference (many to many): This is a situation where many people can participate and collaborative. To do this, each person or class has to connect to a site that is running software on conferencing. Typing the Internet protocol (IP) address of the server system makes the connection and the system receives everything that is being transmitted by the group and then transmits it to the others in the group.

Broadcast (one to many): this is a one-way conference much like television much like television. One computer running the conference software transmits audio and video to all those who are connected. Satellite transmission is usually used for broadcast.

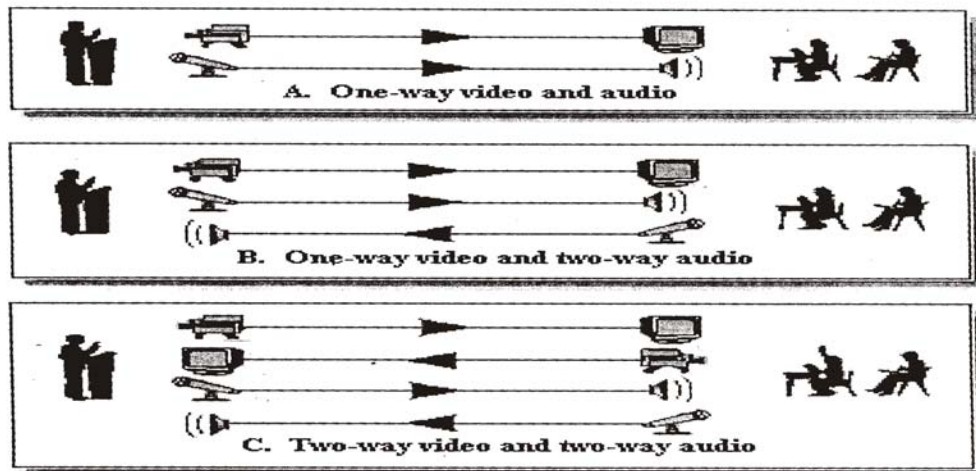


Figure 1: Types of Video Conferencing Modes.

- Studio-based System:** A studio based is specially equipped for the video conferencing by an organization. This kind of conferencing can be used majority by the organization or leased for use for other organization. This will normally include one or more cameras, microphone, one or more large monitors and possibly other equipment such as overhead cameras for document viewing.

Getting familiar with video conferencing and its equipment involves organizing an introduction session if one is scheduled at the operating center. Here, a technician or an experienced user of video conferencing equipment will put all others through with the usage of the software and hardware (Burns et al, 1996). This implies that in the introductory session, the lecturer and students are educated based on the usage of the hardware and software by the technician before they can now get familiar with the video conferencing technology.

Desktop video conferencing is a new paradigm for video conferencing. It is "desktop" based which implies that participants sit at their own desks, in their own offices and call up other participants using their personal computer in a manner much like a telephone.

The rationale behind the selection of equipment used and their description, operating principles and the set-up are emphasized below.

RESEARCH METHODOLOGY

Desktop video conferencing involves technological input on whichever method is used in setting up the system. The technology involved makes use of devices which include a camera, usually attached to the monitor, microphone, speakers (either onboard speakers, external ones or headphones are applicable), video board (to capture the signal from the camera and convert it to digital form), and a Network card (usually an Ethernet card for connection to the Local area network (LAN) or an services digital network (ISDN) card).

In setting up a desktop video conferencing environment, all of the equipment mentioned above has to be connected to a workstation with universal serial port (USB) port for equipment without a parallel connector port. This implies that on the workstation there must be a USB port.

For desktop video conferencing, a better quality signal is required to be transmitted both for visual and audio. So a high bandwidth (the amount of information which can be transmitted every second) is required because audio and video signals are transmitted into achieve. A fast and high capacity digital transmission of voice, data, still images and full motion video are required.

The integrated service digital network (ISDN) or the Internet protocol (IP) is used and this is fast growing because many people already have a connection to an existing IP infrastructure (Huston, 1996).

The basic work is on the development of software, which would be used in achieving the setting up of the desktop video conferencing environment. The software would perform the following functions:

- Multipoint data conferencing
- Video conferencing
- Internet telephony
- Telecommuting Virtual Meetings
- Distance Learning and a host of others

For a complete set-up of video conferencing, the software would create room for the use of office packages like Microsoft PowerPoint® for presentation, words and others for the database of the whole lecture period.

Finally, setting up a desktop video conferencing via the broadcast method requires the above-mentioned hardware already set up on the systems required for the conferencing. The broadcast set up requires a camera to be installed on the lecture system, which serve as lead unit for other system. With this, all other workstations can see the lecturer but the lecturer cannot see them (broadcast video conferencing). Then the software is installed on the workstations and the control system so that communication can occur in real time.

COMPONENTS OF A DESKTOP VIDEO CONFERENCING

The components of a desktop video conferencing include the hardware and the software components as earlier mentioned. Both the features of the hardware and software are enumerated below.

Hardware Components: Hardware component used in desktop video conferencing can be grouped into Viewers, which include monitors and speakers; Senders, which include cameras, microphones, whiteboards, and computers; Controllers, which include the keyboard; Tablet, or remote; Processors, which include codec, bridge or router; Transmission media; Carriers, which include wires (twisted pair and coaxial),

microwave in air, satellite signals, and fiber optic cable; and Network card or the integrated service digital network (ISDN) card, which are used as an interface for communication between the systems and network.

Viewers: Compressed and digitized information sent are decoded and through the receiving site viewers-usually monitors and speakers. A monitor is used as a visual display unit and the speakers are used for sound in the desktop video conferencing set up. A monitor is also used to observe what the lead site is sending to receiving sites. This is particularly important while presenting.

Senders: Senders generate analog signals that are digitized, compressed, and sent to distant desktop video conferencing sites. These might include any or all of the following:

1. Cameras capture pictures at the originated site. For the desktop conferencing, a set camera that are not moved around the room, mobile cameras, or document cameras that work like overhead projectors might be used. A set camera is the most preferable device to be used. It is fixed on the monitor for direct capture of the lead teacher.
2. Microphones capture sound. There are a variety of microphone designs that work best under specific conditions. A microphone with the conditions that works best under desktop video conferencing is used. It might be a headpiece microphone or an ordinary microphone.
3. Whiteboards allow lecturers to write like a chalkboard, but do not generate chalk dust that can impair video conferencing equipment. The whiteboard might not be required in the context of this seminar.
4. Computers, screens and data form computers can be exchanged between sites. Computers used for presentation should have lots of random access memory (RAM) and processing [power because of the number and type of applications as seamless as possible. It is best to use a computer dedicated to the video conferencing system that is separate from the codec. The advantage

to having a dedicated computer is that if an application crashes the computer, it does not crash the codec. A codec crash will result in the loss of communication, and may necessitate rebuilding the codec in order to re-establish communication.

5. Network card. Usually an Ethernet card for connection to the LAN, or an ISDN card is also present on the computer because it makes communication possible.

Controllers: Controllers are interface devices that interact with software and allow you to control the video conference. The keyboard, tablet and pen, and remote control are the most common interfaces. They all allow lecturer to control such things as camera angle and zoom, microphone volume, putting a picture in a picture, which video feed will be sent to receiving sites, which receiving sites will be connected through a bridge or router, and transfer of files.

Processor: Codec. The codec converts analog data to digital form, and digital data to analog form. A codec that converts analog data to form may also “data, by eliminating redundant

information, which reduces the amount of data that needs to be sent for the video conference; another codec that converts digital data to analog form may “decompress” such data. The codec is loaded on the computer associated with the video conferencing system at the lead site. Its job is to convert analog or digital signals and to compress the digital signals so that they can be sent efficiently. It also decompresses and decodes incoming signals so that they can be viewed. This reduces the bandwidth needs of a video conferencing system and thereby speeds up transmission.

A video conferencing is impossible if the codec is unable to decode signals from another system. This is why it is important to make sure that all codec used for a given video conference are compatible.

Bridge or Router: The bridge or router connects the participants in a desktop video conferencing to one another. The bridge or router is normally located away from the lead site and is operated by a separate entity. The lead teacher must make sure that people who are responsible for bridging or routing sites into the conference have been notified and that they make the connections.

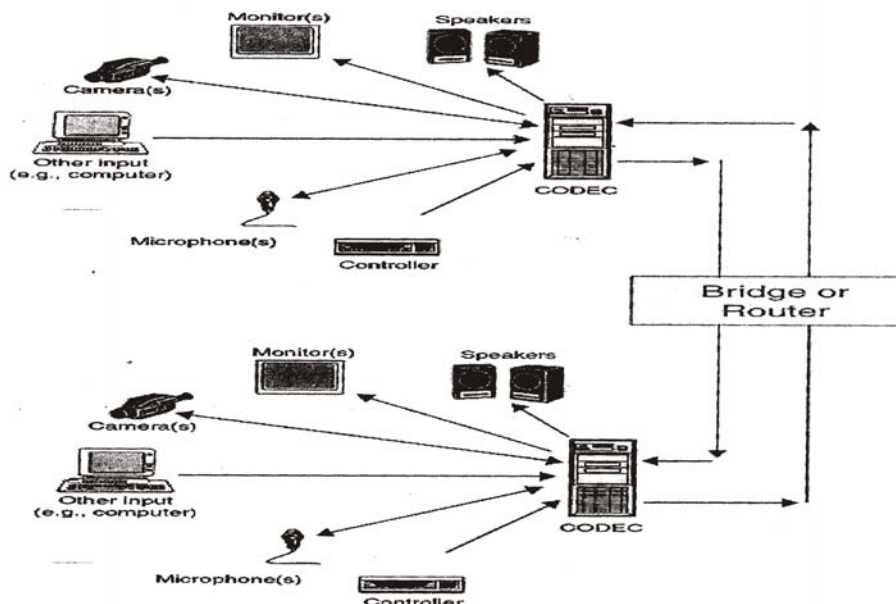


Figure 2: Video Conference Hardware Set Up.

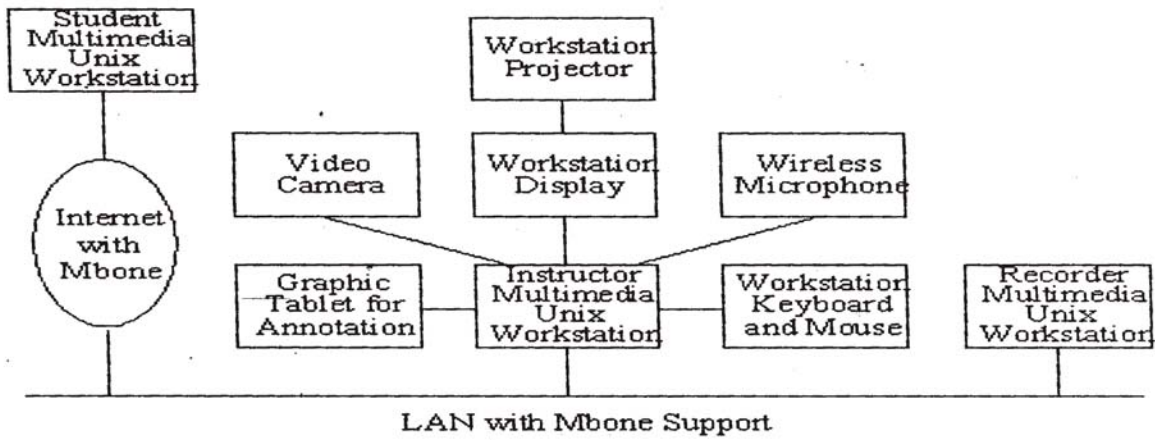


Figure 3: Mbone Teaching Configuration.

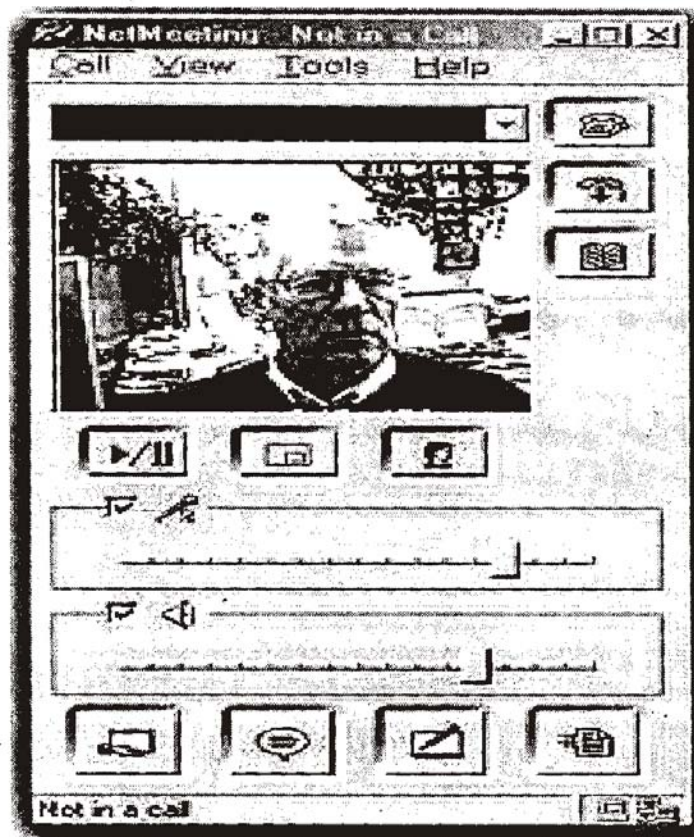


Figure 4: A Typical Net Meeting Software Display.

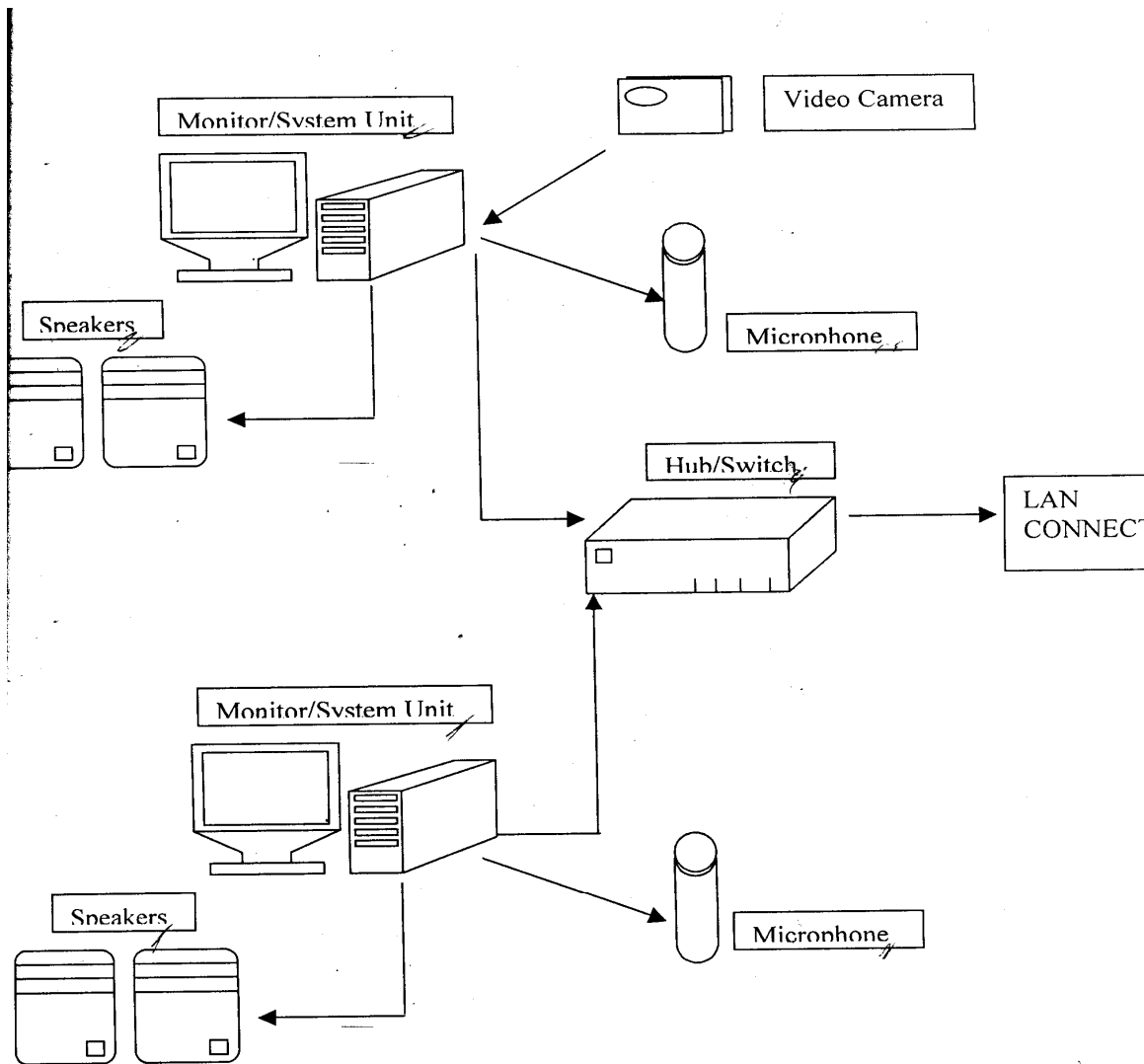


Figure 5: Desktop Video Conferencing Configuration.

DESIGN, IMPLEMENTATION AND TESTING

The design of a desktop video conferencing was carried out by applying the networking concepts, hardware implementation and software utilization. The software package design for the purpose of the desktop video conferencing would be able to perform some major functions as required by the desktop video conferencing process. The program is written using java scripts.

The first module of the program captures the video and audio signal and stores it in a file for

playback. It is stored in the AVI file format and can be played using the media player. It is designed to have an interface which can stop or continue to capture as required.

In the figure below, it can be seen that the specification of the captured video streams is 160x120 and the format which it is being captured. Also the audio specification is given a choice to select which of the mode he wants in both the video and audio

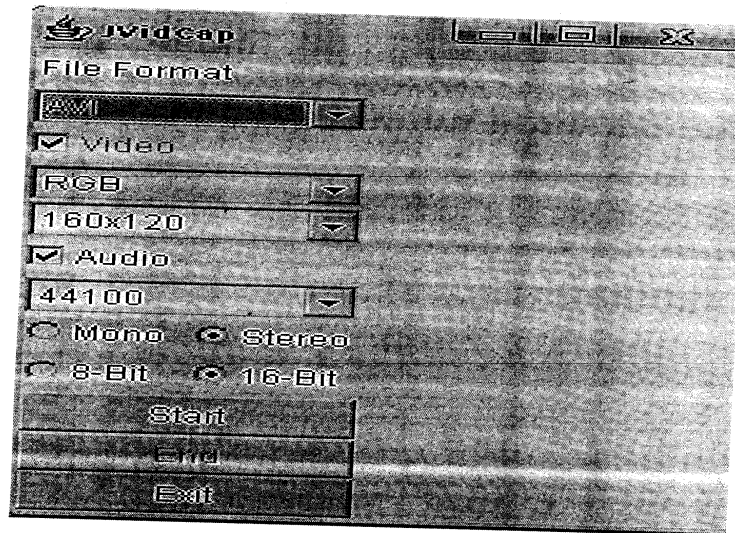


Figure 6: Capture of Video and Audio Signal.

In the second module, the capture video and audio signal is being transmitted from the lead sight to the receiving end. As earlier started, the specification of the internet protocol address and the port number of the receiving end is specified in this module. This enables for easy communication between the lead sight and the receiving end. The transmission is done in a fraction of microseconds because it is a real time synchronous process.

The third module of the program concludes the video conferencing session. In this module the transmitted streams are being received at the destination. The address of the lead sight is also specified here for the package not to be lost during transmission. Here the coordination aspect is being handled.

PERFORMANCE OF THE DESKTOP VIDEO SESSION

In determining the bandwidth of the audio and video streams, and the one-way streaming used, the following information were required and used:

1. The number of simultaneous users that will be on the application at peak load.
2. The connection rate of the users (students) to connect and what percentage of your users will be on a 56k

dial-up connect, on LAN, or Cable.

3. The number of audio/video stream that is on the application per user.
4. The limitations as regards internet connection.
5. The target encode rate of the audio and video streams in your application.

The application is a one-way video. The lead site will serve only stream to the user.

BANDWIDTH CALCULATIONS

Lead site bandwidth:

$$BW1 = N * S$$

N = Number of simultaneous student which is 1
S = Stream encoded at constant kbps

On the local LAN, stream encoded at constant kbps is 10kbps. Calculating the available bandwidth at the lead site for a workstation gives 10kbps.

Calculating receiving site bandwidth needs

$$BWr = S$$

S = A/V content encoded at constant kbps

Also the stream encoded at the receiving end is about 10kbps for the local LAN

It should be noted that for audio and video streaming, each user consumed 400kbps of information and it is a lot of bandwidth and in fact, too much for a local LAN user or on dial-up modem or, in some cases, even on DSL. Users connecting to this application with connections less 400kbps will most likely encounter pauses for rebuffering and other poor quality effects.

Once the bandwidth strategy is in place, then the performance of applications that involve video and audio tend to be very CPU intensive. Once the CPU becomes stressed, video and audio packets may be lost, and the CPU can effectively handle the performance which is measured by the degree to which the system adequately meet the demand of its assigned tasks.

The parameters used to measure the performance hardware configuration of the desktop video conferencing include.

1. Mean Time Before Failure. This is a measure of the expected time between conjunctions of events that are agreed to constitute a failure. This determines the reliability of the system.

MTBF = (1/no of element) x (1/failure rate)

2. Mean Time To Repair and Mean Time To Detect: The MTTR is the measure of the expected time required to covert those effects which has been agreed to constitute failure and MTTD is the measure of the measure of the expected time to detect failure.

CONCLUSION AND RECOMMENDATION

From the foregoing, a video conferencing system can have an important role to play in bringing together staff and students across different institutions, bringing in outside experts from industry and reaching and supporting remote students, either in the local community or those based overseas.

The special feature of the coordination session in

the software used also makes it more efficient. Apart from the transmitting of video signal, audio signal, and data, the interactive session between the students and lecturer; ability of the lecturer to identify which area of the course is difficult for the students to comprehend. This feature enables the student to have a better understanding of the course. The levels of comprehension of the technology involve in the usage the technology has gone a long way in helping the users to improve their skills in various areas. This is why implementation in our immediate environment is a necessity.

The following recommendations were enumerated based on this project.

- Rather than implementing this set up on the local area network, a network mode like the asynchronous transfer mode, ATM can be used for better transmission of the audio and video streams which require a high bandwidth.
- The software can be expanded to handle more than a student and to provide adequate coordination among the participants in the conferencing.

A coder/decoder can be used for compression and coordination in place of the operating system used for the compression to improve on the efficiency.

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