

# DESIGN AND IMPLEMENTATION OF REAL TIME E-LECTURING SYSTEM

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## ABSTRACT

Advancement in information and communication technology (ICT) is making video streaming a viable way of getting a real-time event to people anywhere in the world through computer systems and handheld devices. In teaching and learning, ICT have successfully added values to the process through the Internet. In this research, the process of delivering lectures in real-time to a wide audience was considered. A real-time e-Lecturing system was designed and implemented to aid easy communications between the teacher/trainer and the learners in different locations. The system grouped the learners into two. The first group is located in traditional-like classrooms without the trainer being with them. The learners can communicate directly with the trainer through full-duplex mode of communication using a projector with necessary audio-visual systems connected to a computer system. The trainer can see the trainees as in the traditional classroom through the computer system. The second group comprises connections through handheld devices and connected through simplex mode of communication. They can view and listen to lectures in real-time but cannot communicate with the trainer in real-time. The research shows a better way of blending traditional classroom with other learners located in different environment. It also proved to overcome the barrier of distance in learning and give some degree of flexibility to the learner to decide where to receive lectures. The system will be useful for institutions operating multi-campus system and/or for courses involving large number of students without correspondingly large classroom/lecture halls.

**Keywords:** e-Lecturing, trainer, Learner, real time, learning anywhere, Internet, full-duplex, simplex

## INTRODUCTION

Real Time E-Lecturing describes the use of compressed video technology for live, two-way, interactive communication in a variety of situations - person to person, informal discussions, formal group meeting, and large lectures. In teaching and learning, traditional classroom otherwise referred to as face-to-face classroom can be described as personal interaction between the trainer and the learner in designated environment. The trainer is usually found in front of the classroom. Learning is conducted in an environment where there is interaction between the trainer and the learners as well as between the learners themselves. It is believed that in the traditional classroom, learners derived motivation both from the trainer as well as from other learners like a team effort. Multimedia facilities have now made it possible for trainers to provide learning materials to learners in a flexible way.

The availability of these multimedia facilities as additional method for course delivery encourages many educational establishment to introduce distance learning. The advances in multimedia technologies and broadband communication now allow timely exchange of information between two ends. People can connect in real-time through audio and video communication over the Internet. This method of communication called video conferencing avoids participants at meetings and conferences from having to spend time and money travelling to attend such meetings and conferences. Considering the increasing number of students and the limited number of lecturers, this work explores the possibility of using video conferencing technology for lecturing in real-time.

Real Time E-Lecturing describes the use of compressed video technology for live, two-way, interactive communication between trainer and learners. Primarily the use of video conferencing is to allow the timely

exchange of information without traveling. Much of our communication is visual, and being able to see as well as hear each other significantly enhances the interaction between people. Videoconferencing enables students at distributed geographical locations to interact in much the same way as they would if they were in the same location (Al-Ahdal and Al-Hattani, 2014).

Videoconferencing takes place via the ISDN (Integrated Services Digital Network) using the H.320 Standard, or over Broadband through the Internet Protocol (IP) network, using the H.323 Standard or Session Initiation Protocol (SIP). H.320 and H.323 are standards from the International Communication Union (ITU) series of recommendations. Schools that are Broadband-enabled can use the IP network for videoconferencing. However, the use of ISDN for videoconferencing is not common again because of the improve technology which makes transmission of data through ISDN to be very slow and unreliable. Videoconferencing may be point-to-point, between just two systems, or multipoint, connecting three or more systems. Multipoint conferences, and in specific cases point-to-point conferences, require the use of a Multipoint Control Unit (MCU). Large conferences, or those that need to be bridged between the IP and ISDN networks, require significant MCU resources and gateway facilities (Cavanaugh, 2001).

In teaching and learning, interaction between the learner and trainer is very crucial in other to achieve appreciable goal. Moreover, the satisfaction of the students in a lecture depends on the level of interaction between the students and the teacher (Martin et al. (2012). In the early 2000s the usage of video calls increases due to the popularity of broadband network connection and the availability of high-speed Internet services. These factors and other factors such as the reduced cost of personal computers (PCs), affordable web cameras and the introduction of free software for instant messaging (IM) by some service providers encourages videoconferencing. Videoconferencing technology is now used by trainers and administrators in education for meetings, training and professional development. A lot of related works exist on the use of video conferencing technology in training and learning. (Al-Ahdal and Al-Hattani, 2014) assessed the use of the technology in teaching English language. They concluded that the mode and method of education will spread education fast and will be more interesting and interactive to students. In educational institution where students were found to be more than the available class capacity, videoconference technology was found to be effective in the delivery life lectures (live streaming) to two classes (Guillermo 2014). In medical education, rural doctors and nurses have shown satisfaction in the videoconference technology because it gave them the opportunity to further their education (Chipps et al, 2012). The technology was used across borders for seminars in medical education (Huang et al. (2014). The justification of using videoconferencing in education may also come from concepts and principles related to social learning and social constructivist theory. Many of the previous works did not take into consideration the possibility of having a direct visual and real-time interaction with the trainer. In this work, we describe the implementation of a point-to-multipoint full duplex technology for lecture delivery in Higher Education Institutions (HEIs). The trainer who is located in his office or any other remote location is able to deliver lecture to learners in one or more classrooms. The trainer is able to interact with the learners as in traditional face-to-face classroom settings where the learners can interact with the trainer. In addition, learners who cannot make it to the classroom are able to be part of the class remotely through their handheld devices but cannot interact with the trainer in real-time (simplex). The unique feature of this system is that it is upgraded such that the trainer can interact with learners located in more than one classroom simultaneously. This is in addition to the ability of learners outside the classroom to be part of the lectures through their handheld devices.

## **SYSTEM OVERVIEW**

Real Time E-Lecturing is a full duplex connection of two or more locations through audio and video equipment. Our goal is to devise a system, using Personal Computer (PC) systems and Tablet PC platforms, which enable speakers and listeners to be able to interact real-time as they do in face-to-face settings. In this research, we support videoconferencing between two or more locations using video cameras or webcam with microphones, networked

computer systems with wireless technology and handheld devices. Audio/video streams are captured by the camcorder or webcam (encoder) and pushed to the decoder server which transmits the streams to compatible devices for live streaming. Also, in addition to remote communication among collaborators, this video streaming provides gestural communication medium. The components required for the implementation of this work are divided into two; the hardware and the software.

## **THE HARDWARE COMPONENTS**

The hardware components are distributed to different locations depending on the function.

### **The Computer Server**

The functionality of this project work relies on the computer server. All collaborator devices are connected to the server to get the required signal because the encoder and the decoder are installed on the server. The server is located separately from all the collaborators.

### **Routers and network switch**

Since many of the collaborators devices will access the system from different or remote networks, the router will perform the traffic directing functions by forwarding data packets between the devices. The router is connected to the server. The network switch is connected to the router. The switch gives access to devices that are on the local area network. Another important hardware component is the wireless router which gives access to wireless devices within the network coverage.

### **Capturing devices**

Capturing devices are hardware components needed both at the trainer end and in the classrooms. They are responsible for analogue audio/video content for processing by the encoder and decoder

1. A computer system that is network enabled to process signals for transmission or reception to and from the computer server.
2. Connected to the computer is the projector to project the received images on a screen for the viewing of the audience in the classroom. Television set can be used to replace the projector and screen
3. Speakers are strategically located in the classroom for audible reception of audio signals. The speakers are connected through a digital amplifier to the computer system. The inbuilt speaker of the lecturer laptop was used at the trainer end.
4. Camera for capturing video signals. The camera can be a camcorder or a very good webcam. Webcams were used for this work.
5. Microphone: Super cardioid Electret condenser microphone was used in the classroom, while the built in microphone of the trainer laptop was used to deliver lecture.

## **THE SOFTWARE COMPONENTS**

The operating system requirement for the implementation of the system is Windows 7 and later, or a Windows Server OS with encoder or Linux OS with encoder.

### **Decoder / Multiplatform Server**

This is the server software that is responsible for decoding of video stream that is coming from the encoder system. This software has the additional feature that allows the administrator to know the statistic of viewers at a particular time. The system is capable of accepting any video format and reliably delivers it in multiple formats and with the highest possible quality to any connected device, anywhere. It can also delivers content to the broadest range of player; Apple iPhone, iPad, iPad touch, and QuickTime player; Android smartphones and tablets; a variety of smart TVs; and IPTV/OTT set-top boxes.

### **Encoder software**

This software works with the capturing devices by accepting the raw video format coming in, process it for media output to the network. The software can be deployed on any platform that supports the Java Runtime Environment (JRE).

## IMPLEMENTATION

The project can be implemented without the global Internet. That means it can be implemented within the institution VPN which is divided into wired Local Area Network (LAN) and Wireless Local Area Network (WLAN) for mobile devices and Wi-Fi enabled devices to communicate and be part of the lecture.

The router was configured to give Internet Protocol (IP) addresses automatically (dynamic IP) to connected devices, except the servers. For this work the IP address configured on the router is a class C address (192.168.20.X /24), and this is because it will require the demand of many users requesting for IP address from the router. The IP address ranges from 192.168.20.1/24 - 192.168.20.30/24 for servers and important systems which must have a permanent (static IP) address to achieve the desire result, while from 192.168.20.31 – 255 /24 are dynamic IP address for any device that query the router for IP address. The encoder server was statically assigned 192.168.20.10/24 while the decoder server also was given 192.168.20.11/24 out of the excluded IP address. Also the wireless feature of the router used was enabled and set up for mobile devices that might be willing to participate in the lecture. After all this has been done on the router, the switch was plugged to the router through the patched cable and other devices that must be wired connected including the encoding and decoding server are connected to the switch through the patched cable and IP was statically assigned to them for communication. Figure 1 shows the design diagram of the system.

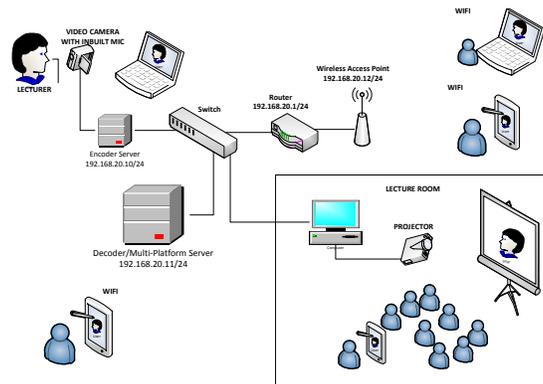


Figure 1: Designed diagram of Real-Time E-Lecturing System

The entire system was setup in such a way that all the hosts are on a single network for easy communication with one server. The client computers which range from the trainer's Laptop to the desktops in the classroom and the handheld devices were also configured to be on the same network. The encoder and decoder application were set up on the server respectively. The server was configured to accept multiple video inputs. In situation where users are not having enough bandwidth to watch the lecture which might be because of a very high bit rate, multiple bit rate was created and a .smil file was created for easy communication of the encoder and decoder system. The system was networked in a way that all hosts in the Real-Time E-Lecturing domain could access one another, and Wi-Fi network was also created for mobile user in order to be able to watch the lecture as long as they stayed within the network coverage area. The complete system operated under the class C IP addressing, the mobile users have 100 – 258 allowed IP which most tablet user make use of, the left out IP address are statically given to important host.

## TESTING

The software package use to test the system was Wowza Stream Engine which was setup on the server. All the clients can access the system with any browser using a specific Uniform Resource Locator (URL) on the address bar of the browser.



**Figure 2: Trainer delivering lecture**

For the trainer, his laptop was used to deliver the lecture as shown in figure 2. Figure 3 depict how the trainer sees what is happening in the classroom. He can see himself and the class. However, the learners in the class and those using handheld devices will see only the trainer as shown in figure 4. It is important to note that the trainer cannot see those who accessed the system with handheld devices. Additional feature of the system is that the lecture can be recorded automatically for download later.



**Figure 3: Trainer's view from his position**



**Figure 4: As viewed from handheld device (iPad)**

## RESULTS

To test the work 25 learners were assembled in the classroom and 5 students outside the classroom with different handheld devices. The learners were informed that they have access to download the lecture after the class as the system has the feature. At the end of the test, 20 learners in the classroom attested to the viability of the system to teaching and learning if some of the short comings are put in place, while the remaining 5 were undecided.

However, the shortcomings observed are the illumination of the classroom which should be reviewed, and the fear of power failure in the cause of lecture. They preferred the real-time interaction as it will give immediate answers to contending issues on the lecture for better understanding while studying. All the 5 students outside the classroom attest to the viability of the system if there could be consistent network access and power to the system. 3 of them prefer to alternate between being in the classroom and using handheld device while 1 prefer to be in the classroom, another 1 prefer to be outside the classroom.

## CONCLUSIONS

The project was able to accomplish live streaming of a lecture to students in real-time. It also accomplishes the target of pushing out the live stream to other platform (i.e. smartphones and other handheld devices) for other students to access the lecture. Hence, students were able to receive lecture live from any location. Students have the opportunity to determine where to received lectures. Either the electronic traditional face-to-face interaction with the trainer, or remotely through handheld devices. Moreover, the lecture can be downloaded from the server after the lecture is delivered. This makes the system to be fully flexible and blended. The cost of implementing the work is very affordable to institutions. Future works will focus on real-time interaction from handheld devices by chat box.

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