

# IMPLEMENTATION OF ONLINE LEARNING SYSTEM IN FACE-TO-FACE CLASSROOM FOR ONLINE DISTANCE LEARNING

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**ABSTRACT** - In recent years, real-time broadcasting technology has been investigated intensively for possible use in various areas e.g. video conferencing, online video chatting and online e-learning. Hence, online e-learning systems using real-time broadcasting technology have become one of the most popular educational applications in the world. The benefits of using real-time broadcasting technology are to easily transfer the learning information from the teacher to students around the world. Based on Internet, distance students can use their computers for viewing, listening and discussing with the teacher like they are in a face-to-face classroom. In this paper, we introduce a solution of implementing an online classroom which is approaching the ordinary face-to-face classroom by using the online learning system "Easy Online". In the proposed system, the learning information has been recorded from a face-to-face classroom and real-time broadcasted to online students during the lecture time. The proposed system also consists of communication features which allow online students to communicate with the teacher and other online students by chatting and voice channels. The online learning system "Easy Online" had been implemented in University of Technology for graduate and undergraduate distance learning. The evaluation survey with students shows that distance students were largely satisfied with the online classroom and felt that it created a good online learning experience.

**Keywords** - E-learning, Real-time, Stream, Online, Online Learning.

## I. INTRODUCTION

The explosive growth of network technology has spurred a very intensive research and development in the area of real-time broadcasting such as video conferencing, video telephony and online learning. Countless online learning systems have been proposed throughout the years, with real-time broadcasting techniques the most promising choice. Particularly, most successful online learning systems are achieved by using online video/audio streaming for real-time communication between the teacher and students over Internet [1]. This is because that the real-time video/audio stream of lecture presentation come to distance students like they are in the same face-to-face classroom with the teacher. Some of the common online features offered by online learning systems include: text-based chat; audio and video communication; slide show presentation and screen sharing. Also, many online learning systems use more than one real-time video stream combining with teacher's voice for conveying information of the lecture to distance online students [2]. Here, video streams often require synchronization with the audio stream for the same duration schedule and the synchronization process become more complicated when the number of video streams increase. This is due to the vulnerability of audio and video quality of online lecture to bandwidth insufficiency from both online learning system and students' network connection. There are many researches proposed different synchronization algorithms for improving service quality of online systems [3].

In this paper, we introduce a solution of implementing an online classroom which is linked with an ordinary face-to-face classroom by using the online learning system "Easy Online". In the proposed system, all video stream are mixed into one real-time video stream before combining with the audio stream for real-time broadcasting to distance students computers as the learning information, see Figure 1. The proposed structure aims to minimize the need of synchronization whilst maintaining the online classroom information for distance students.

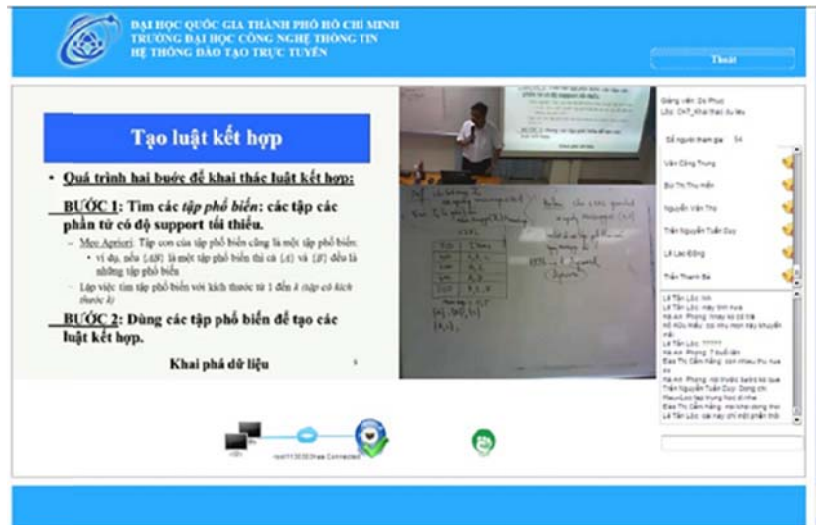
Actually, the quality of online e-learning system depends on the quality of the transmission of knowledge from teacher to students and the communicative interaction between online students and the teacher. Hence, online students can obtain the learning information like in-class students where they can see the teacher's behavior, classroom whiteboard and shared screen of the teaching computer. In the online learning system "Easy Online", the learning information is real-time translated directly from an ordinary face-to-face classroom and the teacher can discuss with online students by two-way audio communications, see Figure 2. The online learning system "Easy Online" had been implemented in University of Technology and the evaluation survey shows that distance students can understand the subject matter just by attending the online lecture. Also, the system was used for online teaching Network communication courses with an interactive simulation software, that is an opportunity for teachers and students to participate in interactive experiments via their computers for both in-class and online distance learning [4].

## II. LEARNING INFORMATION BROADCASTER

Consider an online classroom scenario where online teacher is delivering lecture presentation to online students over Internet from a face-to-face classroom with in-class students. Here, providing online students with the same learning information as in-class students is the basic goal of the online learning system. In the ordinary face-to-face

classroom, the learning information is that student can hear and see from the teacher for their learning process. Actually, there are three main learning information sources for in-class students to look during the learning time:

- Teacher sitting area (desk and chair). Looking to this area, students can see the teacher's behavior.
- Shared screen of the teaching computer, the shared screen is be projected to a projector screen for in-class students.
- Classroom whiteboard where teacher can write or draw during the lecture time.



**Figure 1.** Online learning information with shared screen of the teaching computer, real-time video streams of the teacher sitting area and the whiteboard

In the online learning system "Easy Online", all three learning information sources have been real-time broadcasted to online students' computers from the classroom by using a computer's screen recorder and two video cameras, see Figure 1. Also, the teacher voice and other sounds in the classroom have been recorded and real-time broadcasted by using an Omni-directional microphone connected to the teaching computer. In the system "Easy Online", a learning information broadcaster is implemented in the teaching computer for information capturing and real-time broadcasting to students' computers. As such, by using the learning information broadcaster, three video and one audio streams are real-time broadcasted to online students for their learning during the online learning time. For solving the synchronization problem, all three video streams have been mixed into one video stream with frame size 1000x450 pixels and frame rates of up to 30 FPS before encoding for real-time broadcasting, see Figure 3. The frame size has been chosen so that this frame can be embedded with other control communication sources into one HD frame 1280x720, see Figure 1. Figure 3 shows the block diagram of the proposed learning information broadcaster where video and audio streams have been multiplexed and broadcasted to a network video server. Then, online student computer can connect to the video server for getting learning information by video/audio streaming.

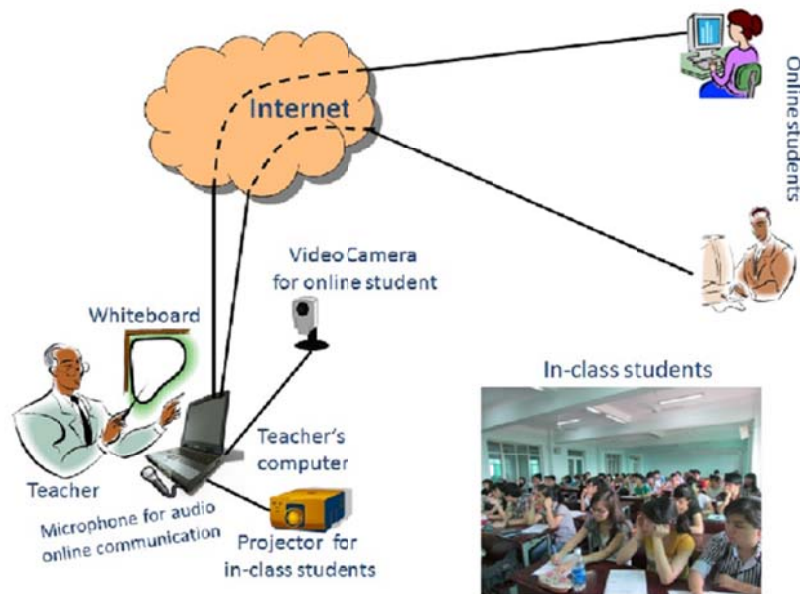
### III. FRAMEWORK OF THE ONLINE LEARNING SYSTEM "EASY ONLINE"

The design of the online learning system "Easy Online" has been oriented toward the need of the teacher, online students and in-class students. As such, the following requirements are essential:

- For the teacher: using of online learning system should take a minimal effect on the teaching process in the classroom with in-class students. Also, the teacher has control and communications tools for communicating with online students.
- For online students: online students can receive all leaning information from the online learning system and have tools for communicating with the teacher and other online students
- For in-class students: using of online learning system should take a minimal effect to their learning process. However, it is good for in-class students if they can hear and discuss with online students.

The online learning system "Easy Online" is based on the Client-Server model and composed with teacher-side, student-side and communication server-side. Here, the teacher-side and student-side are communicated with each other through a communication server which includes a video server and an web-based system for data exchange and controlling the learning process. For helping the teacher with teaching process and on-line learning management, the teacher-side software consists of two separate parts installed in two computers for teaching and online controlling processes. Hence, two computers i.e. teaching computer and online communication computer, are connected to the communication server via network, see Figure 4. In the teaching computer, only the learning information broadcaster is installed for real-time broadcasting of learning information to the video server for online students. As such, the teacher

can use the teaching computer for presenting the lecture by projecting the screen to in-class students and sharing the screen to online students via the broadcaster. Other teacher-side software modules are installed in the online communication computer which has a loud-speaker for online students speech, see Figure 4. During the teaching time, the teacher can use the online communication computer for chatting with and giving speak permission to online students.



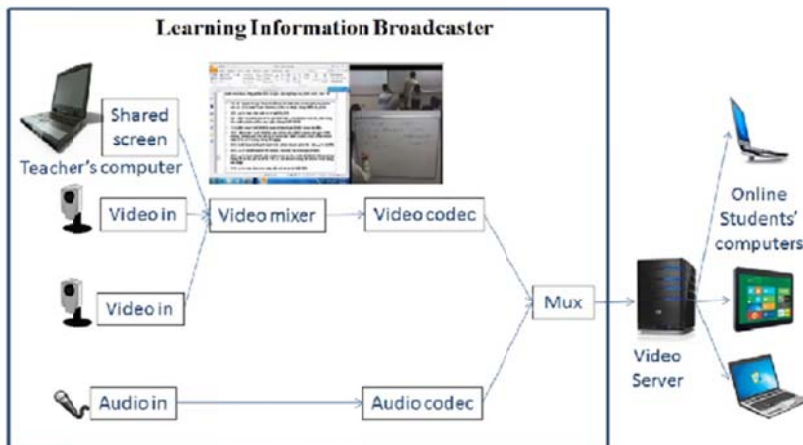
**Figure 2.** Model of online learning where online students can obtain the learning information from ordinary face-to-face classroom

In the communication server, a web-based system is developed for managing all online learning process and online students can connect to the server by using an web browser without any pre-installed software. The heart of the communication server is a video server implemented for delivering the video and audio streams over network. Here, the Red5 server software is chosen because of its live video/audio streaming capability. Red5 is an open-source media streaming server implemented in Java that can stream audio/video data over network by using RTMP protocol [5]. Based on Red5, audio/video streams are real-time transmitted between teacher-site and student-site for online learning process. In the communication server, each online classroom has a defined classroom domain for all audio/video streams and other communication channels like chatting and controlling. Hence, online students can connect to the server for accessing to the classroom domain and they can't get learning information from other online classrooms due to the classroom domain difference.

Due to the fact that our online system is implemented in ordinary face-to-face classroom so only classroom teaching and online controlling computers have a permission to connect with the classroom domain in the communication server. Hence, a security checking routine is developed for protecting the system from unauthorized access even in the case if the copy software is to use. Then, the computer UUID information is used for identifying the access permission of both teaching and online controlling computer to the classroom domain in the communication server. As such, an UUID permission list and a students permission list have been created in the communication server for system access controlling. The communication between teacher-site computers and communication server can be summarized in following:

- When communication server receives an access request from a teaching computer in one face-to-face classroom, the computer UUID information is required for checking with the UUID permission list.
  - If the checking is passed, a stream ID is generated and sent to the teaching computer for setting a stream connected to the classroom domain in communication server.
  - After stream setting, learning information broadcaster begin broadcast learning information to the Red5 in communication server for delivering to online students who have the connection with the classroom domain.
- When communication server receives an access request from an online controlling computer in one face-to-face classroom, the computer UUID information is required for checking with the UUID permission list.
  - If the checking is passed, a stream ID is generated and sent to the teaching computer for setting a stream connected to the classroom domain in communication server.

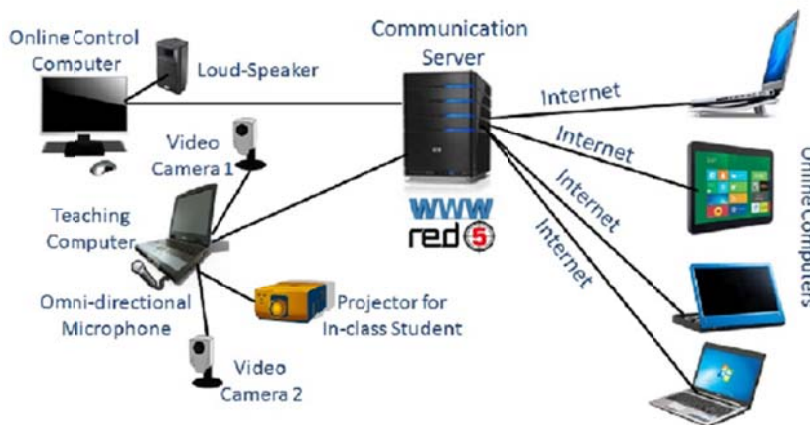
- After stream setting, the chatting and controlling modules can exchange data like chatting text with the server for sharing information with online students who have the connection with the classroom domain.



**Figure 3.** For solving the synchronization problem, three video streams are mixed into one video stream in online learning system "Easy Online"

The communication between student-site computers and the communication server can be summarized in following

- When communication server receives the access request from an online student computer for access to an online classroom, the user name and password are required for checking with the students permission list.
- If the checking is passed, a stream ID is generated and sent to the online student computer for setting a stream connected to the classroom domain in the communication server.



**Figure 4.** The Framework of the online learning system "Easy Online"

- After stream setting, the online student computer received all real-time audio/video streams and other data exchange related to the classroom domain in the communication server.
- When an online student wants to speak with the teacher then
  - A speak request is sent to the communication server and the communication server forwards the request to the online control computer of the online classroom.
  - The teacher can see the speak request sign on the screen of the online control computer and if the request is approved, a permission is sent back to the communication server.
  - A temporary stream ID is generated and sent to the online student computer for setting a temporary audio stream connected to the classroom domain for delivering the student voice to the teacher and other online students.

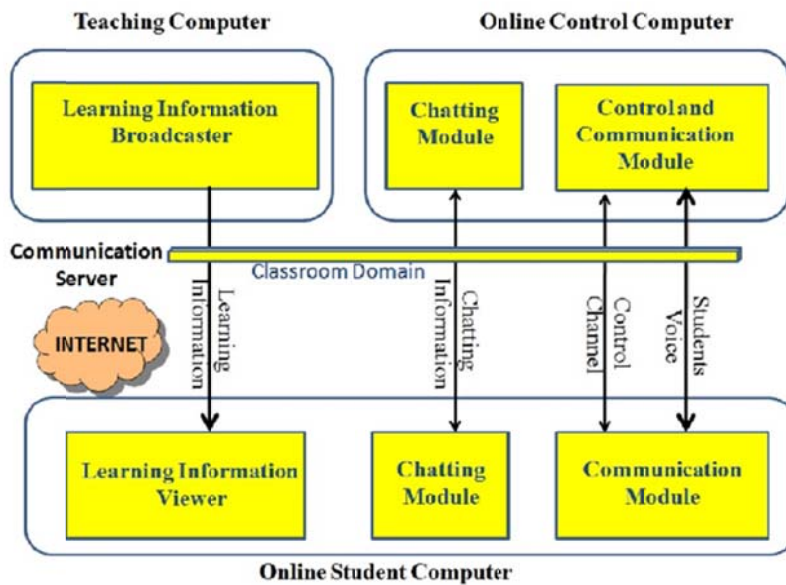


Figure 5. The model of communication between teacher-site and student-site in the online learning system "Easy Online"

Figure 5 shows the model of communication between teacher-site and student-site in the online learning system "Easy Online". Here, the communication server play a key role in communication between teacher-site and student-site connected to the same classroom domain.

Table 1. Result of the survey to measure the usefulness of the online learning system "Easy Online"

Survey Questions	Strongly Agree	Agree	Somewhat Agree	Disagree	Mean
Do you understand the subject matter just by attending the online lecture	38	5	2	0	3.8
Do you satisfy with the interface of the online learning system	33	6	2	4	3.50
Do you satisfy with video and audio quality of the online learning system	33	4	1	7	3.4

#### IV. EVALUATION AND DISCUSSION

The online learning system "Easy Online" had been used for online graduate and undergraduate learning in University of Information Technology. A survey was conducted to measure the usefulness of the system for online students. The survey was based on the view of groups of students from graduate 2013 intake in our University. The group consists of 145 students and half of them live far away form Ho Chi Minh City. Hence, a lot of distance students in the group used the online system for their online learning and the present number was about 60 students for each online lecture. The evaluation was based on three following survey questions (1)"Do you understand the subject matter just by attending the online lecture", (2)"Do you satisfy with the interface of the online learning system", (3)"Do you satisfy with video and audio quality of the online learning system". The number of distance students participating in the survey is 45. The convenience sample of students responded to the survey, which was based on the following, 4-point scale: "4 = Strongly Agree"; "3 = Agree"; "2 = Somewhat Agree"; "1 = Disagree".

The survey result is shown in Table 1. For the all questions, most of students chose "Strongly Agree" and the mean values are higher then 3:4. This result indicates that our system was useful for most of distance students. For second question, some students chose "Disagree" and this indicates that the interface of our system needs to be improved especially in graphic resolution. However, for third question, the number of unsatisfied students is risen due to the fact that the Internet quality is still unstable in some country areas. Here, in our estimation the minimum network bandwidth requirement is 185Kb=s for smooth video and audio stream so it is affordable for all kinds of Internet connection in Vietnam .e.g. 3G, ADSL and Optical fiber. The survey result shows the proposed online learning system is applicable for online distance learning.

#### V. CONCLUSIONS

In this paper, we introduce a solution of implementing an online classroom in the ordinary face-to-face classroom by using the online learning system Easy Online. Here, providing online students with the same learning information as in-class students is the basic goal of our online learning system. The online learning system "Easy

Online” had been used for online graduate and undergraduate learning in University of Information Technology. A survey was conducted to measure the usefulness of the system for distance students. The survey evaluation for real graduate teaching shows that the proposed software is applicable for online distance learning.

## VI. ACKNOWLEDGMENTS

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