Using a greek LMS to enhance distributed multimedia content to remote and mobile students

D. Glaroudis[1, 2], E. Bompoli[2], S. Pavlidis[3], S. Manitsaris[1, 2]
1 PhD Student, Department of Applied Informatics, University of Macedonia
2 Teaching Staff, Technological University of Thessaloniki
3 Teacher, Hellenic-French School "Calamari"
University of Macedonia, Economic and Social Sciences,
156 Egnatia Street,
GR-540 06 Thessaloniki,
GREECE
dglaros@uom.gr, ebompoli@gmail.com, sapavlidis@yahoo.gr, sotiris@uom.gr ,

ABSTRACT

The evolution in Internet and Multimedia Technology and the continuously increasing demand for enhanced remote and mobile services render as essential the adaptation of educational material in these requirements. The main topic addressed in this paper is to propose an alternative process for students attending courses. It refers to multiple types of students meaning that the educational material can be accessed by in campus, remote and mobile students. This paper describes a methodology for creating and adapting synchronous and asynchronous communication for each type of students. The educational material, such as SCORM based courses and video lectures, are transmitted via streaming media technologies, through an open source greek LMS, called ASDL.

KEY WORDS

LMS, streaming media, video lectures, mobile services, data transmission

1. Introduction

The new and evolving technologies of supporting and distributing multimedia content through the Internet, improve the educational process. The enrichment of the educational material (videoconferences, presentations-narrations, online exercises and evaluation), published in the Internet, extends the possibilities of comprehension and assimilation of complex significances. Moreover, the interaction between teacher and students is influenced positively exploiting suitable equipment (electronic table, students' screens synchronization etc) and creating telecourses with additional educational scopes for improvement. The contact directness existing between teachers and students in a traditional class could never be completely substituted.

2. Synchronous communication & ASDL

In previous years most e-learning systems were based on asynchronous communication. Students and teachers had to communicate with services such as email and blogs resulting to long time intervals and insufficient learning. Nowadays, synchronous communication can overcome such shortcomings, enhancing the overall learning process.

2.1 Project's objective

The aim of our project was to extend the conduct of courses in a traditional class. The educational material is addressed both to the students that attend the class in a traditional way and to those who do this by using a mobile device. The proposed approach is considered to be essential especially for the students that do not attend classes in a regular basis due to an abundance of reasons emanated from the modern student life (family, work, leisure time). The main axes of this project were the creation, transmission and management of multimedia content through organized e-courses using SCORM and video lectures via streaming technologies. The resulting educational material will be delivered to students who are registered to attend courses in our department. The following approach has been used in an educational project funded by the Hellenic Ministry of Education.

2.2 ASDL ergonomics

ASDL is a learning management system that offers a significant solution to the direction of active attendance of each person involved in educational process. ASDL supports storage and projection of educational multimedia files and SCORM lessons in order to achieve reusability, accessibility and interoperability of the content only by using any internet browser [1]. Furthermore, distance administration of the system, through an internet browser, creates no demand for both the users to possess technical

knowledge and for the administrators to be physically presented. The support of different kinds of users provides personalization; protection of the files and the parameters of the platform and easy administration. Finally, ASDL through the videoconferencing and streaming video services supports synchronous learning resulting in the amelioration of the educational process.

2.3 ASDL, remote & mobile users

Since there is the problem of educators who can not always attend the conducted lectures in the campus, we categorised students in three main types; 'typical', 'remote' and 'mobile'. Typical refers to students inside the campus who may or may not attend the lectures; remote refers to the students outside the campus having a desktop computer with internet access and finally mobile students are those accessing the learning material with a pocket pc. This categorization is based upon the special characteristics associated with the necessary network bandwidth rates for delivering the multimedia educational material in each of the above cases.

Typical students can use desktop computers which share a T1 line. Taking into account the fact that there is a great availability in bandwidth when using the local network inside the campus, users can access without problems any type of multimedia files, such as video lectures of high video quality, and even conduct videoconference sessions with the instructors.

On the other hand, remote students usually share lower bandwidth rates than typical students when using PSTN and ADSL lines. This fact has a negative impact in the video quality and may cause significant delays in data transmission when accessing the same services and multimedia files as typical students. So, for remote students it is preferred the SCORM version of the e-courses and video lectures with differentiated streaming characteristics.

For 'mobile' students, restrictions such as small screens, limited memory and storage capacity, costly internet connection and not stable bandwidth rates have to be addressed. Similarly to remote students, the SCORM approach is preferred, while specific methods are proposed for the video lectures.

2.4 Related Approach

The work described in this paper is a further extension of ASDL services. This learning management system has been used in the past for publishing educational material such as transparencies, PDF and word files, but without exploiting all the synchronous and asynchronous ASDL services (ex. video lectures streaming).

ASDL has been implemented on a Greek High school, via asynchronous communication with pupils. The evaluation of ASDL use, through questionnaires, showed that pupils find the use of ASDL as a motive to study more [2], [3], [4]. A similar approach for delivering educational material using Internet & Multimedia Technologies is the MIT OpenCourseWare [5]. OCW provides MIT's course materials such as syllabus, lecture notes, streaming video lectures and web interactive demonstrations for educators, students, and self-learners around the world [6].

The main advantage of this work is that the scorm lessons and video lectures of high quality are published through an LMS system, while they can be accessed by both 'typical' and 'mobile' students.

3. Composition of SCORM lessons

ASDL is based on the platform Dokeos and it was selected because it incorporates SCORM based courses efficiently. For example it is the only open source platform that presents the arboreal structure of learning objects in combination with the content. This structure works as an index of navigation and it constitutes for the student an exceptionally friendly tool that it will help him to attend the scorm based course. Additionally, even if Dokeos is not absolutely compatible with the SCORM specification, this lack of severity is considered positive, as Dokeos can easily incorporate SCORM courses of different versions (SCORM 1.2 or SCORM 2004) or even courses with small lacks in the coding [3].

We have chosen SCORM approach because it does not deal with specific multimedia formats or versions. If the educational content is Web-based and can be served up by a standard Web browser, the SCORM makes no recommendations or restrictions on media types. Additionally, in respect of affordability, SCORM reduces the time and costs involved in developing and delivering learning content. Finally, the developed e-lecture does not require much bandwidth in order to be accessible, even if it is enriched with multimedia data. This fact serves the students who access learning content through PSTN or ADSL internet connections.

The first objective was the definition of suitable software that would serve the specifications that had been placed; compatible with the Greek language, compatible with the ASDL, free of charge and open code, and finally flexible and functional. At the duration of research, it was checked the efficiency of Reload Editor software, which can compose SCORM type courses, but it was rejected for the following reasons; it was not compatible with the Greek language, each transformation in a sub-section affected all the course parameters, and finally it was not compatible with the ASDL as the files were not always presented.

Thus, it was selected the SCORM type that has already been incorporated in ASDL because it satisfied all the above specifications. It should be noticed that by using

this type each instructor very easily can change the units of the course, erase or enrich them without intervene in the total course's structure.

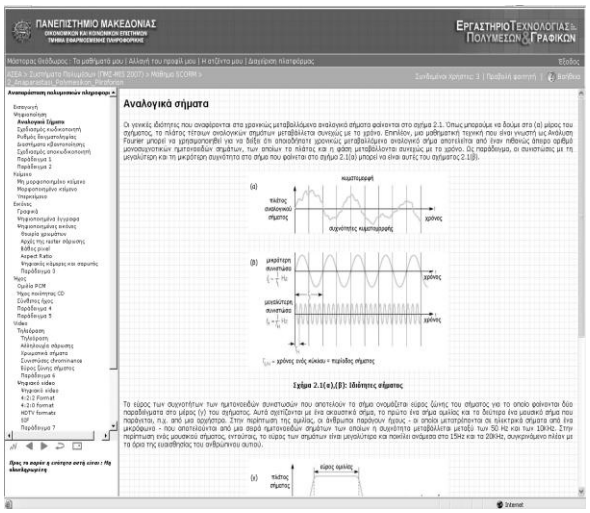

Figure 1. View of a SCORM lesson

4. Video lectures using streaming technologies

Using audio and video streaming is demanding in terms of bandwidth, but ensures lecture's delivery through the web in an effective way. Streaming media minimize the client's waiting time since the transmitted material does not have to be downloaded completely for viewing. Windows Media, Real Media and QuickTime are the most widely accepted streaming technologies.

The proposed system utilizes Microsoft Windows Media platform as it was included in the Microsoft Internet Information Server (IIS) which was already in use. The key features of Windows Media Technologies are the wide bandwidth range and multiple bit rate encoding, the intelligent streaming, the built-in multicast service, the wide availability for end user due to their support of both Internet Explorer and Media Player, and the choice of on-demand or live presentation. Especially it's characteristic of using different bit rate during encoding, according to user needs and its hardware profiles, ensures qualitative result for students, enforcing the learning process. Additionally, media server can monitor and automatically adjust the bit rate of each client stream according to current bandwidth so that end users receive the highest quality stream.

4.1 Structure of the video lecture

For video lecture development, each instructor has been asked to perform the lecture in a classroom with the appropriate equipment for digital video recording and broadcasting. Specifically, the classroom is equipped with a Sony digital video camera opposite to the smartboard where the lecturer acts. The professor uses a wireless microphone for communication with students and the visual and acoustic learning data are recorded in a Sony DVD recorder. Data synthesis is achieved by the EXTRON matrix hardware and software installed in the professor's personal computer. The final video file is stored and it can be broadcasted using the Windows Media Encoder open software.

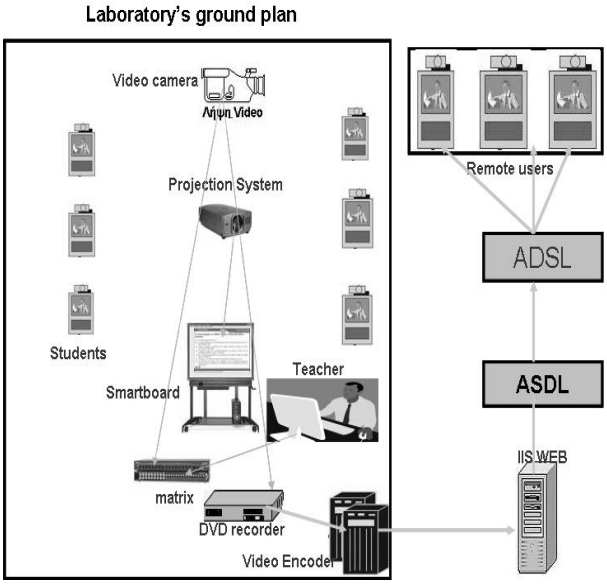

Figure 2. Laboratory's ground plan

Windows Media Technologies offer wide bandwidth range and multiple bit rate encoding. This characteristic helped us to concentrate our interest in encoding the video lectures to suitable quality and capacity rates for the types of students we refer to.

The first task is to deliver the educational material to students who work inside the campus (typical students), and provide them additional services than the 'traditional' lecture in the classroom. These services are the video lectures live streaming, and on demand delivery of the video lectures. Typical students share a T1 line so there is enough available bandwidth in campus local network. Thus it is chosen high quality encoding. The software used is Windows Media Encoder and the encoding options are high definition quality (CBR) for video and CD quality (CBR) for audio. The used bit rate is 5173 Kbps, with frame rate 29.97 fps and output video size 1280X720. Although the video size is predefined in certain bit rates, it can be changed by Encoder's Session properties window, accordingly to the users' preferences. The image and sound quality is considered as excellent and there is minimum delay in signal's delivery.

Two scenarios are tested; at first the live lecture is recorded and broadcasted producing a high capacity video file. Another option is to capture the teacher's screen

image (in this case the lecture's transparencies) and the instructor's comments in the transparencies, combined with the possible questions by the students. This is an option in Windows Media, choosing as encoding sources the screen's image and the wireless microphone that captures the lecturer's and student's comments. Its advantage is that the resulting streaming file has smaller size in case of video on demand service.

The next stage was to offer the streaming service to remote students. In this case there is not enough available bandwidth for very high definition quality, so it is preferred the multiple bit rates choice for video encoding and cd quality for sound encoding. This choice offer the advantage that the recorded video file can be streamed to two or more bit rates and the outcome can serve both ADSL and PSTN internet users. The used bit rate are 340 Kbps, with frame rate 29.97 fps and output video size 320X240 for ADSL line, and 58 Kbps, with frame rate 15 fps and output video size 160X120 for PSTN line. The same two scenarios as before were tested but the image and sound quality were not very good, while it has been noticed delay in signal's delivery. To overcome some of these problems the sound encoding was set to FM quality AUDIO (CBR) and for screen capture scenario the lecture's transparencies were formatted with larger font size in order the video's clarity to be better. For live lecture's case the video encoding is set up to 109 Kbps, with frame rate 15 fps and output video size 240X 180 and to FM quality AUDIO for PSTN line. The file streaming and its quality were better, although the overall result was not excellent.

4.2 Accessing video lectures through ASDL

Above, we describe the steps made so as to encode and stream the video lecture using the Windows Media technology. Next, it will be described how the lecture can be viewed by students who use ASDL learning management system. ASDL facilitates synchronous communication through the "streaming technology" service. The initial platform, Dokeos, has shortcomings in services of synchronous communication. The possibility of transmitting a video file with streaming technology is not friendly to the user. It depends on the administrator-professor to assign a reference in a streaming server with no help or connection with a list of available video-courses. In addition, the video file is presented in a new window that alias the main course window, causing confusion and complicating the overall presentation of the educational material. In ASDL system, aiming to the confrontation of the previous problem we modified the code of unit "Conference" of Dokeos.

After installing the videoconference server in a multimedia computer, each learning module has its own virtual conversation room for the students to choose from. Inside this window there is a link responsible for the automatic launch of a videoconference to the "streaming" section. Showing a streamed lecture within the ASDL window requires the employment of a computer running Microsoft Windows Media Services. It has been inserted an additional link to the "conference" section's configuration panel, leading to the administration page of the Media Server's repository. Instructors can then add a publishing point. There is a corresponding shared folder for any created lesson in the ASDL environment. Following the previous steps, the assignment of a specific publishing point to a lesson, becomes an effortless task.

So, in order a student to attend a live video lecture through ASDL he/she has to subscribe to the specific lecture, choose the conference section and a windows media player panel will broadcast the educational material.

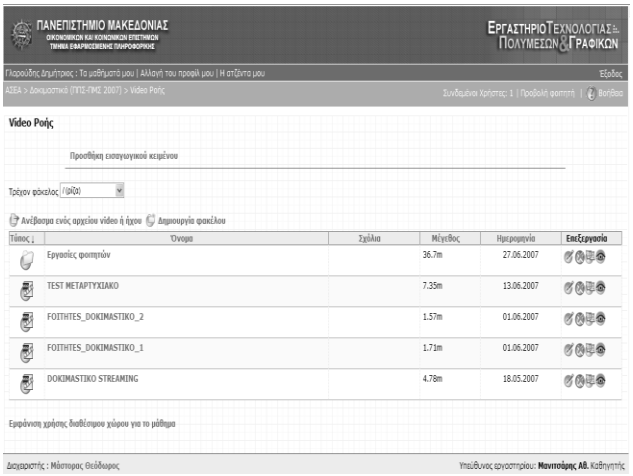

Figure 3. Lecture's video on demand link

5. ASDL serving mobile users

The final stage was to provide the educational material to students using a pocket pc device. This option has been selected because accessing a computer with internet access or being obliged to attend courses in a restricted timetable can be important restrictions for students. Mobile communication technologies can overcome such restrictions and prepare the learners for more flexible training environments. Portability and easy transport of mobile appliances combined with their possibility of connection in a common network or with other mobile appliances for data transport set them attractive for training activities [7],[8]. If we also take into consideration that the cost of portable appliances is relatively smaller than the cost of personal computers we comprehend that "mobile education" is an approach that deserves further study and development.

The pocket pc used in our tests is HP iPAQ hw6915 Mobile Messenger. It was selected by a number of other portable appliances because its operation is dual; it functions as a mobile phone as well as a pocket pc.

Additionally, it allocates sum of characteristics so that it can support to a large extent, with its peripheral devices, the requirements for a direct connection to an educational platform. The installed operational system is Microsoft Windows Mobile 5.0 for Pocket PC, Phone Edition. For browsing the web content it is used Microsoft's Internet Explorer or the Opera Mobile Browser. Especially the Opera browser offers a user-friendly access to the web pages and it can recognize the capabilities of the mobile appliance, optimizing web pages accordingly for fast and easy browsing.

When accessing the ASDL's web content with the mobile browser it is obvious that the relatively small pocket pc's screen size affects the resulting browsing. Although all the features of the ASDL's graphical interface are 'inherited' by the mobile browser, the overall view of the site is not very user friendly. Nevertheless, by focusing or zooming in specific areas of the graphical interface the user can enlarge the site's picture and access the educational material, such as word, excel PDF or video files.

Windows Media streaming technology is also used to deliver the video lecture to the pocket pc. The encoding options are Pocket PC widescreen video (CBR) for video and CD quality (CBR) for audio. The used bit rate is 259 Kbps, with frame rate 20 fps and output video size 208X160 or 320X240, depending on the dimensions of the screen. The output video size can be changed in the video size properties window so as to be adjusted to the pocket pc's screen size. As before, live lecture and lecture's transparencies with instructor's comments scenarios are tested. Because mobile communication suffers from limited bandwidth, it is thought as preferable to encode and broadcast the screen capture plus sound as it requires less bit rate. Additionally, the resulting streaming file has smaller size in case of video on demand service.

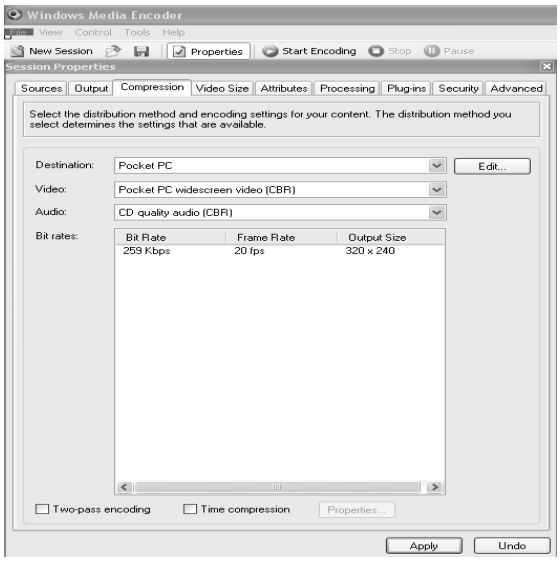

Figure 4. Parameters for pocket pc streaming

Mobile users can access the video lecture in ASDL by choosing the appropriate link in videoconference section, as the ASDL administrators have added a publishing point for mobile streaming. The tests conducted show that delivering video lectures to mobile users is a very promising service as postgraduate students were enthusiast in the idea of accessing the educational material using mobile technology. A small team of students participated in the tests and they commented the video lecture satisfactorily good quality, but they suggested that the navigation of the site was difficult via a pocket pc. Nevertheless, further research and tests have to be done in order video quality to be improved and scorm-based structure of ASDL to be suitable associated with mobile technology, aiming to students' participation in the learning process.

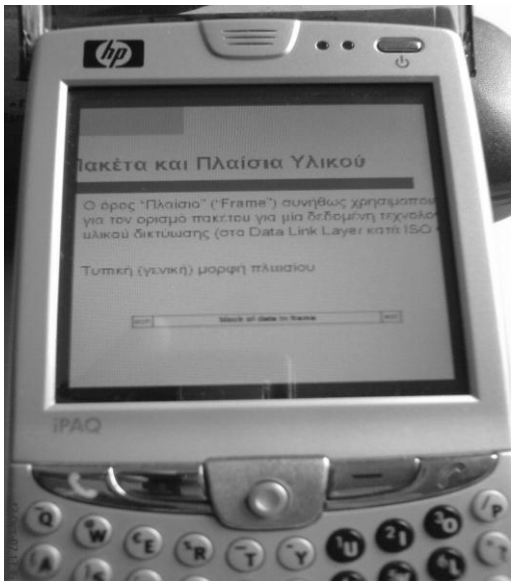

Figure 5. Streaming video for pocket pc

6. Conclusions - Future work

This paper describes the methodology of SCORM-based courses and the video lectures creation and distribution through the ASDL learning management system using streaming media and mobile communication technology.

There is no evaluation of the proposed methodology yet, because the relevant to the project courses will be presented to the authorized students in the following semesters. Nevertheless, receiving satisfactory feedback from both instructors and students who voluntary participated to the tests, our future plan is to evaluate the followed method by forming and analyzing questionnaires for professors and students. Then, it can be conducted a survey on the academic performance of students who use or do not use the ASDL for attending lectures or an estimation of the benefits of the proposed approach. Furthermore, as SCORM does not directly address how

learning content could be delivered to wireless or mobile devices, research is conducted aiming to overcome the mobile devices' restrictions of limited memory and screen size and offer a SCORM-based, user friendly educational environment to mobile users.

Through this approach, it has been provided to participant students the educated means in order to cover potential voids, to supplement and to improve knowledge. Moreover, remote or mobile students have the possibility to substitute their "not-attended" lectures. Consequently, it is considered that a strong number of students follow-up the courses, since they have the ability to revise a lecture whenever they wish. Thus, it is achieved the biggest possible knowledge improvement. Finally, using mobile services to deliver educational material, students with special needs (eg kinetic problems) they will not be excluded from the educational process.

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