TOWARDS DEVELOPING AN INTEGRATED MULTIMEDIA FRAMEWORK FOR ENHANCED e-LEARNING

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Abstract: In recent years, information and communication technology and multimedia technology have increasingly altered the landscape of the educational field particularly in higher education. In that, e-learning in its broad sense makes use of network and computing resources for bringing general education to the potential benefits of distant education and face to face classroom education. The amount of multimedia support facilitated by the e-learning systems has given significant consideration in order to make distance education as effective as classroom education and make the blended leaning experience more effective. While the technology is moving toward a multimedia rich learning management system, its practical deployments is still far away, due to many unsolved technical and pedagogical problems. In this paper we discuss the design and implementation of a prototype system *umeLMS* which features an integrated framework that interacts with a rich set of hypermedia contents and provides ubiquitous access. The main focus of this design is threefold: first *input integration* by which multimedia can be incorporated into the LMS in various ways. Second, *content Integration* by which different forms of hypermedia is linked to the course contents. Third, *access integration* by which a wide array of mobile devices are supported for multimedia content browsing which creates a real u-learning environment by enabling active participation in the learning/teaching process.

1 INTRODUCTION

In recent years, information and communication technology and multimedia technology have increasingly altered the landscape of the educational field particularly in higher education. Ritsumeikan Asia Pacific University (APU) in Japan, whose mission is to create world leaders in Science, Management and Economics through a bilingual curriculum, has increasingly been using many computer supported learning and teaching modalities to promote its educational delivery, since its establishment in 2000. The authors have involved in developing a prototype system (Nishantha, 2008) that extends APU's e-learning platform with interactive multimedia.

Computer modalities and software systems, which are used to achieve the blended learning objectives together with the support to administrate and monitor educational courses are generally termed **Learning Management Systems** (LMS) (Bersin, 2008). Choosing an LMS platform, however, is a critical decision which can have a significant impact on the academic institutions' ability to help students and lecturers meet their educational objectives.

Use of multimedia in learning content has been identified as an important element (Chris, 2007). According to United States Department of Defense data (Oblinger, 1991), we have short-term retention of approximately 20% of what we hear, 40% of what we see and hear, and 75% of what we see, hear, and do. The WebCT/Blackboard system (BlackBoard inc., 2009), heavily used commercial LMS today, has integrated virtual classroom/collaboration functionality in its latest (Windows Vista compatible) version. Moodle, a heavily used open source LMS, has also integrated a multimedia plug-in, named *DimDim*, to facilitate primitive video conferencing capability. Many academic institutions

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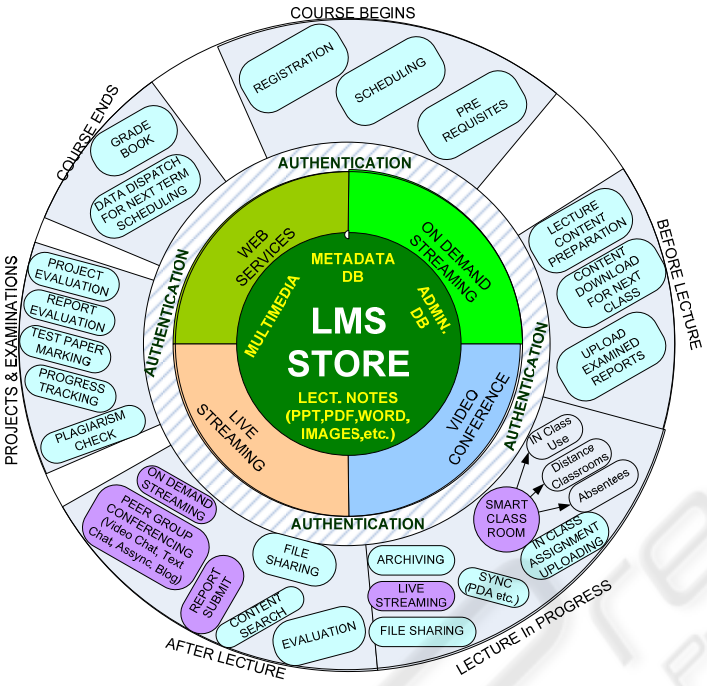

Figure 1: Activities throughout a course life cycle in a fully integrated LMS.

reportedly have added an array of custom multimedia functionalities either as an integrated tool to the LMS or as an independent tool to quickly cater the demanding needs for multimedia functionalities. While the technology is moving toward a multimedia rich learning management system, its practical deployments is still far away, due to many unsolved technical and pedagogical problems. Therefore, in Asia Pacific University in Japan, we have started developing a *Ubiquitous Multimedia Enhanced Learning Management System* (**umeLMS**) to enhance its education quality while reducing the user burden. The term *ume* (ゆめ : pronounced as Yume) in Japanese Language means dream: hence we envision an ideal LMS (dream LMS) to enhance the quality of education.

In this paper, we present our three fold contribution to enhance LMS. Firstly, **input integration** by which multimedia can be ingested into the LMS in many ways. Second, **content Integration** by which different forms of multimedia interact with the course contents. Thirdly, **access integration** by which a real u-learning environment is made possible by allowing an array of mobile devices to participate actively in the learning/teaching process.

The rest of this paper is organized as follows. In Section 2, we present the design rationale of the proposes system. Section 3 presents implementation and deployment of webELS prototype. Conclusions appear in section 4.

2 DESIGN RATIONALE

In devising a prototype for a Multimedia Enhanced Ubiquitous Learning Management System, considerations should be given to all stake holders of the system to be provided with facilities to (a) reduce cost and time consumption (b) reduce workload (c) enhance educational quality (d) enhance the accessibility and (e) enhance usability. In achieving some of these objectives rich use of multimedia plays a significant role. Figure 1 illustrates the activities and interaction of a fully integrated LMS over a generic course life cycle indicating the interaction of all stakeholders (i.e. administrators, teachers & lectures with the contents stored in LMS store and the interfaces provided). Multimedia is used in this model with close integration with the lecture content for supporting students to understand the course content, report back to the lecturer as well as group discussions. Further, multimedia is an integral component to realize smart classrooms that serves outside audiences.

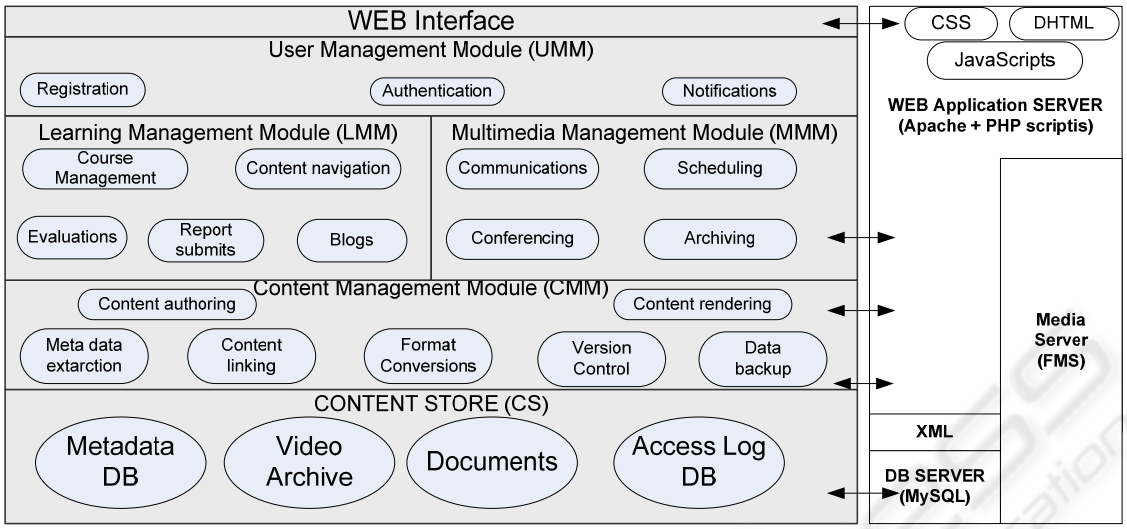

Figure 2: Modular architecture of umeLMS.

2.1 Design Architecture

Despite the availability of many famous open source learning management systems, we have opted to implement a novel system to cater for the special needs of the system that we envision.

The access interface identifies the client side devices and performs custom rendering to the device's screen resolution. Personal computer (PC) and mobile devices like third generation mobile phone and PDA (Personal Digital Assistant) could access the system through mobile connections like 3G or through wireless LAN connections.

The target learning system essentially consists of four functional modules as shown in Figure 2 namely: *user management module* (UMM), learning management module (LMM), internship management module (IMM), and *content management module* (CMM). UMM manages users as well as user groups and provides access authorization to the system resources through the functional modules LMM and MMM. LMM manages the learning and teaching where students teachers and administrators interacts with didactic and administrative material. Multimedia Management Module (MMM) houses the functionality to handle multimedia. This modular design enables networking with the other functional modules developed by the authors (e.g. projects management module in (Long, 2008) as well as exiting third party modules.

2.2 Content Integration

Three types of integration methods are incorporated in webLMS, namely: *input integration*, *content integration* and *access integration*.

2.2.1 Input Integration

Input integration refers to capturing various multimedia inputs to enhance the richness of lecture contents. Following multimedia input methods are of major concern for maximizing multimedia effects in teaching as well as learning.

- **Lecture recording:**

Lecture recording has become more and more popular in every university nowadays. However, in most cases it is used as a single stream audio video recording and often not integrated to the LMS. In this paper we propose a cost efficient methodology that uses a single dedicated PC per classroom to process inputs and form a composite stream for recording as illustrated in Figure 3. Three video inputs are captured from three IP cameras pointing to the lecturer's desk, whiteboard and the students and combined at the dedicated PC and then archived at the Flash Media Server (FMS) (Adobe Inc., 2008).

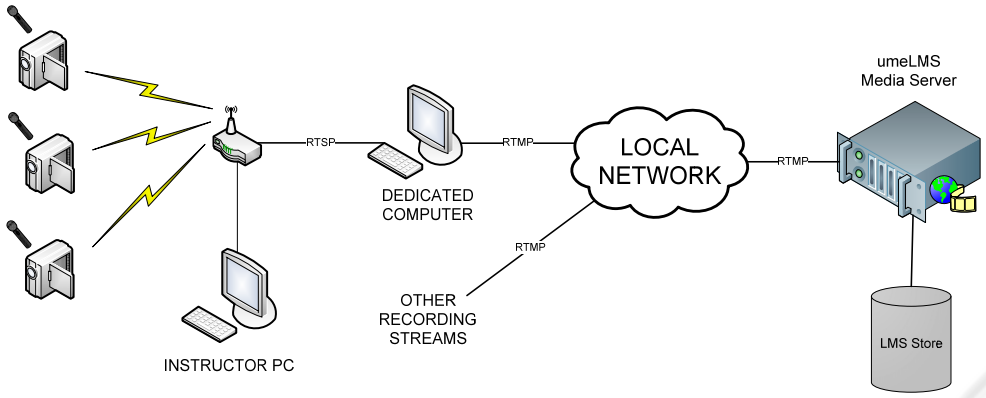

Figure 3: Lecture recording architecture.

- **User side recording:**

The users should be facilitated with an interface to upload live audio/video recordings which allows them to submit their reports/suggestions/comments using rich multimedia formats. This enables enhanced interaction among students and teachers by providing an interface to answer or issue queries without wasting time, without the need to be active to respond, and without the need to be familiar with multimedia processing knowledge.

- **Live conferencing:**

Live conferencing features are considered as a very strong tool used in many areas like business, medical, and government. In education, live conferencing is strongly supported by commercial LMS. Open source LMS have less built-in-features than the commercial ones but they are open source and easier to be developed to extend the features. umeLMS with FMS server can provide high quality and flexible synchronous media streaming which can be used for live conferencing integration.

2.2.2 Content Integration

Having built up the content store with a mixture of related hypermedia elements (i.e. lecture contents, lecture recording, report submissions and client side multimedia) it is required to relate different elements for enhanced accessibility. We adopt a metadata model to implement a semantic linking mechanism as presented in (Hiromitsu, 2005) to relate different elements in the LMS store.

- **SCO content model**

We propose a Sharable Content Model (SCO) that can be easily modified, shared and reused to store multimedia contents. We adopt this model, similar to SCORM (Gord, 2004); to facilitate a high-level and well defined content structure while keeping the content development burden as painless a manner as possible to the university lectures. However, in order to keep this SCO methodology less complex, we keep away from the Standard SCO models such as SCORM-2004 (Victor, 2008) but using a simple custom tool for content authoring.

- **Content Authoring**

Figure 4 (left side) shows the formation of SCO script in *manifest.xml*. The SCO publisher in takes different type of hypermedia inputs as shown in (I) and generates manifest.xml file (II). Hypermedia input in (I) is saved in the proper service location (ie. Data Server, Web Server or Media Server). Metadata for generating the SCO object is captured from user behaviour, user input, and scanning the input contents by the system. Input files which do not generate any metadata description will all be stored as linked *assets* of the course contents. In this approach, contents corresponding to one course are packaged in to one container with a *manifest* file.

- **Content rendering**

When a client request to access an object from Web Server (1) , the web Server will check from data server and get the info of that object (SCO compliant) (2,3). After receiving the requested information from data server (objects permission, file info, etc) (4), web server will render the html output, with embedded objects or hyperlinks to contents. In case of media streaming, the web server will pass the required information for the client to communicate directly with the media server (6,9) and instructs the media server to service the client (7,8).

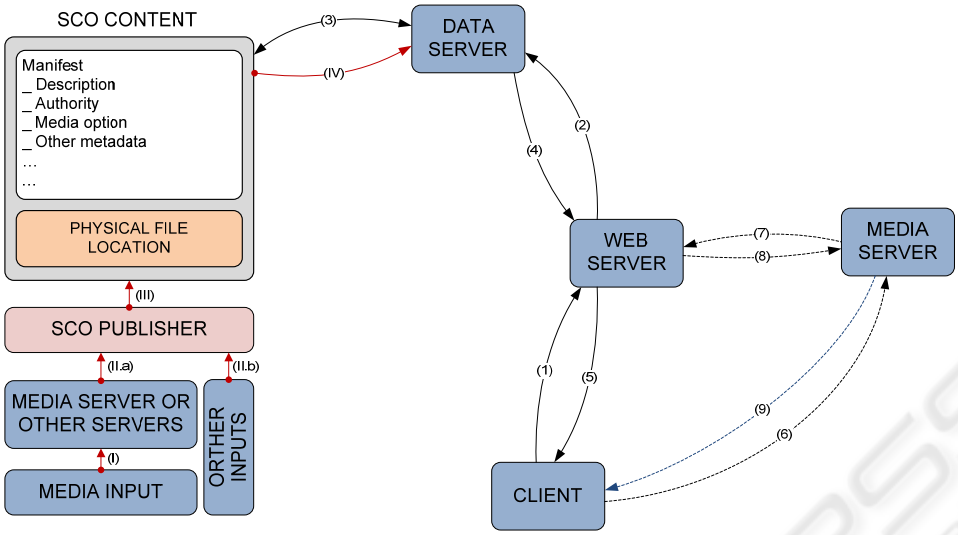

Figure 4: SCO content integration.

2.2.3 Access Integration

Access integration is one of major goals of the development of umeLMS by which the LMS systems is open to ubiquitous access through desktops as well as mobile devices. This is made possible by using Flash Streaming Technology (adobe, 2009) which is supported by almost all internet browsers and installed virtually in all computers irrespective of the operating system.

The Media Streaming System we use is multimedia framework using Flash Media Interactive Server provides the ability to stream live videos or video on demand contents as show in Figure 5. Nearly every device which can access the Internet has the built-in Flash supported browser for rich Internet contents, like PSP, iPod Touch, and other PMP (portable music player) devices. With Flash being widely supported by many devices, umeLMS will gain a fully fledged ubiquitous connectivity.

3 SYSTEM IMPLEMENTATION

3.1 Working environment

umeLMS Web Server is built upon a L(W)AMP stack (which stands for Linux (or Windows), Apache, MySQL and PHP). umeLMS Media Server (with is powered by Flash Media Interactive Server) is using another dedicated Linux or Windows server. A dedicated Database server is optional, it can be used in case of large-scale organization, in this development stage, we use one computer to act as both Web server and Database server for easy control and cost efficiency.

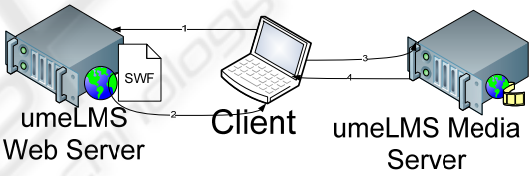

Figure 5: Media streaming in umeLMS.

3.2 Implementation

umeLMS Web Server and *umeLMS* Media server communicate with each other through a low-level API system. When Media Server wants to connect to the web server, it will use the web service (written in PHP) and make an XML-RPC (Remote Procedure Call) to request the user authenticating data. On the other hand, when Web Server wants to make a Live Conference through Media Server, it will request Media Server to open live streaming service. The client (desktops or handheld device) only need a Flash supported browser to access Web Server, everything will be taken care in server-side.

To maximize system efficiency as well as compatibility for other LMS integration, we have developed a set of APIs for umeLMS web server which implements the modular architecture we explained in Figure 2. Figure 6 illustrates a snap shot of umeLMS umeLMS showing video playback and student's personal notes. By this way, each student can maintain his/her own study profile.

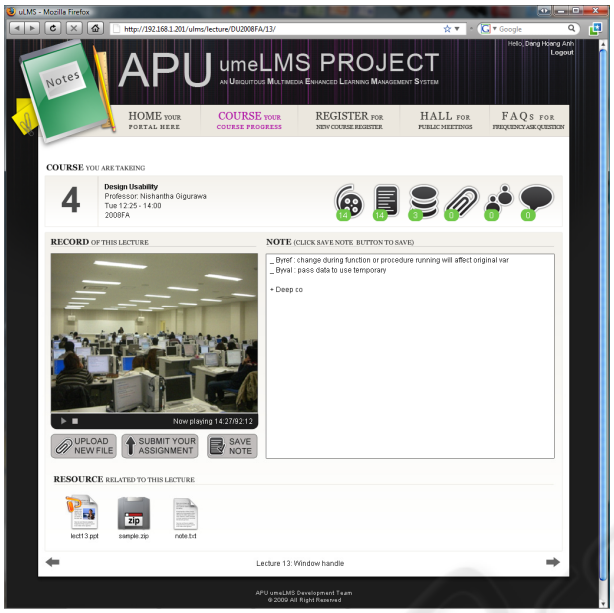

Figure 6: A snapshot of umeLMS showing video playback and student's personal notes.

4 CONCLUSIONS

In this paper we presented a framework for implementing a ubiquitous multimedia enhanced enhanced learning management system (umeLMS). To implement this we propose SCO based content model and a flash based multimedia framework, with which content captured from various sources is integrated. Due to the dominant use of multimedia in our system, we believe 3G devices will find these very attractive thus enabling students to actively engage in the learning process from anywhere and at any time. We hope our pilot run in Asia Pacific University will be an example for other universities to revise their learning systems.

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