The Building of Mobile Interactive Learning System based on Cloud Computing
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Abstract
An interactive mobile learning system based on cloud computing, have developed a practical and
cost-efficient solution, the presentations given by the instructors uses the same methodology but the
development technology itself takes care of broadcasting the content to the students’ mobile devices.
The class sessions are broadcast live, which allows for synchronous participation by the remote
students using different modes of interaction specifically designed for easy usability with a mobile
device. In addition, the combination of Cloud Computing and mobile learning promoted mobile
learning to content richer, more widely applied, and more powerful.

Keywords: Mobile Learning, Cloud Computing, Live Video, Eucalyptus Cloud

1. Introduction
Many online classes simply provide recorded instructor lectures to which students listen after
downloading. This format only reinforces the negative effects of passive non-participatory learning.
The main idea here is to develop an interactive live mobile learning system, which streams live
lectures to student’s mobile devices with interacting facilities, using a mixture of existing and self-
developed codec’s.
The lectures are held as usual in university, not requiring the costly preparation of especially
authored mobile learning materials. The system takes care of compressing the video and audio data
efficiently so that it can be live-streamed, while maintaining high visual quality. With the interaction
feature the student can interact with the lecturer, and the lecturer can post his reply.
To improve the system still further we took mobile learning to cloud computing environment. Cloud
computing is user-centered to provide secure, rapid and convenient data-storing and network
services, so it can allow the Internet to become every user’s data and computing center and as well
users will shift from various desktop-centered applications to various web-centered actions. It is a
virtual and highly usable platform that can provide dynamic resources.
Luo Zhong et al. in [5] discuss the characteristics and key techniques of 3G mobile learning based
on cloud services. His research mainly focuses on mobile learning mode including active mode,
passive mode and hybrid mode. Then personalized learning method and resource integration approach
are applied and analyzed. At last, he propose to employ cloud computing to mobile learning and build
basic framework and simulation application for 3G mobile learning based on cloud services. J. C.
Costa et al. in [9] present an application named MLI (Mobile Lecture Interaction) which is used for
enhancing lecture interaction between a teacher and the students. However, the mobile application
allows them to ask questions and support question from other students by voting for them. These
questions are presented to an instructor application running on a PC, so that the instructor can then
answer the question in details.
In order to develop a new system with the combined advantages of above models such as better
interaction facilities, reduced delay, cloud computing environment, etc, we propose here “Interactive
Mobile live video learning system in cloud environment”. Initially the lecture is captured through
webcam and spitted as two second video clips in mpg format. Every two second clip is progressively
downloaded to the cloud once captured. Finally Mobile clients can receive the live lecture through the
buffer created at the local memory.

2. RELATED WORK
Ganesh Narayana Murthy et al. in [6] presents a novel method for adapting lecture videos as, non-changing portions of a lecture video are identified and one image is extracted from each such region. The output is a slide-show of such images along with the audio stream of the whole lecture. Though it reduces the redundancy and reduces bandwidth usage, the slide show of images will not have that much continuity to view. It shows the delay between audio and the image. Carsten Ullrich et al. in [12] described about design structure of mobile learning and the interaction facilities that can be provided.

Akio Koyamat et al. in [8] propose a mobile education system (MES) and an extended mobile HTTP (MHTTP) protocol. It supports the student's learning by downloading the teacher agent (TA) into the student's cellular phone. The MHTTP is a protocol extended from the HTTP in order to deal with problems caused by HTTP for the cellular phone network. But the work has not supported the Multimedia contents. Since now a day’s multimedia contents plays a main role in learning, absent of that will reduce the reality of learning. Xin Bai in [13] suggests transferring learning contents through FTP and HTTP protocols. He also added some ideas to develop learning contents with interoperability.

Jian Chen et al. in [7] deal with intelligent mobile learning platform along with 3G and data mining techniques. Still it should be improved to support the high-quality real-time video and audio transmission with low cost, high-speed downloads of digital learning resources and real-time display, variety of mobile devices and operating system platforms, demand of all types of learners for personalized information and retrieval of digital learning resources. Jian Li at [1] summarizes the characteristics and models of traditional mobile learning, analyses the features of cloud computing and clarifies the superiority of mobile learning model development in cloud computing environment.

It deals with two kinds of mobile learning models: one is autonomous mobile learning model, and another is reception mobile learning model. Xuefei Chen et al. in [2] sums up the traditional mode of mobile learning, analyses the characteristics of various patterns, provides the characteristics of the cloud computing, and then make mobile learning mode under a cloud computing environment. He discussed the learning mode into two types, acceptance-based mobile learning mode and autonomous mobile learning. Hong-qing Gao et al. in [4] the model of mobile learning based on hadoop is proposed and its functional modules is analyzed. He describes about how the learning materials, which are stored in the hoop cloud can be retrieved and provided to the viewer.

3. LIVE MOBILE LEARNING IN CLOUD ENVIRONMENT

3.1 Mobile Learning

Mobile learning refers to the use of mobile and handheld devices such as Personal Digital Assistants (PDAs), mobile telephones, laptops and tablet PC technologies, in teaching and learning. The introduction of mobile computing suddenly poses a fresh and innovative way for the students to learn. Awareness of the constraints of the user interface is also vital. Mobile devices suffer from small screens, poor input methods and limited battery life. Therefore, the interface design for M-learning services must meet user needs without overloading them with unnecessary complexity or operating too slowly. The framework of the system is shown in Fig.1.
3.2 Cloud Computing

Cloud computing is an emerging computation paradigm. The basic principles of cloud computing is to make the computing be assigned in a great number of distributed computers, rather than local computer or remoter server. A cloud consists of massive resources, and provides some mechanisms to provide workload rebalance and monitor those resources. It represents as one or more unified resource entities, and renders users with services to access those resources without knowing the detailed information. Cloud computing aims at realizing scalable integration of all kinds of distributed resources for effective use. One of the most important features of Cloud computing is scalability and the key technology which makes it possible is virtualization. Virtualization breaks down the physical barriers inherent in isolated resources, and automates the management of these resources as a single entity through hypervisor technologies such as VMs.

3.3 Eminence of Mobile Learning in Cloud Environment

Cloud computing is the promising infrastructure which can provide tremendous values to Mobile learning system, due to its abilities of delivering computation and storage resources as services. Deficiencies in the traditional mode of mobile learning make it difficult to popularize mobile learning and it also fundamentally limits its development. Cloud era will compensate the deficiencies in traditional mode, causing changes in mobile learning mode. Cloud computing provides the most secure, reliable data storage center, so a large number of educational resources can be stored in the cloud server, making up for deficiencies of mobile devices with low storage capacity. Cloud computing with powerful computing capabilities focuses on providing the infrastructure, platform or application
services for users, and providing unlimited computing power for the completion of various types of applications [2].

In Live Mobile-Learning the cloud plays a vital role because data sharing is the very important role of this learning system, so cloud takes the responsibility of data sharing security and also the load management during the peak hours of access without affecting the network band access. The cloud helps to increase the storage space if the data content are posted more by the users and also during peak hours the total number of user who uses the system will be increased so the load has to be tolerated automatically.

The web search found that organizations of all sizes were using mobile devices for learning because technological advances meant that there was no longer the need for large infrastructure and support costs, and even small enterprises could deliver mobile learning simply by structuring learning around web-based content that could be accessed from web enabled mobile devices. So under cloud computing environment, there is no other requirements for mobile devices except the computing power to run the browser and so a general mobile is enough to meet this requirement.

4. PROPOSED SYSTEM DESIGN

This system is implemented for education using cloud computing environment. The main objective of Live Mobile-Learning to be implemented in the cloud environment is to provide learners the knowledge from the centralized shared resources at anytime and anywhere.

4.1 Function of the System

The instructor wants to register first, once they finish their initial registration, they can login further using their username and password registered. When the instructor logs in, webcam is enabled automatically and starts to capture the session. The video is spitted as two second video clips in mpg format. Every two second clip is progressively downloaded to the server once captured. The person who wants to make use of those live videos has to register and get the credentials to use it via Streaming Protocol (RTSP). Once the students logs in, he can view the set of available online instructors and can select the one he needs.

Then through the GPRS/WIFI connectivity in the mobile, students can access the live content over the server. Once the access starts, the live lecture are taken to the buffer present at the student’s device local memory (Mobile memory). Two threads are used here, one for the progressive download and other for playing the video. They both are synchronized properly for a smoother play.
The data might be text based documents, audio and video files which is buffered from the server to that mobile user and viewed in the mobile. The user can read the documents, look at the video tutorials and finally listen to lectures or seminars. To improve the usability and availability, cloud environment is introduced. The whole server part is introduced to be implemented at the cloud environment. This system helps to “Learn while you roam” and also education for all at any time any where globally. Experts can also share their valid tutorials in to the cloud for development of the education community.

4.2 SMS Gateway

It is a service added in the architecture, to transmit or receive messages between mobile network traffic and other media such as server. With the help of this service, students can interact with the lecturer directly without the need to log out from the application. The lecturer can view the sender and his message in his application and as a response he can post the reply back to the students mobile.

4.3 Mobile Media API

This API is an optional package that supports multimedia J2ME applications in mobile phones. However, this API is designed to support internet protocols such as Hyper Text Transfer Protocol (HTTP) or Real Time.

The Mobile Media is divided into three main parts: the data source, the manager, and the player. The MIDlet can receive data source (i.e. media data) from different sources such as media data located in a MIDlet's JAR file, media data is rendered over the internet connections via different protocols such
as HTTP, or RTP, and from user input via an audio or video capture device. The data source class provides access to a media file by locating the media file and opening a connection to this file.

4.4 Application Features

The design includes the following application features, which helps in the good learning performance and increased student involvement.

1) Videos: The feature provides on demand learning and sharing of learning materials by providing the student with a list of recorded lecture and tutorial videos to be viewed via mobile phones.

2) Live Lecture: In this feature the student would be able to watch real time streaming (i.e. live lecture) of lectures and tutorials.

3) SMS Interaction: Due to the synchronous (live) nature of the system, students can interact with the teacher during the lecture, using a set of pre-programmed interactions that facilitate feedback with mobile devices with limited input facilities.

4) Library: In this feature the student can view the images of books, and on clicking that they can get the downloading link.

5) Screenshots: This feature provides with the screenshots of tutorials, power point presentations, videos, etc.

5. SIMULATION AND RESULTS

The application is designed to be flexible, user friendly and portable. The application at the instructor end is developed using jsp and java coding. The application at client side is developed using Java 2 Micro Edition (J2ME) so that it can be installed on different mobile phone devices. The application also supports Mobile learning and delivery of learning materials at anytime and anywhere by playing lectures and tutorials videos on the application itself through the use of J2ME Mobile Media API (J2ME MMAPI).

At the experimental setup, Tomcat server was used and it acts as a bridge between instructor and student. Later to improve the system, server was replaced by cloud environment. The cloud used here is Eucalyptus private cloud; it is designed with a modular and extensible Web services-based architecture that enables Eucalyptus to export a variety of APIs towards users via client tools. It is designed with a cloud controller, a cluster controller and two nodes.

The initial stage of application involves registration of instructor and students. After instructor login is successful, webcam starts to capture and the video stream is spitted as chunks and uploaded to the cloud through the terminal. Once an instructor store the study resources into the cloud storage server, monitor cluster will provide the main server with status information of nodes, the main server will make load balancing according to the state of nodes, and assign the storage nodes and compute nodes which is most suitable for user's application to the user, so that make the user's operation to highest efficiency. When users use the upload and download operations, storage node is transparent to the users. Users do not need to know how many storage nodes or do not know where their files are stored. Users see only one server, and students can easily and efficiently upload and download files and all storage nodes are transmitted in parallel, so that not only implements the server load balancing, and also enhance the transmission rate.
At the viewer end local memory, a buffer was created. It avoids the situation of downloading and playing from the server/cloud end. Mobile devices can directly access the live lecture from the buffer itself. Two threads are used here. One for the progressive is downloading and another for playing the live video. This decreases the delay at viewer side because one thread checks the other frequently, once the playing thread stops another thread loads the new chunk to play.

Fig. 5 shows the comparison performance of the presence and absence of local buffer created at the client side. Before the buffer creation, the entire chunks will be at the server side until the present chunk finish playing. Once the current chunk stops playing, it downloads the next chunk. So it increases the time of downloading and playing the chunk. But after the creation of local buffer at client side, though the current chunk finishes playing or not, all the following chunks will be sequentially downloaded and kept at the local buffer. So once the current chunk finish playing, the next chunk will be fetched from buffer without any delay. This results in the reduced delay and increased throughput.
Fig. 6 compares the chunk size and delay with varied bandwidth, clearly shows that the delay increases with the increase in chunk size as well as decrease in bandwidth. Though very small chunk size results in missing of chunks and flickering, it is better to create chunks at medium size which is not too large as well as too short.

![Graph showing increase in delay with increased chunk size for varied bandwidth](image)

The above graph shows the increase in delay with the increased chunk size for varied bandwidth.

The recent surveys and experiments about Mobile Learning and Cloud Computing clearly show that they are attaining the peak in recent trends. From 92% of 26 students agreed “The mobile application in this course has potential to become a good learning tool.” [13]. It is noted that above 50% of people appreciates the concept of Mobile learning through cloud environment [10].

6. Conclusion

In the field of education, cloud computing provides new ideas and solutions for live mobile learning. Because of expensive mobile devices, high cost of network, poor network transmission rate and limited educational resources, it is difficult for mobile learning to take its own advantage and to be popular as well. In the future, cloud computing will be the basic environment and platform in which mobile learning is supported and promoted by cloud services.

7. References


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