

# Real Time e-Learning System using Cloud Computing

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## ABSTRACT

Today due to the evolution of networks and internet there is a rapid growth in information and availability/sharing of this information. It is necessary to have effective e-learning systems to make the learning process more effective and interactive. We have developed, implemented and tested two of such system dedicated only for the purpose of e-learning using the latest technology and documented the results.

## Keywords

Networks, Cloud Computing, Android, e-Learning, Web Programming, Distributed Computing.

## 1. INTRODUCTION

Real time interactive learning systems are in growing demand as there is constant development in the modern world technology and students are always more comfortable in new effective teaching methods. The demand for education is increasing by the day and the number of students opting for such educational courses keeps going up and they thus sometimes prefer distance education. It has also been observed that due to increase in student numbers and constraints in the available physical space, e-learning method is most preferred by many educational institutes. Also most of the faculties use the traditional approach of teaching where the student is dependent only on the content delivered. It is hence required to make the classrooms communication more interactive since they provide a better understanding of the topic being taught.

A system in which comprises of computations whose correctness depends not only on their logical correctness, but also on the time at which the result is produced, is termed as 'Real Time System'. Any information processing system which has to respond to externally generated input within a finite and specified period can be categorized as Real Time System. The correctness depends not only on the logical result but also the time it was delivered. Failure to respond is as bad as the wrong response! This is a typical misconception: Real-time computing  $\neq$  compute things as fast as possible. Real-time computing = compute as fast as necessary, but not too fast.

Our objective is to achieve a constructive and measured exchange between the students and teachers in order to support interactive learning and promote new technology which will take care of the following:

### 1. Online Class/Tutorials/Tests

A real time insertion, submission and analysis of the data of the current subject or topic at hand.

### 2. Announcements:

Notifications, updates should be made available as required to everyone.

### 3. Query/Doubt Resolving:

An online/offline query/doubt resolving provision for the students.

### 4. Level of Understanding:

A feedback mechanism to constantly improve the learning methods in system from the student point of view.

### 5. Online Attendance/Reporting:

The ultimate is to achieve a flexible e-learning system in order to provide a virtual learning environment. It is also ensured that the latest data content is made to the users in both offline/online mode and communication carried out in the same way.

## 2. LITERATURE REVIEW

In this paper [1] different push messaging alternatives available for Android are observed. An important aspect of server-to-device communication is provided by Push messaging service and this paper specifically focuses on the amalgamation of cloud computing with mobile devices by using push-based technologies. A benchmarking test is conducted and the performance of four relevant push technologies for the Android platform, namely C2DM, XMPP, Xtify and Urban Airship is evaluated.

This paper [2] describes a the basic ideas related to the development of semantic web services along with the various mechanisms and approaches required for organizing the basic e-learning systems.

Also a lot of study was made on the current technologies in order to implement the real time e-learning system. We had to study the latest android technology [3] along with some of the server side programming languages, database systems, cloud computing and web servers and services. They are highlighted further.

**Real Time Computing:** In the world of computer science Real Time Computing (RTC) is also known as 'Reactive Computing'. The study, research and analysis of software and hardware systems which are subject to any 'Real Time Constraint' is termed as Real Time Computing. These constraints are well known in computer science by their generic name 'Deadlines'. It is important that all the Real-time programs show guaranteed response within the given overhead of strict time constraints. These Real-time responses are either of the order of milliseconds or even microseconds.

**Real Time System:** A system controlling a given environment by receiving data, then processing it and finally responding the results after applying some processes on it, adequately quickly i.e. instantly, to affect the given environment at that given time can be called Real Time Systems. Real-time softwares may use one or more of the following:

- RTOS (Real Time Operating System)
- Real-time networks
- Synchronous programming languages

The above mentioned three factors give significant frameworks so that a real time software application or system can be produced.

**Real Time Constraint:** If the Real Time Constraint is not able to meet its time constraint parameters and not meeting the constraint results in a crash or a blunder, the real time constraint is called a hard real tie constraint. All the other given time-constraints are called soft.

**Example:** A simple example of a real-time computing system is the anti-lock brakes on a car. The real time constraint in this given system is 'the time in which the brakes must be released to stop the spinning wheel from locking it'

**Classification:** An application or system can be classified as follows:

- **Non-real-time System:** In this type of system no important deadlines for anything or any parameter; it won't make a difference even if all its deadlines are missed.

- **Real-time:** A real-time system can be further divided into soft and hard real-time system on the basis of severity of complying by its deadlines.

1. **Hard Real Time System:** This type of real time system cannot afford to miss a single deadline i.e. it has to comply by all the deadlines in order to be a hard real time system. Lets us take an example of a flight controller; if the action in response to the upcoming events is pending within the given time, the result could be an unstable aircraft or for that matter even a disaster.

2. **Soft Real Time System:** The concept of soft real-time system falls in between a non-real-time system and a hard real-time system i.e. it allows missing of deadlines sometimes. Let us take an example of Cruise Control; let us assume that the software is not able to measure current speed in the given time period for the control algorithm to use it. In that case the algorithm can fetch the previous value since

there won't be a lot difference in the values of the new and the old one and this negligible difference won't make a very high impact on the final outcome.

**Cloud Computing:** The technological process of maintaining data and applications through the use of internet and central remote servers is termed as 'Cloud Computing'. Only with internet access one can use applications without installing them on their computer which is very useful for any individual or business. Thus cloud computing technology centralizes parameters such as data storage, processing and bandwidth which allows us effective and efficient computing. This technology uses the computing software and hardware resources and delivers it as a service over a network. The name 'Cloud Computing' is derived from the use of a cloud-shaped symbol as an abstraction for the complex infrastructure it contains in system diagrams. The following three fundamental service models are offered by the cloud technology:

- **Infrastructure as a service (IaaS):** In this type of cloud service model, physical components and resources like hardware resources are offered as services to customers. For Example, storage and computing power like CPU and RAM. This is very advantageous to businesses since they can rent these resources rather than spending money and buying expensive hardware and computing power such as dedicated servers and networking equipment. In short, all the hardware infrastructure is provided as a service rather than a product. Example: Amazon1 offers S3 for storage, EC2 for computing power and SQS for network communication.

- **Software as a service (SaaS):** In this type of cloud service model, the software applications are offered as services on the Internet or Intranet rather than as software packages to be purchased by individual customers. In short, all the software applications are provided as a service rather than a product. For example: Salesforce.com, Sugar CRM, Microsoft Dynamics, etc offer its Customer Relationship Management application as a service. Other examples include SAP, Google web-based office applications such as spreadsheets, word processors, presentation management, document management, etc and Oracle's CRM.

- **Platform as a service (PaaS):** This type of cloud service model refers to facilitate support to the entire Software application development lifecycle (SDLC) including all the significant factors related to it such as implementation, design, deployment, debugging, testing, operations, support of essential Web applications and services on the Internet and all other parameters required to build a software application. In short, it supports the entire software development environment as a service rather than a product. In such cases Internet browsers are frequently used as the development environment. Examples of platforms in this category are Google App Engine7, Microsoft Azure Services platform6, etc.

**Types of Clouds:**

- **Private Cloud:** This type of cloud infrastructure is basically used by a single organization or a Multi National Company having large number of consumers. It may be financed, administered and run by the organization themselves or a third party or some combination of both, and it may be physically present at the office premises or any location in the world.

- **Public Cloud:** In this type of cloud infrastructure applications, the service provider i.e. the party that provides

the cloud service enables the general public to use resources such as storage. Such services are either free of cost or chargeable. Public cloud service providers like Amazon, Microsoft and Google own and operate their infrastructure from their premises and offer access only through Internet.

- **Community Cloud:** This type of cloud infrastructure is shared by a number of organizations from a specific domain, industry or community with common area of concerns such as security. This type of cloud service can be managed and hosted internally or externally. It is more economical than public cloud since the cost is spread over a number of users contrary to public cloud.

- **Hybrid cloud:** This type of cloud infrastructure is ideally a composition of two or more than two cloud infrastructures that may include either of the three cloud infrastructures such as private, community or public cloud. However all three remain unique entities but are bound together and this is known as Hybrid Cloud.

- **Distributed Cloud:** This type of cloud infrastructure that can be enabled by a distributed set of machines that are running at different locations is termed as a distributed cloud infrastructure. However these distributed set of machines are simultaneously connected to a single network or hub. For example 'BOINC' and 'Folding@Home'

- **Multicloud:** A single heterogeneous architecture using multiple cloud computing services to reduce dependence on services from a singular vendor is known as a Multicloud infrastructure. This will increase flexibility through choice, reduce disasters, etc. The only difference between a multicloud infrastructure and a hybrid cloud infrastructure is that multicloud infrastructure uses multiple cloud service where as hybrid cloud uses multiple deployment methods.

- **Intercloud:** This type of cloud infrastructure refers to being a global interconnected network such as "cloud of clouds" and an extension of the Internet "network of networks". The primary idea behind this infrastructure is that direct interoperability is offered between public cloud service providers, rather than between providers and consumers

#### Advantages and Benefits of Real Time E-learning System using Cloud:

- Enables Ubiquitous Computing since it acts as a common platform for students, professors, administrators, etc.
- Another key advantage of online study is that it encourages and enables students to collaborate and communicate with their fellow students as well as their tutors.
- The most implicit benefit of online study is that students can utilize their time efficiently to learn or take a course through e-learning at any time convenient to them.
- No Back-up or copying of data required while signing off or when you are buying a new device.
- Data remains intact even if system crashes.
- It provides universal portability to students so that they can work from any place at anytime using any device; only internet is required.
- Cloud computing allows user to dynamically scale as demands fluctuate.

- Allows students to create content through the browser, instead of only searching through the browser.
- They can download Podcasts, notes, documents and downloadable lectures anytime which means that students are no longer constricted by a conventional timetable of lectures.
- The Productivity is increased by training people on e-learning systems enabling people to do more in less time.
- The usual file compatibility issues are eradicated since it supports all the types of file extensions as the file are running on cloud.
- It is almost impossible for any interested malicious student to determine where is located the machine that stores some wanted data (tests, exam questions, results) or to find out which is the physical component student needs to steal in order to get a digital asset.
- It thus provides a lot of flexibility to the students and is quite affordable.
- With real time systems using cloud one can always get the instant software updates almost immediately which can enhance productivity even further.

### 3. DESIGN

The system was designed and developed in stages and has undergone lot of changes, there are two versions of the system, one for a small medium type of network and one for a large scale distributed network.

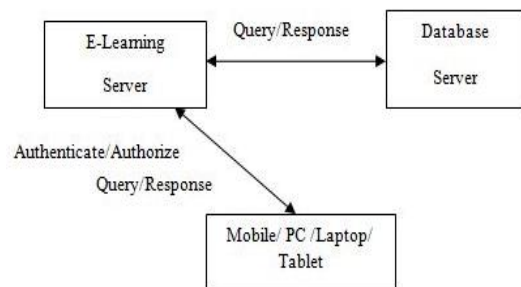


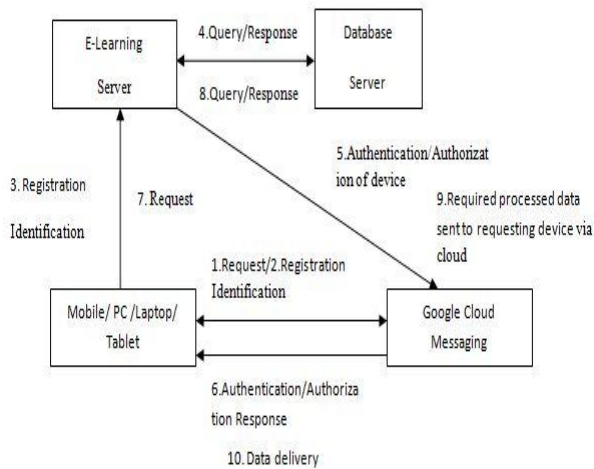
Fig 1: Basic Level System Model (version 1)

The three main important components in this version of the system are: the clients, the e-learning server and the database server. The clients have to first register with the e-learning server and depending upon the nature of the client they have been granted the authorization level eg. Students, teachers, system admin. After successful authentication and depending upon the level of authorization the user can perform the respective operations by interacting with the e-learning server.

This type of system is effective for small scale or medium networks where it covers a particular area or a small region and has adequate amount of users and could be hosted on the internet using high processing web hosting servers other than local area networks or extranets.

As cloud computing is an evolving technology and because of its distributed nature it is very reliable and delivers high performance, so cloud computing concept was integrated and our system was designed to a better new version where after carrying out extensive study on various cloud messaging techniques we preferred Google cloud messaging, which gave better performance as far as the system application was concerned. The functionality of the system is similar to its

older version but the only difference is cloud acts as the middle party in terms of security and required data delivery.



**Fig 2: Advance Level System Model using Cloud (version 2)**

The clients first send registration request to the Google cloud messaging (GCM) server which then generates unique identification and sends it to the device, the device then sends this registration identification to e-learning server which stores it for future references and operations and generates its respective authorization rules and authentication. This is then sent to the device through GCM server, after this operation is successfully completed the device then can interact with the e-learning system. The main administrator through the e-learning server can invoke/revoke the rights of the devices accordingly and can blacklist misbehaving users as it not only stores the unique registration identification generated by GCM server but the MAC address of the devices. The main administrator also authenticates devices.

#### 4. 4. IMPLEMENTATION

We have created the application in Android API [4] and Web API [5] so that this application can be made available to android as well as desktops and laptops having their own operating systems. Eclipse IDE [6] was used for the android application development and the server is PHP [7] based and was created in CodeIgniter [10], which is a Model-View-Controller (MVC) framework for PHP. The server files have been hosted on a remote server. The server uses an underlying MySQL [8] database for storing important values for the application. The PHP server stores scripts majorly used for implementing the basic data retrieval queries. The android application or Web API will communicate with the PHP page with necessary parameters and the PHP scripts will in turn communicate with the MySQL database to perform the desired database operations.

The server is PHP based and mostly the client is Android based with Java and xml as their basis. In such a case we need to be careful while transferring data between the two systems as both of them must be capable of understanding the message being transferred. In such a case we need a language independent medium of transferring messages. JSON [9] provides one such medium. JSON is a lightweight text-based format which forms the syntax for storing and exchanging text information on the web. All requests to the server must be done in AsyncTasks. AsyncTask is an abstract class provided

by Android which helps us to use the UI thread properly. This class allows us to perform long/background operations and show its result on the UI thread without having to manipulate threads.

#### A. Hardware Requirements

##### 1. Minimum Specifications for Android based Client

- 512 MB RAM
- 1 GHz Cortex A8 Processor
- WI-FI/2G/3G enabled
- 4GB Internal Storage

##### 2. Minimum Specifications for Desktop/Laptop based Client

- 512 MB RAM
- 1 GHz Processor
- LAN/WI-FI/ Internet Access
- 20GB Internal Storage

##### 3. Minimum Specifications for Server

- 2GHz + CPU
- 2GB RAM
- 5GB Database Storage

#### B. Software Requirements

##### 1. Minimum Requirements for Android Client

- Android Device running with Android 4.0 Operating system.
- Requires JDK, JRE and JVM

##### 2. Minimum Requirements for desktop/Laptop

- Operating system.
- Requires JDK, JRE and JVM
- Google Chrome Web Browser

##### 3. Minimum Specifications for Web Server

- PHP version 5.1.6 or newer
- Supported databases - MySQL (4.1+), MySQLi, MS SQL, Oracle, SQLite and ODBC
- Required Web Services

## 5. RESULTS

A set of operations were performed through the devices both desktop/laptop and android devices. The results in terms of basic operations such as authentication/authorization, user operations such as registration, submission of content on the portal and its access, the collection of online attendance report, real time doubt solving and admin operation related to blacklisting of a user for both the systems are documented.

**TABLE I. Operation Results**

Sr. No.	Operation Timings		
	Operation	System 1	System 2
1.	Authentication/Authorization	0.11sec	0.3sec
2.	User Opeation 1	0.29 sec	0.45sec

Sr. No.	Operation Timings		
	Operation	System 1	System 2
3.	User Operation 2	0.23sec	0.36sec
4.	User Operation 3	0.13sec	0.25sec
5.	Admin Operation 1	0.15sec	0.22sec

## 6. CONCLUSION

The real time e-learning system is very user friendly and effective in terms of interaction and knowledge delivery. The system can be deployed on servers thus making it available to hundreds of millions of users across a wide range of devices from personal computers, phones to tablets and beyond. It automatically adapts UI to look its best on each device, while giving the user as much control on different device types.

The application which can be used by teachers to get a glimpse of how their students are grasping about the topics that they are teaching. A student's understanding is also being tested by the means of quizzes that can be taken by the teacher on the fly. A student is able to get the attention of the teacher instantaneously by means of the grab attention module that generates a push notification on the teacher's device. A teacher is also able to push announcements that to students.

## 7. FUTURE WORK

The following features can be implemented and can be considered as future work

Biometric Identification: Authorization of Users for various modules.

Application Lock: In android devices when the main application is initiated at the start of a class, all other features and applications of the tablet will be disabled to prevent any distractions.

Platform Independent: Currently the application is restricted to android technology so can be accessed by android devices and Chrome browsers but work is to be carried out to make it available for other devices and browser applications so there is a need to investigate a new technology for this purpose and also better in terms of performance and reliability.

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