The Design and Implementation of an Android Based Student Learning Resource

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ABSTRACT
The progression and multiplications in Information and Communication Technology (ICTs) has prompted movement of learning past the customary classroom Face-to-Face (F2F) to various sorts of adapting, for example, Distance Flexible Learning (DFL), Electronic Learning (eLearning) and to all over and whenever known as Mobile Learning (mLearning). [1] The broad utilization of versatile innovations has brought about expanding enthusiasm for portable learning. [3] In this paper we investigate the difficulties the cell phones has on learning and further talks about the outline and execution of android based understudy learning apparatuses which is worked to upgrade learning. The proposed framework has numerous learning devices, for the most part the auspicious notice for various modules, for example, exercises due dates, exam alarm and discourse notice. Incorporated with MOODLE (course administration framework) to upgrade learning, it additionally has instructional exercise apparatus for understudies-guides to decrease paper work and superfluous workload on the mentors. Other learning instruments gave to students are exam timetable, college news, exchange gathering, college and general data benefit. This proposed framework's devices gives greater adaptability, portability and advantageous than eLearning mode which rises routine consideration regarding self-learning modules which may support student's abilities in learning.

I. INTRODUCTION
In the context of education, ICT provides incredible chances and benefits in teaching and learning (L&T). There are many elements and challenges to consider when incorporating ICT in L&T. These challenges include cost in setting up, users’ attitude, teaching workload, technical support and technological characteristics [4]. Although there were many challenges faced with including ICT in learning, both the developing and developed countries has successfully merged the ICT in learning to most areas which resulted in change of modes of learning from electronic learning to mobile learning which is our main focus for this paper.

The use of mobile technologies has grown extremely recently and have overtaken the use of personal computers in modern professional and social contexts. [5] The authors argue that these changes will create reasonable conditions for the pedagogical use of mobile technologies based on authentic learning. [8] mLearning has gained lot of interest mainly for its boundless and convenience ways of learning.

Mobile Learning is the use of mobile devices for learning at anytime, anyplace and anywhere. It is believed to be more effective than eLearning since the students are mostly with their mobile phones then eLearning devices such as personal computer. Mobile learning also discovers how to progress in learning process by adapting course content presentation to student learning styles in multi-platform environments. [7]

There are some problems faced by students and lecturers which can be solved by using mobile devices. Some of the problems faced are, firstly timely notification and alerts on various items such as notifying students about changes in their schedule and timetable, changes in room allocations for lectures, reminding students of deadlines and dates/venues for exam.[10] The system implemented in [10] compresses the SMS to less than 80 letters which will minimize the cost. The SMS can be costly and for this reason, the university gets sponsors from some stakeholder, for example in [10], 2 million SMS are sponsored.

SMS is not only for social and personal purposes but can be used in learning in various ways. The architecture and details on how SMS works are discussed in [9]. There are other universities using the SMS system for notification as discussed in [11, 12, 13, 14 and 15]. These SMS notifications have some drawbacks, first the cost and second the user interface. Due to this drawback, Google Cloud Messaging (GCM) is used for this proposed system. It is used for instant notifications/alerts for different features. The main reason for using GCM is that it’s free and is easy to configure or register to the service.

There can be a number of other tools implemented using mobiles. An important tool describe in [16] which is a handheld learning device that supports children to capture everyday events such as notes, images and sounds, relate them to web-based learning resources and share them with other learners and teachers. There are many tools such as exam timetable, discussion forum, university/course news and events are included in proposed system to timely inform the students with updates and guide them with general information.
A. Moving Towards Mobile Learning

The question now is how mobile learning can match the tradition form of learning consisting classroom, workplace and informal learning. The authors in [17] discuss the design of new technologies to support mLearning. This can be done through a series of projects to design technology for mLearning. The framework described in the paper is a step towards integrated models of mLearning that could inform both the design of new technologies and modes for learning and the analysis of learning in a mobile world.

The authors in [18], discuss on students’ acceptance of mobile phones for learning purposes to care and absorb distance education students by using mobile devices for distance flexible learning tutorials.

B. mLearning versus eLearning

Both eLearning and mLearning require uses of ICT in learning modes and have benefits and drawbacks over each other. Some of the advantages of mLearning over eLearning are as follows. The first advantage is freedom of learning by with mLearning mode. Learning cannot be done anywhere and anytime in eLearning as opposed to mLearning which allows learning can take place any time and at anywhere. Second factor involved is portability of device used in 2 modes. The eLearning devices are not as portable as mLearning which restricts the devices from moving to different location. Other benefits with mLearning are; the shy students can learn at their own pace and at their own pace, updates can be received in the phone and interesting learning tools boost mLearning as students are not eager for game and such applications. [17,19]

Some of the advantages of eLearning over mLearning are as follows; firstly, the cost of device used in eLearning is usually less expensive than smart mobile devices used in mLearning. Input devices such as keyboards and mouse and output devices such as screens in eLearning are more user-friendly than the devices used in mLearning. Most eLearning desktop computers have a higher processing power in comparison to mobile devices used in mLearning. Memory and storage in most desktop computers used in eLearning store more data compared to mobile devices used in mLearning. [19]

C. Context-Aware Mobile Learning

The main idea discussed in [20] is an advantage of mobile devices is that they enable learning across different contexts. Context-aware in a mobile learning experience benefits in intelligent feedback, adaptation, personalization and recommendation which leads to presenting more personalized data to the learner.

In [21], different learning contexts are discussed with the new experiments that are related to cope technically with the existing multimedia learning material. The proposed system in that is a web-based framework to solve mobile-environment issues which will make it a vastly cross-platform solution.

D. Using SMS as supplementary learning tool

The short messaging system (SMS) is used as a supplementary tool in Open University Malaysia (OUM) which is called mySMS. [22] This system provides multiple services to the learners which includes:- multiple choice questions with feedback, self-test, quizzes and assignment notification, crucial assignment reminders, accessing examination and test marks, fact of the week, web links, reading material lists, course schedule and calendar as well as access to financial statements and courses registration.

In addition in [23], group messaging, and challenges faced with it are discussed. The university either pushes the sms or user pulls the sms after requesting via SMS.

SMS pushed includes Content Motivation Tips, Course management, Forum while pull includes Self-managed learning-Use of Modules, Online learning - forum discussions.

E. Mobile Based Student Attendance System

This system is an android based attendance monitoring system based on the concept of web services which communicates with the database residing on a remote server was implemented in K.L. University in India. [24] The application required connecting to the database either General Packet Radio Service (GPRS) or Wi-Fi technology. The system is well designed as the retrieval and storing data is fast and efficiently, reports are easily generated as per requirement (monthly or on request), very less paper work involved since all data fed in computer directly and is computer operated so there is no chance of error.

F. Goals of this system

This proposed system is an android based learning tools application which is targeted for students and teachers to enhance learning and teaching of the university. It has many services in it which can be used by students. Some of the features are course module services containing tutorial and upcoming activity service, exam timetable service, news service, events service, discussion forum service and information service.

This research paper aims to discuss the current implementation and future plans of the proposed system. The following section discusses problems faced by students and teachers in learning and teaching and design of the proposed system. We then start with describing web services-based system. The implementation details and issues together with the results are discussed next. The paper then discusses how the proposed system will solve the problems faced and future plans of the system.

II. PROPOSED SYSTEM

A. Problem Scenario

There are number of problems faced in learning although we have advance eLearning tools. The learning can be made more flexible and accessible with the use of mLearning. In this section the problems in learning without mLearning will be discussed.

Most importantly, in current eLearning and traditional F2F mode of learning, there are a lot of students missing out on important due dates such as assignment due date. This results in losing of unnecessary marks due to late submission of activity or by not submitting the activity at all. The eLearning mode has many interventions to notify the students about these activities, however the notifications are mostly sent to the email which is not timely as students are not always on email.

There are always a major problem with exam timetable and venue for the student every semester. A number of cases recorded by many university [25] where students missing the exams since they forget their timetable or didn’t know their timetable at all. There is some University providing the exam information via a SMS request from the student; however this service can be expensive. [11, 12, 13, 14 and 15]

The teaching staff are required to do same task twice, when it comes to tutorial attendance in the current system of L&T. Firstly, the tutor takes the tutorial attendance in the class and then later has to mark the same attendance on the course management system for example on MOODLE [2] or on personal computer for analysis and reporting purpose.
There is also a need of immediate/instant alert/notification to students or staff about some issue.

For example, if a lecturer has a class in next ten minutes, but he is busy with a meeting and want to cancel the class. Inform students instantly would be a problem since students who probably half way to the lecture room.

Query and discussion about the university or course/activities are essential in any university. While it can be done on MOODLE, but timely notification is not received by the user who started the discussion or the user involved in it. The notification might come on the email, however not all users read email and misses the discussion at important time.

All organizations have some sort of events so does the university, however many staff and students miss out events they wanted to attend since they missed out on events advertisement in the e-mail or somewhere else.

Finally, there are always basic information about the university is asked by students over and over again.

B. Proposed Features

After analysis of the problems and looking at the requirements of the users, an android based system was proposed with the following features as shown in Fig. 1 and 2 for students and teachers respectively.

2) Course Module Service

One of the main components of any L&T is the course the student is taking. In the course module, the course information on MOODLE is placed in the mobile for easier accessibility. These modules are listed below:

i) Upcoming Activities

This feature is only for students which notifies the student about any upcoming activity which will be due in next seven days. The notification is through the Google Cloud Messaging (GCM) notification which notifies the students instantly when the cron is run. [28]

ii) Instant Notification

This feature allows teaching staff to send some immediate short notification to students. The lecturer will be able to send message to all students or selective students from his mobile phone using this feature.

iii) Tutorial Module

This feature is only for students which notifies the user who started the discussion or the user involved in that discussion of tutorial attendance.

Fig. 1. Tools/services available for the students 1) Discussion Services.

This is a feature where students and teachers can discuss the queries from the students. This discussion is done with the mobile device via this feature and upon any interaction in a particular discussion thread; all the users involved in that discussion gets a notification on their device.

'Cron is a set time for a script to be run so that the students get the reminder instantly and can view it. [27]

Fig. 2. Tools/services available for the lecturers.

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The logic is that the main service server will call other service server with parameters. Therefore, it doesn't matter what technology the end service uses to get information. The following subtopic explains the process of implementation of features/services.

A. Google Cloud Messaging for Android

Google Cloud Messaging (GCM) is a service which allows send/receive message from your server to the Android operated devices. The GCM service handles the aspects of queuing of messages and delivering them to targeted Android application running on the device. It is free and that is the reason for using such notification system. [28]

There are basically 3 types of messages sent, first is sending data from server to device, this could be lightweight message telling the app there is update by the server. Second is “send-to-sync” message which pings the server upon opening the message. Third is message with payload that has message for the user. All of these three types of messages are used in the implemented system. [28]

1). Requirements

There are few requirements to implement the GCM.

➢ To create a project in Google APIs Console. [32]
➢ This project number will be used as sender ID, it identifies the project the message and targeted to.
➢ Enable GCM service of Google API.
➢ Obtaining a server or browser key which will be used in your server implementation.

2). Architecture of GCM

After completing the requirements list above then the GCM server and client side can be implemented as architecture shown in Fig. 4.
The 3rd party server (main server service of proposed system) sends the message and target devices id to GCM connection server in JSON format. The GCM connection server takes the message from 3rd party server sends to client app. The client app receives the message and proceeds further. If client is sleeping, it wakes up and delivers the message. In case of device is off GCM puts message on queries.

3) Registering with GCM Server

The device registers the GCM server and in the main service server using the architecture shown in Fig. 5. This is done using following order:

- Device sends sender id (project id from [32]) and application id to GCM server for registration.
- If the registration is successful with GCM server, GCM server issues a registration id to device.
- Device sends this registration id (RegID) to main service server which stores it in its database.

![Fig. 5. Architecture of the GCM registration process. The registration is with GCM and system's main server.](image)

Whenever the main service server sends the message to GCM server, it takes the message and sends it to device with RegID.

B. Login Process and SQL Lite

There are many applications such as Facebook, Messenger, Gmail requires only initial login and the user is kept logged in unless, they logs off. [3] This application is implemented in the same way to prevent the user from multiple logins and the user can get notification since they is logged in.

1) Process Flow

![Fig. 6. Process of logging in function and saving user preferences in the application to prevent multiple logins.](image)

This login functionality is called whenever the application starts or is awoken by any notification as shown in Fig. 6. The application first checks if the user is existing in the application database (SQL lite) to identify if user is logged in [34]. If the user detail exists in the database, the user is shown the main dashboard where he can continue using the services.

The user is required to enter their username and password (same username/password given by university). The application sends the encrypted password and username using the http post method to main server. The main server checks if username and password is correct through its database. If it’s correct, the server gets the user detail, formats it in JSON as shown in Fig. 7 and sends it back to the application.

![Fig. 7. Sample user result returned from the service. Result is in JSON format.](image)

A. Services Integrated with MOODLE

All the course information about the student is in MOODLE. The tutorial, upcoming activity instant messages and discussion services relays on MOODLE. When the user starts a course module service, the application gets the course ID, user ID and the service ID and requests the main server for data using http post method with these parameters. The main server checks the parameters, identifies which service server it is and which server is to be called. Upon calling of the designated server, the service server generates the information and passes it to main server in JSON format which sends it back to the application. The following services show how each server on MOODLE works.

1) Tutorial Module

There are different operation for students and tutors for this service. MOODLE server analysis the tutorial detail for that student for a particular course and sends the information back in JSON format as shown in Fig. 8 and sample result shown in Fig. 9.

![Fig. 8. Sample student tutorial result returned from the Moodle service. Result is in JSON format.](image)
2) Upcoming Activities

This feature shows students all the upcoming activities for each course and is implemented as shown in its Fig. 10.

As the cron runs at main server to get the upcoming activities for each student per course. [27] The main server requests this information from the MOODLE server. MOODLE server runs a script to get the upcoming activities in next seven days and returns the result to the main server in JSON format as shown in Fig. 11.

3) Instant Message

The feature is for sending important messages to all or group of students by the lecturer and works as shown in flowchart in Fig. 12.

Lecturer using this feature are asked to fill in the title and actual message together with selecting the group of student they want to send the message. MOODLE server send the list in JSON format and main server gets each user’s RegID from its database. The main server then generates a GCM notification with payload message [28] is sent to each of the users RegID devices as shown in Fig. 13.

4) Discussion Service

This service is on MOODLE and at the general university’s discussion forum. The module requests for all discussion going in the class and sends to Moodle service via main service which returns all discussion list including title, creator and number of discussion in each in JSON format. This is retrieved by the application and lists on the screen using ListView library of android. [35]

The user opens the desired discussion and if the user adds comments/discussion in them then the application takes the parameters (user ID, course ID, discussion ID and comment) and sends them to Moodle server.
The Moodle service updates its database and gets list of all students involved in that discussion and sends to main service. The main service gets RegID for those students and sends a message that “user x has added in discussion” as shown in the fig. 14. Upon clicking on the notification is synced by the server for updates on discussion.

![Android Notifications](image)

**Fig. 14. Sample result when the student receives notification when there is any update in the discussion and syncs the server upon opening the notification.**

5) Exam time Service

Students will be able to view their timetable search for friend’s timetable and get notification few hours before the exam. For getting students own timetable, the application takes logged in students id and sends to exam server and get the exam timetable in JSON format.

VI. Discussion

Mobile learning challenges many of the concepts and theory about higher education. It challenges the timing, freedom and location of learning over the traditional tools and resources. The increase in the use of mobile devices has the potential to enable universities to adopt mobile learning in sound and significant ways.

There were different problems faced by students and teachers stated in this paper from the literature review. The main problem identified in this research was the timely notifications to students and the existing systems of using SMS notification was not the complete solution as it was costly. The implemented system in the paper solves this problem by using GCM to send timely notifications, messages, warning, updates and information at no cost. Another major issue discussed was regarding the tutorial attendance was solved by having android based tutorial service which reduces unnecessary workload of the tutor. Other issues with exam timetable, news, events and discussion forum is solved by the system with the implementation of each of this services are discussed in this paper.

Designing the framework/architecture for the system was a challenging part to make the framework dynamic. There can be more features and services added to the system by adding it to the main service server and similarly more end user application can be implemented for different mobile OS. Adding those applications won’t affect other applications which exist already in the system. The architecture handles all the changes since only the http request with parameters will be needed to call from new application and the rest of the system remains untouched.

The problem faced in the prototype was with integrating MOODLE with the system. MOODLE has its own configurations and security features which was making it complex with the process. This was solved by having a separate service for MOODLE modules, which calls MOODLE server when any data from MOODLE is needed.

The implemented system has been tested and can be implemented in some university. The issue that would be faced in actual implementation is the expectance of the system by the universities with their other requirements. Therefore, the system can only be implemented if the institute agrees with the proposal and implements the main service server for the system.

The system can be enhanced further with an offline version of android application for the system which won’t need full time internet connection to get services. As soon as the application gets connected to internet, it should automatically get synchronize with the real time service data. Another enhancement could be to implement university’s own XAMP service instead of using GCM so when the student is inside the university, notifications can be sent via university’s wifi (intranet).

VI. Conclusion

The proposed system prototype was implemented successfully and the system can implemented in real platform. The system’s main goal was to implement a flexible architecture to implement multiple learning tools for students and teachers. This was implemented with the design discussed in this paper which is very efficient and secured. The main service server only calls those service servers for which the request came for from the application. The service servers can have their own technology used to make it really secured. The only thing needed to be part of this framework, is that they create an http request with parameters that can be passed in the newly created application. The main service that calls the service server for required information will return it to the end user application.

The system design has enabled to provide several features to the students and teachers to enhance teaching and learning. These features/services are course module services containing tutorial and upcoming activity service, exam timetable service, uni news service, uni events service, discussion forum service and uni information service. The testing of the system was done using many approaches and documentation was compiled. Finally, we will be taking this research further to incorporate the enhancements discussed in section 5.

VII. Reference


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