

Contextual M-Learning System For Higher Education Providers in Oman

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Abstract: M-learning is the basis of digital learning where, the effective combination of Information and wireless network technologies, make knowledge available anywhere at any timerealizing the real sense of autonomous, socialization and lifelong learning. M-learning is a new research area, that has become an emerging tool for our education system. M-learning can be used to enhance the overall learning experience of our students and teachers. The students and teachers demand for customized M-learning systems is increasing. However, many designed M-learning systems failed to meet students and teachers expectations and requirements. This paper provides general overview and network architecture of M-learning system. This paper discusses the three layers of M-learning system based network architecture. The paper describes M-service center as storage of M-learning services. The paper presents a frameworkof a contextual mobile learning system taking intoaccount the learning environment in the sultanate of Oman.

Key words: Mobile Learning • M-Learning • Education and Learning Management System

INTRODUCTION

The use of Information Technology (IT) tools in the field of Learning Management Systems (LMS) has gained a lot of popularity. During the last decade, IT and telecommunication technology have developed so rapidly both in software and hardware. These technologies increase the opportunities of applying mobile devices and wireless network in the learning environment. The advancements in modern IT and telecommunication capabilities have led to the concept of anytimeand anywhere education. The integration between mobile devices and wireless network technologies represent a huge opportunity to improve and facilitate the education process. However, these are not withoutlimitations. The E-learning or Internet educational transaction, can only be done anywhere, the terminal is available and anytimewhere the network is inoperation. In fact that mobile devices have demolishes the notion of distance andboundaries [1]. The term E-learning or Internet educational transactionrefers to more than online learning, distributed learning, virtual learning or web-based learning. The use of mobile devices and wireless network technologiesin the education system has shifted the

concept of E-learning to mobile learning (M-learning). M-Learning refers to the use of mobile and handheld IT devices, such as mobile telephones, laptops, PDAs and tablet PC technologies, in training, learning and teaching. The mobile learning can be considered as the third wave of learning with mainframe and, desktop computers as the first and second waves[2].

Related Work: The experts in this field have offered different definitions for this form of learning. Such as that the M-learning is E-learning through mobile computational devices [3]. Keegan [4] has simply defined the term M-learning as the stipulationof training and education on personal digital assistant, smart phones andmobile phones. In 2002 Chabra and Figueiredo defined M-learning as a learning with a specific device, at any time and in any place [5]. In 2003 another definition has been provided as a learning mechanism that can be available anytime and anywhere with the help of a mobile computer device. [6]. The mobile learning can be defined as a new learning technique using mobile network and tools, expanding digital learning channel, gaining educational services, educational information and educational resources anywhere at any time [7]. Mobile devices show

a dramatic departure from traditional computing platforms as they no more represent a static or fixed notion of context, where changes are small, absent, or predictable. With the continued evolution of modern mobile devices an opportunity has arisen for much more comprehensive integration of these modern devices into educational environments [8]. Mobile device is a personalized device where it must continuously monitor its environment, thus making mobile applications inherently context aware (collectively location-aware, device-aware, time-aware, etc.) [9, 10]. M-learning applications are now contextualizing proximity, time, weather, location, ... etc, to deliver dynamic, hyper-specialized, rich content to learners via context-aware applications. M-learning using context awareness is new feature and one of the primary factors directing the popularity of M-learning applications. Georgieva and Smrikarov [11] have provided a general classification of current M-learning systems. Hosseini [12] provided a framework of M-learning emphasizing that M-learning is essentially the evolution of E-learning that completes the missing components of E-learning solution. Cavus and Momani [13] have described the M-learning implementation using wireless network technologies act as a big classroom that makes a service available for users in a wider range.

General Overview of M-Learning System: In general, the proposed M-learning system will consist of three main components:

- Mobile devices.
- WiFi access points.
- M-service center.

The proposed approach provides mobile access to M-learning services for users equipped with wireless devices (Smart phone, Laptop and PDA), via a set of WiFi deployed in key points around the intended campus.

The mobile clients interact directly with the web service provider (M-service center). This architecture is built upon a number of wireless communication standards IEEE 802.11 WLAN (WiFi) and IEEE 802.16 WMAN (WiMAX) utilized to deliver these services to the mobile devices of registered users.

Network Architecture of M-Learning System: The WiFi access points are deployed throughout the education campus area and provide wireless access to M-learning services. While mobile device's user within the range of WiFi access point, both mutually discover each other. The WiFi access points has another duty then the authentication of mobile users which is the authorization. For that the WiFi access points must always maintain up to date copies of users profiles and the provided services catalogue. When the user profile is analyzed the M-service center distinguishes from the services catalogue which services are applicable to this user considering the user preference. Figure 1 shows the initial network architecture of M-learning system.

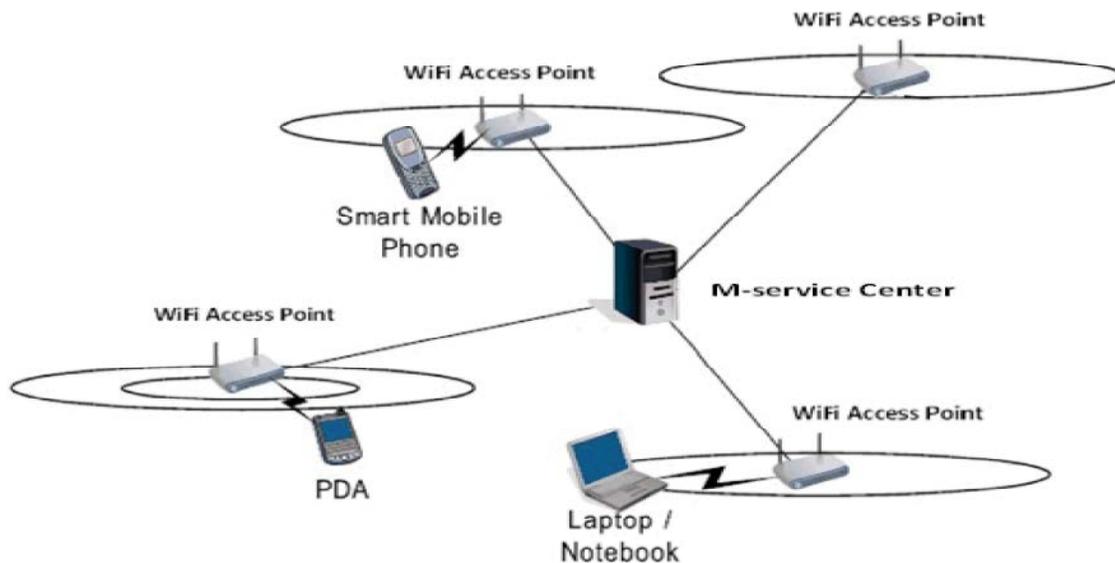


Fig. 1: Network architecture of M-learning system of higher education provider

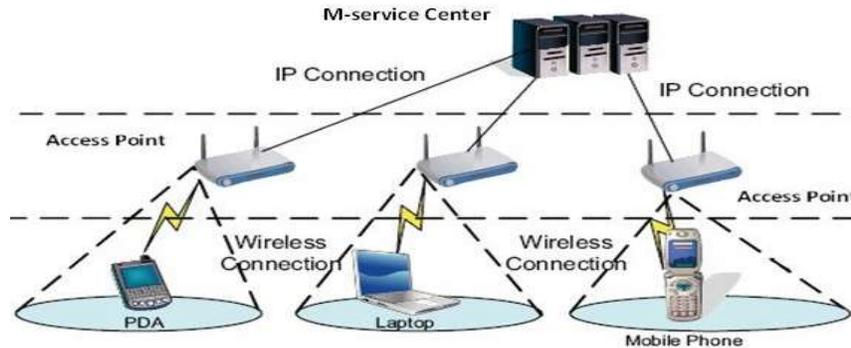


Fig. 2: Three layers of M-learning system of higher education provider based network architecture

Three Layers of M-Learning System Based Network Architecture:

There layers of network architecture is proposed as illustrated in Figure 2: user mobile device, WiFi access point and M-service center. The user may request M-learning services (via their mobile devices) from the nearest access point via available WiFi or WiMAX connection. The M-service center should always decide the most appropriate and quickest way of delivering the required M-learning service to each user according to his/her current individual location and mobile device's capabilities.

- The first layer of the network architecture encompasses mobile devices (Smart phone, Laptop and PDA), equipped with intelligent agent that act as personal assistant for the users. The intelligent mobile agents can be installed on users' mobile devices and will be designed to function autonomously to accomplish tasks without any personal interaction.
- The second layer consists of WiFi access points deployed around the intended campus. These access points should facilitate the mobile user's access to the M-learning services through high speed geographically intermittent connection. In order to provide sufficient access for a great range of mobile devices, the WiFi access points are equipped to support multiple communication protocol as shown in Figure 1. The second layer acts for mobile client like gateway to services.
- The third layer is the M-Service center itself that acts as web service provider. Its main functions are to control the provided services, update and synchronize information across the M-learning system, manage different types of profiles. The M-Service center is responsible for facilitate the delivery of the services to more and wide variety of devices.

M-Service Center as Storage of M-Learning Services:

The main aim of the proposed M-learning system is to help students in their indoor and outdoor activities within the university campus and to simplify the learning process and bring it to the mobile world. The current mobile systems concentrated only on indoor or outdoor activities. Moreover, these M-learning services are not well utilized by students, which indicate that the provided M-learning services do not satisfy students' requirements [14]. Since it is important for the M-learning system to meet students' requirements, the first stage of M-learning system development is to figure out students' requirements. Based on the students requirements, a proper framework for implementing and developing a M-learning system will be designed. The main and most important part of this research is to determine students' requirements. In order to obtain the students requirements, a questionnaire research method are used. The survey focuses on the features of the M-learning system that had been assumed as a part of the students' requirements. As illustrated in Figure 3 M-service center as storage of M-learning services and these M-learning services are the actual students requirements.

- Information about class schedule.
- Information about changes in class schedule.
- Information about faculty news
- Announcement about university's or faculty's activities
- Online submission of assignments.
- M-Lecture: downloading course material.
- M-Test: access test material.
- Online discussion forum
- Ability to send and receive messages to/from their lecturers.
- Information about bus schedule
- Information about shops close to them.

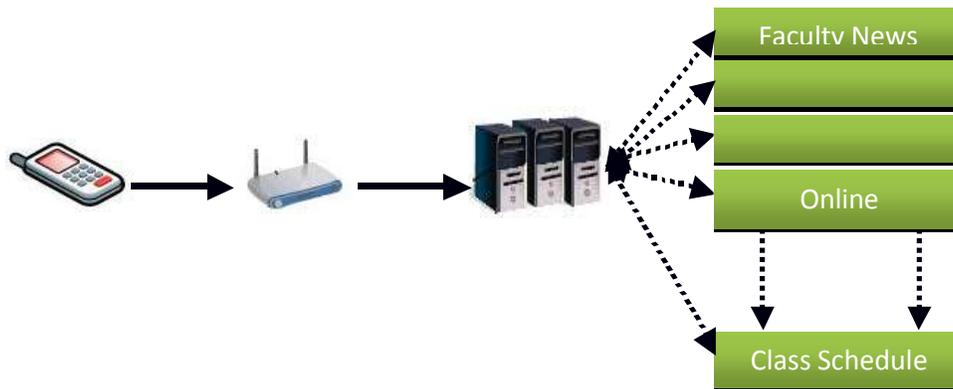


Fig. 3: M-service center as storage of M-learning services

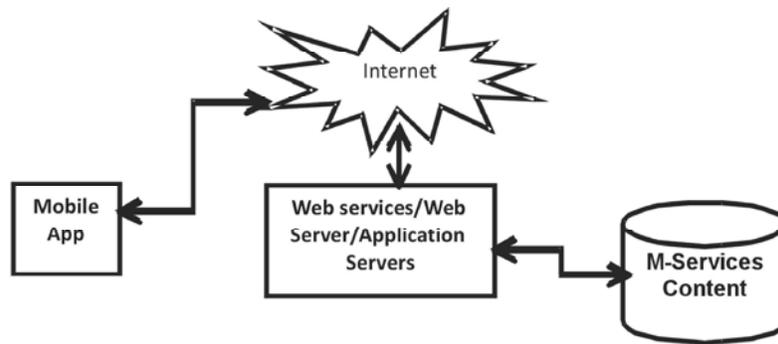


Fig. 4: M-learning system initial architecture

Initial Architecture of the Proposed M-Learning System:

The initial architecture in Figure 4 shows that the mobile application communicates with the M-services using web services/web server/application servers. M-Service center acts as web provider. Whereas, its main responsibilities are to control the provided services, update and synchronize information across the M-learning system, manage different types of profiles. The M-Service center is responsible for facilitate the delivery of the services to more and wide variety of devices. The web services/web server/application servers provide a flexible way for client mobile application to get the desired M-services that built on mobile platform.

Initial Design: Figure 5 shows the initial flowchart of the proposed M-learning system (student access layer). From the main menu, there are a number of options for the end user to choose i.e.announcement, class schedule, M-Lecture andonline submission. Before a student choose any option, the user has to login in order to load a user profile and to specify the right level of access privileged i.e. Teachers are able to set exams or assignments questions and the administrator has a full privilege to control the system and user of the system. After a user

successfully login, the M-learning system provides the necessary information about the user in order to append the appropriate content to its access role or layer.

High Level Architecture: The proposed M-learning system uses a client-server approach for wireless communication [15]. This approach was chosen since 802.11b is the protocol that is present on most types of handhelds. It is also chosen to be the system protocol because the system will seek to have the advantage of the ability to run computation-intensive operations remotely on the more powerful server. Then download application-specific tasks to the handhelds (client side) as needed. The proposed architectural model of M-learning is also designed to take advantage of mobility, as students can be in different areas of the classroom or even in different locales and still participate in collaborative M-learning activities. The technologies used for the proposed approach are divided into two sides; the server side and the client side.

Server Side Architecture: The server consists of Java Servlets. A servlet is a Java programming language class used to extend the capabilities of servers that host apps.

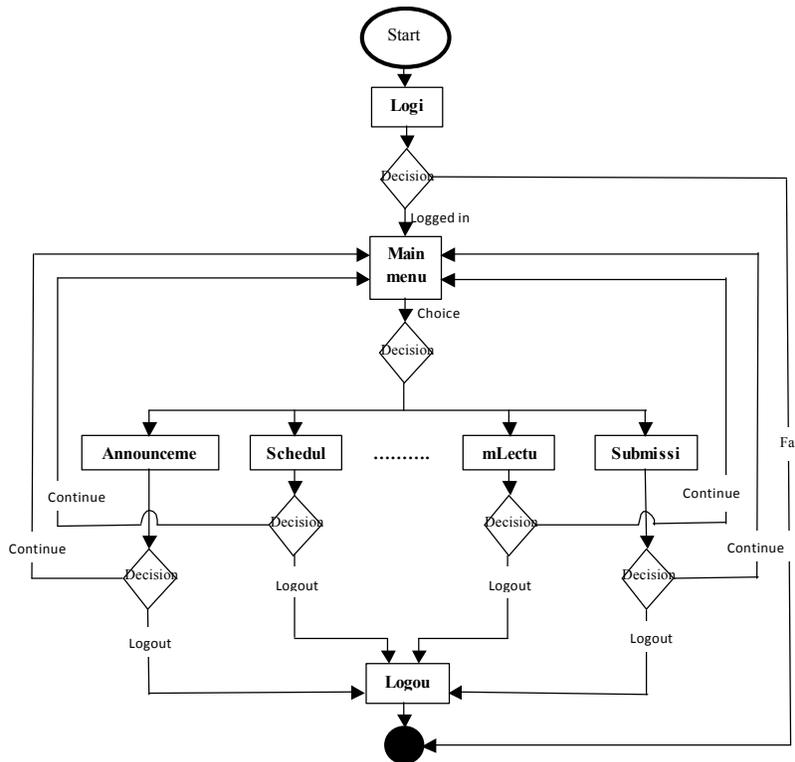


Fig. 5: Initial flowchart of the proposed M-learning system (student access layer)

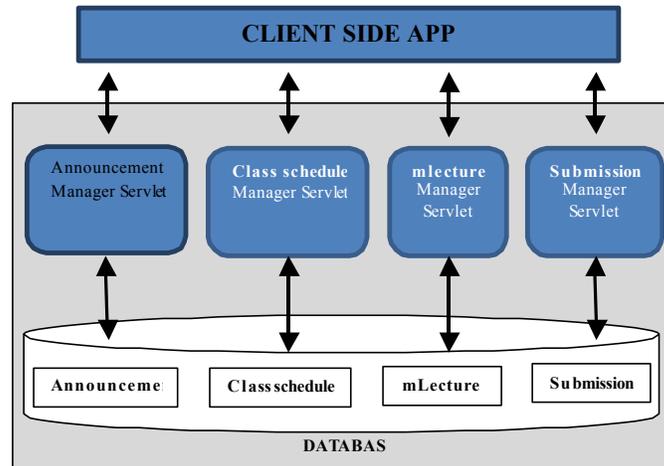


Fig. 6: Initial layout of Server-side architecture for some M-learning system components (announcement, class schedule, M-Lecture and online submission).

The Java servlets are part of server side components that provide a powerful mechanism for developing server side programs. Servlets provide component-based, platform-independent methods for building Web-based apps [16].

These Servlets are responsible for coordinating the requests that are received from the handheld application (client-side) via wireless network. The server also has a collection of database files or tables that contain user and

learning material specific information. The server-side architecture and its components i.e. announcement, class schedule, M-Lecture and online submission are illustrated in Figure 8.

These Manager Servlets shown in Figure 6 (Announcement Manager Servlet, Class schedule Manager Servlet, M-Lecture Manager Servlet and Submission Manager Servlet) are responsible for receive

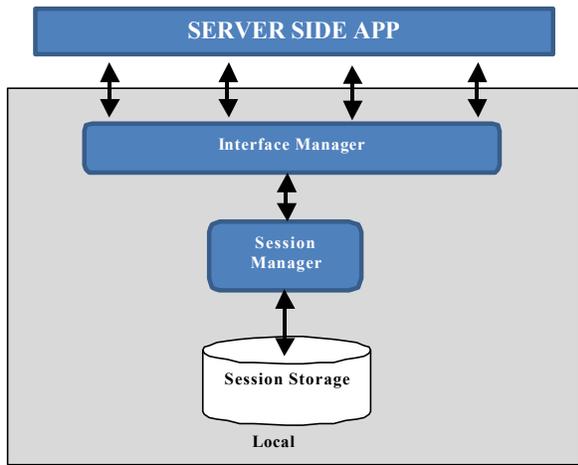


Fig. 7: Initial layout of Client-side architecture

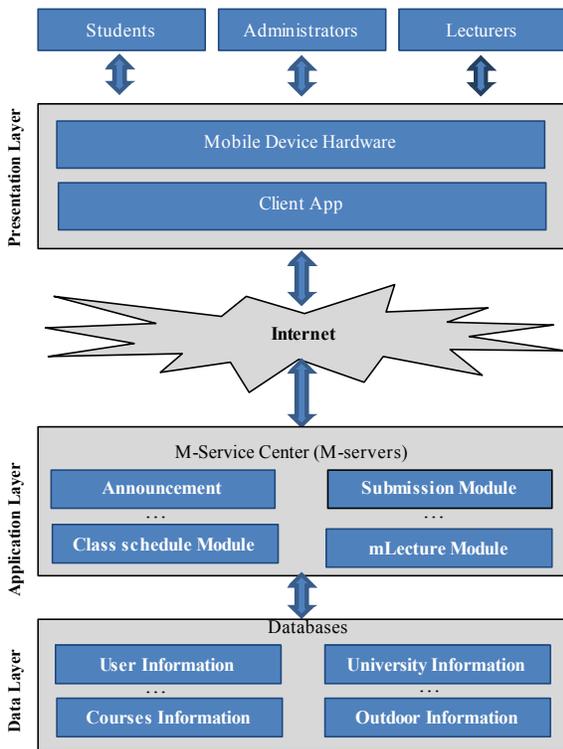


Fig. 8: The initial framework of M-learning system

requests from user, gets the required information from the files or tables in database and sends back the required information to the client. These servlets are also responsible for oneway communication between client and server.

Client Side Architecture: The client-side architecture consists of three main components: Interface Manager, Session Manager and Session Storage as shown in Figure 7.

- The Interface Manager is a mobile application interface, that will be written in Java programming environment built for mobile devices, which is presented to the mobile users during a session. The interface manager should be modeled with particular consideration of some issues such as text size, screen real-estate, ease of movement between screens.
- The Session Manager is the backbone component of the mobile application which will use a stack approach to transition the screens that are presented on the device. The session manager also keeps track of changes in user data as the user moves through the session as well as the current state of some features of the interface.
- The Session Storage is used for storing the data that is used during the session, such as schedule files and lesson material that are requested by the session manager when needed. Any data that are stored for these items are overwritten as the user progresses through lessons in order to preserve the limited memory space on handhelds.

Framework: One of the most important parts of this research is to design new framework. Whereas, the framework should be designed to cover university students' requirements and it is designed based on general mobile applications principles, such as location-awareness or real-time responses. The initial framework of the proposed M-learning system is illustrated in Figure 8. The Proposed framework has three main components: presentation layer, application layer and data layer. The presentation layer is in the client side, application layer and data layer are in the server side.

Presentation Layer: The presentation layer is interactive interface between users and the M-learning system. This layer is responsible for the interaction between users and system. The client side mainly includes two main parts the mobile device hardware and the client application. The client application is mainly client application programs of the mobile equipment operation systems and browsers. Users visit M-learning service center (M-servers) through the browsers and return the data to the browsers according to their requests. The presentation layer provides separate different user interfaces for students, administrators and lecturers.

Application Layer: The application layer is the main part of the whole M-learning system; the services of the M-learning system are encapsulated in this layer, it has the

responsibility to deal with the application requests of the presentation layer and deal with the required data. The number of function modules in the M-learning application layer depends on the students requirements. Whereas these requirements should be analyzed to design the required function modules to achieve the students requirements i.e. announcement module, class schedule module, submission module and M-Lecture module.

Data Layer: The data layer provides data sources for the running applications. The data layer databases of the M-learning system includes different information to manage students requirements i.e. user information, courses information, university information, outdoor information. For example, in user information table or file, not only the basic information about students, lecturers and administrators, but also the processing information of students learning and lecturers teaching are stored. The courses information, may include M-learning courseware, electronic schedule, e-books and other M-learning software i.e. online courses information such as the name of the class, the teacher and the course credits. University information may include information about faculty news and announcement about university's or faculty's activities. Outdoor information could be about any outdoor activities such as information about bus schedule, shops and any social or professional activities closed to close to education institute.

CONCLUSION

M-learning can be used to solve the traditional learning system problems. Both teachers and students need a proper and handy system to interact with each other and facilitate the teaching system. The M-learning systems are not to replace traditional classrooms but they can be used to complement the learning process in our schools and universities. This paper has provided a general overview of m-learning system and network architecture of M-learning system. The paper has discussed the three layers of m-learning system based network architecture. It also described the use of M-service center as storage of M-learning services. The paper discussed the proposed M-learning system initial architecture and the approach initial design and framework. The present architecture design and framework is general in nature and quite simple in away that it can be applied to any higher education system using client server architecture. However, the provided M-

learning system initial architecture, Server side/Client side architecture and framework was specifically designed to suite the demands of higher learning providers in the sultanate of Oman. The designed approach still in its first stage of designing thus, in order to demonstrate the approach worthiness and feasibility for Omani higher education providers, an implementation prototype needs to be performed and an interview based qualitative method needs to be utilized. Which then, can be used as an implementation roadmap of any higher education providers for an effective M-learning system.

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