Chapter 7

JXTA based Mobile-Learning for University Education System

7.1 INTRODUCTION

Mobile device has become an indispensable part of human life. M-Learning enables students to gather information about availability of lectures, live streaming of lectures, recorded audio and video tutorials and collaborative learning inside the campus through JXTA connected to the university server. Mobile learning has enhanced interactivity and hence information management can be achieved that facilitates on-demand information retrieval in an educational environment. The enhanced study provides attractive generic infrastructures that rapidly defines and implements M-learning in university and information services when compared to traditional classroom learning. Mobile learning and teaching have overtaken the traditional classroom teaching with the help of hand held mobile devices like laptops, tablet PCs, PDAs and smart phones. It supports 24/7 learning regardless of their locations (since teacher is mobile, learner is mobile, content is mobile etc.). M-learning application frameworks facilitates the learner to access the learning objects (like audio-video lectures, tutorials, assignments, projects and so on.) and it interacts with the instructor and other learners simultaneously. The JXTA/JXME framework is used for message passing and file sharing. In P2P systems every peer contribute and takes advantage from other peers. The potential for P2P architecture, which includes distributed environment and P2P Mobile android JXTA (peerdiod) for instance, will be fully exploited in the coming years. With the consideration of cooperative learning over the Internet, the JXTA M-Learning not only ropes better academic interfaces amongst learning peers, but also provides individual learners with greater satisfaction.

7.2 JXTA M-LEARN ARCHITECTURE

The proposed JXTAM- Learning System takes a move from traditional classroom learning to constructive high retention personalized learning, distributed over educational environment away from the classroom. M-Learning is considered as an extension of E-Learning which offers learning any time anywhere by using...
mobile-devices such as mobile phones, tablets, PDAs and laptops. JXTA platform has generalized group of protocols that allows different devices to communicate and collaborate among them. JXTA offers a platform covering basic needs in developing P2P networks. In P2P network every node’s role is equal. Each node could be a server node to provide the service to their nodes, and share the service provided by other server nodes as a client. This work is motivated by the need to develop decentralized P2P approaches that could support learning and teaching activity in virtual universities. University resources are connected to JXTA network with the help of APIs (Application Programming Interfaces) and protocols for communication. Edge peers are the outermost leaf peer on a JXTA network graph, usually passing clients to the JXTA overlay with a potentially high rate. Edge peers to the JXTA network is directed by querying a rendezvous peer for nearby peers via a relay peer. Rendezvous peer is the JXTA peer providing a superset of the functionality provided with the edge peer, it is the backbone of a JXTA which coordinates among all nodes. Relay peers provide broad services within the JXTA network. Peers with common features form peer groups, and these group offer services which are available to multiple peers in the group.

Figure 7.1: JXTAM-Learn Architecture
All communications in the JXTA network is achieved by sending and receiving messages. These messages are called JXTA messages. Peers use pipes to send and receive messages where pipes setup virtual communication channel in JXTA environment. A relay routes are messages to and from mobile peers in the network. Peer 1 sends query to find resource such as study material. JXTA network resolves the query. And through APIs and protocols requested query is fed into university server, suppose a learner wish to search their courses based on a keyword search for "Book Name", “Book Author” or other key word information and the Material Type such as ( Videos, CD-ROMs/DVDs, Audio) to find the required resource. JXTA networks facilitate the learners to search for subject. It also provides many multimedia systems for viewing digital videos and other formats. Learner can also subscribe online Journals, E-Books, and magazine and newspaper articles from international societies incorporated with the university.

7.3 JXTA M-LEARN SERVICES

The proposed system also enables services where the learner will be able to locate the resource management, live streaming, collaborative learning and group communication among peers.

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Figure 7.2 JXTA M-Learn Services
7.3.1 COMPONENTS OF JXTA MOBILE

- Mobile Devices - e.g. IPod, Android, Nokia, Smartphone, Laptop
- University Resources - e.g. Faculties, Library, Courses, Lectures (Audio-Video)
- JXTA Network - e.g. (P2P, Peer Group, Relay, Pipes)
- Protocols - e.g. XML based, GPRS, 3G, TCP/IP, HTTP
- Students

System \( S = \text{JXTA M - Learning system. System } S = \{ M, U, Pr, Output \} \)
\[ M = \text{Mobile Devices, U = University Resources, J = JXTA Network, P = Protocols, St = Students, N = Mobile Network} \].

7.3.2 UPLOADING RECORDED VIDEO

Data delivery protocol handling involves reading data onto a source (from a capture device or a file, for instance) into a media-processing system. To store video content a server we used Generic Connection Framework (GCF) over the HTTP protocol. Real-time Transport Protocol, or RTP, is a packet format for transmitting audio and video encoded with various encoded types over the internet or local networks, much software and hardware applications support RTP, such as Windows Media Player, QuickTime, VLC, mp4Player, and ff.mpeg etc. RTP is transmitted over UDP (User Datagram Protocol).

The Real Time Streaming Protocol, or RTSP, is used to control the playback of an RTP stream. A RTSP Server allows a viewer to receive the RTP packets sent from the device. A viewer (e.g. VLC or ff.mpeg) cannot directly open an RTP stream, therefore an RTSP server is required to provide additional streaming information and controls the start and stop of the streaming packets. RTSP is supported by the latest versions of the Safari and Conquer browsers. Each video being transferred from the mobile device requires processing, therefore an efficient encoder and decoder is desired for optimal scalability. FF.mpeg was chosen as the default transcoder (decode and re-encode) as it has the best picture quality and low CPU and memory usage per video stream.
7.3.2.1 STREAMING LECTURES TO MOBILE

Video streaming from the server to mobile devices entails a combination of many elements. The custom RTSP server built to interact with the mobile devices, their video streams and applications (for example ff.mpeg or VLC) capable of playing live video. The server opens many different listening ports that accept in coming connections. The protocols used for the ports are TCP and UDP. The server’s pawns two listeners, one for clients peer wishing to view the incoming video, and one for client peer wishing to send the video via the mobile phone. A concurrent hash map is used to synchronize the users viewing the video and the phones streaming the videos.

![Diagram of video streaming](image)

Figure 7.3: Live Video Streaming From Database

The RTSP server is a custom RTSP server built based on the specifications to provide the stream information which forwards RTP packets to the correct destination. The TCP port 554 are recommended as this is the default port. The server attempts to limit the consumption of UDP ports by only binding to as many as necessary. Therefore most peers will be provided with the default UDP port. The RTP server receives of the RTP packets from the Mobile device. Each time a
peer has joined or left the stream is updated in the database so that an update list of peer is available to the web interface. The mobile wireless model in a P2P system has a strong openness, expandability, no time constraints and enhances information management with flexibility, thus convincing the educational environment. University server has vibrant role of storing all the recorded lectures tutorials, library books and physical location of the faculty members in university. According to the environment, learners can operate mobile device to select the appropriate video and audio learning resources (courseware). The Classrooms sends live video and audio files through the server to the mobile device via JXTA network with different user interfaces for students, instructors and administrators.

![Figure 7.4: Live Lecture Streaming](image)

API (Application Programming Interface) and protocols makes the transmission synchronous. Data layer provides data sources for the applications. If the student needs to know the previous lectures the server can provide tutorials and guidelines for students in the form of audio and video files on request.
The student requests for a JXTA network through their mobile IP and retrieve the data using streaming technique. The streaming technique will be more helpful in the case of student absence or the student can view the lecture even if he is out of the campus. To make JXTA networks available to mobile P2P users, we need a set of JXTA APIs for mobile devices. It routes messages to or from mobile peers, translates the relayed messages from JXTA XML format to JXTA Binary Message format, and vice versa, in order to enable interoperability between mobile peers and ordinary peers. The relay interacts with other peers and pipes, and uses group services.

![Image of JXTA interface](image)

**Figure 7.5: Lecture Videos Ready to Transmit.**

The proposed system has a certain simple process where learners have not to worry about the missed lectures. They can view the missed lecture during day or night. The only few precondition s are to be followed by the student, that is he/she must register and be authenticated before he/she can takes part in the M-Learning System.
7.4  JXTA ACTIVE GROUP CREATION

Group creation includes the following

- Start the jxta network
- If(!group created)
- Create group
- Recognise the peers in the group
- Find the active users in the group

The system uses peer authentication which creates a session for any signed in student via message. Above Fig. represents lecture videos ready to transmit to the student mobiles. The most important and frequently used method of evaluating the effectiveness of the proposed system is the span of the session and the cookie remains valid until the learner logs out. The JXTA support mobile device in such a way so that live streaming lecture cannot be affected due to high resolution and video format, it supports the auto resume in case of power failure of mobile devices. Live lecture is captured by digital web cam organology video cameras, which is encoded and sent to JXTA network. The JXTA network broadcasts it among peer groups. Thus make the learning session alive, any peer can generate the query to ask the doubts and request for clarification. Many students at different locations can attend the live lecture.

7.5  JPBL (JXTA PROJECT BASED LEARNING)

It’s a collaborative project reviewing system based on JXTA. The architecture of JPBS is shown in figure which is divided into the platform layer and the JPBS layer. The JPBS layer is built upon the platform layer. Platform layer consists of two tiers; the lower tier is the Java SE run time environment, while the upper tier is JXTA platform. JPBS layer is the frame work of project reviewing systems, and it is divided into three tiers. The lower tier provides core services, such as platform initialization, resource discovery, etc. The middle tier is logical business layers, and it provides services such as instant messaging, file transfer, etc. The upper layer is GUI, offers users a friendly interface.
Figure 7.6: Peer Group Project Based Learning

Figure 7.7: Peer Group Construction

Figure 7.8: Different Peer Groups From JXTA Configurator
In JXTA network, communication among peers is based on peer group. When JXTA platform is started, each peer will join the default group, Net Peer Group that all the peers belong to. JPBS applies peer group concept to divide the Net Peer Group into some virtual Communities. When a specific group is established, the message can only be propagated among users who have joined this group. So
according to users’ interests, they can create their own communities to do a group discussion. In group communication, JXTA Multicast Socket is also utilized to receive group chat messages. When a new group is created, a multicast pipe advertisement is also created, which is written to the group description. If a user has joined a group, he needs to extract the group multicast pipe advertisement.

7.7 PEER GROUP CONSTRUCTIONS, COMMUNICATION AND MAINTENANCE ALGORITHM

For Peer group construction4peers (peer0, peer1, peer2, and peer3) join the network. The idea of hypercube topology is maintained when a new peer id enters the complete hypercube topology unfolds as needed. When a student peer id removes from the peer group other peer id jumps into cover the positions previously covered by the node.

![Figure 7.11: Construction of Peer Groups](image)

![Figure 7.12: Communication between Peer Groups.](image)
**Initialize.** Only peer0 is active at the Initial stage.

**Phase1:** Peer0 is contacted by peer1 which wants to join the P2P network. Student Peer0 integrates another student peer1 as 0-neighbor since it does not currently have any other neighbour.

**Phase2:** Student Peer2 contacts one of the two student peers (0 or 1) to join the network. The first vacant neighbour level of peer1 is since it already maintains a 0-neighbor peer0.

**Phase3:** Peer1 opens up a new dimension. Peer1 becomes the so-called integration control node for the complete integration of peer2 into the P2P network. It is responsible for providing peer 2 with all necessary links at the end of the integration process. Peer 2 has to have neighbour links connecting it all currently existing neighbour levels, in order to be able to carry out complete broadcasts.

**Phase4:** In Phase4 peer1 has two neighbours 0 and 1. It knows that it has to provide peer2 with 0 and a1 neighbour too (for good balancing). Peer 1 itself has become peer2’s 1-neighbor. Since there is currently no alternative, peer1 selects peer 0 as the new 0-neighbor for peer2.

**Phase5:** Peer 0 can only be a temporary 0-neighbor for peer 2 because it already has another 0-neighbor, namely peer1. Peer0 now covers a vacant position in the hypercube, i.e., it act says if it occupies two positions in the hypercube, as depicted by the thin copy of peer0.

**Phase6:** To mark the link between peers 2 and 0 as temporary relationship, it is tagged with the link set [0, 1] (instead of [0]): This link set denotes the path from peer2 via the position at which the link set is originally aiming to peer 0, the peer which currently covers this position. Temporary link sets are always constructed by this rule.

**Phase7:** Peer 3 wants to join the network. Assume peer3 contacts peer0 to join the network. In case peer3 contacts peer0 to join, peer0 follows the general rule to integrate the peer on its first vacant neighbour level which is1, since peer0 has a 0-neighbor, but no 1-neighbor. As its new 1-neighbor, peer3 will now cover the temporary position that peer 0 used to maintain in the hypercube
**Phase 8:** Hence peer0 can pass on links that are associated with this position to peer3. Due to the construction rule of edge labels for temporary link sets, peer0 is able to determine that link [0,1] to peer2 is a link that is to be passed on to peer 3. Peer3 then establishes a link tagged by link set[0] to peer3.

**Phase 9:** Peer 4 arrives and contacts peer 0. Now, the network crosses a threshold a hypercube with 2 dimensions cannot accommodate 5 peers, hence a third dimension is opened up. Peer0 integrates peer4 on its first vacant neighbour level as its new 2-neighbor. Peer4 needs 3 neighbours, one on each neighbour level but neither peer0’s 1-neighbor, peer3, nor peer0’s 0 neighbour peer1 are linked to their own 2-neighbor which they could provide as a new neighbour to peer4.

**Phase 10:** Peer3 acts as temporary 1-neighbor for 1 peer4, where as peer 1 acts as temporary 0- neighbour for peer 4, indicated once again by the link sets [0, 2] and [1, 2] among these peers.

**Phase 11:** Positions that are additionally covered by peers determine the temporary connections the peers have to maintain, plus their edge labels.

Figure demonstrates another basic rule: Peers that are closest to a vacant position in the hypercube structure are always chosen to cover it. Closest means that the peer on the highest neighbour level to a vacant position covers it.

**Phase 12:** Adding another dimension to the graph means the multiplication of existing links, too: For example, peers 1 and 2 could now both integrate 2-neighbors, which would then be linked on neighbour level 1. They tag their already existing [1] link additionally as [1, 2, 2] link. So do peers 2 and 3 with their already existing [0] link.

### 7.8 IMPLEMENTTION OF JPBL

#### 7.8.1 USER LOGIN

In login module, there are two main tasks, one is to acquire username and check whether the username is unique, and the other is to allocate resources for user and
start necessary threads. JPBS will initialize JXTA platform and build a P2P network environment for user. After one user inputs username, Jxta Platform is initialized, and then functions end New Peer Msg() is invoked to announce appearance of user. If there already exists one peer p with the same name as u, function notify Change Name () will be invoked to informing you to change his /her login name. “Delay a certain time” indicates that a peer should wait a “Name has existed” message for several seconds in case of a reduplicate name with another peer.

- Create a jxta network for message passing.
- Send the list of connected devices to network
- If message exist then change the name of user for security
- Check for the users login and connection in the jxta network
- Add the students to the peer list
- Sort the students and lecturers from the peer list to groups based on the project.
- Allocate resources

### 7.9 PRIVATE COMMUNICATION

Communication among users is classified into two categories, private communication and group communication. Private communication is equivalent to unicast, while group multicast. All the resources in JXTA are published in the form of advertisement, and an advertisement is equivalent to the name card of resource. Fig5 also shows an example of a pipe advertisement. It is an XML document that describes such information: this Pipe.

- Start the jxta network
- Send the message to recognise peers online
- Wait for a message
- Respond to the message from peers and declare them active
- Check if it’s a peer and if so send a message
- Add to the peer list if its a new peer, Send a response presence in the group
- Keep checking the responses to see active users at regular intervals
Figure 7.13: Lecture Peer Interacting with student peers

7.10 EXPERIMENTAL EVALUATION

The University education is considered for our evaluation with 5 mobile devices with android all connected through the JXTA network. The students register through their mobile devices with separate IP. Student interested in collaborative and project based learning with increased number of registered users has improved drastically.

Figure 7.14 Success Factors of M-Learning system
M-learning has a list of success factors that are in need to be satisfied like suitable content, connectivity, technology planning, marketing, quality of materials, administrative efforts and the list moves on. A simple graph that explains the impact of these above specified factors in M-learning is displayed.

Figure 7.15 JXTA Learning System vs Current E-Learning System

Figure 7.16 Peer Group Status Per Week
Table 7.1: Feedback using M-Learn application

<table>
<thead>
<tr>
<th>Feedback on our application</th>
<th>Points scale of 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>It was easy using the application</td>
<td>4.1</td>
</tr>
<tr>
<td>The consultation process was straightforward</td>
<td>4</td>
</tr>
<tr>
<td>I rarely make mistakes while using the Application</td>
<td>2.9</td>
</tr>
</tbody>
</table>

Table 7.2: Efficiency of M-Learn application

<table>
<thead>
<tr>
<th>Feedback on efficiency of our Application</th>
<th>Points (5)</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portable and available when ever needed than the manual system</td>
<td></td>
<td>4.5</td>
</tr>
<tr>
<td>Does the application cover the entire Teaching methodology</td>
<td></td>
<td>3.5</td>
</tr>
<tr>
<td>Is the application better than the manual classroom learning system?</td>
<td></td>
<td>3.5</td>
</tr>
<tr>
<td>Can the application be useful for future Fulltime learning consultation?</td>
<td></td>
<td>3.5</td>
</tr>
</tbody>
</table>

Fig 7.17: efficiency and usability of the Proposed System
The results generated by the application are of two variants, the positive and the negative result which actually determines the state of the users’ current situation. Using 5 point Likers scale, with 1=Disagree3=average and5=Agree onTable2. Mobile Learners generally noticed that the application was faster and accessible all the time than the manual system of consultation, they also realized that the application cover sand follows the normal Tradition classroom learning mechanism. A survey conducted in a university where there respondents also feel that the application is better than the manual system of operation with a scale of 3.75 and they also feel the application will be useful in the nearest futurethiswitha3.66 scale.

7.11 CONCLUSION

The paper presents a system model that can apply to educational environment. It increases work and learning performances relevance to the learners. It develops a success full earning environment or PDAs, smart phones and mobile phones over the JXTA network that supports mobility of technology, mobility of learning and mobility of learners. It also brings strong portability by replacing books and notes with small personalized learning gadgets. M-Learning may use more stand point understanding to provide most adaptive contents for learners. Overall online/offline Learning System plays an important role in the existing educational environment, but due to lack of information learners might, miss the chance of participating in live conferences, class etc. Hence proposed systems laid an important role to fill the gap between JXTA networks in M-Learning systems also ensures better learning and makes the model reliable and trust worthy over them oblige environment. As the resultant, our proposed system is one of the useful systems over the mobile devices.