DESIGN AND DEVELOPMENT OF HILOLOGICAL PROTOTYPES FOR MOBILE COLLABORATIVE LEARNING (MCL)

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Abstract:
Collaborative learning is becoming more attentive approach within all educational environments. With new emerging technologies on mobile devices, collaborative learning has grown in popularity to be able to boost the pedagogical learning model in nomadic environments. This paper describes theoretical and technical foundations for designing and developing an effective Mobile collaborative learning (MCL) environment. The focus of this paper is to suggest the client and server based prototypes with support of functional components and working procedures, which help the user to get contents from server to meet the pedagogical needs. We have also proposed novel concept of integrating the features of content-server with cache-server, which helps the users to obtain the fast contents for MCL process. Our proposed prototypes will provide best MCL environment particularly for those students who do not want to attend the institutions but want to learn at homes and working places through mobiles. Finally, we propose new application named "group" with complete prototype design and development to facilitate the students for obtaining the contents for collaboration. Some valuable recommendations are also suggested to incorporate with "group" in Android operating system (OS) and we also implement some part of group application.

Keywords
Mobile collaborative learning (MCL)
Environment, Optimization of architecture,
Client & Server side Prototypes for collaboration,
Mobile device.

INTRODUCTION
The trend of competition has been growing rapidly in global market with advent and deployment of new technologies. The leading companies have spent their maximum efforts for introducing human-friendly product. From other side, the demand of people has always been in search of magical device to maximize benefits and utilize their minimum amount for collaboration. The latest technological evolution is the emergence of mobile wireless communication technology. Mobile phones are only cheaper hand held device, which we can carry and use whole day everywhere. With incorporation of emerging technologies in mobile devices; such as motion sensors, cameras, Global positioning System (GPS), Infra-Red, Bluetooth and GSM supported by broadband connections, which make the mobile as attractive tool to complete the demand for collaborative learning (CL). mobile devices provide the rich features like Memo diary, Address book, Reminder, To-Do list, Alarm ,E-mail ,WAP Enabled, Calculator, Audio player, Video player, Flash Player, Real player etc. Mobile devices are also more flexible to integrate the existing services by employing web based interface. The applications developed for mobiles can provide geo-location, motion recognition, history of activities and academic profile of user [6] .mobile devices are easy to use due to designed menus in form of text, graphics and icons. Each
individual can easily identify the associated functions. Navigation control buttons and touch screen provide a better user graphical interface suited for CL. The concept of mobile-based learning is completely different from classroom-based learning method. This pedagogical method of learning provides many possibilities, such as providing the opportunities to group of persons, working in same or different organizations to participate for accomplishment of specific goal. Now-a-days Collaboration has been getting more importance in educational environment. The focus of collaborative learning has been implanted from elementary to higher educational institutions. The demand of collaboration Learning has been increasing due to launching the joint projects. For example, University of Northwestern has started "Oncofertility Consortium program" with support of Oregon Health and Science University, University of Pennsylvania and University of California for San Diego. This program addresses the medical improvement reforms for cancer patients by initiating new detection and diagnosing methods. The launched mechanism of health care also tackles the issues of young infected cancer patients. The consortium brings various professional together by using Breeze and H.323-based video conferencing protocols. Latest study shows that mobile collaborative learning environment (MCL) is highly focused paradigm for research particularly in distance and online education. MCL provides advanced features and necessary functionalities for all participants to obtain the knowledge in open, large scale, dynamic and heterogeneous environments. However, some of major challenges are raised in developing MCLE for education such as knowledge sharing, request for modified contents, fully access to enterprise data warehouse, delivery of large rich multimedia contents (Video-on-demand), selection of technological components in designing appropriate architecture and application protocol. To overcome these issues, we propose linguistic client and server based prototypes to improve knowledge sharing process; and provide access for all users to enterprise data warehouse, have content-modification facility at later stage and delivery of large rich multimedia contents. Our contribution will make it easier for students to gain some sort information and feedback through MCL.

2. Related Work

In this section, we discuss the salient features of related published work. Xiaoyong Su et al.[1] propose the four layer framework for multimedia content generation and prototype for multimedia mobile collaborative system. The proposed framework provides support for user, device and session management. They claim that mobile collaborative environment could be possible by upgrading the devices and network technologies. The work is interesting but framework is not completely elaborated and lacks incorporation of many components, which are necessary for such type of framework. Our work is based on four layers architectures and removes the shortcomings found in architecture and optimizes [1]. and proposes the prototype to support the architecture in Mobile collaborative learning environment. Vladimir Zanev and Rodney Clark [2] provide development process of prototype concept for wireless course management system and highlights login and authentication, wireless syllabus, wireless calendar and wireless testing. It also gives the description of course contents and tells how the teacher can interact with students by using HTML based interface. Lahner F and Nosekabel H [3] have implemented the program in University of Regensburg, Germany, which supports e-learning contents to be displayed on mobiles. The structure of system provides the facility to users to get same contents via mobiles. Limitations of data transfer and Shortcomings of screen size have been controlled with some extend by providing the facility to students to personalize information. Mildard Marcelo et al. [4] have designed C-note in University of Vaxjo, Sweden. C-note provides opportunity to collaborate for storing the notes and information in database on their progressive project. The specialized C-Pen is used to scan the project research material with support of C-note application. Finally the
scanned information is stored in database and teacher can check the performed activities of each group in collaboration. Jorge Bardosa et al. [7] proposed the prototype for undergraduate course of reference (nicknamed GRefe) by using mobile and ubiquitous computing. Authors claim in [7] that their proposed approach will improve academic and learning activities. The prototype is based on user profile which stores the information regarding learning process. The second is location system, which is used to identify the physical location of user supported by generic architecture. Third is personnel Assistant (PA), which resides in the mobile. Fourth is learning object repository, which stores the contents, related with the process of pedagogical teaching. Fifth is message sending system to be controlled automatically or using administrative interface by operators. Final component is Tutor that searches learning opportunities. The proposed prototype does not provide the mobile collaborative learning and this is only generic idea of online learning. Allison Druin et al. [5] have discussed the prototype for their ongoing participatory design project with intergenerational design group to create mobile application and integrate into iP Phone and iPod touch platforms. They claim that designed application can provide the opportunities to bring the children and grand parents together by reading and editing the books. Ch. Bouras et al. in [1] have introduced INVITE Architecture and discussed the user's requirements to meet the demand of e-learning in collaborative virtual environment. They have also talked about the technology and standards required for designing the INVITE; the concept is interesting but lacks completion. It does not lead to existence of any solid prototype. Our client and server based prototypes provide smooth transaction of data exchange for Collaborative learning environment. These prototypes give the information regarding the course materials, easy access to check the grades and use of labs. The application running on this architecture can give substantial feedback for collaboration such as exchange of delivery of communication contents include platform for group discussion, short message service (SMS), Emails, audio and video-on-demand to offer on-line information to students who are the part of collaboration. Testing and assignments procedures can be conducted. Teachers also pass the instructions to group at same time.

3. Prototype Design of MCL at server side

At the server side, Content server is core component of Content generation layer shown in figure: 1 with architectural design, which is based on content server engine (CSE). Content server keeps on watching the interface (folder) whether new request from client side is received or not. If new request is arrived then it is displayed on website through template. Hence writer, system operator (administrator of a multi-user computer system) and rest of team members are informed through email. The Content server forwards the content requested messages to CSE. Engine is implemented on Internet Information server (Web server). The function of engine is to receive URLs (Request of client for contents), checks and triggers (Stored Procedures) process the requests. First, CSE sends the request to authentication tool (AT) to verify the status of the client, AT saves the profiles of legitimate clients and checks the client in client profile, If illegitimate client sends the request for getting the contents for collaboration that requested contents are declined and intimated about the status of client to CSE. If client is legitimate, the request for content is forwarded through storage drivers of CSE to communicate with storage medium. CSE can save and get data from either database driver or file system driver. These both database and file system drivers forward the request to the Database Manager GUI and Database Manager CLI. Single CSE can support to many storage mediums. To obtain the contents fast. We propose HTTP client and integrate with CSE. At the server side, we also introduce the Cache server, which has feature of setting up its own hyper text transfer protocol (HTTP) connection. The cache server gets the request from HTTP client and delivers the requested contents immediately; if they are already cached on server, otherwise forwards the client's incoming request to other servers because
Cache server has direct access to other servers for getting the requested contents. We have another advantage of cache server because we do not need backups and log monitoring. Database Manager CLI tool creates monitors, manages backups and restore the instance of database. This tool supports to interactive and background operations. We can access the database Manager CLI tool by using Java, C++, XML and other languages. This tool helps to create the programming interfaces, Module and documentation. Database Manger GUI tool functions like Database Manager CLI but provides more features such as updating database software, diagnosis options and displaying information. Database Manager GUI also supports different featured mobile devices, which are located at different places because supporting feature of GUI can provide friendly user-based interface to remote mobile devices for collaboration.

GUI and CLI help to store and extract the contents forwarded from Database or file system drivers by using different repositories. Content repositories get the requested content message from GUI and CLI and search the requested contents in storage devices of content management system (CMS). The content repositories are also part of CMS, which supports and functions like logical storage for different storage devices. The Repository can also be helpful to store different kind of contents in single repository table such as comments, articles, questions, answers, news, tutorials. So, we can switch from Rep₁ to Repₙ in single table for finding the requested contents easily for collaboration. We can also monitor the performance of each repository with their respective servers shown in figure 2.

4. Prototype Design of MCL at Client side

The contents obtained by single mobile client shown in figure: 3, can be shared with group of mobile nodes by using the Feed Demon or Net News Wire software. These softwares are supported with mobile Really Simple Syndication (RSS) 2.0 software. The RSS creates RSS feed (which are online resources). The RSS feed is storage area, where handheld devices (clients) store the contents obtained from server side for collaboration. We should use RSS aggregator with integration of video aggregator. The advantages of using these aggregators are to get information from various online sources (RSS feed) and store onto it. The deployment of video aggregator; on-line video

Figure 1: Architecture Prototype of MCL at server side

Figure 2: Function of Server with Repository
can be collected and sorted out for RSS feed. The Apple iphone is best choice for MCL but needed Lite feed RSS reader. Lite feed has an efficient utility for compressing the file, cache and having the fast access to attain the feeds. Lite feed also provides good features in hand held devices to view the whole article, sharing the information and clipping the buzz net photos and flicker.

Figure 3: Client received the requested contents from server side

Bit-Torrent based peer-to-peer applications can also support mobile RSS 2.0, which permit the client applications to download the files automatically. Fo-Cus application also helps the handheld device (client) to obtain RSS contents from web (RSS aggregator) to display on the screen of hand held devices. with use of RSS 2.0, the shared information can be downloaded on other client’s mobile to use for collaboration. Mobile RSS supports audio and video updating. The idea of introduction the specific RSS aggregators can resolve the issue of MCL in education because RSS software is positive approach for making the blog [8]. RSS reader software can check the client’s subscribed feeds. It also produces the user friendly interface. Each participating client should be assigned separate feed. RSS 2.0 can also assist to read and monitor the feeds. If single client gets the requested contents from server side, which will be saved onto the respective RSS feed in order to be shared by other clients. The content receiving client should be give one more responsibility to send multicasting message to the rest of the member of group to collaborate. The multicasting message is based on client group. The clients can join and leave the group and be identified with class D. To send multicast messages to the group of clients for collaboration; track group membership and route data grams are needed. The group membership management is controlled by local for local delivery. Remote multicasting routing is done by global [9]. Internet Group Management protocol is used to locate the clients. Multicasting at local level is done with support of multicast router, which has capability of group manger, which can send the queries to members of group in local area. when members of group send the response with reports then they are identified, who are the members, taking part in MCL. Similarly the Global does the process of multicasting the messages to remote clients.

In response, the rest of members can get stored information from feed of client by using RSS 2.0 software. If client gets the contents, then MCL process starts given in figure: 4.

Figure 4: Content storing and extracting process from client side

4. Proposed Group application and Case Study Prototype for MCL

MCL is an revolution for education, which allows the user to obtain computer-based information through mobile devices. MCL provides various advantages
such as context awareness, portability, connectivity and social interaction [10]. Mobile can be successful tool for collaboration, allowing the students to share the information to achieve targeted pedagogical activities. from one side, mobile makes bridge of opportunities, and from other side, limitations create the hurdles and affect its deployment in collaborative learning. The limitations, which highly affect the performance of hand held devices include small size of screen, navigation issue, mobility, low resolution, bandwidth, and limited memory. Due to emerging technologies and its best use make the task easy and accessible for all. Our proposed application and prototype as case study for MCL can solve the deep dream of students to make the collaboration with mobile anywhere and anytime. Our Group application and prototype help the students to obtain the required contents from enterprise database warehouse (EDW) of University of Northern Virginia (UNVA) to meet the course requirements. Let us take a look overall procedure. Suppose, course Decision Support System (DSS) is offered online from UNVA. Some of the students do not have access to computer during some hours of day but possess the handheld devices. As these hand held devices get the course contents from through server of UNVA and helps in CL. Various information is stored in EDW to meet the standard of course explained in [2]. An information of course comprises of Textbook Information, course Name, Course ID and Course description. The focus of case study is around the course description that is actually based on course contents. How to complete the course contents during the semester for getting the course objectives? course objectives are met with support of tests, quizzes, assignments, discussion, projects, labs etc. All these items can be obtained to complete the course by using MCL. Figure 5 supports the process of case study prototype for MCL.

Figure 5: Process for obtaining the course contents through MCL

Suppose, parsing Engine and its components are the contents of the first chapter of DSS course. To meet the objectives, we need MCL but limited capability of mobile and installed software cannot provide the easy access for MCL. Hence we suggest to incorporate Feed Demon or Net News Wire software with support of (RSS) 2.0 software but objectives cannot be achieved. We suggest some following recommendations to incorporate Android mobile operating system, which consists of software stack for mobile devices.

- Add new application with name "group" in application section by using Java programming.
- Resource Manager and Activity Manager should be extended and provided extra responsibilities to control different features of "group" application.
- libraries section should be modified and particularly SQLite because extension of this, will make easy for structured data storage.
- Display Driver of Linux Kernel should be enhanced to support MCL activities. If these recommendations are incorporated in Android, New application "group" with new features will support for obtaining the contents from server side up to completion of CL explained in figure 6.
The application "group" consists of Control option and Delivery option. The control option performs the functionalities of Add New contact, Delete contact, Edit Contact, Existing Collaborative Group (C-G) and Make New C-G. Delivery Option does the function of Receive and send. When client (Mobile device or hand held device) gets the requested contents from server side, receives through delivery option and saves by using the store component given in figure 10.
The store component is the place of mobile where all data is available obtained from server side for collaboration. The store component has download option. The participating clients use this option by downloading the data to be stored on RSS 2.0 for collaboration. Each section of store component manages the various files, audio and video. If once data is obtained that will be saved onto the store component of mobile (requested client) and uploaded in respective RSS Feed. The upload section helps the mobile to put any type of data in RSS feed to be used by participating members of the group for MCL displayed in figure 11.

When mobile (requested client) finishes the process of storing the data in its store and RSS feed, informs the collaborative group by sending multicasting message to participate in collaboration. When participating members of the group get the message of collaboration and starts to download the data from RSS feed of requested client required for collaboration. The process of sending the multicasting message is given in figure 12.

When all of collaborative members of group complete the process of downloading the required contents from RSS feed of requested client, starts to follow the process for MCL given in figure 13. If participating members need file for CL, open the file to get the knowledge of the contents by reading. If they need more information to clear their concept about the topic then play the video of related information given process in figure 14.
in figure 15. The process can be supported with H.323 standard published by International Telecommunications Union Telecommunications (ITU-T) to facilitate the real-time audio and video communication. This protocol will help to collaborative members to discuss the contents after reading and watching the video of related information. This protocol provides the point-to-point and point-to-multipoint communication. The key feature of H.323 is point-to-multipoint, which creates the opportunities all of the members to participate simultaneously. The Quality of service can be maintained by using H.323 [11]. With integration of "group" application in mobile application section, the course objectives can be met with MCL.

![Figure 15: Collaboration among the Mobile Collaborative group for achieving the objectives](image)

5. Conclusion and Future Work

The main objective of designing and developing the linguistic prototypes are to obtain the learning materials on hand held devices particularly on mobile devices. With implementation of prototypes, students can get the contents of the course anywhere and anytime. First, We have introduced the server based architectural prototype to support to MCL in education; The design and development of server based architecture can provide the faster method of delivering the contents to users. We have also optimized the content server by integrating with cache server at server side. As this integration saves the time for delivery of data. Second, our client-based architectural prototype gives the complete directions to researchers and market oriented organizations how to make capable to mobile device to get the content and store onto RSS 2.0 for collaboration. Finally, We have proposed and implemented some features of new application named "group" and recommended some valuable suggestions in Android operating system of mobile and explained the prototype based case study for UNVA to meet the course objective by using MCL. Our architectures meet the challenge of MCL. In future, we will focus to implement the client based architecture to meet the needs of MCL. The successful experiment can bring revolutionary changes in education. We will also integrate and implement the features of content server with cache server.

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