Master Thesis

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A New Generation of Interactive Learning Application on the iPhone

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Thema der Master Thesis
Eine neue Generation der interaktives Lernen-Anwendung auf dem iPhone

Stichworte
iPhone, jQuery, jQtouch, comment, m-Learning, e-Learning, link, annotation, Ajax, JSON, hyLOs, groupdiscussion

Zusammenfassung
Der avantgardistische Wandel in der Web- Technologie interpretiert ein neues Verständnis für das Internet. Es weist uns weg von unserem traditionellen Einwegdenken, dass der Benutzer nur eine Art Zuschauer im Internet ist. Dies sollen in der Regel die drei R's darstellen: *Receiving (Empfangen), Reading (Lesen), Researching (Recherchieren)*. In der Moderne wurde die Rolle des Benutzers reflektiert und neu disponiert. Es sollte nun vielmehr zwischen dem Benutzer und dem Web eine Konversation stattfinden. Die drei R's wechselten rasant zu den drei C's: *Creating (Erstellen), Contributing (Beitragen), Collaborating (Zusammenarbeit)*. Diese Innovation und die Kombination der drahtlosen Technologie und des Mobile- Computings bringt ein neues und positives Verständis bzw. eine Umwandlung im Bildungswesen mit sich. Gegenwärtig können tragbare Mobile-Geräte nicht nur zu Informationaufnahme benutzt werden, sondern auch für die Erstellung von Informationen verwendet werden. Die vorliegende Master-Arbeit liefert eine Anwendung, die eine interaktive Lern-Plattform auf dem iPhone und iPod-touch anbietet, damit die Benutzer ihre Ansichten und ihr Wissen mit anderen Benutzern austauschen können. Dies können sie entweder in der kooperativen Umgebung tun oder in dem unabhängigen Umfeld. Diese Anwendung motiviert den Nutzer und fördert den natürlichen Wunsch des Menschen, Wissen mit anderen Menschen, hier Nutzern, teilen zu wollen und von dem Wissen anderer Nutzern profitieren zu können. Der Wissensaustausch basiert auf der Grundlage von spezifischen Themeninhalten, die die Anwender von anderen Webseiten in die vorliegende Anwendung abrufen und darin arbeiten können, ohne die Original- Webseite zu verändern. Die vorliegende Anwendung implementiert die meisten "*bells and whistles*" des iPhones, um Benutzern ein erhöhtes Graphical User Interface (GUI) zu bieten, sowie um ein komplettes Gefühl der iPhone Anwendung zu haben. Dies stellt eine benutzerfreundliche Schnittstelle dar.

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Abstract

A revolutionary change in web technology has moved the Internet from our traditional one-way information *(" user was just audience ")* to two-way conversation *(" now user is also a participant ")*, means three customary R's: *Receiving, Reading, Researching* have been superseded by three C's: *Creating, Contributing, Collaborating* . This innovation and the combination of wireless technology and mobile computing is resulting in escalating transformations of the educational world. Now Mobile devices can be used not only for consuming information but can also be used for creating information as well.This master thesis provides an application which offers an interactive learning platform on the iPhone and iPod touch for users to share their views and educational informations with other users in both environments (independent or collaboratively). It encourages and facilitates the natural desire to share what user know and to learn from other peer on the learning contents retrieved from the web by virtue of this application. This application also implements most of the "*bells and whistles*" of the iPhone to give users an enhanced GUI to have a complete feel of the iPhone application which enriches a user friendly interface.

Contents

1 Introduction

1.1 Motivation

E-learning, provides a new dimension to learning process independence of both location and time. However, a personal computer is also one of the requirement to access e-learning, which bound users to a fixed place. Even though the use of notebooks could not attain the independence of both location and time requirements because liberty of location relies on the continuos changing technology. These kind of problem can be solved by using technological devices such as smart (mobile) phones. Some studies[1][2] had been done and results reveal that global mobile phones are being widely used and there is a progressive hike in the number of users with the time. There is a great disparity of usage of mobile phone between the past students (4 years back) and new generation students, where almost all students both at secondary schools and universities posses at least a mobile phone. Hence ,Mobile Learning (M-learning) could be a new tool for assist learning in future.

Learning is a cognitive process of acquiring skill or knowledge over an entire lifetime. Currently, the approach and the concept of learning are taking new dimensions- especially in the universities please refer to source [1] for more information. Even in the schools there is a total modernization of Learning practices[3]. Different academies are following different methods of teaching and learning techniques, for example Abilene Christian University (ACU[4]) endeavoring to investigate the capabilities of smart phone's to transfigure teaching and learning itself. In this the new technology can be exploited to offers possibilities for learners to join and interact with visual learning aids and simulated environments. Therefore, these emerging technologies can boost motivation levels of students, which is the vital facet of learning, deliver information at need and stir up solving problems and satisfy their attitude of exploration.

The use of mobile devices can diversify learning odds and resolve the problem of being tied to a particular location, for instance in American Ohio State medical school[5] where the medical students are accessing their learning documents by virtue of iPod and can analyze high-quality images of organ and body parts from different angles, which is better than scanning the whole books to spot pictures or surgery instructions. They can access this knowledge in the palms of their hands during travel to college without carrying books or laptops. Even students can access videos documenting the different surgical operations

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[1] a national survey done by CTIA in sep 2008 http://www.ctia.org/advocacy/research/index.cfm/AID/11483 and the results are shown: http://files.ctia.org/pdf/HI_TeenMobileStudy_ResearchReport.pdf

[2] done in 2009 see Mobile:Always connected: http://www.scribd.com/doc/16753035/Nielsen-Study-How-Teens-Use-Media-June-2009-Read-in-Full-Screen-Mode

[3] m-learning in schools http://www.smriders.net/Mobile_Learning/

[4] ACU Connected http://www.acu.edu/technology/mobilelearning/

[5] Ohio state medical school http://www.eschoolnews.com/2008/12/12/students-use-ipods-for-med-school-study/

and procedures to review their knowledge. In General Mobile learning is a collaboration of E-learning and mobile computing, where the composition of these two make learning applications accessible anywhere, anytime.

Some of the advantages of e-learning on mobile phones are:

E-learning was shackled either by location or continuos changing technology, but m-learning breaks this barrier and provide learning application at need. Wherever and whenever the learning is desired it can be easily achieved through the mobile phones using mobile learning engine (MLE[6]-Moodle).

M-learning can be exploited in different ways and is not restricted to any age group or gender means comprise people of all ages, from grandparents getting involved in family learning, adults looking to improve their employment prospects, to get health advice and guidance as shown in case study[7].

In educational environment, collaboration can be carried out as a superlative learning tool. One of the objective of m-learning applications is to encourage collaboration amongst learners. Collaboration between the learners can be synchronous or asynchronous. Asynchronous feature of a collaboration tool provides group solidarity where the group members working individually at different location and at different time to work out on a common topic. Forum is a classic example of asynchronous collaboration tool. Where synchronous collaboration tool allows users to work concurrently on the same task. M-learning equip users with an option of discussing problems online and get the information and feedback instantaneously.

Hence, e-learning on the smart (mobile) phones is the latest important feature of the mobile phones and in e-learning dimension.

1.2 Thesis Overview

This work is focused on providing a platform for the user to learn in an virtual interactive learning environment, where users can interact with other on some specific topics and give his feedback on other learners activities in both synchronous and asynchronous way. These actions can be done using tools provided by the application, which empower the system to classify and store the activities done by the users.

Application furnish an appropriate learning platform in that it is accessible from virtually anywhere. This interactive learning application, is also collaborative; sharing is almost instantaneous among everyone using the same content, which stir up the receipt of prompt feedback or suggestion. Collaboration done by means of grouping users, where user activities in collaborative environment are bound to a group and only obtainable for this specific

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[6]MLE-moodle http://mle.sourceforge.net/mlemoodle/index.php?lang=en

[7]Global heath http://mobileactive.org/files/MobilizingSocialChange_full.pdf

group. It also provides user the capability of doing private messaging with other learners within the group.

The system equip users with tools to create new contents and displaying them as an overlay on remotely retrieved content without affecting the original document.

The mobile web safari is used as a platform for the system to display the user interface, which is used by learners to interact with application. User Interface (UI) is highly interactive and have an intuitive "look and feel" which provides an easy navigation tool to explore the application.

Appropriate design pattern is contemplated to fabricate the application, outcome of this process is an efficient system provides potential of retrieving remote documents and manipulate its content (without affecting original documents on remote location) as required to share information with other learners, also offer group communication.

M-learning application on smart phones or other devices take away the burden of carrying the books and heavy laptops all the time and applications are filled with tailored learning contents. In addition, it is simple to utilize mobile learning for a more convincing and absorbing experience.

1.3   Organizing of report

The remainder of this work is organized as follows:

Chapter 2 discusses the new emerging m-learning technology.This chapter covers overview of the the m-learning system, and how it is different from the existing e-learning technologies? some pro's and con's are also considered. It also consist the characteristics and the information about standardization of m-learning.

Chapter 3 is an introduction to the iPhone and Ajax techniques.This chapter briefly cover the specification of the iPhone and discuss the finer points on the iPhone technology. Some information about the uniqueness of the iPhone are also recount in this section. Followed by introduction to asynchronous web technology (AJAX) and its characteristics.

Chapter 4 covers the information which has been analyzed to create precise depiction of all requirements that the product must assist or services that must be performed. Commencing with User Interface and then followed by general use case diagram, activity diagrams of retrieval and exploitation of extracted contents , group discussion essentials and messaging approach.

Chapter 5 describes system specification, which gives an expression of views about the system functionalities. It tells only outer functionality of the system and exclude implementation (covered in later chapter). Kick off with a brief discussion on the services of the system followed by the safety requirements. Later highlighting on how a user is provided the ability to interact with a application to enhanced his knowledge or share his information on some topic.

chapter 6 discuss the fundamental requirements analyzed by me for developing a m-learning web application on the iPhone. Choosing appropriate architecture for a application is key. So in the first section system architecture is discussed and shows how the different units of the system communicate with each other. Followed by the design of each units of the system architecture according to the requirements discussed in the chapter 4.

chapter 7 set out the implementation of this application. Implementation is done in a way that it comprises all the requirement described in chapter 4 and utilize the AJAX approach . Commencing with detailing on the tools used to make the implementation easy and resilient. Followed by the software architecture and concluded with explaining on how it is coded using HTML, CSS and Javascript for client side and PHP and MySql on server side, to make application executable on the iPhone.

chapter 8 used to show the functionalities detailed in design chapter are fully implemented to produce the desired results. The execution of the application and its usage is shown as screen shots captured from the iPhone simulator on MacBook. Concluded with describing the problems catch during the test phase.

chapter 9 conclude the work of this thesis. This chapter describes what is achieved, what can be done in the future for improvement , how could make the application more resilient and suggestion on how could it be implemented.

2   M-Learning - a New Subset of E-learning

2.1   M-learning

The field of learning by means of technology is huge one with fine distinctions among its diverse sectors. As already mention in the chapter 1 under section 1.1 laptops cannot provide users possibility of adapting the continuos changing technology, if user is mobile (moving). Nowadays educationalists are approaching a new technology called m-learning (mobile learning) which is a subset of e-learning and has the potential to make learning more extensively accessible than the provided e-learning environment.

M-learning can be accessible by the use of mobile devices like Personal Digital Computer (PDA), Laptops, smart-phones, iPod and so on. In his article "Mobile, Wireless, In-Your-Pocket Learning"(source [2]) , Quinn writes *" The vision is clear. mLearning is the intersection of mobile computing and elearning: accessible resources wherever you are, strong search capabilities, rich interaction, powerful support for effective learning, and performance-based assessment."*

As seen from the statement above, it explains some of the features about the m-learning in the above paragraph, where he mentioned about the continuos accessibility of the resources which signifies achieving the objectives of "anywhere, anytime and by anyone". Author also mentioned on rich interaction denoting highly interactive UI to easily navigate the application without any prior knowledge of the system. Performance based propose before designing application for m-learning, a requirement assessment must consider all the constraints of the mobile devices which are going to access the application in future and also design a context-based (content adaption) m-learning, which provides a mechanism to identify the device and configure the learning application according to it. Hence m-learning can affords flexibility and accessibility.

2.1.1   History

Arguably the first instance of m-learning was introduced by Alan Kay in 1968, with the proposal of Dynabook[8]. He introduced a small sized computer to run dynamic simulation with the forethought to replace books and making learning process more absorbing among children. Alan Kay mentioned Dynabook in his note source [3] as *" It may, however, provide us with a better* **book** *, one which is active (like the child) rather than passive. It may be something with the attention grabbing powers of TV, but controllable by the child rather than the networks."* From his document we can easily figure out that this gadget is aimed at giving children access to digital media. Adults could also use a Dynabook, but the basic notion was to lift the interest of learning among children in a play way method. This invention was big landmark in digital educational technology.

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[8]Dynabook http://en.wikipedia.org/wiki/Dynabook

In early 90's Palm Corporation launched first version of handheld PDA[9]and to boost the accessibility and usage of PDA's ,Palm corporation offers grants to universities and companies who create and test the use of Mobile Learning on the PalmOS platform.

In the early 2000 the MOBILearn[10] project started (first international group to discuss development of mobile learning) and these projects are funded by the European Commission .

The main aim of MOBIlearn was to provide an enhancement in accessing knowledge and giving global access to relevant learning objects for particular target groups by connecting to the internet through mobile devices and technologies, as stated by advanced interfaces and paradigm. Put into context, MOBIlearn provides a platform which is used for distribution of knowledge and learning by the the virtue of mobile environment.

The objectives of MOBILearn are[11]:

1. establishing new educational paradigm and strong instruction for teaching, learning and sound specifications of content design for mobile frameworks. Comprises organization for further research on an educative aspects of m-learning.

2. to devise,design and deploy a distinguish m-learning architecture that supports adaptation of the exploitation of new educational and business model for learning access and also collaboration in mobile context.

3. Influence international standards and specifications bodies for extensions and integrations for mobile learning requirements.

The main target of MOBIlearn was to achieve very productive mobile environment which upgrade the standards of acquiring knowledge by providing easier, contextual and global access to learning objects. Despite the fact that MOBIlearn system will specifically design for selected and popular areas like medical information, business administration and cultural information, these paradigm designed for specific sectors can easily be upgrade to establish in any other business or educational model in mobile context. The achievement by MOBIlearn in these sectors are mention below.

- Medical information:- provides a basic knowledge of medical support and can be accessible from anywhere, by anyone and at anytime, when needed.

- Business administration:-

  Now international MBA (master in Business Administration) academies are providing a platform via mobile networks to get through to their current range of blended learning

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[9]PDA http://en.wikipedia.org/wiki/Palm_(PDA)

[10]MOBILearn http://www.mobilearn.org/

[11]http://www.mobilearn.org/objectives/objectives.htm/objectives

offers, and also providing learners with individualize and customize subscription to the contents on mobile networks.

- Cultural information:- users can access the information about art ,cultural and historic values while exploring museum and galleries through their mobile devices.

For more information about the results achieved by MOBIlearn please refer to their site[12]

From E-learning to M-learning project led by Ericsson   This was a groundbreaking European Commission Leonardo da Vinci project (From E-learning to M-learning, 2001) which defined "mobile learning" as the provision of education and training on personal digital assistants (PDAs), smartphones and mobile phones, thus eliminating wired computers and laptops from the field.

The project solved the problems of presenting mobile learning on PDAs be developing a 1000 A4 page course for PDAs, and then using Microsoft Reader to create a comfortable study environment for the student, with mobile corrections of assignment and communication with the tutor and fellow students.

The project grappled with the problems of constructing a satisfactory learning environment on smartphones and mobile phones and made considerable progress in providing solutions for these issues.

"From E-learning to M-learning" Aims   The Mobile learning: the next generation of learning project addresses itself to four different target groups and potential users[13]:

1. The European telecommunications industry;

2. The European e-Learning industry;

3. Stakeholders and decision makers in European vocational and education training (VET);

4. Trainers, students and training organisations in Europe especially those interested in facilitating access to learning.

To read more about the project information please refer to the official site[14]

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[12]http://www.mobilearn.org/results/results.htm
[13]http://learning.ericsson.net/mlearning2/aims.shtml
[14]http://learning.ericsson.net/mlearning2/project_one/index.html

Mobile and Ambient Learning   Professor Sharples is director of The Educational Technology Research Group at the University of Birmingham which runs the HandLeR programme whose aim is to develop mobile technologies for learning. The focus of this programme is the study of hand held computing devices for use in primary schools.

Professor Sharples has made extensive contributions to the literature of mobile learning. Some of his contributions in the fields of mobile and ambient learning can be found on his official site[15]

The published paper by Prof Sharples is aimed at presenting a systematic review of the research on mobile learning in order to produce a pedagogically sound set of guidelines for the future deployment of mobile learning systems. Mobile learning is said to come from the confluence of three technological streams: ambient computing power, ambient communication and intelligent user interfaces. The guidelines are based on theories of learning, mobile learning projects and any existing guidelines that could be identified.

MoLeNET   In 2007 MoLeNET[16] (Mobile Learning Network) program is introduced in UK. The Mobile Learning Network (MoLeNET) is a unique collaborative approach to encouraging and supporting mobile learning in English post-14 education[17]. MoLeNET uses a broad definition of mobile learning i.e: The exploitation of ubiquitous handheld technologies, together with wireless or mobile phone networks, to facilitate, support, enhance and extend the reach of teaching and learning.

Participating institutions and the Learning and Skills Council (LSC) [18] share the cost of mobile learning projects, investing over £12 million during 2007-2009. The Learning and Skills Network (LSN)[19] provide a support programme including advice and support, learning materials, training and CPD, mentoring, provision and facilitation of systems for on-line peer-to-peer support, networking and resource sharing, research and evaluation.

LSN and the Learning and Skills Council (LSC) are championing the use of mobile technology in education by creating eight cutting-edge Academies[20] to support mobile learning throughout England.

Each MoLeNET Academy will become a centre of excellence for mobile learning staff development and will champion the use of mobile technologies such as phones, PDAs, handheld gaming devices and MP3 players in teaching, learning and assessing.

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[15]http://www.lsri.nottingham.ac.uk/Staff/Mike_Sharples.php

[16]MoLeNET http://www.molenet.org.uk/

[17]POST-14 education http://www.education.leeds.ac.uk/research/lifelong/post_14.php

[18](The Learning and Skills Council (LSC) website has now closed. It has been replaced by the websites of the LSC's successor organisations) Young PeopleÕs Learning Agency - www.ypla.gov.uk and Skills Funding Agency - www.skillsfundingagency.bis.gov.uk

[19]http://www.lsnlearning.org.uk/

[20]http://www.molenet.org.uk/academies/

MoLeNET Success and Impact   MoLeNET is certainly the UK's, and possibly the world's, largest and most diverse implementation of mobile learning.

115 colleges and 29 schools are, or have been, involved in MoLeNET. Approximately 10,000 learners were involved in 2007/08 and around 20,000 learners had involved by the end of the 2008/09 academic year together with more than 4,000 staff.

From history one can see how rapidly the m-learning concept has grown and incorporate in all the major sectors like education, business and cultural fields. Nowadays more and more educationalist and institutions from different sectors are researching to bring more advanced technology in this field. If we take an example of MoLeNET, we can figure out how briskly colleges and schools absorbed this environment in just one year. There are lots of information available on the internet which witness the success of m-learning and its adaption in every sector. We can say, now researchers broaden the vision of Alan Kay "Dynabook concept" by giving it new dimension call m-learning.

2.1.2 Standards

Seen from the past experiences, innovative changes do not become airborne without extensive adoption of common standards. Success of Internet, is a good example of an extensive adoption of the common standards of TCP/IP, HyperText transfer protocol (HTTP), and HyperText Markup Language (HTML). Common standards for metadata, learning objects, and learning architecture are mandatory for similar success of the knowledge economy.

Consulting the W3C recommendations in conjunction with the M-standards, will provide an understanding of the broader frame in which the m-standards fit [21].

These standards are drafted on W3C mobile web initiative and available at www.w3c.org. There are thousands of W3C standards covering all aspects of web development, and to list them all here would not be a good thought. Instead we are going to summarise the most commonly used standards, help to ensure that the developed web site is recognised and endorsed by W3C. Full details of all the W3C standards are available on their website [22].

Standards recommendation

- Usage of HTML & CSS - These technologies has to be used for creating web pages, Where X/HTML is used for the page structure and CSS provides the style of the page

- File size - Mobile implementations should avoid the use of large graphics, image buttons, or graphic rich form elements, and assume constrained resources for bandwidth,

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[21](W3C mobile web initiative http://www.w3c.org)
[22]http://www.w3.org/TR/2008/REC-mobile-bp-20080729/

screen size, color, and resolution. If graphic images are utilized, they should be compressed to decrease download times. Other file types such as Java Script, CSS and HTML should also be compressed as appropriate.

- Graphics - W3C has specified the use of PNG raster, SVG Vector and Canvas API formats for web graphics.

- Audio & Video - W3C approved formats for AV presentation include HTML, SVG and SMIL.

- Mobile Web - W3C's Mobile Web Best Practices promotes the use of "One Web" and provides developers with the tools to create content which is viewable on a variety of mobile devices.

- Web Addresses - Specialized website addresses for mobile sites should be avoided in preference to using standard Web addresses. Using one address the site will render on a computer browser or a mobile device.

- Testing - Test mobile website implementations in as many targeted devices and simulators as is practicable.

Best Practice Summary   The following best practice summary has been taken from the W3C Summary of Mobile Web Best Practices at http://www.w3.org/TR/mobile-bp/summary (please note not all the statements are included here only). Detailed about these Guidelines can be fetched from the main W3C document w.r.t their name defined in the square brackets.

1. [THEMATIC_CONSISTENCY] Ensure that content provided by accessing a URI yields a thematically coherent experience when accessed from different devices.

2. [CAPABILITIES] Exploit device capabilities to provide an enhanced user experience.

3. [TESTING] Carry out testing on actual devices as well as emulators.

4. [URIS] Keep the URIs of site entry points short.

5. [NAVBAR] Provide only minimal navigation at the top of the page.

6. [NAVIGATION] Provide consistent navigation mechanisms.

7. [LINK_TARGET_ID] Clearly identify the target of each link.

8. [IMAGE_MAPS] Do not use image maps unless you know the device supports them effectively.

9. [POP_UPS] Do not cause pop-ups or other windows to appear and do not change the current window without informing the user.

10. [AUTO_REFRESH] Do not create periodically auto-refreshing pages, unless you have informed the user and provided a means of stopping it.

11. [SUITABLE] Ensure that content is suitable for use in a mobile context.

12. [PAGE_SIZE_LIMIT] Ensure that the overall size of page is appropriate to the memory limitations of the device.

13. [SCROLLING] Limit scrolling to one direction, unless secondary scrolling cannot be avoided.

14. [LARGE_GRAPHICS] Do not use images that cannot be rendered by the device. Avoid large or high resolution images except where critical information would otherwise be lost.

15. [PAGE_TITLE] Provide a short but descriptive page title.

16. [NO_FRAMES] Do not use frames.

17. [STRUCTURE] Use features of the markup language to indicate logical document structure.

18. [TABLES_ALTERNATIVES] Where possible, use an alternative to tabular presentation.

19. [IMAGES_SPECIFY_SIZE] Specify the size of images in markup, if they have an intrinsic size.

20. [IMAGES_RESIZING] Resize images at the server, if they have an intrinsic size.

21. [STYLE_SHEETS_SIZE] Keep style sheets small.

22. [CONTENT_FORMAT_SUPPORT] Send content in a format that is known to be supported by the device.

23. [CHARACTER_ENCODING_SUPPORT] Ensure that content is encoded using a character encoding that is known to be supported by the device.

24. [ERROR_MESSAGES] Provide informative error messages and a means of navigating away from an error message back to useful information.

25. [CACHING] Provide caching information in HTTP responses.

26. [FONTS] Do not rely on support of font related styling.

27. [AVOID_FREE_TEXT] Avoid free text entry where possible.

28. [PROVIDE_DEFAULTS] Provide pre-selected default values where possible.

29. [DEFAULT_INPUT_MODE] Specify a default text entry mode, language and/or input format, if the device is known to support it.

The W3C Mobile Web Best Practices: Basic Guidelines (MWBP) mentioned above is the first deliverable of the working group (MWWG).

mobileOK   mobileOK [23] is the second deliverable from the W3C Mobile Web Best Practice group (MWWG). The goal is to create machine-readable labels and a mobileOK trustmark to indicate that the Mobile Web site adheres to the Best Practices recommendations. While optional, the mobileOK scheme is intended to help increase advocacy, education and adoption of a people-centered Mobile Web experience. The mobileOK scheme currently supports 2 levels, mobileOK Basic and mobileOK, corresponding to two different levels of testing required. mobileOK scheme is appropriate for low end devices. MobileOK is a useful tool to help site builders to check that their work well on low-end devices but developers should not limit themselves to targeting such limited devices.

These standards show that there is a way to provide interoperable m-learning system just only by configuring them according to the guideline describe by W3C. This application is only designed for iPhone and iPod touch and supported images for this project are PNG instead of JPEG, but there are no restrictions of using JPEG on the web safari. Most of the standards are implemented in this project like style-sheets are used to steer layout and presentation, Provide informative error messages and a means of navigating away from an error message back to useful information and usage of Extensible HyperText Markup Language (XHTML) and Ajax technologies etc..

Since we transit an e-learning service i.e. hyLOs on the m-learning system, so the standards and specification of e-learning are relevant here. Fortunately, the work to create such standards for learning objects and related standards has been going on around the world for the past few years. This includes the creation of accredited standards from the IEEE Learning Technology Standards Committee (LTSC) for Learning Object Metadata (LOM), Computer Managed Instruction, Course Sequencing, Learner Profiles and much more[4]. The base level standard for learning technology is the Learning Object (LO) which is described in the following section 2.1.3.

2.1.3   IEEE Learning Object Metadata- LOM

The learning objects are productive in that they are used as many times as they are needed even in other programs. Learning objects, according to IEEE LTSC, are defined as ([5]) *"ele-*

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[23]http://www.w3.org/TR/mobileOK/

*ments of a new type of computer-based instruction grounded in the object-oriented paradigm
of computer science. They allow instructional designers to build small (relative to the size of
an entire course) instructional components that can be reused a number of times in different
learning contexts. They are generally understood to be digital entities deliverable over the In-
ternet, meaning that any number of people can access and use them simultaneously"*. Each
Learning Object (LO) has the ability to communicate with a learning system that organises
and manages it. LOs have been designed not only to be reused, but also so that they can be
easily delivered via variety of media, particularly the Web, and this enables any number of
people to access and use them simultaneously. They provide a means for efficient develop-
ment of computer-based, interactive, multimedia instruction. The Idea of "Learning objects"
can also be described as follows (taken from the Wisconsin Online Resource Center, Robert
J. Beck)[24]:

- Self-contained - each learning object can be consumed independently an overview,
  and a summary.

- Reusable - a single learning object may potentially be used in multiple contexts for
  multiple purposes on multiple campuses.

- Can be aggregated - learning objects can be grouped into larger collections, allowing
  for their inclusion within a traditional course structure.

- Are tagged with metadata - every learning object has descriptive information allowing
  it to be easily found by a search, facilitating the use.

- Allow for learning that is
  - just enough - if you need only part of a course, you can use the learning objects you
  need.
  - just in time - learning objects are searchable, you can instantly find and take the
  content you need.
  - just for you - learning objects allow for easy customization of courses for a whole
  organization or even for each individual.

The first main standard to be developed upon the concept of LOs was the facility for
each LO to have information-in particular, semantic information-attached to it that describes
its contents. In the eLearning field, one of the main standards for meta data is IEEE LOM,
which describes meta data instance of a learning object as, the relevant characteristics of
learning object to which it applies and these characteristics are grouped under nine different
categories namely life, cycle, meta-metadata, educational, technical, rights, relation, annota-
tion, and classification. A brief explanation of these categories according to IEEE LOM v1.0
Base Schema source [6] is given below :

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[24]http://en.wikipedia.org/wiki/Learning_object

1. The General category, groups the general information that describes the learning object as a whole which includes the details about the identifier, title, language, structure of the learning object. A textual description of the learning object and language used within it for communicating to the intended user, coverage which tells the The time, culture, geography or region to which this learning object applies for instance smallest unordered - LangString ("en", "16th century France") ,keywords are also mentioned within this category.

2. The Lifecycle category describes the history and current state of the learning object and those entities that have affected this learning object during its evolution.It tells the version of the learning objects and mentions the current status . It also provides the information about the contributions of entities (people and organizations) to the state of this learning object, and also consists information and identity of entities, date of contribution and their role in it

3. The Meta-Metadata category describes about this metadata record itself (rather than the learning object that this record describes). It tells how the metadata record can be identified, who created it, how, when and with what references.

4. The Technical category describes the technical requirements and characteristics of the learning object which comprises the format, size, location, necessary technical capabilities (multiple requirements are also mentioned) for using this learning object, also tells the duration a continuous learning object takes when played at intended speed and some other attributes.

5. The educational category describes the key educational or pedagogical characteristics of the learning object which include.

   - Interactivity type, tells predominant mode of learning supported by this learning object which could be either "Active" learning (e.g., learning by doing),Expositive" learning (e.g., passive learning) or both.

   - Learning resource type, specific kind of learning object. The most dominant kind shall be first.(e.g. exercise, simulation questionnaire and so on.)

   - Interactive level, interactivity in this context learning object. Interactivity in this context refers to the degree to which the learner can influence the aspect or behavior of the learning object.

   - Semantic density, describe the semantic density of a learningobject may be estimated in terms of its size span, or –in the case of self-timed resource such as audio or video– duration.

- Intended end user role, specify principal user(s) for which this learningobject was designed, most dominant first (e.g. teacher, author, learner, manager)

- Context,specify the principal environment within which the learning and use of this learning object is intended to take place (e.g. school, higher school and so on.)

- Typical age range, describe age of the typical intended user. This data element shall refer to developmental age, if that would be different from chronological age.

- Difficulty, indicate how hard it is to work with or through this learning object for the typical intended target audience. (very easy, easy, medium and so on.)

- Typical learning time, specify approximate or typical time it takes to work with or through this learning object for the typical intended target audience

- Description,Comments on how this learning object is to be used.

- Language, the human language used by the typical intended user of this learning object

6. The Rights category describes Whether copyright or other restrictions apply and conditions of the use for the learning object. It specifies whether use of this learning object require payments.

7. The Relation category defines the relationship of the learning object with other learning objects. It consists the nature of the relationship between this learning object and the target learning object (based on Dublin Core relation[25] for e.g. ispartof , isbasedon and so on). It also contains information about the target learning object and identifies it by using identifier a global unique label. This identifier relates to different attributes like entry, description of target learning object and so on.

8. The Annotation category provides comments on the educational use of the learning object providing information on when and by whom the comments were created. It also consists information about the entities, when created and content of this annotation.

9. Classification describes where the learning object falls within a particular classification system.

This metadata information decorates the content and is helpful for automatic processing. It simplifies the discovery and exchange of eLOs over the Web.The default learning document hyLOs [7] (describe in section 2.2) used for this thesis are e-learning objects and implemented as stated by IEEE LOM standards mentioned above.

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[25]http://dublincore.org/documents/1997/12/19/relation-element/

Currently, E-learning standards are being developed by four main organizations: IEEE LTSC [26], AICC (Aviation Industry CBT (Computer-Based Training) Committee)[27], IMS (Instructional Management System)[28], and ADL (Advanced Distributed Learning)[29]. Based on accepted technology standards, including Extensible Markup Language (XML) and JavaScript, SCORM (Sharable Content Object Reference Model) source[8] is fast becoming the de-facto E-learning technology standard widely embraced and supported today by world-leading corporations, universities, system providers, and content vendors.

The SCORM standard is focused on enabling the plug-and-play interoperability, accessibility, and reusability of Web-based learning content source[9]. Adopting the work of different eLearning standards, SCORM describes this technical framework with a set of guidelines, specifications and standards. The SCORM is actually a set of related documents. There are three main SCORM documents: Content Aggregation Model, Run-Time Environment, and Sequencing and Navigation. These are briefly described as follow:

- SCORM describes a mechanism for assembling Sharable Content Objects (SCORM defined Learning Objects) using a Content Aggregation Model (CAM). It includes the metadata information to enable search and discovery of the content, content packaging component representing the learning experience that will be presented to the user and the packaging of the components for exchange between system to system. And it also provides the rules for sequencing the components.

- SCORM provides Run-Time Environment specifications to control how Learning Management Systems (LMS) to deliver, display the SCORM conformant content to the learners and track the content through a common SCORM RTE v.1.1.1 (SCORM 2004 4th Ed.) Data Model.

- Sequencing and navigation are the rules that an LMS must follow in order to present a specific learning experience. The content developer is responsible for defining the rules to which an LMS must adhere.It is described by SCORM for delivering the learning content dynamically based on the learner needs [10]

But in case of mobile devices there is another form of SCORM standards are recommended called Pocket SCORM [11] [12]

2.2   Hypermedia eLearning Object System (hyLOs)

The hypermedia learning Object system is Content Management System provides e-learning contents. A Content Management System (CMS)[13] designed for higher education purpose

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[26]IEEE LTSC http://www.ieeeltsc.org:8080/Plone

[27]AICC www.aicc.org

[28]IMS http://www.imsglobal.org/

[29]ADL http://www.adlnet.gov/

is often called as a Learning Content Management System (LCMS) [14] . It facilitates author-ing, maintenance, production and publishing of the Learning content. LCMSs which main-tain learning content on the Web and publish the content in the form of Web pages for the users, are known as eLearning Content Management Systems or online educational content management systems e.g. LON-CAPA[30] , an educational Learning Content Management System.

hyLOs is build upon more general Media Information repository (MIR) [15] and the MIR adaptive context linking environment (MIRaCLE) [16], its linking environment. Grounded on a powerful media object model, MIR was designed as an open system supporting XML[31] and JNDI[32] standards to provide easy modeling and implementation of complex multimedia applications. All the eLearning Objects reside within MIR and are composed of rich media components decorated with IEEE LOM metadata, interconnected by qualified relations.

The modeling of hyLOs content is as follows: All the metadata and particular content enti-ties such as titles, authors, keywords or information about courses etc., are singled out. The separation of entities in this way provides content normalization and allows easy updating of content for authors and automatic generation of navigational overviews. The remaining content units are organized in paragraph objects which are sub structured according to its XML schema. By means of external structuring the paragraph units are collected to pages and hence, content entities of paragraph dimensions are easily re-used by applying multiple structural references in a static or dynamic way. The hyLOs implements these concepts for practical implementation by using XML technologies and provides the consistent separation of content, structure, logic and design elements [17].

hyLOs offers different content access views to the learners, with each view presenting the content of the underlying eLearning Objects according to a specific learning pattern or publication context. A linear path hierarchy composed by an instructional designer using appropriate eLOs from a knowledge repository is one perspective. Another view which is formed by content authors is a primary content structure with root eLO giving most common description and leaves with detailed information. Besides the above mentioned views, a con-structivist view is also provided to the learner, which is based on educational semantic nets formed by the eLOs depending on their qualified relations. In this view, a set of constructivist tools are provided to the learners for supporting self-exploration of the eLOs. In contrast to the above accessing methods that are more focused on eLO structures, it is more concen-trated on the eLO-centred view. Upon accessing any eLO in this view, user will be supplied with a list of related eLOs. User can access the eLOs of interest and navigate along any learning paths by switching between the three perspectives at any point [18].

hyLOs constructs educational semantic nets based on the named inter-object relations

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[30]http://www.loncapa.org/

[31]http://www.w3.org/XML/

[32]http://java.sun.com/products/jndi/

and present them to the learners for navigation and knowledge exploration, as well as to the author and instructional designer. The relations of IEEE LOM metadata, taken from Dublin Core library metadata set is limited to administrative approach, hence the relations are redefined in a semantic meaning. Additionally four pair-wise inverse, qualified relations, which are missing in LOM standards are chosen to provide educational semantics. Adding a new eLO into a repository requires manual identiÞcation and updating of appropriate relations with large amount of already existing entries. To avoid this manual netting, relation semantics are encoded in OWL ontology[33] and processed by an inference engine, which is provided with a set of inference rules accounting for logical dependencies between related properties. Consequently any newly inserted object or relation will lead automatically to a chain of subsequent link placements within the hyLOs system, thereby forming a dense educational semantic mesh [19]. More information on hyLOs feature, concept and idea, solution and publication on hyLOs is available [34]

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[33]OWL ontology http://www.w3.org/TR/owl-ref/

[34]Prof. Dr. Thomas C. Schmidt introduction to hyLOs http://inet.cpt.haw-hamburg.de/projects/hyLOs/

3 iPhone And Asynchronous Web Technique

3.1 iPhone, Introduction of A Smarter Phone

An iPod-like mobile phone called iPhone is launched by Apple Co. on June 29, 2007, and was only available at Apple's or AT&T's store. The people were hyped up because they wanted to be among the first to posses a phone which was a phenomenon at time of its launch. It was the distinctive technological innovation in mobile industry and also has a superlative user design. It signified a new look at the entire mobile phone trade and the feasibility of improved technology that wouldn't be afraid to obliterate in bold new directions.

270,000 iPhones were sold in just two days and its hype produce a result in selling a million units in just a month and half. After this successful launch of the iPhone on 11,July, 2008 Apple released the new third generation (3G) iPhone and this time million units were sold in a record time of just three days. Question arises, what are the innovative technologies that made iPhone a sensation?

A few distinctive specification are briefly described in the following section.

3.1.1 iPhone specification

Core specification The iPhone is undoubtedly a new generation of ergonomic mobile phone technology than a simple cell phone or a smartphone like the ones that have allowed an insubstantial amount of internet access and other functionality over the last several years.

The two predominant version of the iPhone were 2007 and 2008 3G release. In July 19, 2009 Apple introduces a new version called 3GS iPhone. The previous two version have almost same configuration, each is a 133.1-or 136.1-gram computing device. 2007 version have 412 MHz and 3G, 3GS having 620 MHz ARM CPU that has been under-clocked [35] to improve battery performance and reduce heat. PowerVR MBX-Lite Graphic Processing Unit is used to support accelerometer[36] mechanism on all the versions of the iPhone, which provides the 2d/3d animation and lot more through this mechanism on the iPhone. The main use of accelerometer on iPhone is to detect the rotation of the device and this mechanism is also used in this project for providing application in a landscape mode because of screen size limitation, discuss under other specifications.

Original and 3G version have 128 MB of dynamic RAM (DRAM), and from 4 to 16 GB of Flash memory whereas the 3GS version has 256 MB of DRAM and 16 to 32 GB of flash memory. The primary differences between the two devices center on the global positioning system (GPS) and networking.

The operating system running on the iPhone is known as iOS, it is based on the modification of the same Mac OS X. Xcode, the same development environment that's used to write

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[35]under clock http://en.wikipedia.org/wiki/Underclocking

[36]http://en.wikipedia.org/wiki/Accelerometer

code for the Macintosh, is the nucleus of native programming for the iPhone. Combination of these two elements evince a mature development and runtime environment of the sort that hasn't been seen on most other cell phones (with the possible exception of Windows Mobile) and that upcoming smarterphone technologies won't be able to challenge for years.

These specification plays a significant role in programming a web application. Application does most of its processing on the client side, so the power of processor is a vital tool in this approach.

Input and output specification   Input and output rendition of a device plays a major role on its peerless triumph. The iPhone program developers also have to give thought to the input and output capabilities of the iPhone feature cutting-edge functionality.

The iPhone has a multi-touch capable screen and input is regulated by one or more fingers taped or swiped on the screen. The stylus or other tools like joy stick are of no worth for iPhone. It is equipped with touch sensors to senses the user's multi-finger gestures on the touch screen e.g *pinch gesture* means it squeeze the application window size to minimum.

The iPhone's display is focus on a 3.5" 480x320-pixel screen.In contrast to other cell phones (having 320x240 pixels to 320x320 pixels) iPhone has larger screen but astonishingly has small comprehensive size. It's because screen covers almost all the device. The iPhone can be rotated in all direction i.e vertically and horizontally to view either in portrait mode which is 480px tall or in landscape mode which is 480px wide. The input and output of the iPhone is briefly described in the later section 3.1.2.

In contrast to portrait mode landscape mode is used to display web application in this project because it provides wider content-view pane, discuss more on this in later chapters.

Network specification   The iPhone offers two methods of network connectivity: local area and wide area network

Technically, iPhone connect to internet via local-area network in preference to other methods. If it detects any Wi-Fi network in range then automatically ask to join the network by requesting for password when required.It provides support for the 802.11g[37] protocol to join any Wi-Fi network (provided one has the credentials for it). By virtue of Wi-Fi connection, users can access the internet at high speed of up to 54 megabits per second (Mbit/s).Once successfully connected to a Wi-Fi , passwords and other connection attributes are stored on the iPhone, which are used at later stage to automatically link up to a known network whenever it is available.

For wide area wireless connectivity the original iPhone exploit the EDGE[38] network. This network support speed upto 220 kbit/s and can analogize this speed support to old-style modems, which were used to access internet in back 90's, this is fairly fast, but contrast

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[37]http://en.wikipedia.org/wiki/IEEE_802.11g-2003

[38]EDGE http://en.wikipedia.org/wiki/Enhanced_Data_Rates_for_GSM_Evolution

to broadband connectivity it's not that good.The strongest asset with regard to link up to network of the iPhone is that it will automatically choose the strongest network, mechanized switching from EDGE to Wi-Fi when it is available.

The 3G iPhone supports the third-generation standards(International Mobile Telecommunications-2000 (IMT-2000)), which are well expanded in Europe but still not extensively implemented in the United States. Standards for Network speed of 3G's are not fixed, with stationary transfer speeds estimated as low as 384 kbit/s or as high as several Mbit/s (approx. 7Mbit/s). Furthermore,cellular networks doesn't support downloading files size over 10 MB. Hence, this kind of big files, examples email attachments or podcasts, can only be downloaded via Wi-Fi ,where there is no file size limit exists. A 3G connection is generally quicker than EDGE but couldn't be equated to a local-area network which is far more faster than it. Moreover, the mechanism of automatically switching to and from the network also used when there is an inadequate 3G coverage,which let iPhone to link back to EDGE connectivity.

These network specifications will place the first curbs on the iPhone web development. Therefore, on analyzing requirements for developing a web application, these specifications must be considered carefully for the application performance issue. If application is only used by virtue of Wi-Fi than no necessity of bearing in mind how latency could effect the application performance. But when considering for wider use than network specification should be taken into account. As some percentage of users can access application via wide-area wireless network, which has some constraints on transfer speeds, therefore the design of web application should be considered to overwhelm these limitations. On account of this constraint, web pages should be smaller and use clean style-sheets and images should be attentively designed with allowed sizes on devices; Ajax technology should be used to download data on the iPhone or other technologies that allow for sporadic access to small bits of data.

This project is presumed also to be accessed by wide-area wireless network, hence implementing AJAX technology to keep up with the network connectivity requirements. Introduction to AJAX and its specification are briefly covered in section 3.2.

Browser specification The iPhone has a mobile version of Safari, designed by using the same "WebKit" executing engine as used to implement desktop-grade browser with access to DOM, CSS, and Javascript, but with a revised feature to fit the mobile browser essentials because of restraint of size. Despite that, two frequently used third-party software packages aren't accessible indigenously to this device are Java and Flash.

There are lots of small changes has been done to optimize web browser on the iPhone. In particular, instead of displaying the safari's standard tabbed browser, individual tabs are popped out as separate windows that a user can switch between as if they are individual

page. Moreover, there is a limitation of numbers of individual windows on iPhone refer table 2.

" Chrome " is also one of the unique feature's of the iPhone's web Safari, which is its depiction of toolbars. A basic iPhone's safari interface, consisting of a top toolbar, a content area, and a bottom toolbar shown in fig.1 . At the top toolbar of each page current URL is shown with reload button and a adjacent box for Google search. At the bottom toolbar, there are options like bookmark, switch to other tab, and back and forth history navigation. It's a fixed feature on iPhone web pages. This iPhone chrome can easily be noticed than to the desktop browser because of the it's small screen size.

There are ways to partially hide the top toolbar to get more content area usage for screening web applications on the iPhone and this method is used in this project , explained in chapter 7.

This section highlighted only some specification of the iPhone, to cover more on the the iPhone detailing please refer to source [20].

3.1.2 Understanding the iPhone input and output

iPhone viewport   Displaying web pages is a very interesting aspect of the iPhone's small size screen. Web pages are rendered at a resolution of 980 pixel and display it on to the 480x320 pixel screen. Which means user look at a screen of 480x320 where the page could be more highly rendered than device own width. Therefore, on accessing web pages of greater resolution than what iPhone itself supports, the device will default to its own supported resolution by scaling them down by a factor of–2:1 or 3:1–exclusively relying on the position of the iPhone.

This 480 or 320 pixels wide scaled view is known as "viewport" on the iPhone. The size of the viewport can be designed according to the application requirements and done by forcing a page to scale either more or less by assigning a viewport attribute with a specific number where this number represents the size to be scaled in percentage, e.g. 1.0 means 100% ,when it's translated onto the iPhone. However, default web page has 980 pixel size without an explicit viewport command.

The viewport also plays an important part during the implementation of the application for this thesis work, as the application retrieving contents from the external web sources, where some sources are not designed for iPhone devices. Hence, scaling down their sizes are of major importance for this project also.

output and orientation   Already briefly discussed above about one of a significant feature i.e output orientation of the iPhone. As mentioned iPhone has an ability to show application in two different orientation either portrait or landscape mode –480x320 or 320x480 pixels respectively.

Each orientation has its own importance on accessing application for different purposes. When comes to show results as listing then portrait orientation is perfect for screening them, example for listing emails in inbox section, while the landscape orientation is usually easier to read for example browsing CNN site for latest news .

The two orientation also effect the the size of visible area for web contents cause for it is "chrome", which is also shown differently with different orientation. In contrast to SDK programmed web application this chrome is consistent when viewing web application in Safari , and thus we can show an example of orientation's impact on chrome, as shown in figure 1.
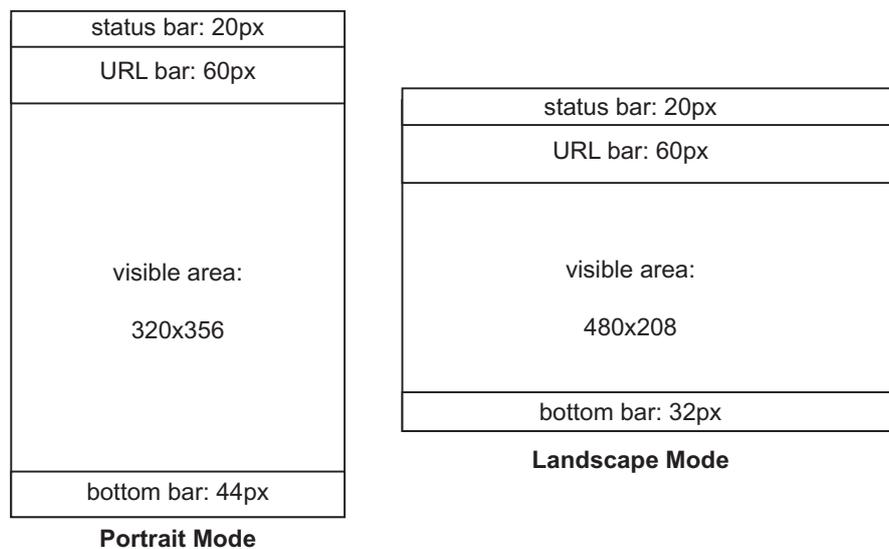
Figure 1: The iPhone supports two significantly different views, landscape and portrait source [20].

Mode	Chrome % with URL	Chrome %without URL
Portrait	26%	13%
Landscape	35%	16%

Table 1: Different amounts of screen real estate available , depending on the iPhone's orientation source [20].

From the figure 1 one can easily figure out that there is a drastic change of 12 pixel in the size of bottom bar, interesting fact is that in spite of this change in the bottom bar the chrome covers the maximum percentage of the iPhone screen in landscape mode see table 1. The reason for it is because the width is increase but height is now decreases.

Change in the size of bottom bar shows its impact when considering application without the URL bar. Url bar is scrolled off the top of the screen when users scrolled down the pages. The percentage of space occupied by the web chrome on the screen is shown in table 1.

Despite this constraints of landscape mode, performance of many applications will be outstanding in that layout, as the built-in YouTube application shows. Discussion on the most significant unique element of the iPhone, "output" shows that on implementing applications on the iPhone this element has a major impact on their success for instance if you access Gmail on the iPhone, then you might notice it is easily accessible on portrait mode but when it comes to landscape the pop down menus are no more accessible in this mode. The iPhone input may be even more innovative and are briefly described in next part.

input and iPhone tapping   As mentioned before, the iPhone has a touch screen with built-in sensor to sense single/multi-finger touch. Users exploit applications or other utilities on the iphone simply by touching around with their finger.

We assume that all are agreed with the statement that *"finger"* and *"mouse"* cannot be treated as same, on level with their functionalities. Generally a finger is going to be larger and less accurate than a more traditional pointing device. Moreover the finger cannot produces the events like "onrightClick" or "onCopy", which effects the functionality of the application and force developer to write a heavy code to get around these problems. In addition, the iPhone doesn't consists scroll bars on screen, users scroll the pages just by taping anywhere on the screen and whisk it in the desired direction either up-down or left-right to scroll .

One more engrossing feature of the iPhone is its multi-touch capable screen. This enables users to interact with the application differently and this kind of multi-touch functionality is not possible with the mouse. There are lots of different functions are there which tells the contrast and capabilities between finger and mouse on the computing devices. The "pinch" zooming of the iPhone is one such example. To zoom into a page, you tap two fingers on a page and then push them apart, while to zoom in you similarly push them together.

3.1.3   iPhone web standards

Before the launch of the iPhone, different web standards were being evolved for smartphones.The domain name mobi is a top-level domain (TLD) in the Domain Name System (DNS) of the Internet. Its name is derived from mobile, indicating its use by mobile devices for accessing Internet resources via the Mobile Web, built on the Wireless Application Protocol (WAP) and the Wireless Markup Language (WML) standard for cut-down, mobile HTML a good example to this is Smart Learner[39] m-learning site on this domain.

After going through different aspects of the iPhone, I am of the opinion that the mobile standards and even .mobi domain are for the most part trivial, when implementing to the

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[39]m-learnig site on .mobi domain http://www.smartlearner.mobi/

iPhone.The strong justification for this is that the device (iPhone) is furnished with the most characteristics of desktop-class browser and has enormously improved input, output and network capabilities and on the other hand it doesn't support WML (refer table 3). As more smarter-phones appear, be of the opinion that the mobile standards being worked on now will quickly become entirely superannuated.

But this doesn't reflect, that the iPhone has no boundaries or restriction. It does not and cannot exploit the standard of experiencing a display, a keyboard, and a mouse of a desktop or Laptop.

In my judgement standards describe by W3C for developing a m-learning environment must be followed by developers, so that as more smarter-phones appear, have freedom to access the web pages on any kind of mobile browser without the restriction of compatibility like the three leading desktop browsers IE, Mozilla and Safari.

3.1.4 iPhone limitation and constraints

Mobile devices have lots of limitation and constraint when come to web page displaying. The iPhone is a mobile device, it is obviously going to have some resource constraints that one need to be fully aware of beforehand, developing for iPhone and iPod. Table 2 lists the resource limitations and technical constraints.

What's more, certain technologies (listed in Table 3) are unsupported, and one need to steer clear of them when developing for iPhone and iPod touch.

for more information on the unsupported iPhone OS technology please refer to Apple'S developer site [40]

3.2 Asynchronous Web Technique, Ajax

Fabricate a productive client interface is a bit more complex than designing a web page. A rich user interface model is one that can support a variety of input methods that can respond intuitively and in timely fashion. Ajax is the tool to achieve a truly rich browser based application. Ajax terminology is injected in the web application world by Jesse James Garrett, President and a founder of Adaptive Path,in an online article *"Ajax: A New Approach to Web Application"*[41]. Literally saying, the term is an acronym -AJAX for "Asynchronous Javascript And XML".

Ajax technology were around before Garrett' article, it is related to the term XMLHTTPRequest objects (XHR), which was introduced by Microsoft in their Internet Explorer (IE 5) as an Active-X control. Later on, it is adopted by Mozilla and Safari. It is important to note that XHR is not a W3C standard, the little-used object and the basic concept are even covered by

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[40]Unsupported iPhone OS Technologies: http://developer.apple.com/safari/library/documentation/appleapplications/reference/s
[41]http://www.adaptivepath.com/ideas/essays/archives/000385.php

Resources	Limitation
Downloaded text resource (HTML, CSS, JavaScript files)	10MB
JPEG images	128MB (all JPEG images over 2MB are subsampled-decoding the image to 16x fewer pixels)
PNG, GIF, and TIFF images	8MB (in other words, width*height*4<8MB)
Animated GIFs	Less than 2MB ensures that frame rate is maintained (over 2MB, only first frame is displayed)
Nonstreamed media files	10MB
PDF, Word, Excel documents	30MB and up (very slow)
JavaScript stack and object allocation	10MB
JavaScript execution limit	5 seconds for each top-level entry point (catch is called after 5 seconds in a try/catch block)
Open pages in Mobile Safari	8 pages

Table 2: Resource Constraints source [20]

Area	Technologies not supported
Web technologies	Flash media, Java applets and plug-in installation
Mobile technologies	WML
File access	Local file system access
Security	Diffie-Hellman protocol, DSA keys, self-signed certificates, and custom x.509 certificates
JavaScript events	Several mouse-related events
JavaScript commands	showModalDialog(), print()
Bookmark icons	ICO files
HTML	Input type="file", tool tips
CSS	Hover styles, position:fixed

Table 3: Technologies Not Supported by iPhone and iPod touch source [20]

W3C standards: the DOM level 3 Load and save specification [42]. Currently Firefox, Safari,

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[42]Document Object Model (DOM) Level 3 Load and Save Specification is present as draft on http://www.w3.org/TR/2002/WD-DOM-Level-3-LS-20020725/

Opera, Konquerer and Internet Explorer all implement the behavior of XHR object homogeneously. Ajax provides a strong base for forming interactive web applications with XML or JSON-based web services by using javascript in the browser to process the web server responses.

3.2.1 Characteristics of Ajax application

Applications, Not Just Web Sites Now a days people talk more about web applications than websites. As all application on computing devices needs a platform and an operating system. Hence, for web applications browser act as a platform which distinguish its compatibility with the program and web as an operating system which provide services queried by the application. Now people are using web not only for just reading mails or doing some e-commerce, but also for social activities, sharing ideas and interest, learning, entertainment in form of videos of their choices and lot more. So web is now no more one-way information provider but become a two-way conversation platform which offers a high interactive application to its users.

Smooth, continuous interaction As we all experience with traditional web-sites, where all the activities are a synchronous process mean user do a query for some information and wait for seconds to get the result, during this course of time user can't do any other activities on the application, which were time consuming and tiresome. Even on the failure of an attempt to registering for a site cause page refresh involve in filling the whole form again. Its annoyingly slow and inconsistence sequence. Introduction to Ajax brings a new innovative model and provides a rigid approach to these problems.

Ajax engine made up of different components and predominantly powered by the javascript resides in the browser and can handle the display directly, which support steering of small changes in the display and let you without sending a whole new page from the server in order to alter an element or reorder the page.

Javascript handles the server interaction, means you can send a request to server by virtue of Javascript and download new information without page refresh. One of the advantage of Ajax is that it can provide form submission where all the field authentication process can be done simultaneously during the form filling process, just by user action such as "onKeyUp" events handled by Javascript, so interaction is lot richer than just filling in a form and hitting Submit.

All these supplements provided by Ajax engine drive application interaction smooth and more continuous.

Live The browser-server interaction provides a liberty of yielding a new information at any instant of time, therefore, it's possible to constantly tally the server for new information. Thus,

an Ajax App can be designed to continually update the pages for the latest news, call for detail on current active users, or to pass messages to desired users. The content is "Live".

Supportive   Ajax application can be proactive in identifying and supporting whatever work is undertaken by the user's on the application. Some small action like selecting a word can also cause a server call, where the server's knowledge and processing power can be employed to provide useful content sub second later. A good example is when user is filling some information and he left a field blank before, so an error message appears informing user to give input to the required field.

Therefore, Ajax can guide users to avoid doing unintentional mistakes and provides support for accessing application without any prior knowledge to the system.

Visual effects   Ajax Apps are not different to conventional web apps, but can provide some more shape for garnishing the web pages with animation. Not the kind of flashy animation, but animation that gets across a message about what's happening and what the user can do next. For example, user remove a section from the page and Ajax provides potential to pull off the section by showing a shrink process of that section and then disappear.

3.2.2   The Ajax Technologies

Ajax isn't a single technology. Rather,a group of web technologies that complement one another. These technologies and the responsibility that each has to perform are mentioned below.

Javascript   Ajax Apps take place in the browser. Javascript is the client-side programming language that coordinates browser activity. Ajax engines are based on Javascript and XML-HTTPRequest, which is used to call standard web services. Javascript plays a major role in implementing Ajax in the web application. In other word we can say javascript is the heart of the Ajax engine.

CSS   Cascaded Style Sheet (CSS) is a style sheet language to improve the display of web pages and contribute in splitting the document structure from its style attributes. Commonly used for enriching display of web pages designed with HTML or XHTML. The great thing about the CSS is that it can easily be altered with Javascript. With just one line of code, one can make an object disappear, move it around the page, or alter its appearance. Hence, it provides a dynamic view to the web pages.

Document Object Model (DOM) The Document Object Model (DOM) presents the structure of web pages as a set of programmable objects that can be manipulated with the JavaScript. Scripting the DOM allows an Ajax application to modify the user interface on fly, effectively redrawing parts of the page.

XMLHttpRequest object The (misnamed) XMLHttpRequest object allows web programmers to retrieve data from the web server as a background activity. The data format is typically XML, but it works well with any text-based data. While XMLHttpRequest is the most flexible general-pupose tool for this job, there are other ways of retrieving data from the server, too like iFrame and XmlDocument.

To get the detailed information on all these techniques please refer to source [21]

3.2.3 Structure of a Ajax Server call

In contrast to standard request/response approach found in classic web client, an Ajax application does things bit differently shown in figure 2 source [22].
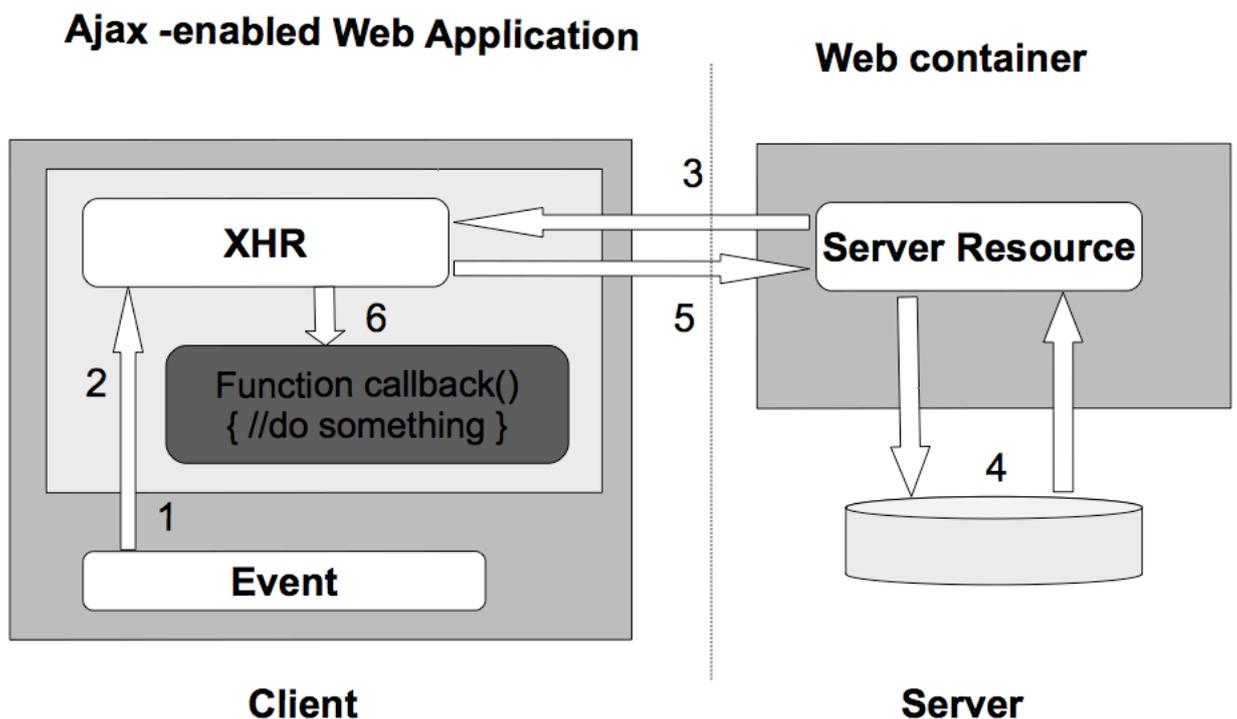

Figure 2: Standard Ajax interaction source [22].

1. An client side event triggers an Ajax event. Any number of things can trigger this, from

a simple *onchange* event to some specific user action.

2. An instance of the XMLHTTPRequest object is created. Using the open() method, the call is set up–the URL is set along with the desired HTTP method, typically GET or Post. The request is actually triggered via a call to send() method. As show below.

xmlHTTP = new XMLHTTPRequest();

//a call is setup with type GET along with the url for the remote page.

xmlHTTP.open("GET", url);

//invoke the handler depend on the readyState property of XHR object.

xmlHTTP.onreadystatechange = callback;

xmlHTTP.send(null);

3.A request is made to the server. This might be a call to a JSP, a PHP script, or any other server-side technology.

4.The server can do anything one can think of, including accessing a data store or even another system.

5.The request is returned to the browser. The Content-Type is set to text/xml–the XHR object can process results only the text/html type. In more complex instances, the response might be quite involved and include Javascript, DOM manipulation, or other related technologies.

6.In the above figure 2, it configures the XHR object to call the function *callback ()* when the processing returns. This function checks the *readyState* property on the XHR object and then looks at the status code returned from the server. Provided everything is as excepted, the *callback ()* function does something interesting on the client.

3.2.4 Why and Why not Ajax ?

Why Ajax ?   As the web continues to grow, the demand for more expressive and engaging interfaces will continue to increase. Potential of Ajax provides highly interactive, desktop-like web application that can be deployed through any modern browser without the need for special plug-ins.

Some of the Ajax potentials are emphasize below:-

Intuitive and natural user interaction

- Events could be anything means no clicking required, keystroke can also invoke a server call

- gesture of mouse can also trigger a event

Partial screen update replaces the "click, wait and refresh" user interaction model

- only the targeted elements are updated asynchronously on the web pages (no interruption to user operation)

- The rest DOM structure remains displayed without intervention (no loss of operational context)

Data-driven (as opposed to page-driven)

- UI is handled in the client while the server provides only data

Asynchronous communication replaces "synchronous request/response model."

- A user can continue to use the application while the client program requests information from the server in the background

- Separation of displaying from data fetching

Why not Ajax ?

- Bookmarking of tabs cannot give precise information on returning back to them. So users can't save the information they want.

- Search engines don't see the data that isn't in the first tab, because they can't access the Ajax.

- Ajax is not accessible, so the content in the other tabs would not be visible to anyone using a screen reader, or even older browsers that don't have good JavaScript support.

- If one of the tabs had a lot of information, it could take a long time to load on a slow connection. And because Ajax do its job at the background and doesn't indicate anything is happening and this cause a perception of a broken page by the user.

"Who is using Ajax ?"

Real Life classic examples of Ajax

AJAX Chat Applications   :- Chat application is a typical sample of an excellent AJAX experience . Chat requires asynchronous communication and can not afford "full page re-fresh", which is one of the reasons that many chat/IM applications showed up since Ajax became popular.

- Gabbly : Gabbly[43] is a new application provide a ability of introducing a chat box in any web page. As a user, you see the target website as the way it is except for an additional chat window. From the chat window, you can have real-time chat with other users.

  Gabbly uses Iframe which is an alternative to Ajax to display the target website. Then in a separate Iframe, it displays the chat window. The chat window uses XmlHttpRequest object to communicate chat messages with the server asynchronously.

  Gabbly is a great web 2.0 application that can add significant value to various web-sites. For example, it would enable all CNN.com readers to be able to interact with each other in real-time just by typing gabbly.com in front of desired URL e.g. " Link : http://gabbly.com/cnn.com" . Such real-time interaction between random web visitors turns the web from a static, passive media into an interactive social environment.

- Meebo: Popular IM Systems

  Meebo[44] is a web-based Instant Messaging service that connects with all major IM systems such as AOL, Yahoo and MSN. A user can login using his/her account from any of these IM systems, retrieve the buddy list and chat with them.

  By the end of 2005, Meebo averages about 250,000 logins per day. On December 7, twelve weeks after launch, Meebo had 236,000 successful logins, 6,534,948 mes-sages sent and approximately 13,069,896 total messages carried.

AJAX Office Applications   :-
AJAX Office applications are another category of applications that are not possible before without Ajax ("Ajax" being defined in a broad sense as DHTML and JavaScript). There are word processors, spreadsheet, and slide show and so on.
Ajax Word Processors: **Writerly**,**AjaxWord**

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[43]http://home.gabbly.com/#
[44]Meebo http://www.meebo.com/

- Writerly : Writerly [45] is an Ajax-based word processor, now acquired by Google. Writerly enables online document editing from a browser, share documents instantly with authorized users, collaborate with people and store document securely online.

- goOffice: goOffice [46] is an open source word processor mimicking the Microsoft WORD lookandfeel, written using JavaScript and DHTML. It features server-side file storage that is dedicated to each user. Users would use a familiar file dialog to open or save files. When creating a new file, a user will be prompted to select from a list of templates from a modal dialog.

  Different from all other web-based word processors, goOffice features a multiple windows interface (MDI) that enables a user to work on multiple documents at the same time.

  These all are classic examples of Ajax but nowadays most of the sites are implementing ajax to make their web as a Rich Internet Application (RIA) to attract more traffic towards their site. Like Google, Yahoo CNN and lots of big name in this cyber world are using Ajax to simple down the complexity of their application.

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[45]Writerly http://www.upstartle.com
[46]goOffice https://goffice.com/

4 Requirement Analysis

The purpose of Requirements Analysis is to obtain an extensive and comprehensive perception of the product of users' demand and to divide it into distinct requirements.The quality of the final product is highly dependent on the effectiveness of the requirements analysis.

The objective of this project is to design m-learning web application for the iPhone/iPod touch users, which equip with distinctly interactive and user friendly interface and provides users the prospective of a virtual learning environment.

This chapter covers the information which has been analyzed to create an accurate representation of all requirements that the product must accommodate or services that must be performed. Commencing with general impression of the requirement of the application, succeeded by User Interface and then followed by general use case, activity diagrams of retrieval and exploitation of extracted contents , group discussion essentials and messaging approach.

4.1 Essentials of the Application

A virtual learning platform has to be built so that learners/users can enhanced their knowledge anytime and anywhere. The application provides users to extract the learning contents from the internet and serves it to the users as a learning material, moreover, equipping users with potential tools for sharing knowledge on a specific topic with other learners in both environment (independent or collaboratively). Users must be provided with a tool to work either in groups or independently according to their needs. Through this application learners can exploit the learning contents by means of annotation or linking a word or phrase as an explanation or remark, which helps them to share their knowledge with other learners. Therefore, other peers can use this information either to increase their understanding for that term or they can intensify the description of that word by adding a plausible explanation as feedback to that annotation or link using the tools provided by this application.

As already mention that through the application learners must be provided with an option to work in groups. Where learners can easily discuss on some specific topics as preparation for their final examinations or helping other students to get additional information on a particular topic. One more useful option must be provided to the users that is displaying active user lists and their related information. All these requirement essentials are discussed in detail later in this chapter.

Moreover, in contrast to personal computers or laptop, hand held devices have many limitation when accessing the application. There are many constraints to cop with in the course of transition of e-learning to m-learning. Some of them are discussed in the following section 4.2.

4.2 E-learning to M-learning

The e-Learning or m-Learning need to maintain the learning contents so that they can be accessible per request over the Internet. But there are some challenges when switching from e-learning to m-learning environment . The m-learning process is divided into three distinct groups which are developer, educator and learner. Where, developer is responsible for designing and developing the m-learning system. Educator is responsible for providing learning content using mobile learning systems and learner is a user who uses the learning content with the aid of mobile devices and m-learning system.

All these groups deal with the same challenges which are depicted as technological, development and pedagogical challenges. These challenges are mentioned below (source[23]).

4.2.1 Technological challenges

Mobile devices (example taken as iPhone and iPod touch) have lots of constraints like the small screen size, touch screen keyboard make the input difficult; processing power and absence of supported media types like Java and Flash. All these restraints can easily be perceived by the users when trying to transfer services provided for e-learning platform into services in an m-learninig platform, where devices rendered some of the information to overcome them for example screen size limitation but some of them are not possible like proper formatting of the documents.

Developers Technological challenge is that the developer must be profoundly acquainted with the potential ability and restraint of specific mobile devices and also about the latest mobile communication technologies to design and develop an effective m-learning system.

Educators Educators also need to know well about the mobile devices so that they can develop learning content while taking potential of devices into consideration. It can be achieved only when they work together with the developer. They must collect information about the requirements and limitations of the mobile system from the developer. Moreover educator must be well aware of the modern communication devices used by their students in order to be able to respond to their expectations.

Learners Learner is a user who accesses this system via its devices. From the technological point of view the main challenge they experience is the difference in characteristics and capability of mobile devices contrast to personal computers they use for e-learning. The learner must be aware of the limitation and the capabilities of their devices when displaying learning content. So that they can easily adapt to m-learning environment. Consequently,

they can exploit device capabilities up-to maximum.

4.2.2 Development challenges

Developers Development of m-learning system is the most laborious and full of challenges for the developers. Developer must defined the type of mobile system either on-line/off-line learning or both. Where on-line system means always require internet connection to access the m-learning system and off-line means download once and access anytime without linking to internet. For on-line learning the system can be based on existing e-learning system. In view of the different abilities of the mobile devices to display data, it is essential to chose an appropriate method for adaptation of educational content - server-side, proxy-based, or client-side. Developer also has to confront the design challenge for an effective users' interaction and displaying learning content on the mobile devices in contrast to computers. The developers also must consider the information transfer speeds at different wireless technologies. The other challenge is the problem of the loss connection when a wireless communications are used and to overcome this problem they must use appropriate technologies for exploiting information on the learner's device. The off-line system on mobile devices for m-learning are quite different than e-learning because for e-learning CDs or DVDs can be used which can provides the large video and audio files whereas which is not possible on the mobile devices because of the size of the device's memory.

One more challenge is the ability to test mobile learning system. As opposed to e-learning, where the development and testing can be done simultaneously on the Personal Computer (PC), testing of a mobile learning is usually undertaken first on the emulator and then on the real devices.

Educators The main challenge for the educators is the development of learning content. On one side, they must be acquainted with the authoring tools for mobile learning systems. On another, the system imposes restrictions in what learning units they can use, how to edit these units, how to order them, what communications to use for collaborative learning, etc. That's why it is very important educators and developers to solve main conflicts at the design and development stages. If the educators do not have the mobile devices, they have to learn to work with mobile device emulators when testing the educational materials developed.

Learners Learner in this task is the main user and his challenge is to exploit the system from all perspective to make it successful and a well organised working system. In other words in this context learner is a tester.

4.2.3   Pedagogical challenges

Developers   The main educational challenge to the developers of mobile learning systems is that most of them are computer specialists and have little knowledge about different pedagogical approaches. That is why it is very important that developers and educators work together during the development process of mobile learning systems, so that the system supports a desired pedagogical approach. Another challenge to the developers arise from the technological limitations of the mobile devices. To decrease the content loading time, systems must have the ability to store the users' profiles and predict the learning path of each individual learner.

Educators   Educators are also not untouched from this challenge. They must find a useful way to combine the new communication and mobile technologies with different pedagogical approaches. M-learning is learner oriented learning system, where the whole focus is concentrated on learners needs and their device capabilities.

Learners   A pedagogical challenge to the students is that they need to be self-organized in order to achieve the required goals. In the mobile devices, however, the ability to self-learn is interlaced with the good communication opportunities for collaborative learning source[24].

As seen from all the challenges discussed above, we can say the importance of all group members are the same despite of their roles. Successful m-learning system can only be designed if the cross communication between them is taken into consideration. A successful solution for m-learning can be the mobile learning system which can integrate and makes mutual complementation of traditional learning, e-learning and m-learning possible. Such system will ensure the optimal access of the learners to educational content.

4.3   Graphical User Interface

The user interface look is important to the initial acceptance of any application. The most important component of a Graphical User Interface application is the user. If the application is too difficult to navigate or understand, the users will reject it and cause maintenance to be a nightmare. Application's GUI must be designed to effectively measure up to today's demanding web-application modal needs. This project is considered for the iPhone, so its more important for having a well designed and easily understandable user interface because of space restraints (screen size of 480x320-pixel in landscape mode which is far smaller than the computer or laptop screen). To describe a righteous GUI, is the user understanding of how the application parts work together. The application offers power to users by giving them the possibility to make their tasks quickly and users are permitted to modify parameters directly.

As it is a web application executed on mobile web browsers, so browser is the platform, used for screening the application. In other words, GUI is the heart of the application, so the following requirements has been taken on to achieve a furnished interface.

- It should be ergonomic. Users can easily understand and operate the whole interface with comfort

- It provides cause-effect relationship between the event trigger and the upshot of the application. This instantaneous response plays a major role in convincing user to explore the application.

- It should consists elements and metaphors which are having an intuitive 'look and feel'. This provides an easy navigation within the application. For examples icons used for the buttons.

- It should provides users whenever needed an informative information about the status of the application(any error message) or the current process (in case of group discussion/messaging).

- It must provide all the system tools to all the users with an option to hide them when not needed.

4.4   System Tools

4.4.1   General Use Case

The system is provided with sets of tools to let user perform a required task. The task could be anything content exploitation, viewing or editing contents, messaging or group discussion. Fig 3 shows the general use case diagram with the system tools. Where the actors are either service users or provider, plays a client or server role respectively. The user is one of the actor which uses services of the system by accessing the tools provided to it. System tools are defined as follows :-

- Content altering tools : used to view and alter the exploited contents

- User active tool : used to get the active users information

- Group managing tools : used to create group or join an active group

- Message tool : it resides in the group discussion part for messaging within the group users

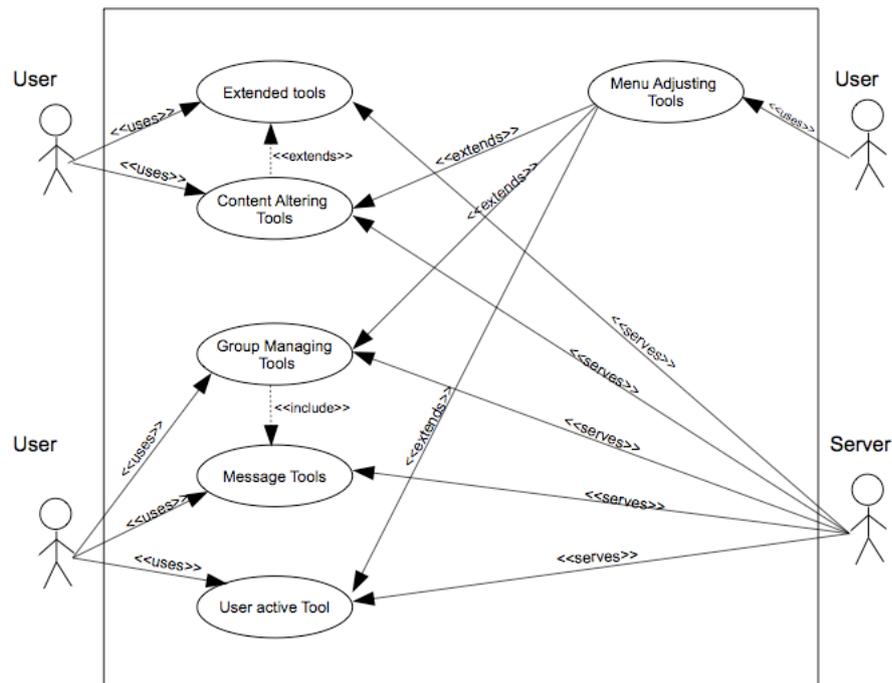- Menu adjusting tool : used to hide or show the main menu

Figure 3: User case diagram for system.

The tools shown in fig 3 are carried out different tasks on the provided learning documents. Tools hold sub-tools for further manipulation or alteration of added information as annotation or link to the learning objects. A good example for this is "content altering tools", which is used to exhibit the words or phrases been utilized to tie suggestive information to them within the documents. When a notation or link is tied to a word or phrase, it can be shown at later stage to all users who are accessing the service of link or annotation tools. Words or phrases exploited by tying additional information (explanation or notes) to them are shown as hyperlinked (blue colored underlined) within the documents. Anytime users can manipulate the exploited contents by updating or feeding them with more information or comments by means of extended tools provided under the content altering tools. It is described extensively in chapter 6 and 7.

The small screen size constraint plays a major role while sketching the tools placement. The iPhone has a screen size of 480x320-pixel in landscape mode which is far smaller than the computer or laptop screen. Hence, layout of the application has to be outlined in a way that it make use of maximum out of the available screen. To thrash out this screen size constraint, "menu adjusting tool" is implemented. This tool provides user a freedom of utilizing the whole screen for documentation and at need provides a menu as a small overlay

(tool's metaphor) on bottom of the documentation layout. In other words it is used for hiding or showing (toggle) the menu toolbar.

This application also provide the possibility of working together i.e. share and exchange ideas with other users. It is accomplished by "group managing tools" which offer options of creating, joining or leaving a group. It also include one more feature or tool call "message tool" , which equipped users with a choice of mailing any information to any user within a group.

As it is learning platform with the information sharing characteristics. Active users information is the essence of system to inform users for the available group partners for live conversations. Hence, "active user tool" is used for the exhibition of the information of currently available users.

On the other hand server is also an actor in fig. 3 plays a major role for providing services, requested by other actors (users). Sending out requests to a server delivers only the data, not content. All tools interact with the server for the provision of requested services. Server serves the requested information back to the user if it is successfully executed on server otherwise an expressive message send to client for informing the cause of failure.

4.4.2   Activity diagram of user's content exploitation

As the web-app is meant for the iPhone, where some constraints doesn't let the developer to use the whole functionalities of javascript such as *onSelect* , *onCopy* and so on. So developer has to make a way out to steer clear of these constraints by means of approaching new methods. The user can interact with the contents directly by selecting either of the options annotation or link, which shows the exploited contents within the documents by marking them as hyperlinks (blue colored underlined) words or phrases.

Fig 4 shows one of the technique (figure shows only for annotation) to add annotate or link to a word or phrase giving explanation or exposition what to do. On taping twice on required tool, an editor is stretched out for user to edit the explanation for specified word. Before sending to store the information for subsequent sharing with other users, the chosen word is checked if it existed within the current document or not. The objective behind this process is to avoid data dangling. Because *onSelect* or *onCopy* events are not implementable on the iPhone so user has to fill the word manually and during this process probability of doing mistake of filing the right word is there, but copy a word or phrase is allowed on the iPhone and is the finest way to evade data dangling snag. If the edited information to a word is effectively submitted to the server and successfully stored in the database for future retrieval, then success must be shared out as an expressive message with the user. In case of storage failure in database, must also be shared with the user and cause of exception should be catch and after explication it into an expressive message, display to the client.

In figure 5 shows the other method to work with the exploited contents, where user can
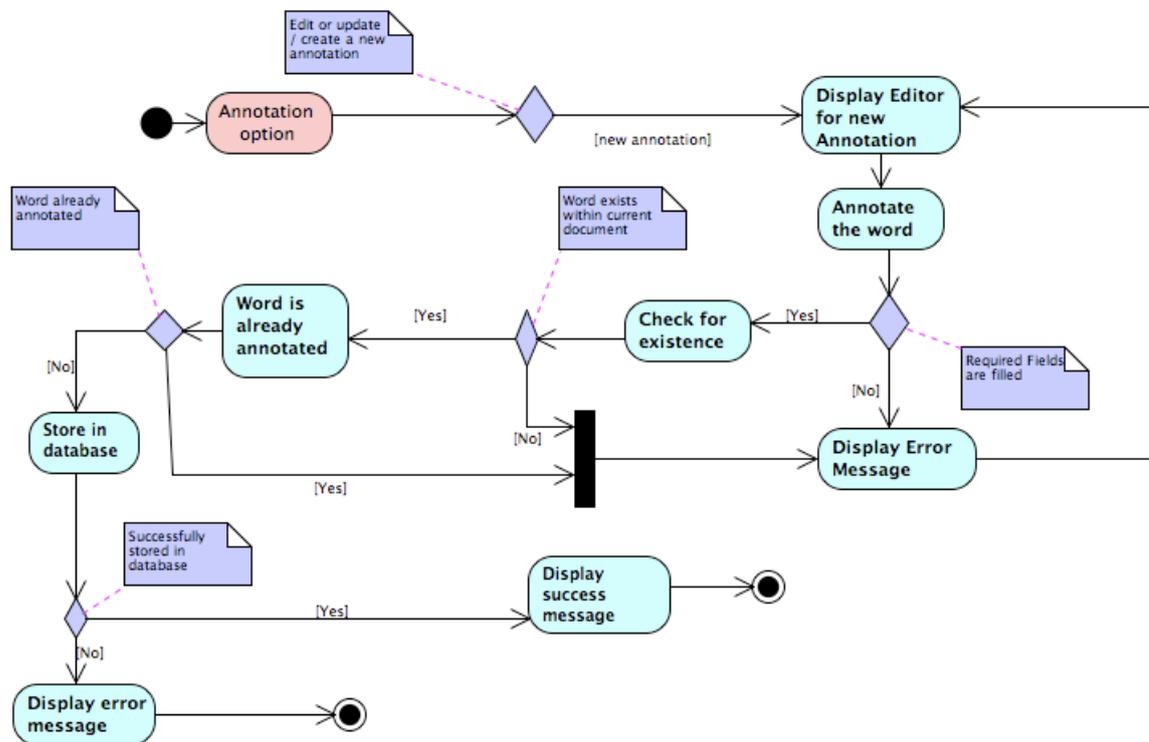
Figure 4: Activity diagram of exploiting contents for sharing information.

select to view the edited information (in the form of annotations or links tied) to a word.

When an annotation option is tapped, all the annotated contents are shown as blue colored underlined word within the document. Now the user can deal with the content simply by touching the edited word, it pop up a box showing original annotation to the selected word and four different options as given to interact with the contents:-

1.Read option, which shows all feedbacks by other users for selected word and give a supplement option of updating the original annotation provided user own this annotation means he created the first annotation on this word.

2.Write option, which allow user to compose his explanation to the selected word or comment on the existed annotation as a feedback to it.

3.Help option, which is used to assist users how to work with the metaphors used as tools.

4.Close option, which recede the box from the screen so that the continuation of work is not interrupted by it.

When an link option is tapped, it checks if annotation is currently selected, then first step is to remove all the annotation from words and then all the linked contents are shown as blue

colored underlined words. Now the whole process of dealing contents are just same as set out for annotation option above.
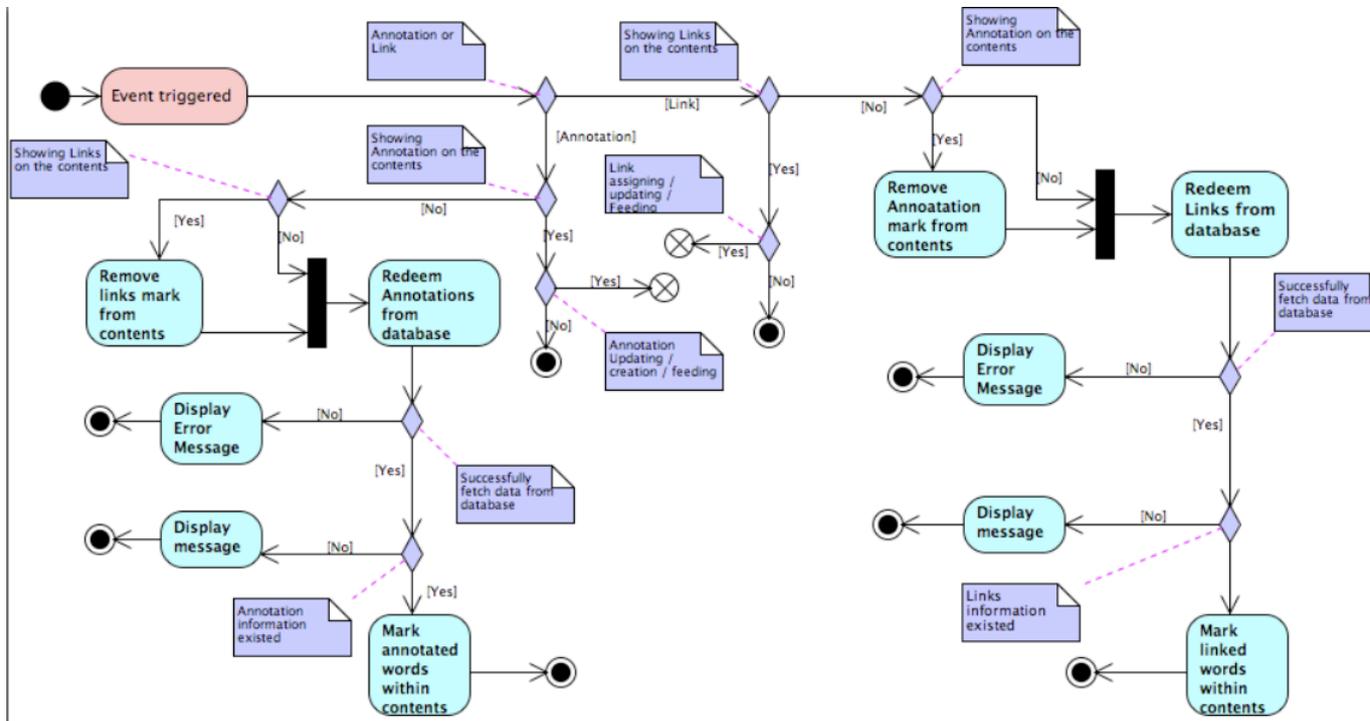

Figure 5: Activity diagram of screening the exploited contents.

4.5   Group Discussion essentials and Messaging

Group discussion is a effective tool for learning, as it is the right tool for learners to express themselves, as it encourages learners to write more thoughtfully and develop critical thinking skills. The different thoughts and theories can bring together to make the learning environment more productive and accomplished is the group discussion aspiration.Therefore it plays a vital role in this application. The group essential for this platform are simple and well designed.

The group can be commenced by any user by giving a label to it and an initial thought as comment, so that later on when other users want to join this group, by means of initial thought they have a notion of what group initiator really signifies to share under this group topic. Any user can join the active group or activate an inactive existing group. Users can see all active groups from the active group selection list and join it only by sharing their information. Once user join a group, he has an access to the additional tool for messaging.

The activities done by users under an collaborative environment is visible to the members of that group only. The options (annotation or linking) for interacting with the contents are exactly same as for non-group members or independent users described in figures 4 and 5. All the edited information and discussion messages or comments on the document contents within the group are couple with the group work so that on later stage it is available to the group members only. One additional tool, which is available for private messaging amongst the group members is also a vital feature. It provide some privacy within the group for interacting with each other without sharing to all group members.

4.6   Back-End technologies

The activities done by learners like editing information on learning contents or their profiles should be saved for future use and this can be done by using Database at the back-end of the system. Hence, MySql database is used to achieve this demand. It is briefly described in the section 4.6.1. Now to extract/update the data from/within the database a server side scripting is used. There are different server side technologies available and for this project we used PHP which is briefly described in section 4.6.2.

4.6.1   MySQL database

MySQL database is most popular open source relational database because of its fast performance, high reliability and ease of use, that is to say, makes it a best contender as datastore for this application. Other databases like Microsoft SQL server and Oracle are also available. Where Microsoft SQL server runs only on Windows platforms, which excludes it use in application where there is a need to run on linux. As our server is running on linux system thats why it is omitted from the choice. Oracle is very expensive and complicated in use, so its selection is also ruled out.

Where MySQL implements the following features, which some other RDBMS systems may not[47]:

- Multiple storage engines, allowing one to choose the one that is most effective for each table in the application (in MySQL 5.0, storage engines must be compiled in; in MySQL 5.1, storage engines can be dynamically loaded at run time):

   - Native storage engines (MyISAM, Falcon, Merge, Memory (heap), Federated, Archive, CSV, Blackhole, Cluster, Berkeley DB, EXAMPLE, and Maria).

   - Partner-developed storage engines (InnoDB, solidDB, NitroEDB, Infobright (formerly Brighthouse), Kickfire, XtraDB, IBM DB2).

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[47] http://en.wikipedia.org/wiki/MySQL

- Community-developed storage engines (memcache engine, httpd, PBXT, Revision Engine) Custom storage engines.

- Commit grouping, gathering multiple transactions from multiple connections together to increase the number of commits per second

For more features and information about MySQL please refer to its official site[48].

4.6.2 PHP: Hypertext Preprocessor

As we are using LAMP[49] the open source web platform to develop this application, where Linux is the "L", Apache is the "A", PHP is the "P", and MySQL is the "M" in the acronym LAMP.

PHP is free software released under the PHP License. It is general-purpose scripting language that was originally designed to create dynamic web contents and it is still best suited for that task. PHP runs on all major operating systems, from Unix variants including Linux, FreeBSD, and Solaris to such diverse platform like Windows and MAC OS X. It can be used with all leading web servers, including Apache, Microsoft IIS, and the iPlanet servers.

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[48]http://www.mysql.com/about/
[49]http://en.wikipedia.org/wiki/LAMP_(software_bundle)

5   System Specification

This chapter describes system specification, which gives a complete statement of what the system is to do, without making any commitment as to how the system is to do it. It constrains only the externally observable behavior and omits implementation bias. Kick off with a brief discussion on the services of the system followed by the safety requirements. Later highlighting on how a user is provided the ability to interact with a application to enhanced his knowledge or share his information on some topic. Conclude with the explanation on the data model of the database used to store the manipulated information which is used for later screening on the contents for other users.

The system provides different services to the users to interact with the applications as mentioned below :-

- authentication service

- content manipulation

- Displaying and Editing Exploited Contents

- feedback service

- group discussion & messaging service

To protect the application from unauthorized users an authentication services is required. At the moment, is the only option provided as safety feature for the application. As noted in the chapter 3 figure 1 the screen to display the application is not that much big, hence all the components of GUI are not shown at initial load. Some of the UI part is generated dynamically and serve to the user at need. At first load user get only the contents and a menu-bar as shown in the figure 6.

Figure 6: Shows the main window with UI.

5.1   Authentication Service

All users have to sign-in first to get access to the application. Through this process system can easily authenticate authorized users and protect the application from unauthorized accessibility. Because application provides feedback on the contents so if any unauthorized user access application without any restriction, can post irrelevant information on the contents, might some of us already experienced on the blogs where there are no login required. The second good reason doing this to keep system itself updated regarding the work done by users and relate to them and display all jobs relate to any user at need. The users can login simply by giving their credential in the required fields of login form and system verifies it and on success takes you to the default learning documents (for this application is hyLOs page).

If user hasn't had the credential to access the application than s/he can register themselves. Registration process is simple and intuitive, where fields are labeled to make user comprehend what is required as input in the field, like username, first name, last name password, email, faculty, and gender. Some of the fields have specific pattern for example email must have @ and should end with a dot along with domain (.com). If pattern is not followed then application warn the user to correct the entry. Password also to be filled twice for the sake of users and application compare them with each other and if they don't match then an expressive message shown to the user for their typo error.

Username is used throughout the application to relate users to the jobs done by them, if any. Therefore username must be unique for every user within the application. During the registration process application take care of the essential of username uniqueness and on encounter a breech of this requirement, must inform user with an appropriate message justifying the cause for rejection of the request. The information which is collected during the registration process is later used as profile for the user to show their information on request by other members.

5.2   Content Manipulation

As mentioned in chapter 4 users can interact with content and manipulate them according to their needs. Manipulation of contents can be done in two ways by adding links to the word or annotate them by tying an explanation or expression to them. This can be done by using a editor shown in figure 7 which is reuse for almost all invoked write action events.

User edits first field of the editor (figure 7) with the word to be linked and on the second field the URL which should be tied to a word specified in the first field. Now the problem is that this editor is not triggered by event like "onCopy" or "onrightclick" on selecting a word, so it is error prone to commit mistakes by mean of giving a word in the first field, which doesn't exists in the document, so to cover this problem application should take preservative measure before submitting it to the repository. On noticing the nonexistence of the given word in the
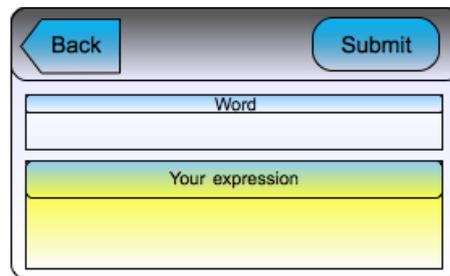
Figure 7: Shows the editor use for updating or editing information.

document leads to prompt a message to user to consider and rectify the problem. System provides the same specification for the annotating a word and the whole process can be equate to link process detailed above .

5.3 Displaying and Editing Exploited Contents

Now screening of the utilized contents within the documents can be done directly from the menu-bar available for the user on the main window. Users have two different options here to display the shared information on current document. Annotation or link display are the options and can be access directly by tapping on relevant image used as button on the menu-bar. On selecting display annotation, application extract all the annotated word and highlight them within the document on the content pane. System offers a functionality which prevents collision between displaying link and annotation simultaneously. It always check at request, if the other option is exhibiting within the document then clear of the other displayed information from the content and then highlight the requested option.
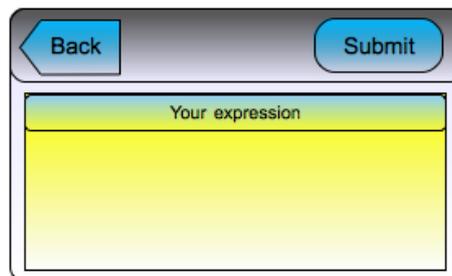
Figure 8: Shows the editor use for annotation or link.

After displaying the annotated words on the main screen user can call other services to edit the utilized contents just by touching the desired one. On touch it provides user a new editor shown in figure 9 with different options like read, write, help and close to remove editor from the screen. This editor shows word as title and the initial annotation to it. Where write
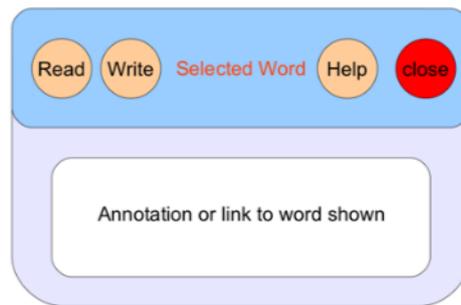
Figure 9: Shows the editor use for editing or reading feedbacks for annotation or link.

option service let user to give feedback on the annotation of the chosen word. Feedback is submitted by virtue of the same write editor as shown in figure 8, where the field is used to insert the feedback given by the user for the specified word. The read option show all feedbacks for the chosen word and also provide an extra option shown in figure 10 of updating the initial annotation. This option is restricted for the users who doesn't own the word. Possessing a word by user means initialization of tying a annotation or link to a word by that user. The help option gives user an overview of the metaphors used for different actions. Last option close simply remove option Editor from the main window.

System provides the same specification to link a word and the whole process can be analogized to annotation process detailed above .
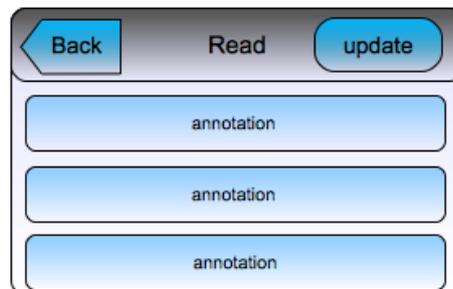
Figure 10: Shows the editor use for updating annotation or link.

5.4   Group Discussion and Messaging

Group discussion service give user more freedom to access learning objects other than hyLOs. They can work on remotely extracted learning documents and do the content manipulation as described in section 5.2. The user is provided with services to create, join, leave and activate a group. Selecting group discussion from the main menu-bar takes user to a option window shown in figure
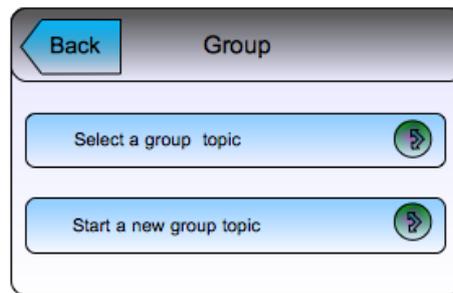
Figure 11: Shows the window use for selecting group options.

11 opt for the available choices either select a group or start a new group. Selecting a group option offer three different choices shown in figure 11 first selection of resources, which tells the sources available for the topics and second reveals the topic created for the selected resource and third option indicate the active groups for the chosen resource. Picking up the start option leads to editor where user insert the topic name, resource (used for abbreviation of the URL), URL of the learning document and a notation for other user to have an impression on the topic shown in the figure 12. After selecting a group topic system display window to the user depends on the status of that user in the group. If user is a member than window shown in figure 13 is displayed to the user otherwise window shown in the figure 14.
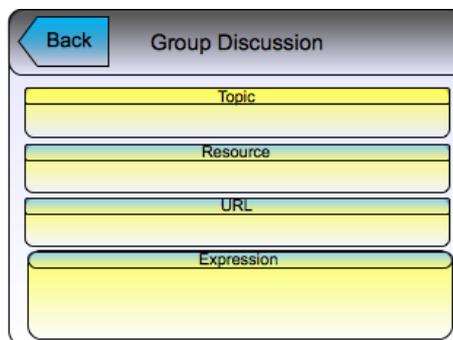

Figure 12: Display editor use to start a new group discussion topic.

Messaging is done by using message icon shown in figure 13. On tapping this option system provide user a window with all the message shown and also compose messages for a specific group member.
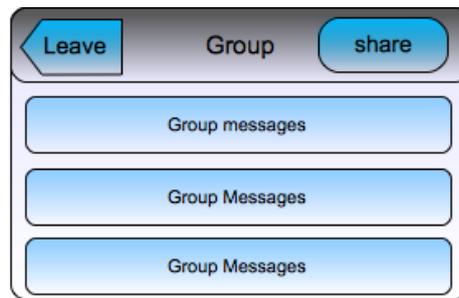
Figure 13: Shows the editor used for sharing information within a group.

Figure 14: Shows the editor used to join a group.

5.5   Database

The manipulated information should be stored somewhere for displaying them at need. So for storing these information database is used on back-end. Figure 15 gives a outlook of the database model. The tables are briefly described as following:-

active_table The user_table composes all the user information which is inserted at the time of registration by the user. The fields of user_tables are as follows :-

- id_user: its important field which is referred by other tables to relate all job done to a specific user

- username: this field holds the username and unique

- firstname: it holds the first name of the user

- lastname: it holdss the last name of the user

- password: it holds the password of the user for authentication

- email_id: it holds email-id of the user

- faculty: it holds the department it belongs to

- date: it tells the date user's register itself

- gender: tells the sex of the user

active_user_table The active_user_table consists information of all active users and fields are described as below:-

- id_user: holds the user_id which is a foreign key. Used to referred the reference table which is in this case user_table

- session_id: holds the session id generated by the system

- longitude: it holds the longitude of the user location

- latitude: it holds the longitude of the user location

- grp_id: it holds the grp_id of the group topic

The grp_id used here to refer to the group discussion table, which is used to show the active group by setting this field to the group id if user is accessing any group otherwise set to 3 reason for this is that it is an auto-increment variable and could not be set to 0, therefore 3 is used because 1 and 2 are already occupied hence, this number is set as default value for this entry.

annotation_table When an annotation is done on a word this table stores the word and the URL where the word exists within the document and also having a reference field which refer to the group discussion table.

- id_annotation holds the id for a annotation which is a uniquely identified record in a table and assign as primary key

- SITE_DESC: holds the URL of a annotated word

- titel_word: holds the word which is annotated

- grp_id: holds the grp id of a group to which it belongs, if any

- date: holds the creation date of annotation

This table only updated when initialization of new annotation for a word is done and assign a unique id to this new annotation which is referred by the edit_annotation_table to relate the annotations belongs to a word.

edit_annotation_table This table holds the annotations and feedback to a word created by users and referred the annotation_table to set a relation between annotation and the word.

- id_annotation: its a foreign key which refers to the reference table annotation_table

- user_id: its a foreign key which refers to the reference table user_table

- annotation: holds annotation to the reference word from the annotation_table

- date: holds the date of creation of annotation for a word

- edit_id: holds the id for the store annotation and is defined as unique

The edit_id is used to when user update the annotation for a word and the initial annotation is used to find its first occurrence.

link_table When an link is tie to a word this table stores the word and the URL where the word exists within the document and also having a reference field which refer to the group discussion table.

- id_link: holds the id for a annotation which is a uniquely identified record in a table and assign as primary key

- SITE_DESC: holds the URL of a link word

- titel_word: holds the word which is linked

- grp_id: holds the grp id of a group to which it belongs, if any

- date: holds the creation date of link

This table only updated when initialization of new link to a word is done and assign a unique id to this new link which is referred by the edit_link_table to relate the links belongs to a word.

edit_link_table It stores the links tied to word and referred to link_table for relating links to the store word in the link_table an this table activities can be compared to edit_annotation_table

- id_link: its a foreign key which refers to the reference table annotation_table

- user_id: its a foreign key which refers to the reference table user_table

- link: holds annotation to the reference word from the annotation_table

- date: holds the date of creation of annotation for a word

- edit_id: holds the id for the store link and is defined as unique.

comments_table

- comments: holds comments written by users

- site_id: holds the URL on which user post comments

- date: holds the submission date for comment

- id_user: use to refer the user_table to relate comment with the user

- grp_id: use to refer the group_discussion_table for the related group if submitted by a group member from a group

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grp_discussion_table

- Grp_id: holds id for a group and is unique (primary key), each group has their own id and recognize with their id

- Topic: holds the group name, as name of group is identified by the topic label to a discussion

- date: holds the group creation date

- Resources: holds abbreviation for the resources used for identifying the URL

- Url: holds the URL used for the discussion

edit_grp_disc_table All the group discussion messages are stored in this table and messages are linked to a specific group by using edit_grp_id field which is defined as foreign key referring to the grp_discussion_table

- id_user: holds the user_id to relate the posted message to a user

- edit_grp_id: holds the id of the group to relate the message to a word

- message: holds all information shared amongst the members in a group

- date: holds date when the message is posted

- messageCount: always set to 1 for messages posted from a group during discussion

edit_grpdisc_update_table This table is used to show the user if any new message is posted by any user during discussion, it uses two fields oldCount and newCount . New count field is update with every message post and the application checks the periodically this the difference between the new and old count and if difference is greater than 1 means a new message is arrived, hence application informed user about new message and display it to the user. Every time when a user join a group it reads the oldCount from the table where oldCount is set as the result of query which extract the sum of all messageCount of a group from the edit_grp_disc_table and save it as variable, then checks newCount periodically and on new message set the oldCount as newCount and set newCount as 0, which is updated with a new message posted by any member.

- grp_id: holds the id of group for relating to a group

- oldCount: holds number of messages extracted from the sum of all the messageCount from edit_grp_disc_table

- newCount: holds the number of new messages received during discussion.

Grp_messagebox_table This table is used for the private messages amongst group members. Which holds the information about sender and messages send to him. The properties of this table is same as grp_disc_table.

- grp_id: holds id of the groups

- id_user: holds id of the user to relate it to the receiver name

- senderName: holds the name of the sender

- message: holds the private message send

- myCount: hold the message count as 1

- date: holds date when the message is posted

grp_messagebox_update_table It is used in same manner as done in edit_grpdisc_update_table

- id_user: hold the id of the user relate to it receiver name

- oldCount: hold the number of old private messages

- newCount: hold the number of new private messages

- message_grp_id: hold the id of the messages

Figure 15: shows the Entity Relation Database model of the application.

6   Application Design

The last two chapters described the fundamental requirements and specifications analyzed by me for developing a m-learning web application on the iPhone. Therefore, this chapter will show, how application can be designed to fulfill all the essentials as discussed in the preceding chapters. Choosing appropriate architecture for a application is key[50]. So in the first section system architecture is discussed and shows how the different units of the system communicate with each other. Followed by the design of each units of the system architecture according to the requirements discussed in the previous chapter.

6.1   System Architecture

Figure 16 shows the whole system consists of three different blocks.
1. Application Front-end
2. Application Back-end
3. Internet
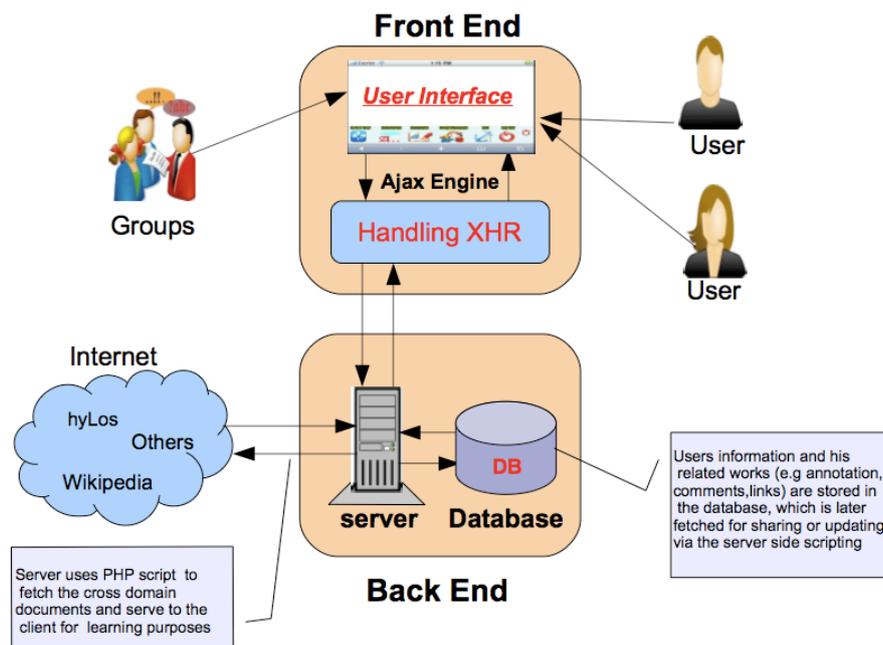
Figure 16: System Architecture of m-learning on the iPhone.

Where the application front-end comprised two components UI (User Interface) and Ajax engine. The design of this part is described in section 6.2.

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[50]fundamentals of architecture is defined http://www.guidanceshare.com/wiki/Application_Architecture_Guide_-_Chapter_1_-_Fundamentals_of_Application_Architecture

The application back-end made up of two components server scripting and database. The design of this part of the system is covered in section 6.3.

Internet is used to extract the learning documents. This is done on the server side and the contents are send to the ajax engine to upgrade the user interface and screen it to user.

6.2   Application front-end

The system front-end communicate with both, the user and the server. Where users use services provided by the system and server provides the services requested by the application. Therefore front-end plays a major role in this process of using and providing of services. The UI component of the front-end is used by the user to interact with the application. Hence it's very important to design it very carefully so that it fulfills all the requirement mentioned in section 4.3.

6.2.1   User Interface design

It was challenging task to design a superlative user interface for the web content so it displays and works well on iPhone, because of the execution limits on the iPhone. The learning documents are fetched from the cross-domain sites, which are designed for the desktop but not for the iPhone.

So vital task was optimizing the layout in a way to provide a easy and well designed user interface. I refer the Apple developer site to get an effective layout design pattern and came across designing the layout using "Columns and Blocks" [51] is most optimize way to design, but is also not possible because the retrieved cross-domain documents have their own CSS and can't be automatically rendered on the iPhone to display it as desired on the "Columns and Blocks" layout because of the size problem as viewport on desktop is different than on the iPhone. To get more information on the configuring viewport and optimizing web content please refer Apple's developer site [52]

Figure 17 shows how the UI is designed to fulfill all the requirement mentioned under section 4.3. Where the available screen i.e. content area (after deducting the pixels acquired by statusbar, urlbar on top and toolbar at the bottom for more info please refer the Apple's developer site [53], where the layout and metrics on iPhone and iPod touch is discussed in detail) is used to display the content retrieved from the cross domain site and the menu-bar

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[51] Apple suggest "Columns and Blocks" http://developer.apple.com/safari/library/documentation/appleapplications/ reference/safariwebcontent/CreatingContentforSafarioniPhone/CreatingContentforSafarioniPhone.html# apple_ref/doc/uid/TP40006482-SW3

[52] http://developer.apple.com/safari/library/documentation/appleapplications/reference/safariwebcontent/ usingtheviewport/usingtheviewport.html

[53] Area available on iPhone http://developer.apple.com/safari/library/documentation/appleapplications/reference /safariwebcontent/UsingtheViewport/UsingtheViewport.html#apple_ref/doc/uid/TP40006509-SW1

is displayed as an overlay at the bottom of the content area screen has been also shown in the figure 17 as "menu option metaphors" and designed as floating so that on scrolling the window, it floats in the direction of scrolling and as a result menu-bar is always available to the user, unless user hides it by using the "close" option available on menu-bar.
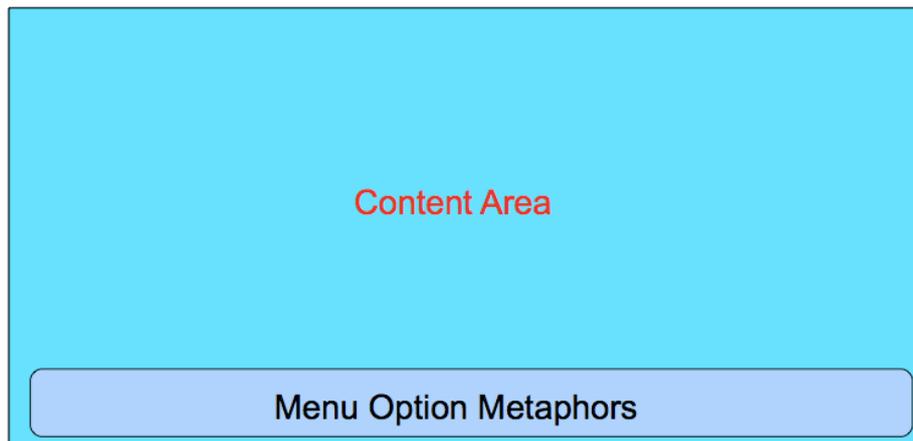

Figure 17: User Interface layout.

Because of screen limitation, content area is used for displaying all the action results, the outcomes of different actions e.g read, write and so on[54] are shown by hiding the current block (Document Object Model (DOM)[55] element or div or section) on the content area and display the desired results on that area using different blocks (div or DOM elements). Results presented to the user are generated dynamically and after use, the data within the shown element (DIV) is wiped out for next request, which generates a new data structure within a element for presenting the other results to the user. Because, menu-bar is overlaying on the content area, might cause trouble to users in reading the learning documents, to overcome this problem an option is available on menu-bar to hide this overlay and show another small overlay menu which appears at the bottom-right on the content area and let user to work untroubled.

6.2.2   Ajax Engine

Ajax (Asynchronous JavaScript and XML) uses an enhancement in JavaScript that allows Web pages to be more interactive and behave like local applications. The Ajax engine has three components HTML, CSS code and Javascript files. So all requests for data from the

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[54](except for showing the annotated or linked words or showing the new document from the same cross domain site, they are shown always on the current fixed block)

[55]to get acquaint with DOM HTML and it's elements, please access to http://www.w3.org/TR/DOM-Level-2-HTML/html.html

server will be sent as JavaScript calls to this engine, which is located as a communication layer between the browser and the server .

Using the Ajax engine to create dynamic content is very straightforward. There are three steps.

1. Register the Ajax request handler. This tells the Ajax engine that a specific web service or server call is mapped to a request handler name.

2. Register the Ajax response handler. This is either specifies an HTML element as the target of the data being returned (in which case the contents of the response is HTML code e.g. to get the help contents) or it specifies a specific JavaScript object like JSON (JavaScript Object Notation)[56] that will manage the response and update the targeted section in the DOM and display to the users at request.

3. Invoke the Ajax request when the appropriate event occurs in the interface for example on submitting a form.

Ajax engine here is not only use to interact with server script on server to get the data, but can also fetch the specific DOM elements or section from a web page on the same domain without interacting any server script.

6.3   Application Back-end

The application back-end comprises server scripts (PHP script used for this project) and the database. The server scripts are used to provide services, requested by the Ajax engine on the client side. The user on the client side generate requests by virtue of Ajax engine and this request invoke asked server script (PHP), which retrieve the required information from the database if necessary. The server script also do the cross domain document (learning contents) retrieval from the internet and pass it to the Ajax engine on client side and then engine process it to update the targeted section (div) in the DOM and display it at need. As noted under section 6.2.2 ajax engine can also do the direct retrieval of document or a specific elements from the different web pages in the same domain without invoking any script on the server e.g displaying "help" option (describe in chapter 7 under section 7.3.3) is implemented in this way .

The requirements stated in chapter 4 for the interaction between user and the contents are processed at the server side. The requested services for altering the contents could be any of the following :-

1. append or tag a annotation to words
2. give feedbacks to annotated words
3. append or tag a link to words
4. add more links as feedback to the linked words
5. write and read comments to the learning documents

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[56]to get more info about JSON object refer to www.json.org

How these requested services are processed by the server is explained in the following sections :-

6.3.1   Administering Annotation

Four different requests for annotation can be invoked on the client side are as follows.

- Get annotation :- get all the annotated words for the current learning documents from the database which is associated to page url

- New :- store initiated annotation on a word or phrase within a current document in the database

- Read :- fetch the initial annotation and all the feedbacks submitted to the selected annotated word from the database

- Write :- write a feedback to the selected annotated word or phrase to the database

- Update :- this option is only invoked to update the initial annotation by the client who initiated the it on a selected word or phrase and write the appended info to the database

Get annotations   The get annotation process flow is depicted in figure 18 a). When a get annotation request along with the current URL (shown learning document URL) and group id (to check if the request is from a active group member) is received at the server side, an appropriate server (PHP) script is invoked by the request, which fetch all the annotated ids of the words belong to the sent URL and group id[57] (provided group member sent the request otherwise group id is set to 3) are fetched from the annotation table,where these ids are used to extract all the related annotation to those words from the edit_annotation table in the database, but the query to fetch the annotation of a word is restricted to get only the initial one, which avert extraction of feedbacks (further shared information) to those annotation for a word. for more information about the database tables please refer to 5.5.

On successfully obtaining the results from the database, response is built in the form of JSON object and the response is sent back to the ajax engine for the further processing on client side.

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[57]where group id is used to detect the groups because application offer both environments (independent or collaborative), so people can annotate words independently means any one can see their contribution and collaborative means annotate same word in a group where annotation from other groups or independent users are not hidden for them, where only the group member can see the annotation of their group and provide their feedback to it and these feedbacks are also only visible for group members to this group

New annotation   The new annotation process flow is depicted in figure 18 b). When a new request (means annotation of a word or phrase is initiated *(first explanation or information tied to it)* by user) together with current URL and group id (as noted before in Get annotation) is received at server, it calls an appropriate script which store the word , document URL and group id (provided a group member start this annotation) in the annotation table in the database, success in inserting information in the table means a unique annot_id is assigned to this new inserted word. The assigned id to this word is fetched from the annotation table and used to store the annotation of the word along with the assigned id in the edit_annotation table in the database. On successfully inserting all the information in the database, JSON response comprise of a status (boolean, tells success or failure) and a message (string, tells the error if any catch by the script on failure) is generated and send to the client.

Read annotation   The read process flow is depicted in figure 19 c). The read annotation request extract all feedbacks for a selected word for the current document from the database table. It is done by fetching annot_id for selected word given with URL and group id (to check if asked by the group or independent user) from the annotation table. After getting the annot_id extract all the feedbacks to the word from the edit_annotation table in database. The upshot of the database query is used to generate JSON response and pass it back to the client Ajax engine for rendering.

Write annotation   The write process flow is depicted in figure 19 a). This request invokes a script which edit a new feedback to the existing annotation in the database table. It's carried out firstly by draw out the annot_id from annotation table associate to this word for the current URL and group id (provided requested by a group otherwise set to 3) and then then store the feedback along with the annot_id to the edit_annotation table for later use. The success of insertion into the database table has been shared with user by generating JSON response consist of status and message as mentioned previously in "New annotation" and pass it back to the client Ajax engine for notifying users .

Update annotation   The update process flow is depicted in figure 19 b). This is restricted request, means it can be called only by specific users, where these users are those who initiate the annotation on the selected word. This action is not available to the users who provides only feedback to the annotated words. Its an updating of information within a table field, so it invokes a script which update edit_annotate field within the edit_annotation table for chosen word in the database table. It's carried out firstly by draw out the annot_id from annotation table associate to this word for the current URL and group id (provided requested by a group otherwise set to 3) and then the updated annotation is stored in the edit_annot field in the edit_annotation table for later use. The success of insertion into the database table has been shared with user by generating JSON response consist of status and message
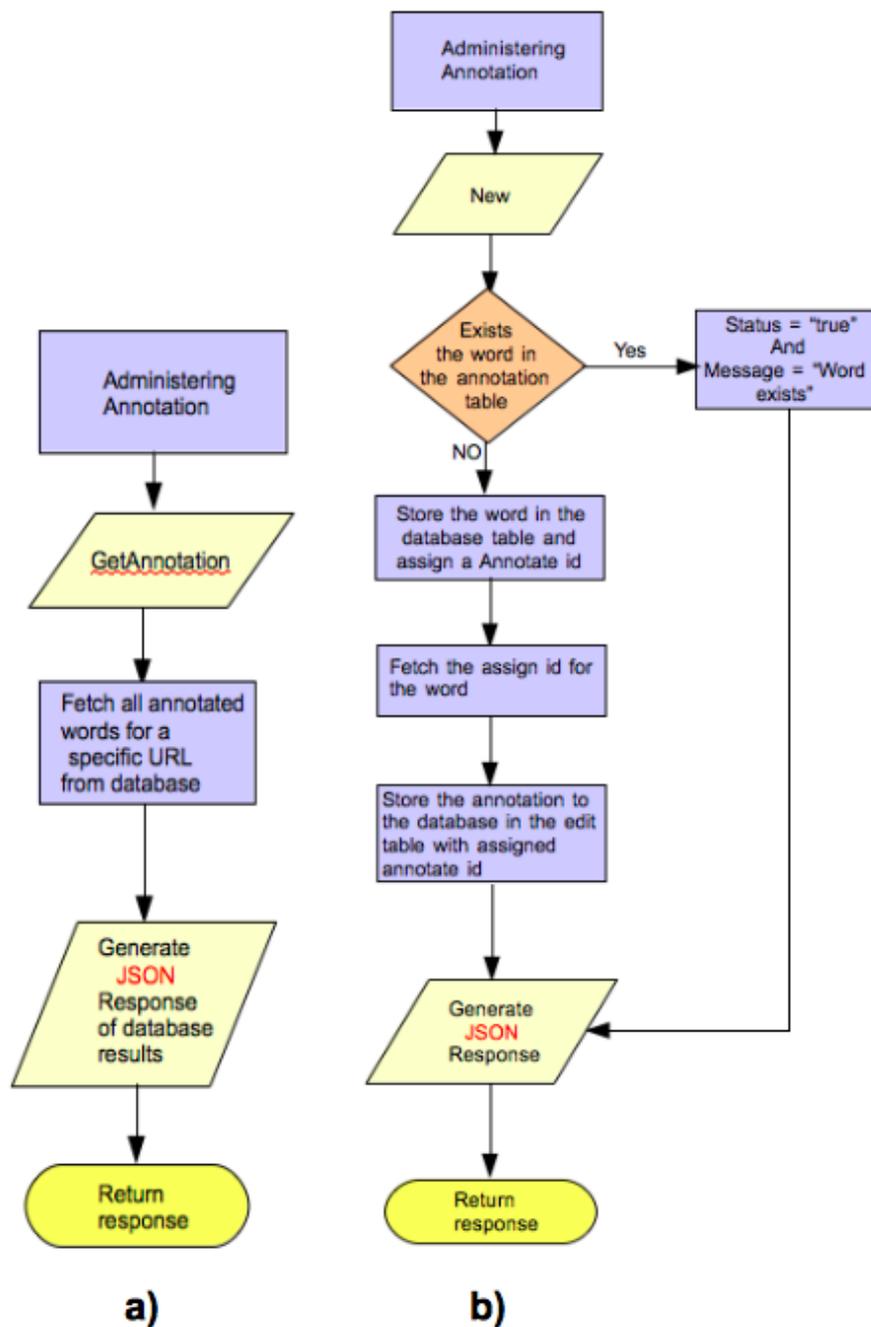
Figure 18: Shows process flow depicted as flow diagram a) shows the process flow for get annotation and b) shows the process flow for new annotation

as mentioned previously in "New annotation" and pass it back to the client Ajax engine for notifying users .

Figure 19: Shows process flow depicted as flow diagram a) shows the process flow for write feedback to a annotation and b) shows the process flow for update a annotation for annotated word and c) shows the process flow for reading all feedbacks on a annotated word

6.3.2   Administering Link

Four different requests for linking can be supplicate on the client side which corresponds to annotation requests are as follows.

- Get link :- get all the linked words for the current learning documents from the database which is associated to page url

- New :- store initiated link on a word or phrase within a current document in the database

- Read :- fetch the initial link and all the feedbacks submitted to the selected linked word from the database

- Write :- edit a new to the selected link word or phrase in a form of feedback and store into the database as table entry

- Update :- this option is only invoked to update the initial link by the client who initiated it on a selected word or phrase and write the appended info into the database table

Get links   The get link process flow is depicted in figure 20 a). When a get link request along with the current URL and group id is received at the server side, server script fetch all the link ids of the words associate to the sent URL and group id (provided group member sent the request otherwise group id is set to 3) are fetched from the link table,where these ids are used to extract all links equated to those words from the edit_link table in the database, but the query to fetch link for a word is restricted to get only the initial one for a specific word , which avert extraction of feedbacks (further shared links) to those link. On successfully obtaining the results from the database, response is built in the form of JSON object and it is sent back to the ajax engine for the further processing on client side.

New link   When a new request (means tying link to a word or phrase is initiated *(first explanation or information tied to it)* by user) together with current URL and group id is received at server, an appropriate script is invoked, which stores the word, document URL and group id in the database link table, success of insertion in the table means a unique link_id is assigned to this new inserted word. This new id to this word is fetched from the link table and used to store the link for the word along with the assigned id in the database edit_link table. On successfully inserting all the information in the database, JSON response comprise of a status (boolean, tells success or failure) and a message (string, tells the error if any catch by the script on failure) is generated and send to the client.

Read link   The read process flow is depicted in figure 21 a).The read link request extract all feedbacks (in form of other shared link) for a selected word for the current document URL from the database table. It is done easily by fetching link_id for selected word given with URL and group id (to check if asked by the group or independent user) from the link table. After getting the link_id, it extracts all the feedbacks (or shared links) to the word from the database edit_link table . The upshot of the database query is used to generate JSON response and pass it back to the client Ajax engine for rendering.
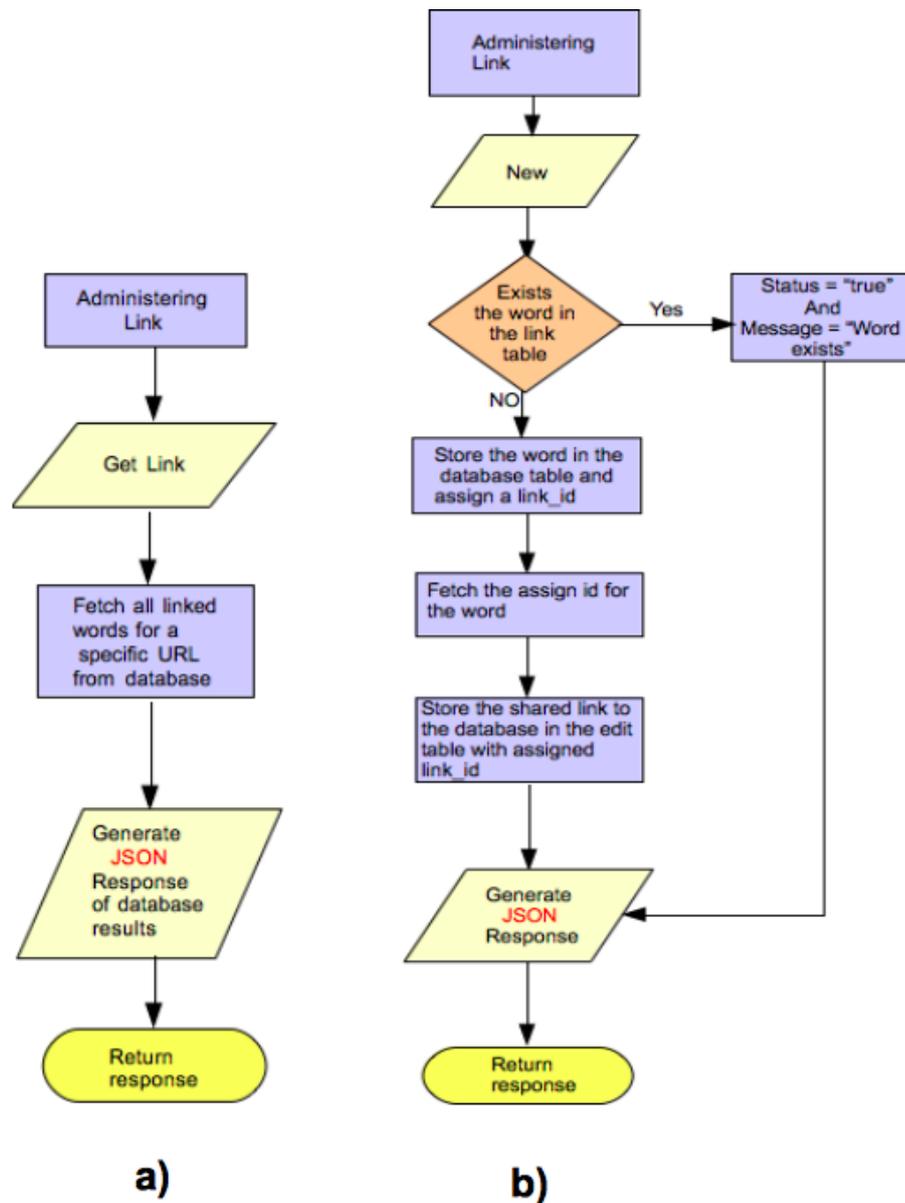
Figure 20: Shows process flow depicted as flow diagram a) shows the process flow for get link and b) shows the process flow for new link

Write link   The write feedback process flow is depicted in figure 21 b).This request invokes a script which edit a new feedback (shared link) to the existing linked word in the database table. It's carried out firstly by draw out the link_id from link table associate to this word for the current URL and group id (provided requested by a group otherwise set to 3) and then store the feedback along with the link_id to the edit_link table for later use. The success of

insertion into the database table has been shared with user by generating JSON response consist of status and message and pass it back to the client Ajax engine for notifying users .

Update link   The update a link process flow is depicted in figure 21 c).This is restricted request, means it can be called only by specific users, where these users are those who initiate link on a selected word. This action is not available to the users who provides only feedback to linked words. Its an updating of information within a table field, so it invokes a script which update edit_link field within the edit_link table for chosen word in the database. It's carried out firstly by draw out the link_id from annotation table associate to this word for the current URL and group id (provided requested by a group otherwise set to 3) and then the updated link is store back to the edit_link table for later use. The success of insertion into the database table has been shared with user by generating JSON response consist of status and message as mentioned previously in "New annotation" and pass it back to the client Ajax engine for notifying users .

6.3.3   Administering comments

Two different requests for commenting on the documents can be called on the client side are as follows.

- Read :- fetch all the comments submitted for a specific URL from the database

- Write :- store edited comment into the database table

Read comments   The read comments request extract all comments for the current document URL from the database table. It is done easily by fetching comments for selected URL and group id (to check if asked by the group or independent (group id = 3) user) from the comment table. The outcome of the database query is used to generate JSON response and pass it back to the client Ajax engine for rendering.

Write comments   This request invokes a script which edit a new comment for the current URL and group id (if provided except 3) in the database. It's done simply by storing the message(comment)along with the current URL and group id (provided requested by a group otherwise set to 3) to the comment table in database for later use. The success of insertion into the database table has been shared with user by generating JSON response consist of status and message and pass it back to the client Ajax engine to inform users .
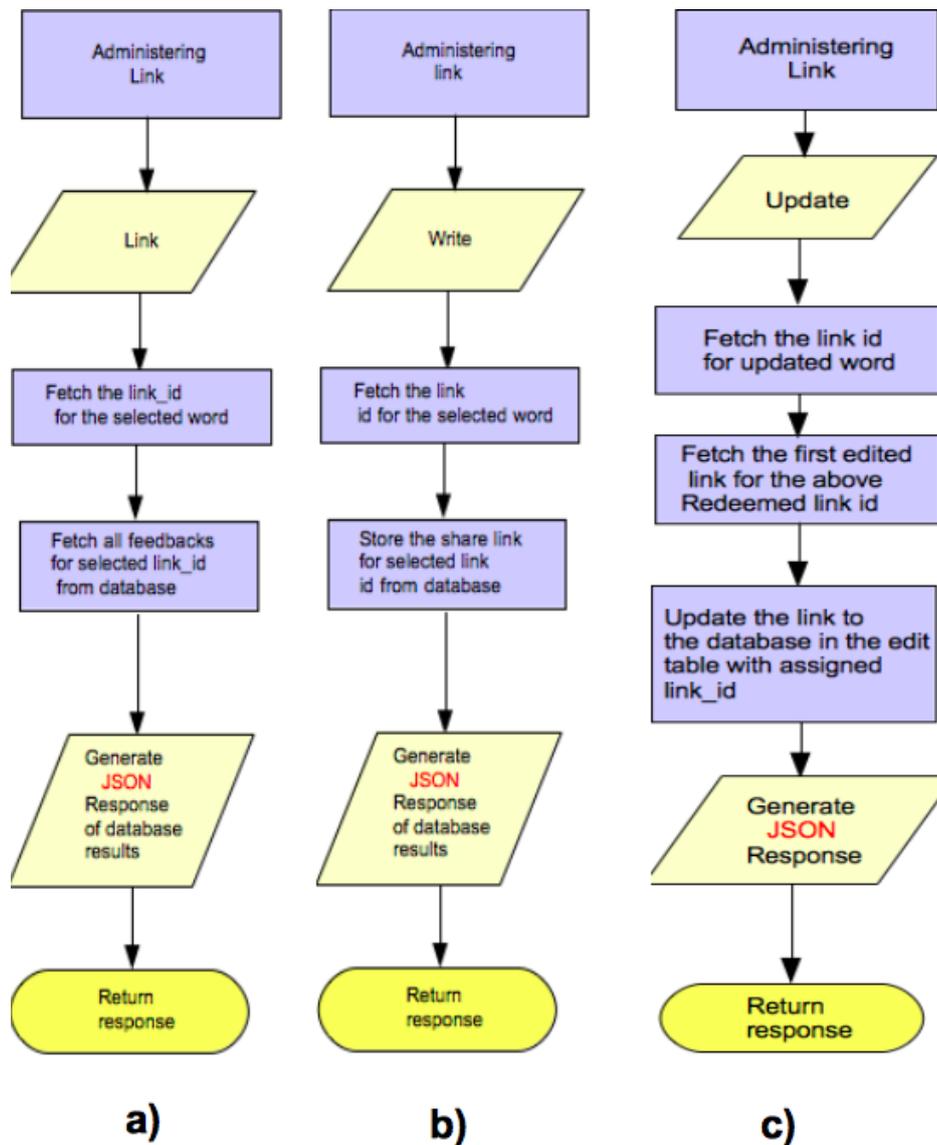
Figure 21: Shows process flow depicted as flow diagram a) shows the process flow for reading all shared links for a word and b) shows the process flow for write links as feedback to a linked word and c) shows the process flow for update a link for linked word

6.4 Group Discussion

As already mentioned in the chapter 4 under section4.5 importance of group discussion. The group can avail all the above defined all request received at back-end except the comment request. Because the comment request masked as chat request, means the user is always updated with the information at arrival of a new comment in the discussion topic and the

new comment is available to the user without doing any refresh by the user, which is not the case in reading the comments for non-groups users (independent user). Every group has a unique assigned group id.The group activities are identified and extracted from the database tables with the help of these group id's as described in all above requested processing on the back-end. Messaging between the group member is designed in the way that user can send private messages to other users in the same group.If the receiver is active (online), he receives the message instantly and can reply back to the sender via his private message, if receiver is not online then user would be inform about new messages, if any, at joining the group after logging in. Showing messages is done by using message_table which stores all the messages and the client (user) sends a check_message request periodically to check if there is a new message or not. Whenever sender(user) sends a new message to the user, it is stored in the message_table and another table is also updated which keep track on the old_count (number of previously shown messages) and new_count (number of new messages) in check_message table. Client checks this entries periodically and compare the difference between the count on old_message and new_message, if the difference is greater than one means a new message is stored in the table and response is send to the user to inform about the new message. When user fetch this new message than the check_message table is updated by setting the old_count equal to new_count. This messaging system provide users privacy for sharing their opinion could be anything. The messages are hidden from other group member and only shown to the targeted member of the group.The flow of process hoe message is write or read is shown in figure 22.
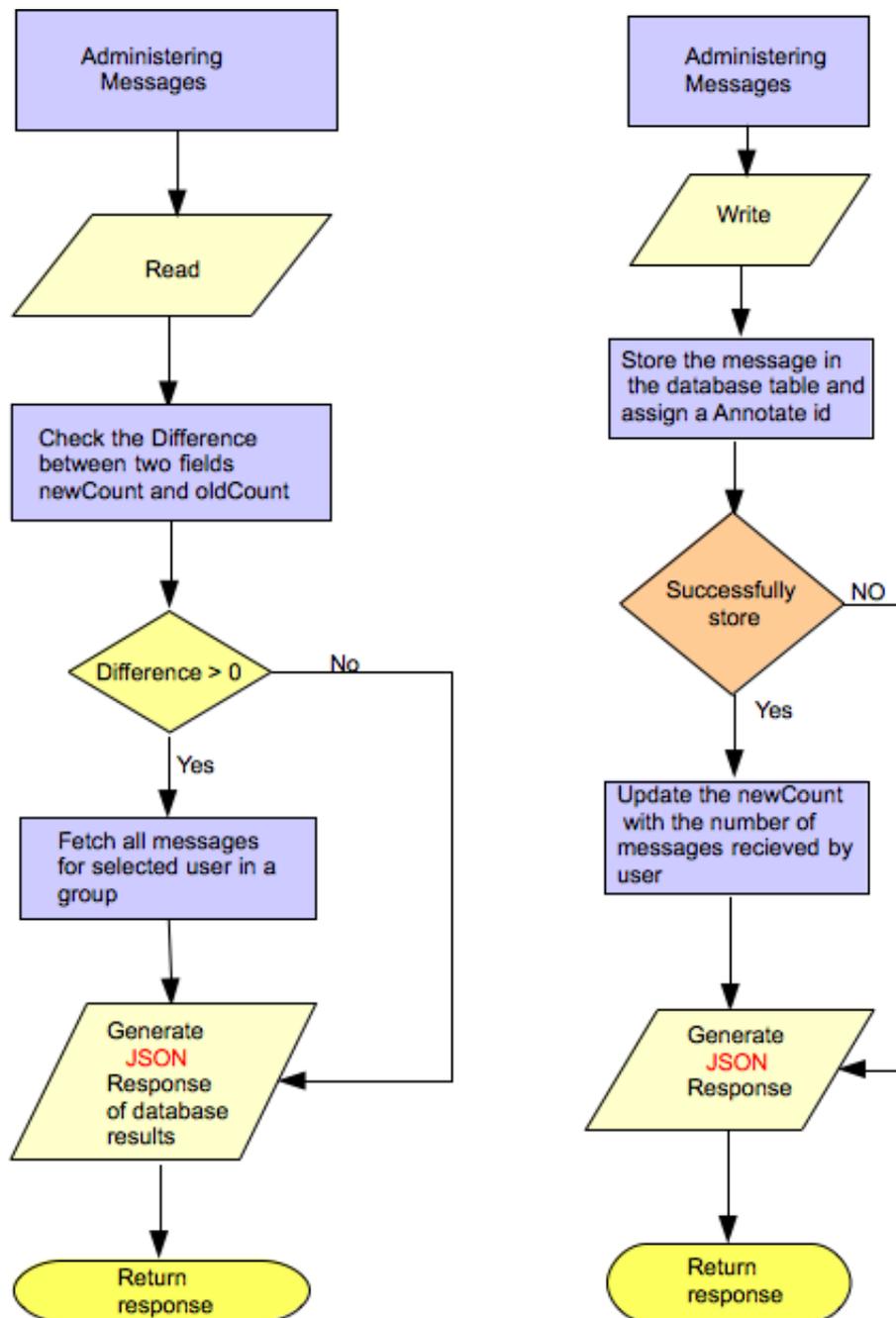
Figure 22: Shows process flow depicted as flow diagram a) shows the process flow for reading all messages for a user in an group and b) shows the process flow for write messages for user

7 Application Implementation

This chapter set out the implementation of this application. Implementation is done in a way that it comprises all the requirement described in chapter 4 and utilize the AJAX approach mark out in section 3.2.3. Commencing with detailing on the tools used to make the implementation easy and resilient. Followed by the software architecture and concluded with explaining on how it is coded using HTML, CSS and Javascript for client side and PHP and MySql on server side, to make application executable on the iPhone.

7.1 Development Tools

Develop a web application requires some necessary tools to make it easy to modify, debug, and optimize an application for peak performance and compatibility. The whole project is developed on Apple MacBook, as it provides a iPhone simulator on which all the designed web pages can be previewed to substantiate the compatibility, which is a key issue because of screen constraint describe in section 3.1.2. This iPhone simulator also incorporate debug option which shows all errors not only coming from Javascript but also from HTML and CSS, which yields a great help in debugging application in real time environment. Moreover Safari on MacBook can also be used to optimize the application, it provides *Web Inspector* as your command center, giving you quick and easy access to the richest set of development tools ever included in a web browser. Whether you're viewing the structure of a page, debugging JavaScript, or optimizing performance, the Web Inspector presents Safari's developer tools in a clean, unified interface designed to make developing web applications more efficient. To get more information about the tools constitute in the Web Inspector please refer to the site[58].

TextMate a general-purpose GUI text editor for Mac OS X is used for the production of the Javascript , CSS, PHP code and markup. For more details on TextMate please visit [59] [60]

For repository on the server side MySql (relational database) is used. MySQL is an extensible, open storage database engine, offering multiple variations such as Berkeley DB, InnoDB, Heap and MyISAM. To understand the multiple storage engine types please check the site[61]. The database for this application is designed using InnoDB engine, which means all tables are of type InnoDB. Question arises why InnoDB instead of others? Here are the following reasons described :-

The default table type for MySQL is MyISAM. It has table level locking, which means during an `UPDATE`, nobody can access any other record of the same table. Which leads to nonavailability of the table for other users, make application inconsistent because if table

---

[58]http://developer.apple.com/technologies/safari/developer-tools.html

[59]official page for TextMate http://macromates.com/

[60]to know history and lot more about TextMate http://en.wikipedia.org/wiki/Textmate

[61]official mysql page on different engine types http://dev.mysql.com/doc/refman/4.1/en/storage-engines.html

belongs to the group discussion then the whole group work is crippled until `COMMIT` is issued.

BDB uses Page level locking, and during an `UPDATE`, nobody can access any other record residing in the same database page of that table, until the locking transaction issues a `COMMIT`. Also cause the same effect as above.

InnoDB however, uses Row level locking. Row level locking ensures that during an `UPDATE`, nobody can access that particular row, until the locking transaction issues a `COMMIT`. Hence, row locking is an advantage over others as it ensures the availability of all tables and row data except a specific row and therefore application behaves as required.

Designing of the database is done by using MySQL Workbench. MySQL Workbench is a visual database modeling and design tool provided by MySQL. It's not only provides GUI to create database and their tables, but also equipped with designing the data model from the existing database and offer server administration services as well (provided you have rights to access the server). It consists many different utilities and aids within the tool exist to help the data modeler quickly design and implement the physical data models being worked on. For more information on tools provided by this workbench and their features please look at their official site[62]

7.2   Software Architecture

The software is depicted as three layer Architecture model shown in figure 23 . The presentation layers contain user interface components such as login form or registration form. These components typically contain code to perform functions such as configuring the visual appearance of controls; accepting and validating user input; and acquiring and rendering data from data access logic components.

The second layer define as logic and communication layer fairly separates the data access logic from the presentation logic. However, while the Data layer cleanly separates the data access details from the presentation layer, it does not enforce any business logic that may apply. Example, for our application we may want to disallow the user to update the annotation fields in edit_annotation table, when a user has not the same user-id as in user_id field in annotation table for this specific annotated word means he doesn't own the annotation. This logic is done on the second layer by application logic component, implemented by not showing the update option to those users who are not in charge of initial annotation. This layer not only provides the client logic but also communicate between presentation and data layer by virtue of Ajax engine. This engine, which runs inside the Web browser, acts as an intermediary between the application's UI and the server. User activity leads to calls to the client-side engine instead of a page request to the server. Likewise, data transfer takes place

---

[62]it provides all information on MySQL workbench http://downloads.mysql.com/docs/workbench-en.pdf
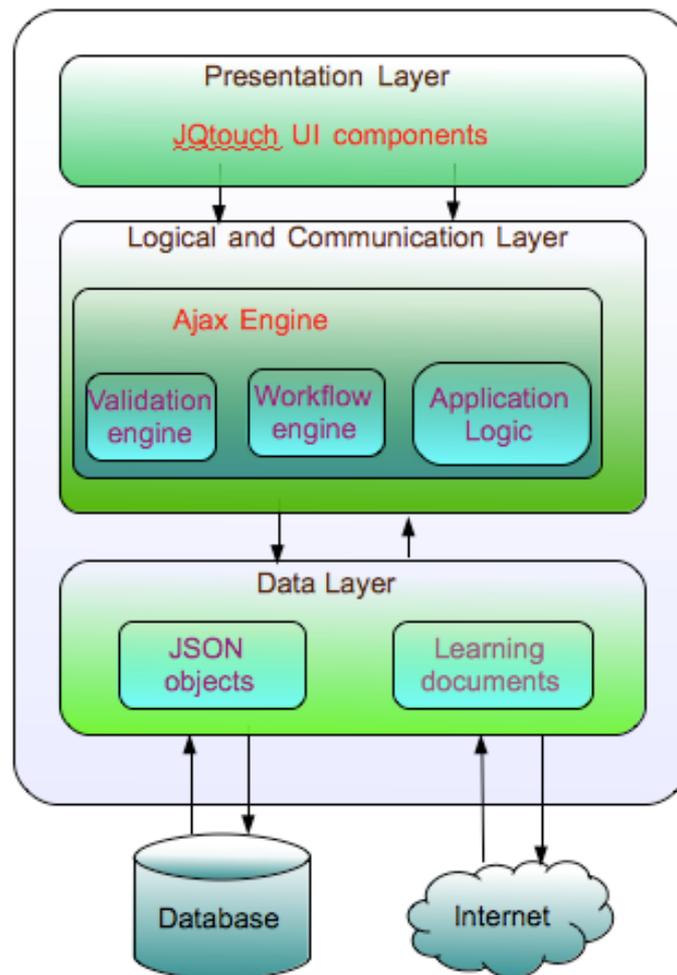
Figure 23: Software Architecture illustrated as three layer model.

between the server to the client-side Ajax engine, rather than directly to the Web browser. Ajax engine is the key to the AJAX application model.

There are many different ways to implement the client side Ajax engine. One approach is to write it from scratch based on the application need. Another approach is to use an Ajax toolkit that is available in the market today. There are many Ajax toolkits today, a lot of which are open source e.g. in my knowledge most popular open sources are jQuery[63], Yahoo AJAX

---

[63]for more info on jQuery , please refer to www.jQuery.com

```
1   /*
2    *Should be add in the DOM
3    * shows inclusion of jQuery library in the project
4    * Accessing the jQTouch UI components
5    * shows the implementation of hide function
6    */
7   <script src="../js/jquery.1.3.2.min.js" type="text/javascript" ↵
        charset="utf-8"></script>
8   <script src="../js/jqtouch.min.js" type="application/x-javascript" ↵
        charset="utf-8"></script>
9
10  <style type="text/css" media="screen">@import "../css/jqtouch.css";</ ↵
        style>
11  <style type="text/css" media="screen">@import "../css/theme.css";</ ↵
        style>
```

Listing 1: show how jQuery and jQtouch loaded in current DOM

Library[64] ,GWT[65], Dojotoolkit [66], AJAX Control Toolkit[67], openRico[68]. I preferred jQuery for this project, because of jQtouch[69], a plugin for jQuery, which provides UI components for screening the application on the browser and listing 1 shows how the jQuery and jQtouch are initially loaded into the HTML head tag.

The third layer is responsible for server side logic and data transferring. Data is extract and store, from and to the database respectively. Where first component JSON object steers the formation of the responses sent to the communication layers. The raw data extracted from the database is used to generate a JSON object and then this object is passed on the Ajax engine for further processing. The second component is a learning content, which is fetched from the cross domain site for learning process and used by the users for learning objectives.

How all layers function together to make the application executable on the browser is mentioned in the next section.

---

[64]Yahoo Ajax is also popular as YUI for more info please visit http://developer.yahoo.com/yui/

[65]where GWT stands for Google Web Toolkit for more info please consult to http://code.google.com/webtoolkit/

[66]for more info on dojotoolkit , please refer to www.dojotoolkit.org

[67]to know more about AJAX Control Toolkit please check http://ajaxcontroltoolkit.codeplex.com/releases/view/33804

[68]to get more on openRico please refer to http://openrico.org/

[69]to get familiar with jQtouch please explore http://jqtouch.com/ and http://code.google.com/p/jqtouch/wiki/GettingStarted

```
1   /*
2   *this  code snippet shows how assigning a current class to the user  ↩
         selected container
3   *It is done by using the jQtouch.js
4   */
5   // Make sure exactly one child of body has "current" class
6                if ($('body > .current').length == 0) {
7                    currentPage = $('body > *:first');
8                } else {
9                    currentPage = $('body > .current:first');
10                   $('body > .current').removeClass('current');
11               }
12               // Go to the top of the "current" page
13               $(currentPage).addClass('current');
14               location.hash = $(currentPage).attr('id');
15               addPageToHistory(currentPage);
16                  ........
17           });
```

Listing 2: show how jQtouch manages to show only one block at a time

7.3   Application Functionality

7.3.1   User Interface

This is what user work with all the time to interact with this application. The interface has different blocks[70], but only one block is shown at a time except in the case of showing learning contents because it requires a menu to manipulate contents or displaying the exploited contents. Otherwise all other blocks are hidden. Initially the application loads the login page, which has two divs, one for the login form and the other one is the registration form for the new users. Login form is always show at first load, but guest users can register themselves to access the application simply by taping on registration link, which switch to registration page by plainly hiding the login page from the view. It is done by assigning a class *" current "* to a div using a javascript function provided by jQtouch plugin for jQuery library as shown in the listing 2 from line 16 to 18 and only one child of body has *" current "* class .

After successful login into the application, takes you to the first page showing hyLOs overview page for navigating through its different e-Learning contents. For displaying the contents a div with class current is composed of two other divs are implemented, which are used as content area and menu-bar, where content area occupies the whole screen and

---

[70](also called as div or element or section or container all have the same meaning here, so please read as it see fit your knowledge)

menu-bar is overlaid at the bottom part of the content area. Menu-bar is implemented as floaty[71] shown in listing 3, so that it always available to user when scrolling the screen. To get more about the classes defined in the listing 3 please check the code[72]

The next section shows how the contents from internet are extracted and serve to the client for viewing and exploiting.

7.3.2   Viewing Remote Learning documents

The documents for learning purposes are provided by the web. So the application extract the learning contents and equipped users with different tools to work on these contents at need. On successful login, application engine excite a remote ajax request[73]. Remote Ajax requests allow you to request remote files, such as Web services, RSS feeds and so on. As jQuery provides the toolkit for Ajax, so it relieves lot of coding on the client side just by few line of code[74]. When using Ajax to access the server without reloading the web page you have two choices on how to pass the information for the request to the server. These two options are use GET or POST. Where the purpose of GET is as its name implies - to GET information. It is intended to be used when one's reading information to display on the page. Browsers will cache the result from a GET request and if the same GET request is made again then they will display the cached result rather than rerunning the entire request. A GET call is retrieving data to display in the page and data is not expected to be changed on the server by such a call and so re-requesting the same data should be expected to obtain the same result. Whereas the POST method is intended to be used where one is updating information on the server. Such a call is expected to make changes to the data stored on the server and the results returned from two identical POST calls may very well be completely different from one another since the initial values before the second POST call will be different from the initial values before the first call because the first call will have updated at least some of those values. A POST call will therefore always obtain the response from the server rather than keeping a cached copy of the prior response. Here the engine use POST method for the server call because the GET method in jQuery have some bugs, if you send payload to server via GET[75]. The ajax engine request (carries the URL for the asked document and return type) invokes a php script[76] on the server. Hence the PHP script does it job of extracting the remote document and return the response as asked by the engine(in our case "text"), which render the received data and pass it to the UI for screening.

---

[71]please check how it moves with scrolling the screen in horizontal or vertical direction cd/htdocs/js/jqt.floaty.js

[72]shows classes designed for menu bar cd/htdocs/css/button.css

[73]for remote ajax call cd/htdocs/js/tapFunction.js->getContents(currentUrl)

[74]more about the ajax call using jQuery http://api.jquery.com/jQuery.ajax/

[75]please check comments part for more details http://api.jquery.com/jQuery.get/

[76]how it extracts the contents from remote using php cd/htdocs/server/test_Hylos_Extract.php

```
1   /*
2   *this  code snippet shows how menu−bar  is designed
3   */
4
5   <div class="floaty" id="myMenu">
6
7   <!−− Active user button−−>
8           <a class="userButton1" id="tapId" href="../client/Active_user. ←
               html" rel="external" target="_self"></a>
9           <p class="para" ><span style="background: −webkit−gradient( ←
               linear, 0...., from(#610), to(#aca), color−stop(.4,#66CD00) ←
               );">Active User</span></P>
10
11          <!−− now for annotation button−−>
12          <a class="annotation" id="tapId" href="/Annotation"></a>
13          <p class="para" id="annoted" style="left: 90px;"><span style=" ←
               background: −webkit−gradient(linear, 0......, from(#610), ←
               to(#aca), color−stop(.4,#66CD00));">annotation</span></p>
14
15          <!−− now for Comments button−−>
16          <a class="comments" id="tapId" href="/comments" rel="external" ←
                target="_self"></a>
17          <p class="para" style="left: 165px;"><span style="background: ←
               −webkit−gradient(linear, 0......, from(#610), to(#aca), ←
               color−stop(.4,#66CD00));">Comments</span></P>
18
19          <!−− now for Group Discussion button−−>
20          <a class="groupDiscussion" id="tapId" href="../client/ ←
               Group_Discussion.html" rel="external" target="_self"></a>
21          <p class="para"  style="left: 240px;"><span style="background: ←
                −webkit−gradient(linear, 0....., from(#610), to(#aca), ←
               color−stop(.4,#66CD00));">Group Discussion</span></P>
22
23          <!−− now for Link button−−>
24          <a class="anchorButton" id="tapId" href="/Linking"></a>
25          <p class="para" id="linked" style="left: 350px;"><span style=" ←
               background: −webkit−gradient(linear, 0....., from(#610), to ←
               (#aca), color−stop(.4,#66CD00));">Link</span></P>
26
27          <!−− now for Log Out button−−>
28          <a class="exitButton" id="tapId" href="../client/logout.html" ←
               rel="external" target="_self"></a>
29          <p class="para" style="left: 400px;"><span style="background: ←
               −webkit−gradient(linear, 0......, from(#610), to(#aca), ←
               color−stop(.4,#66CD00));">Log Out</span></P>
30
31          <!−− now for cancel button−−>
32          <a class="cancelButton" id="tapId" href="/home"></a>
33
34  </div>
```

Listing 3: Shows how the menu-bat is coded

```
1   /*
2    *  instead of " click "   " tap" event is used
3    *
4    */
5     $('a').live('tap ',function(e)
6          {
7          Hylos_url = $(this).attr('href'); //get the clicked url from the ↩
               user
8             tapFunction(Hylos_url,myData,myLink);
9             return false;
10         });
```

Listing 4: Shows how tap event is handled

After displaying the learning script on the content area , data manipulation tools come into action, describe as next part.

7.3.3   Content Exploitation Tools

When the learning document is displayed on the content area, menu-bar is used to utilize the contents to expand user's knowledge. Menu-bar is designed (as shown in listing 3) using CSS[77], where images are used for buttons to trigger events for required actions. The most important part to be noticed down in this application is that instead of `click` a `tap` event is used. Where click is a mouse event and as we know there is no mouse available for the iPhone, finger is used to navigate this device, therefore `tap` is used to accomplish `click` trigger events as shown in the Listing 4. Where the `tap` event is bind to `live`[78] method. This method is used to attach a handler to the event `tap` triggered by all *'a'* elements in the DOM tree (shown on line 5 in listing 4) and also to all dynamically generated *'a'* elements.

Interacting with contents can be done in different ways like showing annotations or links, editing a new annotation or link, commenting on document, group discussion on learning contents and so on.

displaying annotation or link   On tapping the annotation option, application checks if links are already displayed on the contents,verification is done by checking a global variable`linkCount` set to 1 for links, means they are shown on the content words. If `linkCount` is 1 then first step is to remove[79] links shown links on the contents and then

---

[77]please check to inform about the design of menu-bar images and their titles cd/htdocs/css/buton.css

[78]live method http://api.jquery.com/live/

[79]shows how highlighted link words remove: cd/htdocs/js/jquery-highlight.js->removeHighlight(word)

load[80] the annotated words tied to the content words in document[81]. If `linkCount` is set to 0, then it checks for the `annotateCount`. If `annotateCount` is set to 1, means annotation are already displaying on the content words then it asks user for a new annotation to be exploited on document word. listing 5 shows it's implementation.The annotated words are highlighted as blue underlined words to distinguish them from other non-annotated words. Highlighting[82] of annotated or linked words is shown in listing 5 on line 21.

A new annotation for a word is done in the above mention sequence because there is no event like *" onCopy "* or *" onSelect "* is available on mobile safari. A new annotation sets a global variable `wordExploit` to " true ". When a new word annotation is submitted, which triggers submit event result in an Ajax function[83] call to make a request to the server by polling an appropriate request on client side by using variable `wordExploit`, then after a callback function is set to handle the response from the server. For this instance a business logic is implemented on server (see figure18 b) to check if new word is already annotated or not and response from the server depends on this logic.

Adding a new link or displaying links on document contents are comparable with adding and screening the annotations.

editing annotation or link When all linked words are shown on current document then user has an option to edit shared link for a specific linked word just by touching that word. Touching event is bond to all linked words during the screening process simply by calling a `startTouch()`[84] function see listing 5 on line number 22. Touch on a specific linked word give rise to a new editor next to it, which comprises different options [85] like read all shared links, edit, help and close editor. Edit option on this editor is used to give feedback (as shared link) on a linked word. This Edit option pop up a write editor which is just a simple editor with inputs, where the first input is read-only tells about the word and second input is for feedback link to submit. Write editor[86] is reused for all writing or editing purposes according to their needs. Submitting the editing information leads to trigger the same submit event as mention above for new annotation process but have set `wordExploit` to " false" for polling an appropriate request , which calls an Ajax function [87] and set a call back function to handle the response from the server.On successful editing of shared link the div containing the write

---

[80]see how the annotation tied to a word cd/htdocs/js/jquery-highlight.js->Highlight(word)

[81]screening link or annotation on contents: cd/htdocs/js/tapFunction.js ->tapFunction()

[82]see how words are highlighted in documents cd/htdocs/js/jquery-highlighted.js

[83]cd/htdocs/js/tapFuction.js-> tapFunction(Hylos_url,myData,myLink)-> (Hylos_url == '/submit')

[84]see the startTouch() function cd/htdocs/js/TouchEvent.js->startTouch()

[85]see how annotation or link is shown within editor cd/htdocs/js/tapFunction.js -> alertMessage(messageAnn, title,username)

[86]design of write editor cd/htdocs/js/tapFuction.js-> tapFunction(Hylos_url,myData,myLink)-> (Hylos_url == 'write')

[87]cd/htdocs/js/tapFuction.js-> tapFunction(Hylos_url,myData,myLink)-> (Hylos_url == 'submit')-> else

```
1    /*
2     * it shows how annotation tap event display all the annotated words
3      */
4    else if(Hylos_url == '/Annotation')
5                 {
6                 commentStatus = false;
7                    if(annotateCount == 0 && linkCount !=0) //to check if  ↩
                           the links are shown or not?
8                 {
9                   ..............
10               for(var i=0;i<myLink.length;i++)
11                 {
12                  $('div .right').removeHighlight(myLink[i].word); // ↩
                        remove the shown links to words
13                 }
14
15                 if(myData.length > 0)
16                 {
17                       for(var i=0;i<myData.length;i++)
18                 {
19                   $('div .right').highlight(myData[i].word); // show  ↩
                          all annotation words
20                 }
21                   .................
22                 startTouch();  //invokes a handler for binding  ↩
                        touchstart event and its handler to the annotated  ↩
                        words
23
24                 }
25                else{.....}
26
27                 }
28            else if(annotateCount == 0) //to check if annotation is  ↩
                      currently not displaying  on learning
29            {.........}
30              else      //it comes into play only when the annotation  ↩
                      are currently displaying on the content
31                 {
32                   var check = confirm('Would you like to Annotate a  ↩
                          word on this page');
33                   if(check)
34                   {
35                   ...............
36                   jQT.goTo('#textMessage','cube');
37                       }
38                     else
39                     {............................ }//end of if for  ↩
                            annotated word
40            }
```

Listing 5: Shows how displaying annotation is implemented

editor is cleaned up to remove editor from the DOM and send user back to the learning document page.

Editing of annotation is also done in the same way as link using the same editor as described for links.

Read annotation or link feedbacks   Feedback to a link can be done just by editing a link word explained above. Editor which pops out on touching link words has an option to read all feedbacks or shared links suggested by other users contingent on the environment ,if collaborative than from all group members otherwise all independent users. Selecting read option triggers an event which make a request through Ajax function. This request along with data composed of word selected, url and group id (see line number 9 in listing 6)send to the server. Script on server process it and extract the required information from the database and the raw data retrieved from the database is used to generate JSON object, which is the send back to client engine for processing and update a block $(#pageBack) shown in listing 6 on line 22 to display the contents. The block or div having feedback data will hide the current block and assign itself class current as shown in the listing 6

Implementation of reading all feedbacks for annotation is done in very same manner as described for links in listing 6 except invoking a different script[88] for extracting the data.

Help option   This help provides user the information about the icons used as option menu. It calls a load[89] method to obtain directly the DOM elements of a web page on the same domain. The listing 7 shows how straightforwardly it is done. When this method executes, it retrieves the content of /test.html, but then jQuery parses the returned document to find the element with an ID of container here #help. This element, along with its contents, is inserted into the element with an ID of result here#pageBack, and the rest of the retrieved document is discarded.

Group discussion and messaging   Group discussion is implemented in a very simple way. To engage himself in a discussion user must have to join a group first, if they are not a group member. Joining a group is done by showing two selection lists[90], one for group topics and second is active group list. Where active groups means currently member of this groups are sharing their views or information with each other (provided more than one user is active). If user wants to activate an idle group then s/he has to select this group and if s/he hasn't share anything in this group till yet then they are guest for this group. To become a group member they have to share a single information within this group. Once becoming a member of a group they can communicate with the other members of the group. Verifying

---

[88]fetching annotation feedback cd/htdocs/js/AnnotationHandling.js->getAnnotationFeedback(word,cuurentHylos_url,grpId)
[89]please check for load function http://api.jquery.com/load/
[90]selection lists cd/htdocs/js/SelectionList.js

```
1   /*
2   *shows the implementation of fetching the feedbacks for a linked word
3   */
4   function getLinkFeedback(word,currentHylos_url,userIds,checkId)
5       {         ..........
6         $.ajax({
7             type:"POST",
8             url:"../server/getFeedbackLink.php",
9             data:{topic:word,siteDesc:currentHylos_url,grpId:grpId},
10            dataType:"json",
11            success: function(data)
12            {
13              var datas = data.user;                                    ←
                    if(checkId){.............}
14            else{.......}
15              for(var i=0;i<datas.length;i++)
16              {
17                  myAnnotateItems += '<ul class="pageitem"><li class ←
                      ="textbox" ><span class="header">'+datas[i]. ←
                      username+'<span class="timestamp">'+datas[i]. ←
                      date+'</span></span>';
18                  ........
19              }
20              $('#pageBack').append(myAnnotateItems);
21          }//end of success function
22        ...........
23          }
```

Listing 6: Shows how displaying feedback is implemented

```
1    $('#pageBack').load('../client/help.html #help');
```

Listing 7: Simple way to load a specific element from remote document

group membership is done by a global variable `GrpMember` which is a boolean type. Now when user select a group either active or idle, *onSelect* event is triggered which cause an Ajax function call. This function sends a request to server script along with the user-id of the user. Where script sends a query to the database to check if the asked user-id belongs to this group. As each group has a Grp_id assign within grp_discussion database table and this grp_id has a relational link to all id_user (users id) belong to this group. The related id_user list for the group is compared with the sent user-id, If user-id exists in the database table as queried, then it generate a success response as JSON object and send back to the ajax engine, where the call back function is invoked and set the `GrpMember` to *true*. The variable `GrpMember` plays a major role in screening the options. If this variable is true and user select a topic takes user to the new page (another block) with two options shown to the users, one is share option to participate a discussion within the group or second is a leave[91] option to exit the discussion. `GrpMember` with true status allow users to activate a group just by selecting an idle one. When this `GrpMember` variable is set to false then on selecting a active or an idle topic user assist with two options, first is back means user simply depart from the page without doing anything on it and second option is to join[92] the group just by sharing a information with the group. On joining the group set `GrpMember` to true and which let the user to send private messages to other users of the group.

A user can start a new group discussion topic. Bringing in a new topic is done simply by showing a write editor comprises two fields, the first one to label the topic and second field is to write an initial message provide other users a notion that which matter could be discussed here, if they are not sure with the label of user's topic. Submitting a new topic an sends a request via Ajax engine shown in listing 8 along with the new topic (shown in listing 8 on line 2) and server do its queries and check if the topic is already occupied or not. If topic already exists then it generate a JSON object containing the error message and send it back to the engine and it render it to inform user about the error. If no error is received from the server then it sends another request to store this information in the database (shown in listing 8 on line 11).

Messaging within group member can also engross users. It provide users to communicate privately without sharing his information with any other user in a group except the targeted members within the group. It is only Available when `GrpMember` set to true. To check if any message sent for the user a periodic check (see listing 9) is done and on arrival of new messages the icon used for message-box is updated[93] with the number of messages[94]. On click the message-box all the received[95] messages are displayed to the user.

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[91]leave option cd/htdocs/js/JoinLeaveGroup.js->leave()

[92]leave option cd/htdocs/js/JoinLeaveGroup.js->join()

[93]new message update cd/htdocs/js/PrivateMessaging.js->update_private_messages()

[94]new message update cd/htdocs/js/PrivateMessaging.js->showPostIcon(num)

[95]all messages cd/htdocs/js/PrivateMessaging.js->message_call(mydata,title)

```
1   $.post('../server/Start_GrpDisc.php',
2           {topic: $('[name=text_name]').val(),toggle:1,userId: ←
                sessionStorage.userId},
3             function(data){
4                if(data.success)
5                {
6                  alert(data.message);    // to show error message if ←
                        topic already exists
7                }
8                else //start a new topic and take user on the  ←
                    discussion editor
9                {
10                 myToggle = 2;
11                   $.post('../server/Start_GrpDisc.php',
12                   {topic: $('[name=text_name]').val(),comment: $(' ←
                        [name=text_Area]').val(),toggle:2,userId: ←
                        sessionStorage.userId},
13                     function(
14
15                         if(data.success) // call back function
16                         {
17                           .......
18                           jQT.goTo('#Discussion','cube');
19                         }
20                         else{jsvar1=data.message;}                    ←
                                               },'json');
21              }},'json');
```

Listing 8: It shows the implementation of starting anew topic for discussion.

```
1   function call_updateDiv()
2           {
3              myLink = window.location.hash;
4              if(myLink == '#Read') //do the periodic check only at this ↩
                  block
5                {
6                  $.ajax({
7                      type:"POST",
8                      url:"../server/checkGrpMessage.php",
9                      .........
10                     success: function(data)
11                       {
12                          ...........
13                       }
14                    });
15
16                 update_private_messages();//to update private messages ↩
                      after every 5 secs
17               }
18             setTimeout(call_updateDiv,2000);//to update after every ↩
                  5 secs
19               }
```

Listing 9: It shows the implementation of periodic check for new information feed to this discussion or a new private message received by a user.

8 Test and Evaluation

Test and Evaluation is a very vital process through which a system or components are compared against requirements and specifications. The functionalities detailed in design are fully implemented to produce the desired results. This chapter shows the initial setup requirements and rendition of the application. The execution of the application and its usage is shown as screen shots captured from the iPhone simulator on MacBook.

As all web application run on the server unless they are made to work offline as well. So a server for this application is also configured, Apache server is used for this purpose. Apache is configured on mobi2 server in **inet**[96] lab. A virtual host[97] is created on the apache server and port 80 (default port) is assigned to it. The URL *http://mobi2.cpt.haw-hamburg.de/* is assigned to this project. MySql database is also installed on the same server to make it easily available for the application just by using localhost rather than defining an IP to that.

The performance analysis cannot be done because I used a different way to implement this application. As `tap` event is used rather than a `click` event, leads to problem using `tap` event on desktop browser which does not produce the desired action as required by the application. The iPod touch is used for testing in real time environment but problem is that its an external hardware which can not produce screenshots for the testing, hence to cope this hitch the iPhone simulator is used.

8.1 Authentication

On accessing *http://mobi2.cpt.haw-hamburg.de/* a login page (see figure 24) has been shown to the user for authentication. User can only login, if they already registered themselves using the registration option available on the login page. Unfortunately the registration option is not visible on the figure 24 because of the screen limitation.

Registration form is shown in figure 25, which is used to store the essential information of the user in the database, like username, password, gender and so on for future authentication as user. After registration user is send back to the loin page to access the application obviously after logging in.

8.2 Altering and Visualizing contents

As mentioned in chapter 4 application provides user the ability to interact with the contents extracted from the remote web. Contents alteration can be done by different means like anchoring links to a word or annotating the words, editing the annotation by giving feedbacks, updating the links and annotation for a word. This section shows the different options used

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[96](where inet stands for internet network engineering taskforce)
[97]more info on virtual host http://httpd.apache.org/docs/2.0/vhosts/examples.html

Figure 24: Login page fro authorizing users to access the application

Figure 25: Registeration form to become an authorize user for application

by the user for content manipulation Figure 26 shows the initial page which pop up after the login and used to navigate the hyLOs contents. On selecting the desired content to work with, takes you to the content showing a menu-bar overlaying at the bottom of the content area shown in figure 27

Figure 26: Communication protocol at a forwarding node or a destination node

8.2.1   Displaying Annotation and links

When user `tap` on the annotation option, it will show all the annotated words highlighted as blue underlined shown in figure 27 with menu-bar. Now touch any annotated words turn up an editor showing the initial information tied to it by user, where the title shows the word because popped up editor might hide some part of the word. The editor consists four options read, write, help and close option to close the editor shown in figure 28. Same is done for link as well shown in figure 29

Figure 27: Showing the menu-bar tools use for content manipulation with annotation highlighted on the contents

Figure 28: Showing annotation on the contents as blue <u>underlined</u> words and the tool editor

Figure 29: Showing link on the contents as blue <u>underlined</u> words and the tool editor

8.2.2 Read and Edits feedbacks for Annotation and links

Tapping the read button on the tool editor display all feedback to this annotated/linked word to the user. As shown in figure 30 how all the shared links are listed. Homogeneously done for annotation feedback. On using the write option from the tool it swap to the write editor as shown in figure 31 composing title as annotated word to be edited with one button each on left and right top corner besides the title. Where the back button takes user back to the content page and submit button leads to invoke a request using Ajax engine to store the submitted feedback for specified word. Editing the link can be analogous to that of editing annotation. This write editor is reused for all writing purposes throughout the application.

If user cannot perceive the action linked to the tools option then he can use the help option shown in figure 29 (second option from right on editor) to get acquaint with all the actions

Figure 30: Shows all the shared link for a linked word
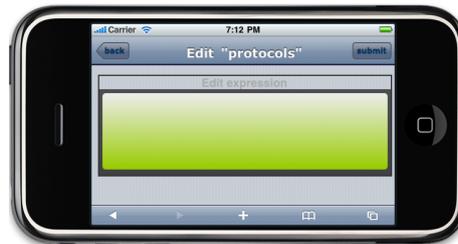
Figure 31: Shows how editing annotation for a word

tied to images on the tool editor. Then help displays all metaphors and their functionalities
explained as shown in figure 32 and 33.

Figure 32: Explain the action tied to the tool metaphors A
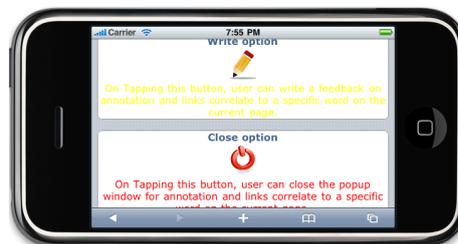
Figure 33: Explain the action tied to the tool metaphors B

8.2.3   Showing the information about active users

Showing active user is very important tool when it comes to the group discussion topics. Where users are keen to know which group members are online to share or ask problems on learning documents. Active user list shows different results in two distinct occasions. When a group user use this action outside the message box then it shows a list of all active group member but if it is utilized from the message box then it shows all the group member so that user can send message to anyone . Calling active user list display a list of users as shown in figure 34 and on tapping on the user name takes you to the block where all information about the ask user is screened as shown in figure 35 and 36.

Figure 34: Shows a list of all active or all user depend on the action call

Figure 35: Shows the information of a user where gender is male seen from the image

Figure 36: Shows the information of a user where gender is female seen from the image

8.2.4 Group discussion and Messaging

Group discussion is very vital part in this application. To start a new group discussion topic user select the start option shown in figure 37. On selecting read group discussion user can join a group by selecting a topic from the group selection list as shown in figure 38. Tapping on selection option it turn up a selection list as shown in figure 39. After selecting a group, if user is not a member of the group, will get the options either to join the group or just go back and look for another group of his interest as shown in the figure 40. On joining the group the option will change to different options as shown in figure 41. These join option is shown directly if user already have a membership of this group.

On receiving a message user simply tap on the message icon and it will take the user to the inbox where user can read all the messages as shown in figure 42

Figure 37: Offers user to start a new group discussion topic or join an existing one

Figure 38: Shows the two selection list one for all groups and second for active groups

Figure 39: Shows how selection list scroll down for users

Figure 40: Show the option avails to the user, if he is not a member of the selected group

Figure 41: Show the option avails to the user, if he is a member of the selected group or just join the group

Figure 42: Shows all the messages received by the user

The test for the accessibility of the application is performed and shown in this chapter, exhibits comprehensible results on the iPhone simulator. The application performs all the

action discussed in the chapter 4. The annotation and link display, editing feedbacks, fetching the remote web contents and display them for exploitation.

The only major problem was noticed during the resting phase is the crash of the mobile safari on zooming in the documents. It is because when we zoom in, it renders the size of the text and rendering is done on the iPhone itself. If page consists lots of images then iPhone require more memory to render the document and when user zoom to a large extent, leads to a memory shortage or memory leak, which causes the shutdown of the web safari. So solution to the problem is simply not zoom in for a large size.

The other problem is displaying the remote contents properly on the defined screen. If you carefully see there is a problem on displaying the contents of the hyLOs. The titles are marginally shifted to the left rather than showing in middle of the container as in original documents. The major cause is the scalability issue of the viewport for the non-iPhone web application. But this problem can be ignored due to the fact user hardly catch this problem.

9 Conclusion and Future works

I have extended an existing e-blended learning system with an extra layer, to offer a more flexible and effective learning process to mobile students (here students with mobile phone devices).

System now provides users the possibility to consult learning materials, to share and to put supporting communication applications at their disposal where, when and with a specific device, that is the iPhone. Sharing is done by annotating or tying links to the words or phrases on the contents extracted from remote sites. Application allows learners to group themselves which authorize them to distribute, aggregate, and share information with ease in a group, resulting in more successful collaboration.

During the testing phase of application some of the problems come across, which are consider here with suggestion and also describe some of the technologies which can be used to expand the system in future and made it more resilient.

As annotation or linking are tied to words within a document which is extracted from the remote web. This Application has no influence on the content of the remote documents so If there is any change in the remote document or remove of the URL from the web leads to abandon links or annotations relate to them. Now these annotation and links are of no use, so a future work could be implementing an option, if the utilized word or phrase is removed or updated than related annotation should also be removed or tied to some other content within the same document provided it give meaningful explanation to it.

The system can be diversified to give user more opportunity of adding hot-spot annotation[98] on the images. Why so? Provide motivation to make application more inviting for learners. Example if you look slide[99] from Prof. Thomas C. Schmidt on default learning document (hyLOs) where an image describe about mobile IPv4. So if user create a group to discuss on this topic, then might cause that the information shared by the learners are not clear to the other members. Cause could be that other peers are not able to point out the relevant content on the image which a learner had tried to spotlight in his explanation . To overwhelm this kind of state one can do hot-spot annotation, technology is not new and already implemented on photo-sharing site Flickr which provides a valuable resource for students and educators looking for images for use in presentations, learning materials or coursework. Many of the images uploaded to Flickr carry a Creative Commons license[100], making them particular suitable for educational use - and the tagging of images makes it much easier to find relevant content.

Beth Harris[101], director of distance learning at the Fashion Institute of Technology, State University of New York, has used this feature-the ability to add hot-spot annotations to an

---

[98]Hot-spot Annotation http://www.leadtools.com/help/leadtools/v16/Main/clib/DLLSTEPS/40Hot.htm

[99]http://hylos.cpt.haw-hamburg.de/staticHTML/MobilityManagementNextGenerationInternet/section/HyLOs/content/Data/MIPv6

[100]Creative Commons License http://creativecommons.org/

[101]About Beth Harris http://smarthistory.org/About-the-Editors.html

image-enable her students to annotate and discuss a series of paintings as part of an online art history course. To have more feeling how it works please try site[102]. Now lots of social networking sites are also providing this facilities of annotating images under the option *link your friend* in the picture example "http://studivz.net".

The application also provide users to do private messaging within a group as a member. This facility is not fully implemented, because it shows only the messages from the group where user is currently active, but not from the other groups where he is also a authorize member. He get the messages only when he joins the group. So this option can be expanded to give a more wider range to express from which other groups he can get the message concurrently with his messages from the current group.

The vital problem which has to be figured out is the back-forth history button. As some of the pages are dynamically generated by the application and are removed after use, but during a call to those pages cause an entry in the history stack. Therefore, it causes crash of the application when back button tries to call a page which does not exist anymore and leads to blank screen with no response. It can be solved by finding a method which takes care about the pages which are dynamically generated and on their removal this method should delete those pages from the history stack as well.

[102]http://www.flickr.com/photos/cogdog/269039506/

List of Figures

List of Tables

Listings

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Acronyms

PDA   Personal Digital Computer

OS   Operating System

DOM   Document Object Model

GUI   Graphical User Interface

PC   Personal Computer

CSS   Cascaded Style Sheet

GPRS   General Packet Radio Service

IrDA   Infrared Data Association

WiFi   Wireless Fidelity

WiMAX   Worldwide Interoperability for Microwave Access

XHTML   Extensible HyperText Markup Language

HTML   HyperText Markup Language

WAP   Wireless Application Protocol

LO   Learning Object

API   Application Programing Interface

UI   User Interface

XML   Extensible Markup Language

HTML   HyperText Markup Language

HTTP   HyperText transfer protocol

LOM   Learning Object Metadata

hyLOs   Hypermedia eLearning Object System

I declare within the meaning of section 25(4) of the Examination and Study Regulations of the International Degree Course Information Engineering that this Master Thesis has been completed by myself independently without outside help and only the defined sources and study aids were used. Sections that reflect the thoughts or works of others are made known through the definition of sources.

Hamburg, August 18, 2010   Gupta, Mahesh