



ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
COLLEGE OF NATURAL SCIENCES
DEPARTMENT OF COMPUTER SCIENCE

**WEB-BASED CONTENT MANAGEMENT SYSTEM FOR DIGITAL RESOURCES IN
ETHIOPIAN UNIVERSITIES: THE CASE OF WOLLO UNIVERSITY**

By
Jemal Hassen Sirage

A Thesis Submitted to the School of Graduate Studies of Addis Ababa University in Partial Fulfillment of the Requirements for the Degree of Master of Science in Computer Science

March 2013

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
COLLEGE OF NATURAL SCIENCES
DEPARTMENT OF COMPUTER SCIENCE

WEB-BASED CONTENT MANAGEMENT SYSTEM FOR DIGITAL RESOURCES IN
ETHIOPIAN UNIVERSITIES: THE CASE OF WOLLO UNIVERSITY

By

Jemal Hassen Sirage

Name and Signature of Members of the Examining Board:

Name	Signature
1. Dr. Solomon Atnafu, Advisor (AAU)	_____
2. Dr. Jose Antonio Gonzalez, Advisor (UPC)	_____
3. _____	_____
4. _____	_____

ACKNOWLEDGEMENTS

This work would not be accomplished without the help and guidance of my almighty GOD, most Merciful and most Gracious, and first of all, my thank goes to the almighty for his endless blessings on all of my endeavors. Then I would like to express my deepest gratitude to my Advisor Dr. Solomon Atnafu, for his unreserved assistance and constructive comments at all stages of my work. I would like to appreciate his commitment, patience and guidance in a lot of discussions we have had on various problems during the course of the work.

Furthermore, I would like to express my deepest gratitude to my external Advisor Dr. Jose Antonio González from Universitat Politècnica de Catalunya (UPC) for his constructive comments and valuable ideas on different parts of my work, and I would like to thank two post graduate students and representatives of UPC's Student association AUCOOP, Jesus Berden Penato and Aida Abiad for their strong dedication for the creation of collaboration between UPC and Wollo University, and for their observation of problems in Wollo University and giving ideas to be done for solving the problems during their stay in Wollo University, and I appreciate also their contribution to my work by giving different valuable ideas and comments on different parts of the work.

Finally, I would like to thank Wollo University staff members and students, Addis Ababa University Computer Science Department staff members, and my classmates for their cooperation and collaboration that contributes many different things in one way or the other for the success of this work.

TABLE OF CONTENTS

<i>LIST OF TABLES</i>	<i>iv</i>
<i>LIST OF FIGURES</i>	<i>v</i>
<i>ACRONYMS AND ABBREVIATIONS</i>	<i>vi</i>
<i>ABSTRACT</i>	<i>vii</i>
<i>CHAPTER ONE: INTRODUCTION</i>	<i>1</i>
1.1 <i>Statement of the problem</i>	<i>3</i>
1.2 <i>Objectives</i>	<i>5</i>
1.3 <i>Scope and Limitations</i>	<i>6</i>
1.4 <i>Methodology</i>	<i>6</i>
1.5 <i>Application of the Results</i>	<i>7</i>
1.6 <i>Organization of the Document</i>	<i>8</i>
<i>CHAPTER TWO: LITRATURE REVIEW</i>	<i>9</i>
2.1 <i>Digital Resources Overview</i>	<i>9</i>
2.2 <i>Learning Objects</i>	<i>10</i>
2.3 <i>Digital Content Management</i>	<i>11</i>
2.4 <i>Content Management System</i>	<i>11</i>
<i>CHAPTER THREE: RELATED WORK</i>	<i>16</i>
3.1 <i>Content Management System for Academic Digital Resources</i>	<i>16</i>
3.2 <i>Content Management System for Administrative Digital Resources</i>	<i>18</i>
<i>CHAPTER FOUR: DATA ANALYSIS</i>	<i>21</i>
4.1 <i>Current Practice of Digital Resources Sharing and Management</i>	<i>21</i>
4.1.1 <i>ICT Usage in the Current System</i>	<i>22</i>
4.1.2 <i>Digital Resources Sharing and Management</i>	<i>27</i>
4.2 <i>Current Teaching and Learning Approach</i>	<i>30</i>
4.3 <i>Need for Intranet CMS System</i>	<i>33</i>
4.4 <i>Communication Needs</i>	<i>37</i>
<i>CHAPTER FIVE: Requirements Specification and Analysis</i>	<i>41</i>
5.1 <i>Principal Actors</i>	<i>41</i>
5.2 <i>Functional Requirements</i>	<i>42</i>
5.3 <i>Product Functions</i>	<i>43</i>
5.4 <i>General Constraints</i>	<i>43</i>
5.5 <i>Assumptions and Dependencies</i>	<i>44</i>
5.6 <i>Non Functional Requirements</i>	<i>44</i>
5.7 <i>System Models</i>	<i>45</i>
5.7.1 <i>Use case Models</i>	<i>45</i>
5.7.2 <i>Use Case Descriptions</i>	<i>48</i>
5.7.3 <i>Sequence Diagrams</i>	<i>60</i>
5.7.4 <i>Class Diagram</i>	<i>67</i>
<i>CHAPTER SIX: SYSTEM DESIGN</i>	<i>69</i>
6.1 <i>Introduction</i>	<i>69</i>
6.2 <i>Design Goals</i>	<i>69</i>
6.3 <i>System Architecture</i>	<i>70</i>

6.4 Subsystem Decomposition	73
6.4.1 Enterprise Content Management Subsystem	73
6.4.2 Course Content Management Subsystem	75
6.5 Deployment Diagram (hardware/ software mapping)	79
6.6 Persistent Data Management	79
<i>CHAPTER SEVEN: IMPLEMENTATION</i>	<i>80</i>
7.1 Development Tools	80
7.2 WUCMS System Interfaces.....	81
7.2.1 Enterprise Content Management Subsystem Interfaces.....	82
7.2.2 Course Management Subsystem Interfaces	87
<i>CHAPTER EIGHT: SYSTEM USABILITY TEST</i>	<i>96</i>
8.1 The ease of use of the system.....	97
8.2 The appearance, look and layout of the system	98
8.3 Multimedia data usage ability	98
8.4 Benefits of the System to the Community.....	99
8.5 System Capability.....	100
<i>CHAPTER NINE: CONCLUSIONS AND RECOMMENDATIONS</i>	<i>102</i>
9.1 Conclusions.....	102
9.2 Recommendations	104
<i>References</i>	<i>105</i>
<i>Appendix A: Questionnaire to be Completed by Teachers</i>	<i>107</i>
<i>Appendix B: Questionnaire to be completed by ICT Technical Personnel</i>	<i>110</i>
<i>Appendix C: Questionnaire to be Completed by Students</i>	<i>113</i>
<i>Appendix D: Questionnaire to be Completed by Administrators and Staff</i>	<i>115</i>
<i>Appendix E: System Usability test Questionnaire</i>	<i>117</i>
<i>Appendix F: Sequence Diagrams</i>	<i>119</i>

LIST OF TABLES

TABLE 4.1: INTERNET ACCESS REPORTED BY STUDENTS	22
TABLE 4.2: MAIN PROBLEMS NOT TO USE INTERNET AS A TEACHING TOOL.....	23
TABLE 4.3: EXPERIENCE OF STUDENTS USING INTERNET AS A LEARNING TOOL	23
TABLE 4.4: A TASK WHICH TAKES MUCH TIME WHILE BROWSING INTERNET	24
TABLE 4.5: WAYS OF SHARING CURRENTLY PRACTICED	27
TABLE 4.6: POSSIBILITY TO UPLOAD AND SHARE DIGITAL RESOURCES.....	27
TABLE 4.7: AVAILABILITY OF DIGITAL COURSE MATERIALS.....	28
TABLE 4.8: SHARING METHODS CURRENT SYSTEM DEPENDS UP ON	28
TABLE 4.9: PREFERENCE OF DIGITAL RESOURCES FOR SHARING	29
TABLE 4.10: DIFFERENT USER ROLES IN THE CURRENT SYSTEM	29
TABLE 4.11: DISTRIBUTION OF STUDENTS' HAND BOOK	30
TABLE 4.12: POSSIBLE REASONS NOT TO DELIVER STUDENTS' HAND BOOK.....	30
TABLE 4.13: AVAILABILITY OF TEXT AND REFERENCE BOOKS	31
TABLE 4.14: AMOUNT OF TEXT AND REFERENCE BOOKS	31
TABLE 4.15: MAIN PROBLEMS IN DISTRIBUTING COURSE MATERIALS	31
TABLE 4.16: PROBLEMS IN NOT USING CONTINUOUS ASSESSMENT	32
TABLE 4.17: PARTICIPATION OF STUDENTS IN THE CLASSROOM.....	32
TABLE 4.18: INSTRUCTORS' AGREEMENT ON STUDENT PARTICIPATION	33
TABLE 4.19: MAIN PROBLEMS NOT TO PARTICIPATE IN THE CLASSROOM	33
TABLE 4.20: EXISTENCE OF INTRANET CONTENT MANAGEMENT SYSTEM.....	34
TABLE 4.21: REASONS HOW INTRANET CMS FACILITATES ASSESSMENT AND SHARING.....	34
TABLE 4.22: PLAN TO ESTABLISH INTRANET CMS	34
TABLE 4.23: AGREEMENT ON ESTABLISHING INTRANET CMS BY ADMINISTRATORS AND STAFF	35
TABLE 4.24: EFFECTIVENESS OF INTRANET SYSTEM.....	35
TABLE 4.25: WILLINGNESS TO PARTICIPATE FOR INTRANET SYSTEM.....	36
TABLE 4.26: TIME TO DEDICATE FOR INTRANET SYSTEM	36
TABLE 4.27: PARTICIPATION OF STUDENTS FOR THE INTRANET SYSTEM.....	37
TABLE 4.28: METHODS OF COMMUNICATION USED	37
TABLE 4.29: POSSIBLE PROBLEMS ON COMMUNICATION METHODS USED.....	38
TABLE 4.30: EXPERIENCE OF USING DIGITAL COMMUNICATION.....	38
TABLE 8.1: RESULTS FOR EASE OF USE OF THE SYSTEM	98
TABLE 8.2: THE GRAPHICAL USER INTERFACE OF THE SYSTEM.....	98
TABLE 8.3: MULTIMEDIA DATA USAGE.....	99
TABLE 8.4: BENEFITS OF THE SYSTEM TO THE COMMUNITY	99
TABLE 8.5: SYSTEM CAPABILITY	100

LIST OF FIGURES

FIGURE 4.1: WIRELESS DEPLOYMENT IN DESSIE CAMPUS.....	26
FIGURE 4.2: WIRELESS DEPLOYMENT IN KOMBOLCHA CAMPUS.....	26
FIGURE 5.1: USE CASE DIAGRAM FOR CONTENT ADMINISTRATOR.....	46
FIGURE 5.2: USE CASE DIAGRAM FOR INSTRUCTOR.....	46
FIGURE 5.3: USE CASE DIAGRAM FOR STUDENT.....	47
FIGURE 5.4: USE CASE DIAGRAM FOR ADMINISTRATIVE HEAD.....	47
FIGURE 5.5: USE CASE DIAGRAM FOR ADMINISTRATIVE STAFF.....	48
FIGURE 5.6: SEQUENCE DIAGRAM FOR ASSIGN ROLE USE CASE.....	61
FIGURE 5.7: SEQUENCE DIAGRAM FOR MANAGE ACCOUNT USE CASE.....	61
FIGURE 5.8: SEQUENCE DIAGRAM FOR SEND MESSAGE USE CASE.....	62
FIGURE 5.9: SEQUENCE DIAGRAM FOR TAKE BACKUP USE CASE.....	63
FIGURE 5.10: SEQUENCE DIAGRAM FOR CREATE COURSE USE CASE.....	63
FIGURE 5.11: SEQUENCE DIAGRAM FOR ENROLL STUDENTS USE CASE.....	64
FIGURE 5.12: SEQUENCE DIAGRAM FOR CREATE QUIZ USE CASE.....	64
FIGURE 5.13: SEQUENCE DIAGRAM FOR VIEW COURSE USE CASE.....	65
FIGURE 5.14: SEQUENCE DIAGRAM FOR SUBMIT ASSIGNMENT USE CASE.....	65
FIGURE 5.15: SEQUENCE DIAGRAM FOR POST NOTICE USE CASE.....	66
FIGURE 5.16: SEQUENCE DIAGRAM FOR VIEW NOTICES USE CASE.....	67
FIGURE 5.17: CLASS DIAGRAM OF WUCMS.....	68
FIGURE 6.1: THREE TIER ARCHITECTURE OF THE PROPOSED SYSTEM.....	71
FIGURE 6.2: PHYSICAL IMPLEMENTATION OF THE SYSTEM.....	71
FIGURE 6.3: WUCMS ARCHITECTURE.....	72
FIGURE 6.4: SUBSYSTEM DECOMPOSITION.....	76
FIGURE 6.5: WUCMS DEPLOYMENT DIAGRAM.....	79
FIGURE 7.1: WUCMS HOME PAGE.....	81
FIGURE 7.2: POSTING DIGITAL RESOURCES.....	82
FIGURE 7.3: UPLOADING DIGITAL DOCUMENTS.....	83
FIGURE 7.4: DOWNLOADING DIGITAL CONTENTS SHARED BY OTHERS.....	84
FIGURE 7.5: MESSAGING SERVICE USER INTERFACE.....	85
FIGURE 7.6: USER SENDING MESSAGE TO ONE OR MULTIPLE USERS.....	85
FIGURE 7.7: SEARCHING FORUMS.....	86
FIGURE 7.8: POSTING FORUM TOPIC.....	87
FIGURE 7.9: LOGIN FORM.....	88
FIGURE 7.10: LEARNING MANAGEMENT SYSTEM HOME PAGE.....	88
FIGURE 7.11: CREATING COURSES.....	89
FIGURE 7.12: ADDING AND ACCESSING COURSE CONTENTS.....	90
FIGURE 7.13: ENROLLING USERS TO PARTICULAR COURSE.....	90
FIGURE 7.14: TEACHERS CAN CREATE GROUPS.....	91
FIGURE 7.15: TEACHERS CAN PREPARE QUESTIONS FOR QUIZZES AND TESTS.....	91
FIGURE 7.16: GRADE REPORTS FOR ASSESSMENTS TAKEN BY STUDENTS.....	92
FIGURE 7.17: STUDENTS CAN VIEW THEIR GRADES FOR ALL TYPES OF ASSESSMENTS.....	92
FIGURE 7.18: STUDENT ACCESSING CHAPTER ONE.....	93
FIGURE 7.19: STUDENT ATTEMPTING QUIZZES.....	93
FIGURE 7.20: STUDENTS CAN VIEW ASSESSMENT RESULTS.....	94
FIGURE 7.21: STUDENTS CAN CHECK MESSAGES AND REPLY TO MESSAGES.....	94
FIGURE 7.22: DISCUSSION FORUM INITIATED BY A STUDENT AND ONE REPLY BY A TEACHER.....	95
FIGURE 8.1: SYSTEM USABILITY TEST RESULTS.....	101

ACRONYMS AND ABBREVIATIONS

AAU	Addis Ababa University
AUCOOP	Association of University Students for Cooperation
CMS	Content Management System
DNB	Digital Notice Board
e-Learning	Electronic learning
HTTP	Hyper Text Transfer Protocol
ICT	Information Communication Technology
ICT4D	Information Communication Technology for Development
IEEE	International Electrical and Electronics Engineering Association
LAN	Local Area Network
LMS	Learning Management System
Moodle	Modular Object-Oriented Dynamic Learning Environment
OS	Operating System
PHP	Hyper text Preprocessor
SRS	System Requirements Specification
UI	User Interface
UPC	Universitate Polytechnica De Catalonia
URL	Uniform Resource Locator
WAN	Wide Area Network
WCMS	Web-based Content Management System
WUCMS	Wollo University Digital Contents Sharing and Management System

ABSTRACT

As content management is a set of processes and technologies that support the collection, management, and publishing of information in any form or medium, its application becomes crucial in different institutions that utilize and produce digital contents in day to day activities. Higher education institutions are one of such institutions that hold a vast amount of digital information that need to be managed including course contents, employee and student databases, academic and administrative rules and regulations, public notices and internal communications, laboratory manuals, maps and images, multimedia contents and so on. As the volume of digital information increases, its complexity of sharing and management also increases. To overcome this problem, there should be a content management system that can ensure the efficient management and sharing of these digital resources. Therefore, the objective of this study is to assess the current practice in digital resources sharing and management in Ethiopian Universities, in particular that of Wollo University, and to identify the possible problems occurred in the current system and to propose a content management solution by developing a particular content management application for the Intranet of Wollo University that improves the teaching-learning process and enhances communications between users by allowing members of the University community to easily create, edit, review, publish, re-use, and manage different digital resources in various formats.

To come up with some solution, we have studied the current practice in teaching and learning and administration activities of Wollo University and we have identified problems of the current system. The identified problems that are related to the traditional teaching and learning and administration activities have been solved by developing and implementing a content management and sharing system. The system is implemented on top of the University's Intranet so that it can run without the need to have Internet connectivity. Moreover, the system can be used to share digital course contents that improves shortage of text and reference books, can facilitate self-learning opportunities to students, can support administration activities in terms of digital resource sharing and integration of modern ways of communication methods such as discussion forums, messaging, and chatting. We have implemented the system, and System Usability Test has been done by using Wollo University community members as participants and real environment data. As the feedbacks collected from users showed, the system has brought great improvements for Wollo University and has shown promising results to be used by other Ethiopian Universities.

Key-Words: - Content Management, Digital Resource Sharing, CMS, Course Management Systems, Digital Communication

CHAPTER ONE

INTRODUCTION

ICT services are improving step by step in Ethiopia, and there are different ongoing initiatives about ICT for Development (ICT4D). Most of these initiatives are related with issues like e-learning, digital libraries or Broadband Internet Access, and some of them are engaged by governmental agencies, in the framework of the ICT4D Capacity Building national plan [1].

In order to achieve the goals of these initiatives educational institutions need to have an internal network infrastructure that will allow the development of the various ICT applications and services depending on the needs of the community, in addition to this, one of the ICT uses for Universities all over the world is the arrangement of internal networks, called Intranets, where digital content and information will be locally available for the community, independently from the Internet Access. In today's higher education environments the availability of digital contents is increasing gradually from time to time in both size and format. Moreover, in this digital age as nearly everything can be digitized through the process of digitization, this results with the availability of huge amount of digital information that need to be managed and controlled through content management systems.

Content management is the set of processes and technologies that support the collection, management, and publishing of information in any form or medium. In recent times this information is typically referred to as content or, to be precise, digital content. Digital content may take the form of text, such as documents, multimedia files, such as audio or video files, or any other file type which follows a content lifecycle which requires management. The digital content in University environments could be: different courses in electronic form, collection of course support e-books, rules and legislations, public notices

and internal communications, student and staff databases, laboratory manuals, administrative letters, digital images or maps, and so on. As the volume of information provided by organizations on the Web increases, so do the problems of managing that information. Moreover, such issues are not only common in the business-to-consumer e-commerce sector, but also increasingly between organizations via extranets and within them via Intranets [9].

Related to this, Content Management Systems (CMS) are one of the most popular tools nowadays for the development of web-based content applications for University Intranets, e-learning platforms and many other related services. A CMS is a collection of procedures and modules used to manage work flow in a collaborative environment, and designed to do several tasks, namely, allow for a large number of people to contribute to and share stored data, control access to data based on user roles, aid in easy storage and retrieval of data, improve the ease of report writing and improve communication between users [2]. In addition to this, a content management system is a tool that enables any staff member in an organization – with or without an IT background – to manage and update web content without the help of a webmaster. Users only see and work with two elements of a content management system – the ‘front-end’ and the ‘backend’. The front-end represents the website as it appears when accessed by visitors, with its WebPages, documents, images, forms, multimedia clips and other types of content that come with today’s websites. The back-end can be considered as a control panel, or the interface with the system’s databases that hold the content and the templates that define the ‘look and feel’ of the site [10]. The use of CMS to develop web-based content applications for the University Intranet will have a paramount importance for the Capacity Building of the whole University community.

There are several Universities in Ethiopia with lack of ICT infrastructure and adequate applications, and most of the time only very few services are available. For instance, a proper Internet Access, Intranets with digital documents available (like e-library), or automated registration systems are some examples of ICT-related services unavailable in most of these Universities even if they have an outstanding importance in higher education environments. Given that, exploring the ways to implement such kind of applications for

the University Intranet is essential to raise the awareness of the use of ICT for development of educational resources.

Web-based Content Management Systems (WCMS) are among the notable ICTs diffusing in higher learning environments globally [3]. It is known that WCMS is the next generation of tools for empowering distributed management of website information. These systems are centrally run and provided to any computer attached to the Intranet of the organization, that is, there is no computer setup necessary to use the systems and no software versions or upgrades to worry about. For the end user, they run entirely within the web browser and provide an interface for finding, editing, and publishing digital contents. An instructor using a WCMS can place course materials online, communicate with students, track their progress, and conduct online tests, quizzes, and so forth. Therefore, the implementation of a web-based content application for the Intranet of an Ethiopian University will increase the quality and productivity of the teaching and learning system and it will make easier the communication among the members of the University.

1.1 Statement of the problem

In a baseline survey conducted by the Ministry of Education, it is identified that most Universities and institutions of higher learning in Ethiopia have computers to certain extent. However, these computers are few in number and in most cases shared at a student-computer ratio of 10:1. The study also showed that despite the presence of computers, most of the institutions (particularly the new ones) lack a network infrastructure and have limited connectivity. The lecturers are yet required to adopt ICT as a teaching tool, and only a small number of students use computers and the Internet as a learning resource [4].

However, there has been some improvement in certain Universities. Addis Ababa University (AAU), for instance, has an ICT Development Office charged with the sole

responsibility of implementing ICT initiatives [5], including the development of systems and infrastructure for students, lecturers, and administration staffs.

But, there are still several new Universities with lack of ICT resources management, as well as a proper Internet access bandwidth, and this is one of the reasons why locally available networks, such as Intranets, play an important role in the use or sharing of digital resources using CMS in many Universities.

As a particular example, it can be stated that Wollo University does not have any established system for digital content management. The development of a web-based content management application will let to use the existent ICT services to share digital resources and will let to create new ones. There is much worldwide information that cannot reach the University, due to the lack of a proper system that manages all this information and that makes it available for the University community, through its Intranet. So, there is a need of implementing a system that helps the community to access this information in a proper way.

Due to the diverse nature of the required tools in the ICT department of Wollo University, the aim of the web-based CMS application proposed in this work would be to join all these applications together in the Intranet, in order to facilitate the management of all of them. This structured ICT web-based application will drive Wollo University to the development of other digital resources and it will contribute to the capacity building of its learning and research activities.

1.2 Objectives

General Objective

The main objective of this study is to design and develop a web-based content management system for digital resources in Ethiopian Universities with a particular case of Wollo University.

Specific Objectives

The specific objectives include:

- Conduct literature review of other similar ongoing projects in other Universities and related works that have used Content Management Systems.
- Conduct review of related work about the state-of-the-art of CMS in University environments, for example Moodle, Joomla, Drupal, etc.
- Identify system requirements and perform requirement analysis.
- Design the web-based content management system application on the basis of the identified requirements.
- Develop the web-based content management system application in order to allow the members of the University to easily create, edit, review, publish, re-use and manage different digital resources.
- Test and evaluate the developed system.
- Create knowledge documentation and user manual for the installation, configuration, administration, and use of the application.
- Access the possible impact of CMS for the development of educational resources in Ethiopian Universities.

1.3 Scope and Limitations

The management of digital resources for the University community includes several applications and services, like Learning Management System, Digital Library System, Registration System, Human Resource Management System, Student Information System, Finance and Accounting System, and Internal Communication System. Therefore, the scope of this work is to develop a particular web based content management system that can be used as a Learning Management System, and a means to facilitate administrative digital contents sharing and management as well as enhance communication between members of Wollo University. This application will operate as a user friendly platform to allow users to share any kind of information related to the University. Moreover, this application and all its content will be available locally, independently from the Internet connection. Because of time and resource limitations, the other systems mentioned above will not be developed and this work is dependent only on the needs and requirements of Wollo University, and digital resources sharing and management activities of other Ethiopian Universities will not be included.

1.4 Methodology

Data collection

Appropriate data will be collected in order to evaluate the current situation of Wollo University, in terms of digital resource sharing, ICT infrastructure and services available. Then, the type of service to be developed will be defined based on the specific needs of the community taking into account the available resources and the different roles of the University community (students, academic and administrative staff). After that concrete specifications that the system should fulfill will be stated, and the system requirements will be defined in order to start the development of the system.

Literature Review

The literature review part will focus on reviewing important literatures that have been done related with content management systems and reviewing some common content management systems.

Development Tools

The web-based content management system application will be developed using one or more of the available open source content management systems. The application files and digital content will be installed in a dedicated server at Wollo University, which is connected to the Local Area Network (LAN) of the University, so it will be accessible from any computer connected in the Campus.

Evaluation

The main goal of the evaluation is to assess the quality and the usability of the system, so different tests will be done, not only to see if the system works as it is expected, but also to check whether it fulfills the requirements from the point of view of the users. Apart from the software tests, different questionnaires will be given to different experts and representatives of the final users of the system (See Appendix E). From the results of this evaluation, it will be possible to rearrange some of the features, and to make the application ready to be implemented in a real environment, that will be the Wollo University.

1.5 Application of the Results

After this work is completed, the idea is to perform a real implementation of the proposed application at Wollo University. Once the final design and testing of the application is completed, the objective will be to install the application on the Intranet of Wollo

University, and test it with real environment information and digital content sharing or management. In addition, all the documentation generated will be used to train ICT staff of Wollo University about the management and maintenance of the application, and also to give different seminars to users from the University community about the uses of the application.

1.6 Organization of the Document

This document consists of nine chapters including this chapter, the introduction part. The literature review and related works are presented in Chapters two and three respectively. Data analysis is discussed in Chapter four, and requirements specification in Chapter five. Chapter six presents the system design, Chapter seven presents the Implementation of the system, Chapter eight system usability test, and the last chapter conclusions and the recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Digital Resources Overview

In this information age, different types of digital resources are becoming common in many institutions. One reason for this could be the increasing awareness of the society about the use of computers and other ICT tools in day to day activities, and another one is the dramatic improvements in computer illiteracy from time to time. As the Internet and World Wide Web contributes a lot for availability of huge amount of digital resources, their benefits also show large improvements. Furthermore, as nearly everything can be digitized through the process of digitization, still their type and size changes increasingly.

Among the different institutions that rely on the use and manipulation of digital resources are higher education institutions and the appearance of digital resources in different formats as texts, images, audio, and video, helps these institutions to improve the teaching-learning process. These days, in most Ethiopian Universities, digital resources like course slides, electronic books, other course support materials, lab manuals, e-mails, different images and maps, audio and video materials are used as a teaching aid to compensate a shortage of printed educational materials. In addition to this, digital resources can be used to create and integrate learning objects in higher education environments that can be used to implement flexible teaching and learning strategies [15] and that will have many advantages to both students and staff members.

Salas and Ellis [15] state that some of the benefits of flexible approaches to teaching and learning for students can be: accommodate for a range of student learning styles and approaches, provide advantage for students who have work and family commitments or

unable to attend classes for different reasons, provide more choices to students about how, when, and where they learn, and can facilitate workplace learning.

In addition to this, flexible approaches to teaching and learning do have benefits for staff members within the University environment, by enabling academic workloads to be organized more flexibly, provide opportunity for teaching across campuses without the necessity of traveling, provide opportunity to share resource materials, and can establish collaborative or commercial situations in which resources developed in one University are used in another.

2.2 Learning Objects

As stated in Salas and Ellis [15], the concept of learning objects is based on the object-oriented paradigm of computer science. The principle of learning objects is related with creating instructional components and reusing them in different learning contexts. The researchers defined learning objects as a unit of instructionally sound content developed based on a learning objective or outcome intended to teach a focused concept. It is a fundamental building block and a self-contained instructional unit by including all the instructionally necessary components. They can be developed using multimedia learning materials such as simulations, animations, tutorials, audio and video clips, quizzes, attachments, illustrations, and assessments for presenting examples, cases, arguments, and practical exercises which can be instructor guided or learner's self-interest.

Learning Objects can be developed in varying size, scope, and depth ranging from a small portion of instruction to a series of resources combined to provide a more complex learning experience in such a way that a particular learning object can be broken up into discrete pieces. This helps teachers and students to construct understanding by creating linkages between these discrete pieces. They have advantages in increasing speed and efficiency of instructional development, in supporting instruction that uses active learning strategies, in supporting student-centered learning environments, and increasing

collaboration and sharing of resources. Therefore, this mode of content development and delivery can play a major role in higher education institutions in improving education and training.

Since the availability of digital contents are common in higher education institutions and from them different learning objects can be constructed to support the teaching and learning process, this results in availability of huge amount of digital contents and production of complex learning objects that makes the management of digital contents very difficult. Therefore, there is a need to implement a system that makes easier the management and coordination of digital resources for their efficient use.

2.3 Digital Content Management

As defined in [10], content means the knowledge of anything and everything contained as information in conventional as well as non conventional form. The process of generating, organizing, digitizing, and making the contents easily accessible to the users is known as content management. It includes a set of tasks and processes for managing content targeted for publication starting from its creation to archive. In content management the content or knowledge units are managed in terms of versions, access control, re-use, etc. It also addresses the process of creating, editing, reviewing, re-using, publishing, and managing elements of content in an efficient manner.

2.4 Content Management System

As stated in [2], a Content Management System (CMS) is a collection of procedures and modules used to manage work flow in a collaborative environment, and designed to do several tasks, namely, allow for a large number of people to contribute to and share stored data, control access to data based on user roles, aid in easy storage and retrieval of data, improve the ease of report writing and improve communication between users. Access to all types of digital assets (content-files) containing images, graphics, animation, sound,

video or text is facilitated by the system. It is usually used to manage digital assets during development of a digital resource [10].

The Need for Content Management Systems

As today's web sites are becoming very large because of the creation and capture of huge amount of digital resources that can be rapidly evolving and dynamic, content management systems are essential for proper handling of these timely information. Moreover, these websites are designed in such a way that they can accommodate a lot of contributors to content and can also upload information from multiple sources [10].

According to this research findings, the main points that can show the necessity of using content management systems are: CMSs are very important if the project involves the capture or creation of digital assets whether the project is small scale or large scale, can facilitate web-based file management which allows the user to browse, edit, retrieve, and download the required information, are essential when there are a lot of contributors to the content, are needed when the amount of change in the content or design is large, are very important if a number of publications are created from the content, and they are necessary for accessing the required digital information in situations that information is changing too quickly.

Types of Content Management Systems

There are a lot of organizations that provide content management system tools, and this results for the availability of large number of content management system tools worldwide that can be grouped into free Open source CMS and Proprietary CMS.

Open source CMS tools are license free software tools that can be downloaded and used for free. Since the source code is also provided to the user, these systems give flexibility to be customized for particular applications or user needs. These days, open source content

management system tools are many in number and Joomla, Moodle, Drupal, and WordPress are among them. Each of these are designed to be used starting from providing full features of website design to a particular design goal such as for forums, shopping carts, blogs, customer relationship management and course management.

Proprietary software is computer software licensed under exclusive legal right of the copyright holder. The license holder is given the right to use the software under certain conditions, but restricted from other uses, such as modification, further distribution, or reverse engineering. Proprietary content management systems are also common and WebCT, Blackboard, and eCollege are among them. As open source content management systems provide flexibility to be customized to a particular requirement as well as reduce development cost and time, they can be used for efficient digital resources sharing and management in different organizations like higher education institutions. Under this section some selected open source content management systems are discussed to make the choice of an appropriate content management system at the design and implementation stage of this work.

a. Joomla

Joomla is an award-winning content management system (CMS), which enables the user to build Web sites and powerful online applications [18]. As stated in the official web site of Joomla, its ease-of-use and extensibility have made Joomla one of the most popular Web site software available. It can be used by individuals, small & medium-sized businesses, and large organizations worldwide to easily create and build websites and web-enabled applications. It is an open source solution and can be used to power Web sites of all shapes and sizes. For example, Corporate Web sites or portals, Corporate Intranets and extranets, Online magazines, newspapers, and publications, E-commerce and online reservations, Community-based portals, etc. Joomla is the most popular open source CMS currently available with over 200,000 community users and contributors [18]. In addition to this, it has powerful application framework that can be used by developers to create sophisticated

add-ons that extend the power of Joomla into virtually unlimited directions. Its core framework enables developers to quickly and easily build inventory control systems, data reporting tools, integrated e-commerce systems, reservation systems, and communication tools. In addition to this, it is based on PHP and MySQL that enable the developer to build powerful applications on an open platform anyone can use, share, and support [18].

b. Drupal

As stated in the official web site of Drupal, it is a publishing platform that provides thousands of free designs and plug-ins for web site development and it is one of open source content management systems. Its well-documented APIs can be used by developers and its flexibility can be also useful for designers. In addition to this, Drupal is designed to be scalable which is preferable by site administrators. Its content management features make it easy to create and manage different web sites and it comes with many tools that can be used by developers to organize, structure, find, and re-use content. Its flexibility handles different content types and manages content with an easy-to use web interface. Its design focuses on social publishing and can be used to create sites and applications to help the users express their opinions [19].

c. Moodle

Moodle (abbreviation for *Modular Object-Oriented Dynamic Learning Environment*) is a free open source e-learning software platform, also known as a Course Management System, Learning Management System, or Virtual Learning Environment [20]. It can be used in different environments such as in education, training and development, and business settings. Educational institutions use it as a tool for creating online web sites for their students to conduct fully online courses or augment face-to-face courses known as blended learning. To build collaborative communities of learning, it includes many activity modules

such as forums, databases, and wikis. It can be used also as a way to deliver content to students and conduct continuous assessment through assignments and quizzes.

d. Wordpress

As stated in the official web site of Wordpress, it is an open source project developed by hundreds of people collaboratively all over the world. It has been designed to be completely customized and used for blogging purpose. Even if it has been started as just a blogging system, it has evolved to be used as full content management system through thousands of plug-ins and themes. It provides the flexibility to users to host their own blogging community, as well as control and moderate all the blogs centrally [21].

To summarize, digital resources are common in different organizations and increasing in size and complexity from time to time, and higher education institutions are one of these organizations that can produce and utilize digital resources for administration or academic purposes, therefore, having a central system that can manage digital contents that come from different sections and departments and that can decentralize the content creation and management activities will have great advantage for these institutions. As stated in the above literatures, content management systems have the capability of managing digital contents that have multiple sources, different data types, and that needs frequent updates. Therefore, it is wise to choose an appropriate content management system and establish a central system that can manage the creation and distribution of digital resources. For this purpose we have selected Joomla to be customized and used for enterprise content management because of its capability to build powerful online applications and its extensibility to be used for the development of many systems. For course content management we have selected Moodle due to the reasons that it is open source e-learning software platform, can be used to create online websites used to conduct online courses, and can be used to easily build collaborative communities of learning.

CHAPTER THREE

RELATED WORK

There are a number of systems based on content management systems in University environments, particularly, for e-learning applications, digital library systems, and internal communication systems like web based notice boards [11, 13, 14]. In addition to this, the usage of content management systems to enhance education and training in some selected higher education institutions are reviewed under this section.

3.1 Content Management System for Academic Digital Resources

The importance of CMSs for academic digital resources management can be noted from their usage as Course Management System in e-learning environments. According to Vovides *et al.* [11], the adoption of Course Management Systems (CMSs) for web-based instruction continues to increase in today's higher education. Some examples of Course Management Systems are **Blackboard, WebCT, eCollege, Moodle, Desire2Learn, Angel**, etc. The main reason for the adoption of Course Management Systems for e-learning environments is their flexibility to reach distance learners where face-to-face teaching and learning practices are not possible. These systems can also improve students' and educators' self-regulation skills, in particular their meta-cognitive skills. Even if e-learning promotes anytime, anywhere learning, it may be difficult to apply it for Ethiopian Universities with regard to the infrastructures it needs and the difficulty of controlling and evaluating the students on different activities. To get the advantages of these systems we recommend blending these systems with traditional face-to-face teaching and learning practices, and this is the main principle used to develop the proposed system for Wollo University.

The work in [13] proposes a Multimedia Content Management System for Digital Library Application (Milos), which is a general purpose software developed to support design and effective implementation of digital library applications. It can manage documents containing different data types and content descriptions, and content based retrieval of any multimedia documents is one of its best features because it has been developed to use metadata models represented in XML. In addition to this it has been developed to be efficient and scalable in the storage and content based retrieval of these documents. This work identifies the solutions to support the management of multimedia documents in the same repository that have different metadata descriptions. As this work illustrates, using content management systems allow digital resources to be stored and retrieved efficiently in scalable manner.

A good example of e-learning system in a University environment is the system at University of Kent [22]. University of Kent uses Moodle as a course management system to create virtual learning environment throughout the campus. The implementation of the course management system has been used to support the conventional face-to-face teaching and learning process. It provides much functionality for both staff and students. Using the system staff members can provide course materials such as handouts, lecture notes and power point presentations to their students. In addition to this, the flexibility of the system enables staff members to conduct interactive sessions such as discussion forums, quizzes and assignment drop boxes which require input from the students, as well as to perform common activities that exist in teaching-learning process such as:-

- Set up course modules
- Add and manage content
- Publish or make module available to students
- Using a calendar add events related to modules such as deadlines or upcoming activities
- Easily create groups of students and manage access to certain resources
- Enroll students to course modules and so on

For students the course management system provides many benefits such as to be enrolled to a particular course, read and download online course materials, participate in discussion forums, answer quizzes and questions online, upload assignments, access news and course information easily. So, by implementing a course management system using Moodle University of Kent creates an environment that supports the teaching and learning activities.

3.2 Content Management System for Administrative Digital Resources

Content management system can be applied for managing administrative digital contents in different sectors in terms of facilitating the administration activities and enhancing communication between departments and sections. The work of Hong *et al.* [12] demonstrates the usage of CMS for digital museum management to solve the physical restriction problem in conventional museums so that one can design different exhibitions about the same topic for adults, children, experts, novices, high bandwidth users, and low bandwidth users, all using the same set of digital artifacts. Different style of exhibition will be displayed for the user and the user can simply click and choose the specific style that he/she wants to explore. For such applications that utilize different data types and entertain different types of users, applying content management systems has many advantages with regard to the difficulty of consuming much time to produce illustrative online exhibitions because one may spend hours designing web pages for just one exhibition alone. The researchers have developed a framework for organizing digital collections, for quickly selecting, integrating, and composing objects from the collection to produce exhibitions of different presentation styles for each user group, and they have implemented and used in a Lanyu digital museum.

Osamor *et al.* [14] presented a state of the art design and implementation of a Digital Notice Board for University Administration. This work focuses at the development of a Digital Notice Board (DNB) program, which can be installed on a server and accessed from various computers connected to the local area network so that relevant information will be

disseminated to the public. Its design and usability with large electronic screen can be its major strength to display information on different strategic points on University campus. This work can be an example of using the flexibility of digital resources to solve different problems of traditional Notice Board System, as Digital Notice Board can have different advantages like it can be used to disseminate both private and public information, it can be more secure than traditional Notice Board, it can be accessed from a lot of access points, and it can be easily updated and managed.

An example of a content management system for digital library system administration in a University environment is the University of Oklahoma Digital Library [23]. University of Oklahoma Libraries designed a system to provide a communication tool where employees can find information about the organization and their unit in one place like work schedules, organizational forms, information for specific employee groups, and employee rosters. It also provides access to content management tools that were designed to permit library personnel to manage content related to their areas of responsibilities. The locally developed content management system in University of Oklahoma libraries has an advantage to be customized to fit the needs of the content managers and of the organization as a whole. According to the survey in [23], the usage of the content management system increased considerably and provides different services for the employees. The content management system encompasses different systems such as:-

- LORA CMS - Allows employees to organize library's electronic resources by subject and alphabetical listing.
- Unit page (Public) CMS - Allows employees to organize their public unit pages by adding links, uploading documents, and providing location directions and contact information that can be used by students and other users.
- Unit page (Intranet) CMS - Allows employees to organize their unit Intranet pages by uploading documents such as rosters and schedules and managing access permissions, and allows students to view uploaded documents, access library catalog, and access reserved books based on permissions.

- Other content areas - Allows employees to add announcements, post unit hours, change front-page web content, manage electronic reserves, associate metadata to digital images, and create usage reports.

Even if the usage of content management systems for University of Oklahoma Libraries provides the above mentioned advantages, it is limited only to the Library sector. Therefore, it is possible to extend this functionality of content management systems by developing different applications for other administration and academic sectors as well.

As illustrated in the above related works, content management systems can be used in different environments for different applications that require a lot of tasks in developing and managing digital contents. Content management systems can be used in the development of e-learning, Digital Library, Digital Museum, and Digital Notice Board applications. The adoption of Content Management Systems for e-learning applications continues in higher education for managing course related contents, this is because of their flexibility in reaching potential distance learners, in providing learners self-learning opportunities, in improving self-regulation skills, and in supporting a number of activities and course management procedures. Even if these are strong points of e-learning content management systems, it is difficult to apply them as a full replacement of the traditional face-to-face teaching and learning approach in Wollo University. The application of CMSs to other areas shows the potential of these systems to be used for efficient digital contents sharing and management. Since the usage of digital resources in University environments is for both academic and administration purposes, applying content management systems in these institutions that contain a lot of digital contents that have different types will be advantageous to easily create, access, publish, store, reuse and manage these contents

CHAPTER FOUR

DATA ANALYSIS

This Chapter emphasizes on the analysis of the data collected during the study. It outlines the methods used to collect the raw data and presents the analyzed results. It describes the findings of the current practice of digital resource sharing and management in Wollo University using content management systems, ICT usage in the current system, Internet access and its usage for teaching and learning, availability of ICT infrastructures, current teaching and learning approach, need for Intranet CMS system, and communication needs of Wollo University Community.

4.1 Current Practice of Digital Resources Sharing and Management

We conducted a survey to investigate the current practice in digital resources sharing and management at Wollo University. We have carried out the data collection using the methods of questionnaire, interviews, and observations. The questionnaire was prepared to address different audiences namely, instructors, students, technical personnel, and administration staff. Using the questionnaire, we have tried to investigate the ICT usage in teaching and learning, availability and adequateness of course materials, Internet dependency in teaching and learning, problems of distributing digital materials, availability of digital resources, difficulties of digital content sharing and management, their communication needs, and their needs for an Intranet system that facilitates digital resources sharing and management.

The questionnaire was distributed to 200 students, 70 instructors, 5 ICT technical personnel (ICT director, ICT officer, network administrators), and 30 administration staff. Among the total 305 distributed questionnaires only 256 (84%) of it was collected and used for the analysis purpose in this study. The following sections discuss the results obtained from the study.

4.1.1 ICT Usage in the Current System

From our survey, we have found that ICT utilization in Wollo University shows some improvements in general, but these improvements are mostly focused on building ICT infrastructures like deploying wired and wireless networks, providing Internet access, and deploying personal computers with Microsoft office package in different sections and departments to support their administrative, financial, and educational routines. But little attention is given to utilize a system that can use the existing ICT infrastructure and electronic resources to facilitate administrative, financial, and educational activities through an efficient digital resources sharing and management schemes. The ICT usage in the current system is analyzed in terms of Internet Access, Internet usage for teaching and learning activities, and availability of ICT infrastructures.

a. Internet Access

Even if, ICT infrastructures including Internet access is being deployed in almost Ethiopian higher education institutions [4], some Universities like Wollo University have connectivity and low bandwidth problems. This inhibits not to use Internet as a teaching tool in the current system. Moreover, students have little awareness about the availability of Internet access and a significant number of students 82.2 % reported that they didn't know whether there is Internet access for them or not as shown in Table 4.1 below, and the remaining 17.8 % that are aware of the availability of Internet access also facing the low bandwidth and connectivity problems of the current Internet access.

Table 4.1: Internet access reported by students

Do you have Internet Access?	Percentage (%)
Yes	17.8 %
No	82.2 %

In addition to the low bandwidth problem the available Internet access has also connectivity problem, as shown in Table 4.2 below and a significant percentage of the

respondents 65.4% from instructors reported that connectivity problem of current Internet is among the main barriers that makes not to use Internet as a teaching tool.

Table 4.2: main problems not to use Internet as a teaching tool

Problems for not using Internet as a teaching tool	Percentage (%)
Connectivity problem	65.4 %
Low bandwidth	18.3 %
Inefficient utilization	2.9 %
No problem	13.4%

b. Usage of Internet for Teaching and Learning

As Internet is becoming a best choice for searching and obtaining information and digital resources in different areas, using it to support the teaching and learning processes show some improvements from time to time in many Ethiopian higher education institutions. To exploit its advantages it should be used wisely and in appropriate manner. This includes, having sufficient bandwidth and connectivity, creating awareness of how to find useful information using it without wasting much time, awareness on known search engines and appropriate web sites that can provide the exact information or information that is very close to the searched query, and so on.

Usage of Internet for teaching and learning purpose was not exploited properly at Wollo University. To see the status of this practice some questions were presented to students whether they have experiences in using Internet for studying purpose or not, and a significant amount 66.09 % of them reported that they didn't use Internet for studying purpose and only 32.76 % reported that they have some experience of using Internet for studying purpose as shown in Table 4.3 below.

Table 4.3: Experience of students using Internet as a learning tool

Are you experienced in using Internet as a learning tool	Percentage (%)
Yes	32.76 %
No	66.09 %
Not sure	1.15 %

From the study, we have clearly understood that the instructors' effort is better towards using Internet for teaching and learning purpose. Among the respondents the majority of them reported that they devote much of their time while browsing Internet for tasks like searching course materials (57.69 %) and for learning and skill updating purpose (28.85 %) and in addition to this 7.69 % of them also reported that they will use Internet for searching course materials, for learning, and communication purposes and only a very small percentage of them 3.85 % reported that they devote much of their time while browsing Internet to use it for communication purposes as shown in Table 4.4 below.

Table 4.4: A task which takes much time while browsing Internet

A task that takes much of your time while browsing Internet	Percentage (%)
For Searching course resources	57.69 %
For Learning and skill updating	28.85 %
For Communications	3.85 %
For Searching, learning, and communication	7.69 %
Not sure	1.92 %

Even if the efforts done by instructors to use Internet as a teaching and learning tool is promising, still they believe that they didn't use it efficiently, because as shown in Table 4.2 above, the majority of respondents reported that bandwidth and connectivity problems are the most inhibiting factors that contribute much for not to use Internet as a teaching and learning tool.

c. Availability of Infrastructures

In this section, we have explored the availability of computers for both students and staff members, the current pupil-computer ratio, and the available network infrastructure. Based on our observation we have found that sufficient computers are available for instructors, and administrative staff. In most of the administration offices all the employees have desktop computers with Internet connection and Microsoft Office package that can be used to facilitate their administrative and financial routines. Each and every department head has desktop computer, and some additional computers are also available for

instructors use. Moreover, there is also a plan to establish Internet centers for each and every college, and some colleges already started to set up Internet centers that contain 10-20 computers.

For students use, there are computers available in three libraries in Dessie and Kombolcha campuses. According to our survey, including the computer laboratories installed in both campuses, and Internet centers for students, the student-computer ratio is 1:13 currently. However, the baseline survey conducted by Ministry of Education [4] showed that the student-computer ratio in most Ethiopian higher education institutions is 1:10, and according to the ICT director, there is a plan to improve this ratio by establishing more computer access pools for students in the future.

Not only the availability of computers, but also the networking infrastructure also improved, and currently in Wollo University there is wired and wireless network connectivity. All the computers in the instructors' Internet center, in all library buildings, computer laboratories, and college Internet centers are connected through a computer network. Similarly, a campus wide wireless network is also deployed in Dessie campus to provide wireless Internet connectivity to the community members (see Figure 4.1), that was designed, configured, and tested by Spanish cooperation project associated to Universitat Politècnica de Catalunya (UPC). The study conducted by this cooperation project identified the wireless connectivity requirements of Wollo University and designed different ways of integration with the previously started wired connectivity, and proposed useful methods for efficient usage of the wireless network [6].

In the same manner, in Kombolcha Campus a wireless network has also been configured as shown in Figure 4.2 [6]. For each campus, in order to spread the wireless signal one Omni-directional antenna and a number of access points were used. From our interviews, Wollo University has a plan to start the campus wide wired network connection to link each and every department, Internet centers, library computer access pools, and computer laboratories together.

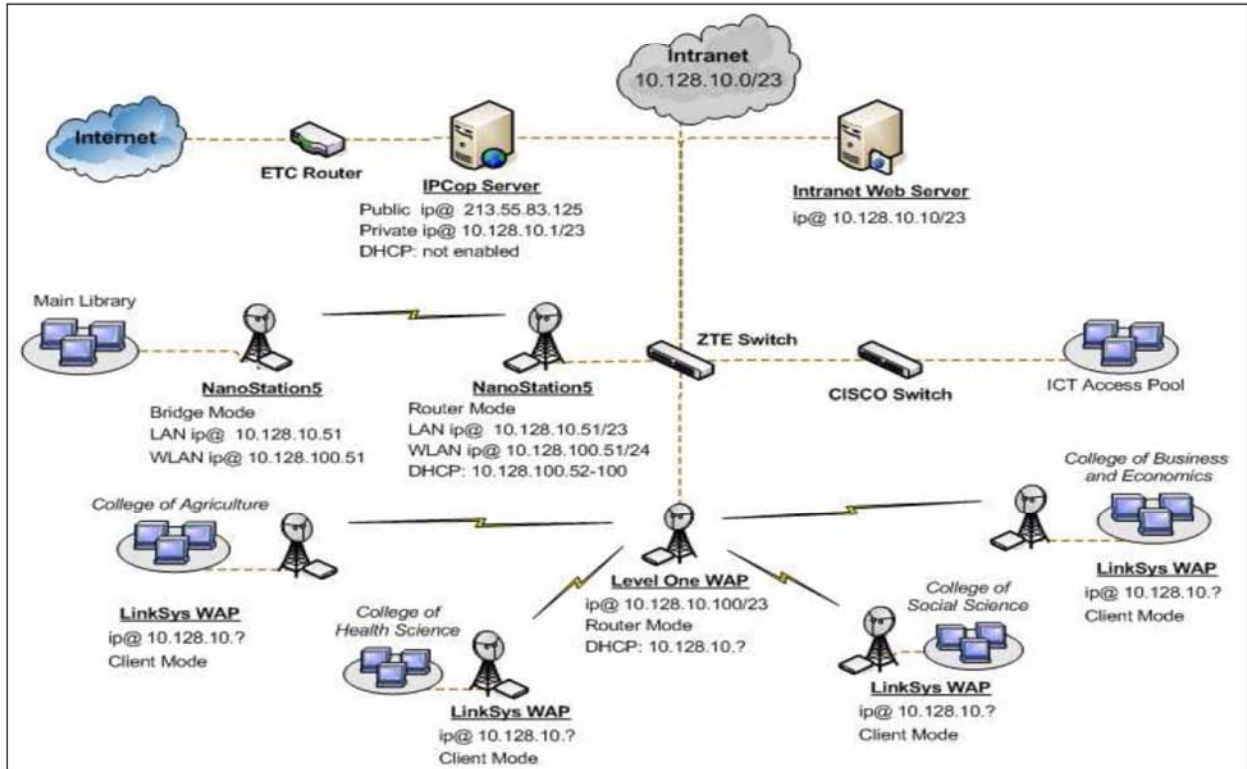


Figure 4.1: Wireless deployment in Dessie campus

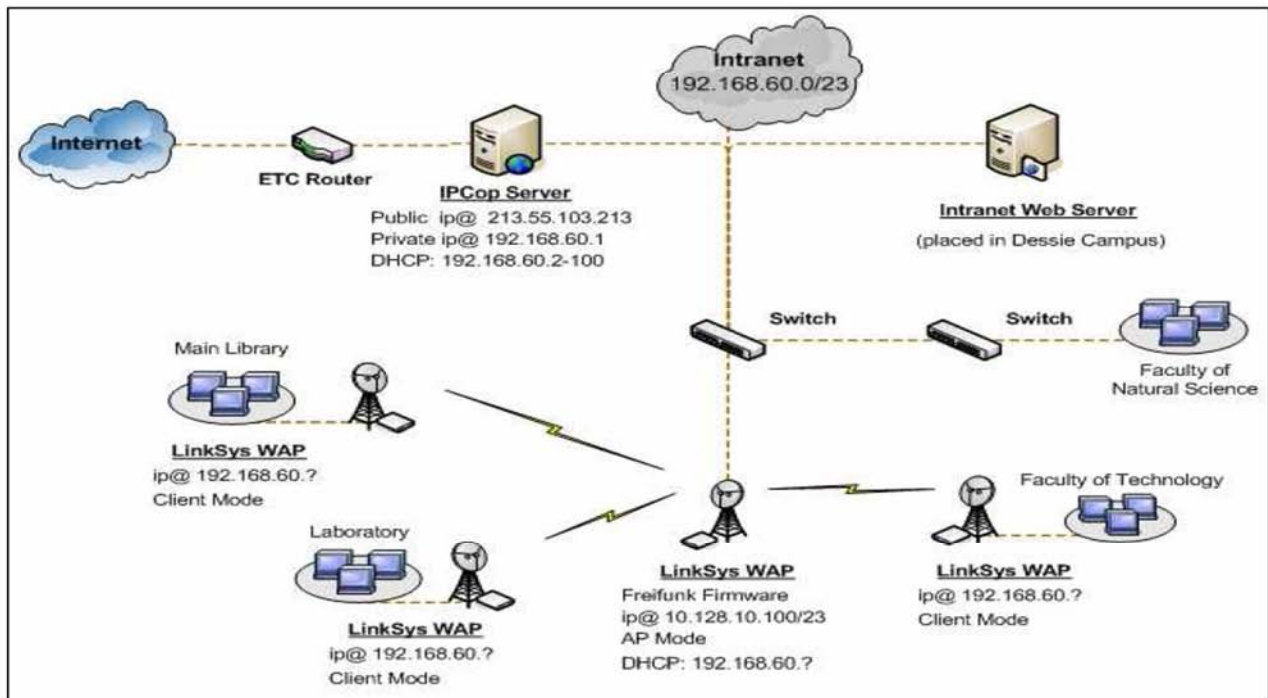


Figure 4.2: Wireless deployment in Kombolcha Campus.

4.1.2 Digital Resources Sharing and Management

To identify the current digital resources management and sharing schemes of the study area, we have presented different questions (see Appendices A to D), among these the ICT technical personnel were asked about the way of digital resources sharing and management they are currently using, and for this a significant percentage 80 % of them reported that they are using the University's web site to share digital information and 20 % of the respondents didn't respond for this question (see Table 4.5).

Table 4.5: Ways of sharing currently practiced

Ways of sharing currently used	Percentage (%)
Using Website	80 %
Using Intranet	0 %
Other methods	0 %
Not sure	20 %

In addition to being dependent only on the web site to present digital information to the University community, the same group of people was asked about the basic information used to be shared, and the majority of them 80 % reported that they are sharing only public information, and private information addressed for specific sections or departments are not entertained. The other thing asked was about the possibility of sharing digital resources and for this question 86.54 % of instructors reported that they don't have possibility of sharing, and only a small percentage 11.54 % reported that they do have possibility of sharing.

Table 4.6: Possibility to upload and share digital resources

Possibility to upload and share digital resources	Percentage (%)
Yes	11.54 %
No	86.54 %
No response	1.92 %

As it is shown on Table 4.6 the possibility of sharing digital resources to others is not decentralized and practiced well. Even if this is the case, the instructors were asked whether they have some digital resources to share and whether they are willing to share

the resources or not, and a significant percentage 55.77 % of them reported that they do have digital course materials to share but no possibility of sharing them, and 25 % of them reported that they have still few important digital course materials on their hand, and only 13.46 % of them reported that they don't have digital course materials currently as shown in Table 4.7 below.

Table 4.7: Availability of digital course materials

Do you have digital course materials for sharing	Percentage (%)
Yes, but no system to share	55.77 %
Few	25.00 %
Very few	1.92 %
A lot of e-books	1.92 %
I don't have	13.46 %
No response	1.93 %

In this study, the type of data the current system includes, how the digital contents are organized, and the type of users and their roles was explored to understand the functionality of the current system and to identify its problems clearly. Majority of the participated ICT technical personnel (80 %) of them reported that the current digital information sharing system relies on sharing static information through web pages, web links, and news only, and as it is indicated in Table 4.8. There is no any possibility to use digital communication techniques like chatting, messaging, and discussion forums.

Table 4.8: Sharing methods current system depends up on

Sharing methods in current system	Percentage (%)
Web pages, web links, and news	80 %
Chats	0 %
Blogs	0 %
Forums	0 %
No response	20 %

From our observations we understood that the current system didn't include digital contents organized at different levels like departmental level, college levels and so on. This inhibits different members of the university community not to share digital contents easily. However, among the respondents, a majority of instructors prefer to share course

materials, electronic books, and lecture notes as shown in Table 4.9. There is also a need to share assignments, quizzes, and results.

Table 4.9: Preference of digital resources for sharing

Preference of digital resources to upload	Percentage (%)
e-books and lecture notes	34.62 %
Course e – books	32.69 %
Lecture notes and slides	13.46 %
Assignments, quizzes, lecture notes, notices	9.61 %
Course Contents developed step by step	5.77 %
Quizzes, assignments and results	3.85 %

As shown above, the current digital resources sharing and management uses only the website of the university, and it has limited type of users. The ICT technical personnel were asked if the current digital resources sharing system incorporates more types of users or not, and a majority of them 80 % reported that the system only incorporates administrators and users, and no user types like instructors, students and groups as shown in Table 4.10.

Table 4.10: Different user roles in the current system

What are the different user roles	Percentage (%)
Administrators and users	80
Guests	0
Groups	0
No response	20

To deliver important rules and regulations including the University’s legislation, the concerned administration offices use printed materials. Because of this, it is difficult to distribute rules and regulations for all, and we have observed that there are many departments that didn’t have a copy of the senate legislation, for example. Similarly, administrators and administration staffs were asked whether they think that the students’ hand book delivered to all students timely or not, and majority of them 76 % reported that it is difficult to deliver it timely to all and only 24 % of them reported that it is delivered timely as shown in Table 4.11.

Table 4.11: Distribution of Students' hand book

Is students' Hand book delivered timely?	Percentage (%)
Yes	24 %
No	76 %

In addition to this those who said No were asked what will be the possible reasons for this, and 36 % of them reported that the main problem is duplication expenses and difficulty of distribution, and 28 % of them reported that it is difficult to reach all easily, and 12 % of them reported that it is because of the reason that there is no centralized system that can be accessed by the students easily, and 24 % of them chosen not to respond for this question. As it is shown in Table 4.12, the method of sharing different rules and regulations is manual method, and it cannot be easily distributed to all, since it is difficult to duplicate and distribute a document for huge number of users like the students.

Table 4.12: Possible reasons not to deliver Students' hand book

Reasons not to be delivered timely	Percentage (%)
Duplication expenses and distribution	36 %
Difficult to reach all	28 %
No easy and central system accessed by students	12 %
No response	24 %

4.2 Current Teaching and Learning Approach

The teaching and learning approach used currently is the traditional face to face approach, and from the study we obtained that there are a number of problems including having less amount of text and reference books as compared to students' number, problems in distributing course materials, and difficulties in using continuous assessment. For this purpose the participants were asked about the availability and adequacy of text and reference books and a significant percentage (82.69 %) of the instructors reported that the available text and reference books are not enough and only a small percentage (17.31 %) reported that the availability of text and reference books are enough (see Table 4.13).

Table 4.13: Availability of text and reference books

Availability of books and references	Percentage (%)
Enough	17.31 %
Not enough	82.69 %

Similarly, students were asked about the availability of text and reference books and a relatively higher percentage 54.60 % of them reported that less amount of text and reference books are available and 24.14 % of them reported as even the availability of text and reference books for their respective department is very less, and some percentage 14.36% of them didn't respond for this question as shown in Table 4.14.

Table 4.14: Amount of text and reference books

Amount of text and reference books	Percentage (%)
Very high	1.15 %
High	5.75 %
Less	54.60 %
Very less	24.14 %
Not sure	14.36 %

Considering the problem in distribution of course materials instructors mentioned a number of reasons, half of them mentioned printing and copying expenses inhibit them not to distribute much amount of course materials to their students since they are using traditional methods of distribution, and the other reasons were, it takes them much time for preparation of it, and hard copy materials are not easily updatable (see Table 4.15).

Table 4.15: Main problems in distributing course materials

Problems in distributing course materials	Percentage (%)
Printing and copying expenses	50.00 %
Hard copy materials not easily updatable	19.23 %
Much time for preparation of it	27.92 %
No problem	3.85 %

The other problem in traditional face to face teaching and learning approach is that the difficulty to apply continuous assessment, for this regard the participated instructors have

given different reasons and a relatively higher percentage 40 % of them reported that the main problem is large class size and 36.54 % of them reported also class size and manual processing as a main problem for not conducting continuous assessment as shown in Table 4.16.

Table 4.16: Problems in not using continuous assessment

Difficulties not to use continuous assessment	Percentage (%)
Large class size	40.38 %
Class size and manual processing	36.54 %
Time taking	13.46 %
No proper time schedule	1.92 %
No problem	5.77 %
No response	1.93 %

To investigate the class participation in the current face to face teaching and learning approach, instructors were asked how many students participated in the class, and half of them reported that very few number of students participated, and a significant percentage 48.08 % of them reported that there is some participation in the classroom as shown in Table 4.17.

Table 4.17: Participation of students in the classroom

How many students participate in the classroom	Percentage (%)
Many	0 %
Some	48.08 %
Few	0 %
Very few	50.00 %
No response	1.92 %

Related with this, the instructors were asked what will be their agreement on the current participation of students in the classroom, and majority of them 44.23 % and 25 % reported that they disagree and strongly disagree on the number of students that participate in the class room respectively, and only 23.08 % of them just agree with the current number of student participation as shown in Table 4.18.

Table 4.18: Instructors' agreement on student participation

Agreement on number of classroom participation	Percentage (%)
Strongly Agree	0 %
Agree	23.08 %
Disagree	44.23 %
Strongly disagree	25.00 %
Not sure	5.77 %
No response	1.92 %

Considering the main problems of low class participation, a significant percentage 38.5 % of them reported that the students fear not to make mistakes in front of their class mates, and 36.5 % of them reported that the reason is many students are shy and lack confidence to speak loudly in the classroom, and 23.1% of them reported that students need one to one communication with the instructor to discuss a particular issue (see Table 4.19).

Table 4.19: Main problems not to participate in the classroom

problem not to participate in the classroom	Percentage (%)
Shy and lack confidence	36.5 %
Fear not to make mistakes	38.5 %
Needs one to one communication with instructors	23.1 %
No idea	1.9 %

4.3 Need for Intranet CMS System

Even if the availability of good Internet access in higher education institutions is a crucial thing to facilitate the teaching, learning, and research activities, there is also a need to establish a well managed and content rich local Intranet system to be used by the community as an alternative to the Internet access and to make the management and sharing of available digital resources very efficient.

In this study, we have tried to investigate the availability of such systems as well as we have assessed the need to establish them, for this purpose the ICT technical personnel were asked about the existence of Intranet content management system or the existence of a

system that can be used for digital resources sharing and management to support administration and academic activities, and a higher percentage (80 %) of them reported that there is no such system at all, and only a small percentage (20 %) of them chosen not to respond, and none of them reported to have such system as shown in Table 4.20 below.

Table 4.20: Existence of Intranet content management system

Is there Intranet CMS?	Percentage (%)
Yes	0 %
No	80 %
No response	20 %

The respondents were asked about the main reasons why they need an Intranet system which facilitates assessment and resource sharing, and 34.60% of them reported that the reason for this is, Intranet CMS can save time, and 25% of them reported that the reason is, Intranet CMS can be collaborative and also saves time, and 19.24 % of them reported that it enables collaborative work, and only a small percentage 3.85 % of them reported that the reason is it will be alternative to the Internet connection, and for this question 17.31 % of them not responded as shown in Table 4.21.

Table 4.21: Reasons how Intranet CMS facilitates assessment and sharing

Reasons for facilitating assessment and sharing	Percentage (%)
It will be collaborative and saves time	25.00 %
It enables collaborative work	19.24 %
It can save time	34.60 %
It will be option to Internet	3.85 %
No response	17.31 %

The ICT technical personnel were asked whether they have planned to establish an Intranet system that facilitates digital resources sharing and management or not, and all of the respondents reported that there was a plan to implement such system and they need it to be deployed on the currently available network infrastructure as shown in Table 4.22.

Table 4.22: Plan to establish Intranet CMS

Plan to establish Intranet system	Percentage (%)
Yes	100 %
No	0 %

To assess the needs of Intranet system we have presented some questions related to the agreement of the respondents on effectiveness of such systems, need to establish such systems and their participation after implementation of such systems. For this purpose administrators and administration staff were asked about their agreement to establish Intranet CMS, and around half of them reported that they strongly agree for the establishment of Intranet CMS, and 44 % of them also agreed for the implementation of such systems, and a very small percentage 4 % of them were not sure (see Table 4.23).

Table 4.23: Agreement on establishing Intranet CMS by Administrators and administrative staff

Agreement on Intranet CMS	Percentage (%)
Strongly agree	52 %
Agree	44 %
Disagree	0 %
Strongly disagree	0 %
Not sure	4 %

Similarly, instructors were asked about the effectiveness of the Intranet system in facilitating distribution of course contents, communicating with their students, conducting continuous assessment easily, and helping their students to improve their academic results, and majority of them reported that it will be effective, and among them 34.62 % reported that it will be highly effective, and 42.30 % of them reported that it will be effective, 19.23 % of them were not sure and a very small percentage 3.85 % of them reported that the system will be ineffective as shown in Table 4.24.

Table 4.24: Effectiveness of Intranet system

Effectiveness of the system	Percentage (%)
Highly effective	34.62 %
Effective	42.30 %
Ineffective	3.85 %
Not sure	19.23 %

In this study, we have tried to assess the participation of the respondents in using the system after implementation. For this, we got that a high percentage (92 %) of administrators and administration staff reported that they are willing to participate, and a

very small percentage (8 %) of them reported that they will not participate as shown in Table 3.25.

Table 4.25: Willingness to participate for Intranet system

Willingness to participate	Percentage (%)
Yes	92 %
No	8 %

Similarly, instructors were asked how much time they will dedicate per week in using the Intranet CMS, and a significant percentage (63.46 %) of them reported that they will participate in using Intranet system as required, and 23.08 % of them reported that they will dedicate two hours per week, and 11.54 % of them reported that they will dedicate more than three hours, and a small percentage 1.92 % of them not responded for this question as shown in Table 4.26.

Table 4.26: Time to dedicate for Intranet system

Time to dedicate for Intranet system	Percentage (%)
As required	63.46 %
Two hours	23.08 %
More than three hours	11.54 %
No response	1.92 %

To assess the participation of the students for the Intranet system, the students were asked how much time they will dedicate in using the Intranet CMS system, and 43.10 % of them reported that they are ready to dedicate time for the system as required, and 25.29 % of them reported that they will participate daily, and 13.22 % of them reported that they will participate weekly, and 7.41 % of them reported that they will participate twice weekly, and a small percentages 6.90 % and 2.30% reported that they will participate monthly, and annually respectively, and for this question 1.72 % of them not responded as shown in Table 4.27.

Table 4.27: Participation of students for the Intranet system

participation for Intranet	Percentage (%)
As required	43.10 %
Daily	25.29 %
Weekly	13.22 %
Twice weekly	7.47 %
Monthly	6.90 %
Annually	2.30 %
No response	1.72 %

4.4 Communication Needs

To assess the communication needs of the Wollo University Community, we have identified the different methods currently used for communication, and found the possible problems on the methods. For this purpose administrators and administration staff were asked about the type of communication methods they have used currently, and 54 % of them reported that notice boards as way of communication, and 28 % of them again reported that newsletters and notice boards as way of communication, and 16 % of them reported that using message distributors as way of communication as shown in Table 4.28.

Table 4.28: Methods of communication used

Methods of communications	Percentage (%)
Notice boards	56 %
Newsletters, Notice boards	28 %
Using message distributors	16 %

The respondents were also asked what are the possible problems on the methods of communication used currently, and 40 % of them reported that the methods are not good to reach all community, and 32 % of them reported that they can be easily damaged or changed, and 24 % of them reported that they are not used for very argent communication, and a small percentage 4% of them even reported that they cannot be private as shown in Table 4.29.

Table 4.29: Possible problems on communication methods used

Problems on the communication methods	Percentage (%)
Easily damaged or changed	32 %
Not used for very argent	24 %
May not reach all	40 %
cannot be private	4 %

The respondents were asked about if there was some experience in using digital communication methods or not, and 52 % of them reported that there was no any experience of using digital communication methods, and 20 % of them reported that they only use the university's website for this purpose, and 16 % of them reported that they have used the website as a means of communication by posting some information like news but they have expressed their fear that it may not be updated timely, and 12 % of them reported that even they did not use email lists and email groups for communication as shown in Table 4.30.

Table 4.30: Experience of using digital communication

Experience of using digital communication	Percentage (%)
Website but not updated timely	16 %
Through website	20 %
No experience	52 %
Even email lists are not used	12 %

Generally, we have done the data collection and analysis in order to identify and specify the requirements of Wollo University with regard to Digital resources sharing and management. Using the questionnaire we have collected data about the Current practice of digital resources sharing and management including the ICT usage, Internet Access and its usage to support the teaching and learning activities, and the available ICT Infrastructures. According to our survey, the ICT usage at Wollo University is focused on network deployment, providing Internet Access, and providing personal computers for office use. Even if having Internet Access is very essential in higher education institutions, low band width and connectivity problems of the current Internet are the main problems at Wollo University. As reported by the majority of the students, the awareness on the available

Internet Access is not created, since they did not know whether there is Internet access or not. In addition to this, high percentage of the respondents from instructors reported that the current Internet has connectivity problem and this makes it difficult to use the available Internet as teaching and learning tool. Besides this, the majority of the instructors reported that they devote much of their time while browsing Internet, for searching course materials and for learning and skill updating purpose. The students' effort in using Internet for academic purpose is not still improved and majority of them reported that they did not use Internet for studying purpose. Regarding to the availability of the ICT infrastructures at Wollo University, we have observed that sufficient computers are available for instructors and administrative staff that are connected to the Internet; moreover there is also a plan to establish Internet centers for each and every college to increase computer access pools for the community. For students, there are computer access pools in all libraries, computer laboratories, and Internet centers. Currently, the student to computer ratio is 1:13 and there is also a plan to improve this ratio for the future.

The network infrastructure is also improved, and currently there is wired and wireless network connectivity at Wollo University. Even if the campus wide wired network is on progress, the wireless network is deployed in both campuses to provide wireless Internet connectivity to Wollo University Community. The current practices in digital resources sharing and management of Wollo University is highly dependent on the web site of the University and it can be used only to share public information and private information addressed for specific sections or departments are not entertained. In addition to this the possibility of uploading digital resources is not decentralized, and there is no any possibility of sharing academic resources and other administrative contents easily. Though this is the case, instructors have reported that they do have digital course materials to be shared and they are willing to share these contents, moreover they have also a need to share assignments, quizzes, and results.

Even if the current system relies only on static information, there is also a need to use more dynamic and recent digital information sharing and communication techniques. The current system has limited type of users and it is difficult to incorporate additional users

like instructors, students, and groups. Since the concerned administration offices use printed materials to share or distribute important rules and regulations, they have reported that they are unable to distribute these contents timely for all because it requires duplication and distribution effort.

The teaching and learning approach used currently is the traditional face to face approach, and as compared to students number, there is shortage of text and reference books, it is also difficult to conduct continuous assessment, and difficult to distribute course materials. To distribute much amount of course materials to students in hardcopy, the main difficulties are: printing and copying expenses, the time taken for preparation of it, and hardcopy materials are not easily updatable. Large class size and taking much time to process it manually makes difficult to conduct continuous assessment. As reported by both instructors and students, the class participation is very low in the current system and the possible reasons for this are: students fear not to make mistakes in front of their classmates, they are shy and lack confidence to speak loudly in the class room, and need one to one communication with their instructors to discuss their problems.

Therefore, to solve these problems the establishment of a central system that can manage and facilitate digital resources is very important to support academic and administration activities of Wollo University. The need for such system by the community members is high because it can facilitate academic and administrative resource sharing, using digital resources can save space and time, can be developed collaboratively, and can be shared and distributed easily. Wollo University community members show high need and willingness to use and participate in such systems because it can be used to support the traditional face to face teaching and learning approach and can improve the current communication methods which have many problems like they can be easily damaged or changed, cannot be used for very urgent and private communication, and they may not reach all at a time.

CHAPTER FIVE

REQUIREMENTS SPECIFICATION AND ANALYSIS

This Chapter contains the Software Requirements Specification and Analysis (SRS) of Wollo University web-based content management system for digital resources sharing and management (WUCMS) which can be used by all members of the community that are connected to the Intranet. The aim of the Software requirements Specification is to describe the functionality of the web-based content management for digital resources sharing and management system, and it is prepared in accordance with the IEEE STD 830-1998, IEEE Recommended practice for software requirement specification [24]. In this section we will first identify the principal actors of the system, and then explain the functional and non functional requirements of the new system, and finally the functional model of the system.

5.1 Principal Actors

The main actors of Wollo University digital resources sharing and management system are then identified and are listed below:

- a. Content administrator
- b. Instructors
- c. Students
- d. Administrative heads
- e. Administrative staff
- f. Guests

5.2 Functional Requirements

As the scope of this work is to develop a workable system that provides a web-based content management system that will allow different users to easily manage and share administrative and course contents easily and efficiently using the Intranet of the University, the following functional requirements have been identified and should be satisfied by the system.

- Administrator (content manager) should be able to:
 - Assign user roles
 - Manage users and accounts
 - View documents
 - Post and participate in forums
 - Upload documents
 - Send and receive messages
 - Take backup
- Students should be able to:
 - Search course contents
 - View and access to courses that they have registered
 - Submit assignments and answers to tests and quizzes
 - Post and participate in discussion forums
 - Download course text and reference materials
 - Chat with course instructors
- Allow instructors to:
 - Create courses and course contents
 - Enroll students
 - Upload multimedia course materials
 - Post assignments and tests
 - Conduct continuous assessment
 - Prepare test and quiz questions
 - View reports about assignment and test results

- View and conduct discussion forums
- Have one to one communication with their students
- Allow administrative Heads to:
 - Upload and share rules and regulations
 - Post notices and announcements
 - Send and receive messages
 - View different documents
- Allow Administrative staff to:
 - View notices and announcements
 - Download documents
 - Send and receive messages
 - Easily access rules and regulations

5.3 Product Functions

Wollo University digital content sharing and management system should support use cases described under use case diagrams section of this Chapter, and all use cases starting from users login to different activities that are important for effective and efficient academic and administrative digital contents sharing and management should be fulfilled by the system and their functionality should also be tested by using different test cases.

5.4 General Constraints

- For full working of the system a network infrastructure (Intranet) is needed.
- The server application shall be available for most of the time except for some maintenance and configuration tasks.
- Safety and security considerations: valid user name and password are the main mechanisms for different security issues, and data protection should be satisfied by the backup process at the server side.

5.5 Assumptions and Dependencies

- The user should be connected to the Intranet to use the system
- The University should have its own web server and backup server to implement the service.
- The users should have knowledge about basic computer skills and should know how to use web based applications.
- Client computers can be Windows or UNIX platforms and should have web browser software like Microsoft Internet Explorer or Mozilla Firefox.
- The accuracy of the information given by the users is the responsibility of them.

5.6 Non Functional Requirements

Non functional requirements of the system include the different requirements that the system should fulfill in addition to the functional requirements that have been stated. These requirements include performance requirements, reliability, availability, security, maintainability, and portability.

Performance Requirements: The system should handle concurrent requests, and should also respond for most of the requests with minimum possible time.

Reliability: The system shall operate 95% of the time

Availability: The system shall be available for most of the time since it is not dependent on Internet connection except for maintenance and configuration tasks.

Security: The system has different types of users so that there are different levels of authorization, and the authorization mechanism will block unwanted attempts to access the server. The content available will depend on the user roles; the application will host both public information for guest users and private information for authenticated users.

Maintainability: The requirements and modules explained in this document are enough to satisfy the customer's needs and wants. In case of a change or additional demand after completion of the system, the system should accept the changes without affecting its previous functionality. Since the system is developed using modular object oriented tools, the maintainability shall be easily done by integrating new modules and offering new software functions for the system.

Portability: The system is a web based application that provides online service to make the service available for the whole University community. Since the system is developed based on LAMP (Linux, Apache, MySQL, and PHP) platform and open source content management systems, it can be migrated and accessed using different standard platforms.

5.7 System Models

The functionality of the system is analyzed using Unified Modeling Language (UML) Use case diagrams [17] as shown below, and the static and dynamic nature of the system also analyzed using class and sequence diagrams respectively.

5.7.1 Use case Models

Use cases provide a means to capture system requirements, and communicate with the end users. A use case is best to identify the actors and defining how the actors will be able to interact with the system. The use case diagram shown in Figure 5.1 illustrates how the content administrator interacts with the system by assigning roles, managing accounts, uploading documents, sending and receiving messages, posting forums, and taking backups. Similarly the instructor will interact with the system by creating course, enrolling students, uploading course contents, creating quizzes, posting assignments, receiving assignments and quizzes, sending and receiving messages, downloading documents, posting forums, and creating groups as shown in Figure 5.2. As a principal actor of the system students can interact with the system by viewing courses and notices, searching

course, submitting assignments, taking quizzes, downloading course contents, and posting forums as shown in Figure 5.3.

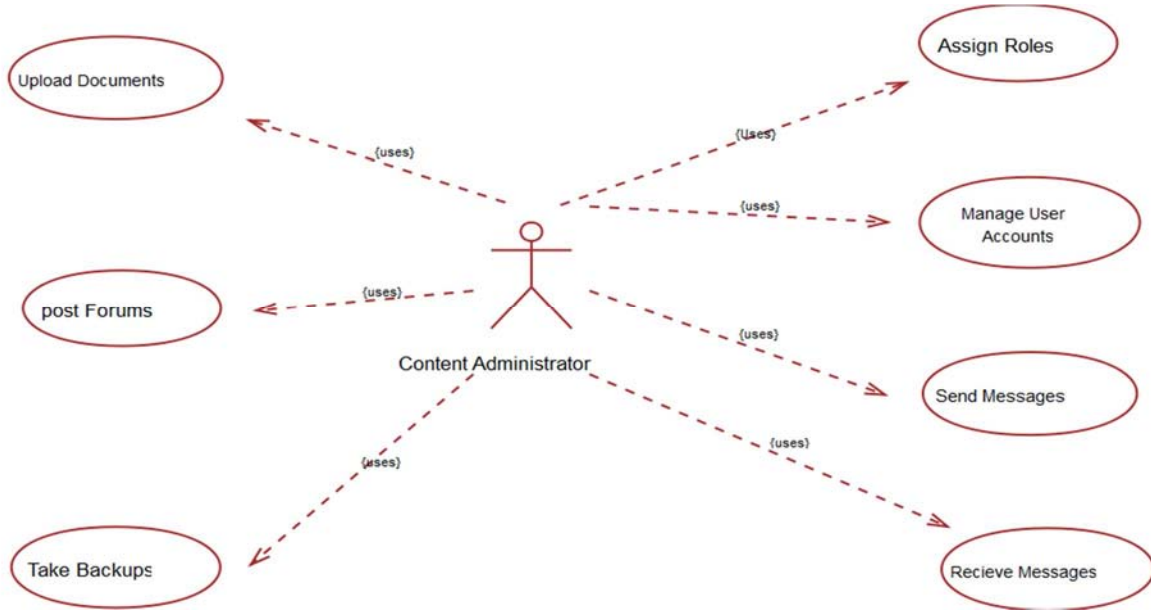


Figure 5.1: Use case diagram for Content Administrator

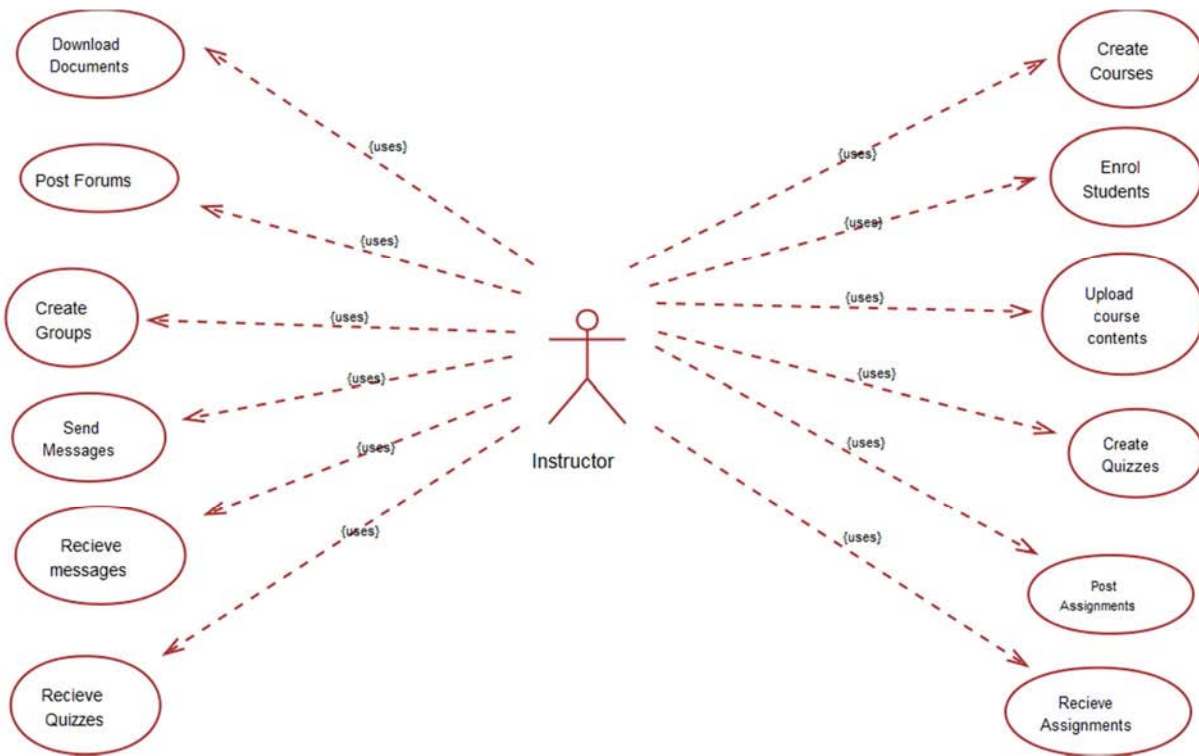


Figure 5.2: Use case diagram for Instructor

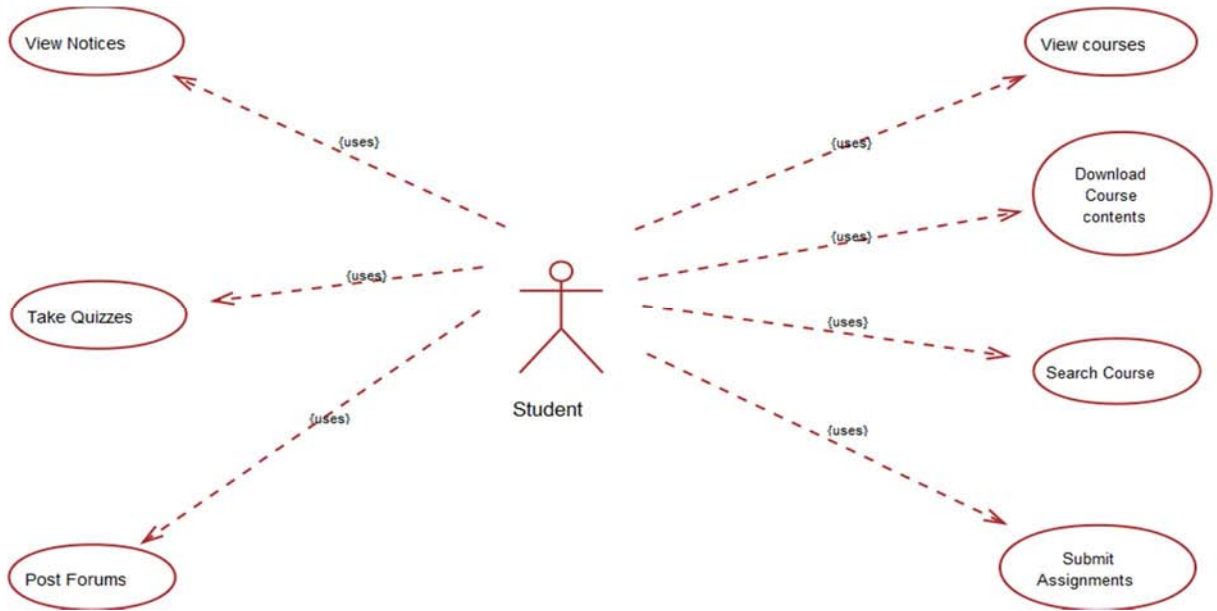


Figure 5.3: Use case diagram for Student

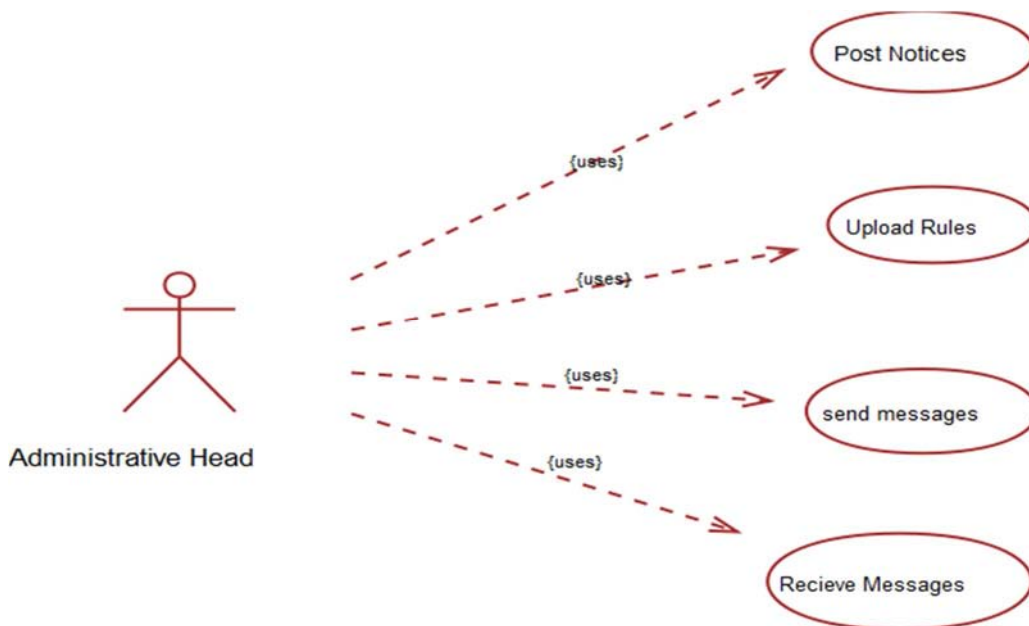


Figure 5.4: Use case diagram for Administrative head

Use case diagram shown in Figure 5.4 illustrates how administrative heads interact with the system as an actor by posing notices, uploading rules, sending messages, and receiving messages. Similarly administrative staff can also interact with the system by viewing

notices, accessing rules, sending and receiving messages, and downloading documents as shown in Figure 5.5.

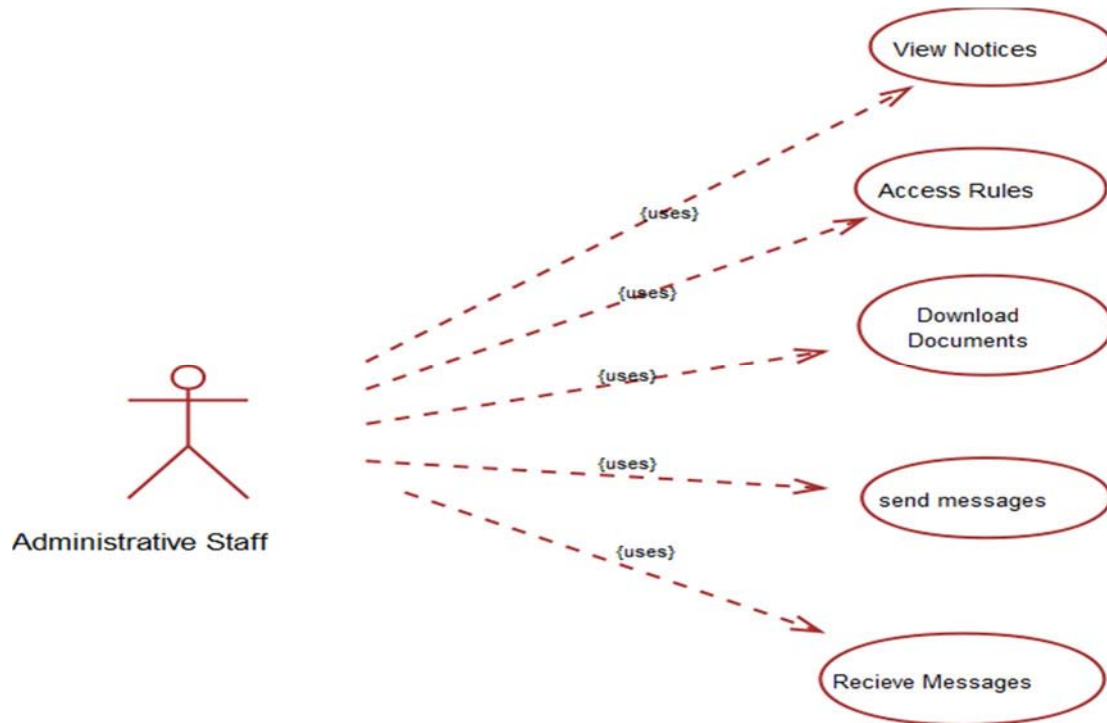


Figure 5.5: Use case diagram for Administrative staff

5.7.2 Use Case Descriptions

Use case related to Content Administrator:

Use case 1: Assign roles

Primary actor: Content administrator

Prerequisite: Content administrator has to logged in

Main scenario:

1. Content manager requests employee registration page
2. Registration page loaded and required fields provided
3. Content administrator fills the registration form
4. Assign a Role for the employee and submits the form
5. The system saves the information in the database

Use case 2: Manage user accounts

Primary actor: Content administrator

Prerequisite: Content administrator has to logged in

Main Scenario:

1. System provides user account management facilities
2. Content administrator create, update, and delete user accounts
3. System sends confirmation messages
4. Content administrator confirms to take the action
5. Systems saves and updates the database

Use case 3: Send messages

Primary actor: Content administrator

Prerequisites: Content administrator has logged in

Main scenario:

1. System provides facilities for sending messages
2. Administrator writes messages and selects the recipients
3. Administrator confirms to send the message
4. System sends the message

Alternate scenario:

3. When administrator fills invalid destination address
 - a. system redisplay the page with an error messages
 - b. administrator refills address and sends the message again

Use case 4: Receive messages

Primary actor: Content administrator

Prerequisites: content administrator has to logged in

Main scenario:

1. System sends messages targeted to content administrator
2. Content administrator views messages and can replay to them

Use case 5: Upload documents

Primary actor: Content administrator

Prerequisites: Content administrator has to logged in

Main scenario:

1. System provides facilities to upload and share documents
2. Content administrator uploads documents
3. System make it available for online users to be viewed and downloaded

Use case 6: Post Forums

Primary actor: Content administrator

Prerequisites: Content administrator has to logged in

Main scenario:

1. System provides facilities to post discussion forums
2. Content administrator post forums and participate
3. System make it available for online users to discuss the issue
4. System provides different comments send by different participants

Use case 7: take backups

Primary actor: Content administrator

Prerequisites: Content administrator has to logged in

Main scenario:

1. Content administrator request the backup page and page loaded
2. Administrator ordered backup based on some criteria(e.g. date)
3. System takes the backup data from its database to the backup system

Use case Related to Instructor

Use case 1: Create Courses

Primary actor: Instructor

Prerequisites: Instructor has to logged in

Main scenario:

1. System provides facilities to create online courses
2. Instructor creates a particular course by entering course information and content.
3. System saves the information to the database

Use case 2: Enroll students

Primary actor: Instructor

Prerequisites: Instructor has to logged in and created course

Main scenario:

1. System provides facilities to enroll students for a course
2. Instructor enrolls students for a course by registering them or using already existing students.
3. Instructor may allow guest access for a course
4. System saves information to the database

Use case 3: Upload course contents

Primary actor: Instructor

Prerequisites: Instructor has to logged in and created course

Main scenario:

1. Instructor selects a particular course to upload content for it
2. System provides facilities to upload multimedia content for the course
3. Instructor uploads multimedia contents and shares.
4. System makes it available to enrolled students for that course.

Use case 4: Create quizzes and test questions

Primary actor: Instructor

Prerequisites: Instructor has to logged in and created course

Main scenario:

1. Instructor selects a particular course to prepare quizzes and test questions
2. System provides different question types to be prepared
3. Instructor choose a question type that will be prepared
4. Instructor prepares questions and save
5. System saves questions in questions bank

Use case 5: Post assignments and quizzes

Primary actor: Instructor

Prerequisites: Instructor has to logged in and created course

Main scenario:

1. Instructor selects a particular course to post assignments and quizzes
2. System provides facilities to post and upload assignments and quizzes for a particular course
3. Instructor posts assignments and quizzes
4. System makes it available to students enrolled for that course

Use case 6: Receive assignments

Primary actor: Instructor

Prerequisites: Instructor has to logged in, created course and posted assignments

Main scenario:

1. Instructor selects a particular course to view submitted assignments for that course
2. System provides submitted assignments for that course
3. Instructor can view submitted assignments

Use case 7: Create Groups

Primary actor: Instructor

Prerequisites: Use case 2, instructor has to logged in and created course

Main scenario:

1. Instructor selects a particular course to create groups of enrolled students
2. System provides facilities to create groups of students
3. Instructor create groups of students enrolled for a course
4. Systems saves updates to the data base

Use case 8: Receive Quizzes

Primary actor: Instructor

Prerequisites: Use case 2, Instructor has to logged in, created course and post quizzes and tests

Main scenario:

1. Instructor selects a particular course to access submitted quizzes and tests by students
2. System provides submitted quizzes and tests for that course
3. Instructor can easily access submitted quizzes and test results

Use case 9: Post forums

Primary actor: Instructor

Prerequisites: Use case 2, Instructor has to logged in, and created course

Main scenario:

1. Instructor selects a particular course to post course related issues
2. System provides facilities to post forums and participate in it
3. Instructor types the issue and post it to participants
4. System makes it available to participants for discussion.

Use case 10: Download documents

Primary actor: Instructor

Prerequisites: Use case 2, Instructor has to logged in and created course

Main scenario:

1. Instructor selects a particular course to download course related documents
2. System provides facilities to download documents
3. Instructor selects particular document to be downloaded
4. System downloads the document

Use case 11: Send messages

Primary actor: Instructor

Prerequisites: Use case 2, Instructor has to logged in and created course

Main scenario:

1. Instructor selects a particular course to send messages and notices related to the course
2. System provides facilities to send messages
3. Instructor sends messages and notices to enrolled students
4. System makes it available to enrolled students for that course.

Use case 12: Receive messages

Primary actor: Instructor

Prerequisites: Use case 2, instructor has to logged in and created course

Main scenario:

1. Instructor selects a particular course to view messages send
2. System provides facilities to view messages targeted to the instructor
3. Instructor view and access messages send from different users

Use case related to student

Use case 1: View courses

Primary actor: Student

Prerequisites: Student has to logged in

Main scenario:

1. Student selects a particular course to view and access contents
2. System provides course contents for courses that the student enrolled
3. Student can easily view and access contents

Use case 2: Download course contents

Primary actor: Student

Prerequisites: Student has to logged in

Main scenario:

1. Student selects a particular course to download contents
2. System provides multimedia course contents for courses that the student enrolled
3. Student selects course content to be downloaded and request to download
4. System downloads the selected course content

Use case 3: Search course

Primary actor: Student

Prerequisites: Student has to logged in

Main scenario:

1. System provides a search facility for student to search course contents
2. Student enters search queries that are related to the course to be searched
3. System takes student queries and searches related contents from the database

4. System displays search results to student
5. Student can easily view and access the search results

Alternate scenario:

2. When student enters queries that are not related to a course
 - a. system displays no search results message to student
 - b. student re-enter another query that will be searched

Use case 4: Submit assignments

Primary actor: Student

Prerequisites: Student has to logged in

Main scenario:

1. Student selects a particular course to submit assignments and test answers
2. System provides facilities to submit assignments and test answers
3. Student submit assignments and test answers for a course
4. System should make it available for the course instructor

Use case 5: view notices

Primary actor: Student

Prerequisites: Student has to logged in

Main scenario:

1. Student selects a particular course to view notices and messages
2. System provides notices and messages send for that course
3. Student can easily view and access notices and messages

Use case 6: Take quizzes and tests

Primary actor: Student

Prerequisites: Student has to logged in

Main scenario:

1. Student selects a particular course to take quiz or test

2. System provides quiz and test questions posted by course instructor
3. Student can take quizzes and tests and submits the answers
4. System sends quiz and test answers to respective instructor

Use case 7: Post Forums

Primary actor: Student

Prerequisites: Student has to logged in

Main scenario:

1. Student selects a particular course to post course related issues
2. System provides facilities to post forums and participate in it
3. Student types the issue and post it to participants
4. System makes it available to participants for discussion.

Use case related to Administrative Heads

Use case 1: Upload rules

Primary actor: administrative head

Prerequisites: administrative head has to logged in

Main scenario:

1. Administrative head requests to upload rules and regulations
2. System provides the facilities to upload rules and regulations
3. Administrative head uploads and shares rules and regulations
4. System saves and makes it available for authorized users

Use case 2: Post notices

Primary actor: administrative head

Prerequisites: administrative head has to logged in

Main scenario:

1. Administrative head requests to post notices and announcements
2. System provides the facilities to post notice and announcements

3. Administrative head post notices and announcements to target audiences
4. System saves the information and makes it available for authorized users

Use case 3: Send messages

Primary actor: administrative head

Prerequisites: administrative head has to logged in

Main scenario:

1. Administrative head requests to send messages
2. System provides the facilities to send messages
3. Administrative head writes messages to be send and selects recipients
4. Administrative head confirms to send the message
5. System sends the message to the target users

Use case 4: Receive messages

Primary actor: administrative head

Prerequisites: administrative head has to logged in

Main scenario:

1. System saves different messages targeted to administrator head
2. Administrative head requests to access the received messages
3. System displays the received messages to administrative head
4. Administrative head easily accesses and views received messages

Use case related to administrative staff

Use case 1: View Notices

Primary actor: administrative staff

Prerequisites: administrative staff has to logged in

Main scenario:

1. System preserves notices and announcements targeted to administrative staff.
2. Administrative staff requests to view notices and announcements
3. System provides the facilities that enable the administrative staff to view notices and announcements
4. Administrative staff can easily view and access notices and announcements

Use case 2: Access rules

Primary actor: administrative staff

Prerequisites: administrative staff has to logged in

Main scenario:

1. System saves rules and regulations targeted to administrative staff.
2. Administrative staff requests to view and access rules and regulations
3. System provides the facilities that enable the administrative staff to access rules and regulations
4. Administrative staff can easily view and access rules and regulations

Use case 3: Download documents

Primary actor: administrative staff

Prerequisites: administrative staff has to logged in

Main scenario:

1. System preserves different documents targeted to administrative staff.
2. Administrative staff requests to download documents
3. System provides the facilities that enable the administrative staff to download documents

4. Administrative staff selects a particular document to be downloaded
5. System downloads the document

Use case 4: Send messages

Primary actor: administrative staff

Prerequisites: administrative staff has to logged in

Main scenario:

1. Administrative staff requests to send messages
2. System provides the facilities to send messages
3. Administrative staff writes messages to be send and selects recipients
4. Administrative staff confirm to send the message
5. System sends the message to the target users

Use case 5: Receive messages

Primary actor: administrative staff

Prerequisites: administrative staff has to logged in

Main scenario:

1. System saves different messages targeted to administrative staff
2. Administrative staff requests to access the received messages
3. System displays the received messages to administrative staff
4. Administrative staff easily accesses and views received messages

5.7.3 Sequence Diagrams

Sequence diagrams depict the dynamic behavior of the system. They can be used to capture the interaction between participating objects in a given use case, and they are also helpful to identify the missing objects that are not identified in the analysis object model. The sequence diagram shown in Figure 5.6 illustrates the participating objects for assigning user roles i.e., User Profile Manager to provide predefined user roles, User Role Controller to register the assigned roles to the database, and Display Role to retrieve and display assigned roles for the user.

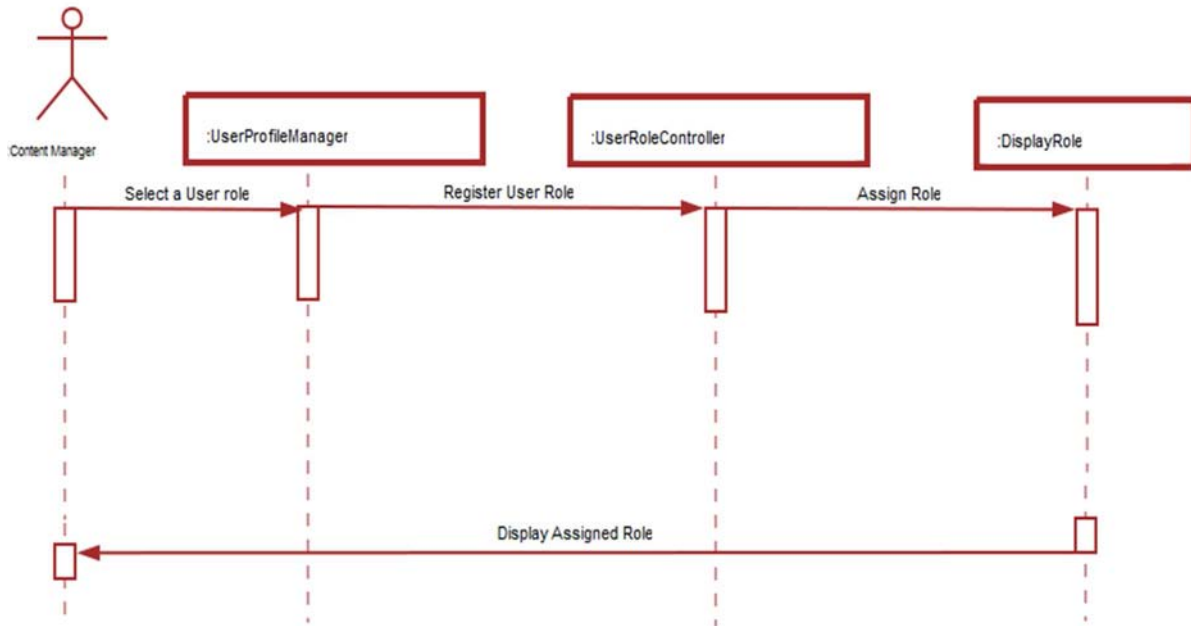


Figure 5.6: Sequence diagram for assign role use case

For managing user accounts the system will use the objects User Account Manager to provide user account management facilities to administrator and Display User Account to display user accounts with appropriate privileges to administrator as shown in Figure 5.7.

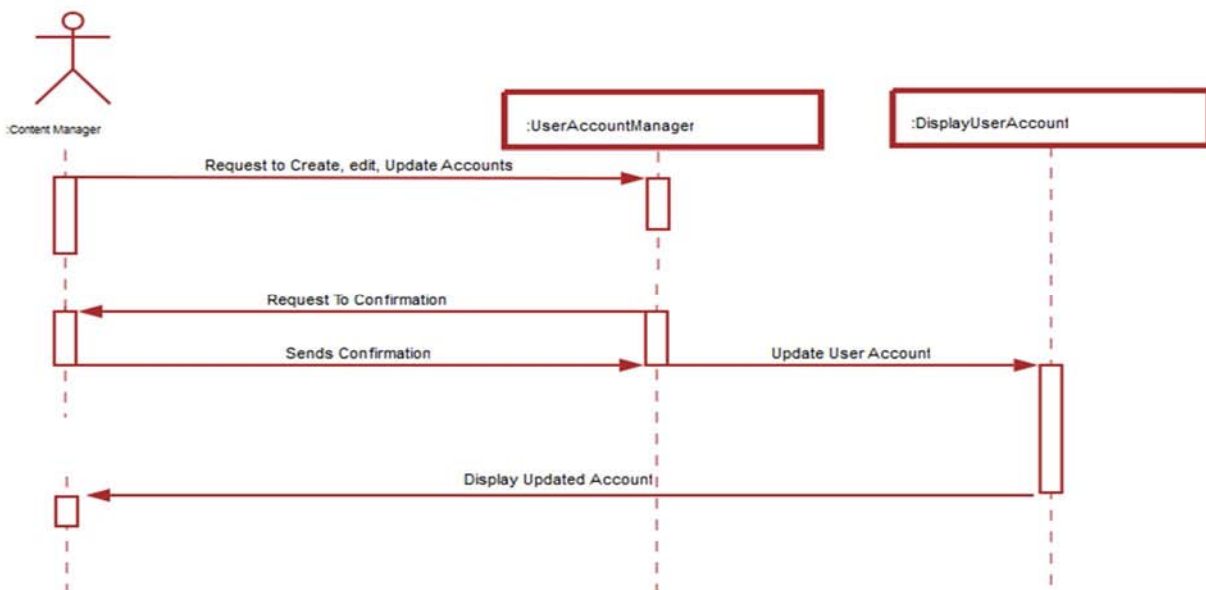


Figure 5.7: Sequence diagram for manage Account use case

For sending messages to users the Create Message object provides an interface to create and edit messages, and request to send messages, after this the Send Message object will accept the request, validate the destination address and sends the message to the appropriate user as shown in Figure 5.8.

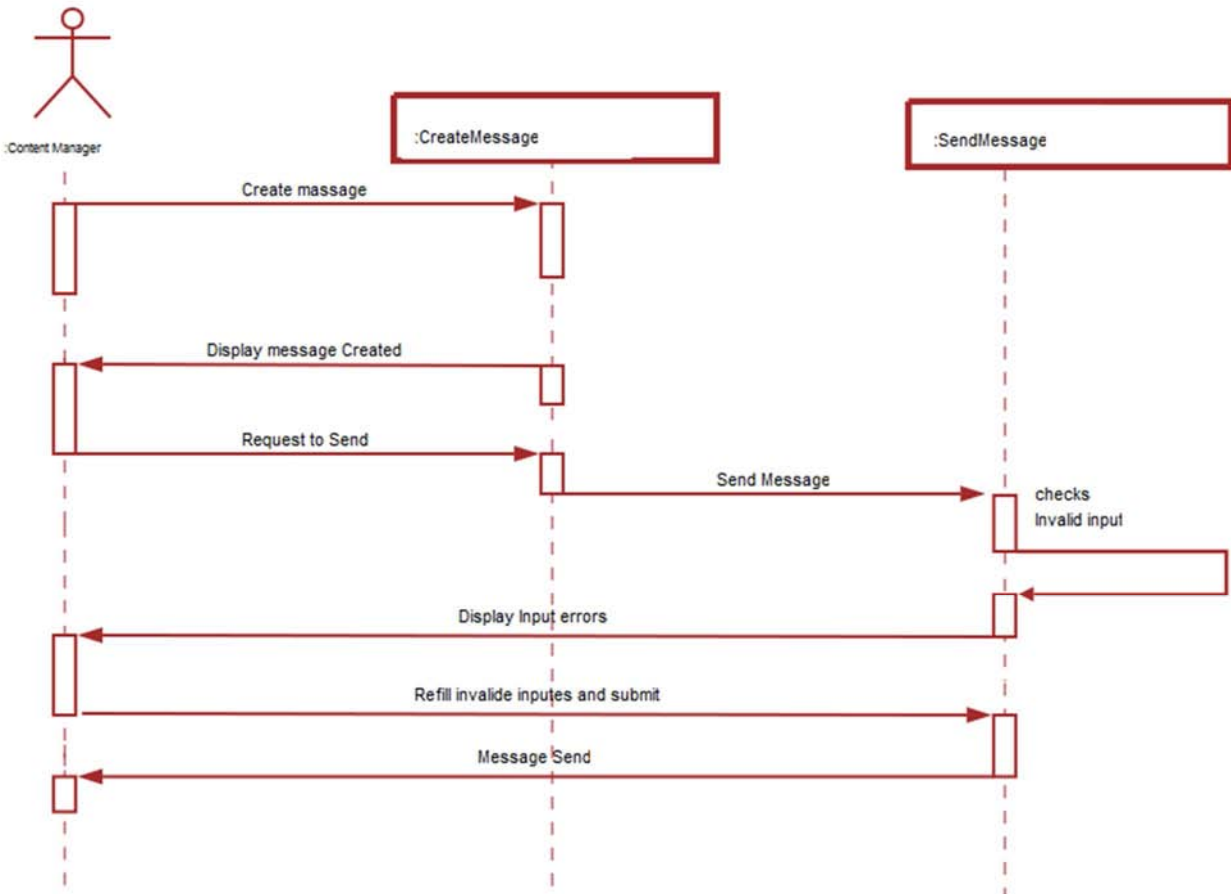


Figure 5.8: Sequence diagram for Send Message use case

For taking backup the Order Backup object provides an interface to enter criteria and it sends it to the Take Backup object and the backup will be created as shown in Figure 5.9. For creating course the Create Course object provides an interface to enter course details and contents and sends to Course Manager and it will be stored in the database to be accessed by appropriate users as shown in Figure 5.10. For enrolling students Course Manager provides an interface to select a course, Enroll Students object allows to select students to be enrolled to that course, Enrollment Manager will save the data as shown in Figure 5.11.

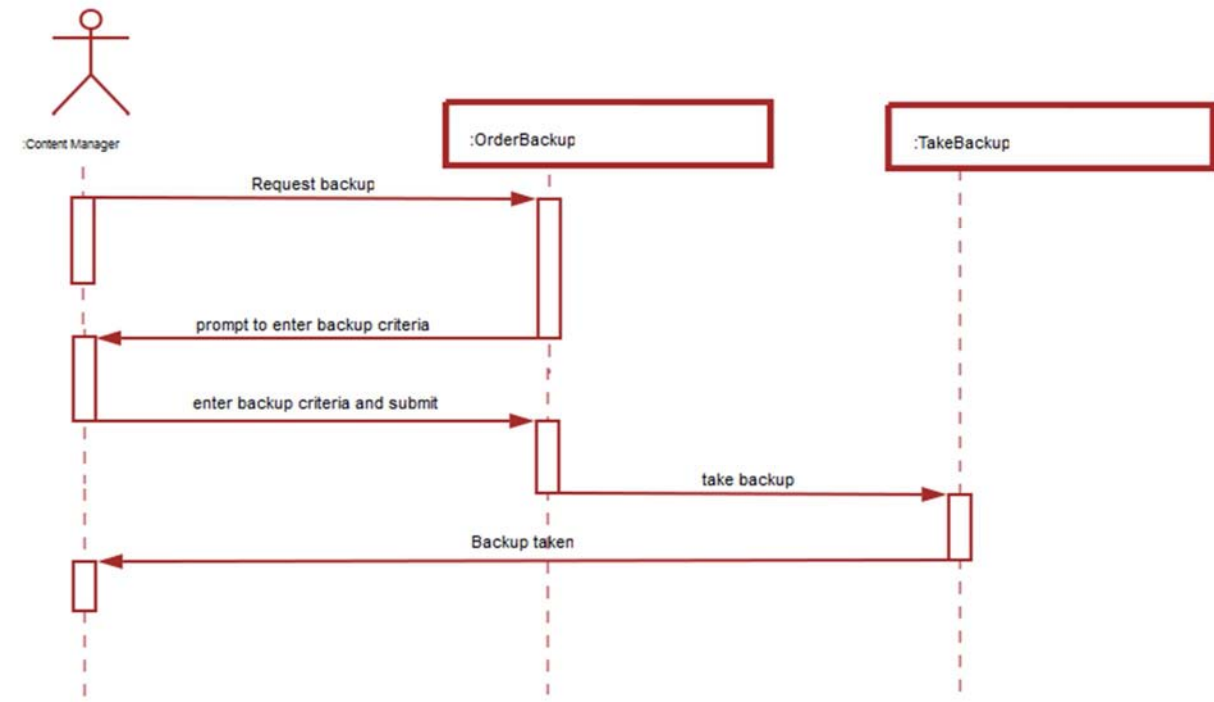


Figure 5.9: Sequence diagram for take backup use case

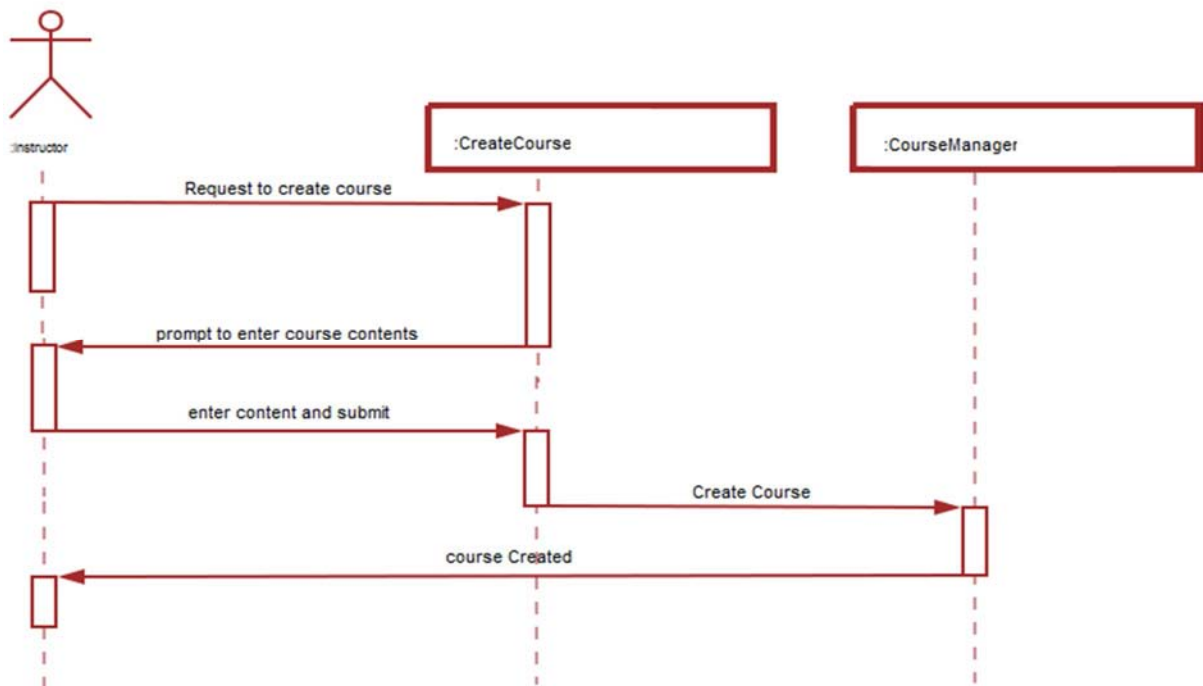


Figure 5.10: Sequence diagram for create course use case

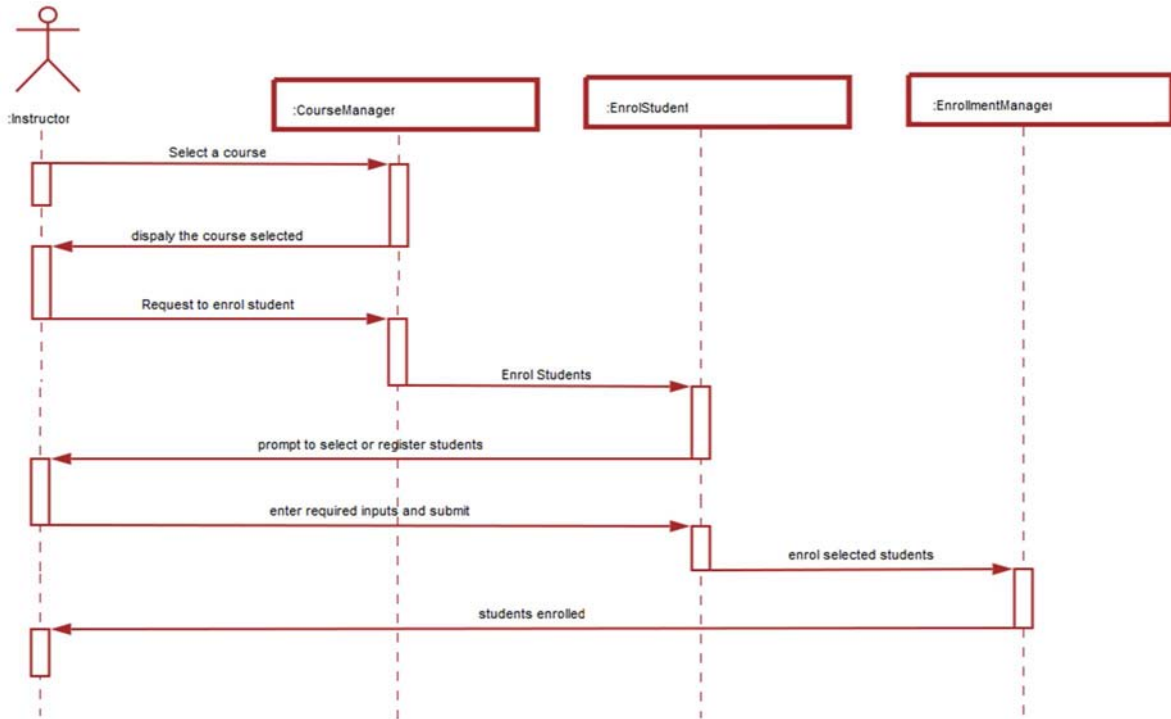


Figure 5.11: Sequence diagram for enroll students use case

For creating quiz Course Manager allows to select a course, Create Quiz provides facility to create quiz, and Question Manager saves the quiz to question bank (see Figure 5.12).

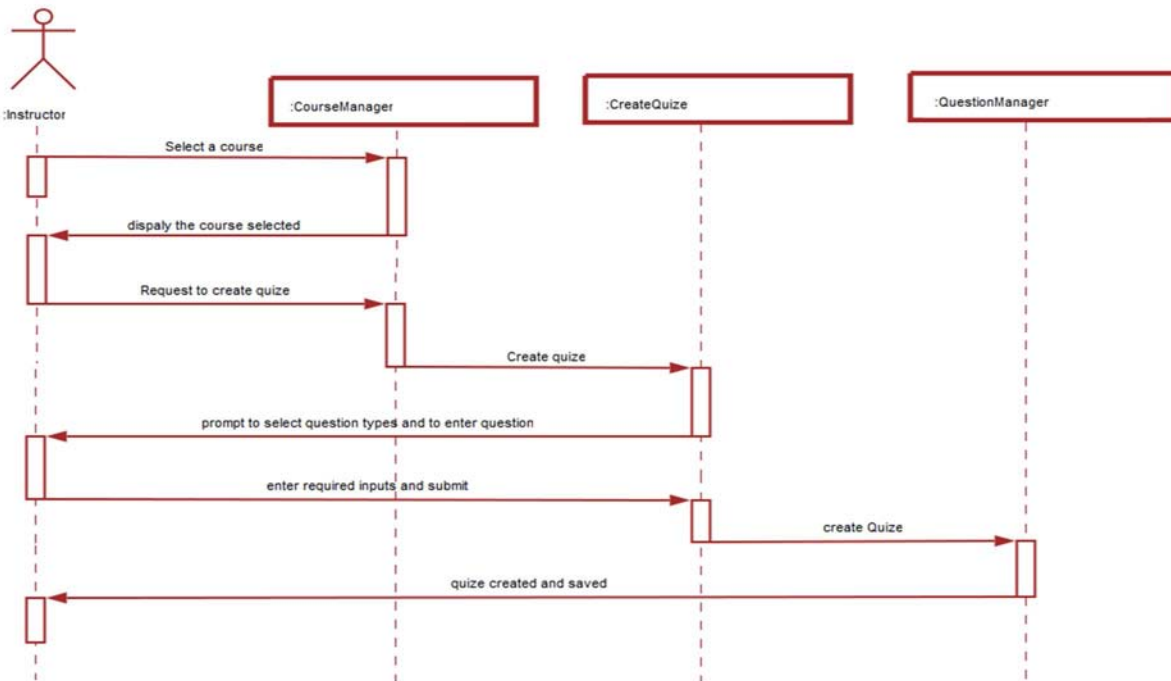


Figure 5.12: Sequence diagram for Create Quiz use case

For viewing course user will be authenticated by Course Manager and the appropriate course will be displayed by Display Course object as shown in Figure 5.13. For submitting assignment Course Manager allows to submit assignment and Submit Assignment saves it to the database as shown in figure 5.14.

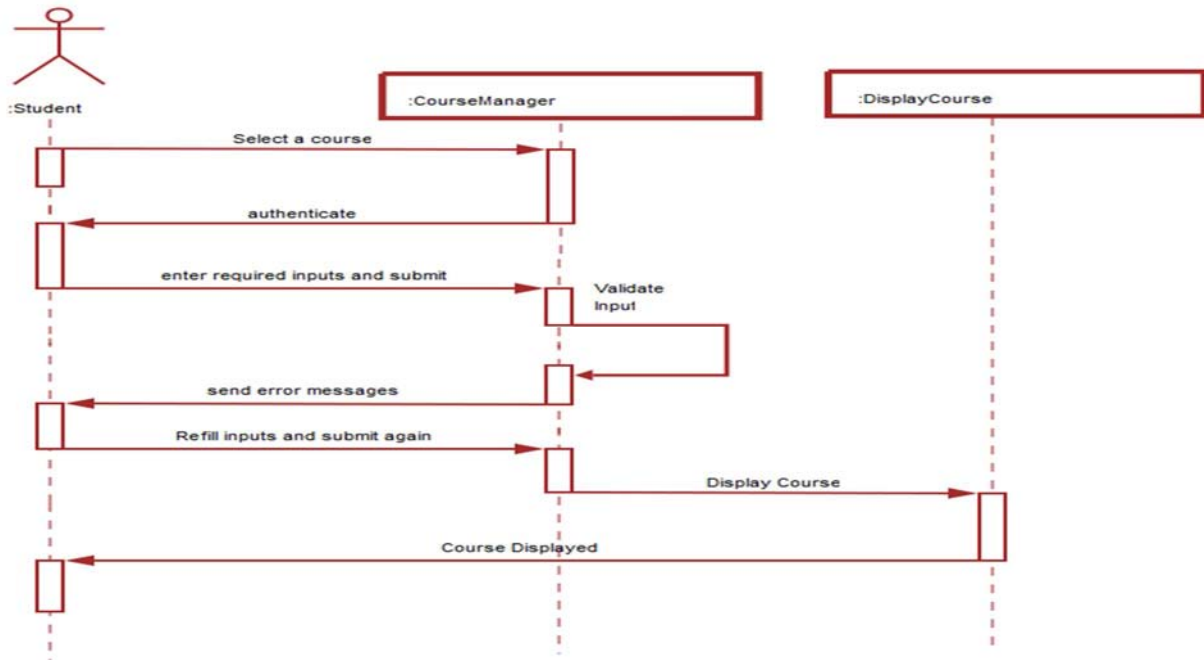


Figure 5.13: Sequence diagram for View course use case

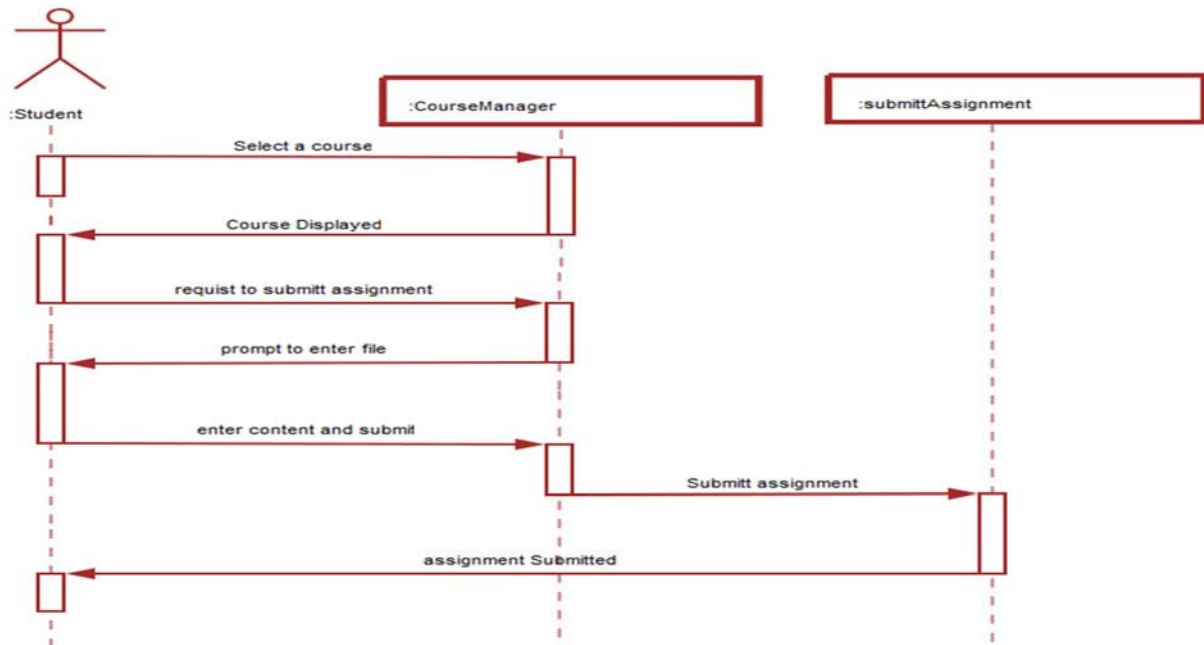


Figure 5.14: Sequence diagram for Submit Assignment use case

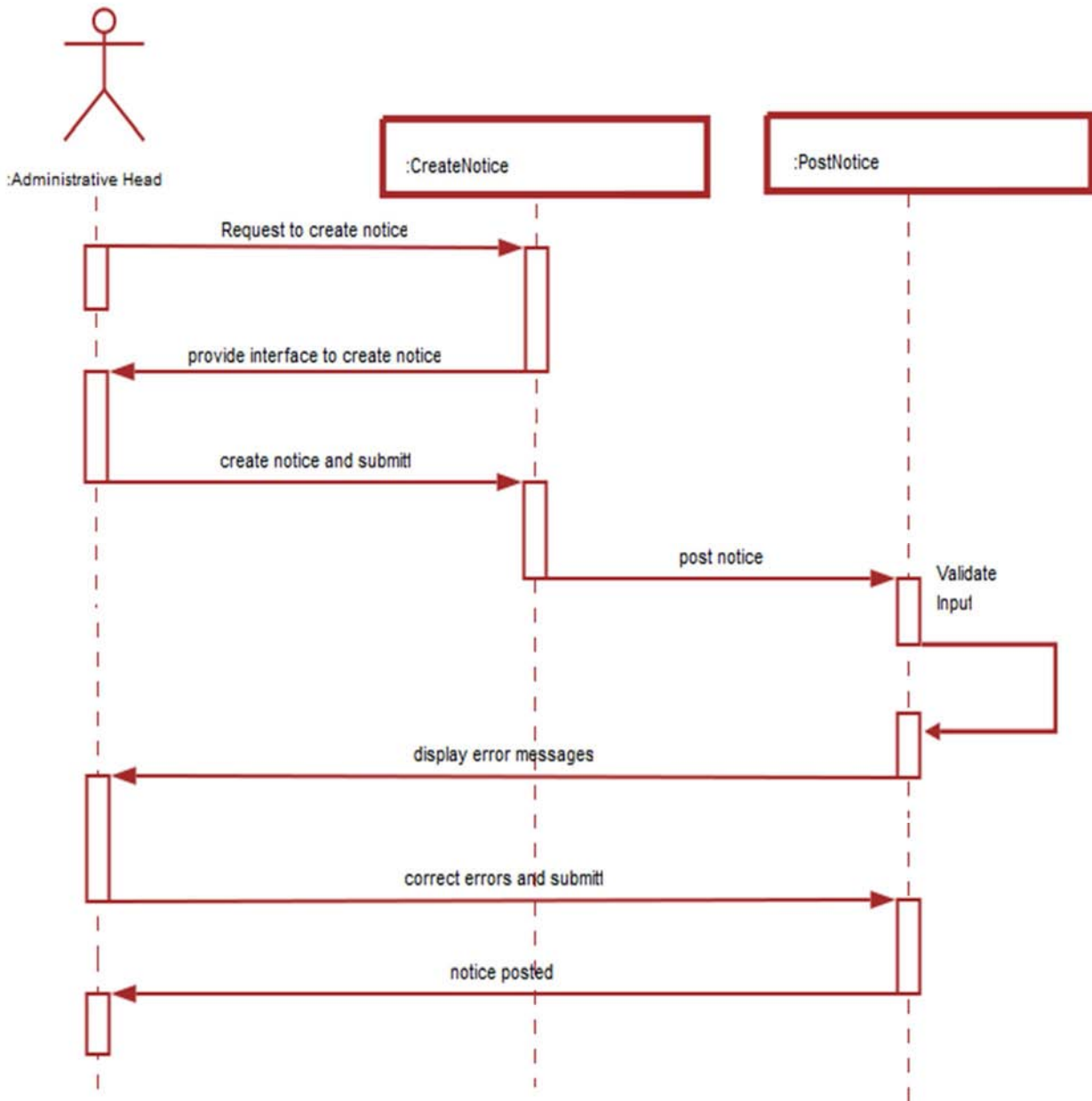


Figure 5.15: Sequence diagram for post notice use case

For posting notices the Create Notices object will provides an interface to post and edit notices and sends it to Post Notice object after validating the inputs it will be posted as shown in Figure 5.15. For viewing notice Document Manager allows to select notices or rules from the available posted notices or uploaded rules based on privileges and Display Document allows viewing the notice or rule that is selected as shown in Figure 5.16. Additional Sequence diagrams can be referred from Appendix F.

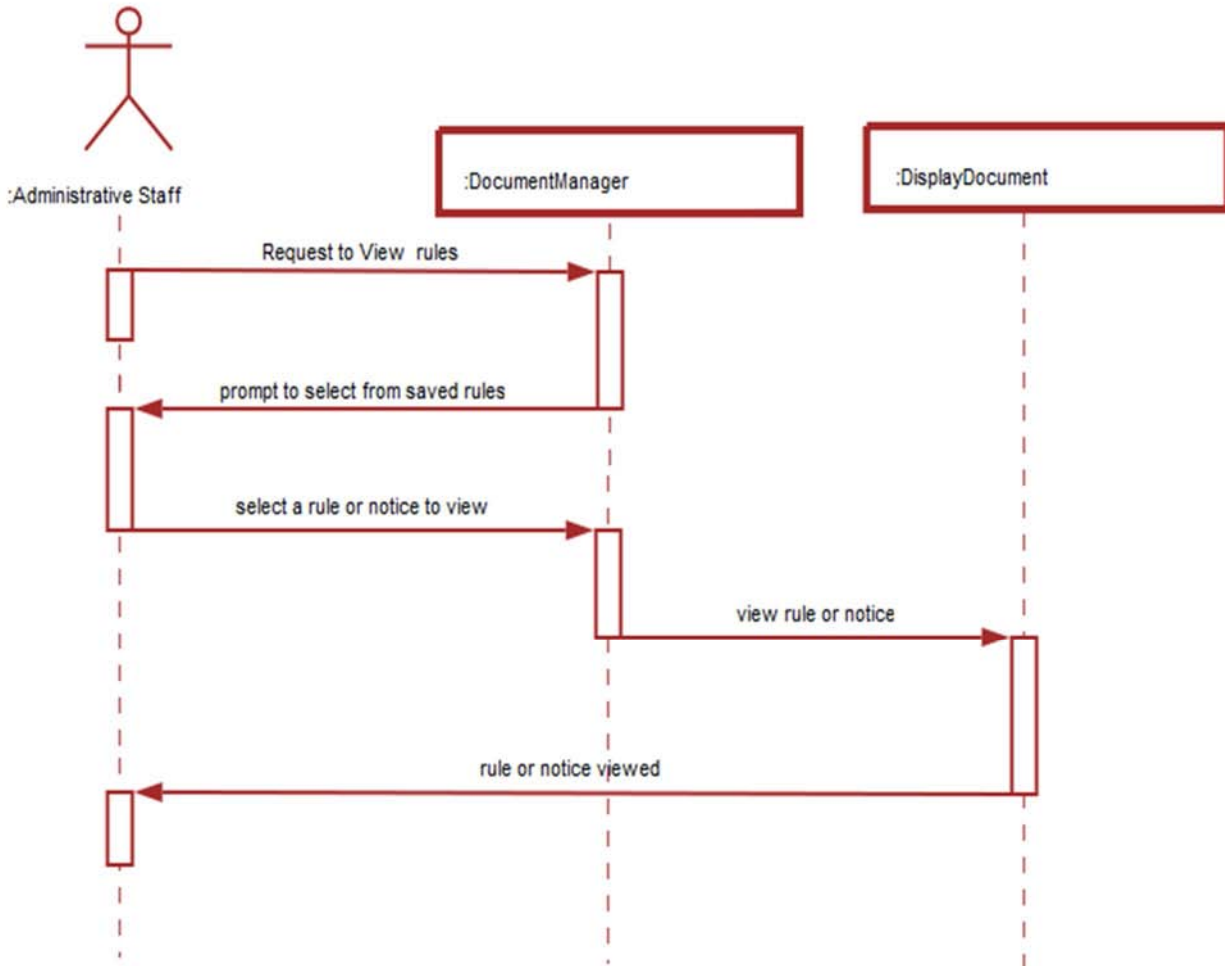


Figure 5.16: Sequence diagram for view notices use case

5.7.4 Class Diagram

A class diagram is a static model that describes the object structure of a system in terms of classes, objects, attributes, operations and associations between different objects. Identified classes and their associations for the system is depicted in Figure 5.17 below.

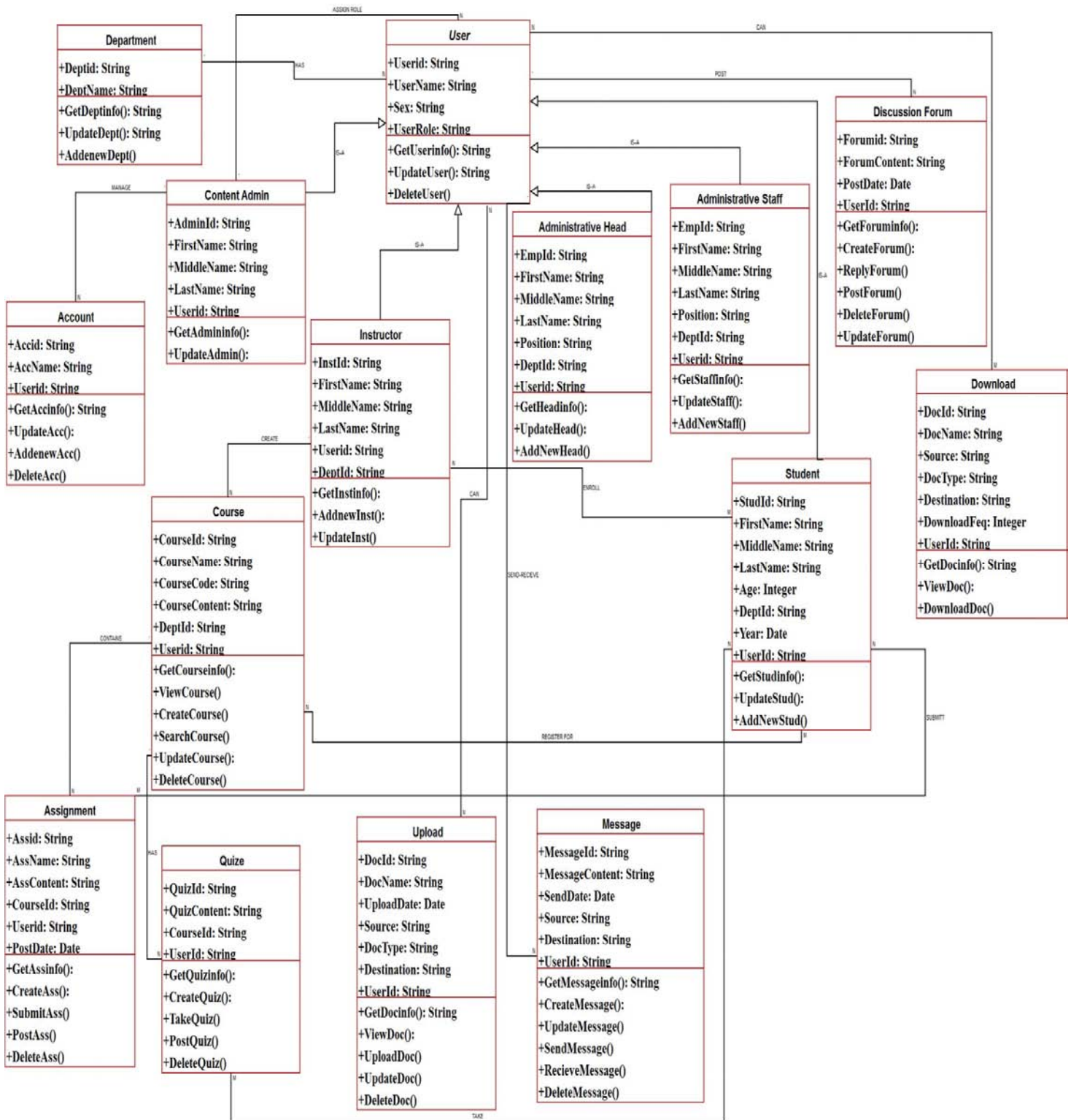


Figure 5.17: Class Diagram of WUCMS

CHAPTER SIX

SYSTEM DESIGN

6.1 Introduction

This section provides a comprehensive overview of the architecture and detailed design of the proposed system by providing architectural views of the various system design models, by identifying architecturally significant elements from each model, and design decisions that have been made for the development of the system. The system design focuses on stating the design goals of the system and subdividing the system into smaller parts so as to tackle the problem in a modular approach, and also provides the description of the subsystems and their deployment.

6.2 Design Goals

The design goals describe the different qualities of the system that are derived from the non functional requirements stated under Chapter four of this document. Based on the non functional requirements and the requirements elicited from the users the following design goals are identified.

Performance Criteria

Performance considers different factors such as throughput, speed, and bandwidth requirements of the system. Throughput considers the issue of concurrent access and the system should accept many users at a time, some content management systems like Moodle [7] will consider around 50 concurrent accesses for one Giga byte of RAM. In addition to this, since the system operates using the local Intranet infrastructure, it is assumed that for most of the requests the system will respond in a minimum possible time.

Maintenance Criteria

Maintenance criteria determine the difficulties of adding new components to the system without affecting its previous functionalities. Modifiability and portability are the most important ones that need to be considered under this design goal. Extensibility is the property of the system that enables the system to add new functionalities without any restriction; this does not restrict the future expansion of the system. The content management systems that the proposed system will be developed have extension manager modules that enable the system to integrate new functionalities [7, 8]. Portability stresses that the system should be migrated and accessed using standard platforms (See chapter five above).

End User Criteria

These criteria consider one of the most important system properties like Usability that can be considered as the determining factor for users' acceptance of a given system. To achieve this goal the system should be user friendly so that users can use it easily without confusion.

6.3 System Architecture

The system architecture determines the type of interactions that the system components will have, and with the consideration of the requirements and the design goals, a three tier distributed client/server architecture is selected to implement Wollo University Digital Contents Sharing and Management System (WUCMS).

In the client/server architecture, the server is responsible to receive request from clients and respond accordingly, whereas the client is responsible to send user requests to the server and display the processed results back to users. In three tier architecture the client is a web browser, and if a user has a request on data, the web browser passes it to the web server (Intranet server) and then the web server responds the client's request by communicating with the database server as shown in Figure 6.1. The main reason for

selecting this architectural design is for its scalability advantage, that is adding server nodes and re-balancing the business logic and data access layer processes across the available server pool can achieve a greater degree of scalability for improving performance.

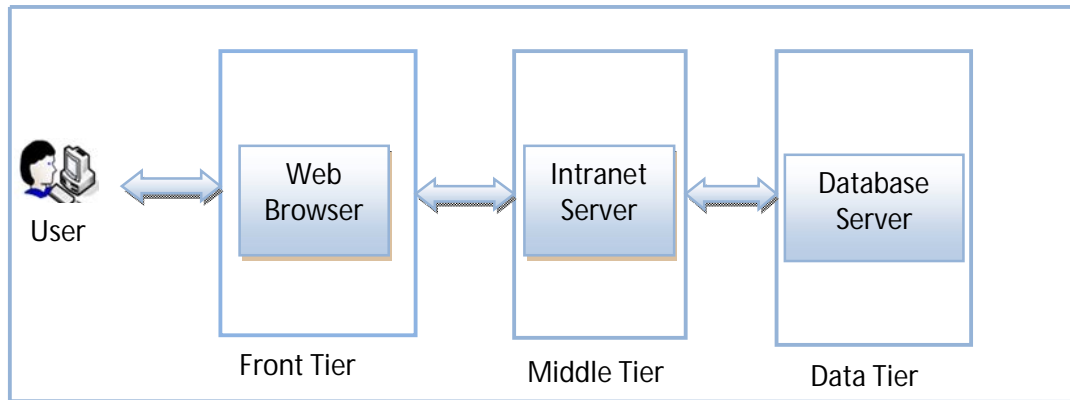


Figure 6.1: Three tier Architecture of the proposed system

To meet the requirements that are stated in Chapter five, the system adapts the above general architecture. The Intranet server in the middle tier will contain the business logic of the system and the Database server will contain course and enterprise data and will provide persistent data access to the Intranet server. The proposed system will be installed on the Intranet server and it will be an alternative to the Internet Connectivity to Wollo University Community members as shown in Figure 6.2.

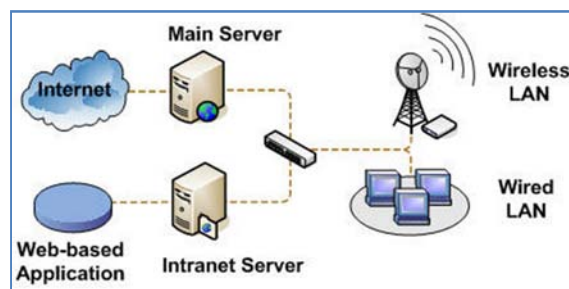


Figure 6.2: Physical implementation of the system

Based on the three tier client/server architecture, the system architecture of WUCMS can be depicted as in Figure 6.3 below. The different components of the system and their interactions can be easily identified from the system architecture and are described as follows.

- **Content Management UI:** - this component provides the user interface at the front tier that can allow users to interact to the main system by uploading documents, sending messages, and posting notices and announcements as well as accessing contents shared by other users.
- **Content Sharing:** - this component provides a facility for users to share their digital contents with each other, and sends users' inputs for searching and accessing contents to content management component, and provides content based on privileges.
- **Content Generation:** - this component collects contents developed by different users collaboratively and sends it to content management component together with necessary data about the content i.e., access level, author data, create date, publish date and so on for further processing.

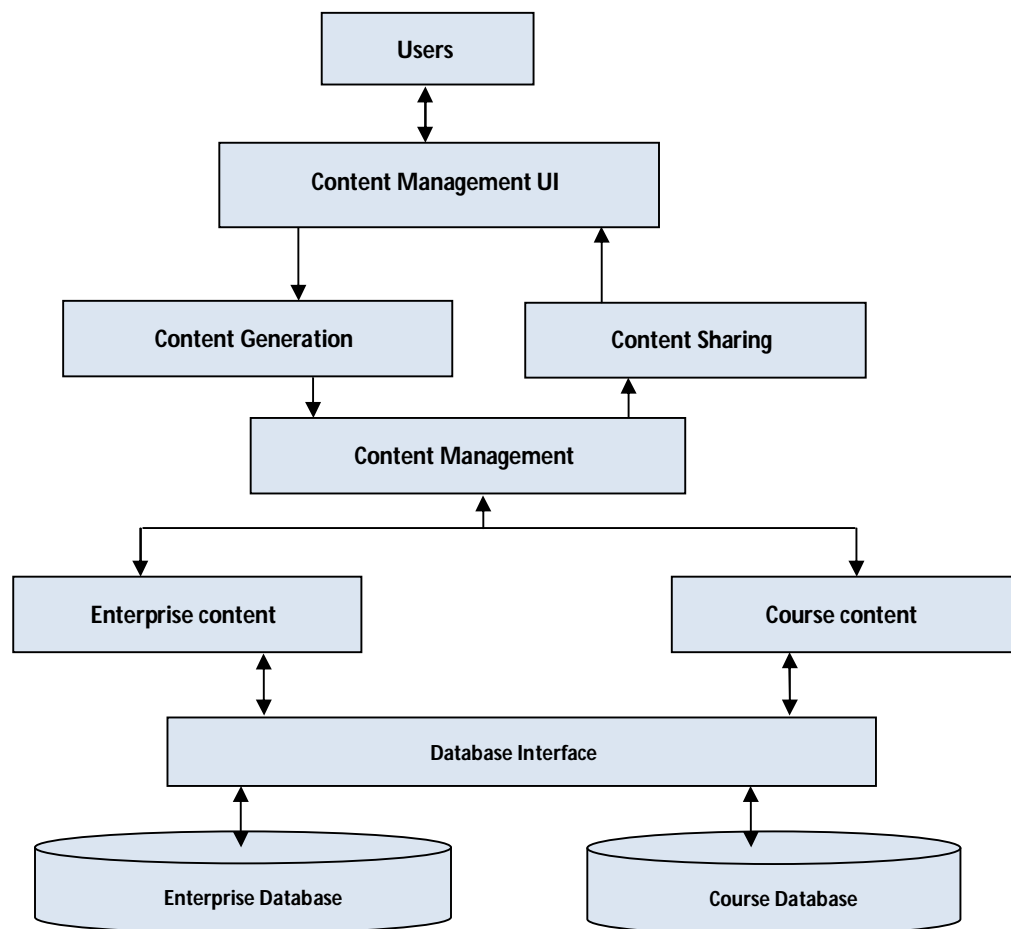


Figure 6.3: WUCMS Architecture

- **Content Management:-** this component performs different actions for classifying contents to different categories, as the system comprises both enterprise and course contents, controls access levels, controls contents developed and managed by decentralized users, versioning and indexing of contents for easy storage and retrieval, and controls and manages the overall content development activities.
- **Enterprise contents:** - this component collects enterprise contents after passing content management component and sends contents to enterprise database.
- **Course Contents:** - this component collects course related contents after passing content management component and sends contents to course database.
- **Database Interface:** - this component provides an interface for easy storage and retrieval of data to and from the database.
- **Enterprise Database:** - Stores enterprise data.
- **Course Content Database:** - stores course related data.

6.4 Subsystem Decomposition

Subsystem decomposition is required in order to simplify the complexity of the solution domain by decomposing the system in to different manageable parts. The subsystem decomposition of WUCMS is depicted in Figure 6.4.

6.4.1 Enterprise Content Management Subsystem

This subsystem is responsible for managing contents generated, accessed and updated by administrative users. This subsystem provides the main functionalities for enterprise content management, and contains document management, communication management, and user management subsystems. These functionalities enable administrative users to share and manage digital resources easily and efficiently and are described as follows.

a. Document Management Subsystem

This subsystem is responsible for managing documents that are shared and accessed by administrative users, this subsystem enables users to upload, download and share digital resources like legislation, rules and regulations, notices and announcements, and so on. The other service of this subsystem is to provide documents based on the user access levels by maintaining access privileges of documents. That is, by checking whether they are shared to public or private users. Moreover, this subsystem will take care of the storage and retrieval of documents throughout the enterprise content management system.

b. User Management Subsystem

This subsystem enables the administrator to manage user accounts, this includes creating new user accounts, updating existing accounts, removing accounts, creating groups, and assigning user roles. This subsystem is responsible to group users for sending and receiving public and private messages and for sharing documents either publicly or privately.

The other responsibility of this subsystem is to assign user roles in order to control the content access and development. For this purpose there are different user role assignments that have been utilized such as Administrator, publisher, editor, author, registered user and guests. Each of these types of users will have different privileges for accessing and developing contents. These different user roles are related to each other in such a way that one user role can have its own privileges and all privileges of its lower users. The identified user roles and their access levels are described as follows.

- **Guest Users:** - guest users are users that are not registered to use the system and have access only to limited contents that are available to the general public.
- **Registered Users:** - A Registered User has no ability to create, edit, or publish content on the system. They have access to restricted content that is not available to guests.

- **Authors:** - Authors can create their own content, specify certain aspects of how the content will be displayed, and specify the date when the material should be published.
- **Editors:** - Editors have the same abilities as an Author and they can edit their own content as well as that of any other Author.
- **Publishers:** - Publishers can perform all the duties of Authors and Editors and have the ability to publish content.
- **Administrator:** - Administrators can add and delete extensions to the web site, change templates or alter page layouts and can even alter user profiles and change certain global characteristics of the web site and so on.

c. Communication Management

This subsystem is responsible for providing the capabilities required for easy and timely communication between users. For this purpose this subsystem provides users different communication facilities such as messaging, chatting, and discussion forums. These services enable users to send and receive messages, to conduct live chatting, and to discuss issues about different topics by participating in discussion forums.

6.4.2 Course Content Management Subsystem

This subsystem is responsible to manage and share course related contents that will be created by instructors and students. This subsystem provides the main functionality for course content management and includes course management, user management, and communication management subsystems. These functionalities enable academic users to easily manage courses, share course related materials, conduct assessment, have one to one communication, and post and participate in discussion forums. The components under this subsystem that provides these functionalities are discussed below.

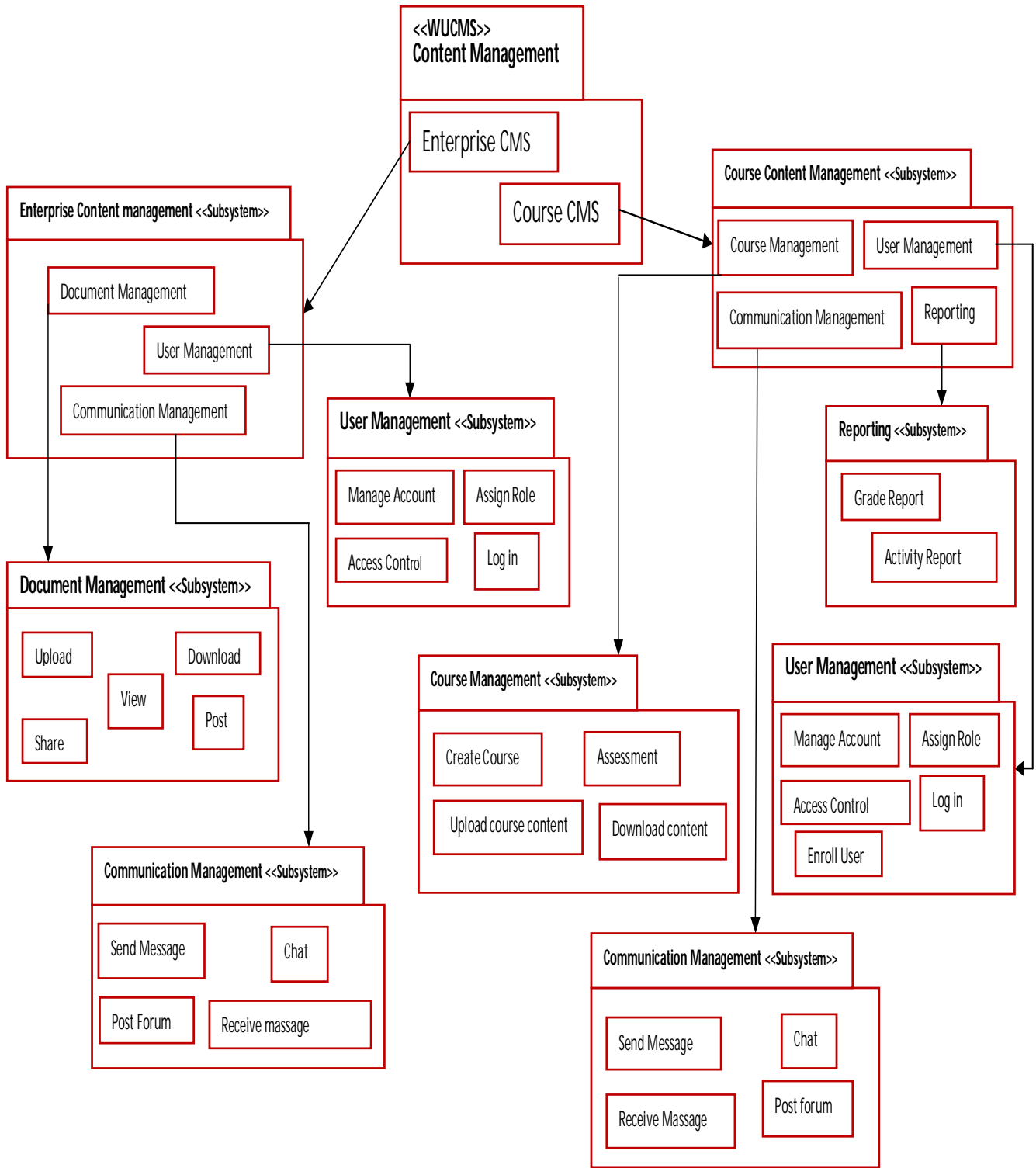


Figure 6.4: Subsystem Decomposition

a. Course Management Subsystem

This subsystem is responsible for managing course related contents that are created, accessed and shared by academic users. It also enables users to easily create courses, upload and download course related materials, conduct assessment, submit assignments and test results. The other service this subsystem provides is that to maintain the security of created courses from an authorized access by providing enrolment key to users, and also keeps the privacy of student private information such as test results and marks. Therefore, students can only access courses that they have registered and see only their own test results and marks.

b. User Management Subsystem

This subsystem provides the necessary functionalities that enable the system administrator to manage academic user accounts, this includes creating new users, updating existing accounts, removing unwanted users, creating groups, and assigning user roles. This subsystem enables to group academic users to different departments and also provides functionalities to create subgroups that can be used to group users such as students to their academic class year.

The other service that this subsystem provides is assigning user roles, this enables to set the users permissions and privileges for accessing and developing course contents. For this purpose this subsystem provides different user roles to be assigned, these are Course Creator, teacher, non-editing teacher, and student and described as follows.

- **Course Creator:** can create course and teaches online using it.
- **Teacher:** teachers can do anything with in the course including changing the activities and grading students.
- **Non-editing teacher:** can teach in courses and grade students, but may not alter activities.

- **Student:** can only access course contents provided by their teachers and participate in different activities available in the courses that they have been enrolled.

The user management subsystem will also take care of the user enrolment for a particular course and used to manage which users are currently enrolled to which course.

c. Communication Management

This subsystem enables users to communicate with each other in timely fashion by providing different communication functionalities such as messaging, live chatting, and discussion forums, these facilities enables users to send and receive course related messages and announcements, to have one to one communication with course instructors using live chatting, and to discuss course related issues by posting and participating in discussion forums. This allows students to discuss different course concepts in groups online without space and time limitation, and instructors can also participate and follow the students' discussions and can have a chance to bring important ideas to the classroom for further clarification and discussion. This solves the problem of many students that have very low class participation to ask any clarifications about the course by making one to one communication with their instructors freely, and by discussing different course issues with their classmates.

d. Reporting Subsystem

This subsystem provides the functionalities to generate different reports for different users, these include, generating grade reports of student assessments, and reports about students' activities and participations in a particular course. This reporting sub system enables instructors to add students' evaluation results from the course management system to the face to face course evaluation.

6.5 Deployment Diagram (hardware/ software mapping)

The deployment diagram describes the relationships of components with that of hardware nodes and gives a high-level view of each component i.e., the user node represents any computer connected to the Intranet of Wollo University that will access the application with a web browser, the developed application software will be hosted on the dedicated server that runs Apache web server, and the database of the application software will be hosted on a database server which runs MySQL database. This is represented using UML deployment diagram as depicted in Figure 6.5.

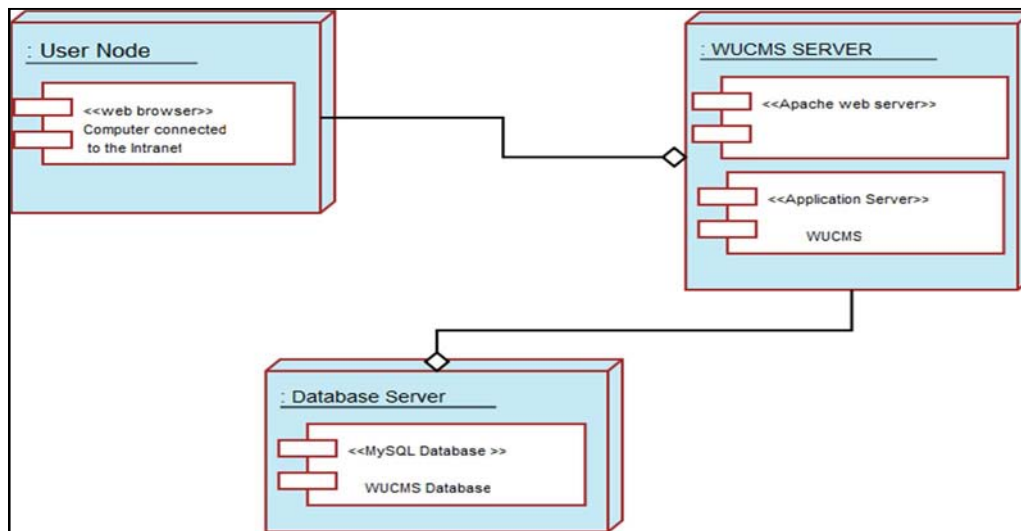


Figure 6.5: WUCMS Deployment diagram

6.6 Persistent Data Management

WUCMS requires keeping persistent data about the different user account information to allow different users to have different views of the system and to allow concurrent access to the system, and course related data also need to be recorded and stored in the database including multimedia course materials and students' course activities and assessment information. For this reason the relational data base management system (RDBMS) is chosen as a persistent data storage because of its advantages in preserving interrelated data and easy for creating relationships between different entities that can participate in the system, and in this work, MySQL, an open source relational database management system has been utilized for its flexibility and ability to be integrated with different open source content management systems.

CHAPTER SEVEN

IMPLEMENTATION

This chapter presents the implementation of the system; the implementation tools used, and identified implementation issues. In addition to this, it presents different interfaces of the developed system.

7.1 Development Tools

When a distributed application becomes an issue, web-based application is the best choice for developing a solution, because it is easy to divide functionalities into tiers, and this enables the task division easy and increases flexibility. The different tools utilized in the web-based application development process of this work are:

Hypertext pre processor (PHP): - for the purpose of server side scripting and for customization of the chosen content management systems to the needs and requirements of Wollo University.

Web-based Content Management Systems: – for the purpose of managing the different types of contents mainly, enterprise contents and course contents generated from different sections and departments. For this purpose well known open source web-based content management systems are chosen namely, Joomla and Moodle.

Joomla will be used for development of the enterprise content management subsystem of WUCMS, because it can be easily customized to a particular need and provides a content management application development environment to develop the system. Moodle will be used for the development of the course management subsystem of WUCMS, because it can be easily customized and provides a course management system development environment.

7.2 WUCMS System Interfaces

The system provides different interfaces for different users to interact with the system, as it is discussed in chapter five of this document the main actors that can interact with the system are Content Administrator, instructors, students, Administrative heads, and administrative staffs. When the system first runs, the Intranet home page will be displayed as shown in Figure 7.1 below and from the home page users are capable of navigating to different parts of the system namely, to course management subsystem and to enterprise content management subsystem. The Intranet home page will display public information that can be accessed by guest users including public news, announcements, notices, reports of different meetings and symposia, and different posts submitted by each and every departments of Wollo University.

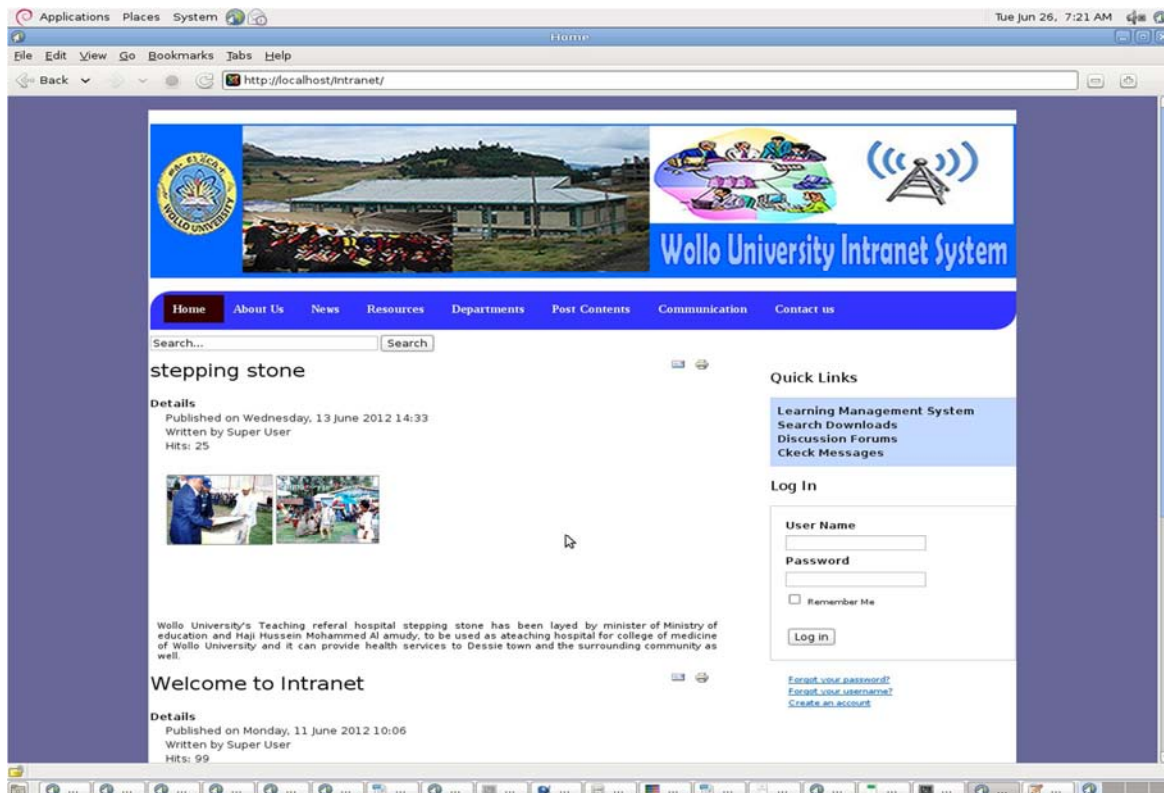


Figure 7.1: WUCMS Home Page

7.2.1 Enterprise Content Management Subsystem Interfaces

From the above home page users can easily navigate to this subsystem by logging in using the log in interface provided to access the different functionalities of this subsystem that is designed mainly for administrative purpose. After the user has been logged in, the user type will be identified by the system and the necessary privileges will be assigned, and the different functionalities will be accessed based on the user's access level. Under this subsystem registered users can access functionalities like, uploading, downloading, and sharing digital resources, as well as sending and receiving messages, and posting and participating in discussion forums.

Digital Resource sharing: users can post public or private news, notices, announcements, and reports to be shared by general public or registered users as shown in Figure 7.2.

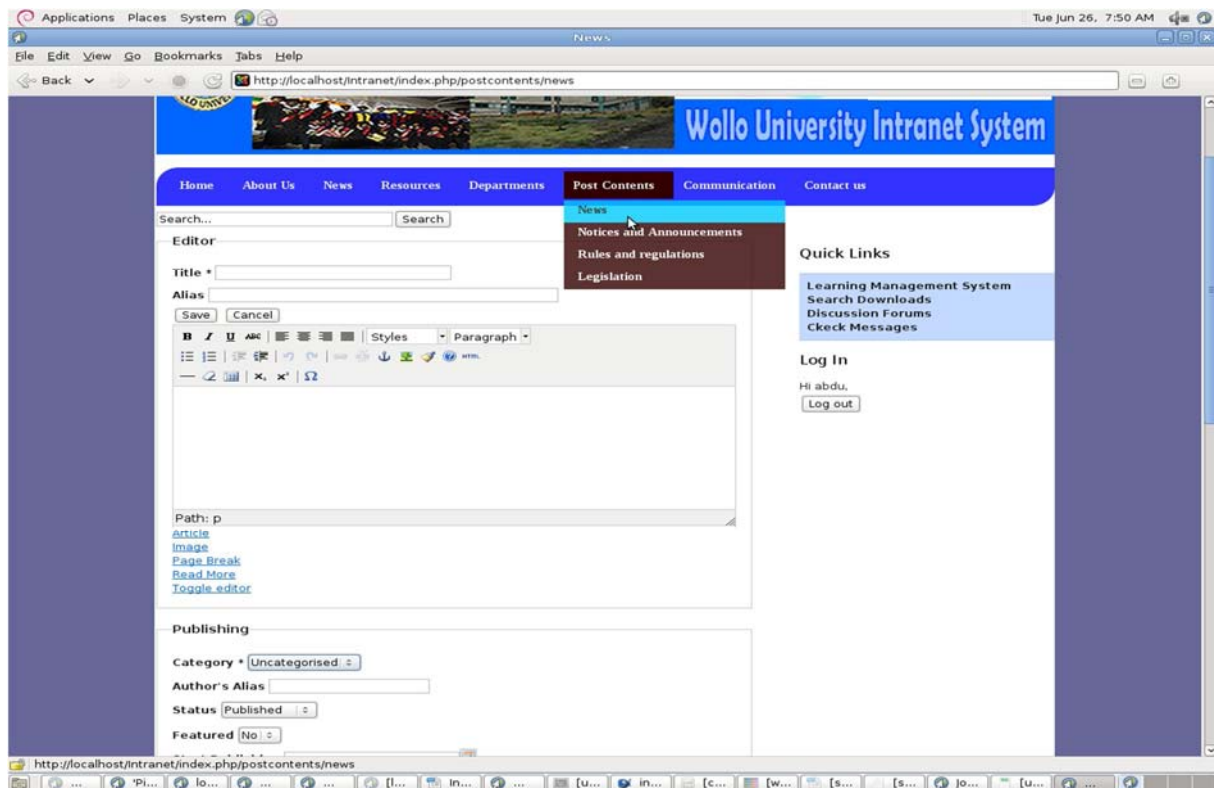


Figure 7.2: Posting Digital Resources

Users can also upload scanned and digital documents to be shared by other users; these can be the legislation, different rules and regulations, Notices, and announcements. For this purpose the system provides the interface for uploading digital resources as shown in Figure 7.3 and the uploaded documents will be organized based on different categories for easy access and management.

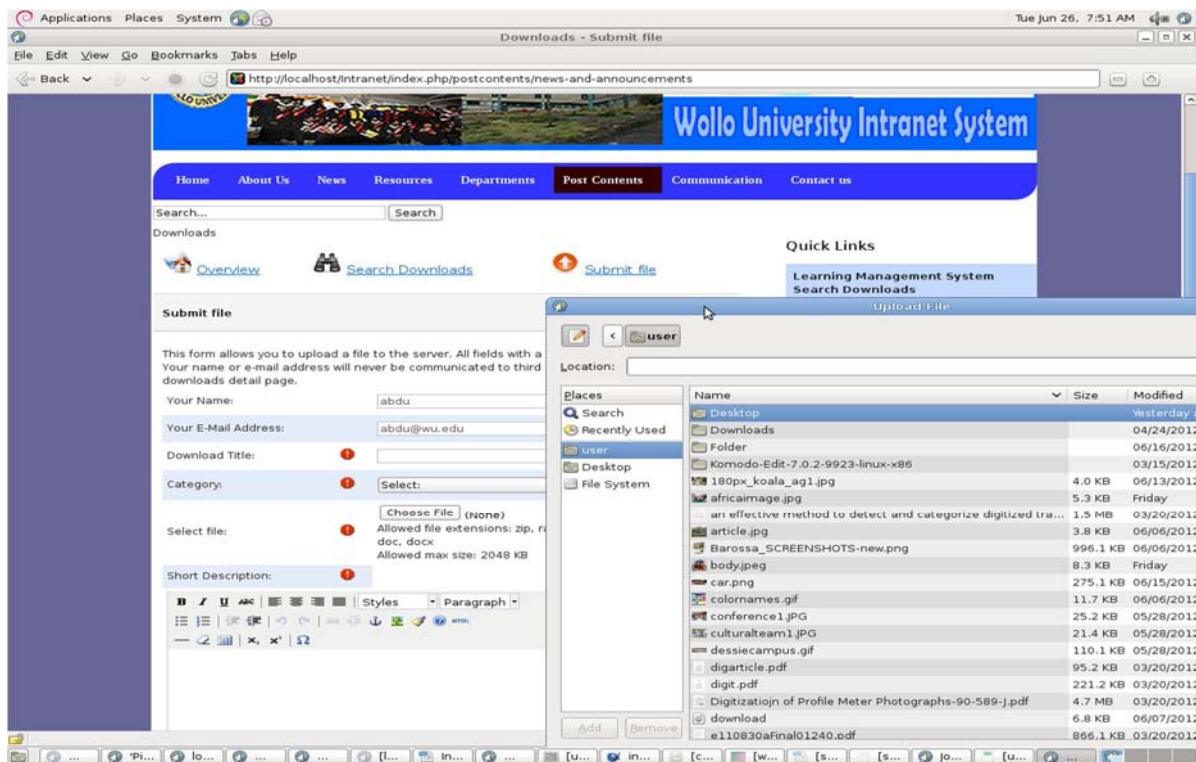


Figure 7.3: Uploading Digital Documents

The uploaded and shared digital resources can be also downloaded and viewed by users based on their access levels. Figure 7.4 shows how the shared digital documents can be downloaded by users.

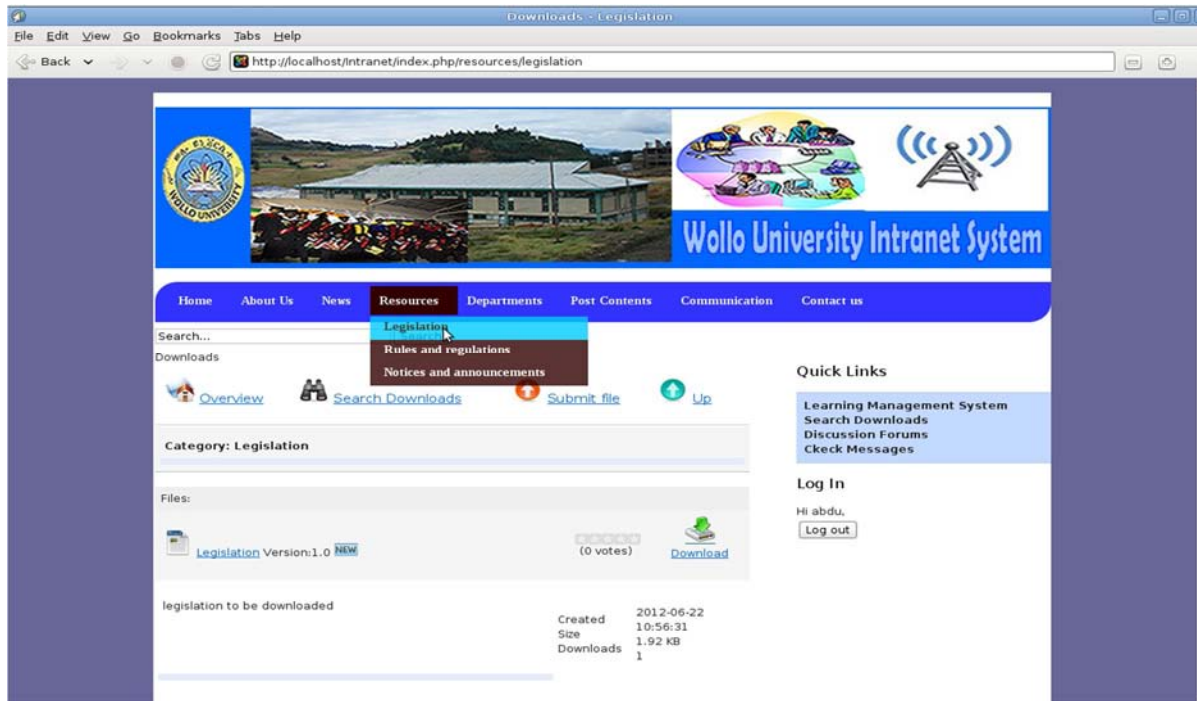


Figure 7.4: Downloading Digital Contents Shared by Others

Digital Communication:- For digital communication purpose the system provides different interfaces to be used by registered users such as sending and receiving messages, and posting and participating in discussion forums. For facilitating communication between users the system provides different interfaces for message management as shown in Figure 7.5 that can enable the user to send and receive messages, to replay and forward received messages and to delete messages that have been viewed, and users can send messages for multiple users as shown in Figure 7.6 below.



Figure 7.5: Messaging Service User Interface

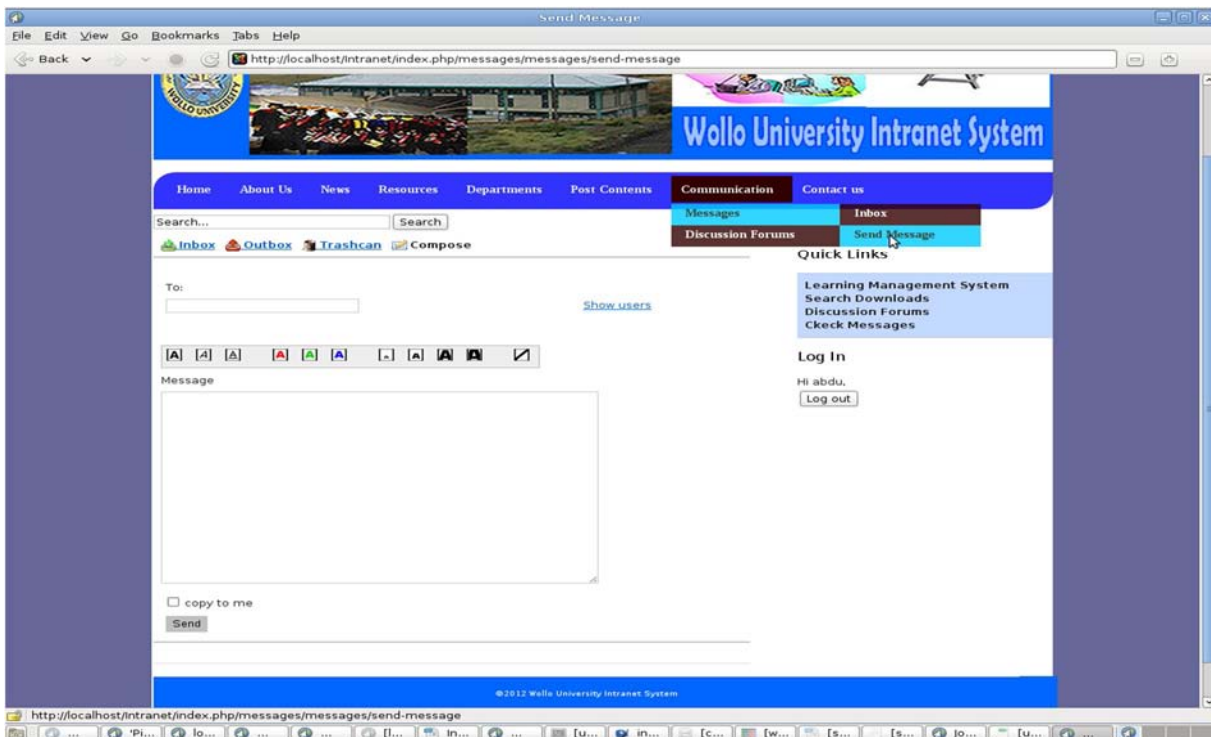


Figure 7.6: User Sending Message to One or Multiple Users

The other communication Interface is discussion forum, under this functionality user can access, post, and participate in discussions on different topics. For this purpose the system provides an interface as shown in Figure 7.7 for searching discussion forums and for posting discussion topic as shown in Figure 7.8 that enhances communication and sharing of ideas between members of the University community. The different topics will be organized in different categories and users will have the capability to search forums, post forums, and viewing their forum profile.

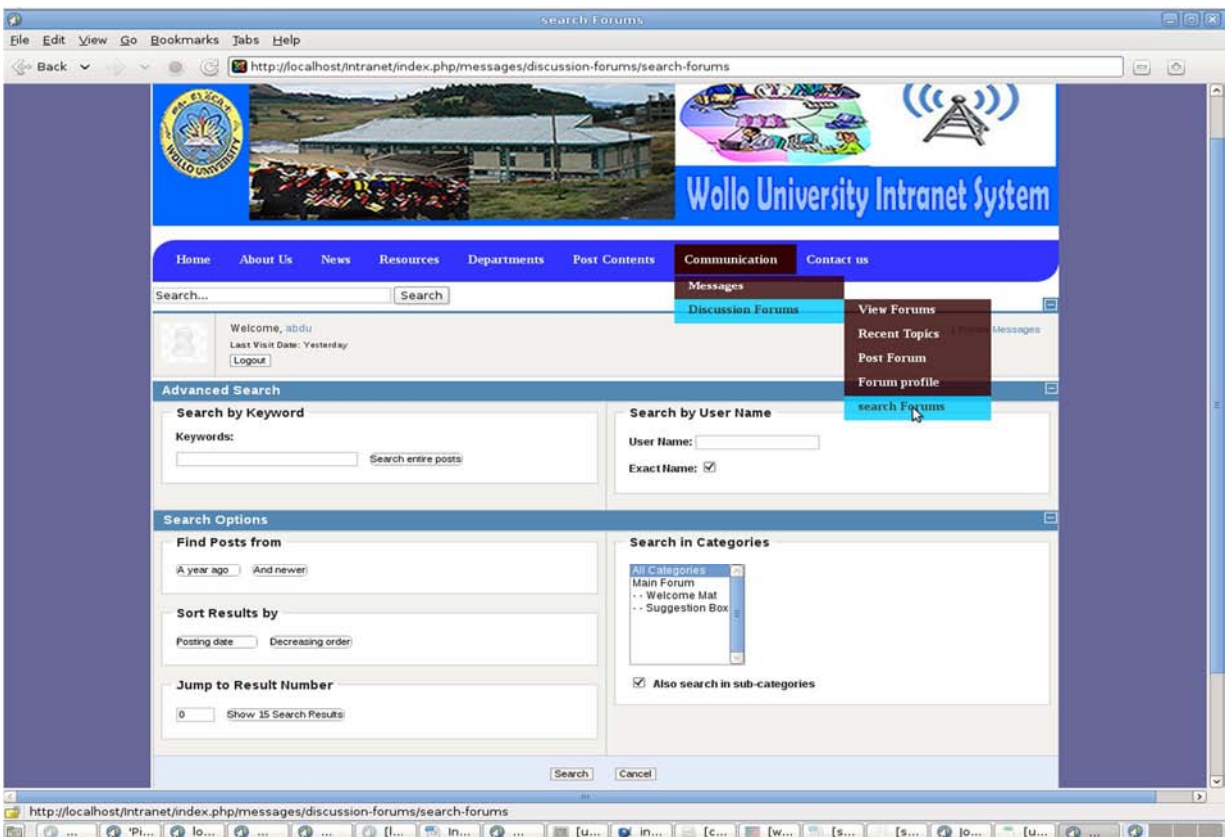


Figure 7.7: Searching Forums

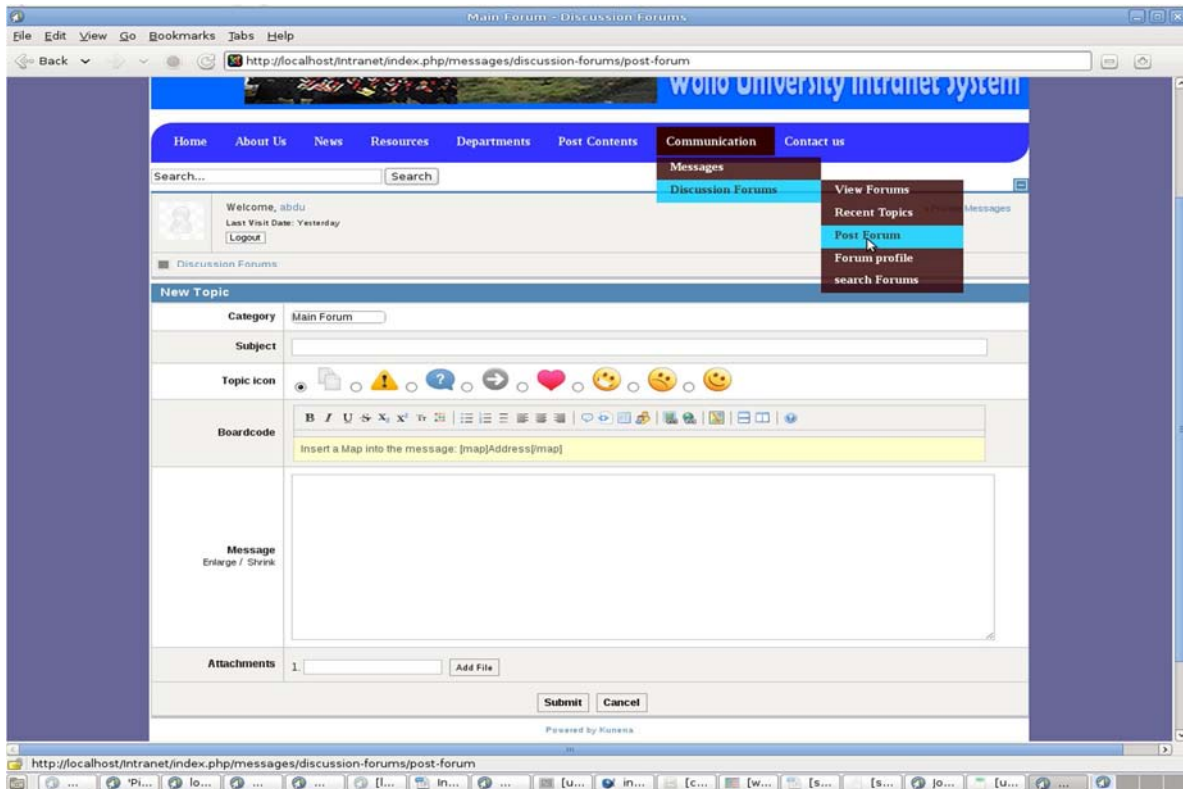


Figure 7.8: Posting Forum Topic

7.2.2 Course Management Subsystem Interfaces

The interfaces in this category have different features that include: login, user management, course management, course presentation, self-test, question entry, exam preparation, student performance monitoring and evaluation, post and conduct discussions, messaging, and announcements. Each of these is described as follows.

Login: - Since the actors that can mostly interact with this subsystem are instructors and students, both will be authenticated to the system. The system then identifies the user's role and displays the different functionalities of this subsystem based on the user's access level after entering a valid user name and password using the log in form as shown in Figure 7.9 below.

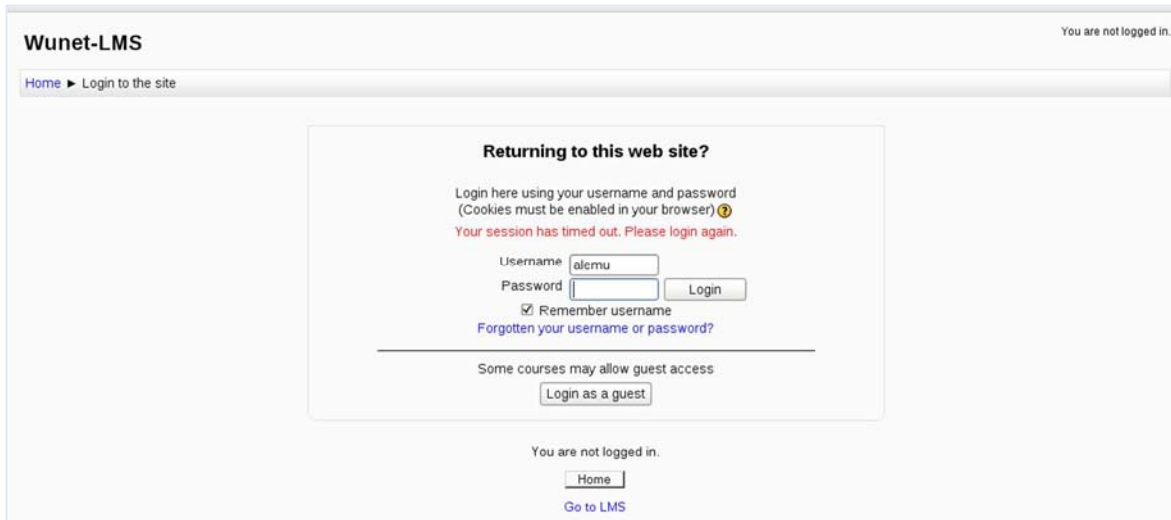


Figure 7.9: Login Form

After logged in the learning management system home page will be displayed as shown in Figure 7.10 below and instructors and students that have user accounts can get all the functionalities of this sub system based on their access levels.

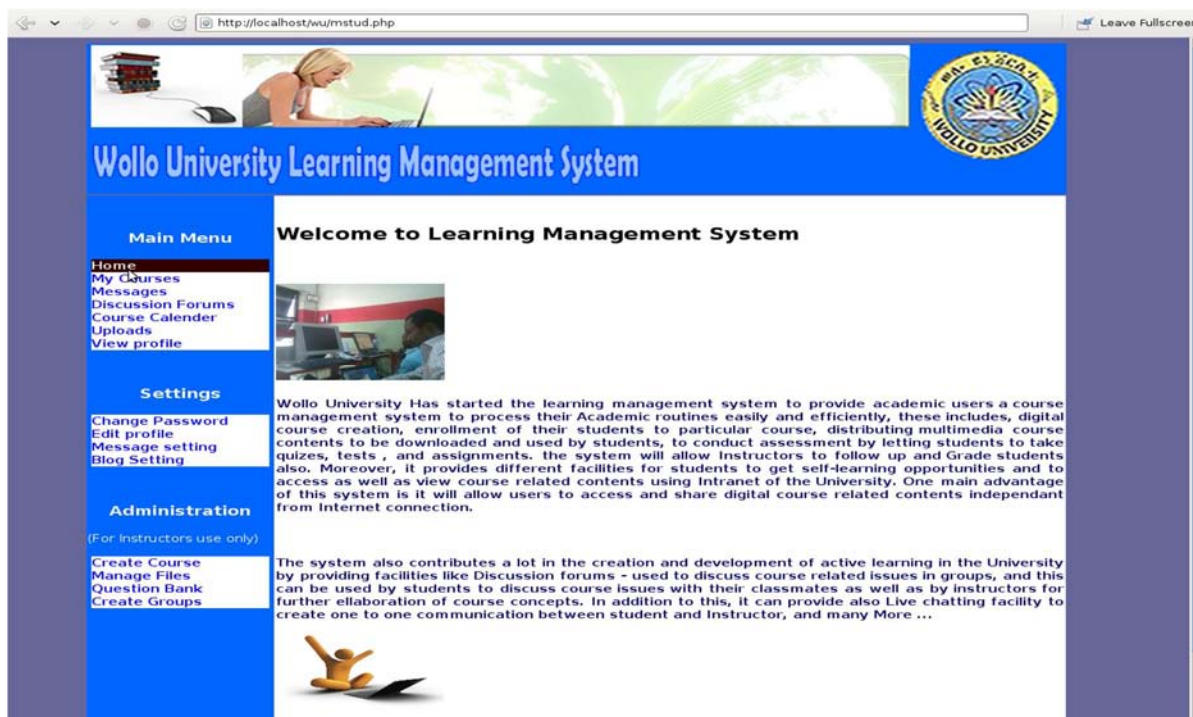


Figure 7.10: Learning Management System Home Page

Course management: - when instructors clicked on my courses from the right hand side menu they can view and create courses as shown in Figure 7.11 below as well as add contents to courses as shown in Figure 7.12 below. After they have finished creating courses they can enable it to be accessed by students at any time, they can set passwords to their courses, and enroll students to courses as shown in Figure 7.13 below. The following course management interfaces can illustrate some of the basic course management functionalities.

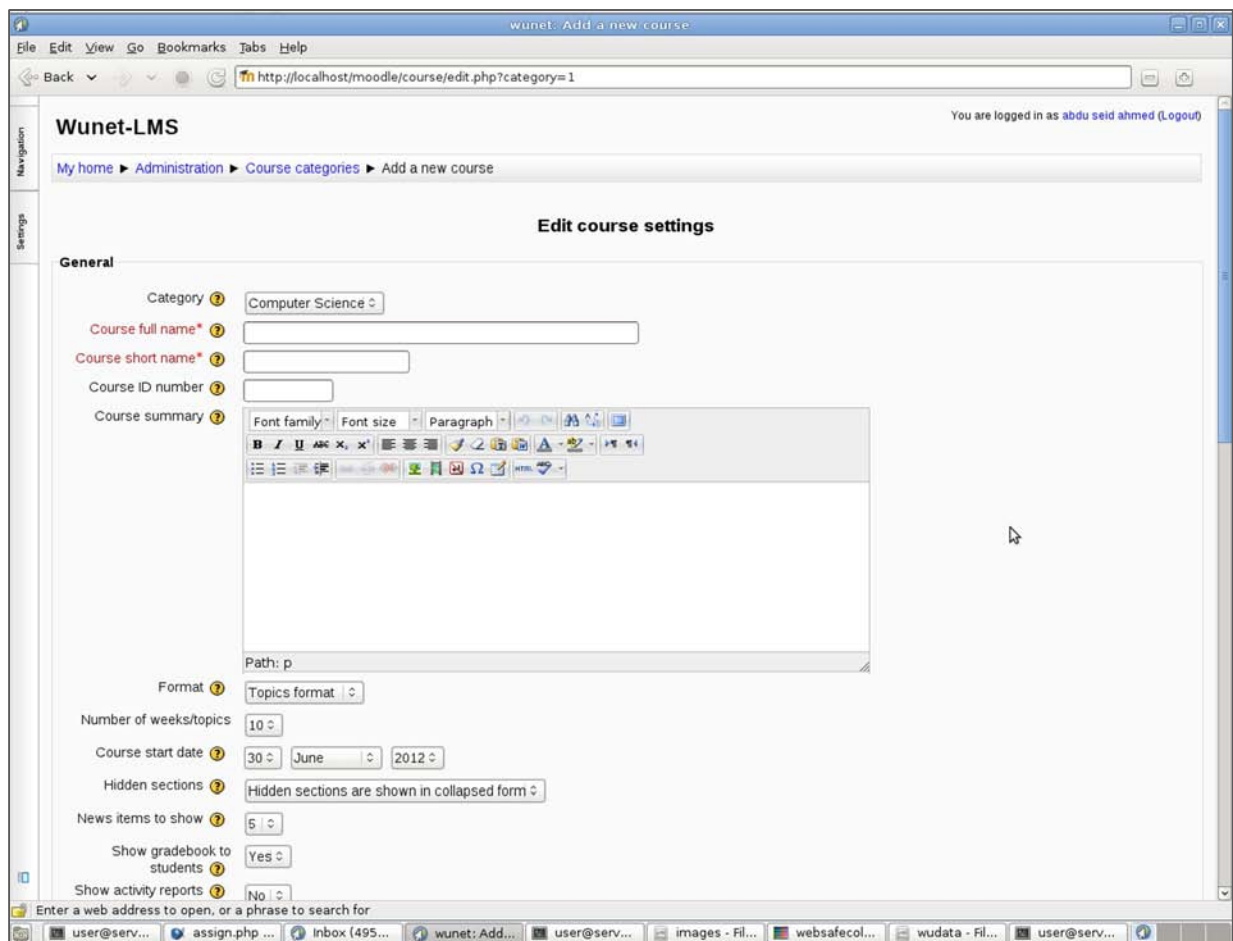


Figure 7.11: Creating Courses

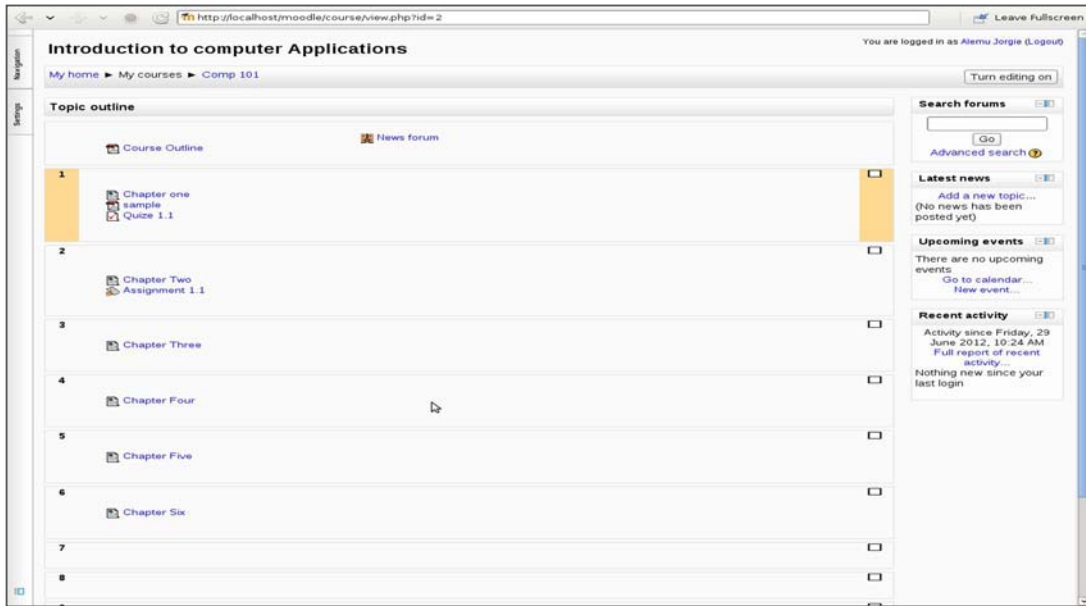


Figure 7.12: Adding and Accessing Course Contents

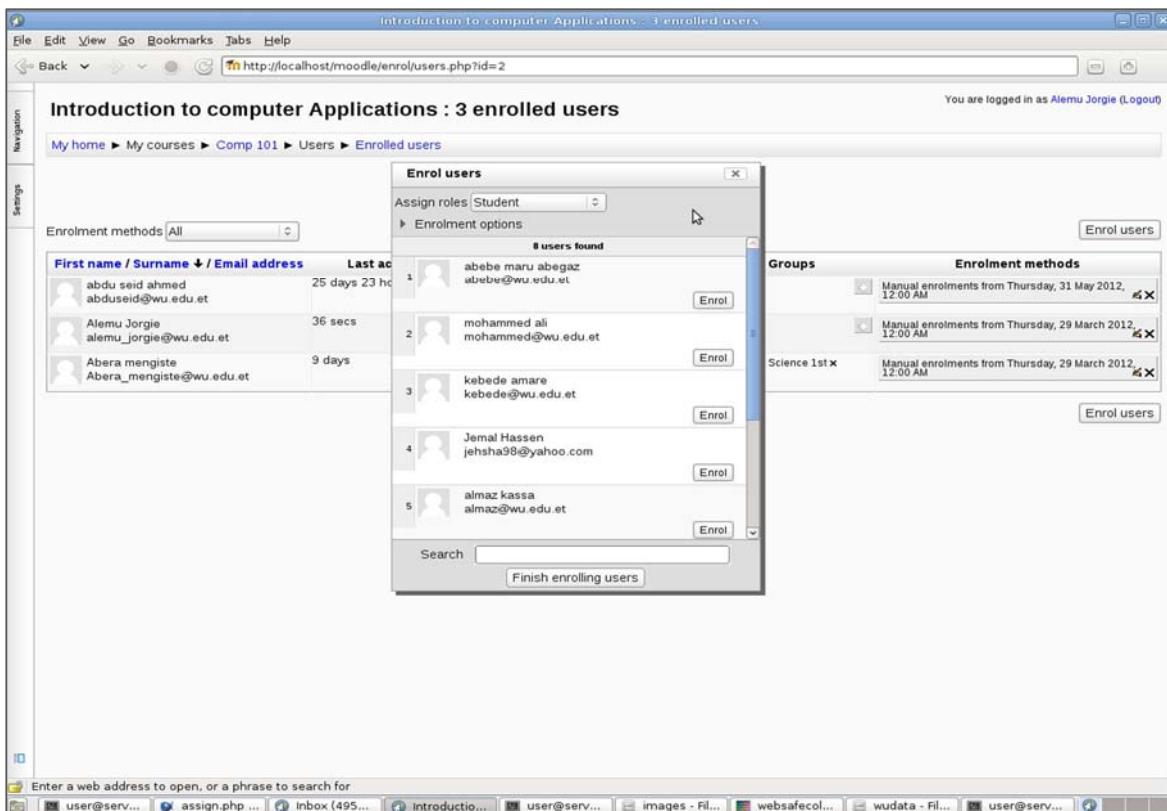


Figure 7.13: Enrolling Users to Particular Course

For a particular course teachers can create groups of the students which are enrolled for that course as shown in Figure 7.14 below

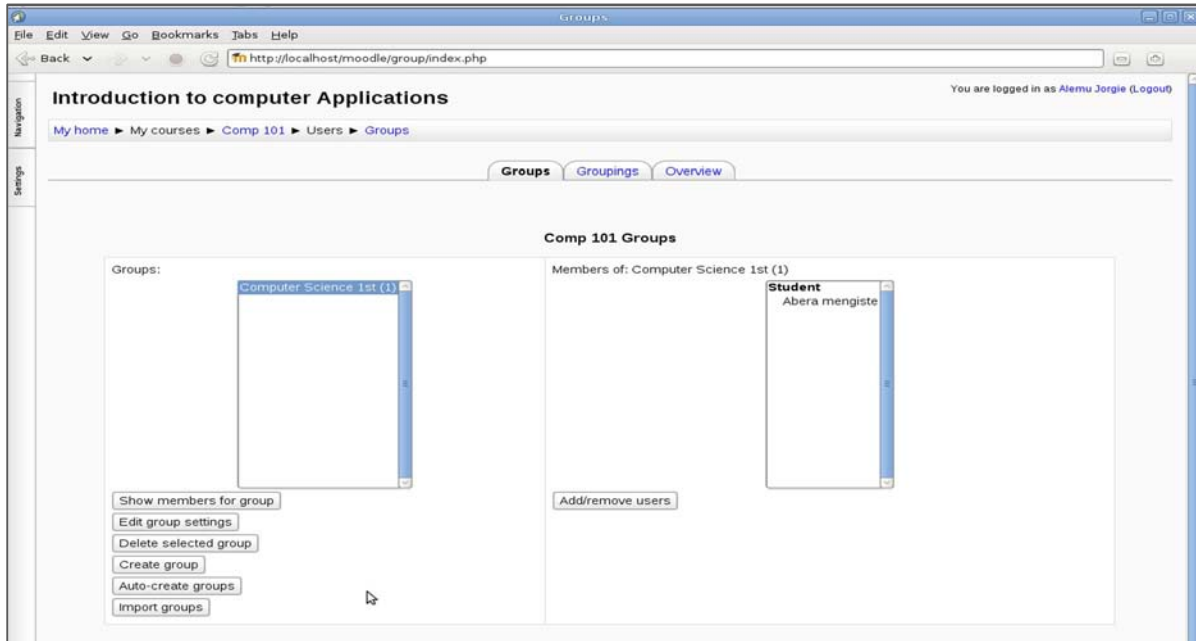


Figure 7.14: Teachers can Create Groups

The system allows instructors to create questions for quizzes and tests as shown in Figure 7.15 below.

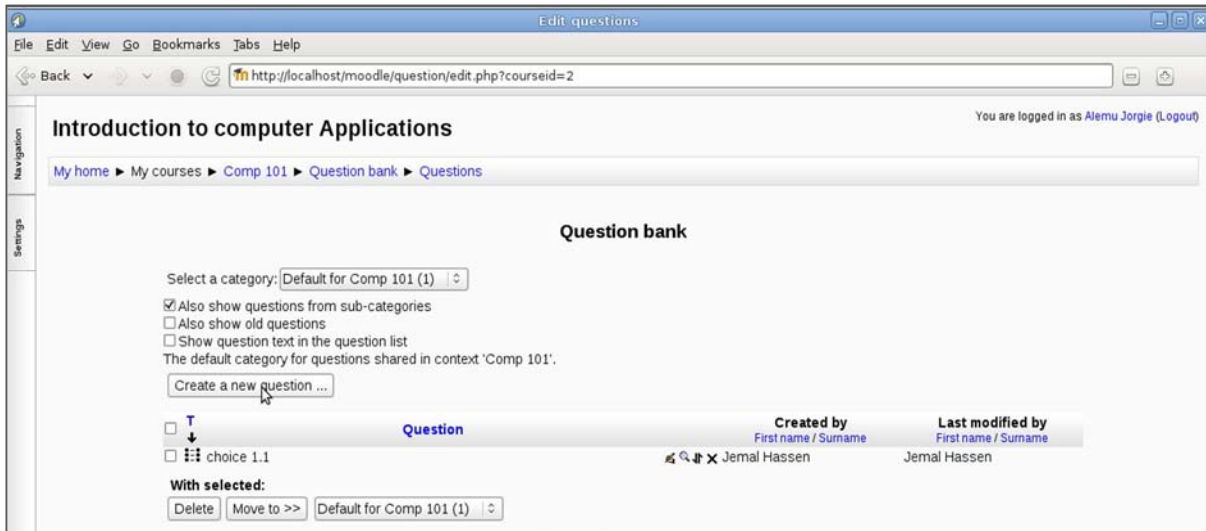


Figure 7.15: Teachers can Prepare Questions for Quizzes and Tests

The system also generates the grade report for continuous assessment for both instructors and students as shown in Figure 7.16 and in Figure 7.17 below respectively.

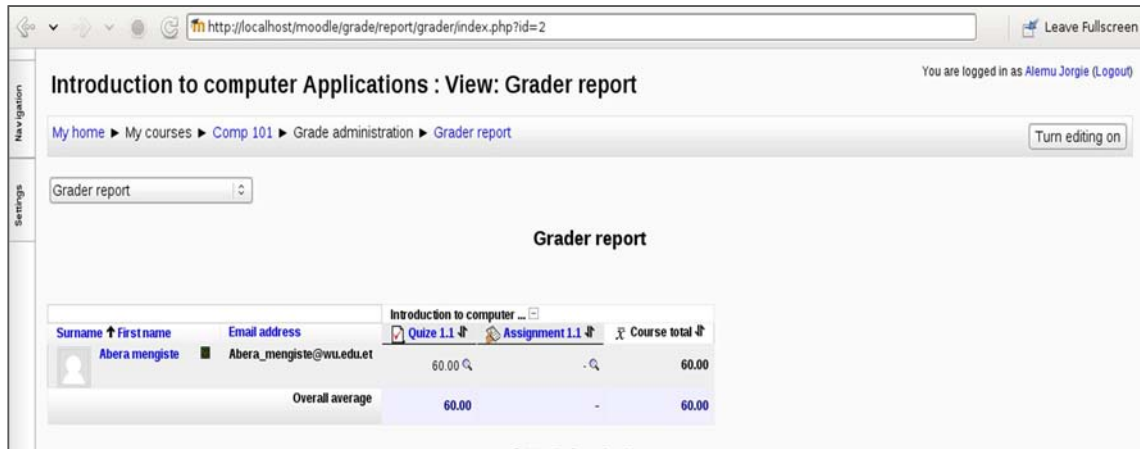


Figure 7.16: Grade Reports for Assessments Taken by Students

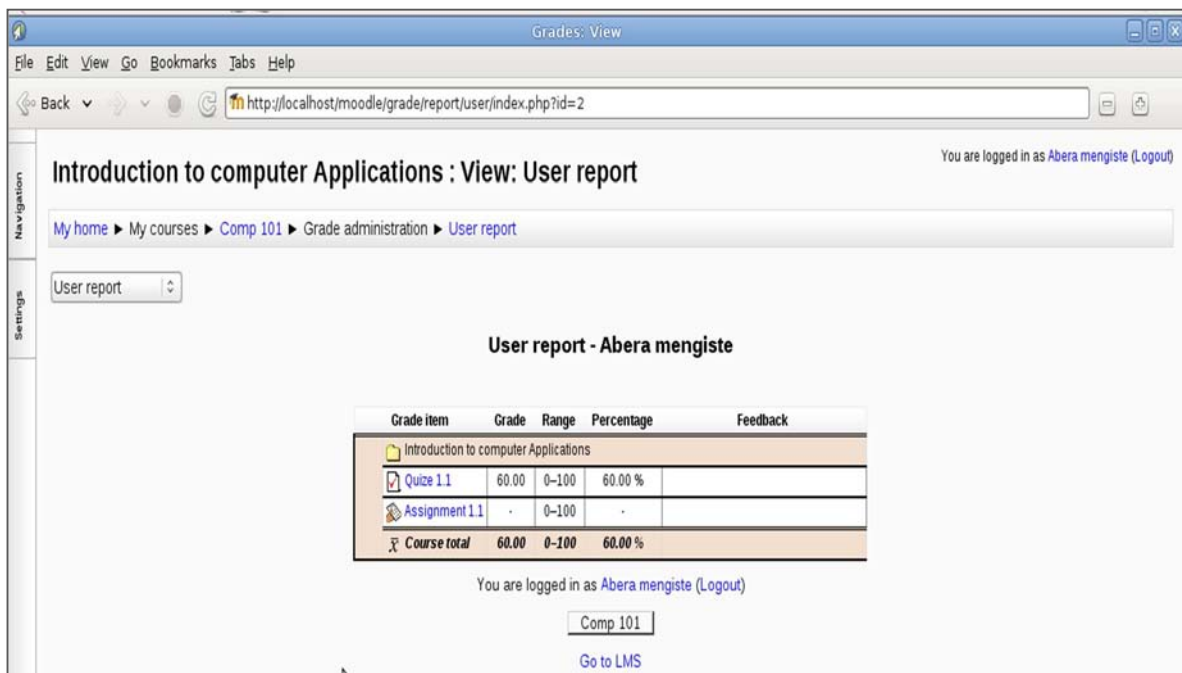


Figure 7.17: Students can View Their Grades for All Types of Assessments

After enrolled to a particular course, students can have access to contents that are uploaded by their instructors and they can view content online as shown in Figure 7.18

below. Moreover, students can attempt quizzes and online tests as well as view their assessment results as shown in Figure 7.19 and Figure 7.20 respectively.

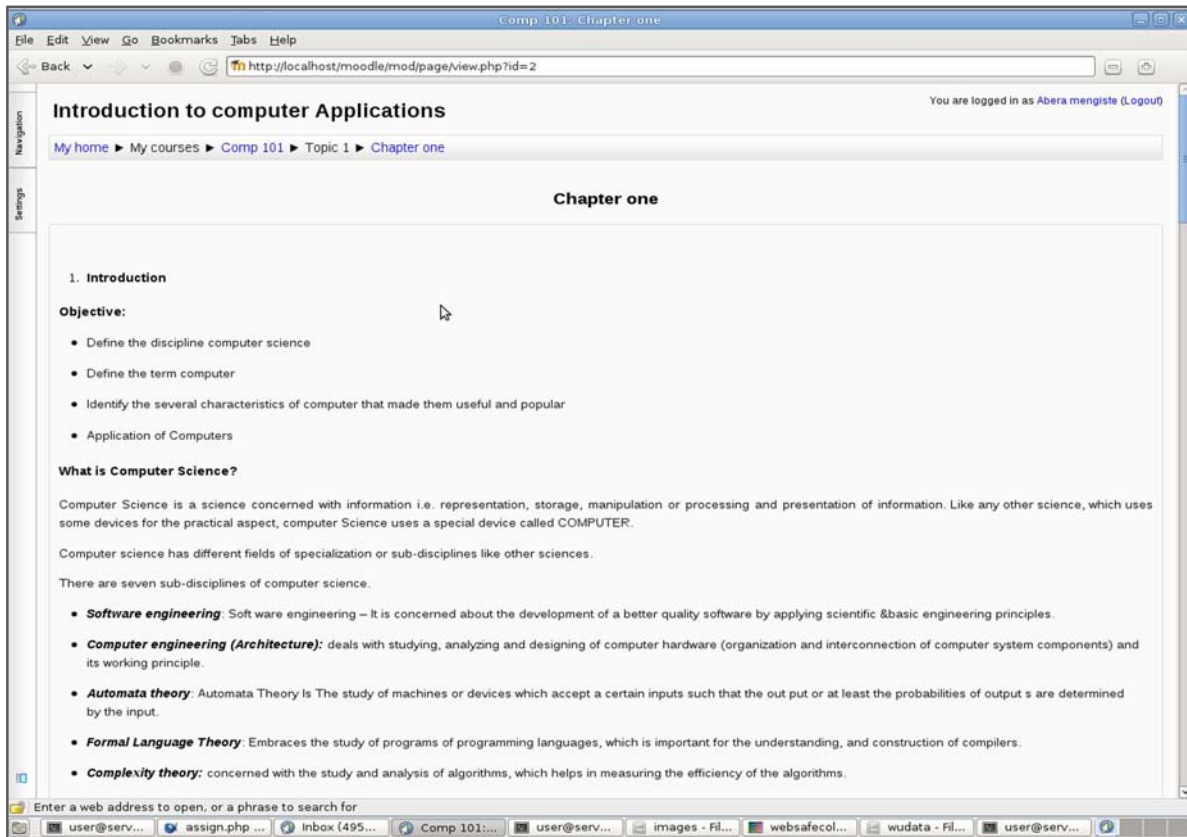


Figure 7.18: Student Accessing Chapter One

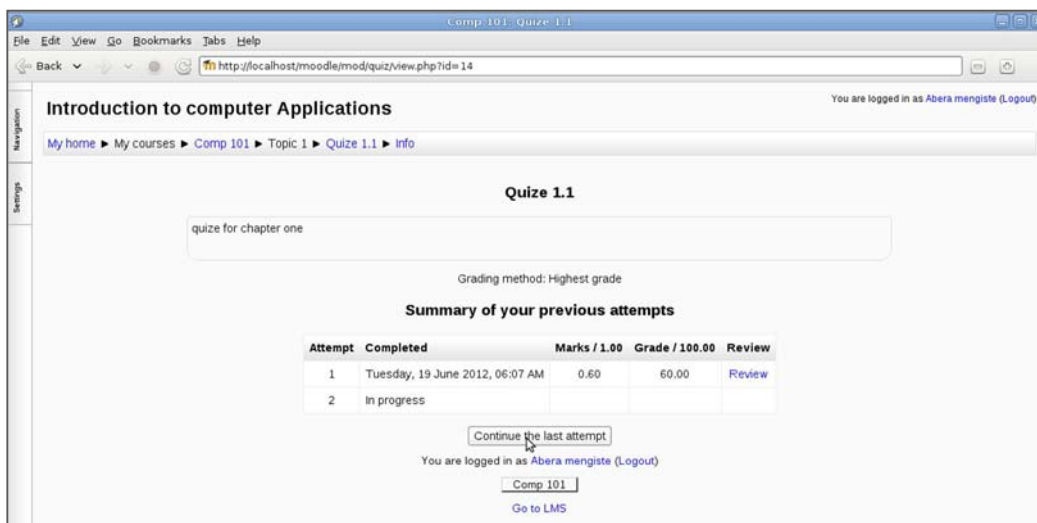


Figure 7.19: Student Attempting Quizzes

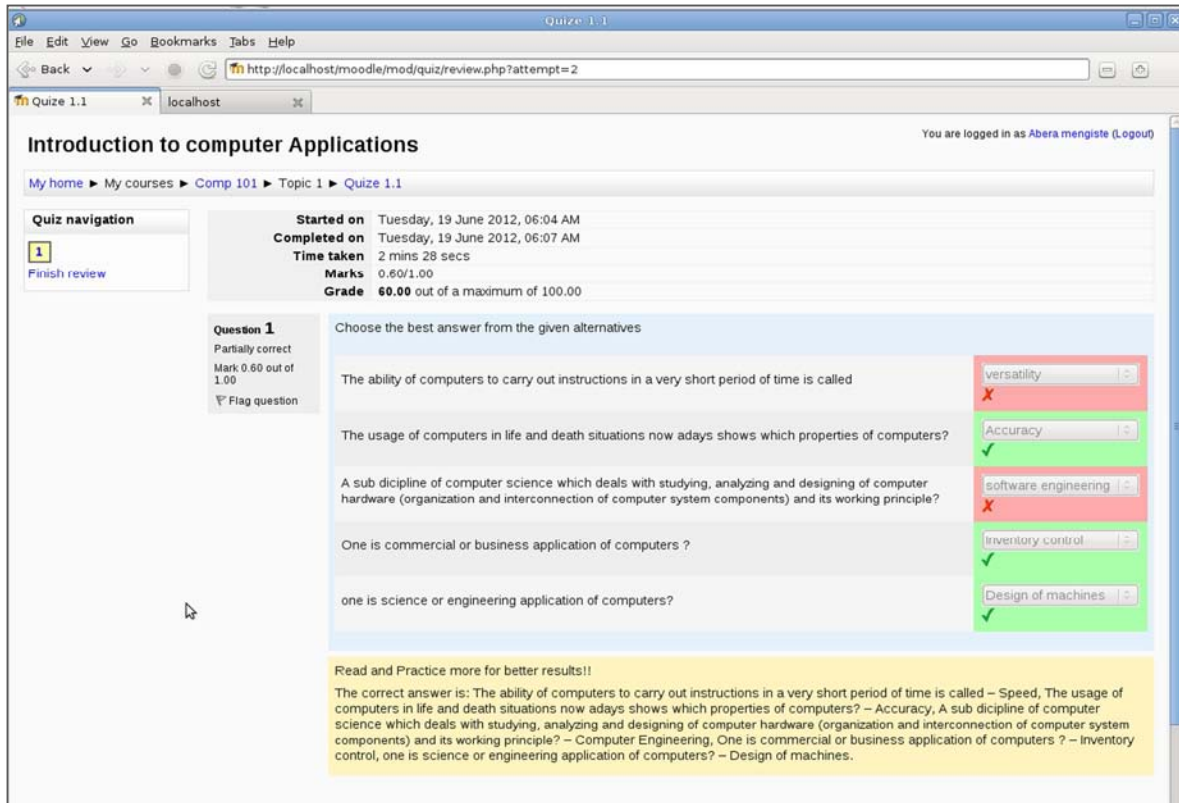


Figure 7.20: Students Can View Assessment Results

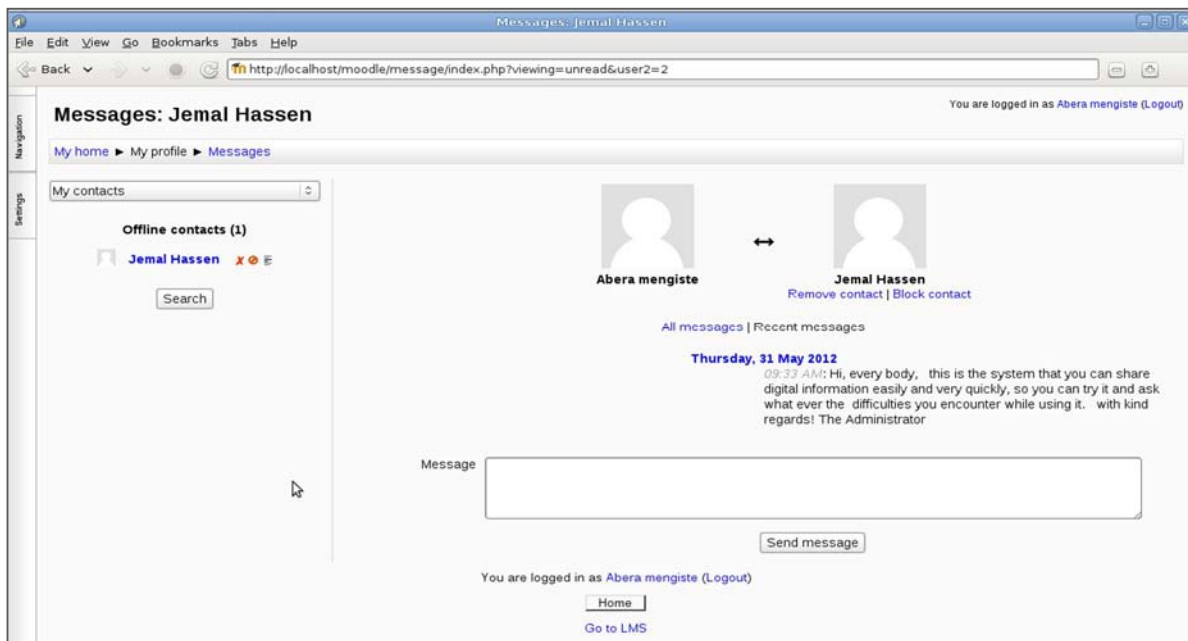


Figure 7.21: Students can Check Messages and Replay to Messages

Students can check messages and replay to messages as shown in Figure 7.21 and they can raise course related ideas for discussion and they can access and view different replies send from their class mates and teachers as shown in Figure 7.22 below.

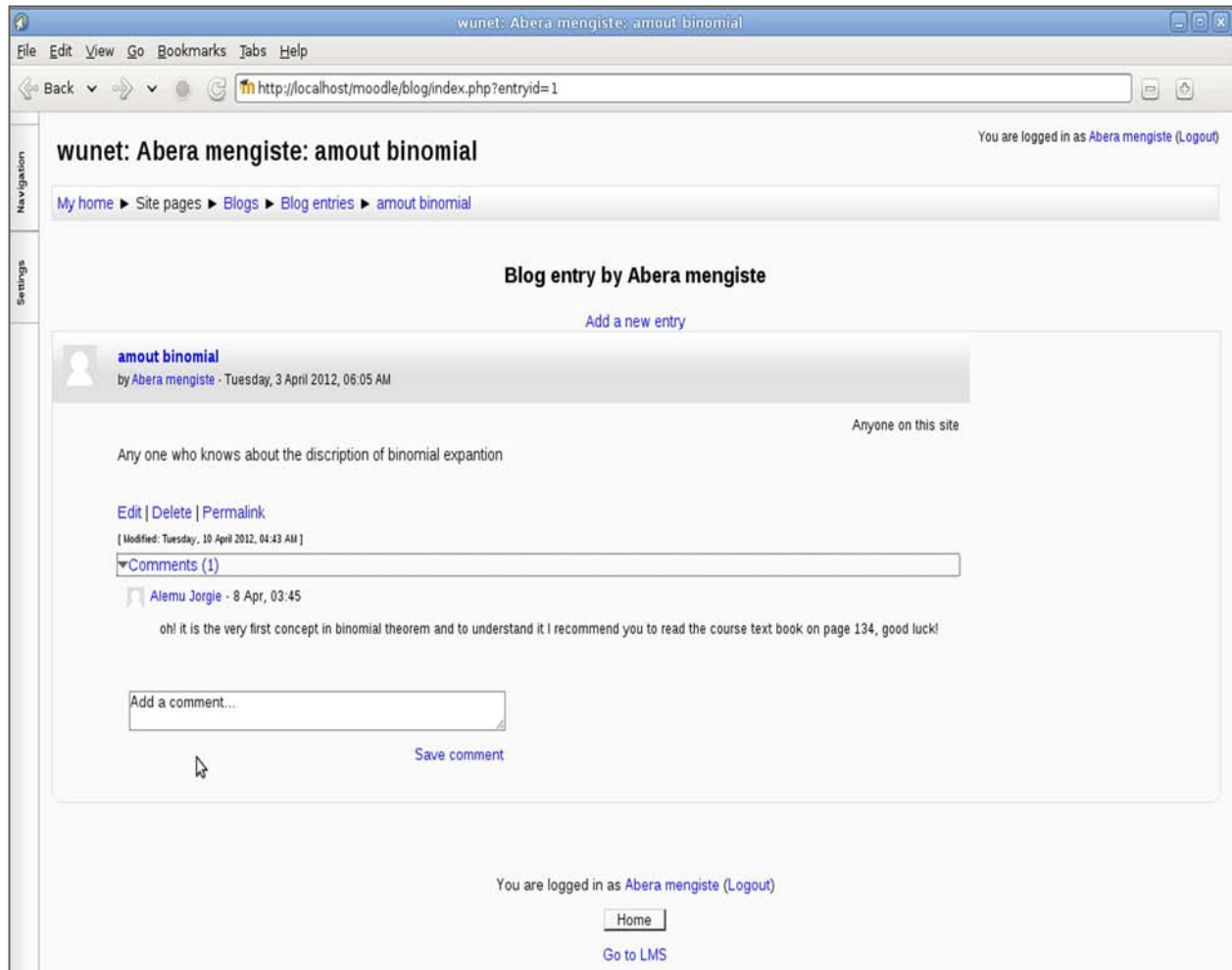


Figure 7.22: Discussion Forum Initiated by a Student and One Replay by a Teacher

CHAPTER EIGHT

SYSTEM USABILITY TEST

The system usability test has been done in accordance with the ISO 9241-11, Guidance on Usability standard [16]. This standard used to measure usability in terms of user performance and satisfaction in using the system. The measurement includes whether the intended goals of use are achieved or not, the amount of resources expended to achieve these goals, and the extent to which the user finds the use of the product acceptable. As defined in this standard, usability is the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction. Based on this standard, system usability test questionnaire has been prepared to grasp the main usability measurement criteria. The system has been developed to be implemented at Wollo University after it has been completed, and the usability testing also done by the real users from the University. For this purpose we have taken a time to be used for implementation of the system, testing of it using real data from the University, and evaluation of it by the University members. Moreover, we have distributed the system usability test questionnaire to collect the users' evaluation of the system. Through the questionnaire we have tried to collect some important data that can best evaluate the usability of the system by the target users. These Includes:-

- The ease of use
- The look, layout, and appearance of the system
- Multimedia data usage ability
- Benefits of the system to the community and
- The system's capability

The acceptance testing questionnaire (see Appendix E) was prepared having all the above points in mind and all the questions also prepared in such a way that to include the necessary points that can be used by the users to evaluate the system.

Before distributing the questionnaire different presentations and orientations have been conducted to make the users aware about the newly installed system and to make them how to start using the system, after this the users were given the usability test questionnaire to evaluate the system whether it meets their requirements or not. Even if we have distributed the questionnaire for most of administrative and academic departments, we can only collect around 30 because of time limit and used for compiling this user acceptance testing report.

The implementation process has been done using Wollo University resources like the already installed network infrastructure (Intranet) and using one available server that has been dedicated to be used only by this system. And the system has been accessed from any computer that is connected to the Intranet, and it has been accessed also from student computer access pools. From this we have noticed that it is ready to be used by any member of the University community. After implementation the users have used the system and evaluate it by filling our acceptance testing questionnaire and by choosing their choice of rating from 1 up to 5 (i.e. very low, low, medium, high, very high) that has been discussed in the following sections.

8.1 The ease of use of the system

To test the ease of use, the users have been asked different questions including the consistency of the terminologies used throughout the system, the simplicity of terminologies and their relation to the work they are currently doing, the clearness and helpfulness of the different messages that appear on the screen, whether the different steps to complete a task follow a logical sequence or not, the appropriateness of the number of steps per task, and the simplicity and understandability of the sequence of steps to accomplish a task. Based on this as shown in Table 8.1, majority of the evaluators reported that the ease of use of the system is high or very high.

Table 8.1: Results for ease of use of the system

	Very low	Low	Medium	High	Very high
Easiness of the system	0.5%	0.5%	16%	45%	38%

As shown in Figure 8.1 below, the users reported that the system is easy to use and user friendly, in addition to this, the user manual has been uploaded and shared by users to make the system more easy and understandable.

8.2 The appearance, look and layout of the system

The appearance, layout and graphical user interfaces of the system has been tested using the questionnaire by asking the users of the system some questions such as whether the texts displayed are easy to read or not, the helpfulness of the layouts of the windows, the appropriateness of the usages of fonts, images and graphics, the easiness and understandability of the sequence of the screens, and the goodness and consistency of the color usage. By using these importance questions that can capture the appearance, look and layout of the system, the users have evaluated the system and majority of them reported that the graphical user interface of the system is high or very high i.e. 45% and 40% respectively, and only 15% of them reported that the system has medium graphical user interface as shown in the Table 8.2.

Table 8.2: The graphical user interface of the system

	Very Low	Low	Medium	High	Very High
The graphical user interface	0%	0%	15%	45%	40%

8.3 Multimedia data usage ability

Since the system is designed to use multimedia contents like images, sounds and video, this capability of the system also evaluated by users by replying to the questions like whether the visibility and quality of the pictures is good enough or not, the acceptance of the multimedia content upload and download speed, and the helpfulness of the possibility of

using multimedia content. Based on this the users evaluated the system and reported that the efficiency and effectiveness of the system is high (68.8% of them) and some of them 20.8% and 10.4% reported that the system has very high and medium efficiency in using multimedia content respectively as shown in the Table 8.3 below.

Table 8.3: Multimedia data usage

	Very Low	Low	Medium	High	Very High
Usage of Multimedia data	0	0	10.4%	68.8%	20.8%

8.4 Benefits of the System to the Community

We have also evaluated the system with respect to the benefits it brought to the community members, and to capture the different benefits, users have been asked some questions like whether the system is useful to them and the University community or not, its helpfulness to enhance internal communication and to improve teaching and learning process, whether it provides self-learning opportunity to students or not, improvements in digital resources sharing and management between members of the University, and whether the system design meets their needs and requirements. Based on these questions majority of users (57%) have reported their hope to be benefited highly from having such system, moreover 31% of them also reported that the system will bring more benefits to them as shown in Table 8.4 below.

Table 8.4: Benefits of the system to the community

	Very Low	Low	Medium	High	Very High
Benefits of the system	0	0	12%	57%	31%

8.5 System Capability

We have tried to evaluate the system's capability in terms of its speed, completeness based on the requirements, simplicity, and supportiveness to users. To capture these capabilities of the system, the users have been asked some questions like: whether the response time for most operations they have tried is fast enough or not, the amount of information displayed while carrying out a particular operation is enough or not, capability of the system to accomplish tasks knowing only a few commands or steps, the helpfulness of the system in simplifying their workloads, new benefits the system brought to them in their day to day academic or administrative activity, the capability of the system to allow them in sharing administrative and academic resources, whether the system meets their internal communication needs or not, the capability of the system that enables them to manage their own contents easily, the helpfulness of the system to upload and download different digital resources in acceptable speed, the capability of the system to share latest information to University members, and capability of the system to accept users' needs and produce results that they expect.

Based on this the users evaluated the system and majority of them have reported that the system's capability is high and excellent (44% and 41% of them respectively) and only 14% of the respondents reported that the system has medium capability in solving their problems as shown in Table 8.5 below.

Table 8.5: System Capability

	Very Low	Low	Medium	High	Very High
System Capability	0	1%	14%	44%	41%

In general, the system's acceptance testing shows promising results as shown in Figure 8.1 below, i.e., the majority of the users participated in the evaluation of the system reported that the system is developed to be easily understood, user friendly, helpful, and capable of solving their day to day administrative and academic problems. Even if this usability test

was carried out in a limited period of time, it indicates that the users' requirements have been met as much as possible from the reports given by the users, and it has also promising application in the study area to solve problems of digital resources sharing and management, internal communication, and teaching-learning activities. In addition to this, the system shows some improvements in using ICT to support day to day administrative and academic activities to increase productivity and decrease workload, therefore, the system plays its own part to reach the University members easily in a secured and efficient way as well as support administrative and academic activities. For its efficient utilization, we recommended that all Wollo University officials play their own part by making their lower level workers to be aware and use the system in their day to day administrative and academic activities, and lecturer also expected to aware their students to use the system to get the benefits of the system designed for them. We hope that the advantage and importance of this system will increase as the number of users of the system increases.

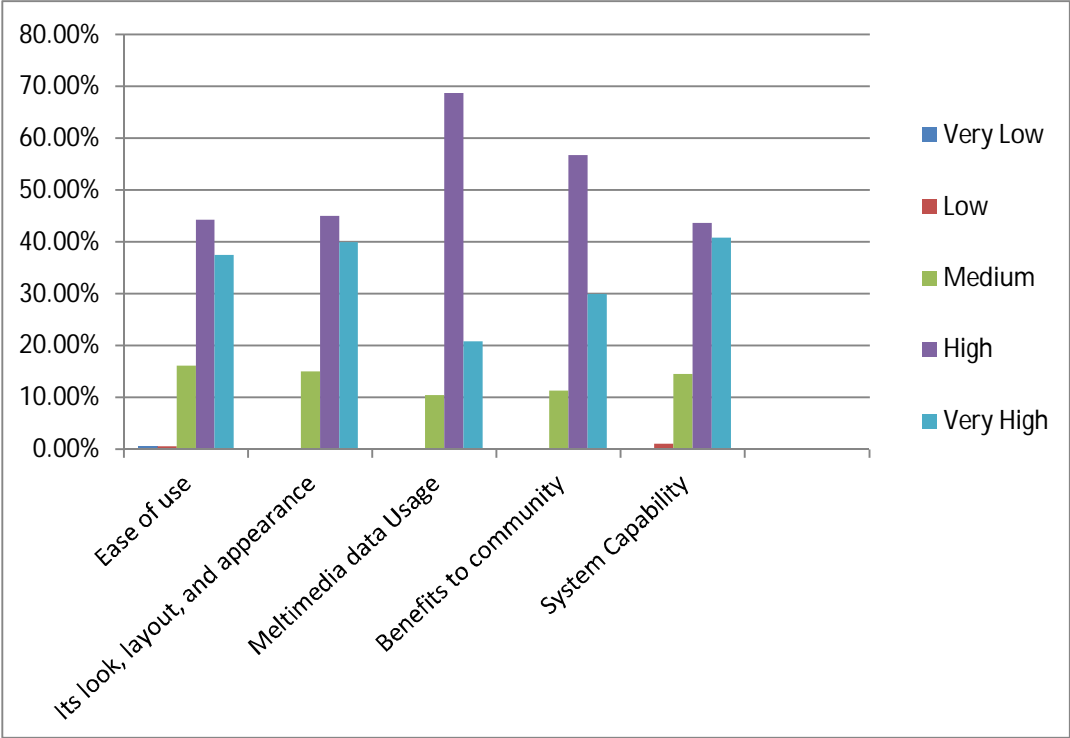


Figure 8.1: System Usability test Results

CHAPTER NINE

CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusions

This study attempts to find ways for the application of content management systems for efficient digital resources sharing and management in University environments, as content management systems have a potential to support the collection, management, and publishing of information in any form or medium. Since the availability of digital resources in Ethiopian higher education institutions increasing from time to time in both type and size, the complexity of sharing and management also increases. Therefore, to overcome this problem the establishment of a central content management system for digital resources sharing and management will be very important. As the result of this work conclusions are given in the following sections by raising identified issues and presenting different solutions proposed.

Based on the survey conducted in Wollo University, we examined technology infrastructure, usage of computers and technology, Internet connectivity, views of the University community on the integration of information technology in teaching-learning process, ways of resource sharing and management currently utilized and their drawbacks, methods of communication between concerned bodies for administrative and academic purposes, and possibilities of using content management systems for solving identified resource sharing and management problems for both academic and administration areas. The current academic and administration activities in Wollo University are largely dependent on manual methods that have many problems, and usage of the available ICT infrastructures like Internet, internal network, and computers is not exploited properly to solve these problems. Hence application of content management systems can be used to utilize the available ICT infrastructures and can solve problems related to the manual methods used through efficient digital resources sharing and management.

To develop the proposed system the data collected from Wollo University have been analyzed, existing problems and requirements of the proposed system have been identified in terms of functional and non functional requirements, from the non functional requirements design goals are specified that state the architectural and detailed design of the system, appropriate content management system tools have been selected to develop the system, and finally the developed system has been implemented on top of Wollo University Intranet to provide the proposed functionalities of the system for the Community. To see its applicability and usability, the system usability test has been done and shows promising results for management of both academic and administration digital resources created and used by members of the University.

Therefore, as an outcome of this work, we have developed a system that can solve the existing problems of Wollo University with regard to digital resources sharing and management. The developed system is capable of facilitating both academic and administrative digital contents sharing and management and provides a central place for Wollo University community to upload and access these contents easily. In addition to this, the system is always available locally and is independent of Internet connectivity since it utilizes the internal Network infrastructure i.e., the Intranet, and hence it becomes an alternative system to the low bandwidth Internet connectivity. Moreover, the system can be used to facilitate academic activities in terms of: sharing digital course contents easily that improves shortage of text and reference books, providing self-learning opportunities to students, improving participation of students to course activities, and providing ways to use and manage academic digital assets properly. Similarly it can support administration activities through administrative digital resource sharing by allowing each department to develop and manage its own contents and improves communication between different sections and departments using digital communication methods. These capabilities of the system will bring great improvements for Wollo University academic and administration activities.

9.2 Recommendations

- To get the advantage of the implemented system and to increase its helpfulness awareness creation about the uses and benefits of the system is very important, therefore, we recommend that concerned bodies of Wollo University should arrange different trainings and seminars. Moreover, administrators should aware their lower level workers to use the system, and even instructors should encourage students to get benefits from the system to support their academic activities.
- Because of time and resource limitations this work is based on the needs and requirements of Wollo University and we recommend that similar projects can be done in other Ethiopian Universities to analyze the ways of digital resources sharing and management in these Universities, to identify problems, and to propose possible solutions for their proper utilization.

References

- [1] Ministry of Capacity Building, The *National ICT4D Five Year Action Plan for Ethiopia*, Addis Ababa, Ethiopia, 2006.
- [2] Wikipedia, *Content Management Systems*, http://en.wikipedia.org/wiki/Content_management_system, date visited, september 09, 2011
- [3] Ifinedo, Princely, *Web-Based Course Management Systems (WCMS)*, acceptance with College Students in Estonia Cape Breton University, Canada, 2009.
- [4] Hare Harry, *ICT in Education in Ethiopia*. <http://www.infodev.org>, date visited, august 27, 2011
- [5] Addis Ababa University ICT Office, <http://www.aau.edu.et/index.php/ict-office>, date visited, September 14, 2011
- [6] Berdún Jesús, *Development of ICT resources for Ethiopian universities: the Wollo University case study*, Dessie, Ethiopia, 2011.
- [7] Jason cole and Helen Foster ,OReilly *Using Moodle*, 2nd edition, Nov, 2007
- [8] Steve white and Andy Wallace, *joomla user guide*, 2006
- [9] Richard Vidgen, Steve Goodwin, and Stuart Barne, *Web Content Management*, 14th Bled Electronic Commerce Conference Bled, Slovenia, June 25 - 26, 2001
- [10] A Kaliammal, G Thamaraiselvi, *Content Creation, Access and Management Processes in the Digital Era with few Websites of International Content Management Systems*, 2nd Convention PLANNER - 2004, Manipur Uni., Imphal, 4-5 November, 2004.
- [11] Y. Vovides a, S. Sanchez-Alonso, V. Mitropoulou, and G. Nickmans, *The use of e-learning Course Management Systems to Support Learning Strategies and to Improve Self-regulated Learning*, *Educational Research Review* 2, pp. 64–74, 2007.
- [12] Jen-Shin Hong, Bai-Hsuen Chen, and Jieh Hsiang, *XSL-based Content Management for Multi-presentation Digital Museum Exhibitions*, *ECDL 2001*, LNCS 2163, pp. 378-389, 2001.
- [13] Giuseppe Amato, Claudio Gennaro, Fausto Rabitti, and Pasquale Savino, *“Milos: a Multimedia Content Management System for Digital Library Applications”*, ISTI-CNR Pisa, Italy, 2004.

- [14] Victor Chukwudi Osamor, Olatobi S. Aloba, and Ifeoma P. Osamor, "From Wooden to Digital Notice Board Design and Implementation for University Administration", *International Journal of Electrical & Computer Sciences IJECS-IJENS* Vol:10 No:02, 2010.
- [15] *Kristy de Salas and Leonie Ellis*, "The development and implementation of learning objects in higher education settings", *Interdisciplinary Journal of Knowledge and Learning Objects*, Volume 2, 2006.
- [16] ISO 9241-11, part 11: Guidance on Usability, first edition, 1998.
- [17] *The Unified Modeling Language Users Guide*, Grady Booch, James Rumbaugh, and Ivar Jacobson, Addison Wesley, 1998.
- [18] Open source matters, inc, What is Joomla, <http://www.joomla.org/about-joomla.html>, date visited, October 21, 2011.
- [19] The official website of Drupal, About Drupal, <http://drupal.org/features>, date visited, November 16, 2011.
- [20] The official website of Moodle, About Moodle, <http://moodle.org/about/>, date visited, October 16, 2011.
- [21] The official website of Wordpress, About Wordpress, <http://wordpress.org/about/>, date accessed, November 09, 2011.
- [22] University of Kent elearning, <http://www.kent.ac.uk/elearning/Moodle.html>, date accessed, November 19, 2011.
- [23] Sarah Robbins, Debra Engel, and James Bierman, "Content Management Systems, part2, Using Library Intranets to manage web content", *University of Oklahoma Libraries, Norman, Oklahoma, USA, Library Hi Tech* Vol. 24, No. 2, pp. 261-272, 2006.
- [24] IEEE STD 830-1998, IEEE Recommended Practice for Software Requirements Specifications.

Appendix A: Questionnaire to be Completed by Teachers

The objective of this questionnaire is to assess and gather information about the habits of digital information sharing, management, and usage in higher education institution. And to use it as an input for the development of a system that can be used for improving the sharing, managing, using and development of the available digital contents effectively and efficiently for the benefit of the whole University community (students, academic and administrative staff).

A digital resource (digital content) is any sort of information in a digital format that can be processed by a computer and can be even shared through a networked environment. The resources may exist either in digital format already or can be converted to digital form from other formats as a result of digitization. The common digital resources in a university set up could be course materials, academic and administrative rules and procedures, student hand books, employee and student databases, news about events, e-mail messages, research publications, blogs (personal comments), and so on

Please fill this questionnaire by putting this (✓) mark inside the box placed in front of the choices and when necessary you can choose more than one choice if you feel that the choice satisfies your requirements to be selected.

Thank you for your time and participation!

Level of qualification: _____ **Organization:** _____

Academic Position/status in the university: _____ **mobile:** _____

e-mail: _____

1. While browsing Internet to which task you devote much of your time?
 - a. For searching educational materials
 - b. For learning and skill updating purpose
 - c. For communication
 - d. Other(please specify) _____
2. What are the main problems in the currently available Internet access that makes you not to use it as a tool in the teaching – learning process?
 - a. No problem, since I use it for very few clarification purpose and as an additional source to my own collections of teaching materials
 - b. I can't get information timely because of connectivity problem

- c. while searching, I may not get the exact information that I want
- d. Other(please specify)_____
3. Do you have digital course materials that you want to share?
- a. I have a lot of e-books but I don't know where to share
- b. I have it but there is no system that can allow sharing to the students
- c. I have few and use them for my own purpose, but I want to share them
- d. I don't have it
4. Do you have any possibility to upload and share digital resources yet?
- a. Yes b. No
5. Do you think that there are enough text and reference books available in the library for your department courses?
- a. Enough, since it has been purchased from time to time
- b. Not enough, when compared to students' number
- c. Not enough, because I still use electronic materials to supplement the deficiency
- d. Not enough, since there is still a problem of books both in number and type
6. What do you think is the main problem or difficulty in distributing digital course materials to your students?
- a. A lot of materials will not be distributed because of printing and copying expenses
- b. I will use hard copy materials that cannot be easily updated
- c. I spent a lot of time during preparation of materials, so I can only share few materials
- d. No need to share digital resources, since I will use available library books to be used by the students
- e. Other (please specify)_____
7. What are the main difficulties or burdens while using continuous assessment?
- a. The large number of students in a class makes it difficult
- b. It is time taking since I will process it manually
- c. No difficulty at all, because I will use only some of the common methods
- d. Other(please specify)_____
8. What are your reasons that you think Content Management System helps you?
- a. Because such system can be used as an option to the Internet

- a. It allows us to do collaborative work and use resources efficiently
- b. It can save time and avoids some tedious manual works
- c. Other (please specify)_____
9. How much time can you dedicate weekly for the works of online digital resource sharing and online assessment?
- a. An Hour
- b. Two Hours
- c. Three hours
- d. More than three Hours
- e. As required
- f. Other (please specify)_____
10. If you are given a chance to upload and share digital resources that can be accessed by your students only for a particular course, which digital resources would you prefer to upload?
- a. Course support e-books
- b. Quizzes, assignments and results
- c. Lecture notes and slides
- d. Course contents developed step by step
- e. Notices and course information
- f. Others (please specify)_____
11. In your current practice of course offering how many of the students ask or answer questions in class rooms freely?
- a. Only very few students ask and answer questions
- b. There is some participation but not satisfying
- c. I can say that no participation at all and needs improvement
- d. No one asks and answers questions
12. Do you agree that enough number of students participate?
- a. Strongly agree
- b. Agree
- c. Strongly disagree
- d. Disagree
- e. Not sure
13. What do you think are the problems of student participation in class?
- a. Some are shy and lack confidence to speak
- b. Some fear not to make mistakes
- c. Some prefer only one to one communication with the teacher
- d. Other (please specify)_____

Appendix B: Questionnaire to be completed by ICT Technical Personnel

1. What kind of digital resources are available associated to the service rendered by your section or department that can be uploaded or shared?
 - a. Textual information
 - b. Images
 - c. Audio
 - d. Video
 - e. All (multimedia)
2. In your opinion which digital contents can be shared in the university set up?
 - a. Course materials
 - b. Academic and administrative rules
 - c. News about events
 - d. Useful links
 - e. Others (please specify) _____
3. Are you willing and ready to share these resources to other interested members of the university community?
 - a. Yes
 - b. No
4. Did you have a possibility of sharing those resources to the community?
 - a. Yes
 - b. No
5. If **Yes** for question Number 4 above,
 - 5.1. In what way you are sharing data?
 - a. Through the website
 - b. Through local intranet
 - c. Other (please specify) _____
 - 5.2. What is the basic information that your sharing scheme depends on?
 - a. Public information
 - b. Private information
 - c. Faculty/departmental level information
 - d. Other (please specify) _____
 - 5.3. Is there any way of updating and sharing digital content by different sections and departments?
 - a. Yes
 - b. No
 - 5.4. Did you implement an Intranet system with digital contents that can be used locally?
 - a. Yes
 - b. No
 - 5.5. Do you agree that there is sufficient Internet bandwidth and connectivity?
 - a. Strongly Agree
 - b. Agree
 - c. Strongly Disagree
 - d. Disagree
 - e. Not sure
 - 5.6. How the digital contents are going to be organized?

- a. Based on access levels b. Authentications
- c. Others (please specify) _____
- 5.7. At what different levels you organize digital contents?
- a. Subject level b. College level c. Department level
- d. No Level e. Others (please specify) _____
- 5.8. What are the different type of information that your system includes?
- a. Web Pages b. Web Links c. News
- d. e-mail messages e. Blogs(comments)
- 5.9. What are the problems you think that your system will not enables you and the community to share and use educational resources?
- a. No problem, since there is digital library already implemented
- b. The system didn't permit a departmental digital content development
- c. The system depends on Internet and no work when connection is unavailable
- d. Other(please specify)_____
- 5.10. What are the different user roles you have implemented?
- a. Administrator b. Users c. Publisher
- d. Guests e. All are applied
- 5.11. Which are the problems you encountered during the management of digital resources?
- a. No management of digital resources at different levels of the system
- b. The increased amount and type of digital resources available makes it difficult
- c. No problem since there are few and common type of digital resources to be shared
- d. There is no privilege to use the network for digital resource sharing
- e. Other (please specify)_____
- 5.12. Is there any possibility that the system provides a way for an easy and social communication?
- a. Yes b. No
6. If your answer is **NO**, for question Number 4,
- 6.1. Do you have any plan in establishing digital resource sharing scheme?
- a. Yes b. No
- 6.2. Which features do you recommend for a digital resource sharing system to incorporate under your university?
- a. A system that can share digital contents within the Intranet

- b. A system that can manage and organize contents easily
- c. If it can be updated by different sections or departments
- d. If its content is collaboratively developed and becomes content rich system
- e. Other (please specify)_____

6.3. What do you think is the reason for not having an efficient digital resource sharing scheme?

- a. We don't have a system to incorporate departmental level sharing
- b. The system is not independent from internet and we have connectivity problem
- c. Since it doesn't allow collaborative work, there is no possibility for individuals to contribute or share digital resources
- d. Because there is work load on web master to update contents timely
- e. Other(please specify)_____

7. In which task you spent most of your time weekly?

- a. For the web site management process(like updating content)
- b. For fixing problems related to network and Internet connectivity
- c. For other technical work (installation, configuration, scanning, ...etc)
- d. For Other tasks (please specify)_____

8. What do you think about the bandwidth and connectivity of the Internet currently available?

- a. Very fast
- b. Fast
- c. Slow
- d. Very slow
- e. No Internet

9. Do you agree with the establishment of a local system independent of Internet connection and can be used to create an easy and improved digital resource sharing and management?

- a. Strongly agree
- b. Agree
- c. Strongly disagree
- d. Disagree
- e. Not sure

Appendix C: Questionnaire to be Completed by Students

1. Are you provided with enough educational materials for the courses you are learning?
 - a. Yes, we have text books for each course and reference materials in the library
 - b. Yes, we have provided with text books mostly but not enough reference books
 - c. No, there is shortage of text and reference materials
 - d. No, we mostly use lecture notes
 - e. No, we mostly use handouts
2. Do you agree that the books in the library satisfy your learning needs?
 - a. Strongly Agree
 - b. Agree
 - c. Strongly Disagree
 - d. Disagree
 - e. Not sure
3. What do you think about the availability of text and reference books for the courses you are taking in both type and number at your department?
 - a. Very high
 - b. High
 - c. Very less
 - d. Less
 - e. Not sure
4. What are the other methods you use for reference and understanding purpose of a particular course?
 - a. Browsing Internet
 - b. Using electronic materials
 - c. Buying books
 - d. Other methods (please specify) _____
5. Do you have free internet access at your university?
 - a. Yes
 - b. No
6. If your answer is **Yes** to the above question, what do you think about the Internet band width currently available in the campus?
 - a. Very fast
 - b. Fast
 - c. Very slow
 - d. Slow
 - e. No Internet access
7. Do you think that you get more reference materials from internet for your courses?
 - a. Yes, but it has connectivity and speed problems

- b. Yes, since no other method to compensate shortage of course materials
- c. No, we don't have sufficient internet rooms
- d. No, sometimes I lose a lot of time without getting appropriate material
- e. Other (please specify)_____

8. How do you rate the class participation in your department?

- a. Very high
- b. High
- c. Very low
- d. Low

9. If the class participation is low what do you think the possible reasons will be?

- a. Some may be shy and lack confidence to speak loudly
- b. Some may fear that not to make mistakes
- c. Some needs only one to one communication with the teacher
- d. other (please specify)_____

10. What do you think your participation will be if a system that will be independent from internet exists locally for the community to enable you discuss and share educational ideas with your teachers and classmates?

- a. Daily
- b. Twice weekly
- c. Weekly
- d. Monthly
- e. Annually
- f. As required
- g. Other (please specify)_____

Appendix D: Questionnaire to be Completed by Administrators and Staff

1. What methods you are using currently for communication purpose for issues related to your work at the university?
 - a. Notice boards installed at different parts of the campus
 - b. There are workers who distribute messages for each department
 - c. Through different media such as newsletters, phone call , etc
 - d. Other (please specify)_____
2. What are the problems on the methods you are currently using for communication of information related to your work?
 - a. Information is not circulated to the whole community (Administrative, academic, and students)
 - b. Since it becomes always public it cannot be secured
 - c. Not appropriate to transmit very urgent messages
 - d. The Information or notices are easily damaged or changed before it reaches the audience
 - e. It will be difficult to contact a specific group privately
 - f. Other(please specify)_____
3. What are your experiences in using digital communication methods?
 - a. we can get some uploaded information through the web site
 - b. the website methods didn't supply sufficient information and may not be timely
 - c. we have implemented an intranet system for internal communication
 - d. No experience, even there is no mailing list to use emails for communication
 - e. No experience, I think we have to do more on this regard
4. Have you used chatting and simple messaging methods for timely communication for your official work?
 - a. Yes
 - b. No
5. If your answer is **No** for the above question, what do you think are the possible reasons?
 - a. Because sending even phone messages to many is expensive
 - b. Because we don't have such systems for university community
 - c. Other(please specify)_____
6. Do you think that the student hand book delivered to students timely?

a. Yes

b. No

7. If your answer is **No** for the above question, what do you think is the possible reason?

a. There may be some difficulty in duplication and distribution

b. It may be also difficult to reach each and every students easily

c. Because there is no easy system that can be accessed by the students

d. Other(please specify)_____

8. Do you agree with the establishment of a local system (Intranet) independent of internet connection and can be used to establish easy and improved communication to the university community?

a. Strongly agree

b. Agree

c. Strongly disagree

d. Disagree

e. Not sure

9. If you agree with the above question, are you willing to facilitate or get involved in different activities including training that is needed for the system that will be implemented?

a. Yes

b. No

Appendix E: System Usability test Questionnaire

ADDIS ABABA UNIVERSITY
POST GRADUATE STUDIES
DEPARTMENT OF COMPUTER SCIENCE
SYSTEM USABILITY TEST QUESTIONNAIRE

INSTRUCTIONS:

1. First take a look and use the system deeply
2. Read each questions carefully and
3. Fill it by ticking on your choice of rating from 1 – 5(i.e., very low (1), low (2), medium (3), high (4), very high (5)).

I. Users Instruction Comprehension	1	2	3	4	5
- Is the usage of terminologies throughout the system consistent?					
- Are the terminologies easy to understand and related well to the work you are doing?					
- Are the different messages appearing on the screen clear and informative?					
- Do steps to complete a task follow a logical sequence?					
- Do you think number of steps per task is right?					
- Is a task can be performed in a clearer /simple sequence of steps?					
II. Screen / graphical user interface layout					
- Do the texts on the screen are easy to read?					
- Are the layouts of the screen/window helpful?					
- Is usage of different fonts, images, and graphics appropriate?					
- Do the sequence of screens clear and easy to understand?					
- Do you think the color usage is good enough and consistent?					
III. Multimedia					
- Is the quality of pictures natural and clearly visible?					
- Is the multimedia content upload and download speed acceptable?					
- Is the possibility of using multimedia content helpful for you?					
IV. Utility of the System to the Community					
- Is the system useful to you and the University community?					
- Does the system is helpful to enhance internal communication and improve teaching-learning process of the University?					
- Do you think that the system provides self learning opportunity to students?					
- Will the system improve digital resources sharing and management between members of University community?					
- Is the system design meets your needs and requirements?					

V. System Capability					
- Is the response time for most operations fast enough?					
- Do you think the amount of information displayed is enough?					
- Could you accomplish tasks knowing only a few commands or steps?					
- Does the system helps you in your carrier and simplifies your workloads?					
- Does the system bring you different benefits in your day to day Academic or Administrative activity?					
- Does the system allow you to share administrative or academic resources?					
- Do you think that the system meets your internal communication needs?					
- Is the system enables you to manage your own contents easily?					
- Does the system help to upload and download different digital resources in acceptable speed?					
- Is the system capable of sharing latest information to the community members?					
- Capability of the system to accept your needs and produce results that you expect?					

Please drop your general opinion and comments here: _____

Thank you!!

Appendix F: Sequence Diagrams

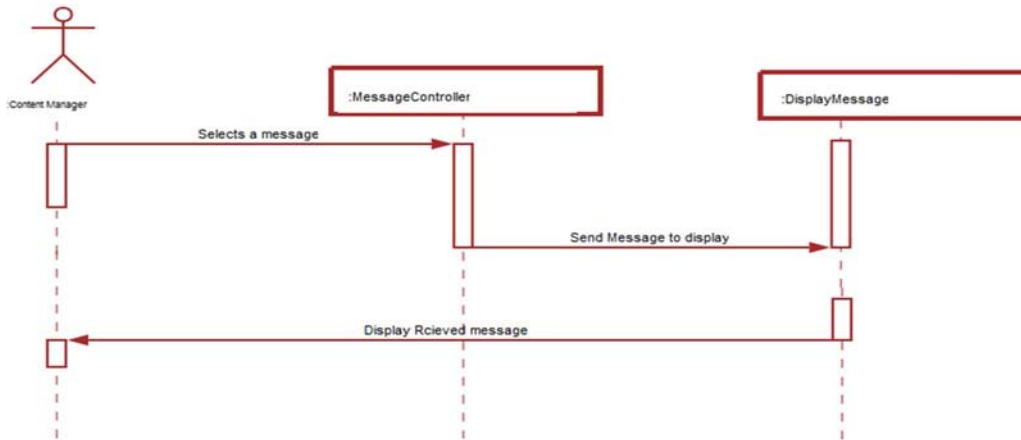


Figure 1: Sequence diagram for Receive Message use case

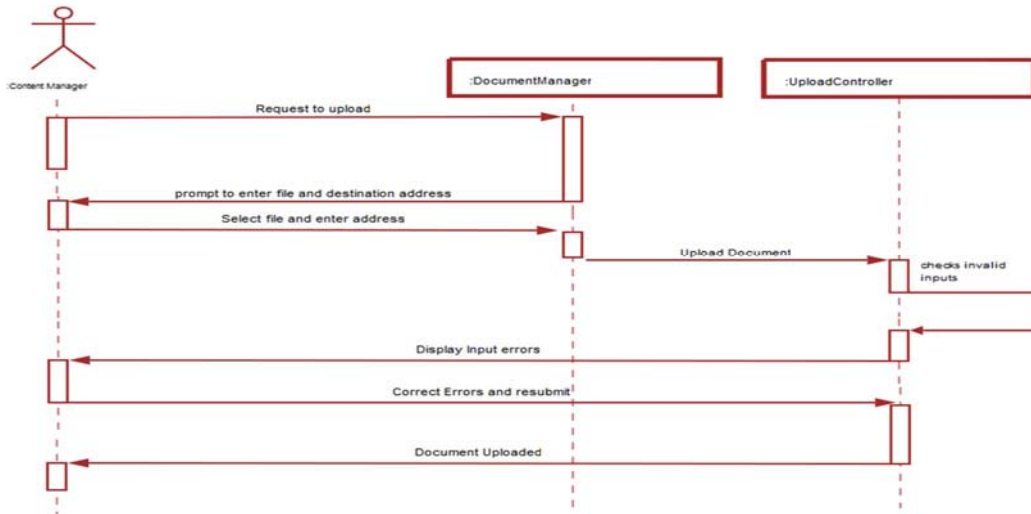


Figure 2: Sequence diagram for Upload Documents use case

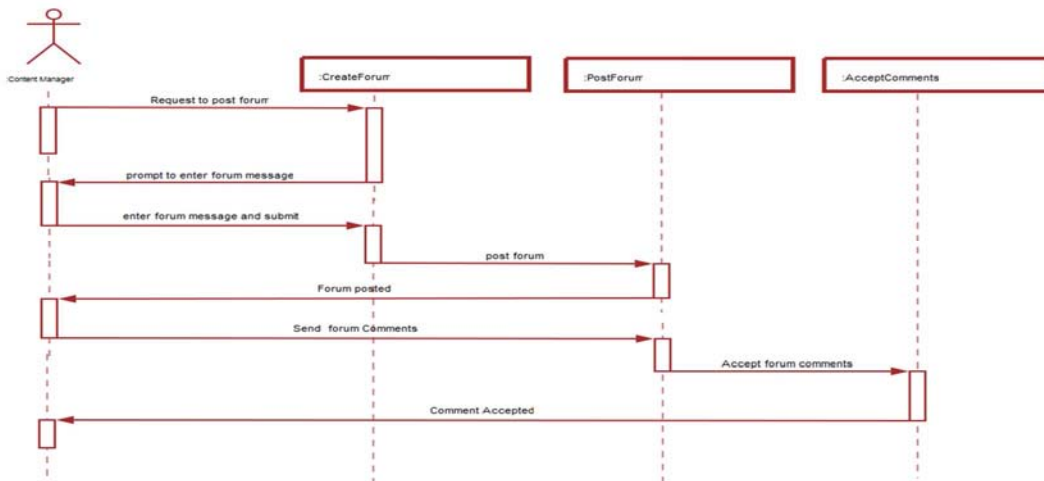


Figure 3: Sequence diagram for Post Forum Use Case

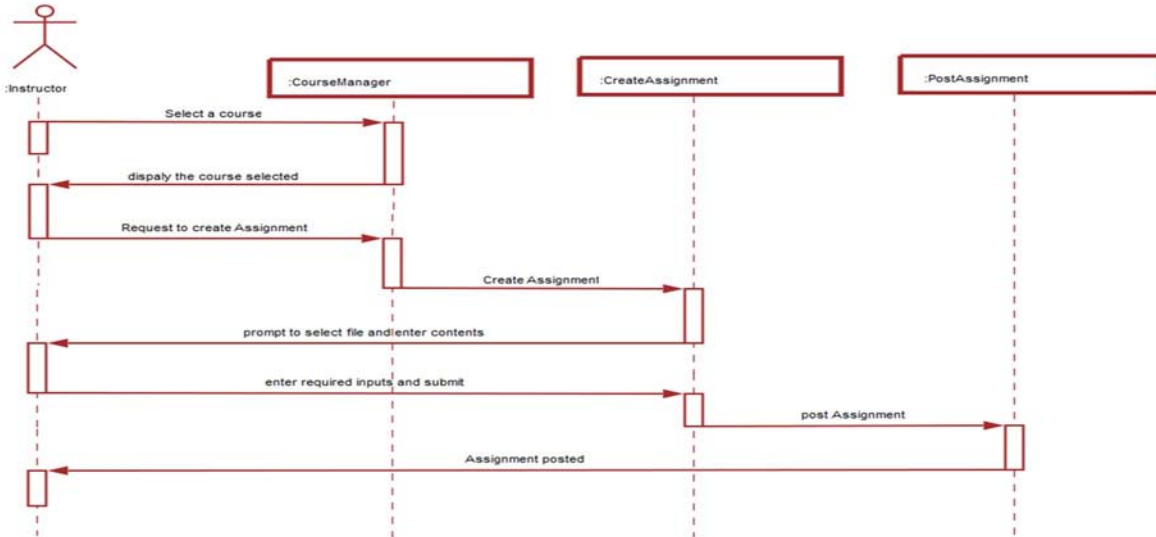


Figure 4: Sequence diagram for Post Assignment Use Case

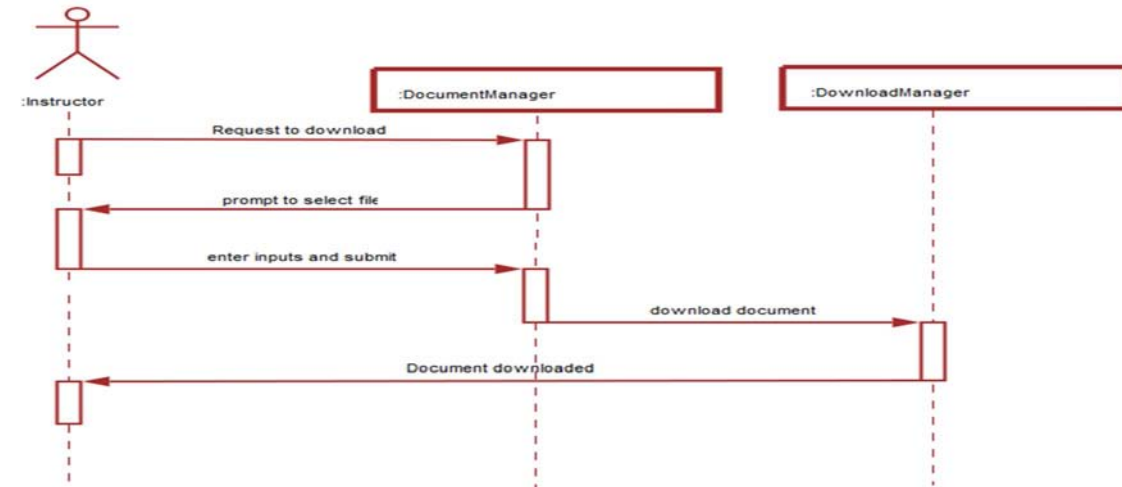


Figure 5: Sequence diagram for Download documents use case

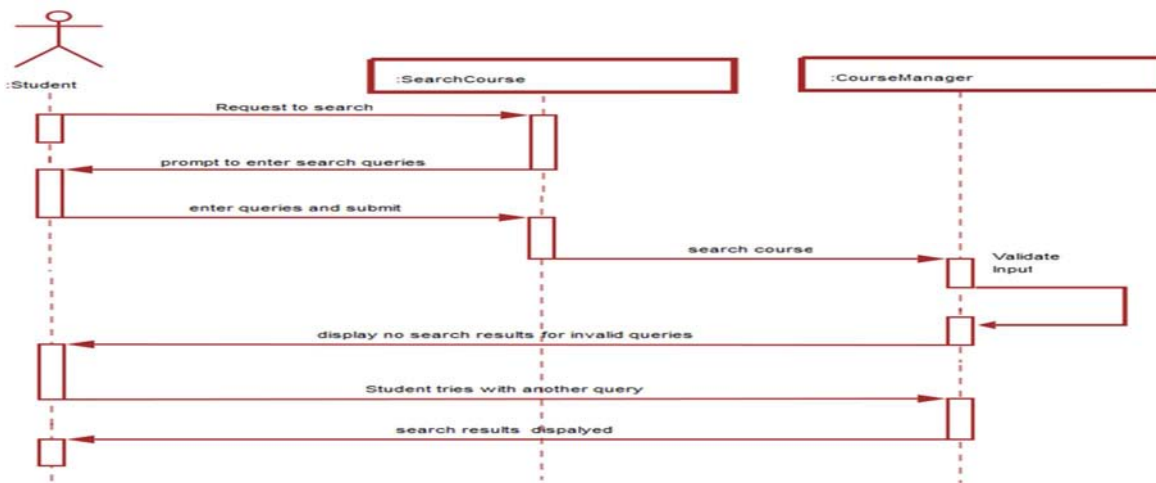


Figure 6: Sequence diagram for Search course use case

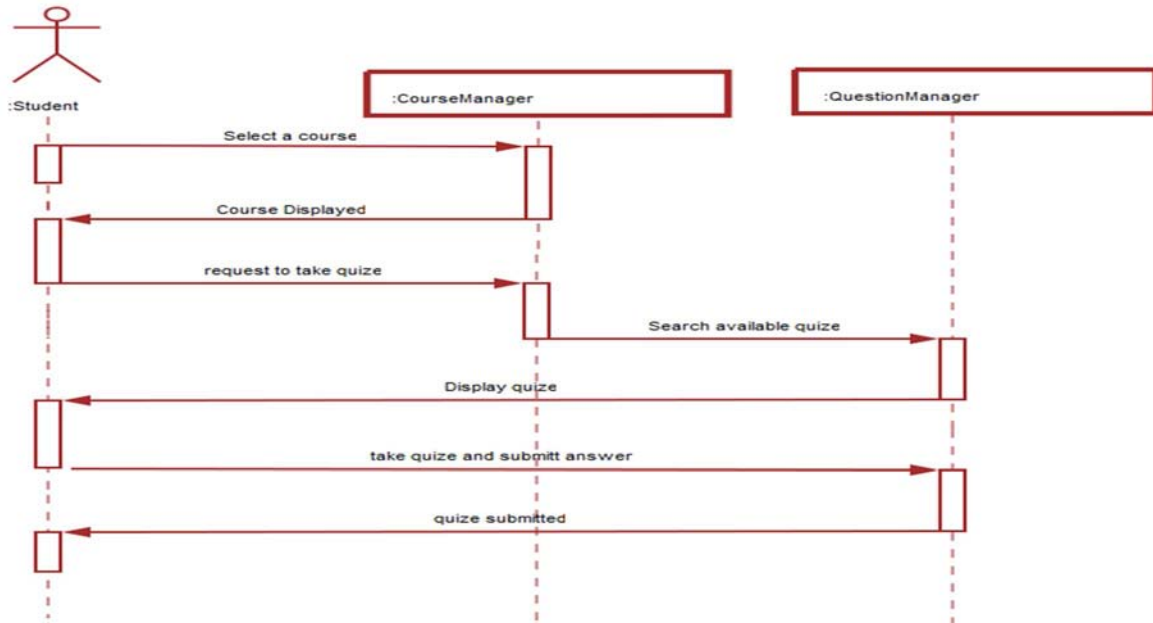


Figure 7: Sequence diagram for Take Quiz use case

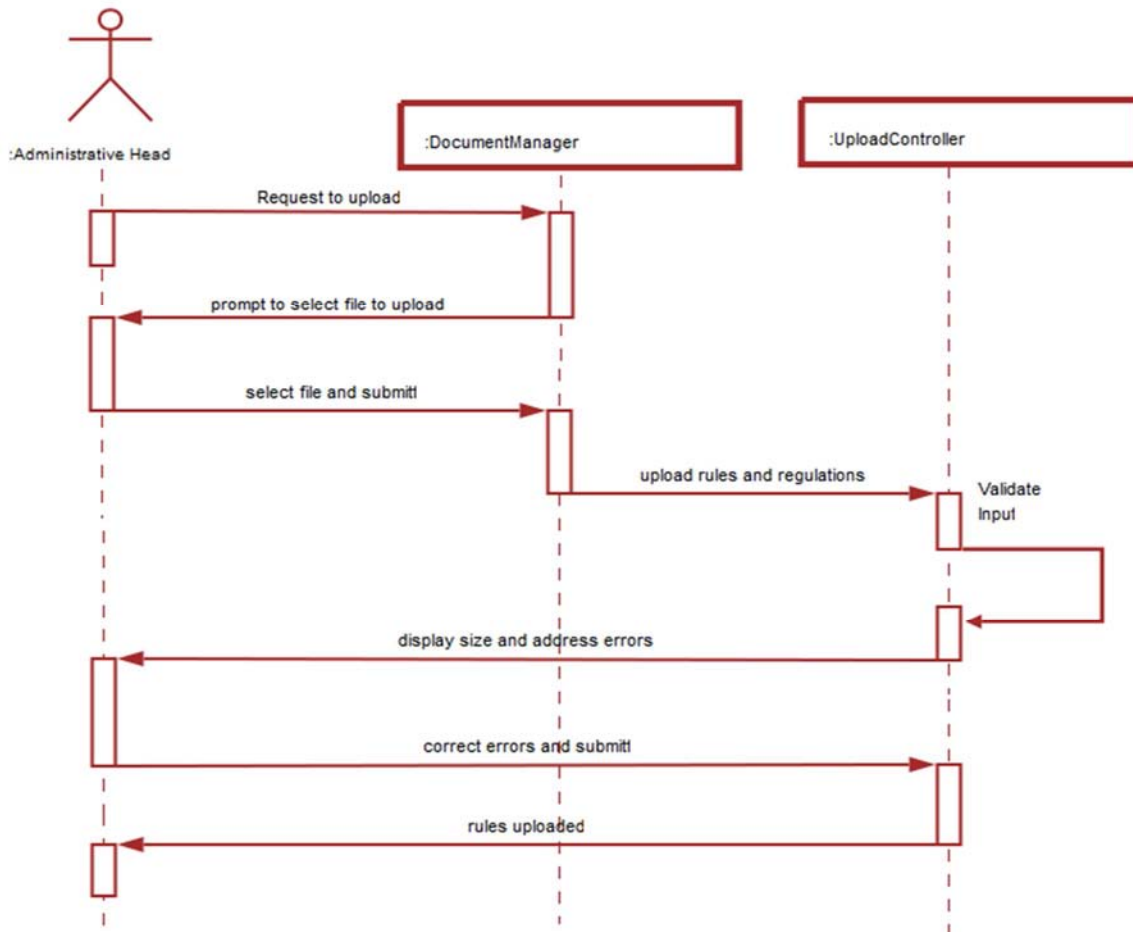


Figure 8: Sequence diagram for Upload rules use case

Declaration

I, the undersigned, declare that this work is my original work and has not been presented for degree in any other University, and all resources of materials used in this work have been acknowledged.

Declared By:

Name of Candidate: Jemal Hassen

Signature: _____

Date: _____

Confirmed By:

Name of Advisor: Dr. Solomon Atnafu

Signature: _____

Date: _____