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WXES 3182 Final Year Project

E-Learning for Software Project Management (e-SoftPro)

By

Sabita Unni (WEK020220)

Supervisor: Puan Zarinah Mohd Kasirun

Moderator: Puan Norazlina Khamis

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Abstract

All third year computer science and information technology students of Faculty of Computer Science and Information Technology, Universiti Malaya are required to produce a final year project as a requirement of the course. This document covers the phases in the development of the final year project, e-Learning for Software Project Management (e-SoftPro).

The first chapter introduces the project and gives an overview of the project objectives, project scope, project motivation, project schedule and the expected outcome. The second chapter studies and analyses the existing systems which are similar to the proposed e-SoftPro and discusses the technologies available to develop the system.

In the third chapter, the methodology that will be used for the development of e-SoftPro is chosen. The fourth chapter will determine and analyze the functional and non-functional requirements of the system using diagrams such as the use case and sequence diagrams.

In the fifth chapter, the conceptual and technical design for e-SoftPro will be explained. The class diagram, flow charts are designed as well as the database and user interface.. The next chapter looks at the whole implementation process of e-SoftPro which includes coding and database manipulation.

The content of the seventh chapter is the explanation about the testing processes, including the types of testing done. The last chapter is about system evaluation as well as discussions about the system.

University of Malaya

Table of Contents

University of Malaya

CHAPTER 3: SYSTEM METHODOLOGY

CHAPTER 4: SYSTEM ANALYSIS

CHAPTER 5: SYSTEM DESIGN

University of Malaya

University of Malaya

University of Malaya

List of Figures

University of Malaya

University of Malaya

List of Tables

University of Malaya

Chapter 1:

Introduction

University of Malaya

1.1 Project Overview

Learning packages are one of the biggest productions of software development companies. The importance of education and the interactive learning approaches provided by the packages have boosted the wide growth of the industry.

This web based system titled "E-Learning for Software Project Management (e-SoftPro) " is a learning package to help students in the computer science and information technology field to learn about software project management in a more interesting and interactive way.

The system will offer tutorials on software project management topics and also assist students to assess themselves through the quizzes available for each topic. Students can also use the search engine to specific notes or templates of certain topics based on the keyword entered. Students can also post questions on the message board, which will be answered by the authorised administrator or by other users as well.. All users of the system can view these questions. Students can also use the templates available to calculate certain equations in Software Project Management, for example COCOMO.

1.2 Project Objectives

This system is especially to help computer science and information technology students to learn about software project management through the Internet. Currently there are not many sites offering tutorials or notes on software project management. Students rely solely on books and lecture notes to study.

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This system will offer users tutorials on software project management using short, concise notes. This will ensure that the users are kept interested and pay more attention to learning that is not possible with a book. The system is also targeted to provide more user involvement in the learning process through quizzes and calculation templates and also through the message board where users can post questions, which will be answered by the administrator.

All information presented in short, easy-to-digest pieces that one can easily skim through to find out just the information that they want. The system will also offer user-friendly interface and better navigation.

1.3 Project Scope

1.3.1 System Scope

Basically the scope of the system is to facilitate the learning of software project management through tutorials, quizzes, message board, calculation templates and the search function. The administrator can perform functions such as update tutorials and quizzes and also answer the questions on the message board.

1.3.2 User Scope

The users of the system will be mainly students of computer science and information technology. Beginners and self-learners in computer studies can also benefit from the system. The other user is the administrator who can

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perform updates and make changes or delete tutorials and questions on the message board.

1.4 Project Motivation

Software project management is an important subject for computer science and information technology students, but there are currently not many sites that offer e-learning for this subject. Students depend on textbooks, which are quite boring and difficult to understand especially for beginners. People usually have attention span measured in milliseconds. Therefore it is difficult to read a book continuously, as books are mostly textual with few graphics and colours.

Based on interviews done with students, e-learning is perceived to be more effective because of the colourful and interesting way the information is presented. Furthermore, students sometimes find themselves having doubts and questions on what they read in textbooks and have nowhere to turn to for clarifications. Through the message board, the students will be able to get concise and detailed answers to all their queries.

1.5 Expected Outcome

The system is expected to deliver tutorials on software project management. These tutorials will be in the form of brief notes presented in an interesting way to attract students to learn. After each topic, there will be quizzes, which can be used by the students to test their understanding of the topic studied. The student can immediately get

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their quiz results and see the correct answers. The administrator can make changes to the notes and quizzes.

Students can also use the search function to find information on a certain topic based on the keyword entered. This way, students can focus on their area of study alone and it will be easier to find exactly what they want.

Students can also use the templates available at the site to calculate and get the value for certain equations in Software Project Management such as using the Constructive Cost Model (COCOMO).

The system will also have a message board where users of the system can post questions and doubts on software project management topics. These questions will be answered by the administrator. The administrator will be able to delete irrelevant or unnecessary questions on the message board.

1.6 Project Constraints and Limitations

The system has several limitations. The first one is that being a web-based e-learning system, it can only be accessed by users who have Internet connection.

Although the system can be used by anyone who has access to the Internet but it can only be fully utilised by users who have basic knowledge in computer studies. This is because without a background in computer studies, users will not be able to fully understand the computer terms used.

Another constraint is that all the information provided in the system is entirely in English. Only users who are proficient in English will be able to understand the tutorials and answer the quiz questions.

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1.7 Project Schedule

A project schedule was created at the beginning of the project to ensure the completion of the project on time. The project was divided into 6 major stages or phases. They are preliminary investigations, literature review, system methodology, system analysis and system design. A Gantt chart is an easy way to schedule tasks. In a Gantt chart, bars represent each task or activity. The length of each bar represents the relative length of the task.

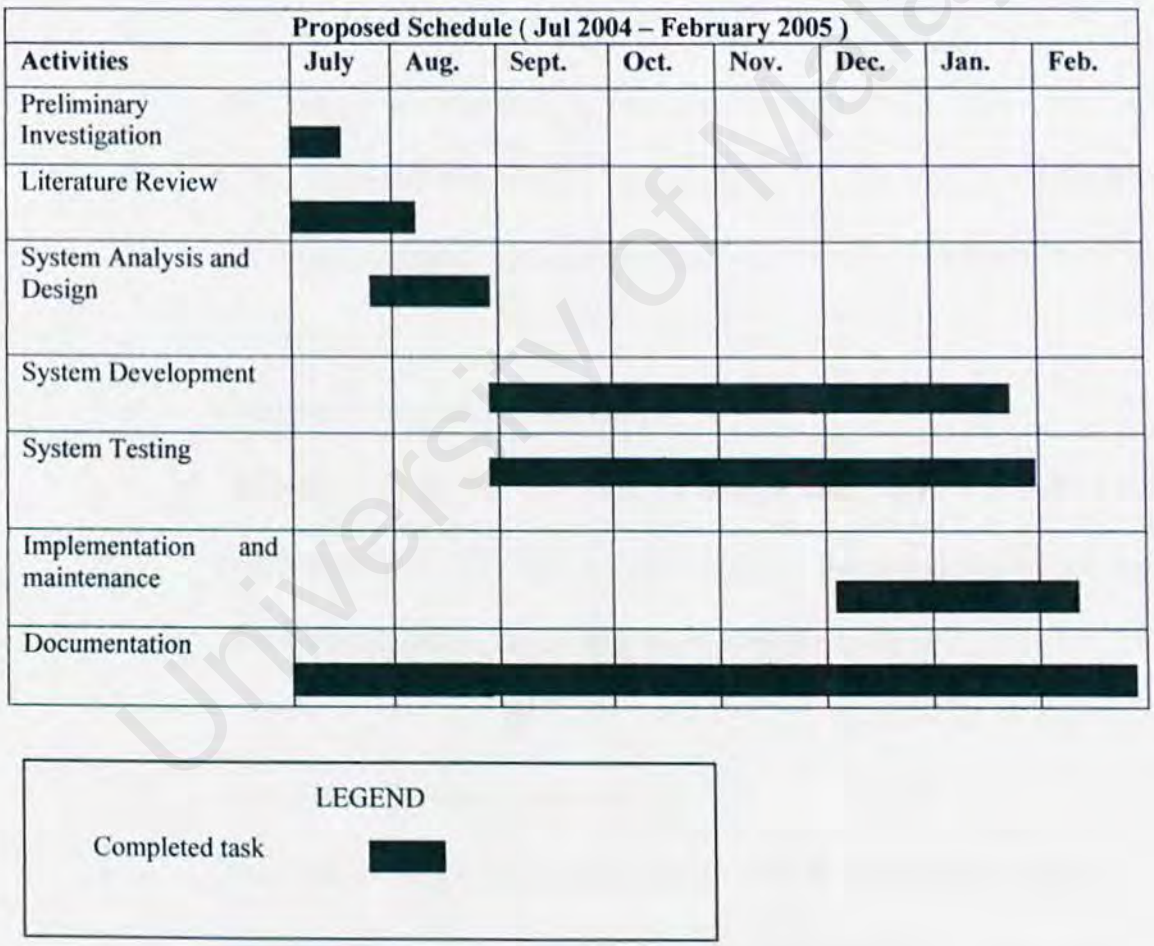

Figure 1.1: Gantt Chart for e-SoftPro

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1.8 Report Layout

This report will discuss these topics in the following chapters:

a) Chapter 1: Introduction

This chapter introduces the project and gives an overview of the project objectives, project scope, project motivation, project schedule and the expected outcome.

b) Chapter 2: Literature Review

This chapter studies and analyses the existing systems which are similar to the proposed e-SoftPro. It also discusses the technologies available to develop the system, such as programming languages, database and server.

c) Chapter 3: System Methodology

Chapter 3 discusses the methodology that will be used for the development of e-SoftPro. It also justifies the methodology chosen as well as the technologies chosen to develop the system.

d) Chapter 4: System Analysis

This chapter will determine and analyze the functional and non-functional requirements of the system using diagrams such as the use case and sequence diagrams.

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e) **Chapter 5: System Design**

In Chapter 5, the conceptual and technical design for e-SoftPro will be explained. The classes of the system will be represented in the class diagram and flow of the system will be shown in flow charts. The database and user interface too will be designed.

f) **Chapter 6: System Implementation**

This chapter will explain the process of system development which includes the website building and database manipulation. The coding process is explained including the methods and languages used.

f) **Chapter 7: System Testing**

Chapter 7 focuses on the testing process done to ensure the completeness and efficiency of the system. The types of testing used and how they were done are explained in detail.

g) **Chapter 8: System Evaluation and Discussion**

In this chapter, the evaluation done to assess the system in the eyes of the users is explained. The chapter also discusses points about the system, such as the weaknesses and strengths.

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1.9 Summary

Overall, this chapter was an overview of the whole project. The system in whole is supposed to help users to learn software project management online. The user-friendly interface and features of the system is believed to help students to fully understand this course. Students can also evaluate themselves and improve themselves through going through the quizzes. Students can also learn and understand the calculations better through the templates.

This system is believed to be able to solve most of the problems found in conventional methods of studying. Users of the system will be able to clear and their doubts through the message board. They can also find the information they want quickly through the search function.

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Chapter 2:

Literature Review

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2.1 About Literature Review

Literature review is a description of what has been published on a subject as a result of research done by qualified scholars and experts. Occasionally it is required to write one as a separate assignment (sometimes in the form of an annotated bibliography), but more often it is part of the introduction to an essay, research report, or thesis.

The main purpose of the literature review is to guide the students or researchers using the best way to access and analysis information regarding their research topic. It also helps the students to develop their information seeking and critical appraisal skill. Students can also recognize relevant information, synthesize and evaluate it according to the guiding concepts. Besides, writing the literature review is also to convey to the reader what knowledge and ideas have been established on a topic, and what their strengths and weaknesses are.

Some of the techniques used to complete the literature review are:

a) Reference to books in libraries

b) Search from the Internet

c) Reference to past year theses in the document room

d) Reference to newspapers and magazines

e) Interviews and Surveys

f) Discussion with friends and lecturers

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2.2 Introduction to e-Learning

E-learning, sometimes called distance learning is a formalized teaching and learning system specifically designed to be carried out remotely by using electronic communication (*Internet Reference*, 11/07/2004).

Distance learning offers chances for students in situations where traditional education methods have difficulty operating as it is less expensive to support and is not constrained by geographical boundaries. E-Learning is also more flexible in terms of time and can be delivered virtually anywhere.

Popular e-learning technologies include:

- Voice-centered technology, such as CD or MP3 recordings or Webcasts
- Video technology, such as instructional videos, DVDs, and interactive videoconferencing
- Computer-centered technology delivered over the Internet or corporate intranet

2.3 Introduction to Software Project Management

Software is basically a set computer instructions or data used to operate computers and related devices. Software can be thought of as the variable part of a computer and hardware the invariable part. Software is often divided into application software (programs that do work users are directly interested in) and system software

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(which includes operating systems and any program that supports application software (*Internet Reference,* 11/7/2004).

Project management is a methodical approach to planning and guiding project processes from start to finish. According to the Project Management Institute, the processes are guided through five stages: initiation, planning, executing, controlling, and closing. Project management can be applied to almost any type of project and is widely used to control the complex processes of software development projects. The systems development life cycle (SDLC) is one example of a methodology for guiding the project management process from an initial feasibility study through maintenance of the completed application. Various SDLC approaches include the waterfall model, which was the original SDLC method; rapid application development (RAD); joint application development (JAD); the fountain model; the spiral model; build and fix; and synchronize-and-stabilize. A number of charting methods, such as the Gantt chart and PERT chart have been developed as tools to create a graphic representation of a project plan and its current status (*Internet Reference,* 11/7/2004).

Therefore, software project management is the approaches involved in handling the execution of a software project from the beginning till the end.

2.4 Introduction to E-Learning for Software Project Management

E-Learning for Software Project Management simply means the formalized learning of the course software project management using electronic media. The media

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can be television, radio, computers etc. In this project, it is an online system created to help students learn software project management in an effective and interactive way.

2.5 Current/Existing System Review

Given here are some systems reviewed which are quite similar to the proposed E-Learning for Software Project Management:

2.5.1 4pm.com

Figure 2.1: The homepage of www.4pm.com

This website is owned by The Hampton Group, Inc. 4PM.com specializes in project management training and consulting. Their training programs are based upon more than 60 years of combined experience in effectively managing corporate programs and projects. They started business in 1986 to bring unique project management protocol and methodology to a wide audience in the books they publish, via the Internet, CD-ROM and in-person seminars.

This website has a few modules. A user can use this site to get links to various articles on software project management. This links are classified under various topics in Software Project Management.

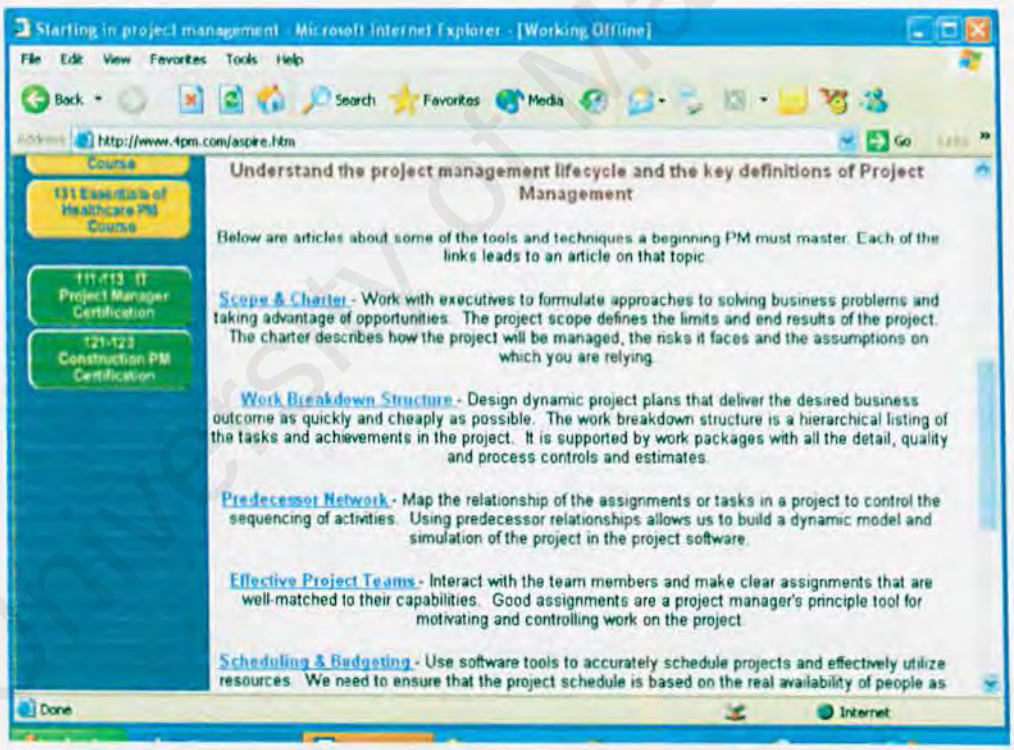

Figure 2.2: The links to articles in 4pm.com

Other than articles, this site also has a list of books for software project management. From this page, users can buy the books online, see a review of the

books or read a sample chapter in the books. Besides that, this site also offers a list of courses available for software project management.

Overall, this site is not a good choice for a person who wants to learn software project management online from the basic. This is because there are no tutorials or questions but only articles. This site will be more helpful for people who have some knowledge on software project management and would like to learn more.

2.5.2 Columbia University Online

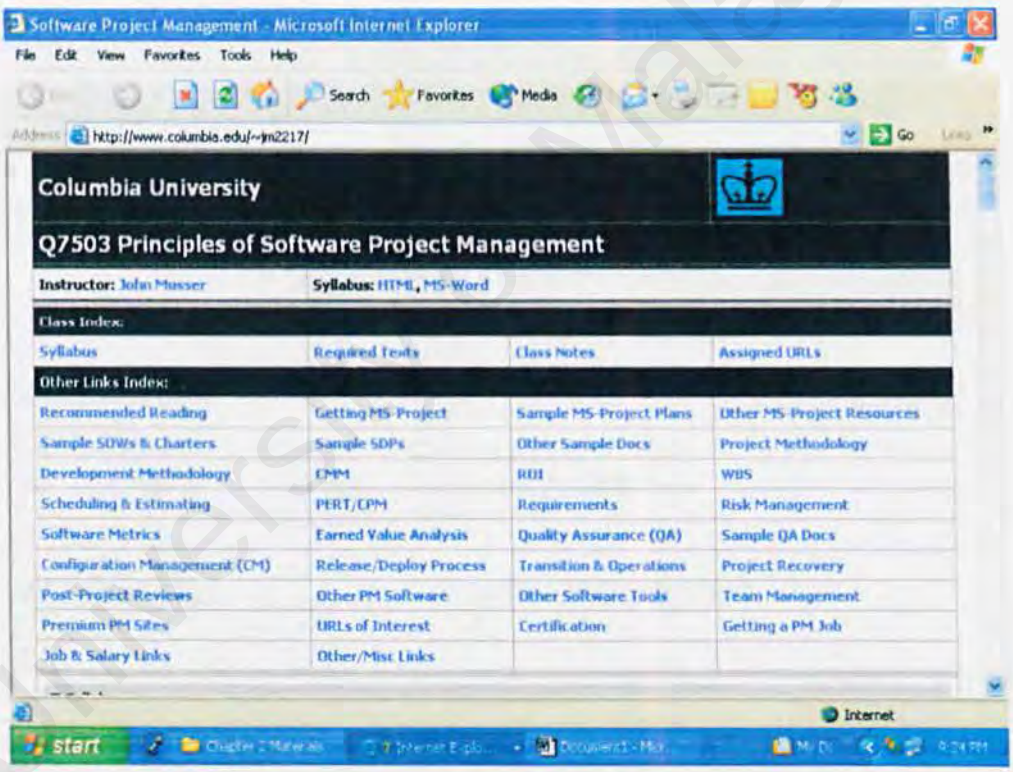

Figure 2.3: The Columbia University's Homepage for the Software Project Management Course.

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This website can be found at http://www.columbia.edu/~jm2217/. This site is offered by the Columbia University of New York.

Users can learn many courses online at this website. The limitation of this site is that it only offers notes online for all the courses. There are no other modules unlike the proposed E-Learning for Software Project Management system. Nevertheless, the notes available at this site are quite complete and useful to even beginners in this field.

2.5.3 SofwareDioxide.com

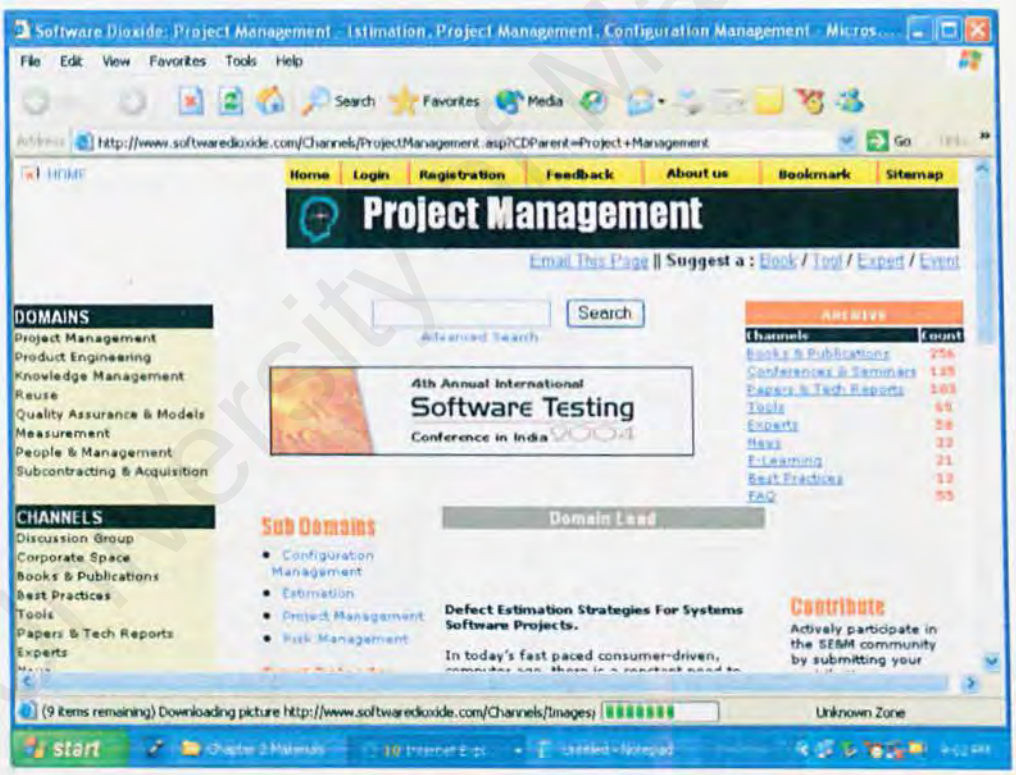

Figure 2.4: The Homepage of SoftwareDioxide.com

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This site is available at the URL address:

http://www.softwaredioxide.com/Channels/ProjectManagement.asp?CDParent=Project+Management.

This website has one similar module as the proposed E-Learning for Software Project Management. There is a discussion group module which can be used by surfers to this site to exchange their ideas and comments. This is same as the bulletin board in the proposed system where users can post questions which will be answered by the administrator or other users of the system.

2.5.4 Comparison of Existing System

Table 2.1: Comparison between existing systems and e-SoftPro

Features	4pm.com	Columbia University Online	Software Dioxide.com	e-SoftPro
Notes	✓	✓	×	✓
Quiz	×	×	×	✓
Message Board	×	×	✓	✓
Search Function	×	×	✓	✓
Calculation Templates	×	×	×	✓
Other features	Links to articles and books	Links to relevant sites	Links to relevant sites	

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2.6 Comparison of Development Tools

2.6.1 ASP.NET

ASP.NET is the latest Microsoft programming framework that allows for the rapid development of powerful web applications. An ASP remotely hosts and manages a software application. An easier way to understand how an ASP works is to think of it as the "renting" a piece of software to customers who access it remotely, most commonly over the Internet or a Wide Area Network (WAN) (*Internet Reference,* 14/7/2004).

The Advantages of ASP.NET

ASP.NET has many advantages, both for the programmers and for the end users.

i. **Powerful database-driven functionality**

ASP.NET allows programmers to develop web application that interface with a database. The advantages of ASP.NET are that it is object-oriented and has many programming tools that allow for faster development and more functionality.

ii. **Faster web applications**

Two aspects of ASP.NET that make it fast are compiled code and caching. In the past, the code was interpreted into "Machine language" when a website visitor views a page. Now, with ASP.NET the code is

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compiled into "machine language" before the visitor even comes to the site.

Caching is the storage of information that will be reused in a memory location for faster access in the future. ASP.NET allows programmers to set up pages or areas of pages that are commonly reused to be cached for a set period of time to improve the performance of web applications. In addition, ASP.NET allows the caching of data from a database (*Internet Reference*, 15/7/2004).

iii. Memory leak and crash protection

ASP.NET automatically recovers from memory leaks and errors to make sure that your web site is always available to your visitors.

iv. Multiple language support

Programmers can actually write their code in more than 25.net languages including VB.Net, C#, and Jscript.Net. This allows programmers develop a site in the language they know.

2.6.2 PHP

PHP stands for PHP: Hypertext Preprocessor. It is a scripting language designed specifically for use on Web pages. PHP is a server side scripting language. A server scripting language has the capability of executing a script on a server and presenting the output as HTML. Server side scripts have the main advantages of interacting

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directly with server database and performing all types of server manipulations directly.

Client side scripting languages such as JavaScript or VBScript, act on your local machine by and large and need to pass instruction to the server, rather than directly interacting with it. PHP is a cross platform supported language, which means, PHP can run on various operating systems like Linux, Windows. Both Personal W

The Advantages of PHP

i. **Open Source**

PHP is open source, open source is one where, user is given a free license to remodel or recode PHP, according to their wish.

ii. **Multi Platform**

PHP supports various platforms, which mean PHP can be installed on almost all the operating systems, like the windows and Linux.

iii. **Easy Syntax**

PHP syntax is quite easy to code, all the syntax are similar to the C language sytax, if you are very new to the programming environment then it will be a bit difficult task for you to code the PHP.

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2.7 Comparison of Databases

2.7.1 Microsoft Access 2002

Since its introduction in 1992, Microsoft Access has become one of the most versatile applications in the Office suite. This versatility is evidenced by the rich set of tools that even the most experienced database user can take advantage of, while offering the same level of simplicity as the other Office applications for first-time database users (*Internet Reference,* 18 July 2004).

In this new version many functionality has improved to help the developers and experienced users to access and build the powerful databases. The beginners also can easily use the existing applications in Access 2002. It also improves the ability for users to access information from corporate-level, back-end databases such as Microsoft SQL Server. Analysis tools such as PivotTable dynamic views and PivotChart dynamic views have improved and enable users to extend corporate databases applications to the web.

Another important feature that Access 2002 developed was the tools that developers needs to build powerful, sophisticated databases solutions that can integrate with enterprise-wide data while ensuring forward and backwards compatibility with new and existing database solutions. They also enhanced tools to build solutions that integrate and leverage internet-standards, such as XML, XSL, and dynamic web pages.

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Access provides multinational organizations and multilingual users with a better experience when working the application. This was achieved with enhancements to working with, displaying, and developing international text in databases.

2.7.2 Microsoft SQL Server 2000

SQL Server is a Relational Database Management System that is capable of handling large amounts of data and many concurrent users while preserving data integrity and providing many advanced administration and data distribution capabilities.

When a client application requests data, SQL Server ensures that the client has permissions to do so, then decides how to retrieve or update the data. It can rollback transactions - if you are half way through entering a new record and there is a power cut, SQL server will not commit the half finished record to the database.

Some of the advantages of Microsoft SQL Server 2000:

- Suitable for web-based application
- Has the speed to support more than a few hundred users over the network at one time.
- Is not limited in the size of each record and each table
- Perform rapid, sophisticated analysis on large and complex data sets using multi-dimensional storage.

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- Multiple applications can be run on a single server, or outsourced.

2.8 Comparison between Operating Systems

Windows operating system is selected because it provides lots of benefits, such as:

- Compatible with Microsoft and Netscape

  Most of the programming tools in today's trend are Microsoft based developed languages. For instance, Visual Basic, Visual C++, and Visual J++. Moreover, some DBMS tools such as Microsoft Visual InterDev and Microsoft SQL are gaining popularity in most corporations.

  Most of today applications are Windows and DOS compatible. Integrity of module into a system will not need any patch from different software developers. Thus, it lessens the time and cost in developing a system. This is beneficial for the previous developed software in terms of investment.

- LINUX or UNIX operating systems do not offer much software development tools especially Web based publishing software. Lack of development tools has contributed to less efficient and slow progressing operating systems. Most of the applications in UNIX are developed via a command line compiler and simple text editor.

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- User friendly Environment

  i. Interface of Windows environment origin from the Windows 3.X operating system where the first and foremost windows like interface that offer multitasking with the user-friendly feature.

  ii. Differ from UNIX or LINUX operating systems where most of the tasks are performed by command script, which is definitely very troublesome. Furthermore, the user interface is too cryptic and not user friendly at all. Learning some command task may waste a great deal of time.

  iii. Besides cryptic user interface, UNIX applications demand step learning curve where it is very difficult for a new user. Thus, it is time consuming and waste lots of learning time and cost.

  iv. Complicated installation procedure

  Each UNIX machine has their different documented installation procedure. Prior to installation, the source code (Kernel) needs to be compiled.

- Security

The distribution of LINUX and UNIX source code is widely available in the Internet. Besides the administrator benefited from the source code, the potential hacker has the possible vulnerability point of attack.

However, this differs from Windows where most of the applications are not freely available in the Internet. Besides, Windows operating system utilizes binary codes, thus result complicated vulnerability points of security. As a result,

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this can seriously compromise the security of many servers at a time where they use the same codes (*Internet Reference, 20/7/2004).*

2.8.1 Advantages of Microsoft Windows XP Professional

- Business-Level Reliability

  Delivers a new level of stability, for example, in most cases, if one program crashes, the computer will keep running.

- Advanced Performance

  Manages system resources efficiently, meeting the performance standards set by Windows 2000 and exceeding those set by Windows 98 Second Edition.

- Remote Desktop

  Allows the creation of a virtual session and desktop computer can be used from another running computer Windows 95 or later, giving access to all data and applications.

- New Task-based Visual Design

  With a cleaner design and new visual cues, most commonly used tasks can be accessed quickly.

- Wireless 802.1x Networking Support

  Provides support for secured access and improves performance for wireless networks.

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- Windows Messenger

  An easy way to communicate in real time on the computer. Enables the viewing of online status of contacts and choosing to communicate with them through text, voice or video.

- Encrypting File System

  Provides a high level of protection against hackers and data thieves by encrypting files transparently with a randomly generated key.

- Fast Resume from Hibernation or Standby

  Laptops can enter Standby or Hibernate mode faster and starts working again faster after resuming.

- Help and Support Center with Remote Assistance

  In addition to a comprehensive set of documentation, Help and Support Center also includes Remote Assistance where an expert user who is also running Windows XP can remotely control the computer to demonstrate a process or fix a problem.

- System Restore

  System can be reverted to a previous state if something goes wrong. (*Internet Reference,* 16 July 2004).

2.9 Comparison of Web Servers

2.9.1 Internet Information Services (IIS)

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Internet Information Services (IIS) 6.0 is a powerful Web server that provides a highly reliable, controllable, and scalable Web application infrastructure for all versions of Windows Server 2003. IIS helps organizations increase Web site and application availability while lowering system administration costs. IIS 6.0 supports the Microsoft Dynamic Systems Initiative (DSI) with automated health monitoring, process isolation, and improved management capabilities.

Other advantages of IIS :

- A robust and capable Web server program
- Suitable for small sites right up to enterprise-class sites
- Provides a central server management from any server on the network
- Inclusions of ASP
- Includes its own Internet Services API (ISAPI)
- Provides database support including ODBC and Microsoft SQL

2.9.2 Apache

Apache is a freely available Web server that is distributed under an "open source" license. Version 2.0 runs on most Unix-based operating systems (such as Linux, Solaris, Digital UNIX, and AIX), on other UNIX/POSIX-derived systems (such as Rhapsody, BeOS, and BS2000/OSD), on AmigaOS, and on Windows 2000. According to the Netcraft (www.netcraft.com) Web server survey in February, 2001, 60% of all Web sites on the Internet are using Apache (62% including Apache derivatives), making Apache more widely used than all other Web servers combined.

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Apache complies with the newest level of the Hypertext Transport Protocol, HTTP 1.1. Free support is provided through a bug reporting system and several Usenet newsgroups. Several companies offer priced support (*Internet Reference,* 11 July 2004).

Advantages of Apache Server

- easy to write powerful modules
- source easily available for free
- is modular in structure, permitting Apache users to pick and choose modules to fit their requirements
- available with any platforms compared to IIS which can only run in Windows environment

Disadvantages of Apache Server compared to IIS

- Unlike IIS, Apache does not provides GUI support for server administration
- IIS provides better integration with Windows OS facilities
- IIS provides the ability to integrate Web server security with Windows security features
- With its tight Windows integration, IIS can also provide enhanced file system security.

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- IIS also provides the ability to administer one or more IIS Web servers from a Web browser (*Internet Reference*, 21/7/2004).

2.10 Tools Confirmation

After analyzing the two main tools, ASP.NET is found to be the best for the development of the E-Learning for Software Project Management (E-SOFTPRO).

There are several reasons, why the ASP.NET was chosen:

- ASP solutions delivered over the Internet are naturally, accessible round-the-clock from any Internet-enabled computer on earth. Content can be added or updated immediately anywhere or anytime.
- E-SOFTPRO is an online system that facilitates the learning of software project management for students and it needs to be updated whenever it is possible. ASP.NET provides a very user-friendly system and is an easy and fast learning code. So, the system can be upgraded in the future without any constraints.

Other Software Development Environments decided were:

- **Database** : Microsoft SQL Server 2000
- **Web Server** : Internet Information Services (IIS)
- **Platform** : Microsoft Windows XP Professional

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2.11 Summary

In chapter 2, the purpose and meaning of literature review were discussed as one of the system development process of E-Learning for Software Project Management. Terms such as e-learning and software project management were defined and the project objectives were also mentioned.

Survey was also done on the existing similar systems as E-Learning for Software Project Management. Three sites were reviewed, they are: 4pm.com, Columbia University Online and SoftwareDioxide.Com.

Other than that, the development environment for the proposed system was also suggested and reviewed. This includes programming tools, database, web servers and operating systems. The tools selected were also confirmed based on the advantages over the other tools.

In short, literature review has been carried out on the system requirements as well as materials and information that will enhance the development of the system. Literature review plays a vital role in determining features as well as requirements that have to be incorporated into the system

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Chapter 3:

System Methodology

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3.1 What is Methodology?

According to the Oxford dictionary, method is a procedure or a way of doing something. Methodology, therefore, is the process of doing things in an orderly or systematic way. In the context of software/ system design, the word methodology is understood as a way of developing a software product [R.Schach, Stephen, 2005].

A methodology in a wider context can be defined as a collection of procedures, techniques, tools and documentation aids. These procedures, techniques, tools and documentation aids help the software developer to speed up and simplify the software development process. [Dr. P.Sellapan, 2000]. A methodology may comprise phases such as analysis, design, coding and testing. There could also be sub-phases for each phase. The phases guide the developers to choose the appropriate techniques. Methodology helps system developer to plan, manage, control and evaluate a system development project.

3.2 Objectives of Methodology

- Record accurately the requirements for a system
- Provide a method of development which is orderly and systematic and ensures that the progress of the development is closely monitored.
- Produce a system/software that is well-documented and easily maintained.

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- Provides a much earlier indication that changes are needed in the development process.
- Ensure that the system developed is user-friendly and fulfills the clients' requirements.

3.3 Project Development Methodology

A system development process basically goes through a few phases such as requirements gathering, analysis, design and implementation. A lifecycle model is the series of steps to be performed while the software product is developed and maintained. There are various life cycle models that have been developed to guide the processes involved in software development such as the waterfall model, Rapid Application Model (RAD), Joint Application Model (JAD), the spiral model, prototyping etc. Sometimes, a few models are combined into some sort of hybrid methodology. Documentation is crucial regardless of the type of model chosen and is usually done in parallel with the development process. Creating a process model helps the development team find inconsistencies, redundancies, and omissions in the process and in its constituent parts. As these problems are noted and corrected, the process becomes more effective and focused on building the final product.

The model chosen should reflect the goals of development, such as building high quality software, finding faults earlier in development, and meeting required budget and schedule constraints. As the model is built, the development team evaluates candidates' activities for their appropriateness in addressing these goals. For example,

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the team may include requirements review, so that problems with the requirements can be found and fixed before design begins.

The model that I have chosen for the development of the E-Learning for Software Project Management (e-SoftPro) is the iterative-and-incremental life-cycle model. This model involves splitting a project up into stages, or *iterations*, with each iteration having a specific goal that provides extra functionality to an evolving system (incrementation). Individual iterations are divided up into Analysis, Design, Implementation and Testing phases. In this model, small unit of development allow developer to step back a phase if a problem is encountered. For example, if an error or deficiency is detected in the design during the implementation stage, the developer can still go back and perform additional design or analysis. This process can be repeated until the problem is rectified. [Jones, Andrews, 2004] This means that at each iteration, design modifications are made and additional functions added to deliver the perfect system which meets all the client's requirements.

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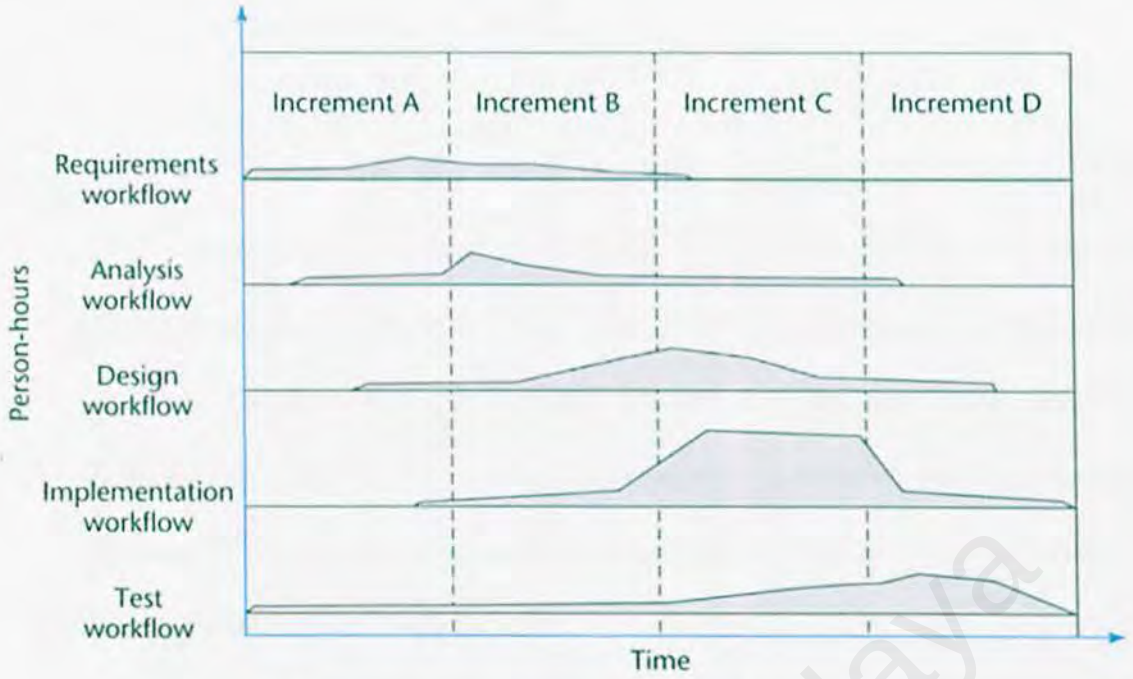

Figure 3.1: The iterative-and-incremental life cycle model

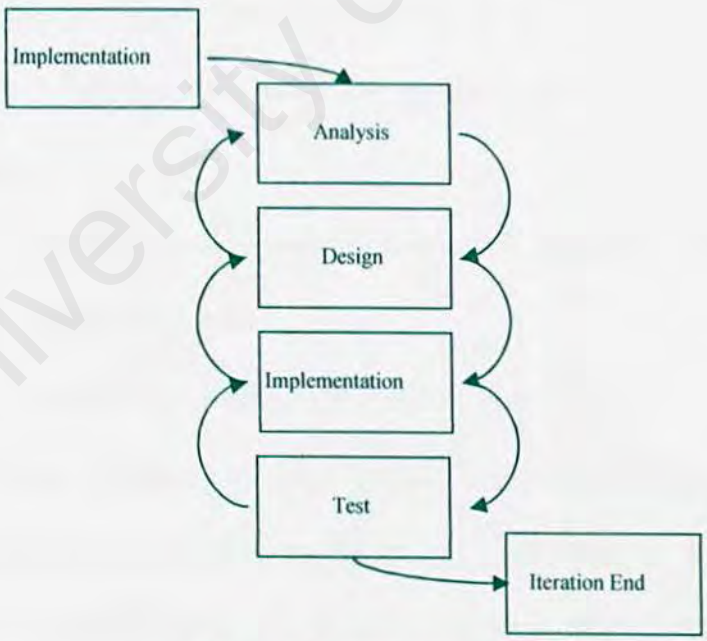

Figure 3.2 : An iteration

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3.3.1 Why was this model chosen?

The reason why this model was chosen is because it has very few disadvantages when compared to other life-cycle models such as the waterfall model, spiral model and prototyping. One of the main weaknesses found in all the other models is that these models assume that software is developed in discrete phases. In reality, software development is iterative and incremental. This is only reflected truly in the iterative-and-incremental model and evolution-tree model [R.Schach, Stephen, 2005].

Other advantages of the iterative-and-incremental model are:

- Better risk management, as risks are addressed much earlier in the project life cycle. The model forces project managers/leaders take stock of the situation time-to-time and corrective action for quality and code can be taken in the early stages.
- Complete functionality delivered per increment, as product is seen in some completed intermediate form.
- Complete Testing is done at the end of every increment
- Higher Client Satisfaction/Project Output Visibility. As each increment is delivered, the client gets to know the look and feel of the product and changes can be suggested early (*Internet Reference,* 1/8/2004)
- Closely models real world software production
- Underlies the Unified Process

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3.3.2 Comparison between the iterative-and-incremental model and the waterfall model

A software product developed with waterfall model performs all the phases in the software development life cycle (requirements, analysis, design and implementation) on the software as a whole. When a problem is faced, the feedback loops are followed. In the iterative-and-incremental model, the software is treated as a set of increments. All the phases are performed on each increment repeatedly until no further iteration is needed. In short, each iteration is a small but complete waterfall model.

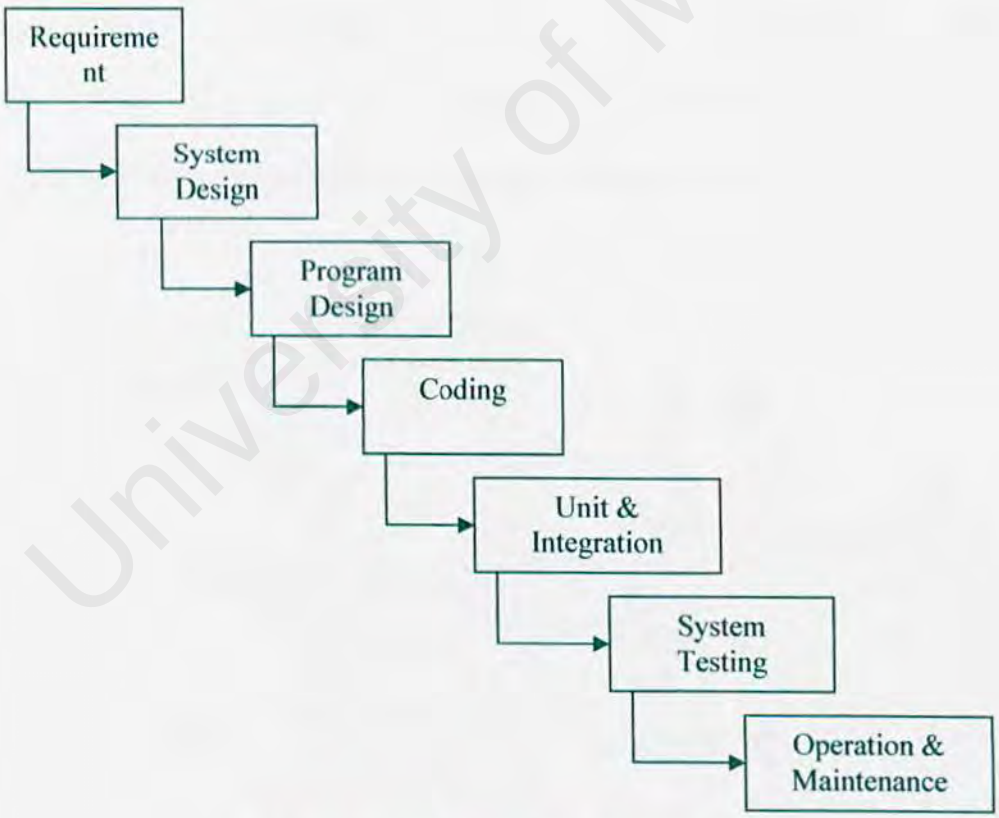

Figure 3.3 : The waterfall model

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3.3.3 Comparison between the iterative-and-incremental model and the spiral model

The spiral model is quite similar to the waterfall model with the addition feature where each phase is preceded by risk analysis. An attempt is made to mitigate risks before the beginning of each phase and if it is impossible to control all the significant risks, the project is immediately called off (*Internet Reference,* 3/8/2004). In the iterative-and-incremental model, risks are also mitigated but very early in the lifecycle. If a risk is felt during the initial stage, then the first few iterations are directed towards mitigating the risk. If the risk is successfully controlled, the project can be continued but if it is found to be uncontrollable, it is reported early to the client so that only a small proportion of the budget has been spent. The client then can decide on whether the project should be continued or cancelled or some other steps should be taken.

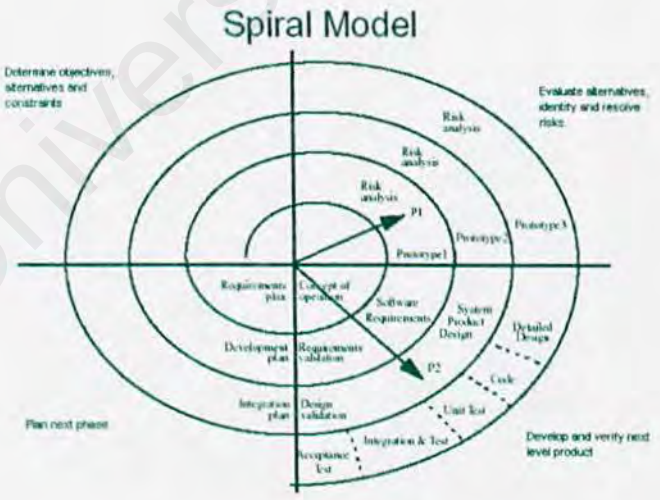

Figure 3.4: The spiral model

3.4 Summary

In chapter 3, methodology for software development was discussed. Several life cycle models were discussed and the importance of these models were also mentioned. These models are different in nature and have their own advantages and weaknesses. It is very important that a proper life cycle model is chosen to ensure that the software is delivered on time and within budget.

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Chapter 4:

System Analysis

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4.1 Purpose of system analysis

System analysis is an essential and important phase in the software life cycle that is used to determine what a system does and also to analyse the system needs (Kendall & Kendall, 2001). It is defined as those development phases in a project that primarily focus on the business problem, independent of any technology that can or will be used to implement a solution to the problem. Extensive system analysis is necessary to get an overview of the functional requirements and non-functional requirements of e-SoftPro.

4.2 Fact Finding Methods Used

4.2.1 Interview

This is a fact-finding technique whereby information is collected from individuals through face-to-face interaction. Interviewing can be used to achieve any or all of the following goals: find facts, verify facts, clarify facts, generate enthusiasm, get the end user involved, identify requirements and solicit ideas and opinions. There are two roles in conducting an interview where the system analyst is the interviewer (responsible for organizing and conducting the interview), and the system user or system owner is the interviewee (who is asked to respond to a series of question). For this e-SoftPro, the interview method was used to elicit the requirements from the clients. Clients expressed their difficulty in finding an online learning package for Software Project Management and gave some of their expectations of the system.

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4.2.2 Internet

The Internet is a collection of wires, protocols and hardware that allows the electronic transmission of data over TCP/IP. The Internet forms a global network of computers that can share data and programs. The computers are connected through a series of local area networks (LAN) and wide area networks (WAN) and transfer data through the communications rules set forth by the Transmission Control Protocol (TCP) and Internet Protocol (IP) (Rayport, & Jaworski, 2003). The Internet is one major source of information for this e-SoftPro project. Information on system methodology, tools and much more were obtained from the Internet. One weakness of the data found from the Internet is that it is not reliable since the name of the author can seldom be found.

4.2.3 Printed Materials

Printed materials can be in the form of books, magazines, newspapers, journals, newspapers etc. This type of data source is very reliable and the information given can be said is true and accurate. The printed material most used throughout the development of the e-SoftPro is books.

4.2.4 Document Room

Document Room in Faculty of Science Computer and Information Technology is a place where all the final year project reports of previous students

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are stored. The reports are very useful as it served as a guideline to complete the report for e-SoftPro.

4.3 System Requirements

System requirements need to be drawn out before the development of a system. A requirement is a feature of the system or a description of something the system is capable of doing in order to fulfil the system's purpose.

4.3.1 Functional Requirements

Functional requirements are descriptions of activities and services a system must provide, how the system should respond to particular inputs and how the system should behave in particular situations. It is frequently identified in terms of inputs, outputs, processes and stored data that are needed to satisfy the system improvement objectives. In some cases, the functional requirements may also explicitly state what the system should not do (Fleeger, 1999).

The e-SoftPro system is divided into a few modules. They are notes, quiz, search, messages, templates and authentication.

a) Notes Module

This module contains the function 'view notes' and. All users can use the system to view software project management notes divided into chapters. The administrator can upload new notes.

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b) Quiz Module

The quiz module contains the function 'Answer Quiz'. Quizzes are prepared for each chapter in software project management. These questions are in form of randomly selected multiple choices questions (MCQ). User can also view the results of the quiz with the correct answer for each question. The administrator can add a new question and edit or delete existing quiz questions.

c) Search Module

The search module is to help users to find the exact notes that they want based on the keywords entered. This "Search for notes" function of the system can be used by all users.

d) Message Board Module

The message module contains the functions for the message board. The message board can be viewed ("View Messages" function) and used by all users and the administrator. Users can read all messages and questions posted by previous users and can also post their own questions or messages using the "Post Message" function. The administrator can view all messages and post answers to the question posted. The administrator can delete the posted messages which are very old or irrelevant.

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e) Templates Modules

Users can use the templates available to perform calculations for certain topics in Software Project Management, COCOMO for example. The administrator can make changes to these templates.

f) Authentication Module

This module is for the authentication process of the administrator. The administrator table in the database stores the username and password of the administrator. The administrator must log-in before performing any functions and the identity of the administrator will be validated against the Administrator table in the database.

4.3.2 Unified Modelling Language (UML)

UML (Unified Modeling Language) is a standard notation for the modeling of real-world objects as a first step in developing an object-oriented design methodology. Its notation is derived from and unifies the notations of three object-oriented design and analysis methodologies:

- Grady Booch's methodology for describing a set of objects and their relationships
- James Rumbaugh's Object-Modeling Technique (OMT)
- Ivar Jacobson's approach which includes a use case methodology

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Use Case diagram is one of the major diagrams in the UML for modeling the dynamic aspects of a system. Use case diagrams are central to modeling the behaviour of a system, subsystem or a class. Each one shows a set of use cases and actors and their relationships.

Use Case diagrams are important for visualizing, specifying and documenting the behaviour of an element. They make systems, subsystems and classes approachable and understandable.

Table 4.1: Symbols used in the use case diagram

Symbols	Meaning
	Actor
	Use Case

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4.3.3 Use Case Diagram for the e-SoftPro

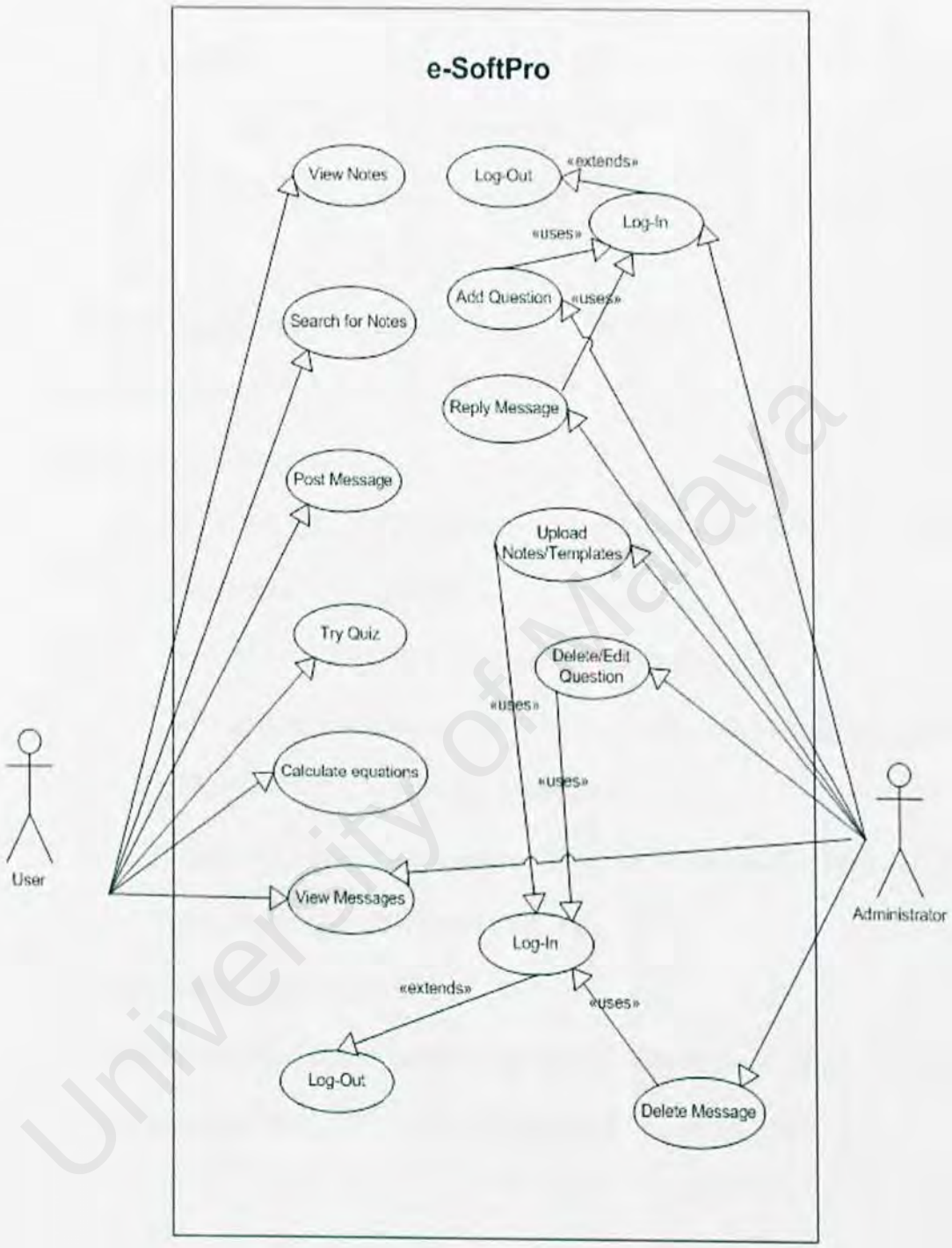

Figure 4.1: The use case diagram for e-SoftPro

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4.3.4 Description of Use Cases

4.3.4.1 Log-In

Description
An ADMINISTRATOR needs to log-in before using certain functions of the system. **Actor/s:** Administrator **Pre-condition:** - **Main Flow of Events** 1. The ADMINISTRATOR enters his/her user ID and password at the login section in the homepage. 2. The ADMINISTRATOR clicks on the Log-In button. 3. The system validates the log-in information against the ADMINISTRATOR table in the database. 4. If the correct details were entered, the system displays the Personal Home Page to the ADMINISTRATOR. **Alternate Flow of Events** If the details entered were incorrect, the system will display an error message. **Post-Condition:** ADMINISTRATOR can use all functions of the system.

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4.3.4.2 Log-Out

Description
An ADMINISTRATOR must log-out after using functions of the system. **Actor/s:** Administrator **Pre-condition: -** **Main Flow of Events** 1. The ADMINISTRATOR clicks on the log-out button. 2. The ADMINISTRATOR is logged-out and directed to the Home Page. **Post-Condition:** ADMINISTRATOR cannot perform any functions which are accessible only after log-in.

4.3.4.3 Search For Notes

Description
A USER / ADMINISTRATOR can use the search function in the system to search for notes or templates based on the keywords entered. **Actor/s:** USER / ADMINISTRATOR **Pre-condition: -** **Main Flow of Events** 1. The USER / ADMINISTRATOR enters the keyword for the notes needed. 2. The USER / ADMINISTRATOR clicks the Search button. 3. The system displays the notes/template that contains the keywords.

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4. USER / ADMINISTRATOR clicks on the link for the notes/template wanted.

Post Condition: -

4.3.4.4 View Notes

Description
A USER can use read the noted provided according to chapters in Software Project Management. **Actor/s:** USER **Pre-condition:** - **Main Flow of Events** 1. The USER clicks on the Notes link. 2. The system displays the titles of each chapter. 3. The USER clicks on the chapter wanted to be viewed. 4. The system displays the notes. **Post Condition:** -

4.3.4.5 Post Message

Description
A user can post messages or questions on the message board which will be answered by the administrator or other users. **Actor/s:** USER

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Pre-Conditon: -

Main Flow of Events

1. The USER clicks the Message Board link.
2. The system displays the message board with messages and questions posted by other users as well as answers and comments by the administrator.
3. The USER clicks on the Post New Message button.
4. The system displays the Post New Message page.
5. The USER types the message or question.
6. The USER click the send button.
7. The system displays the message that has just been posted on the message board.

Post-Condition: Administrator can answer or comment on the message.

4.3.4.6 Try Quiz

Description
A USER can try the quizzes prepared for each chapter. **Actor/s:** USER **Pre-Condition: -** **Main Flow of Events** 1. The USER clicks on the quiz link. 2. The system displays all the quizzes available. 3. The USER chooses the quiz to be answered.

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4. The system displays the quiz.
5. The USER answers the quiz questions.
6. The USER clicks the "Done" button.
7. The system displays the quiz results with the correct answers.

Alternate Flow of Events:

The USER clicks on the "Cancel" button.

The system displays the previous page.

Post-Condition: -

4.3.4.7 View Messages

Description
A USER or the ADMINISTRATOR can view all the messages posted on the message board. **Actor/s:** USER and ADMINISTRATOR **Pre-Condition: -** **Main Flow of Events** 1. The USER or ADMINISTRATOR clicks on the Message Board link. 2. The system displays the message board with messages and questions posted by other users as well as answers and comments by the administrator. **Post Condition:** An USER can post a new message and the ADMINISTRATOR can reply messages that have been posted.

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4.3.4.8 Calculate Equations

Description
An USER can get values of equations in Software Project Management by using the templates available for calculations. **Actor/s:** USER **Pre-Condition: -** **Main Flow of Events** 1. The USER clicks the Calculation Templates link. 2. The system displays all the templates available for calculations. 3. The USER chooses the template needed. 4. The system displays the template. 5. The USER fills all the required fields with values needed for calculations and chooses other options needed from the dropdown menu or checkbox. 6. The USER clicks on the 'Get Value' button. 7. The system displays the value for the equation. **Alternate Flow of events** 7. If all the required values were not given, the system displays an error message and prompts the USER to key in the details. 8. USER enters the details. 9. USER clicks on the 'Get Value' button. 10. The system displays the value for the equation. **Post Condition: -**

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4.3.4.9 Delete Message

Description
The ADMINISTRATOR can delete the messages that are irrelevant or very outdated. **Actor/s:** The ADMINISTRATOR **Pre-condition:** ADMINISTRATOR must have logged-in. **Main Flow of Events** 1. The ADMINISTRATOR clicks the Message Board link. 2. The system displays the message board with messages and questions posted by other users as well as answers and comments by the administrator. 3. The ADMINISTRATOR chooses the message wished to be deleted from the board by clicking on the link available at every message. 4. The system displays the message in full. 5. The ADMINISTRATOR clicks the Delete button. 6. The system pops up a message asking for confirmation. 7. The ADMINISTRATOR clicks the Yes button. 8. The system deletes the messages selected. **Alternate Flow of Events 1** 6. The ADMINISTRATOR clicks the No button. 7. The system redirects to the previous page. **Post Condition: -**

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4.3.4.10 Reply Message

Description
The ADMINISTRATOR can reply questions asked by an USER or comment on a message. **Actor/s:** The ADMINISTRATOR **Pre-condition:** ADMINISTRATOR must have logged-in. **Main Flow of Events** 1. The ADMINISTRATOR clicks the Message Board link. 2. The system displays the message board with messages and questions posted by other users as well as answers and comments by the administrator. 3. The ADMINISTRATOR choosed the message to be replied by clicking the link available for all messages. 4. The ADMINISTRATOR reads the question asked and prepares the answer. 5. The ADMINISTRATOR types the answer or comment. 6. The ADMINISTRATOR clicks on the Reply button. 7. The system displays confirmation message that the reply has been posted. **Post Condition:** The ADMINISTRATOR or USER can view the reply posted on the message board.

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4.3.4.11 Upload Notes/Templates

Description
The ADMINISTRATOR can upload new notes to be viewed by the USER. **Actor:** ADMINISTRATOR **Pre-condition:** ADMINISTRATOR must have logged-in. **Main Flow of Events** 1. The ADMINISTRATOR clicks on the Notes link. 2. The ADMINISTRATOR clicks on the 'Upload" button. 3. The system displays the page for ADMINISTRATOR to choose the location of the notes. 4. ADMINISTRATOR chooses the path for the file to be uploaded. 5. ADMINISTRATOR clicks the O.K button. 6. The system uploads the notes to the folder and also to the NOTES_AND_TEMPLATES table in the database. 7. The system displays message confirming the upload. **Post Condition:** USER can view the notes or templates that were uploaded.

4.3.4.12 Add Question

Description
The ADMINISTRATOR can add new question to be viewed by the USER. **Actor:** ADMINISTRATOR **Pre-condition:** ADMINISTRATOR must have logged-in. **Main Flow of Events**

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1. The ADMINISTRATOR clicks on the Question link.
2. The system displays all the questions available.
3. The ADMINISTRATOR clicks on the 'Add New Question' button.
4. The system displays the page for ADMINISTRATOR to enter the question with all the choices of answers.
5. ADMINISTRATOR clicks the Add button.
6. The system adds the question in the QUIZ table of the database..

Post Condition: USER can view the question that was added.

4.3.4.14 Delete Question

Description
The ADMINISTRATOR can delete questions which are very outdated. **Actor:** ADMINISTRATOR **Pre-condition:** ADMINISTRATOR must have logged-in. **Main Flow of Events** 1. The ADMINISTRATOR clicks on the Question link. 2. The system displays all the questions in the database. 3. The ADMINISTRATOR chooses the question that is going to be deleted by clicking at the link for every questions. 4. The system displays the question in full. 5. The ADMINISTRATOR clicks the 'Delete' button. 6. The system displays a pop-up message asking for confirmation of

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deletion.

7. The ADMINISTRATOR clicks the 'Yes' button.
8. The system deletes the question from the QUIZ table in the database.

Alternate Flow of Events

6. The ADMINISTRATOR clicks the 'No' button.
7. The system displays the previous page.

Post Condition: The deleted question will not be available on the Quiz page.

4.3.4.14 Edit Question

Description
The ADMINISTRATOR can edit existing questions. **Actor:** ADMINISTRATOR **Pre-condition:** ADMINISTRATOR must have logged-in. **Main Flow of Events** 9. The ADMINISTRATOR clicks on the Question link. 10. The system displays all the questions in the database. 11. The ADMINISTRATOR chooses the question that is going to be edited by clicking at the link for every questions. 12. The system displays the question in full. 13. The ADMINISTRATOR makes necessary changes. 14. The ADMINISTRATOR clicks "Update" button. 15. The system updates the question in the database.

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Alternate Flow of Events

8. The ADMINISTRATOR clicks the 'No' button.
9. The system displays the previous page.

Post Condition: The deleted question will not be available on the Quiz page.

4.3.5 Non-Functional Requirements

4.3.5.1 Introduction to Non-functional Requirements

Non-functional requirements are descriptions of other features, characteristics and constraints that define a satisfactory system. They include timing constraints, constraints on the development process, standards and so on. Although non-functional requirements are subjective, they are as important as functional requirements (Sommerville, 1998).

4.3.5.2 Non-functional Requirements for e-SoftPro

- **Reliability**

  The system can run for a long period of time without system crash or failure. Since e-SoftPro is a web-based system, it will be very reliable as it can be accessed from anywhere at anytime.

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- **Usability**

  The system must be simple and easy-to-use without acquiring much skill. All links in e-SoftPro are clearly named to avoid any confusion among users.

- **Robustness**

  Refers to the quality that causes a system to be handled and to avoid disaster in case of unexpected data. In e-SoftPro, all the quiz are in the form of multiple choice questions so there will not be a problem of wrong type of data being input.

- **Efficiency**

  The system must perform the functions correctly. The functions in e-SoftPro will perform as designed.

- **Response Time**

  Time to retrieve information must be short. The output display should be as fast as possible to make the system more efficient in use. The notes in e-SoftPro are short and concise and do not take up much storage. This will ensure that the pages containing notes and quiz are displayed as fast as possible when requested.

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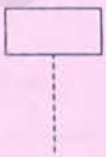
4.3.6 Sequence Diagrams for e-SoftPro

4.3.6.1 Introduction to Sequence Diagrams

The sequence diagram is a diagram that focuses on the time ordering of the messages that go back and forth between objects (Scott, 2001). A sequence diagram has four key elements:

- Objects that appear along the top margin.
- Lifeline for each object which represents the life and death of the object.
- Focus of control which shows the period of time during which the given object is control of the flow.
- Messages that shows the actions that objects perform on each other and on themselves.

Table 4.2: Symbols used in a sequence diagram

Symbols	Meaning
	An object and lifeline
	Focus of Control

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⟶	Message
⟵	Message (Return)

4.3.6.2 Log-In

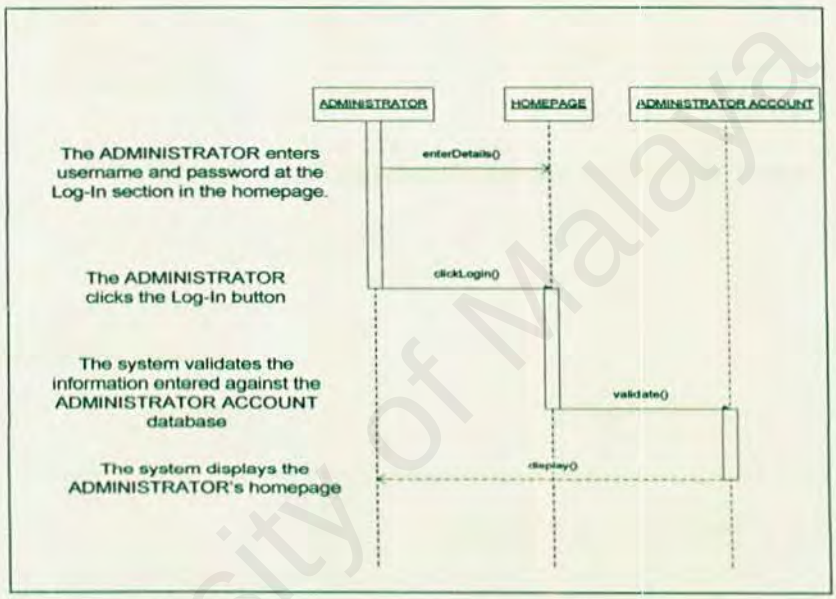

Figure 4.2: Sequence Diagram for Log-In

4.3.6.3 Log-Out

Figure 4.3: Sequence Diagram for Log-Out

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4.3.6.4 Search for Notes

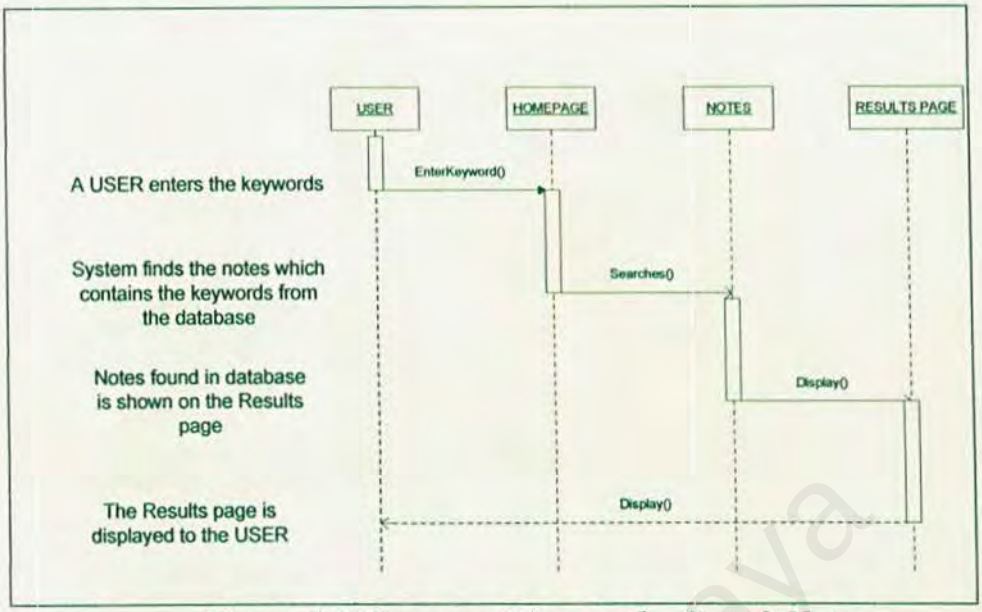

Figure 4.4: Sequence Diagram for Search Notes

4.3.6.5 View Notes

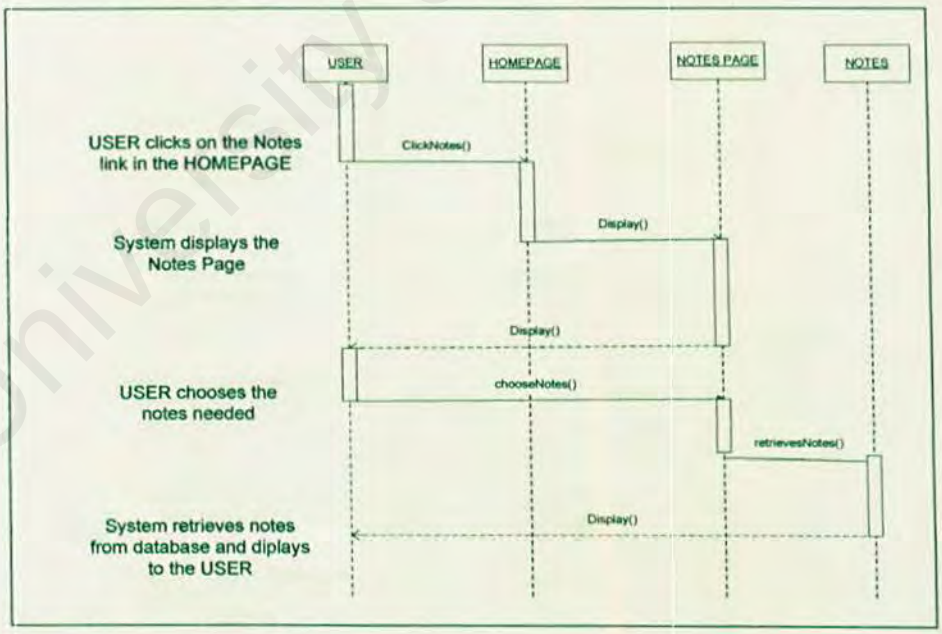

Figure 4.5: Sequence Diagram for View Notes

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4.3.6.6 Post Message

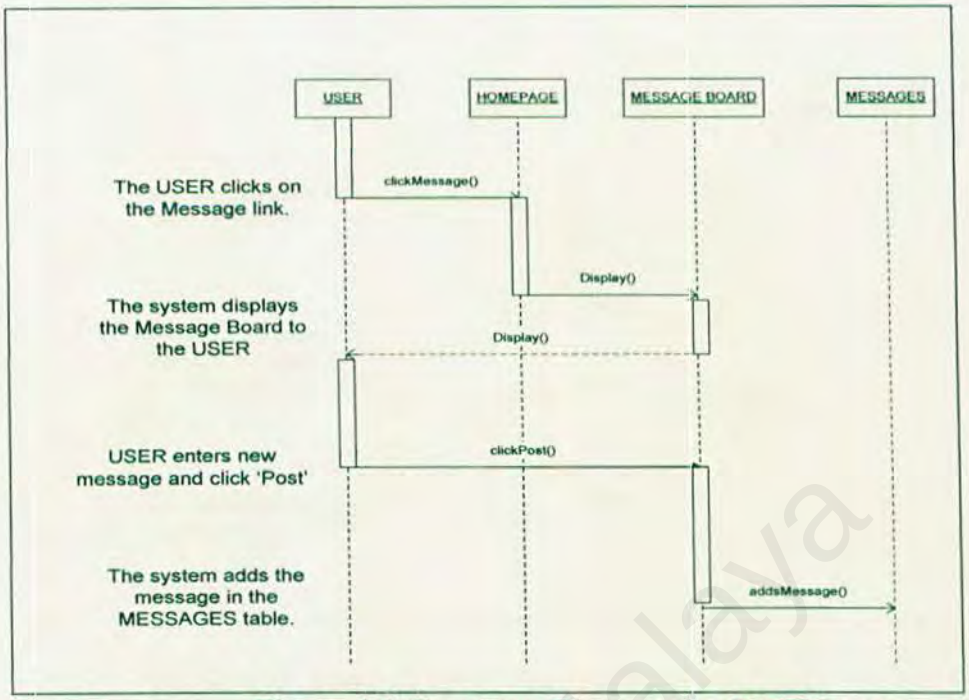

Figure 4.6: Sequence Diagram for Post Message

4.3.6.7 Try Quiz

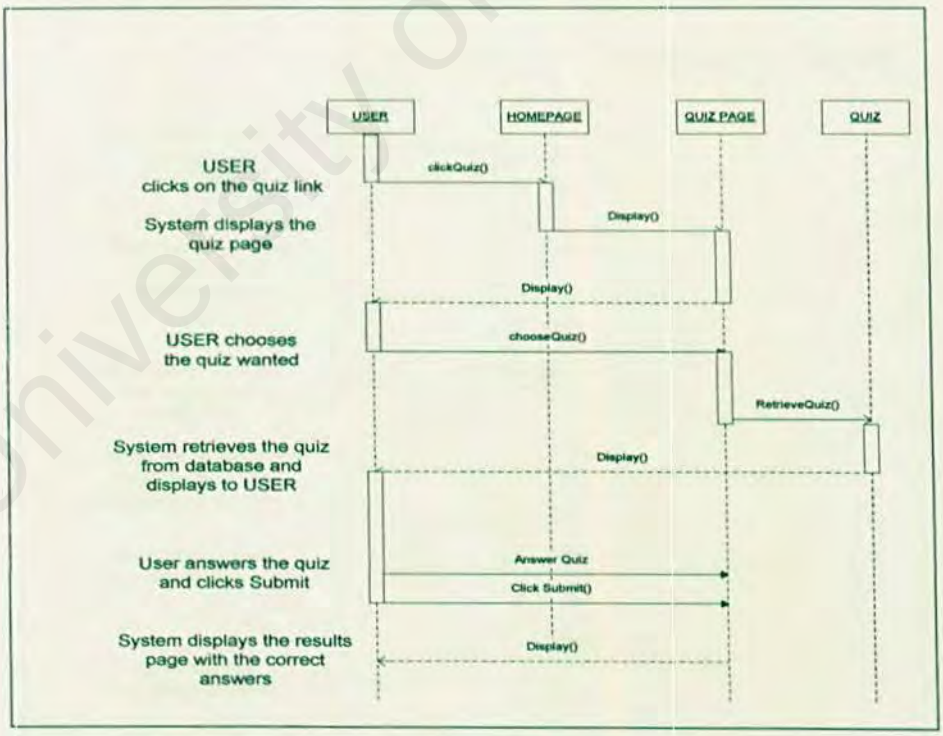

Figure 4.7: Sequence Diagram for Try Quiz

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4.3.6.8 View Messages

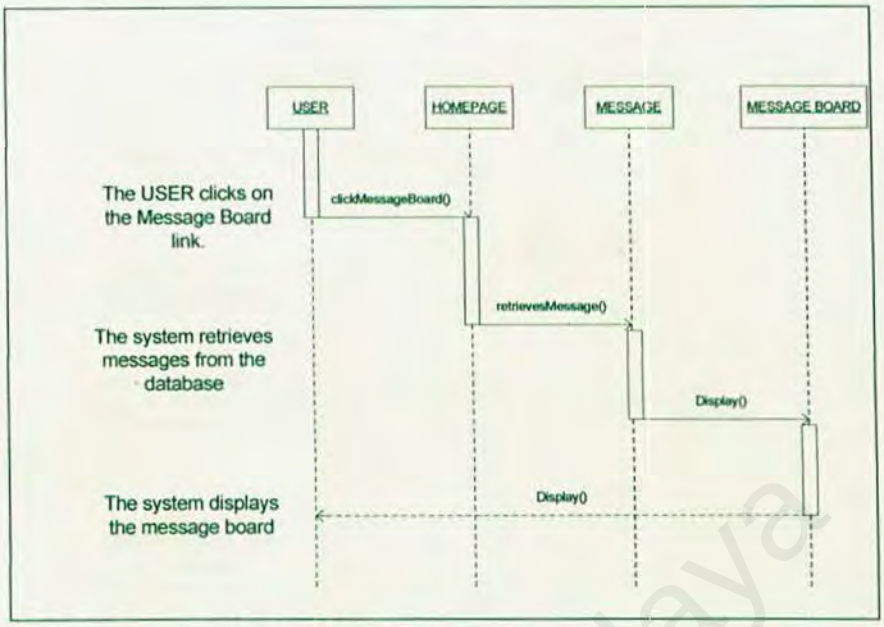

Figure 4.8: Sequence Diagram for View Messages

4.3.6.9 Calculate Equations

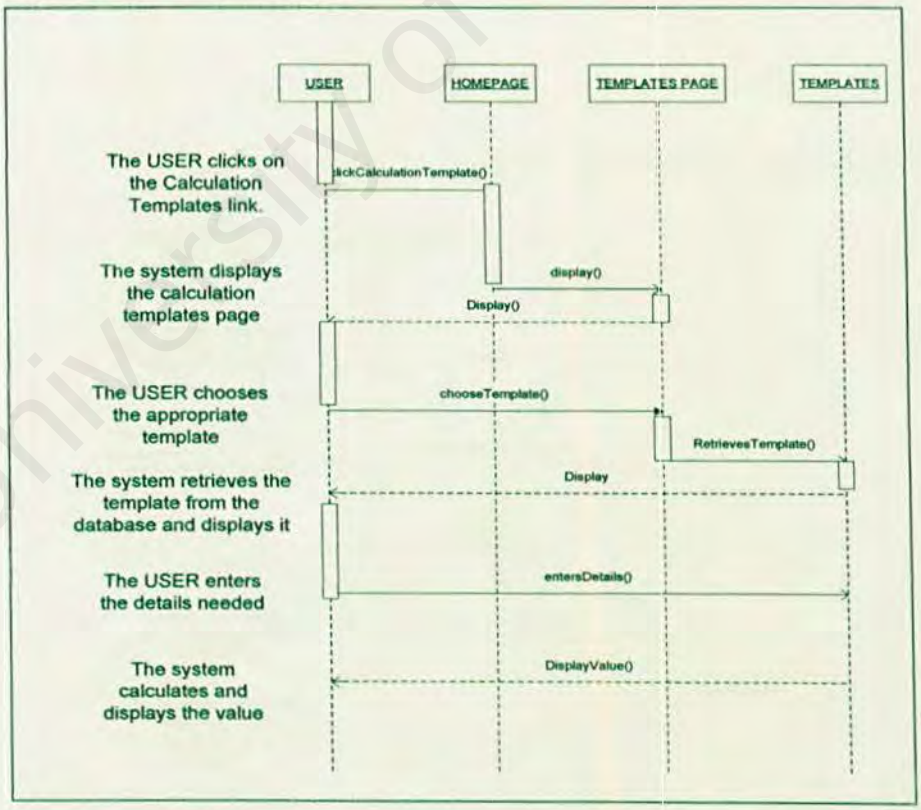

Figure 4.9: Sequence Diagram for Calculate Equations

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4.3.6.10 Delete Message

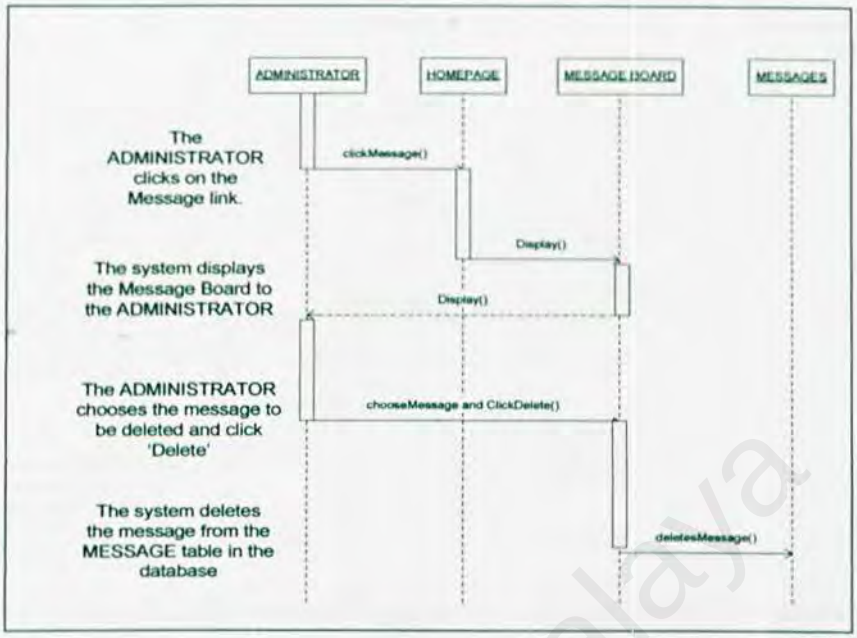

Figure 4.10: Sequence Diagram for Delete Message

2.3.6.11 Reply Message

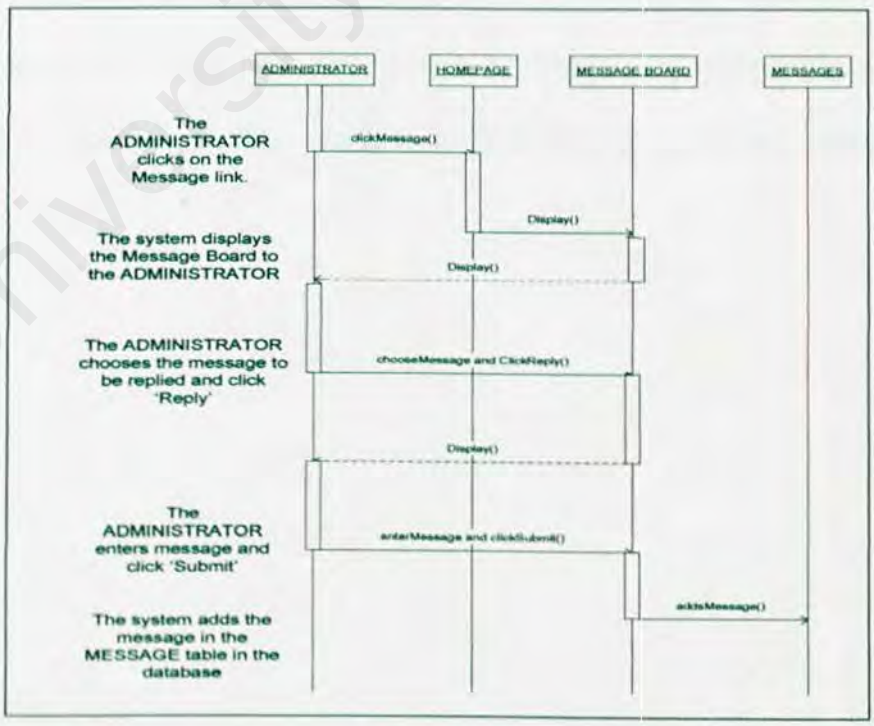

Figure 4.11: Sequence Diagram for Reply Message

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2.3.6.12 Upload Notes/Templates

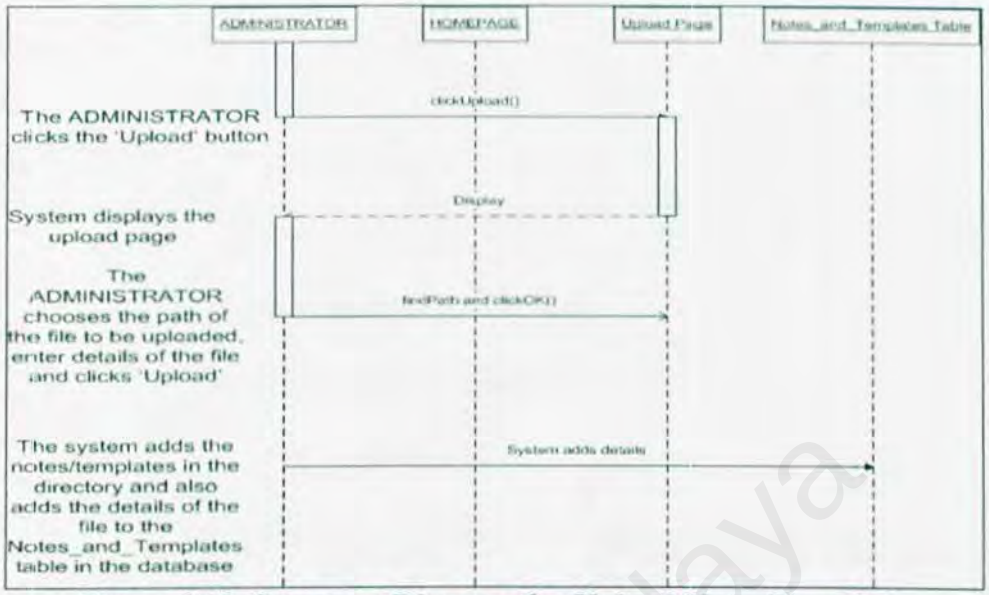

Figure 4.12: Sequence Diagram for Upload Notes/Template

4.4 Tools Confirmation

As mentioned in Chapter 2, the ASP.NET framework was chosen to develop the e-SoftPro. The reason for choosing ASP.NET is that it offers many advantages when compared to PHP, its counterpart. The comparison of both is given in the following table.

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Table 4.3: Comparison between ASP.NET and PHP

Criteria	ASP.NET	PHP 5
Software Price	Free	Free
Speed	Slow caused by the ability to use various programming languages and being object-oriented	Fast
Security	Strong	Works with Apache, which has a proven track record of speed, reliability, and hardened security
Cross-Platform applicability	Runs on IIS and is starting to run on Apache, which can run on a whole host of platforms.	Works only with Apache
Functions	Not case-sensitive	Names are case-sensitive
Object Oriented	Yes	Not designed to be
Other criteria	Sophisticated debugging environment	Free source easily available

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The Visual Studio.NET was chosen as the development tool for the e-Soft Pro. This software from Microsoft enables developers to quickly create data-driven Web applications using familiar Visual Basic techniques and dozens of reusable, browser-independent Web controls. Web applications built using Visual Studio .NET and ASP.NET benefit from improved performance, reliability, security, and scalabilility (*Internet Reference,* 13/9/2004).

Other tools chose are as below:

- Database: **Microsoft SQL Server**
- Web Server: **Internet Information Services (IIS)**
- Platform: **Microsoft Windows XP Professional**

4.5 Summary

In this chapter, the functional and non-functional requirements were analyzed in detail. The functional requirements were represented in the use case diagram and each use case was given detailed description which included the main and alternate flows. Sequence diagrams were also shown for each use case. The development tools chosen for the development of the e-SoftPro too were justified.

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Chapter 5:

System Design

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5.1 Introduction to System Design

System design is one of the core phases in the software development life cycle. This phase will answer questions such as "How will the system operate?" and "How will it be built?". The detailed system design is prepared in this phase where most of the details are depicted in form of diagrams such as flowcharts, data diagram charts, entity-relation diagrams and data dictionary. At the end of this phase the project plan and feasibility analysis are revised to reflect new information that has been gained during the analysis and design phases.

5.2 Flow Charts

5.2.1 Introduction to Flow Chart

A flow chart is defined as a pictorial representation describing a process being studied or even used to plan stages of a project. Flow charts tend to provide people with a common language or reference point when dealing with a project or process. There are four types of flow charts, top-down flow chart, detailed flow chart, work flow diagrams and a deployment chart. Each of the different types of flow charts tends to provide a different aspect to a process or a task. Flow charts provide an excellent form of documentation for a process, and quite often are useful when examining how various steps in a process work together.

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The basic flow chart symbols below are used when analyzing how to operate a process.

Table 5.1: Symbols used in a flow chart

Symbols	Meaning
	Process
	terminator
	Decision
	document

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5.2.2 Flow Chart for Administrator

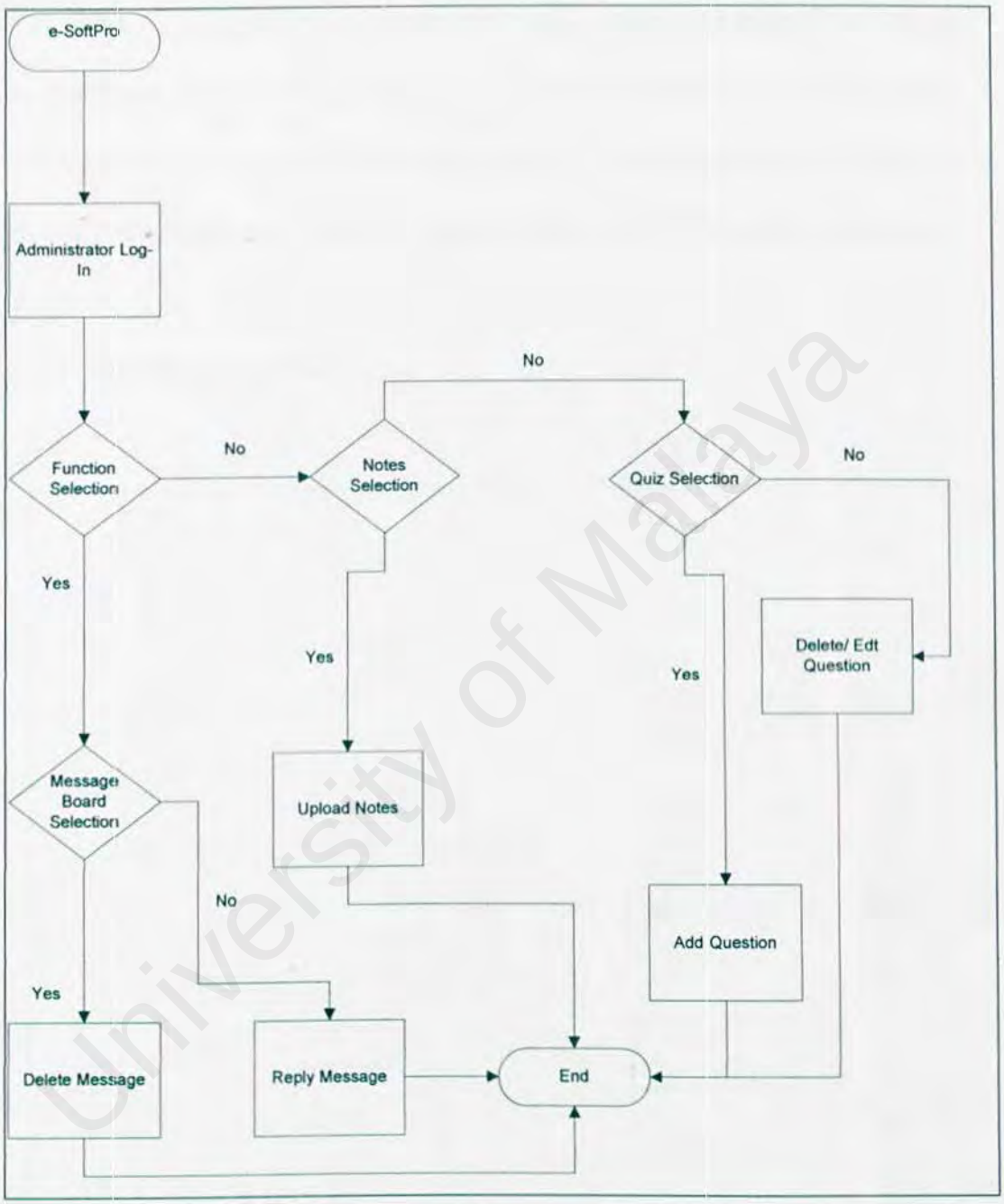

Figure 5.1: Flowchart for Administrator

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In this chart, the processes involving the administrator are shown. After the administrator is logged- in, he/she can choose to do 3 main things; message board, notes or quiz. If the administrator chooses 'Message board' , he/she can further decide whether to reply message or delete messages. If 'Notes' is chosen, the administrator can either upload new notes or delete existing ones. If 'Quiz' is chosen, the administrator can add new question or delete/edit existing questions.

5.2.3 Flowchart for User

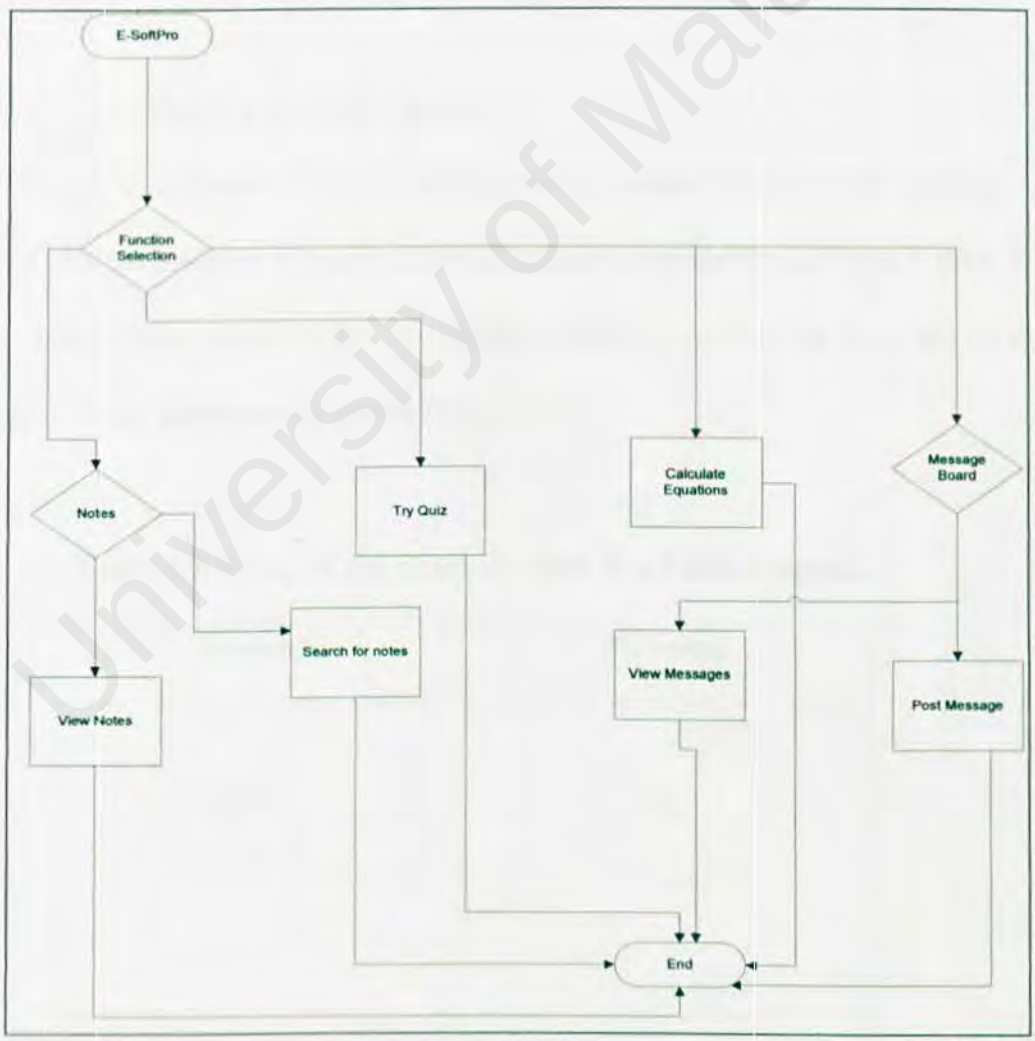

Figure 5.2: Flowchart for User

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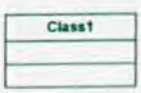
In this chart, the processes involving the user are shown. Once the user accesses the system, he/she can choose either the notes, try quiz, message board or calculate equations selection. If 'Notes' is chosen, user can either view the notes or search for a particular chapter of notes. The user can also choose to try the quizzes available. If user selects 'Message Board', he/she can either just view the messages that have been posted or post a new message. User can also select to calculate equations using the templates available.

5.3 Class Diagram

5.3.1 Introduction to Class Diagram

A class is a collection of objects that have the same type of characteristics. A class diagram shows classes and the various relationships in which they are involved. Class diagrams are the primary means by which the structure of the system being developed is shown (Scott, 2001).

Table 5.2: Some of the Symbols Used in a Class Diagram

Symbols	Meaning
	Class

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	Generalization
	Dependency

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5.3.2 Class Diagram for e-SoftPro

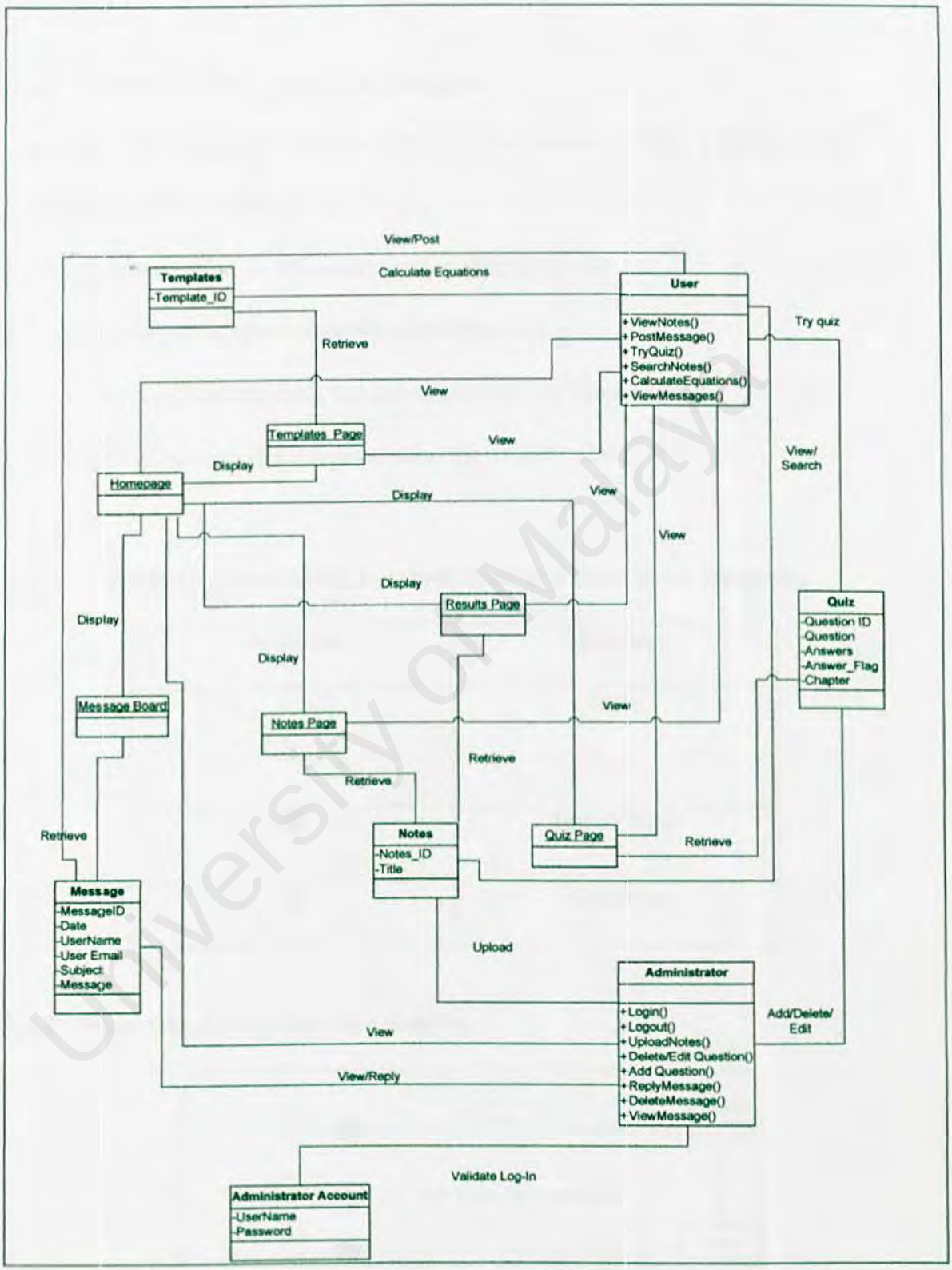

Figure 5.3: Class diagram for e-SoftPro

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5.4 State Chart Diagram

5.4.1 Introduction to State Chart Diagram

The State chart diagram shows an object's state machine. State machine is the combination of the following:

- The states that an object can assume during its life
- The events to which that object can respond
- The possible responses the object can make to those events
- The transitions that occur between the object's states

Table 5.3: Some of the Symbols Used in a State chart Diagram

Symbols	Meaning
	State
	Initial State
	Final State

5.4.2 State Chart Diagram for e-SoftPro

Figure 5.4 Statechart diagram for Message in e-SoftPro

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5.5 Database Design

5.5.1 Introduction to Database Design

Database is collections of a large storage of computerized data. Without doubt, databases always are the nucleus of most information systems. Database design involves the process of designing the structure used to store and manage data. It transforms the unstructured information and the processing requirements of the e-SoftPro into representation that define the functional specifications.

5.5.2 Database Dictionary

Data dictionary is the description of the database's structure. Data dictionary defines the fields, field type and other descriptions of each table in the database.

The database of **e-SoftPro** is contains six tables. They are:

- δ Administrator Account Table
- δ Notes_and_Templates Table
- δ Quiz Table
- δ Quiz_Answers Table
- δ Message Table
- δ E-SoftPro ID Table

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5.5.2.2 Administrator Table

Table 5.4: Administrator Table

Column Name	Datatype	Length	Allow Nulls	Description
ID	varchar	10	No	Name used by the administrator to login.
Password	varchar	10	No	Administrator's password
ROLE_ID	int	4	No	Role

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5.4.2.3 Notes_and_Templates Table

Table 5.5: Notes_and_Templates Table

Column Name	Datatype	Length	Allow Nulls	Description
ID	int	4	No	Unique ID for each chapter of notes and template
Title	Varchar	100	No	Title of the chapter
File name	varchar	100	No	Name of the uploaded notes/template
Type	Char	10	No	Type of file uploaded, whether notes or template

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5.4.2.4 Quiz Table

Table 5.6: Quiz Table

Column Name	Datatype	Length	Allow Nulls	Description
Q_ID	Int	4	No	A unique ID for each question
Q_Chapter	Int	4	No	A unique ID for each chapter for quiz
Title	Varchar	100	No	Quiz Title
Hyperlink	Varchar	100	No	The link for the quiz which will be displayed in the quiz page

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5.4.2.5 Quiz_Answers Table

Table 5.7: Quiz_Answers Table

Column Name	Datatype	Length	Allow Nulls	Description
Q_ID	Int	4	No	A unique ID for each question
Answer_ID	Char	2	No	ID for each of the 4 choices of answers for a question
Answer	Varchar	1000	No	Answer for the question
Question	Varchar	1000	No	The question
Answer_Flag	Int	4	No	To determine whether the answer is correct, 1 if it is correct and 0 if it is wrong

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5.4.2.6 Message Table

Table 5.8: Message Table

Column Name	Datatype	Length	Allow Nulls	Description
Message_ID	Int	4	No	A unique ID for each message
Name	Varchar	50	No	Name of the person who posts the message
E-mail	Varchar	50	No	Email of the person who posts the message
Date	Datetime	8	No	Date and time of the message
Subject	Varchar	50	No	Subject of the Message
Message	Varchar	1000	No	The message
Admin_Reply	Varchar	1000	No	The administrator's reply to the message

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5.4.2.7 E-SoftPro_ID Table

Table 5.9: E-SoftPro_ID Table

Column Name	Datatype	Length	Allow Nulls	Description
ID	Int	4	No	The ID for each type
Type_ID	Varchar	50	No	The types (Message, Quiz Questions, Notes and Templates)

5.6 User Interface Design

5.6.1 Introduction to User Interface Design

The User Interface design establishes the layout and interaction mechanism for human-computer interaction. It is built by taking into consideration user friendliness which consists of three concepts; ease of use, consistency and performance.

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5.6.2 User interface Design for e-SoftPro

5.6.2.1 Main Page

Figure 5.5: The main page

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5.6.2.2 Notes

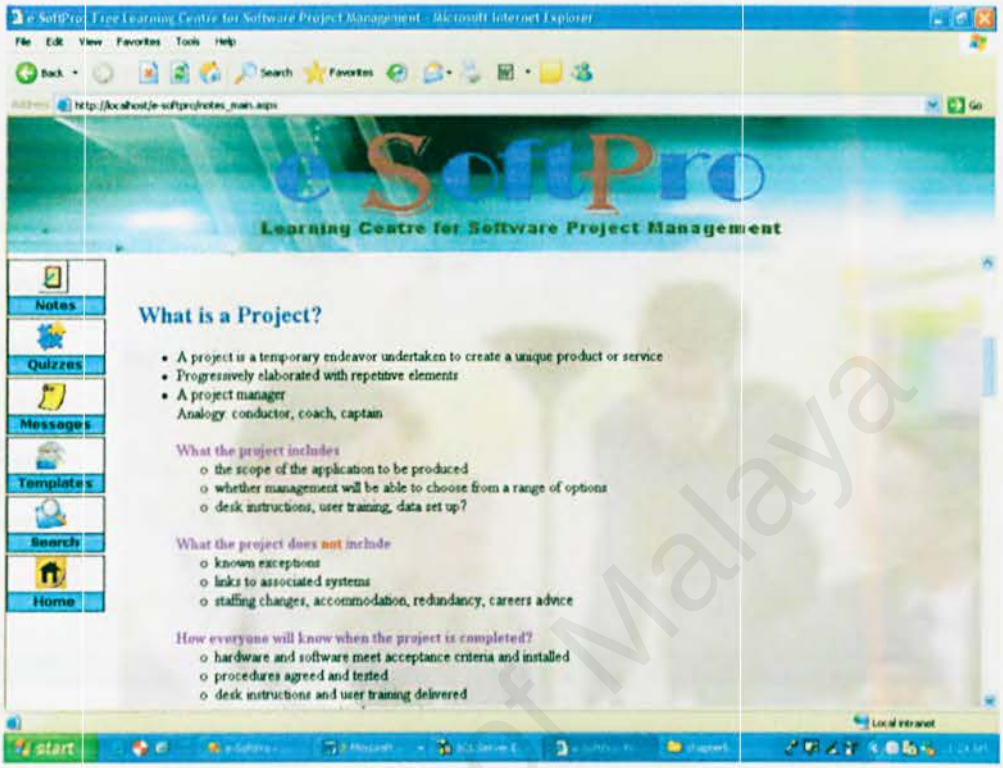

Figure 5.6: One of the notes

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5.6.2.3 Message Page

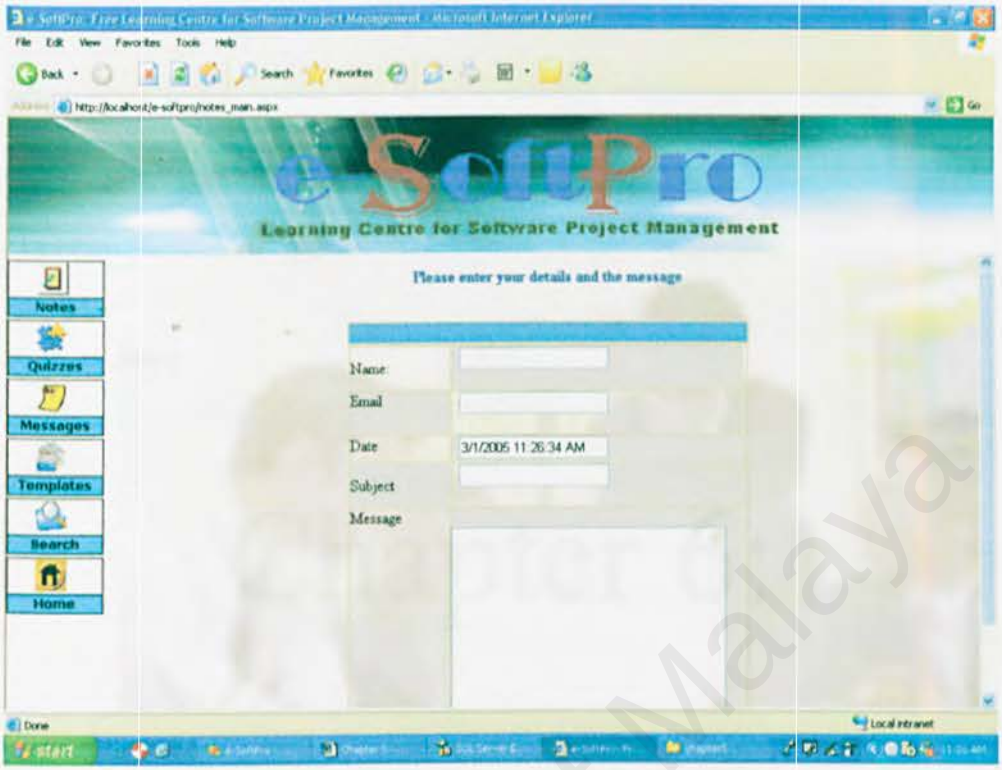

Figure 5.7: The Post a Message Page

5.6 Summary

This chapter focused on design of the system. Firstly, the flowcharts of the system were given where they depict the flow of the processes in e-SoftPro. The class diagrams represented the classes in e-SoftPro and the relationships between them. Database design focused on data dictionary where all the fields in each table for the e-SoftPro database were defined. The user interface designs for a few important pages of the system were also shown.

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Chapter 6:

System

Implementation

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6.1 Introduction to System Implementation

System implementation is the process of putting the design specification for the proposed system in actual operation. In other words, system implementation is the delivery of the system into production. It involves the system development environment, program coding and database development where the system requirements and design are converted into program codes. This phase also involves some modification to the previous design due to the limitation of the programming language used.

The effort spent in this phase will actually determines the success of the system and ease the process of modifications, debugging, testing, verifications, system integration and for future enhancement.

6.2 Development Environment

Development environment plays a major role in determining the speed of the system development. This is because speed helps programmer to debug errors more effectively and efficiently. The combination of software and hardware used to develop the e-SoftPro are as follow:

6.2.1 Hardware used

- Intel Pentium 4 Processor
- Random Access Memory (RAM) 192 MB
- Hard Disk 15 GB

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- CD-RW Drive
- CD-ROM Drive
- Floppy Drive 1.44MB
- Other standard desktop PC accessories.

6.2.2 Software Used

- Operating System: Windows XP Professional Edition
- Microsoft Visual Studio .NET (ASP.NET)
- Microsoft SQL Server 2000
- Web Server : Internet Information Service (IIS)
- Adobe Photoshop 7.0
- Microsoft Paint

6.3 System Coding

6.3.1 Coding Approaches

In developing e-SoftPro, two types of coding approach have been used. They are **Modular** approach **and Top-Down** approach.

6.3.1.1 Modular Approach

Modular approach is a concept where the whole system structure is separated into smaller structure called modules. Each module represents certain functions of the system. Modular approach enable easier maintenance of the coding as it is self independent

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where writing, debugging and error tracing involves only one module. Besides that, it is also easier to understand the logic flow within the module itself as compared to the whole system [Kendall, 1999].

6.3.1.2 Top-Down Approach

Top-Down approach means developing high-level modules before the low-level modules. In this approach, high level modules are coded, tested and integrated before low-level modules. An advantage of this strategy is that errors in high-level module interface and sometimes the most serious type of errors are identified early. [Fleeger, 1999]

6.3.2 Coding Style

Source code documentation of high quality is important in reducing coding errors throughout the maintenance of the program or software. Internal documentation is descriptive material written within the codes. All other form of documentation are external documentation. Good coding style ensures good understandability and is a criterion of good programming. It helps the developer to understand better when there is a need for a recheck of coding in the future.

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6.3.2.1 Website Coding

Visual Studio.NET is the tool used to develop ASP.NET pages. Visual Studio.Net, an optional development tool contains a rich set of productivity and debugging features. ASP.NET is a platform service that allows you to program web applications and Web Services in any .NET language, with almost any features from the .NET class library. The extension file for ASP.NET is "***.aspx***" In this case there is two types of coding that implemented in this e-SoftPro, that is ASP.Net using HTML script and ASP.Net using VB (Visual Basic) Code. (*Internet Reference,* 21/1/2005)

1. Coding ASP.NET pages using HTML

```
<%@PageLanguage="vb"AutoEventWireup="false"
Codebehind="WebForm3.aspx.vb" Inherits="e-SoftPro.WebForm3"%>
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.0 Transitional//EN">
<HTML>
        <HEAD>
                <title>WebForm3</title>
                <meta name="GENERATOR" content="Microsoft Visual
Studio.NET 7.0">
                <meta name="CODE_LANGUAGE" content="Visual Basic
7.0">
                <meta name="vs_defaultClientScript"
content="JavaScript">
                <meta name="vs_targetSchema"
content="http://schemas.microsoft.com/intellisense/ie5">
        </HEAD>
        <body MS_POSITIONING="GridLayout">
                <form id="Form1" method="post" runat="server">
                        <asp:Label id="Label1" style="Z-INDEX: 101;
LEFT: 96px; POSITION: absolute; TOP: 104px" runat="server"
Width="280px" Height="16px">Welcome To ASP.NET</asp:Label>
                </form>
        </body>
</HTML>
```

The above code will display "**Welcome To ASP.NET**".

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2. Coding ASP.NET pages using VB Code

```
lblResults.Text = ""
    If txtUserName.Text = "" Then
            lblResults.Text = "Username not entered"
       Exit Sub
    End If
```

The above code will display **"Username not entered"** if the *txtUserName* textbox is empty.

3. Program variables in VB Code

To use variables in the ASP.NET pages, they have to be declared first, for example

```
Private Sub count()
        Dim counter
        Dim a
End Sub
```

This is to ensure only variables relevant to the program are used in the ASP.NET codes. Meaningful names were chosen for the variables in the development of e-SoftPro. These names reflect their use or meaning and do not confuse readers into believing it as referring to something else. Meaningful names can be greatly enhancing the self documenting features of a program.

For example, writing counter = counter + 1 makes more sense to the reader than a = a + 1

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4. Program comments in VB Code

Comments lines are used throughout a program to explain the nature of the program, its various components and flow of logic. Program header comments can be used to describe the overall purpose of the program, major functions performed by the program and important part files used. Module comments can be used to explain the function performed by a module and how it fits into the overall program. Line comments can be used to explain complex pieces of logic in the program. In VB (Visual Basic) code, a program comment can begin with (‘). All comments are single-lined comments that terminate at the end of the current line. For example:

```
'txtName is the name of the textbox

 If txtName.Text = "" Then
 lblResults.Text = "Lecturer name is empty"
```

5. Formatting to Enhance Understanding

Program source codes needs to be layout properly so that it is to read. The fornat of the program codes can help a reader understand the objective of the codes and how the objective is met. The indentation and spacing of program codes and statements can reflect good control structuring.

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6. Form Validation

Since this system are involves lots of data entry, form validation controls were therefore necessary to guarantee the correctness of the data and data type entered in the system by the user. This was done by using Java Scripts. Users will be prompted when they delete the data from specific page before they allowed continuing to the next process. For example,

```
function ValidateDelete()
            {
                  var ret = confirm("Are you sure to delete the
message?");
                  if ( ret == true )
                  {
                        return;
                  }
                  else
                  {
                        event.cancelBubble = true;
                        event.returnValue = false;
                        return;
                  }
            }
```

6.3.2.2 Database Manipulation

The system interacts with the e-SoftPro database stored in Microsoft SQL Server in ways such as retrieve data, insert data, update data and delete data. Below is the command for connection to the database:

```
'Setting up connection to database
Dim DBConn = New SqlConnection("server=HOME-9ACD668624\HOME;" _
          & "Initial Catalog=e-SoftPro;" _
          & "User Id=sa;" _
          & "Password=sa;")
```


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SQL statements such as SELECT, INSERT, DELETE and UPDATE are used to perform the necessary database manipulation.

```
'Executing Select statement
        DBCommand = New SqlDataAdapter _
                ("Select * from Message Where " _
                & "Message_ID = '" & messageID _
                & "'", DBConn)
```

SQL statements such as SELECT, INSERT, DELETE and UPDATE are used to perform the necessary database manipulation.

6.4 Stored Procedures

A stored procedure is a program (or procedure) which is physically stored within a database. The advantage of a stored procedure is that when it is run, in response to a user request, it is run directly by the database engine, which usually runs on a separate database server. As such, it has direct access to the data it needs to manipulate and only needs to send its results back to the user, doing away with the overhead of communicating large amounts of data back and forth (*Internet Reference,* 18/1/05).

In e-SoftPro, stored procedures were used for functions such as add message, edit message, delete message, delete question, edit question etc. Below is an example of stored procedure:

```
CREATE Proc sp_delete_message
(
      @MessageID  char(10)
)
AS
      Delete From Message
      where Message_ID = @MessageID
```


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6.5 Summary

Chapter 6 discussed the system implementation phase of the e-SoftPro development. The development environment as well as the coding process was explained including the coding approaches and coding style. Stored procedures were also discussed in this chapter.

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Chapter 7:

System Testing

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7.1 Introduction to System Testing

System or software testing is a formal process carried out by a specialized testing team in which a software unit, several integrated software units or an entire software package are examined by running the programs on a computer. All the associated tests are performed according to approved test procedures on approved test cases [Galin, 2004].

System testing is required to measure the system functions accordingly to its specification and in line with the user's requirement and expectations. The phase will identify and reveal as many errors as possible in the tested system. After making necessary corrections, the tested system will be brought to an acceptable level of quality.

7.2 Testing Strategies

In the testing process of e-SoftPro, 4 testing strategies are used. They are:

:

- Unit testing
- Module testing
- System integration testing
- System testing

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7.2.1 Unit Testing

A unit is the smallest compilable component. of one programmer Unit testing is equivalent to program testing. It focuses on small unit of codes such as individual subroutines or functions to locate errors. During the testing process, testers are giving the responsibility to detect errors in coding and logical mistakes that are contained within that module itself [Sommerville 1998]. The interactions between modules and initially discovered during this testing, as each is tested separately. Unit testing was carried out in all the 7 modules of e-SoftPro.

Notes Module

The main testing done for this module is to test whether the notes page displays correctly all the notes uploaded from the database. Upload process was done several times to confirm that the upload information was correctly stored in the database and the list of links is updated each time after an upload.

Quiz Module

The unit testing of this module was done rather extensively because of the algorithm involved. The quiz page is such where when a user clicks on a chapter of quiz, the system will randomly select and display ten questions for the chapter from a number of questions in the database. Testing was done several times to ensure that the question and answers match because both were stored in different tables in the database.

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Templates Module

For this module, the testing process involved data test. Data test is a type of test where a series of tests is conducted with data that are individually designed to represent the real environment as much as possible. It involved entering normal test data, extreme test data and erroneous test data to determine how the system responds to these types of data. The system is tested to ensure that it either shows an error when a wrong type of data is entered or displays the answer of the calculation if the correct type of data is entered.

Message Board

Unit testing in this module was done to ensure that the administrator is able to view the message posted by a user and reply to the message. Testing is done to determine whether the reply is updated in the database and displayed to the users.

Search Module

Search function was tested to ensure that all the pages are searched for the keywords entered by a user.

Authentication Module

The login process was tested a few times to determine if login works correctly and whether a user can access administrator's pages without login.

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7.2.2 Module Testing

Module testing is performed when individual functions of these modules are integrated. It is only performed after the integration takes place to ensure that all units in those module functions well and according to user specification and requirements.

During testing, each of these modules is tested as an independent component, unrelated to another. Black box testing approach has been used where this system can be treated as "black box" where its characteristic is determined through a study of the collection between the input and output [Sommerville, 1998].

7.2.3 System Integration Testing

System testing takes place when modules or subsystems are integrated. This eventually means that the testing is done on an integrated system. This type of testing is important to verify whether the product is working perfectly and according to user's specification and requirements once all the modules and functions are integrated.

The system testing activity was carried out before the user acceptance test to ensure end-to-end flow of the e-SoftPro.

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Objective of System Integration Testing

- To ensure that system delivered meets user's requirements.
- To detect and fix errors found.
- To ensure that the system meets requirements specification in chapter 3 (function requirement).
- To ensure that the system is ready for acceptance test phase at the end of the system integration test phase.

7.2.4 System Testing

After all the modules are believed to have satisfied the requirements, the system is finally tested as whole to ensure that it runs smoothly without any interruptions. The program flow and the testing needs each of the modules are identified before the system is further reviewed and tested.

After that, the entire system is tested with some test cases, using this method; several data entries and circulation transaction are performed on the system to test the reaction of the system towards the user inputs. For example, to test the authenticate login function, several combination of login IDs and passwords are entered into the system to test the login authentication process.

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7.3 Testing Manual

Table 7.1: Testing Manual

Module	Checklist	Pass/Fail
Notes (User)	- Open the notes.aspx page. - Test if links for all the notes stored in database is displayed. - Test if each link correctly displays the right chapter of notes.	Pass
Notes (Administrator)	- Test if when upload is done by administrator, all the information is stored in database and the file is uploaded to the project folder.	Pass
Quiz (User)	- Run the quiz_list.aspx page. - Test if all the links displayed are working and correctly displays the questions from the respective chapters. - Test if the correct questions and score are displayed after the user submits the answers. - Test what happens if a user does not answer all the questions.	**Fail**
Quiz (Administrator)	- Test if the when the admin adds a new question, the question is stored correctly in both the Quiz and Quiz_Answers table in the database. - Test when the admin edit an existing	Pass

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	question, the question is updated in the database. - Test if the user is able to delete the question from the database.	
Templates (User)	- Test if error is displayed when wrong type of data (e.g alphabet instead of number) is entered. - Test if error is displayed if no values are entered.	**Fail**
Message Board (User)	- Test if message entered is correctly saved in database. - Test if all the existing messages are displayed to the user.	Pass
Message Board (Administrator)	- Testing is done to determine if the administrator is able to enter the reply and is updated in the database.	**Fail**
Search (User and Administrator)	- Test if search works correctly by entering different keywords.	Pass
Authentication (Administrator)	- Test login with correct and wrong passwords and IDs - Test whether login is possible if the same password in uppercase is entered.	**Fail**

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7.4 Results of Testing

After the testing phase, the system was found to have problems in four parts. The error detection process did not take much time but fixing the error was time consuming. This is because changes in one part affect the other parts in the coding. This requires compilation again and again.

The errors were detected after a series of repetitive testing was done. All the errors detected were in the codes and not in design. Since all possible situations were visualized and tested, the system is free from any future problems.

7.5 Changes Made after Testing

Table 7.2: Changes after testing

Module	Changes Made After Testing
Quiz (User)	The error detected was that the quiz page displays all the chapters even if there is only one question for a particular chapter in the database. This means that the user will be displayed with that one question ten times. This was fixed by changing the SQL statement from "Select Distinct Title, Hyperlink from Quiz" to "Select Distinct Title, Hyperlink from Quiz where Q_Chapter IN (Select Quiz.Q_Chapter From Quiz Group by Quiz.Q_Chapter Having Count(Q_Chapter) >= 10)"

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Templates (User)	The error detected was that the system did not display any error messages when an alphabet was keyed in instead of a number. This was fixed by adding the following code:
	If Char.IsDigit(Mid(value, 1)) = False Then
	lblError.Text = "Invalid value! Please enter an integer."
	Else : Calculate()
	End If

Message Board (Admin)	The Reply function did not work and the posted reply was not updated in the database. This was fixed by adding this code in the Page Load function.
	If Not Page.IsPostBack Then
	RetrieveMessageAdmin()
	End If

Aunthentication (Administrator)	The login worked well even if the password was entered in the uppercase. This was fixed by running a statement in the SQL Server Query Analyzer: ALTER TABLE [user] ALTER COLUMN [Logon] varchar(20) COLLATE SQL_Latin1_General_CP1_CS_AS NOT NULL

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7.6 Summary

System testing is a very important part of the system development process. It ensures the efficiency and correctness of the system. Through system testing, all errors are detected and corrected and this ensures that the system meets all the expectations of the users. System testing also produces system of high quality. In the development of e-SoftPro, four main testing strategies were used; unit, module, integration and system testing. The errors or problems detected were analysed, corrected and retested.

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Chapter 8:

System Evaluation & Discussion

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8.1 Introduction to System Evaluation

Evaluation is important to access the effectiveness and acceptance of the system by the users. Evaluation also determines if the system meets the user's needs and expectations.

User acceptance evaluation was conducted because the users have to be satisfied and happy with the system. Users must be able to use all the functions easily without any problems or confusions.

Evaluation was done by 10 course mates from the Faculty of Computer Science and Information Technology, University of Malaya.

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8.2 User Acceptance Questionnaire

Please use the below scale
[1] Very Poor [2] Poor [3] Average [4] Good [5] Excellent

1. What do you think about this system, e-SoftPro in terms of its **interface**?

i)	Color combination	[1]	[2]	[3]	[4]	[5]
ii)	Images	[1]	[2]	[3]	[4]	[5]
iii)	Wordings	[1]	[2]	[3]	[4]	[5]
iv)	Ease on eyes	[1]	[2]	[3]	[4]	[5]
v)	User friendly	[1]	[2]	[3]	[4]	[5]

2. What do you think about this system, e-SoftPro in terms of its **navigation**?

i)	User friendly	[1]	[2]	[3]	[4]	[5]
ii)	Straight forward	[1]	[2]	[3]	[4]	[5]
iii)	Fluent flow	[1]	[2]	[3]	[4]	[5]
iv)	Speed	[1]	[2]	[3]	[4]	[5]

3. What do you think about this system, e-SoftPro in terms of the **information** provided?

i)	Properly arranged	[1]	[2]	[3]	[4]	[5]
ii)	Short and concise	[1]	[2]	[3]	[4]	[5]
iii)	Easy to understand	[1]	[2]	[3]	[4]	[5]

4. What do you think about this system, e-SoftPro in terms of the **functions** provided?

i)	Helpful	[1]	[2]	[3]	[4]	[5]
ii)	Interactive	[1]	[2]	[3]	[4]	[5]
iii)	Ease of use	[1]	[2]	[3]	[4]	[5]

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8.3 Results of Evaluation

Interface Evaluation

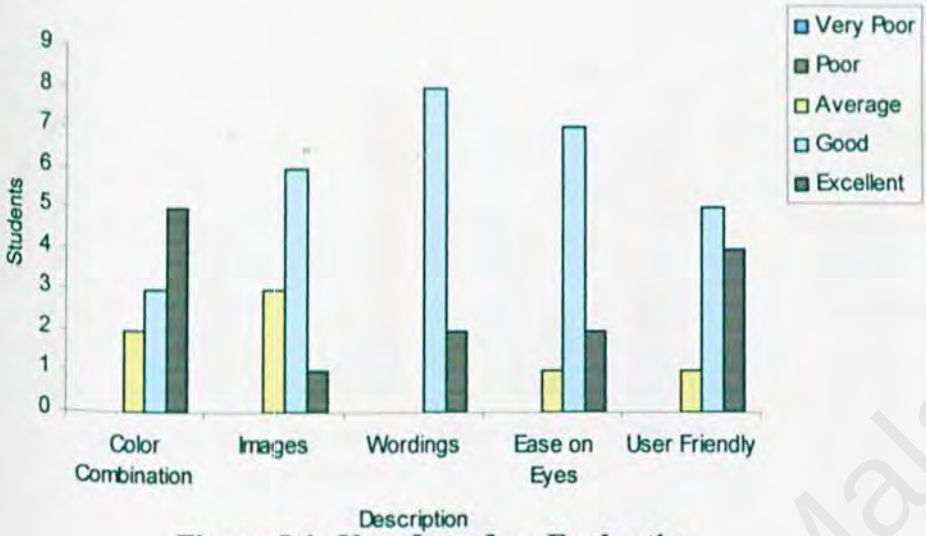

Figure 8.1: User Interface Evaluation

The graph above shows that most users were satisfied with the user interface design and rated it highly in terms of color combination and user friendliness.

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Navigation Evaluation

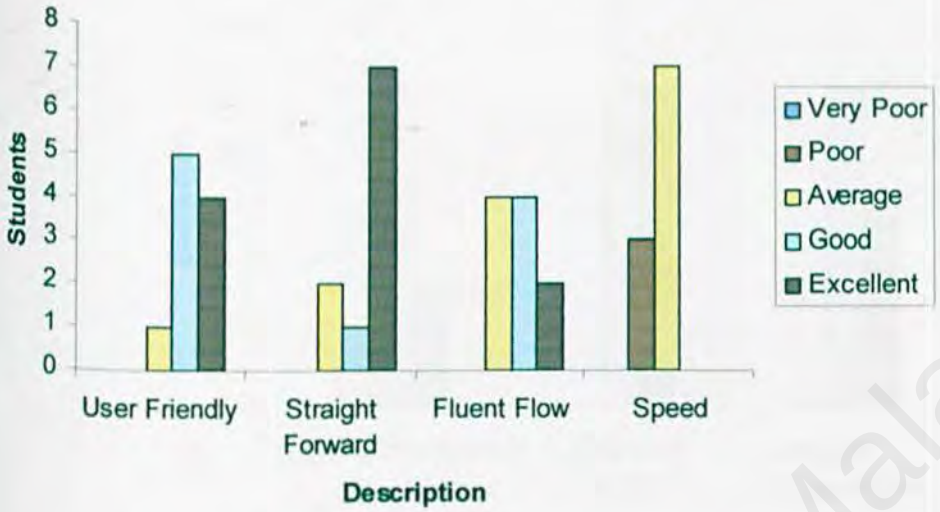

Figure 8.2: User Navigation Evaluations

Users did not give high ratings for the speed of the system. This is probably because almost all the pages have displays data from the database and the retrieving process takes time.

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Information Evaluation

Figure 8.3: User Information Evaluation

The information in e-SoftPro was evaluated by users as short, concise and easy to understand. The information was also said to be properly arranged.

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Function Evaluation

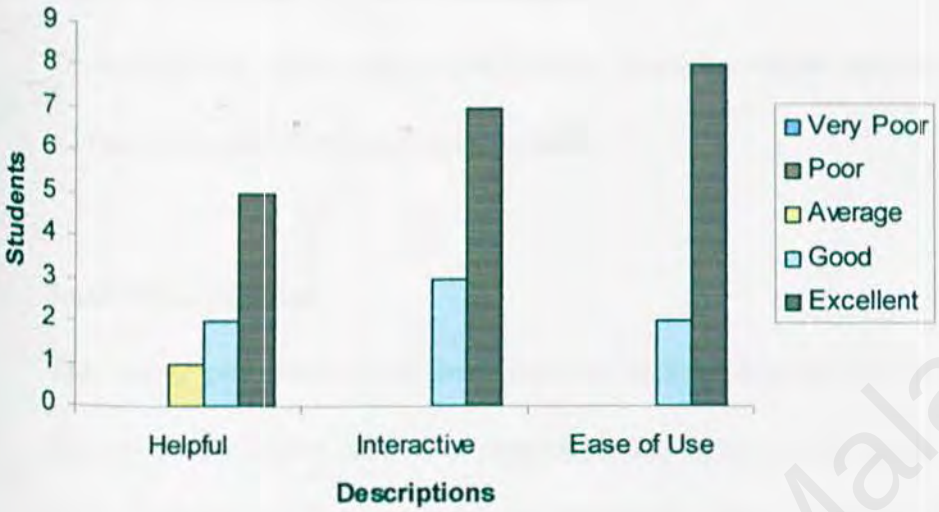

Figure 8.4: User Function Evaluations

The above graph shows that e-SoftPro meets the user needs and. The functions were rated highly by users as easy to use and interactive.

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8.4 Discussion

8.4.1 Problems Encountered and Solutions

Throughout the development of e-SoftPro, many problems were encountered but all the problems were handled succesully.

Lack of Knowledge

The major problem encountered was the lack of knowledge in fields such as system development and also languages and applications such as ASP.NET, Microsoft Visual Studio.NET and Microsoft SQL Server 2000. The problem was managed through various books, online books, websites and not forgetting help from friends. Discussion among course mates was an effective and productive way to learn about a lot of things as each person had knowledge and experience in different fields.

Confusion in Choosing Development Tools

Choosing the right tools to develop the system was a difficult task because of the lack of experience and unfamiliarity with new programming tools. This was fixed through discussion with the supervisor and research on different tools.

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Lack of Knowledge and Experience in Graphics Design

Since e-SoftPro is a learning package, good design is very important. As there was very little knowledge in design, a lot of time was taken up during the creation of the banner and other designs.

8.4.2 System Strengths

The strengths of the e-SoftPro are discussed here.

Easy Deployment

e-SoftPro was developed on the windows platform which is the most popular and widely used operating system in the worls. Therefore incompatibility issues are least likely to arise as the system can be easily deployed into any machines running on the windows platform.

Quiz with Random Question

The questions in the quiz of e-SoftPro are randomly selected from a number of questions in the database. This means that the user will have a different set of questions to answer every time they click on the quiz link. This is essential to avoid users from being bored of answering the same questions each time.

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User-Friendly Interfaces

e-SoftPro provides systematic arrangement of menu bar and content, giving the web site a structured appearance. This makes it easier for users to navigate and become familiar with the system. The colours used are soft and standardized to avoid confusing users with too many colours.

Security Feature

The system is secured enough since it prompt for user ID and password whenever a user tries to enter administrator functions. Only administrator will have the appropriate user ID and password for validation and authentication before they can further proceed with administrator's functions.

8.4.3 System Limitations

The e-SoftPro has its own limitations and they are discussed here.

Number of administrator is limited

This system can be updated by only a single administrator. This is to avoid multiple changes to the database.

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Limited Search Function

The search function is limited only to the templates and notes in e-SoftPro. This is because the quiz and messages are displayed from the database whereas the search function only looks through the files in the project folder.

No Reply to Message Function for User

Users can only answer to a question posted in messaging board by creating a new message. Only the administrator can reply to existing messages.

8.4.4 Future Enhancements

System development is a dynamic process. This system was developed in less than three month, while developing this system new ideas have come over. However, due to time constraints not all the new ideas can be incorporated into the system. Some of the new ideas are:

- More professional interface design with the use of graphics and animations to attract users and to provide a more interesting learning atmosphere.
- Creation of a forum-like message board where users can reply to existing questions and the questions will be displayed in the "tree-view" format.

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- Search function to also include search in database so that the search process covers the messages and quiz questions.
- Provide password encryption to protect the password from "hackers". Password is store directly into the database and if the password can be encrypted, the system security will increase.
- The system should provide database back-up to restore the data if the database is corrupted. The database has valuable information such as quiz questions and need to be protected.

8.5 Summary

Chapter 8 discussed about the system evaluation process which involved evaluation by 10 students and the result of the evaluation. The strengths and limitations of the e-SoftPro were also discussed. Plans for future enhancements to further enhance the system's functionality were also discussed.

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SUMMARY OF REPORT

The development of the e-SoftPro took approximately seven months. Software engineering methods were used in the development methods and the software development life cycle was followed.

In these seven methods, so much of knowledge and experience was gained. This includes knowledge in the computer science field itself such as learning of new programming languages such as ASP.NET, Microsoft SQL Server and Adobe Photoshop as well knowledge in self development such as time management, communication skills and many more.

The system managed to meet and fulfill all its objectives and requirements. The e-SoftPro will definitely serve as tool for students to learn software project management through notes, quiz, templates and message board. The administrator can always update the system by adding new notes, templates or quiz questions and also by deleting old questions and messages.

In conclusion, the development of e-SoftPro was very beneficial in preparing to face the working world in the software engineering field.

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