FACULTY COMPUTER SCIENCE & INFORMATION TECHNOLOGY

ASYCHRONOUS DISTANCE LEARNING SYSTEM (ADLS)

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Abstract

Asynchronous Distance Learning System or ADLS for acronym is a web-based system that provides an asynchronous e-learning between the users which, the learning media can be accessed at any time and any way and each individual can set the pace of their own learning A few types of services; such as the forum, bulletin board and mail are prepare for ADLS to become the system more effective and efficiency. Asynchronous Distance Learning System will be implemented in both Intranet and Internet environment.

The main purpose of Asynchronous Distance Learning System development is to implement a computerized learning system to substitute the current traditional In-Class Course Management System. In addition, a few types of new features will enhance within in this system that the users can involved themselves easy, convenience and flexible in the learning system.

Asynchronous Distance Learning System consists of three main modules, which are the Administrator Module, Lecturer Module, and the Student Module. The Administrator Module provides system administrator with full authorization to access the database and the whole system. The Lecturer Module provides the functions for editing notes, tutorials and quiz by lecturers. Student Module provides students to access the learning system and other features such as e-mail, notices and forum are prepared for all module to support the ADLS.

The benefits of using this system to substitute the current system are to enable better management and speed up the learning processes. Asynchronous Distance Learning System also able to increase the effective and efficiency of current traditional In-Class Course Management System.

Acknowledgement

During the process of developing and completing this Asynchronous Distance Learning System, many people have been very kind in lending helping hands, giving invaluable advices and encouragement that contributed to the success in the compilation of ADLS project.

Most of all, I would like to express my greatest acknowledgement to my supervisor, Assoc. Prof. Raja Noor Ainon Zabariah Raja Zainal Abidin, for being so dedicated and patient in giving me advices and consultation at any time and providing me with the detail of ADLS in FCSIT. Her encouragement and kindness in helping me throughout the project is deeply appreciated.

I wish to express my gratitude to my moderator, Puan Siti Hafizah Abdul Hamid, for giving me invaluable suggestions and ideas to further enhance the value of Asynchronous Distance Learning System project. Thank you for his suggestions and ideas to improve the functionality of the current system. Also thanks him for giving me valuable information, suggestions and ideas to develop the proposed system during an interview, yet improve the functionality of the current system.

I also would like to take this opportunity to thank the lecturers and staffs from UM for providing me advices and some important information in developing ADLS. Especially to those lecturers, who have provided me with useful knowledge, advices and suggestions.

Last but not least, not forgotten also to thank all of my fellow and helpful friends. Every time when I encountered some problems, they are very willing to assist and advise me. Thank for their full supports, valuable advises and helps for me to complete the ADLS project.

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Chapter 1 Introduction

1.1 Project Background

Studying actually is to apply the mind to the learning or understanding of (a subject), esp. by reading. By having a good study system, students can always have the positive study mood for them to study in. Students may select the appropriate time, environment, and attitude to study.

Due to fast development of internet, the internet has becoming a major influence in education field. Most of the students can feel the impact and the important of the Internet technology. The education strategy has started to change their manual teaching system to online web-based learning system (E-Learning).

E-Learning is an instructional content delivered over the internet. E-Learning is best defined as the category consisting of training and learning over the web. E-Learning is a training that can be delivered over an Intranet, Extranet, or the Internet. Since courses can be centrally administrated, it easy to track students (thereby providing motivation to complete courses), control content (for easy updates as material changes), and inexpensive to deploy (since distribution of media is not as issue). Students can access training from their desktop.

1.2 Project Definition

Asynchronous Distance Learning System on the web (**ADLS**) is an online web-based application that provides online learning and studying using the internet. ADLS let students have their learning anytime, anywhere as long as they have internet access. This is more flexible for both students and lecturers (trainees and trainers).

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1.3 Project Overview

There are two popular forms of E-Learning: Asynchronous and Synchronous learning. Asynchronous consists of learning that is stand-alone.

Asynchronous E-Learning systems allow the organization of remote seminars, meetings, presentations, via the internet or corporate network (intranet), without the need of simultaneous attendance of trainers and trainees.

"Asynchronous" is a word that essentially means, "recorded for later presentation". The learning media can be accessed at any time and each individual can set the pace of their own learning.

The main feature is that the student takes courses when it is convenient for them. Delivery is through the web, so that an instructor can take advantage of new technologies such as electronic presentation delivery, chat sessions (with text, audio, video and animation), and collaborative electronic blackboards. Essentially, the concept of classroom training is extended to distance learning through the use of technology.

1.4 Project Motivation

The main motivation of the project to encourage me to develop an Asynchronous E-Learning is students can have distance learning from anywhere, anytime as long as they have internet access. Students don't have to attend the boring lecture and limitation of their study ability.

Realizing that the power of the web is paramount for success in today's leaning environments, many schools and universities are frantically web-enabling their network-based (web-based) learning software. Fully utilizes the latest web technologies to build up web-based system.

There is a problem that always faced especially when the server is down or the system is under construction. Students cannot proceed on their study online. So, administrators have to maintain the system an update the database currently.

1.5 Project Objective

ADLS provides an easy way to let students have a distance learning via internet or corporate network (intranet). The learning media can be accessed at any time and each individual can set the pace of their own learning.

The system provides functions to allow the lecturers to give the lecture in the web-based format. Lecturers may upload the lecture notes to the system. This wills convenience the lecturers, because lecturers can prepare the notes anytime, anywhere as long as they have internet access.

Hence, the students may set the pace of their own studies through the learning system. Students can download or study the notes online using the system. They do not have to attend any boring lecture class and they can study as much as possible based on their ability and capability on study.

The system will increase the productivity; this is because the trained personnel absence time is minimized. The cost will of implementing a seminar will be reduce, since there is no need of traveling and hosting trainees. There is no attendance taken in the asynchronous learning system. Therefore, there is a flexibility considering learning attendance from the trainees.

1.6 Project Scope

Asynchronous distance learning refers to learning methods in which students and lecturers do not have direct interaction.

The ADLS is focus on the syllabus of undergraduate courses. This system will divide into Administrator module, Lecturers module and Students module.

1.6.1 Administrator's View

Administrator module is a database system that has the capability to house all data pertaining to the system is developed. The Administrator is allowed to modify, update, delete and edit the information if necessary. Administrator also assign the access read, write, edit, delete to lecturers and students. Administrator will maintain the system by updating current database and make sure the system is always available.

1.6.2 Lecturer's View

The lecturers can login get the full information about the course and made modification to the course. Because of this, the lecturers have an important task to update the course content currently. This includes update the notes, tutorial, quiz and some multimedia electronic presentation. The lecturers have the ability to check the current student information and let the student know the result of their test or quiz taken, by sending e-mail to them. The lecturers also have the responsibility to send the feedback to students when students asked question. This can enhance the relationship between the lecturers and students although there's no direct interactive.

1.6.3 Student's View

Students' module is a module to let students have the pace of their own learning via internet. The students can view the entire web page, through a simple information

board that introduces some of the hot spot of the courses and also view the courses outline. If they satisfy with the courses provided, they can login as a member or in order word learner, and get the more information about the course. If the user is not a number, that user has to sign up first before can become a member. After they login as a member, they can enjoy the distance learning using internet. Students can view the course outline, study lecture notes, do tutorial or attend online quiz test. Students can also view, reply the forum topics.

1.7 Strength and Limitation of the Project

The strength of the project:

i. **Distance learning through internet**

Students will be able to study from anywhere via internet as long as they have internet access. Students and trainers do not have to attend lecture.

ii. **Security control**

The system provides more security features. It's only allowed the users who are given the necessary access authority to login the system. Unauthorized users are prohibited from accessing its records stored in the database. The authorize user are given UserID and Password to enter the system.

iii. **User Friendly and Convenient**

This ADLS is user friendly and caters for all age learners. Besides it is also convenient and easily accessible by anyone using the internet access.

The limitation of the project:

i. **Internet access**

The main limitation is depending on the availability of Internet services. Without the internet services, students can't make any distance learning.

iii. **Unreliable control**

The information of the course or the course content on the web maybe unreliable if the administrator does not update the latest information currently. Besides, students can't check their test result and can't proceed on the next section of their study.

1.8 Project Expectation

In any project, certain expectations of the outcome will be define before the work started. Some of the factors must be consider for making these expectations. One of the most important factors for the outcome is time available to complete the whole project and also the technique, methodology and resource available. Below is some of the expectation of the project:

i. System can perform some basic function and meet some criteria such as stable, consistency, user friendly and also reliability.

ii. The systems will be able to fulfill the requirement of trainers and students. Besides, it must perform the required functions efficiently and effectively.

iii. The proposed system is quite a complete solution. However, it needs to enhance so that more functionality can be added.

iv. The final implementation should allow for future enhancement as well as additional module to add functionality to the learning system as education environment change rapidly.

1.1.9 Project Schedule

Project scheduling involves separating the total work in a project into separate activities and judging the time required to complete it. A project guideline that was

planned to manage the times and accomplish the implementation of ADLS is as below.

	Task Name	Duration	Start	Finish
1	Preliminary Study and Planning	10 days	Mon 6/30/03	Fri 7/11/03
2	Literature Review	15 days	Tue 7/8/03	Mon 7/28/03
3	System Analysis	20 days	Mon 7/28/03	Fri 8/22/03
4	System Design	20 days	Fri 8/1/03	Thu 8/28/03
5	Development and System Coding	45 days	Wed 8/27/03	Tue 10/28/03
6	Unit Testing	14 days	Wed 10/8/03	Mon 10/27/03
7	System Testing	15 days	Thu 10/23/03	Wed 11/12/03
8	System Documentation	10 days	Thu 11/6/03	Wed 11/19/03
9	Implementation and Maintenance	10 days	Tue 11/18/03	Mon 12/1/03

Figure 1.1: Asynchronous Distance Learning System Project Schedule
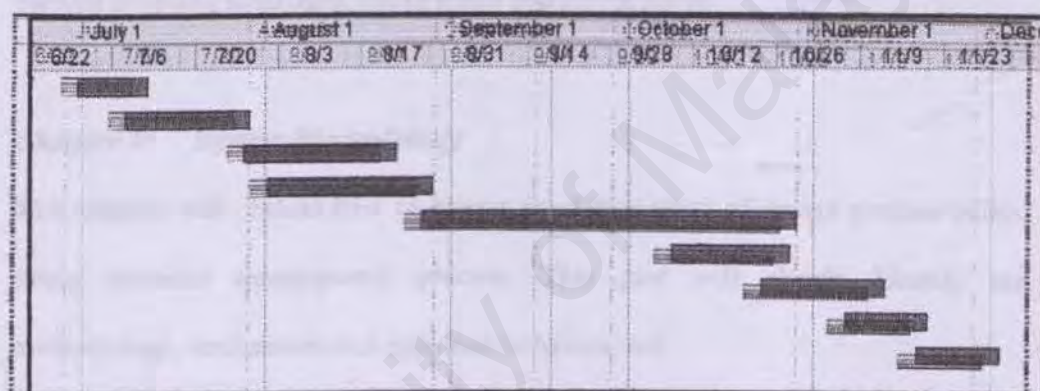
Figure 1.2: Asynchronous Distance Learning System project PERT chart

1.1.10 Report Overview

The system divides into 9 phrases to develop. The purpose of this report is to gathering all the essential document information during system development and implementation phrase. This report can help developer have a good planning about the project development. Proper preparation and planning will produce a better system. The main idea of this report is divided into six respective chapters. But for first phase of ADLS project documentation is divided into five parts, which from chapter 1 until chapter 8.

Chapter 1:   Introduction

This chapter gives a brief about the project definition, project overview, project motivation, project objective, project scope, strength and limitation of project, project expectation and project schedule.

Chapter 2:   Literature Study

For this chapter, it discusses the researches that are carried out during the system analysis and system design phrase during the project development. It also includes studies on the client-server architecture, online registration and learning between various scripting languages, client script and server script.

Chapter 3:   System Methodology

This chapter will discuss how to have a good procedure of design process before doing software development process. This part will clearly identify the methodology, mechanism and approach to be adapted.

Chapter 4:   System Analysis

This chapter discusses the functional and non-functional requirement of the system based on the requirement analysis. It also makes details comparisons of the various software and web technologies. All the tools software, operating system and strategy to tackle this project are analyzed and decided in this section. User's requirement and administrative software and hardware are listed here.

Chapter 5:   System Design

This chapter will cover the architecture, database design and functional design as well as interface design of the project. The various component of proposed system will be identified and explained. Expected outcome of this project can be view through the interface design.

Chapter 6:   System Implementation

This chapter will integrate the designed modules or functions to develop a system based on the given requirements. It is the process takes place after the system design phase. This phase describes how the initial and revised process design put into the real work.

Chapter 7:   System Testing

This chapter discusses how to ensure the system fulfills the user's requirements and assures the quality of the delivered system. Testing provides a method to discover logical error and to test the system reliability.

Chapter 8:   System Evaluation & Conclusion

This chapter discusses the process that occurs continuously at all phases of the system development. Evaluation phase was to determine the extent to which the system the expected outcomes have been realized, and the prescriptive value of the process where extraneous factors were taken consideration. Lastly, conclusion will be making for this system.

Chapter 2 Literature Study

The literature study is a critical look at the existing research that is significant to the work that is carrying out. Literature study is an important process in system development. In this stage finding, summarize, analysis and synthesis of the system will be done. This is to ensure the understanding of the system that will be developed and to choose the best way to achieve objectives of this system.

For the case of Asynchronous Distance Learning System researches have been carried out to understand the current workflow a managing resources and processes of this system. This includes researches various fields including introduction of intranet/internet, web-based architecture, client-server computing, database servers, generation of web application, server side language, client-side language and system security.

2.1 Review of Existing System

A research is done for finding various existing Asynchronous Distance Learning System available online in Internet. However, I just can find out lots of samples for this system because this system stills a new concept to the local education institute. One of the reason is the local colleges or universities still don't have a systematically and efficient computerized system web based with DBMS to develop this system.

Normally, this Asynchronous Distance Learning System is prepared by the foreign company, which offers the courses to teach their customer use their products. Some foreign education institutes also begin to develop this type of ADLS for their institutes. Actually ADLS still more developed for commerce using. The following are case studies for ADLS.

2.1.1 Case Study – redhat ADLS System

This web site is an asynchronous distance learning web site offered by redhat Company. This web site offers a few courses on the latest programming languages, scripting, e-commerce, as well as other topic areas, which the courses are alternative with the company's products. URL of this web page is http://www.redhat.com/.

The Result of Analysis

The pros of the ADLS are below:

❖ Graphics user interfaces are quite interesting and the layout is also consistent, which the design is simple that the information can display with efficient, better view and the user can easy catch out the information in web page. With red color, the interfaces more attract the user attention.

❖ All courses are classifying into different categories and list down with each hyperlink at left hand side on interfaces and also provide the searching function. This is convenient to user speed up the process of finding the courses and information.

❖ Each course will explain with a details course description such as overview, objective, price, etc to user in the next page before they designed to attend the course or not.

❖ A results-oriented, interactive learning environment with a few interaction tools like e-mail and chat room between the tutor and student, which tutors grade exercises and answer questions via email and interaction with classmates via email, discussions, and chat rooms. Let learning system more effective and efficient to students.

❖ A simple and text-oriented graphics user interface designs less the respond time and loading time of the web pages.

❖ An obvious and smooth web flow design, which the linking of web pages is relevant. Those users easy access to other web pages and observer their activities during visiting.

The cons of the ADLS are below:

❖ Less animation graphical design, users will bore after a period of visiting. This style of design also limits the scope of visitors, normally for the professional or programmer.

❖ The visitors always limit by login/register procedure.

This is a commerce asynchronous distance learning web site. Its web site's design is very professional, which its web flows, graphics user interface design and information contents are very obvious and interesting. The users will feel user-friendly when users using it, but it only especially for their customers, which buying or using their products. Anyway, it is a good sample of Asynchronous Distance Learning System.
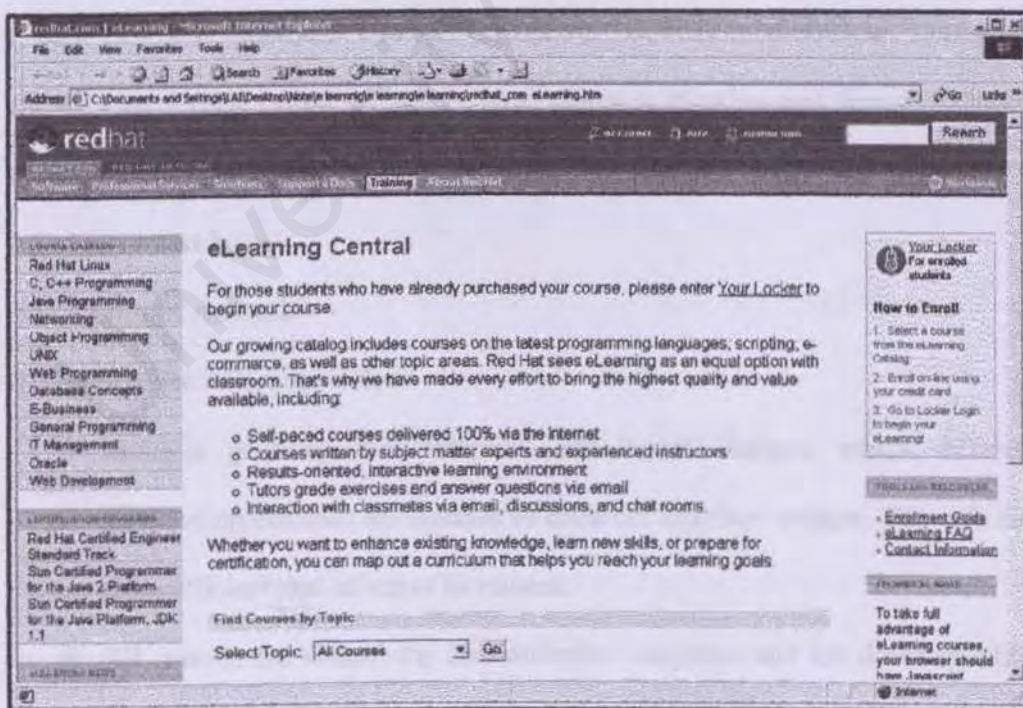
Figure 2.1: Main Page of redhat Web Site
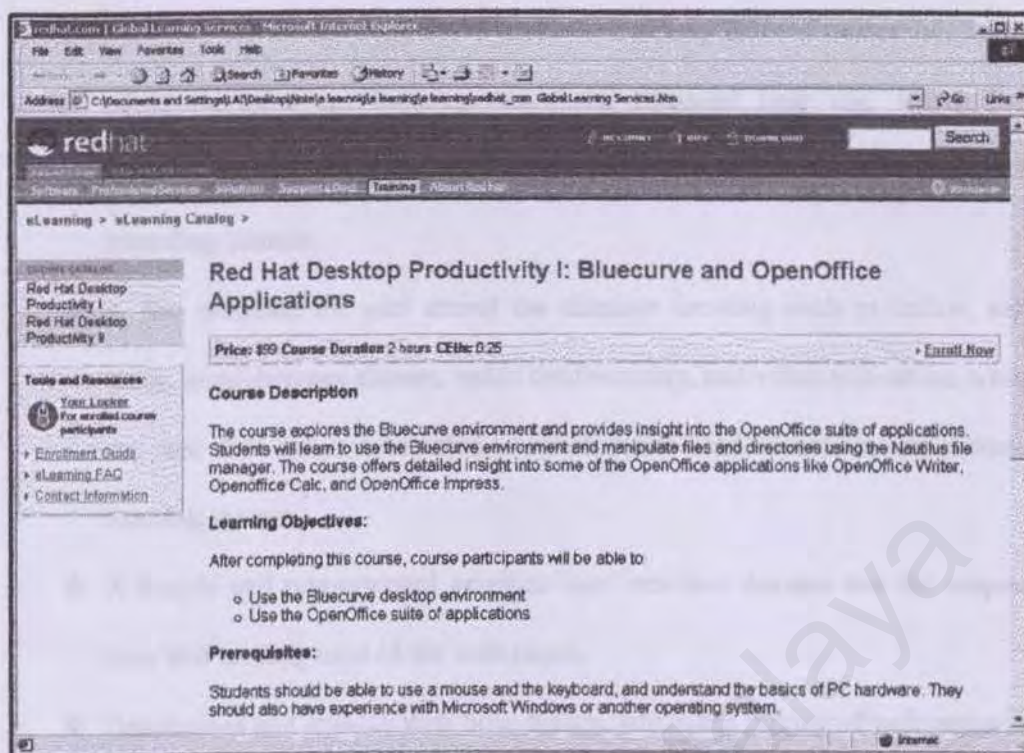
Figure 2.2: Next Page of redhat Web Site

2.1.2 Case Study 2 – COTR Online ADLS System

COTR Online is an ADLS web site provides by an education institute, College of the Rockies. COTR Online provides a large selection of online and distance learning courses to support the diverse needs of the communities. URL of the web site is http://www.cotr.bc.ca/.

The Result of Analysis

The pros of the ADLS are below:

❖ Multiple graphics user interface and layout designs, which different information contexts are suitable to different interface designs. The web site more efficient and effective to visitors.

❖ All courses are classifying into different categories and list down in table. Users easy to search the relevant courses.

- Provides the online support of distance learning such as online bookstore, education advising, learning resources, financial help etc, which help students solving their personal problems and education problems during attending courses.

- A few methods for user attend the distance learning such as online, self-study, semi distance classes, video conferencing, and video tele-series, which support the semi automated, asynchronous and synchronous distance learning system.

- A simple and text-oriented graphics user interface designs less the respond time and loading time of the web pages.

- An obvious and smooth web flow design, which the linking of web pages are relevant. Those users easy access to other web pages and observer their activities during visiting.

The cons of the ADLS are below:

- Less animation graphical interface designs, users will feel boring after a period of visiting. This style of interface design also limits the scope of visitors, normally for the more professionals, programmers and expedite personal.

- Multiple graphics user interface designs make the users conflict and complexity when they are visiting the web site.

- The visitors always limit by login/register procedure.

This is a distance learning system web site, which not a purely asynchronous distance learning system. It support the semi manual, asynchronous and synchronous learning in system. It develops for education purpose but it still needs its student's payment to attend the course.
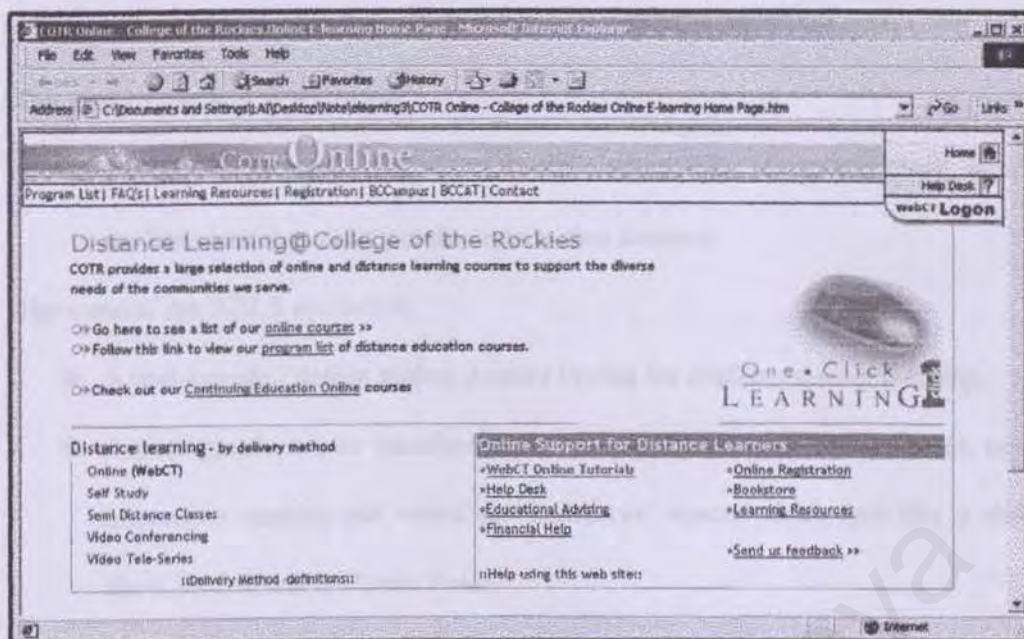
Figure 2.3: Main Page of COTR Online Web Page
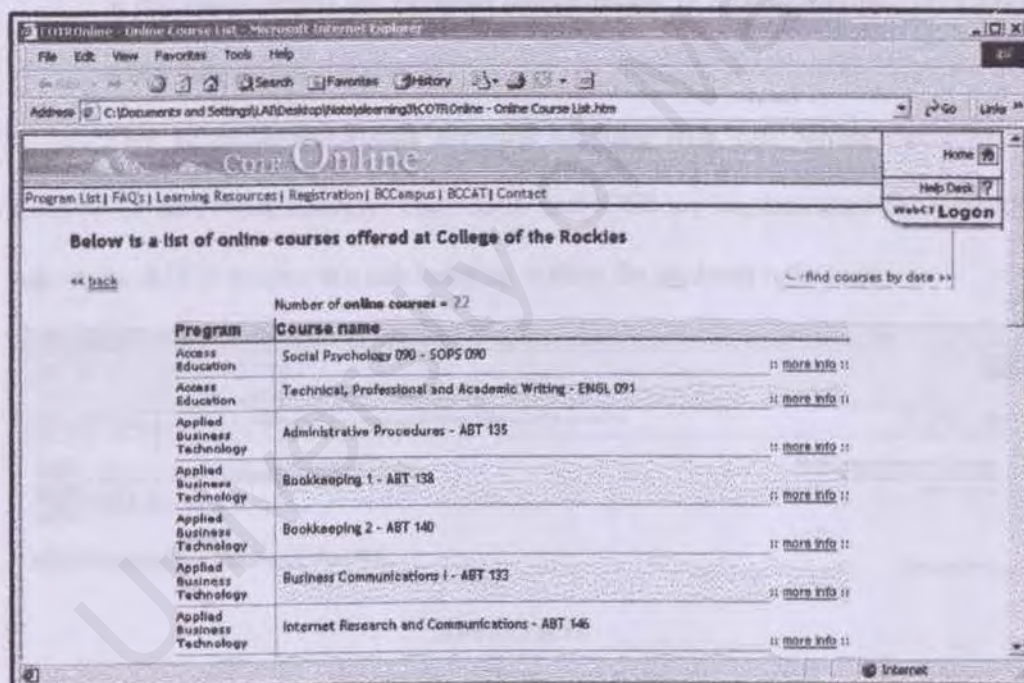
Figure 2.4: Next Page of COTR Online Web Page

2.1.3 Case Study 3 – University New South Wales ADLS System

The below is a sample ADLS web site from school of computer science, University

New South Wales at Sydney Australia. Its URL is http://www.unsw.edu.au/.

The Result of Analysis

The pros of the ADLS are below:

❖ Provides a printing method to students when they attend the class, which students can easy print out the note in that moment.

The cons of the ADLS are below:

❖ A text-oriented design makes it more boring for students during learning.

❖ A poor graphics user interface and layout designs make it non-attract, non-interest to student and waste the interfaces' space, which just like a slide show for Microsoft Power Point.

❖ Haven't provides linking of integration tools like e-mail, forum and so on. It is not convenience for students communicate to other classmate or lecturer when they attend the classes.

This is an asynchronous distance learning web site, which develops by UNSW for their students only. The ADLS and ICCS are implemented concurrently, which the ADLS system is a sub learning system for students refer back.
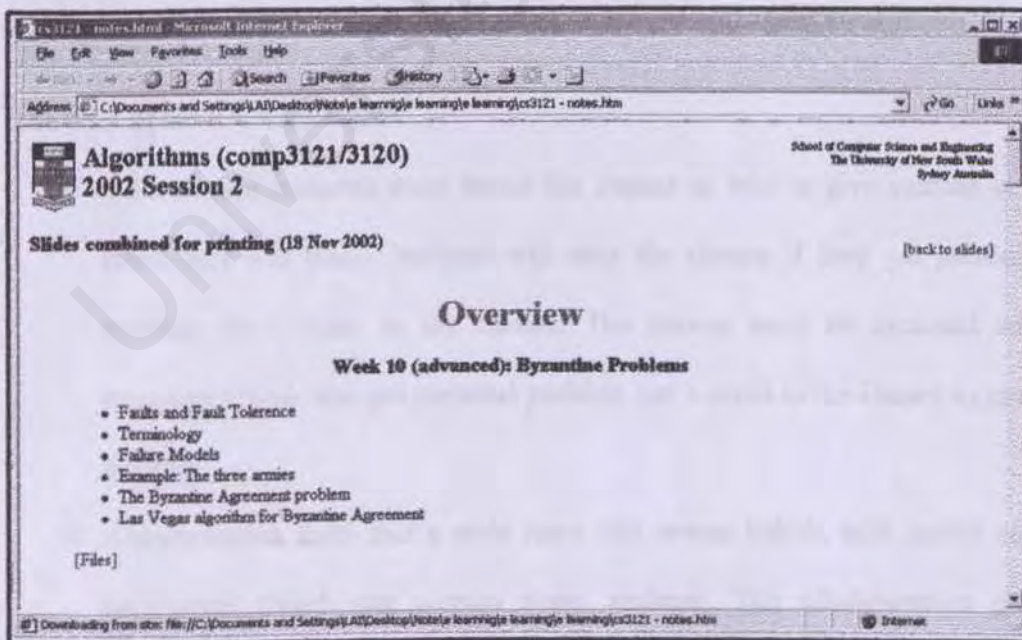
Figure 2.5: Web Page of University New South Wales Web Site
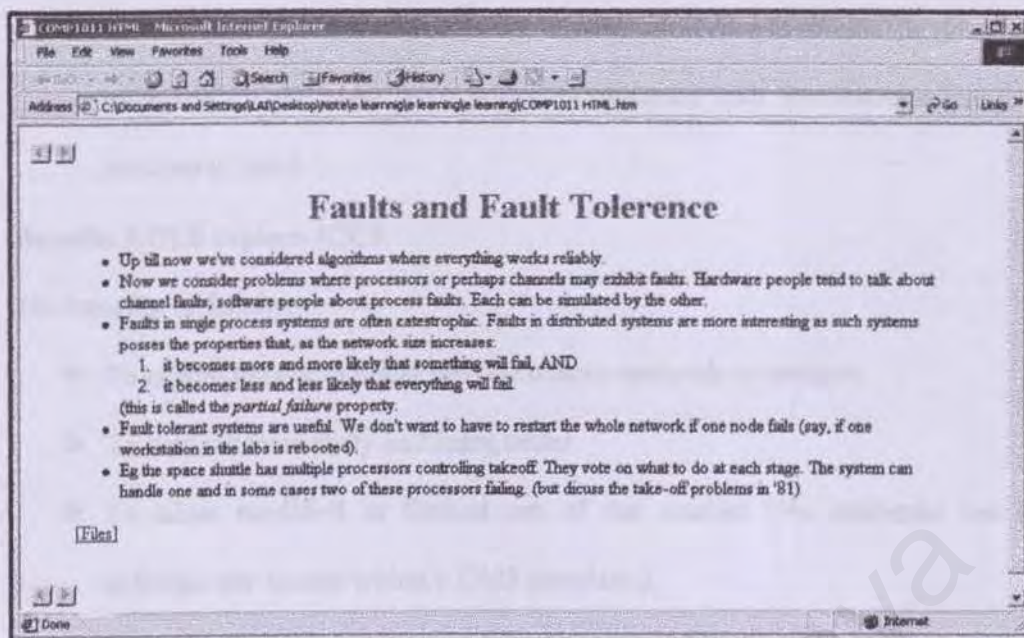
Figure 2.6: Web Page of University New South Wales Web Site

2.1.4 Case Study 4 – In-Class Course System in FSCIT

In-Class Course System, ICCS is a traditional manual learning system still using in FSCIT, University of Malaya, which the entire system implement manually by administrators. This system also involves the students and lecturers.

The Result of Analysis

The cons of the ICCS are below:

❖ Students and lecturers must attend the classes to take or give courses at a fixed time and place. Students will mist the classes if they get personal problem can't come to the classes. The classes must be canceled and proposed if they also get personal problem can't come to the classes to give lectures.

❖ Administrators must find a wide place like dewan kuliah, bilik kuliah and auditorium, which can contain many students. The administrators also coordinate the time table for classes used

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- ❖ Lack of coordinated materials for in-class course activities. The learning materials for the class were primarily designed with the distance learning sections in mind.

Benefits ADLS replace ICCS

The benefits of faculty:

- ❖ To enable faculty to better provide course materials to students.
- ❖ To help students study and learn better.
- ❖ To allow modified or limited use of the product (No instructor has to redesign any course within a CMS template.).
- ❖ To make the process as easy-to-manage as possible.

The benefits to students:

- ❖ To permit "anytime, anyplace" access to course materials and assignments.
- ❖ To encourage interactive learning, through email, discussion boards, or chat rooms.
- ❖ To improve learning in the specific course.
- ❖ To improve general information literacy and resource research strategies

The benefits of university:

- ❖ To better coordinate delivery of instruction and student interaction.
- ❖ To improve services to students and potentially reduce costs, especially in lower-level, high-enrollment courses.
- ❖ To achieve more widespread instances of IT-enhanced courses.

2.1.5 Comparison of Case Study

The following are the comparison features of the case study redhat, COTR Online, University New South Wales and FSCIT.

Table 2.1: Comparison of the Case Study

Redhat	COTR Online	UNSW	FSCIT
Automated and computing transaction	Automated and computing transaction	Automated and computing transaction	Manual transaction
Non-integration between lecturer and student	Non-integration between lecturer and student	Non-integration between lecturer and student	Integration between lecturer and student
Formal GUI design	Multiple GUI design	Text-oriented GUI design	None
Integration tools and search function	Integration tools and delivery methods	Printing function	None

2.2 Project Background Study

2.2.1 What Is An Information System?

Information system is a set of interrelated elements or components that collect input, manipulate and store, disseminate data and information as well as feedback mechanism. The feedback is critical to the successful operation of the system.
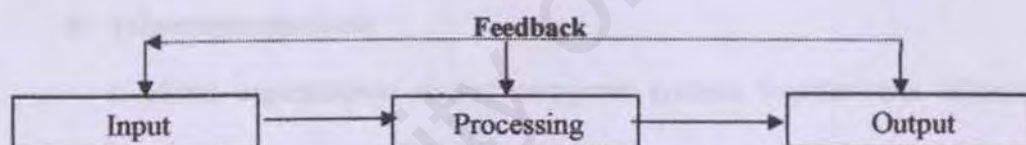
Figure 2.7: The Components of Information System

2.2.2 What Is a Computer-based Information System (CBIS)?

CBIS is any information system that uses computer, computer systems and technology. A typical CBIS employs hardware, software, databases, people, telecommunications, and procedure to collect, manipulate, store and process data into information [1].

❖ **People**

People or users are the most important element in Computer-based Information System. Information system personnel include all the people

who manage, run, program and maintain the system. Users are staffs, supervisor, Human Resources Department and others that use the system for their benefit.

❖ **Hardware**

It consists of computer equipment used to perform input, processing and output activities.

❖ **Software**

It consists of programs and instructions given to the computer and to the user.

❖ **Database**

Database is an organized collection of facts and information such as facts and information on employees, comments of first and second supervisor and the merit.

❖ **Telecommunications**

It allows organizations to link computer systems together into effective networks.

❖ **Procedures**

Procedures include the strategies, policies, and methods and rule that human use to operate the CBIS.

2.2.3 What Is A Web Application?

Web-based applications are computer programs that execute in a web browser environment. An example of such an application would be an online store accessed via Netscape Navigator or Internet Explorer. Built on the foundations of the World Wide Web, such applications can be run anywhere in the world at any time and are

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completely cross platform. Web applications provide a rich interactive environment through which the user can further define their unique online experience.

2.2.4 The Generic Web Application

Regardless of the specific tasks they perform, all web applications do the same things generically. Specifically, all web applications must do the following:

i.   Get data from a user on the web

ii.   Validate the user's data

iii. Process that data

      Processing often involves:

      ❖ **Data Storage and Retrieval**

        Often a web application must have access to data from some data source like a RDBMS database or a local file on the web server. Web applications usually able to read and write to these data sources.

      ❖ **Inter-Application Communication**

        Web applications also need to be able to work with other application resources such as email, fax-gateways, paging-gateways, encryption protocols and even other web servers.

iv.   Respond to the client who submitted the request in the first place.

2.2.5 Issues Involved

In performing these generic functions, a web application should be [2]:

i.   **Secure**

      Both the privacy of the data and the access to supporting server resources must be secure.

ii. **Scalable**

The application must be able to serve one client at a time or one hundred thousand clients at the same time without a noticeable degradation of service.

iii. **Fast**

The execution of the application must appear rapid to the user even within the context of clogged Internet bandwidth.

iv. **User-Friendly**

The application must be so simple to use that a user on the web should need no or minimal instructions in order to perform the task they want to complete.

v. **Maintenance-Friendly**

Because web application services must change so rapidly, the application must be built so that it can be modified, fixed, or maintained with little cost of time or money.

vi. **Reusable**

The cost of reinventing agent processing for each task is too great. Processing agent technology must be reusable between projects if it is to be useful.

2.2.6 Database Management System (DBMS)

A DBMS is usually a very large software package that carries out many different tasks including the provision of facilities to enable the user to access and modify information in the database. The database is an intermediate link between the physical database, the computer and the operating system, and on the other hand, the users. To provide the various facilities to different types of users, a DBMS normally

provides one or more specialized programming languages often called Database Languages. Different DBMS provide different database languages although a language called SQL has recently taken on the role of a de facto standard. [3]

The advantages of DBMS are:

❖ **Redundancies and inconsistencies can be reduced**

The data in conventional data systems is often not centralized. Combining all the data in a database would involve reduction in redundancy as well as inconsistency. It also is likely to reduce the costs for collection, storage and updating of data.

❖ **Better service to the Users**

Since the data can be shared and the DBMS makes it easy to respond to unforeseen information requests, the ability to quickly obtain new and combined information is becoming increasingly.

❖ **Cost of developing and maintaining systems is lower**

Although the initial cost of setting up of a database can be large, but the cost for maintaining application programs to be lower than for similar service using conventional systems.

❖ **Standards can be enforced**

Since all access to the database must be through the DBMS, standards are easier to enforce. Standards may relate to the naming of the data, the format of the data, the structure of the data etc.

❖ **Security can be improved**

Since the data is now centralized. It is easier to control that who has access to what parts of the database and make it easier for a determined person to breach security.

❖ **Integrity can be improved**

Because all data is stored only once, it is often easier to maintain integrity than in conventional systems.

2.2.7 Comparison of Database Organization

Table 2.2: Comparison of Database Organization

Type Distributions	Advantages	Disadvantages
Centralized database	No duplication of data and little reorganization are required. Ensure the security and integrity of data because central facility is easier to control than a dispersed collection of data.	Contention among multiple processors attempting to access data simultaneously. For large database, response time is slow.
Replicated database	Each processor has access to database without contention. Fast response time. During failure, new copy of data can be obtained.	High storage cost due to extensive duplication of data. Update of one copy must subsequently be made to all other copies. High database reorganization costs.
Partitioned database	No duplication of data and minimum storage cost. Size of database is determined by application of node, not total corporate requirement. Fast response time.	Ad hoc or management reports must be obtained from different databases.

2.2.8 Why Use RDBMS?

RDBMS or Relational Database Management System performs the same basic functions provided by the hierarchical and network DBMS system plus the host of other functions that make the relational database model easier to understand and implement.

RDBMS have the ability to let the user or designer operate in a human logical environment. The RDBMS manages all of the complex physical details and most important of all is that RDBMS model achieves the structural independence

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not found in other database models. Furthermore, in the RDBMS model has a very powerful query language called Structured Query Language (SQL), which makes ad hoc queries possible.

2.3 Introduction of Network

In the computer world, the term 'network' describes more than two or more computers connected together by a cable so that they can exchange information. There is a few types of network can be considered to be used in this project like LAN, WAN, Internet, Intranet, and Extranet.

2.3.1 Local Area Network (LAN)

The first LANs were limited to a range (from the central point to the most distant computer) of 185 meters and to no more than 30 computers. Today's technology allows a larger LAN, but practical administration limitations require dividing it into small, logical areas called workgroups. [4]

A LAN tends to use just one set of networking options. For example, a LAN generally uses a same type of network operating system (NOS), transmission media, and logical topology. A LAN is usually set up for a small group of people such as a department or a division. A LAN is not limited to any particular computer operating system. Operating System such as MS Windows, MS DOS, Macintosh, Linux and UNIX can all run across a LAN. Using different Operating System in a single LAN might need a further more complicated configuration.

2.3.2 Wide Area Network (WAN)

A wide area network, or WAN , is any network that crosses metropolitan , regional ,

or national boundaries. Most networking professionals define a WAN as any network that uses routers and public network links. WAN differ from LANs in the following ways: [4]

❖ WAN covers greater distances. So WAN speeds are slower.

❖ LANs are limited in size and scope; WANs are not.

❖ WANs can be connected on demand or can be permanently connected. LANs have permanent connections between stations.

❖ WANs can use public or private network transport. LANs primarily use private network transport.

WANs can be further classified into two categories, which are the enterprise WANs and the global WANs. An enterprise WAN is a WAN that is dedicated to a particular organization. A global WAN interconnects the networks of several corporations or organizations. An example of global WAN is the Internet.

2.3.3 Internet

Internet is a collection of communication networks interconnected across 2 or more LANs or sub-networks. It is a global network connecting millions of computers. More than 100 countries are linked into exchanges of data, news and opinions.

Each Internet computer, called a host, is independent. Its operators can choose which Internet services to use and which local services to make available to the global Internet community.

There are a variety of ways to access the Internet. Most online services, such as America Online, offer access to some Internet services. It is also possible to gain access through a commercial Internet Service Provider (ISP) such as TMNet or Jaring in Malaysia.

2.3.4 Intranet

An intranet enables the people in an organization to collaborate efficiently, sharing information and files. Intranets use Internet standard, and so users can conduct business on the intranet with the Internet tools they already know how to use. Applications might include the following: [4]

- ❖ Messaging, Conferencing
- ❖ Database access
- ❖ Information libraries

Like the Internet itself, intranets are used to share information. Secure intranets are now the fastest-growing segment of the Internet because they are much less expensive to build and manage than private networks based on proprietary protocols.

2.3.5 Extranet

An extranet involves granting certain outsiders limited access to an organization's internal resource. An extranet might enable an organization to share information with an external service provider, such as a payroll company or a marketing house. An organization might implement the following technologies on an extranet:

- ❖ Shared database access
- ❖ Conferencing [4]

Whereas an intranet resides behind a firewall and is accessible only to people who are members of the same organization, an extranet provides various levels of accessibility to outsiders. Users can access an extranet only if they have valid usernames and passwords. A user's identity determines which parts of the extranet he or she can view.

2.4 Software Architecture

The term client/server was first used in the 1980s in reference to personal computers (PCs) on a network. The actual client/server model started gaining acceptance in the late 1980s. The client/server software architecture is a versatile, message-based and modular infrastructure that is intended to improve usability, flexibility, interoperability, and scalability as compared to centralized, mainframe, time sharing computing.

The following are description of client/server architecture, two-tier architecture and three-tier architecture.

2.4.1 Client/Server Architecture

The client/server architecture (sometimes call two-tiered architecture) emerged because of the limitations of file sharing architectures. This approach introduced a database server to replace the file server. Using a relational database management system (DBMS), user queries could be answered directly.

A network architecture in which each computer or process on the network is either a client or a server. Servers are powerful computers or processes dedicated to managing disk drives (file servers), printers (print servers), or network traffic (network servers). Clients are PCs or workstations on which users run applications. Clients rely on servers for resources, such as files, devices, and even processing power.

The client/server architecture reduced network traffic by providing a query response rather than total file transfer. It improves multi-user updating through a GUI front end to a shared database. In client/server architectures, Remote Procedure Calls (RPCs) or standard query language (SQL) statements are typically used to communicate between the client and server.

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2.4.2 Two-Tier Architecture

The two-tiered architecture contains two computers-a clients, and server-with areas of logic combined on the client. The three components of an application-presentation, processing, and data-are divided among two software entities or tiers:

❖ Client application code (Client)

❖ Database server (Server)
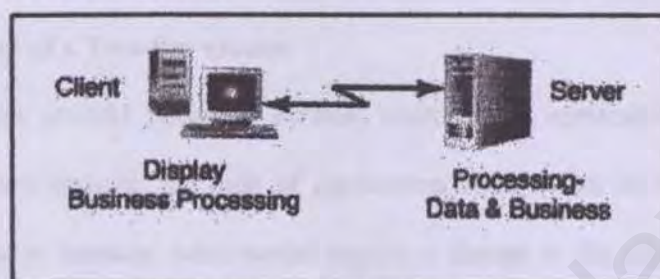
Figure 2.8: Two-tiered Architecture

The user system interface is usually located in the user's desktop environment and the database management services are usually in a server that is a more powerful machine that services many clients. A robust client application development language and a versatile mechanism for transmitting client requests to the server are essential for a two-tier implementation. Presentation is handled exclusively by the client, processing is split between client and server, and data is stored on and accessed through the server. The PC client assumes the bulk of responsibility for application (functionality) logic with respect to the processing component, while the data base engine-with its attendant integrity checks, query capabilities, and central repository functions-handles data intensive tasks. In a data access topology, a data engine would process requests sent from the clients. [5]

Advantages of Two-Tier System

❖ Work well in relatively homogeneous environments with fairly static business rules. They are less suitable for dispersed, heterogeneous environments with rapidly changing rules.

❖ Application development speed is the most compelling advantage of a two-tier environment.

❖ Most tools for two-tier are very robust and lend themselves well to iterative prototyping and rapid application development (RAD) techniques, which can be used to ensure that the requirements of the users are accurately and completely met.

Disadvantages of a Two-tier system

❖ It faces several potential version control and application redistribution problems because the bulk of application logic exists on the PC client. A change in business rules would require a change to the client logic in each application in a corporation's portfolio affected by the change.

❖ System security in the two-tier environment can be complicated because a user may require a separate password for each SQL server accessed.

❖ Client tools and the SQL middleware are also highly proprietary, and the PC tools market is extremely volatile.

2.4.3 Three-Tier Architecture

Sometimes it also referred to as the multi-tier architecture. The components of three-tiered architecture are divided into three layers:

❖ Presentation layer,

❖ Functionality layer,

❖ Data layer.

Each of these layers must be logically separate. The three-tier architecture attempts to overcome some of the limitations of the two-tier scheme by separating presentation, processing, and data into separate distinct entities. A middle tier was

added between the user system interface client environment and the database management server environment. This tier performs calculations or makes requests as a client to additional servers. The middle-tier servers are typically coded in a highly portable, nonproprietary language such as C. Middle-tier functionality servers may be multithreaded and can be accessed by multiple clients, even those from separate applications.
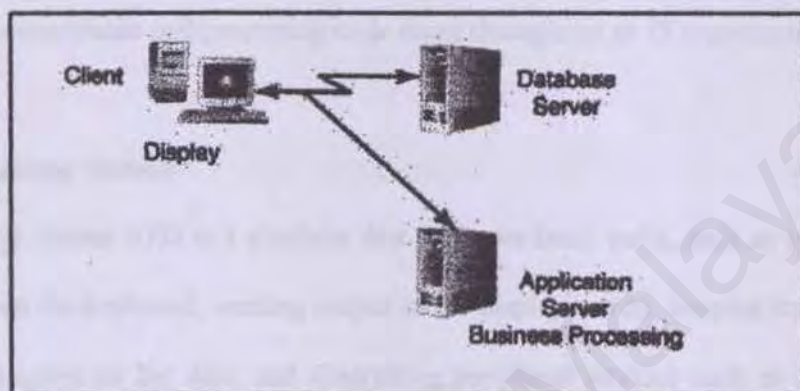
Figures 2.9: Three-tier or Multi-tier Architecture

Advantages of Three-Tier Architecture

❖ Provides for more flexible resource allocation. Middle-tier functionality servers are highly portable and can be dynamically allocated, shifted as the needs of the organization change and network traffic may be reduced.

❖ The three-tier presentation client is not required to understand SQL. Because SQL in no longer required, data can be organized hierarchically, relationally, or in object format. Having separate software entities allows for the parallel development of individual tiers by application specialists.

❖ Three-Tier systems such as Open Software Foundation's Distributed Computing Environment (OSF/DCE) offer a variety of additional features to support distributed applications development.

❖ Modularly designed middle-tier code modules can be reused by several applications.

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Disadvantages of Three-Tier Architectures

❖ Three-Tier brings with it an increased need for network traffic management, server load balancing, and fault tolerance.

❖ Current tools are relatively immature and require more complex 3GLs for middle-tier server generation. Maintenance tools have underdeveloped facilities for maintaining server libraries a potential obstacle for simplifying maintenance and promoting code reuse throughout an IS organization.

2.5 Operating System

Operating system (OS) is a platform that performs basic tasks, such as recognizing input from the keyboard, sending output to the display screen, keeping track of files and directories on the disk, and controlling peripheral devices such as disk drives and printers.

Besides that, the OS ensures that different programs and users running at the same time do not interfere with each other. For security, OS will restrict the access of unauthorized users to the system. OS provides a software platform to allow application programs run on it. The most popular operating systems currently are Microsoft Windows, Linux and Unix.

2.5.1 Microsoft Windows 98

Microsoft Windows 98 is one of the Microsoft products. It was considered as a cheap alternative to serve as the development platform for the proposed TMS. It is perfectly capable of administering a small site but unfortunately it is unable to handle high loads due to the unavailability of certain features like load balancing, which is available in Windows NT. [6]

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It is able to serve web pages due to the inclusion of Personal Web Server on the Windows 98 CD. Installation of this utility would enable Windows 98 to function as a web server for small networks thus no need to pay for the higher fee that is required to run a copy of Windows NT Server on a machine. Windows 98 has a better File Allocation Table format called FAT32.

Windows 98 also supports a wide range of hardware and peripherals. In this case this feature is not a useful one as Windows 98 sacrifices its stability by supporting all kinds of peripherals in the market. Since the system proposed is web-based, a better alternative would be an operating system that is more suitable for a server environment.

2.5.2 Microsoft Windows 2000 Professional

Microsoft Windows 2000 Professional built on Windows NT technology and an easy-to-use, familiar Windows 98 user interface; Windows 2000 Professional makes business users more productive.

Its integrated Web capabilities and broad support for mobile computers and hardware devices makes it the easy way for business users to connect to the Internet anywhere and anytime. And its rock-solid reliability and improved manageability simplify desktop management for IT professionals.

The combined features of Windows 2000 Professional create the mainstream operating system for desktop and notebook computing in all organizations. It has the best business features of Windows 98 Plug and Play, easy-to-use user interface, and power management-and made them better. Plus integrated the strengths of Windows NT standards-based security, manageability and reliability. Whether deploy Windows 2000 Professional on a single computer or via a worldwide network,

Windows 2000 Professional increases the computing power while lowering the total cost of desktop ownership.

The following are the advantages of Windows 2000 Professional Server:

❖ **Windows File Protection**

Protects core system files from being overwritten by application installs. In the event a file is overwritten, Windows File Protection will replace that file with the correct version.

❖ **Driver certification**

Provides safeguards to assure that device drivers have not been tampered with and reducing the risk of installing non-certified drivers.

❖ **Full 32-bit operating system**

Minimizes the chance of application failures and unplanned reboots in system.

❖ **Microsoft Installer**

Works with the Windows Installer Service, helping users install, configure, track, upgrade, and remove software programs correctly, minimizing the risk of user error and possible loss of productivity.

❖ **Windows Logo Program**

Provides assurance that applications have met a comprehensive set of standards developed by Microsoft in cooperation with customers and third-party developers.

❖ **Dramatically Reduced Reboot Scenarios**

Eliminates most scenarios that forced you to reboot in Windows NT 4.0 and Windows 9x. Many software installations also will not require reboots.

2.5.3 Microsoft Windows 2000 Server

Microsoft Windows 2000 Server operating systems are the next generation in the Windows NT Server series of OS. In addition to providing a comprehensive Internet and applications platform, Windows 2000 Server builds on the strengths of Windows NT Server 4.0 by delivering increased reliability, availability, and scalability with end-to-end management features that reduce operating costs.

The most critical new features and enhancements offers by Windows 2000 Server are those that relate to Internet capabilities. The Windows 2000 Server operating system builds on the solid Internet technologies delivered in Windows NT Server 4.0 to provide an agile, powerful Internet platform.

The advantages for Windows 2000 Server is the ideal platform for building and running rich Web-based applications and services:

❖ **Scalability and flexibility**

Host lots of Web sites and more Terminal Services users while getting better use of bandwidth and high performance even on the fastest networks.

❖ **Security**

With flexible authentication and authorization options, strong encryption services and flexible and secure network access.

❖ **More system uptime and less unplanned downtime**

Reboot up to 90% less often! Increased server and network availability - It is resilient to application failures and allocates resources to preserve availability Easy to deploy, configure and use.

❖ **Centralized management**

A lower cost of ownership to play well with existing infrastructure: other operating systems, servers, mainframes, applications, directories, network

devices and peripherals Supports the newest networking devices and technologies.

Windows 2000 Server supports upgrades of NT4.0 server meaning all applications and settings will be saved. In the other word it replaces NT4.0 Server and having mostly probably all the features of it.

2.5.4 Linux

Linux is a free; UNIX work-alike designed for Intel processors on PC architecture machines. Linux is not UNIX, as UNIX is a copyrighted piece of software that demands license fees when any part of its source code is used. Linux was written from scratch to avoid license fees entirely, although the operation of the Linux operating system is based entirely on UNIX and it shares UNIX's command set.

Linux supports a wide range of software, from TeX (a text formatting language) to X (a graphical user interface) to the GNU C/C++ compilers to TCP/IP networking. It is well suited to function as a development environment for web applications. Its superior stability is a feature that cannot be beaten even by Windows. Linux is capable of running 24 hours 7 days a week without system failures or crashes. Memory management is dynamic and used memory is released after a particular application ends unlike Windows.

In addition Linux has the following features:

- ❖ It is capable of multitasking.
- ❖ Has support for Netware clients and servers.
- ❖ Includes a LAN Manager/Windows Native (SMB) client and server.
- ❖ It multi-platform that is it can run on any processor.
- ❖ Many networking protocols supported.

❖ Has memory protection between processes ensuring that a program cannot crash the entire system.

Linux's only weakness is a lack of support for hardware making it a little difficult to setup a machine with Linux. Fortunately support for Linux is growing every single day and more peripherals are being added to Linux's list of supported hardware.

2.5.5 UNIX

UNIX is one of the popular operating systems worldwide because of its large support base and distribution. It was originally developed as a multitasking system for minicomputers and mainframes in the mid-1970s, but it has since grown to become one of the most widely used operating systems anywhere. Anyway, it sometimes has confusing interface and lack of central standardization.

UNIX is a multitasking, multi-user operating system. This means that there can be many people using one computer at the same time, running many different applications. (This differs from MS-DOS, where only one person can use the system at anyone time.)

Under UNIX, for users to identify themselves to the system, they must log in, which entails two steps: Entering user's login name (the name by which the system identifies you), and entering his/her password, which is the user personal secret key to logging in to his/her account. No one else can tog in to the system under his/her username without knowing the password.

In addition, each UNIX system has a hostname assigned to it. The hostname is used to identify individual machines on a network, but even if the machine isn't networked, it should have a hostname.

2.6 Database Server

A database is a structured collection of data. To add, access, and process data stored in a computer database, a database server is needed. There are several database servers available currently to consider for the project such as the Oracle, MySQL and SQL Server.

2.6.1 Oracle8i

Oracle8i is a multi-user database. It provides unprecedented ease-of-use and is pre-tuned and pre-configured for today's dynamic workgroup and line-of-bus environment. Oracle8i can run on UNIX, Linux and Windows platform.

Oracle8i includes a fully integrated set of easy-to-use management tools, full distribution, replication and web features. Oracle8i also provides the highest levels of availability through fast fail over, easier management, and zero data loss disaster protection, with Data Guard, the only complete data protection solution available on the market.

An enhancement to Oracle8i is the Oracle Internet File System (iFS). Oracle iFS is a revolutionary extension to the Oracle8i database. Oracle iFS provide the best of both the relational database and file system worlds. Not only does it provide the reliability, availability, and scalability of Oracle8i, it also provides the familiarity and ease of use of a standard file system. Oracle iFS expands the database platform to present documents and media as files and folders that users can access through familiar interfaces such as Windows, the Web, e-mail, and FTP. For the first time, companies can ensure valuable content is secure and searchable from a central location. Customers can also use iFS to customize a file server for specific application purposes. [7]

2.6.2 MySQL

MySQL is a relational database management system. MySQL stores data in separate tables rather than putting all the data in a location. This adds speed and flexibility. The tables are linked by defined relations making it possible to combine data from several tables on request.

MySQL is a small, compact, easy to use database server, ideal for small and medium sized applications. It is client/server implementation that consists of a server and many different client programs. It is available on a variety of UNIX platforms, Linux, Windows NT, Windows 95/98 and Windows 2000.

Today MySQL is the most popular open source database server in the world with more than 2 million installations powering websites, data warehouses, business applications, logging systems and more. Customers such as Yahoo! Finance, MP3.com, Motorola, NASA, Silicon Graphics, and Texas Instruments use the MySQL server in mission-critical applications. [8]

2.6.3 Microsoft SQL Server 2000

SQL Server 2000 provides agility to data management and analysis, allowing organizations to adapt quickly and gracefully to derive competitive advantage in a fast-changing environment. From a data management and analysis perspective, it is critical to turn raw data into business intelligence and take full advantage of the opportunities presented by web. It is a fully web-enabled database server, providing core support for Extensible Markup Language (XML) and the ability to query across the internet and beyond the firewall. It provides the following features: [9]

❖ Simplify the integration of back-end systems and data transfer across firewalls using XML.

- ❖ Connect to SQL Server 2000 databases and OLAP cubes flexibly, by using the Web with no additional programming.

- ❖ Ensure applications are secure in any networked environment, with role-based security and file and network encryption.

- ❖ Use and manage both structured and unstructured data, including searching through Microsoft Office documents.

- ❖ Enable the implement of merge, transactional, and snapshot replication with heterogeneous systems with SQL Server 2000.

- ❖ Automatic tuning and maintenance features enable administrators to focus on other critical tasks.

- ❖ User-defined functions, cascading referential integrity, and the integrated Transact-SQL debugger allow users to reuse code to simplify the development process.

2.7 Database Connection

Getting data from a data source (database) isn't a direct way and it requires the use of a data access interface. Fortunately, there are several methods that can be used to do so. It is significant to choose a suitable data access interface as it can result in better performance, easier of programming steps and also programming flexibility.

There are many type of database connection but I only will focus on ODBC and JDBC since it was a good solution for dynamic web language.

2.7.1 Open Database Connectivity (ODBC)

ODBC is a standard database access method developed by Microsoft Corporation. The goal of ODBC is to make it possible to access any data from any application,

regardless of which database management system (DBMS) is handling the data. [10]

When programming to interact with ODBC user only need to talk the ODBC language (a combination of ODBC API function calls and the SQL language). The ODBC Manager will figure out how to contend with the type of database user are targeting. Regardless of the database type is using, all of calls will be to the ODBC AP.I. As mentioned earlier, all that need to do is have installed an ODBC driver that is specific to the type of database you will be using.

The ODBC drivers are available in ODBC version 4.0 are,

1.Microsoft Access   5. Microsoft ODBC for Oracle

2. Microsoft dBase   6. Microsoft Paradox

3. Microsoft Excel   7. Microsoft Text

4. Microsoft FoxPro   8. Ms SQL Server

For a web database application, System DSN is the most appropriate choice of DSN because the database can be access by every user. The ODBC drivers will depend on the DBMS used in the system.

2.7.2 Java Database Connectivity (JDBC)

JDBC technology is an API (Application Program Interface) that let user access virtually any tabular data source from the Java programming language. It provides cross-DBMS connectivity to a wide range of SQL databases. The JDBC API allows developers to take advantage of the Java platform's "Write Once, Run Anywhere" capabilities for industrial strength, cross-platform applications that require access to enterprise data. [11]

JDBC is modeled on ODBC (Object Database connectivity) but in addition provides an object-oriented model for accessing databases, permitting use of Java

methods as well as SQL for querying and updating data. The JDBC standard means that applications can be written without considering what driver will be used in the final deployment, and gives system managers the freedom to change database engines without requiring a change in program logic.

The Types of JDBC Technology drivers are:

❖ **A JDBC-ODBC Bridge**

Sun provides this simple JDBC driver with the Java Development kit. It implements the JDBC API by making ODBC calls, allowing connection to any ODBC data source available on the local machine. This is because some ODBC native code and in many cases native database client code must be loaded on each client machine that uses this type of driver. This type driver is normally written in platform-specific code and thus limit the application's potential for cross-platform deployment.

❖ **Native-API Partly Java Technology-Enabled Driver**

Native-API means that the driver talks directly to the database management system's API rather than any mapping layer such as ODBC. *Partly Java Technology-Enabled* simply means that it can be accessed from Java. The implication is that it either

a) Does not provide the complete JDBC API but provides enough to drive the native database API, or

b) Is not written completely in Java, thus losing out in cross-platform functionality.

❖ **Net-protocol fully Java technology-enabled driver**

Net-protocol means that the driver uses a DBMS-independent network protocol to bridge the network. The driver is thus a client-server pair. Fully

Java technology-enabled means that the client is written in Java preserving the applications potential for cross-platform deployment. It translates JDBC API calls into a DBMS-independent net protocol that is then translated to a DBMS protocol by a server. This net server middleware is able to connect all of its Java technology-based clients to many different databases. This is the most flexible JDBC API alternative and suitable for Intranet use. In order to support Internet access they must handle the additional requirements for security, access through firewalls, etc., that the Web imposes.

❖ **Native-protocol fully Java technology-enabled driver**

A native-protocol fully Java technology-enabled driver written entirely in Java that converts JDBC technology calls into the network protocol used by DBMS directly. This allows a direct call from the client machine to the DBMS server and is a practical solution for Intranet access. Since many of these protocols are proprietary the database vendors themselves will be the primary source for this style of driver. The driver code is cross-platform as for Type 3. It is more likely to be blocked by a firewall.

The following table summarizes of four type JDBC drivers.

Table 2.3: Comparisons of 4 Type JDBC Drivers

	Type 1	Type 2	Type 3	Type4
Can connect to ODBC Data Sources	Yes	No	Not always	No
App has 'Write once/run anywhere' platform independence	No	No	Yes	Yes
Can connect across internet	No	No	Subject to firewall	Subject to firewall
Can replace database engine without changing JDBC driver	Yes	No	Not normally	No

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2.8 Security Technology

Security is an important part in developing a web site. Without a good security system, a web site can be hacked and make the user to loose confidence of web site. SSL is considered for securing the transport of information in DECP.

2.8.1 Secure Sockets Layer (SSL)

SSL is a security protocol designed to ensure data moving between a browser and a server remains private. In theory, someone could intercept information, such as a credit card number while it is in transit between the browser and the server. One solution to prevent information from being usable if it is intercepted is to encrypt it. The most widely implemented encryption system for the web at present is SSL.

SSL is an open, non-proprietary protocol developed by Netscape Communication. It uses industry, accepted RSA public key cryptography for authentication and encryption. The SSL protocol was designed to provide a data security layer between TCP/IP and application protocols such as HTTP, Telnet, NNTP or FTP. SSL provides data encryption, server authentication, message integrity and optional client authentication for TCP/IP connection.

The advantage of the SSL Protocol is that it is application protocol independent. A "higher level" application protocol (e.g. HTTP, FTP, TELNET, etc.) can layer on top of the SSL Protocol transparently. The SSL Protocol can negotiate an encryption algorithm and session key as well as authenticate a server before the application protocol transmits or receives its first byte of data. All of the application protocol data is transmitted encrypted, ensuring privacy.

2.9 Web Server

A Web server is a program that serves Web pages upon request. Every Web server has an IP address and possibly a domain name. For example, if a user enters the URL http://www.examples.com/index.html in a browser, this sends a request to the server whose domain name is examples.com. The server then fetches the page named index.html and sends it to the user's browser. Web servers and browsers communicate using HTTP (Hypertext Transfer Protocol), a simple but effective protocol for requesting and transmitting data over a network.

Web servers run a specialized program or service called an HTTP daemon. The daemon runs as a process within the operating system and is responsible for responding to all requests from a Web browser. These responses include negotiation for an HTTP connection and the actual delivery of files. In addition to HTTP daemons, Web servers may also have the capabilities for running scripts. [4]

Web servers come in various shapes and sizes. They run under a variety of operating systems, have varying levels of power and complexity, and range in price from rather expensive to free.

2.9.1 Microsoft Internet Information Server (IIS)

IIS is the largest web servers available from Microsoft. It is a Web server that enables to publish information on a corporate intranet or on the Internet. IIS transmits information by using the Hypertext Transfer Protocol (HTTP) and it can also be configured to provide File Transfer Protocol (FTP) and gopher services. The FTP service enables users to transfer files to and from the Web site. The gopher service uses a menu-driven protocol for locating documents. The gopher protocol bas been largely superseded by the HTTP protocol. [12]

IIS is built on the Windows NT security model. Windows NT security helps to protect the computer and its resources by requiring assigned user accounts and passwords. Administrator can control access to computer resources by limiting the user rights of these accounts. The Windows NT File System (NTFS) can assign permissions to folders and files on computer to control the accessible folders and files by preventing users from copying files. In addition to the Windows NT security features, Read-only or Execute-only virtual directories can set by using Internet Service Manager. IIS also provides a way to deny user access to computers with particular IF addresses. IIS supports the Secure Sockets Layer (SSL) protocol, which securely encrypts data transmissions between clients and servers.

When an IIS receives a browser request for information, it determines whether the request is valid. If only one computer running IIS at server site, Internet Service Provider (ISP) can help with many details, such as router configuration and the IF address of the default gateway that Web server will use. But if there are multiple computers running IIS on network, their TCP/IP settings must configure to operate correctly through Internet connection configuration, including any routers used between the servers and the default gateway. Typically, sites with more than one computer running IIS will add another router. With the addition of another router, the servers can be grouped into a single subnet isolated from private network.

IIS provides a graphical administration tool called Internet Service Manager that can use to monitor, configure, and control the Internet services. Internet Service Manager is the central location from which user can control all of the computers running IIS in organization. IIS can run on any computer that is running Windows NT Workstation or Windows NT Server and that is connected through the network to the Web server. With remote administration user can administer Web servers

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from the server computer itself, from a management workstation on the corporate local area network (LAN), or even over the Internet.

Internet Service Manager uses the Windows NT security model, so only validated administrators are allowed to administer services, and administrator passwords are transmitted in encrypted form over the network. In addition to Internet Service Manager, IIS provides an HTML-based Internet Service Manager that can run from any web browser. [13]

The creative possibilities offer on an IIS Web server is endless.

- ❖ Publish a home page on the Internet for business featuring a newsletter, sales information, or employment opportunities.
- ❖ Publish a catalog and take orders from customers.
- ❖ Publish interactive programs.
- ❖ Provide your remote sales force easy access to sales database.
- ❖ Use an order-tracking database
- ❖ Publish an employee handbook

Internet Information Server, IIS provides other information services and supports a variety of interfaces that can use to develop other features for Web site. There are:

- ❖ Create high performance client-server applications using the Microsoft Internet Server Application Programming Interface (ISAPI).
- ❖ Customize the WWW Service by creating ISAPI filter programs that listen to incoming or outgoing requests and automatically perform actions, such as enhanced logging.
- ❖ Run Common Gateway Interface (CGI) applications or scripts.
- ❖ Transmit or receive files using the FTP service.

❖ Publish archives of information, spanning multiple computers, using the gopher service.

2.9.2 Microsoft Personal Web Server (PWS)

PWS same as IIS are packaged together as part of the freely downloadable Windows NT 4.0 Option Pack. PWS is a scaled-down version of the commercial Information Internet Server (IIS) included with the Server edition of Microsoft Windows NT. It is designed for Windows 95 and Windows NT Workstation users. PWS is a great entry-Level Web server that makes it easy to publish personal home pages, serve small Web sites, and share documents via a local intranet.

The advantage to using Personal Web Server over Internet Information Server and similar high-end Web servers is the client's ease of use. PWS is one of the best servers available for helping to start up and running quickly. Wizards are included to guide user through the process of setting up home pages and sharing files. Besides the PWS administrator reduces the complexity of actually running the Web server itself.

While PWS does lack some of the more advanced features found in IIS (most notably the Index Server, Certificate Server, and Microsoft Site Server Express tools), the server does include support for Active Server Pages (ASP), script debugging, and many other important features found in its commercial sibling. One of these is the Internet Service Manager, a comprehensive administration tool used in IIS as part of the Microsoft Management Console.

Additionally, PWS presents the ability to develop transactional Web applications using the Microsoft Transaction Server. Overall, while most large enterprises will likely bypass Microsoft's Personal Web Server for the high-end

Internet Information Server, PWS will remain one of best available options for individuals wanting to serve their own personal home pages and for small organizations.

2.9.3 Apache

Apache is UNIX web server and available free of charge. It also can run in Windows NT. Apache can obtain from the Internet and all the core and module source code can be get and modified to suit developers' needs. Hosting multiple IP addresses on an Apache server is done with little configuration. [14]

There are many good features in Apache. Apache supports

❖ **Dynamic Shared Object (DSO) support**

Apache modules may now be loaded at runtime; this means that modules can be loaded into the server process space only when necessary, thus overall memory usage by Apache will be significantly reduced.

❖ **Support for Windows NT/95**

Apache supports the Windows 95, Windows 98, Windows ME, Windows NT, and Windows 2000 operating systems.

❖ **Support for NetWare 5.x**

Apache now experimentally supports the NetWare 5.x operating systems.

❖ **Re-organized Sources**

The source files for Apache have been re-organized. The main difference for Apache users is that the "Module" lines in Configuration have been replaced with "AddModule" with a slightly different syntax. For module authors there are some changes designed to make it easier for users to add their module.

❖ **Reliable Piped Logs**

2.9.4 Netscape Enterprise Server (NES)

Netscape Web Server produces it. It supports Oracle, Informix, Java, LDAP and use to convert .pdf file to HTML. NES can run either in UNIX or Windows NT Server. It has a direct link to a DBMS and automatic directory tree.

This server allows users to serve several different Web sites using the same server on the same machine. It uses the standard NCSA log format and has built-in image maps (NCSA) and supports the Windows CGI interface.

This web server has full-text search features, such as automatic index updates, allowing immediate search access to newly changed data, and searched by content or by document attributes, such as author, title, and modification date.

Besides, Enterprise Server also supports stored procedures, multiple database connections and persistent transactions. This commercial server is one of the most expensive available today.

2.10 Web Browser

A Web browser is an application that is used to submit requests for Internet content to Web server using the Hypertext Transfer Protocol (HTTP). The Web browser also displays the responses to those requests on the screen.

Although there are a many types of Web browsers available, they all hare a similar look. Because Web browsers today are based, in some way, on the work done by the National Center for Supercomputing Applications (NCSA), they all have at least a few items in common such as: [15]

- ❖ Browser window
- ❖ Location bar
- ❖ Menu bar

- ❖ Button bar

- ❖ Activity indicator

- ❖ Status bar

- ❖ Etc

2.10.1 Microsoft Internet Explorer 5

Microsoft Internet Explorer 5 is an update of the award-winning Internet Explorer browsing technologies. Using IntelliSense technology, Internet Explorer 5 aims to save time for business users, corporate administrators, and application developers by completing their most frequently performed tasks.

Internet Explorer browser software, and its related tools are designed to meet the most demanding requirements of enterprises. In designing Internet Explorer 5, Microsoft conducted extensive research and testing to better understand the needs of these key audiences, who are the business end-users, corporate administrators and corporate application developers. [16]

Internet Explorer 5 furthers Microsoft's leading commitment for Internet standards via enhanced support for HTML, Cascading Style Sheets (CSS), Extensible Style Language (XSL), and scripting and support for the Document Object Model (DOM), which enables new levels of interactivity in Web content while reducing network congestion. Internet Explorer 5 also enhances support for Extensible Markup Language (XML). Internet Explorer 5 also brings the benefits of true componentization to Web authoring through innovations like Dynamic HTML Behaviors. Finally, enhancements to the browser-programming model enable further richness on the Web platform, such as drag-and-drop capability across frames and applications.

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2.10.2 Netscape 6.2

Netscape 6.2, the latest update to the Netscape browser suite, lets you accomplish more online with efficiency in completing tasks, power through more choice and safety with more control. It also supports MacOS X and Microsoft Windows XP.

Netscape 6.2 includes Netscape Navigator, Netscape Mail, Netscape Instant Messenger, Netscape Composer, and Netscape Address Book. Netscape 6.2 also delivers advanced add-on applications that help you get more from the Internet. Netscape 6.2 offers Java for running web applets, Nullsoft Winamp for audio playback, RealPlayer8 for streaming media, Macromedia Flash for high impact web content and Print Plus from Hewlett Packard for easy access to printing services and features. [17]

2.11   Scripting Languages

Scripting languages are an intermediate stage between HTML and programming languages such as Java, C++, and Visual Basic. HTML is generally used for formatting text and linking pages. Programming languages are generally used for giving a series of complex instructions to computers. While scripting languages can also be used to give instructions to computers, their syntax and rules are generally less rigid and intricate than those of compiled programming languages. Scripting languages focus on formatting text or calling and using compiled components written in a programming language.

Unlike more complex programming languages, scripting languages are interpreted, where an intermediate program called a command interpreter sequentially executes instruction statements. While interpretation reduces execution efficiency, scripting languages are easy to learn and provide powerful functionality.

Scripts can be embedded in Hypertext Markup Language (HTML) pages to format content or used to implement COM components encapsulating advanced business logic. [18] The script languages are classified to the two categories, which are script languages for server side and client server.

2.11.1 Active Server Pages.Net (ASP.net) - Server Side

Active Server Page.NET, or ASP.NET, is Microsoft's latest version of its popular dynamic Web programming technology, ASP.NET however, is much more than a simple upgrade from classic ASP: A new programming model and plethora of brand-new tools are just two of the many new features of ASP.NET.

A Microsoft server-side Web technology, ASP.NET takes an object-oriented programming approach to Web page execution. Every element in an ASP.NET page is treated as an object and run on the server. An ASP.NET page gets compiled into an intermediate language by a .NET Common Language Runtime-compliant compiler. Then a JIT compiler turns the intermediate code to native machine code, and that machine code is eventually run on the processor.

The new features in ASP.NET make designing dynamic Web pages quicker and easier that ever before. For example, ASP.NET offers developers a number of powerful Web Controls, which are HTML-like tag that provide useful functionality, such as displaying a calendar, showing a random banner advertisement, and displaying an HTML table whose rows and columns contain data from a database. These Web Controls allow developers to provide rich, W3C-compliant HTML with minimal amount of coding.

2.11.2 Active Server Pages (ASP) - Server Side

ASP is a server-side scripting technology. ASP is indeed a HTML page with an .asp extension. ASP enables the HTML scripts and a scripting language such as VBScript, JScript or Perl to be interspersed in a Web page. When a browser requests an ASP page, the Web server generates a page with HTML code and sends it back to the browser. One of the most important features about ASP is that it allows user to easily access data and put it on a Web page. User can simply display data from an ODBC-compliant database, or use ASP to make decisions about what to display on a Web page. User can then format the results in anyway or in any specific format that they want.

Another important ASP feature is the ability to use cookies to store and retrieve information. The Request object has a Cookie collection, and user can use this in data processing.

2.11.3 PHP Hypertext Preprocessor - Server Side

PHP Hypertext Preprocessor (PHP) is a most popular open-source server-side; Hypertext Markup Languages (HTML) embedded scripting language used to create dynamic Web pages for e-commerce and other Web applications. In an HTML document, PHP script is enclosed within special PHP tags. Because PHP is embedded within tags, the author can jump between HTML and PHP (which is similar to Active Server Pages) instead of having to rely on heavy amounts of code to output HTML. And, because PHP is executed on the server, the client cannot view the PHP code.

PHP offers excellent connectivity to most of the common databases (including Oracle, Sybase, MySQL, ODBC and many others). PHP also offers

integration with various external libraries, which allow the developer to do anything from generating PDF documents to parsing XML.

PHP is the natural choice for developers on Linux machines running Apache server software, but runs equally well on any other UNIX or Windows platform, with Netscape or Microsoft Web server software. PHP also supports HTTP sessions, Java connectivity, regular expressions, LDAP, SNMP, IMAP, COM (under windows) protocols. It also supports WDDX complex data exchange between virtually all Web programming languages.

2.11.4 Java Server Pages (JSP) - Server Side

Java Server Pages (JSP) is a Web-scripting technology that can mix static HTML content with server-side scripting to produce dynamic output. By default, JSP uses Java as its scripting language. However, the specification allows other languages to be used, just as ASP can use other languages (such as JavaScript and VBScript). While JSP with Java will be more flexible and robust than scripting platforms based on simpler languages like JavaScript and VBScript.

JSP provides a number of server-side tags that allow developers to perform most dynamic content operations. So developers who are only familiar with scripting, or even those who are simply HTML designers, can use JSP tags for generating simple output. Advanced scripter or Java developers can also use the tags, or they can use the full Java language if they want to perform advanced operations in JSP pages.

2.11.5 Visual Basic.Net (VB.net)-Client Side

Visual Basic .NET 2003 provides the easiest, most productive language and tool for rapidly building applications for Microsoft Windows® and the Web. Ideal for existing Visual Basic developers as well as new developers in the Microsoft .NET development environment, Visual Basic .NET 2003 delivers enhanced visual designers, increased application performance, and a powerful integrated development environment (IDE) to get you on the fast track to application development. Developers can use Visual Basic .NET 2003 to Solve Today's Problems More Effectively. [15]

❖ Build Robust Windows-based Applications.

❖ Resolve Deployment and Versioning Issues.

❖ Easily Create Web Applications.

❖ Use Your Visual Basic Skills to Program Smart Devices.

❖ Provides Flexible, Simple Data Access.

❖ Get on the Fast Track to Building Tomorrow's Applications Today.

❖ Upgrade for Success

2.11.6 JavaScript-Client Side

When Netscape Communications Corporation began working on a scripting language called LiveScript, the scripting language quickly evolved into what is now JavaScript? Although JavaScript and Java is not the same thing, Netscape intends JavaScript to tie into Java; hence the name change. Netscape and Sun Microsystems (the developers of Java) are working closely on the development of the two languages. There are few other major differences between LiveScript and

JavaScript, the biggest being that LiveScript was case-insensitive and JavaScript is case-sensitive. [19]

JavaScript is a lightweight object-based scripting language for developing Internet applications. JavaScript is easy to learn and productive, in contrast to much more complex languages such as Java, C and C++.

JavaScript can be used to develop both server applications and client applications. JavaScript statements are embedded in Web pages, which are written in HTML (Hypertext Markup Language) to create interactive and dynamic pages. JavaScript is an extension to HTML that lets users create more sophisticated Web pages than with HTML alone.

2.11.7 VBScript-Client Side

The Microsoft Visual Basic Scripting Edition language (VBScript) is a simplified version of the Visual Basic for Applications family of programming languages. It also considered to be closely related to the BASIC programming language. [20]

VBScript was created by Microsoft to use either as a client-side scripting language for the Microsoft Internet Explorer or as a server-side scripting language with the Microsoft Internet Information Server (IIS).

Much of the power of VBScript comes from its ability to control the ActiveX controls that are available. It is a fairly straightforward exercise to create ActiveX controls using ActiveX Control Pad that is free from Microsoft.

One of the big drawback or perhaps the only disadvantage to use VBScript is that non-Internet Explorer browsers don't support it.

2.11.8 JScript-Client Side

JScript is the Microsoft implementation of the ECMA 262 language specification. It is a full implementation, plus some enhancements that take advantage of capabilities of Microsoft Internet Explorer. [15]

JScript is an interpreted, object-based scripting language. Although it has fewer capabilities than full-fledged object-oriented languages like C++ and Java, JScript is more than sufficiently powerful for its intended purposes.

The limitation in JScript is that standalone applications cannot be written in it and JScript also has little capability for reading or writing files. Moreover, JScript can run only in the presence of an interpreter, either in a Web server or a Web browser.

2.11.9 Hypertext Markup Language (HTML)-Client Side

Hypertext Markup Language (HTML) is the most popular language for creating Web documents. With fundamentals that are easy to learn and high-end capabilities that satisfy many advanced publishing requirements, HTML is the main language of Web publishing. HTML code is not always elegant; it does not lend itself to searching, and different browsers will frequently interpret the same HTML document differently, but at present HTML is the standard language of Web publishing. [4]

2.12 Web Application Development Tools

HTML can be typed in as a series of format codes (or scripts) in a plain text editor such as "vi" in UNIX or "Notepad" in Microsoft, or also generated from graphical

Web authoring software. Often Web authoring software is initially used to create the Web page, and the user modifies the resulting HTML code.

Development tools such as the Adobe Photoshop and the GIF Animator provides the users with easy to use environment towards creating productive animation (GIF file etc.) and graphical files. These tools are supplementary to the authoring tools in the development of Web-base programs or pages.

2.12.1 Microsoft Visual Studio.Net

Visual Studio .NET is a complete set of development tools for building ASP Web applications, XML Web services, desktop applications, and mobile applications. Visual Basic .NET, Visual C++ .NET, and Visual C# .NET all use the same integrated development environment (IDE), which allows to share tools and facilitates in the creation of mixed-language solutions. In addition, these languages leverage the functionality of the .NET Framework, which provides access to key technologies that simplify the development of ASP Web applications and XML Web services. Features of Visual Studio include:

❖ **Language Enhancement**

Microsoft Visual Basic, Microsoft C++, and Microsoft JScript have all been updated to meet your development needs. Additionally, a new language, Microsoft C#, has been introduced. These languages leverage the functionality of the .NET Framework, which provides access to key technologies that simplify the development of ASP Web applications and XML Web services.

❖ **Web Forms**

Web Forms are an ASP.NET technology that you use to create programmable Web pages. Web Forms render themselves as browser-compatible HTML and script, which allows any browser on any platform to view the pages. Using Web Forms, you create Web pages by dragging and dropping controls onto the designer and then adding code, similar to the way that you create Visual Basic forms.

❖ **XML Web Services**

XML Web services are applications that can receive requests and data using XML over HTTP. XML Web services are not tied to a particular component technology or object-calling convention and can therefore be accessed by any language, component model, or operating system. In Visual Studio .NET, you can quickly create and include XML Web services using Visual Basic, Visual C#, JScript, Managed Extensions for C++, or ATL Server.

❖ **XML Support**

Extensible Markup Language (XML) provides a method for describing structured data. XML is a subset of SGML that is optimized for delivery over the Web. The World Wide Web Consortium (W3C) defines XML standards so that structured data will be uniform and independent of applications. Visual Studio .NET fully supports XML, providing the XML Designer to make it easier to edit XML and create XML schemas.

2.12.2 Photoshop 5.5

Photoshop is a powerful graphics editing software package. It is becoming something of an industry standard due to its professional features. Web developers,

however, have always found that Photoshop comes up a little short. Version 5.5 introduced a lot of Web-friendly features, and despite a few minor deficiencies, (the main one being lack of support for animated GIFs), Photoshop can now claim to be a complete graphics powerhouse suitable for both online and print applications. [21]

Photoshop's improved Web support, in combination with ImageReady's cutting-edge Web features, lets you create, refine, and optimize Web graphics with ease, or produce Web animations, rollover effects, and other dynamic Web graphics. Selective refinements to the core set of image-editing tools help you mask complex images more easily and expand your creative power with new painting tools and contact sheets.

2.12.3 Ulead GIF Animator 4.0

Ulead GIF Animator 4.0 delivers a complete set of tools that lets users produce creative animation for Web pages, presentations and multimedia titles. GIF animator is commonly used to produce GIF animation files. GIF Animator 4.0 supports a wide variety of file types to be converted into GIF animations. The file types that are supported by Ulead GIF Animator 4.0 are BMP/RLE/UPI, EPS, GIF, IFF, IMG, JPEG, MAC, MSP, PCD, PICT, PCX, PNG, PSD, PSP, TGA, UFO, UGA, AVI, FLC/FLI/FLX, MOV/QT, and MPEG.

GIF Animator 4.0 has an improved tab-style interface for instant navigation between composing, editing, optimizing and previewing tabs. The filmstrip view mode also enables users to view frames in true scale with clear frame reference numbers. [22]

GIF Animator 4.0 also provides automation for the processes during the production of the animations such as the banners, icons etc.

Chapter 3 System Development Methodology

3.1 Introduction of System Development Methodology

A system development methodology is a very formal and precise system development process that defines a set of activities, methods, best practices, deliverables, and automated tools for system developers to develop and maintain most or all information systems and software. [23] This part of the deliverable is concerned with a review of the methodology to be used in system design part of the Asynchronous Distance Learning System. Methodology ensures that a consistent reproducible approach is applied to ADLS. It reduces the risk associated with shortcuts and mistakes. And it also produces complete and consistent documentation.

3.2 Project Methodology

It is an important to have a good procedure of design process before start doing any software development project. Effective development of a project depends on thoroughly systematic planning progress of the project. Thus, a plan must be drawn up to guide the development towards the project goals.

System or software development generally takes the form of life cycle. This life cycle refer as the system development life cycle (SDLC). All system goes through the same generic stages in their lifetime. [23] The stages are:

- ❖ Feasibility study
- ❖ Analysis and requirement specification
- ❖ Design
- ❖ Implementation

❖ Maintenance

The system development methodology is a method to create a system with a series of steps or operations or can be defined as system life cycle model. Every system development process model includes system requirements (user, needs, resource) as input and a finished product as output.
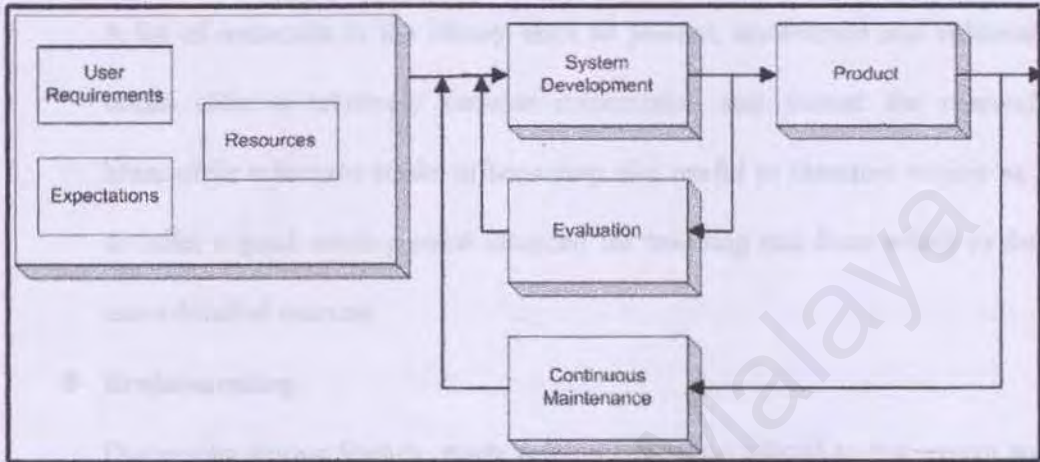

Figure 3.1: System Development Process Model

The software process consists of a set of steps that encompass methods, tools, and procedures. These steps are often referring to as software engineering paradigm or software life cycle models. There are many software engineering models:

❖ Build & fix model

❖ Waterfall model

❖ Rapid prototyping model

❖ Spiral model

❖ And other

The methodology or software engineering models use in Asynchronous Distance Learning System is Spiral Model. The research and development of ADLS will be in progress throughout two semesters.

3.2.1 Research and Analysis

The research and development of this ADLS system will be in progress throughout two semesters. In the process to gather the useful information for thesis project, there are several resources have been use.

- ❖ **Library and Bookshop**

  A lot of materials in the library such as journal, conference and reference books offer a relatively concise information and format for research. Meanwhile reference books in bookshop also useful in literature review as it do offer a good starting point intended for teaching and from which to find more detailed sources.

- ❖ **Brainstorming**

  Discussion among friends, study some information related to the project and have creative thinking can be helpful as providers of information about recent trends and latest technology. Furthermore we can have a research in more specialized sources.

- ❖ **Documents Room**

  These can be useful sources of information to gain the related information by studies the existing thesis. Several seniors thesis in the FSCIT document room can help to gain the skill of software development such as technology, software architecture and development tools.

- ❖ **Internet**

  Internet is the main resource in this project. It is the fastest-growing source of information or in another word it is the latest information that we can get. Since the Internet is the huge information warehouse, we can find and do a comparison for the resources gathered.

❖ **Questionnaire**

Questionnaire is a good technique to capture the general requirements, information and problems of real life systems. It can be regarded as the ultimate development of the structured interview plan. The precise interview's question can prepare according the feedback of questionnaire. Several informal people had been carried out between the students and lecturers about the current problems encounter in the ADLS system.

❖ **Interview**

Several informal interviews had been carried out between the student and lecturers in this faculty and other faculty about the current problems encounter in management of the course or ADLS and ICCS system.

3.2.2 Spiral Model

The development strategy used in the project is Spiral Model. The spiral methodology reflects the relationship of tasks with rapid prototyping, increased parallelism, and concurrency in design and builds activities. The spiral method can still be planned methodically, with tasks and deliverables identified for each step in the spiral.

The main purpose of this model is to make improvements over the traditional "Waterfall model". It emphasizes:

❖ Objectives and alternatives studies

❖ Risk analysis reviews

❖ Development/design reviews

❖ Reevaluations of work flows

The reason Spiral Model is chosen because spiral model implies learning at

all stages, redefining the problem as we go and vigorous examination of the solution's viability. Thus our learning culture leads us to spirals, but external forces and "the way it's always been done," lead to a waterfall approach. Other reason is Spiral makes us feel out of control, unplanned, and tends toward chaos; however, intermediate goals lend closure and easily traceable progress to our process.

The following are strong effect on productivity and the appearance of productivity of Spiral Model:

❖ Smaller investment at each level, iteration

❖ Requirements, and problem can shift

❖ Success criteria determined for each iteration

❖ Client may see product sooner, although product is likely to be of lower quality initially

❖ Inherent to the world, because the world is influenced by our design

❖ Product failure is just part of the design process, so no big deal

❖ Costs similar across the board

❖ Prototype dependent

The below are four phases are associated with each major cycle of the Spiral Model:

❖ Phase 1: The baseline approach and appropriate alternatives are developed to meet program objectives.

❖ Phase 2: The approaches are evaluated against the objectives, alternatives, and the risks associated with these approaches are evaluated.

❖ Phase 3: The prototype is evaluated, and the next level of the product is developed. This phase results in a prototype of the design.

❖ Phase 4: The product is reviewed, and plans for the next development stage are established.

The processes start in the center of the spiral. Each completed cycle along the spiral represents one stage of the process. As the spiral continues, the product matures.

Table 3.1: Table of Spiral Model Stage

Cycle	Step	
Cycle 1 – Early Analysis	Step 1:	Objectives, Alternatives, and Constraints
	Step 2:	Risk analysis and Prototype
	Step 3:	Concept of Operation
	Step 4:	Requirement and Life cycle Plan
	Step 5:	Objectives, Alternatives, and Constraints
	Step 6:	Risk Analysis and Prototype
Cycle 2 – Final Analysis	Step 7:	Simulation, Models, and Benchmarks
	Step 8:	Software Requirements and Validation
	Step 9:	Development Plan
	Step 10:	Objectives, Alternatives, and Constraints
	Step 11:	Risk Analysis and Prototype
Cycle 3 – Design	Step 12:	Simulation, Models, and Benchmarks
	Step 13:	Software Product Design, Validation, and Verification
	Step 14:	Integration and Test Plan
	Step 15:	Objectives, Alternatives, and Constraints
	Step 16:	Risk Analysis and Operational Prototype
Cycle 4 – Implementation and Testing	Step 17:	Simulation, Models, and Benchmarks
	Step 18:	Detailed Design
	Step 19:	Code
	Step 20:	Unit, Integration, and Acceptance Testing
	Step 21:	Implementation (Deployment)

In the Spiral methodology, as often quoted and viewed, the process spirals from stage to stage, with each spiral getting closer and closer to a final solution. However, the Spiral software engineering methodology also has a steady progress from one stage into the next stage with an explicit review between each stage. Thus the Spiral Model is a hybrid of both a sequential and a cyclical software engineering methodology. However, in engineering practice, the term spiral is used as a generic name to any cyclical software engineering methodology, including cycles leading to prototypes and multiple versions.
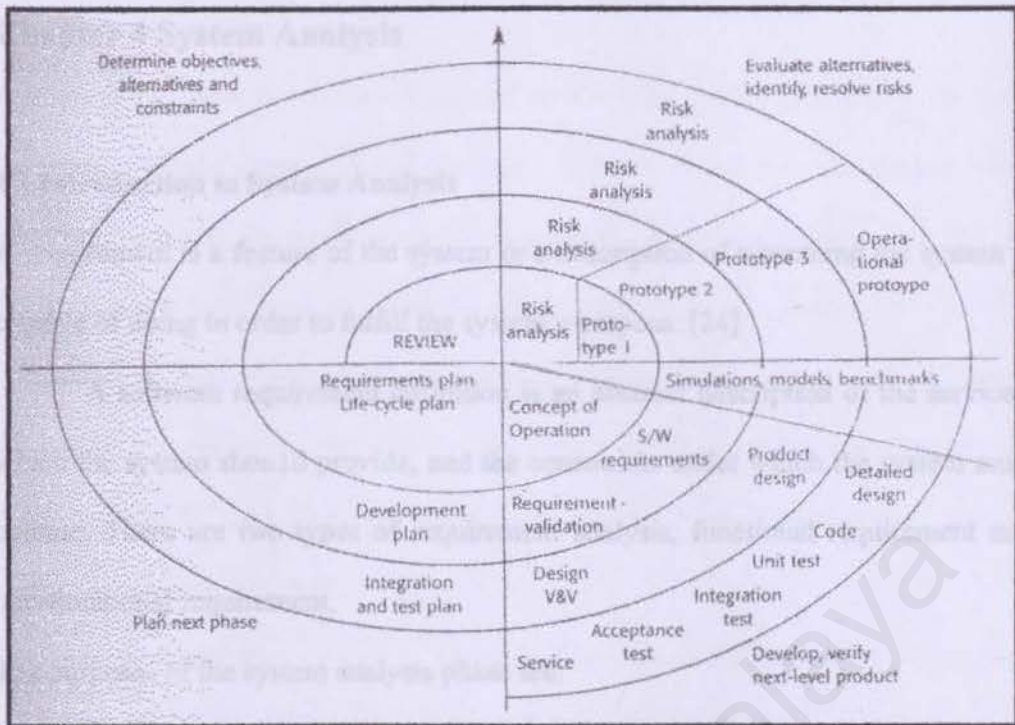
Figure 3.2: Chart of Spiral Model

Chapter 4 System Analysis

4.1 Introduction to System Analysis

A requirement is a feature of the system or a description of something the system is capable of doing in order to fulfill the system's purpose. [24]

A software requirement definition is an abstract description of the services, which the system should provide, and the constraints under which the system must operate. There are two types of requirement analysis, functional requirement and non-functional requirement.

The purposes of the system analysis phase are:

❖ To gain an overall understanding of system data flow and system process.

❖ To survey how available system of this type had been developed and how does it work.

❖ Research on how this system can be developed using current or latest new emerging technologies.

❖ To analyze and plan control features to develop a robust and reliable system.

❖ To identify the major components that will to be included in the system.

❖ To identify the software and hardware requirement to develop and reside the system.

4.2 Requirement Specification

A software specification definition is an abstract description of the services, which the System should provide, and the constraints under which the system must operate. There are two types of requirement analysis, functional and non- functional requirement.

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4.2.1 Functional Requirement

Functional requirements are statements of services the system should provide, how the system should react to particular inputs and how the system should behave in particular situation. In some cases, it also stated what the system should not do. Furthermore, it is independent from the implementation of the solution.

There are three main components recognized as the most important functional requirements for the Asynchronous Distance Learning System are Administrator Module, Lecturer Module and Student Module, which each module contains a few sub modules.

For administrator module, functional requirement consists of registration module for administrator, lecturers and lecturer management modules. The administrator also has the responsibility to manage the system database. For lecturer module, functional requirement includes asynchronous teaching and tutorials module, online quiz module and forum online. For student module, functional requirement includes asynchronous learning and tutorials module and online quiz module.

Furthermore, there is an authentication & authorization module and Bulletin Board module that control the access of those three levels of user.

4.2.1.1 Authentication and Authorization Module

ADLS system provides logging-on service and logging-off service to improving the security of authorization and authentication of the system by restricting access to database This module provides checking for user's level when user login to the system. This module will check the username and password that user key in and

users will be given the appropriate access to the system. The user need to key in valid username and password to be able to use the entire system.

ADLS also allow every user to change their password for security purpose. They can change it may be one month or other period of time up to the user. But the letter of the password must be more or equal to eight digits to enhancement system's security. This module allows each user has responsibility to add, update, and delete their information records in the ADLS management database.

4.2.1.2 Registration Module

The registration module divided into 3 parts that are administrator registration, lecturer registration and student registration.

4.2.1.3 Database Management Module

The database management module allows the administrator to manage and coordinate the database, which delete the outdated records, information, etc in databases. The module authorization in control the using storage database.

4.2.1.4 User Management Module

For this module, system identifies different role and status which different access control will give depending to their role and status. It is important for the security control system.

There are 2 parts of user management module. Firstly, administrator will mange lecturer. Another part is administrator will manage students. Basically, this module allow administrator to add and remove user, view and edit user's information and also give right to user.

4.2.1.5 Asynchronous Teaching Module

This module is to allow lecturer to create the lecture note using the existing template, which the different layout designs, background, graphics animation etc are prepared. This module also allow lecturer to create the lecture tutorial with uploading file in any file format such as .pdf, .doc, .ppt etc.

4.2.1.6 Asynchronous Learning Module

This module is to allow student to attend the lecture course. Student is allowed to download the lecture note in .doc file format and visit the relevant resources using the hyperlinks. Printing function is prepared for student print out the note in a standard format.

4.2.1.7 Online Tutorial Module

Lecturer will upload the tutorial to server. Then students can download the tutorials from the system.

4.2.1.8 Online Quiz Module

Lecturer will create the quiz question using the existing template, which the multiple choices and true-false question is allowed in this template. The module will automate to mark the student's answer and calculate the student's result.

For students can have a brief online quiz on the course studied. General rules and instruction for taking the test will be generated by the system. Result will be shown to the user after the test. A statistics of the test result will also be auto generated for the module instantly.

4.2.1.9 Forum Module

User can search for the discussion topics by using keywords in this module. Besides, user will also post new topic or question and reply to the related topic. Administrator may also delete a topic after the specific purge time. Lecturer also can post the solution to the discussion to let students more understand to the topic.

4.2.1.10 Bulletin board Module

Users can view the announcement made by the lecturer and administrator at the home main page when login the ADLS. The lecturer and administrator can post, update and remove an announcement instantly. But the student just allows viewing the announcement for bulletin board.

4.2.2 Non-Functional Requirement

Non-functional requirements are the other factors that must be taken into consideration in the systems development cycle. [20] These requirements are very subjective but they play important role to ensure the system robustness and successful. The non-functional requirements define the system properties and constraints.

A few considerations of non-functional requirements will be taken into account during the development of the ADLS system. These considerations include user-friendliness, robustness, correctness, loading time and respond time, reusability, expandability, modularity, functionality, reliability, efficiency, maintainability as well as security.

4.2.2.1 User-friendliness

User interfaces design creates an effective communication medium between human and computer. Therefore, it is very important to make sure that the interfaces fulfill user-friendliness so that it would not cause trouble to users. GUI design principles such as user familiarity and consistency shall be taken into considerations. The usage of intuitive and meaningful menus and icons are also required.

4.2.2.2 Robustness

The modules for ADLS system will be wholly tested to ensure each module achieve its expectation. The modules will be integrated and system testing will be started after the integration. Any error that is discovered during system testing will be solved immediately. This will provide a robustness measure to the system expectations and reduce the possibility of failures during the implementation of the system.

4.2.2.3 Correctness

A system must operate correctly or it provides little value to its users. Correctness is the degree to which the software performs its required function. To ensure this application quality, lots of testing and trial-and-errors will be carried out.

4.2.2.4 Loading Time and Respond Time

The system must be able to provide short loading and respond time (more critical if the system is online). All desirable information or downloads should be available to users at any point of time. The requirement for up-to-date information is also important. Slow loading time and respond time might cause the user to wait and

discourage them from using the system again. However, the system's performance sometimes depends on the hardware used.

4.2.2.5 Reusability

ADLS system should be build with program codes that are easy to maintain and modify. This will increase the reusability of the system to support other subjects and courses for the faculty FSCIT.

4.2.2.6 Expandability

ADLS system should be build with the capability to accept enhancement. The system should be able to include new features, functionality and supports for larger databases.

4.2.2.7 Modularity

Modularity means the system is broken into small modules so that distinct functions of objects could be isolated from one to another other. This will make the system testing and maintenance process easier because the processes can be done portion by portion and not involving the whole system.

4.2.2.8 Functionality

The functionalities stressed here are the searching and retrieving capability, which is very important in any web applications that deal with data retrieval from existing database. Besides, navigation and browsing features as well as application domain-related features will be taken into account.

4.2.2.9 Reliability

This system should reliable and should not cause unnecessary downtime of the overall environment. It should have set up the acceptable failure rate. However, It must be easily to be maintained simplicity and effective.

The system should be consistent when functioning. It should run smoothly although there are many web users using the system simultaneously. The system should not produce dangerous or costly failures when it is used in a reasonable manner.

4.2.2.10 Efficiency

Undeniable, efficiency is the main key for implementing the new meetings management system. Efficiency is understood as the ability of a process procedure to be called or accessed unlimitedly to produce similar performance outcomes at an acceptable or credible speed. Efficiency is measured base on response time performance, page generation speed and graphics generation speed.

4.2.2.11 Maintainability

System maintenance accounts would require more effort if the system is not designed according to good programming practices. Maintainability is the ease with which a program can be corrected if an error is encountered, adapted if its environment changes, or enhanced if the customer desires a change in requirements.

4.2.2.12 Security

The proposed system has also security measures to minimize the risk of data exposure to unauthorized people. The ADLS might require a very good firewall

protection and anti-virus software to protect against possible attack of hackers and viruses. Anyway, the ADLS to be developed will be using the authentication system, which is the login name and password as the basic protection.

4.3 Techniques Used To Gathered Requirements

In system analysis phase, I have used a few requirements gathering technique such as interview and questionnaire to gather the requirements from users like lecturers and students from University of Malaya (UM).

4.3.1 Interview

Interview has been gone though with our advisor Mr. Chiew Thiam Kian. Throughout the interview, Mr. Chiew has provided a lot of opinion based on his experience. He gave us some of the useful and efficient advice on the modules. Besides, he also provided us about the lecturers' requirements on the system such as the forum discussion part, question bank for students to have online quiz test and some other useful ideas.

4.3.2 Questionnaire

There are two types of user to gather requirements through questionnaire. They are lecturers from Faculty Computer Science and Information technology (FCSIT) and students from University of Malaya (UM).

4.3.2.1 Statistic Generated From Lecturers' Questionnaire

Question 1: How many student(s) per class that you usually handle?
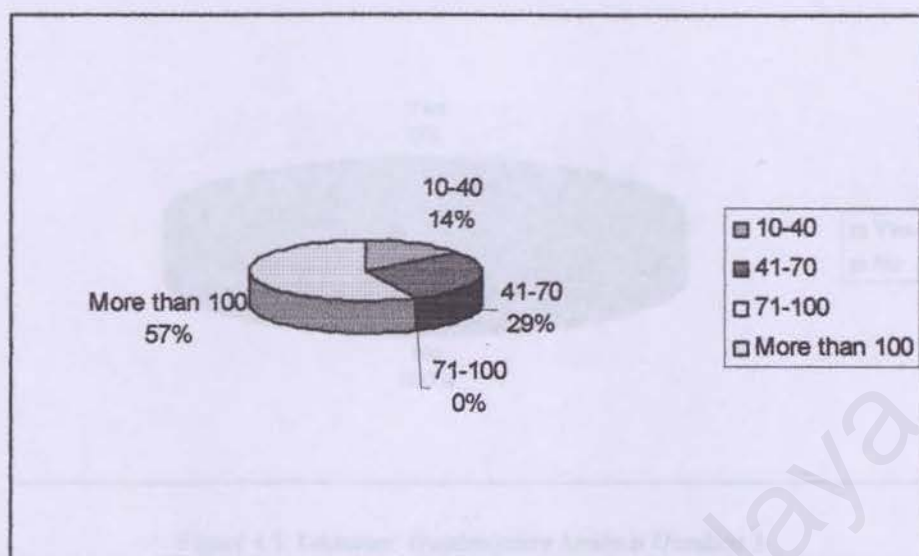
Figure 4.1: Lecturers' Questionnaire Analysis Question 1

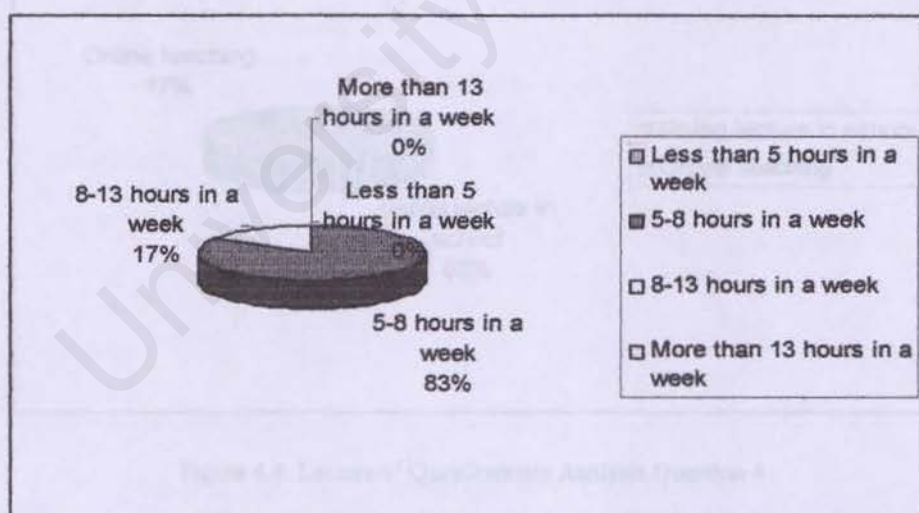**Question 2:** How many hour(s) do you spend for your lecture class in School/ University?

Figure 4.2: Lecturers' Questionnaire Analysis Question 2

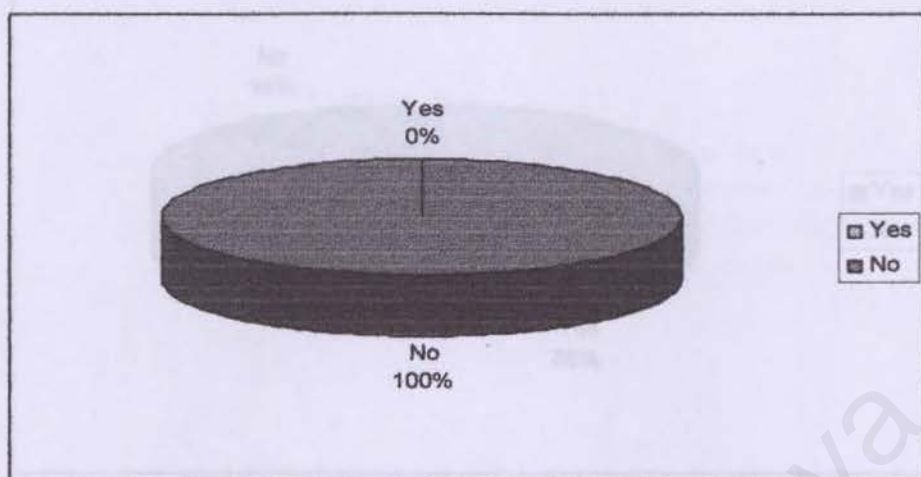**Question 3:** Do you think attending lecture class will limit students' strength on study compare to Asynchronous E-Learning system that study anytime, anywhere.

Figure 4.3: Lecturers' Questionnaire Analysis Question 3

Question 4: Which learning method do you MOST prefer?
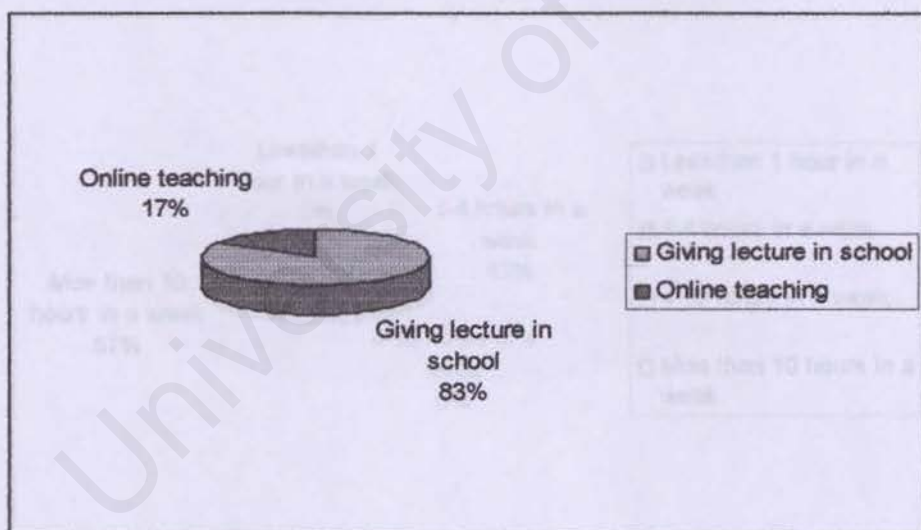
Figure 4.4: Lecturers' Questionnaire Analysis Question 4

Question 5: Do you have internet access at home?

No
14%

Yes
86%

□ Yes
■ No
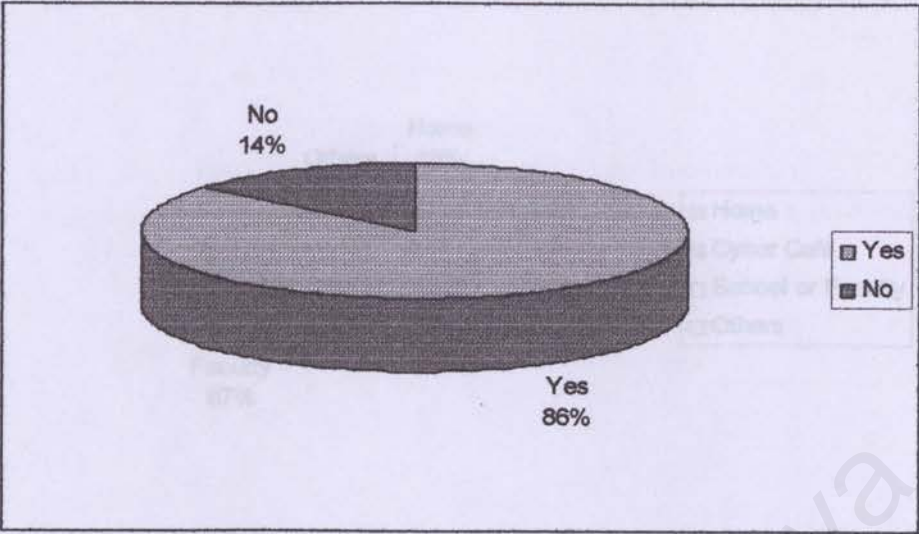
Figure 4.5: Lecturers' Questionnaire Analysis Question 5

Question 6: How often did you surf internet?

Lessthan 1
hour in a week
0%

1-4 hours in a
week
43%

Moe than 10
hours in a week
57%

4-10 hours in a
week
0%

□ Lessthan 1 hour in a
week

■ 1-4 hours in a week

□ 4-10 hours in a week

□ Moe than 10 hours in a
week
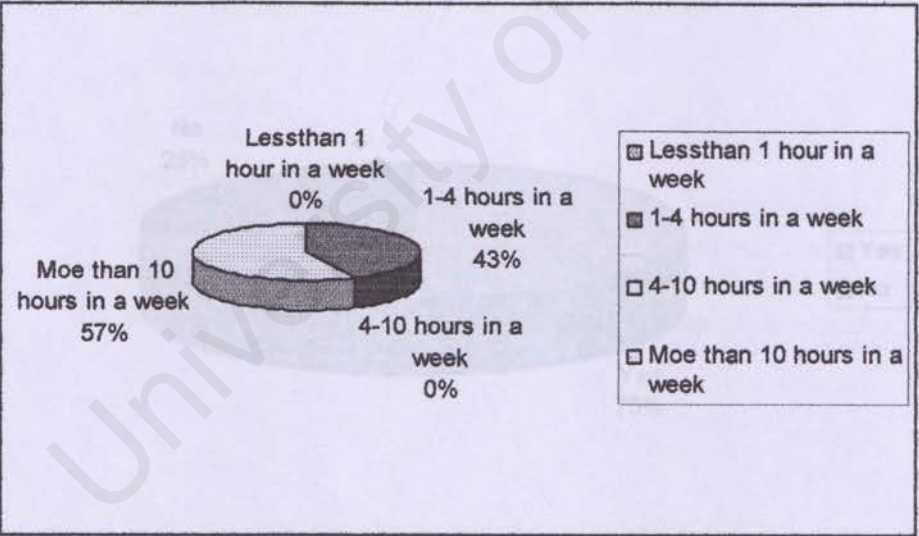
Figure 4.6: Lecturers' Questionnaire Analysis Question 6

Question 7: Where do you surf internet most OFTEN?
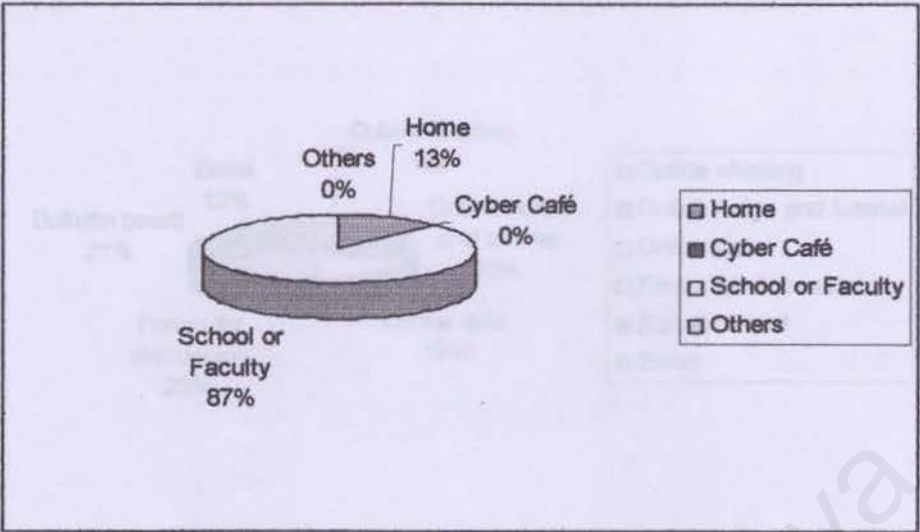
Figure 4.7: Lecturers' Questionnaire Analysis Question 7

Question 8: Have you use the E-Learning tools before?
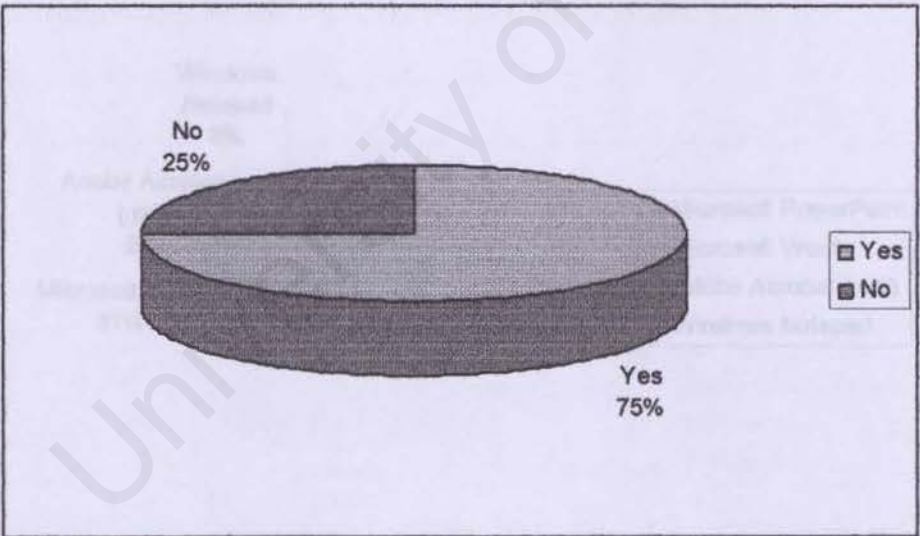
Figure 4.8: Lecturers' Questionnaire Analysis Question 8

81

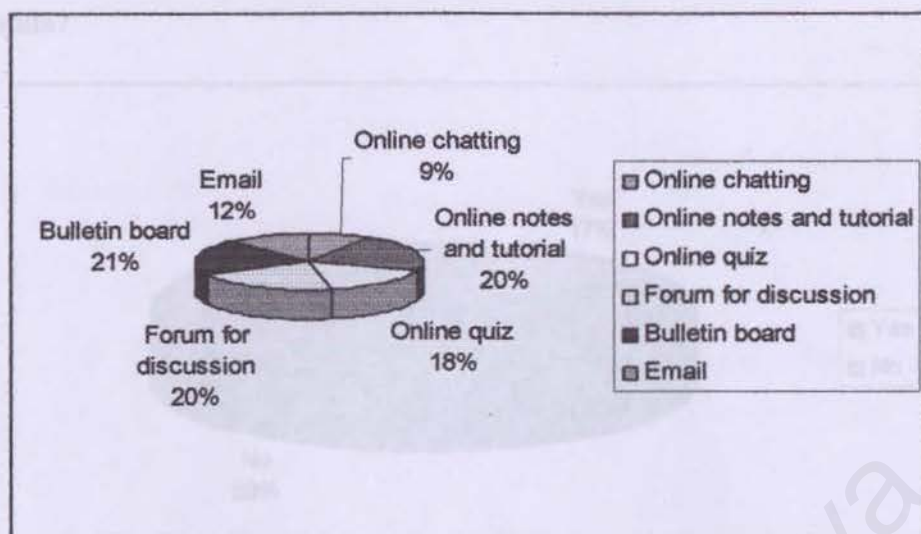**Question 9:** What do you expect in the Asynchronous E-Learning system?

Figure 4.9: Lecturers' Questionnaire Analysis Question 9

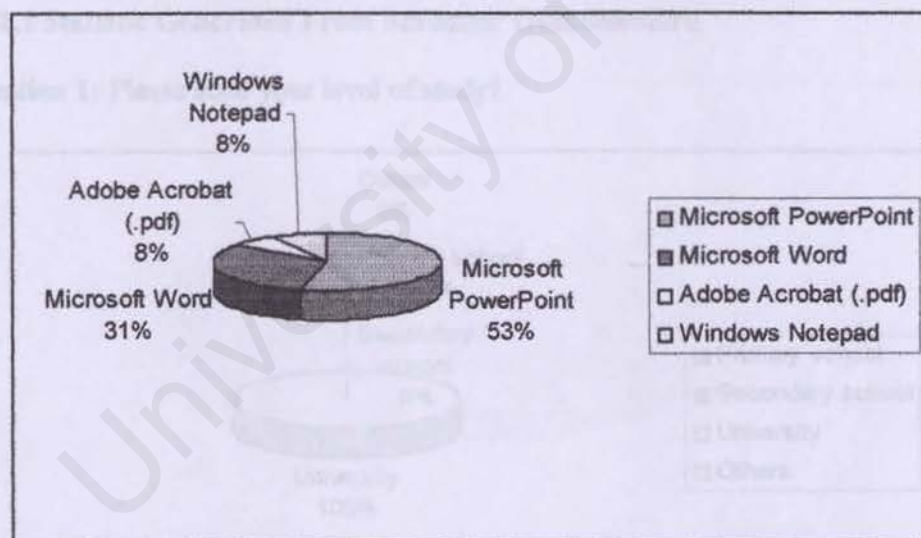**Question 10:** Which learning tool(s) do you prefer for preparing your lecture notes?

Figure 4.10: Lecturers' Questionnaire Analysis Question 10

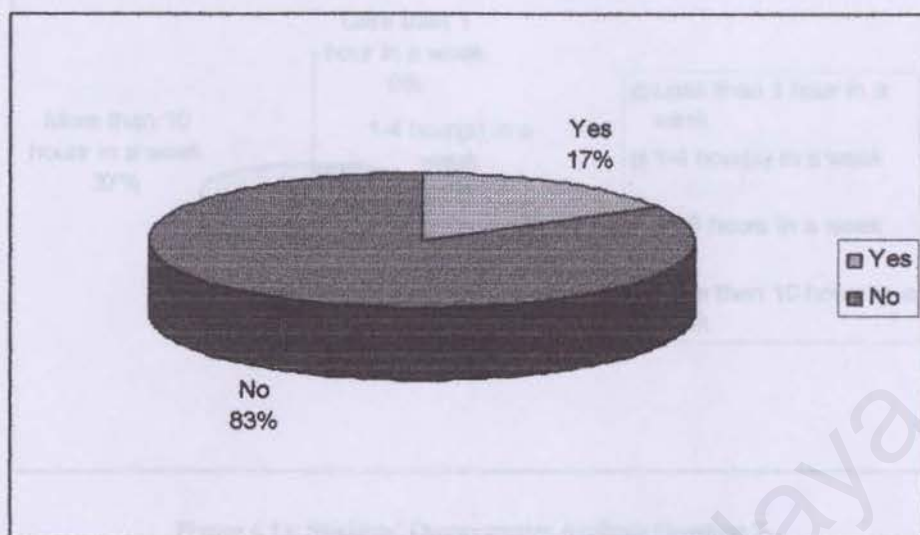**Question 11:** Do you think your university will implement fully E-Learning method in future?

Figure 4.11: Lecturers' Questionnaire Analysis Question 11

4.3.2.2 Statistic Generated From Students' Questionnaire
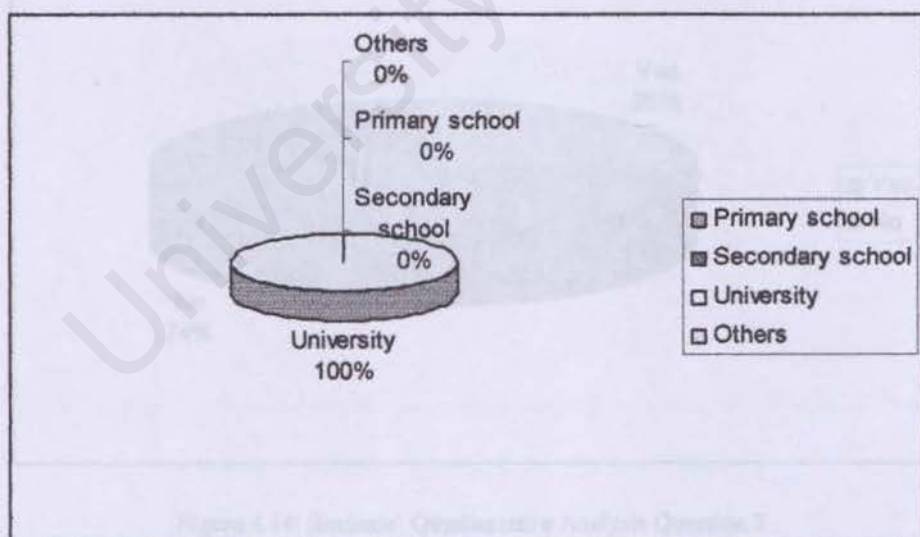
Question 1: Please state your level of study?

Figure 4.12: Students' Questionnaire Analysis Question 1

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Question 2: How many hour(s) do you spend for your study in School/ University?
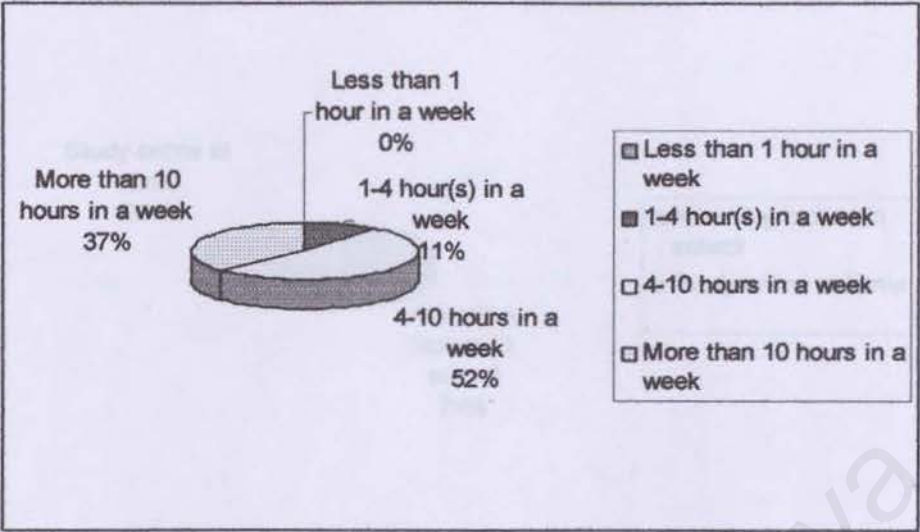

Figure 4.13: Students' Questionnaire Analysis Question 2

Question 3: Do you think attending lecture class will limit students' strength on study compare to Asynchronous E-Learning system that study anytime, anywhere?
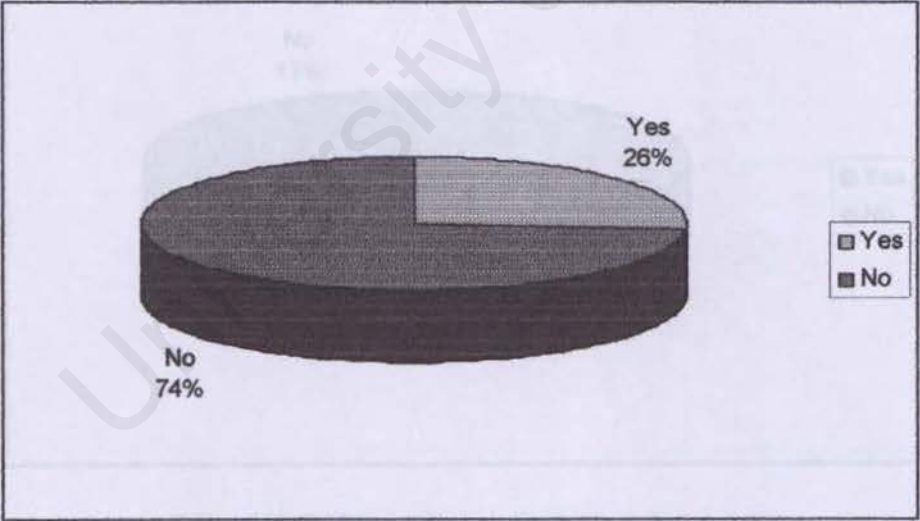

Figure 4.14: Students' Questionnaire Analysis Question 3

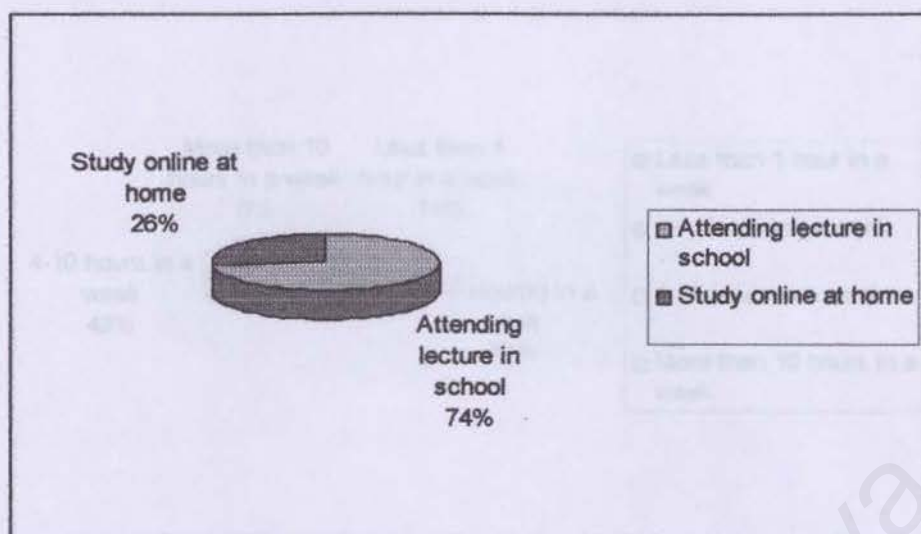**Question 4:** Which learning method do you MOST prefer?

Figure 4.15: Students' Questionnaire Analysis Question 4

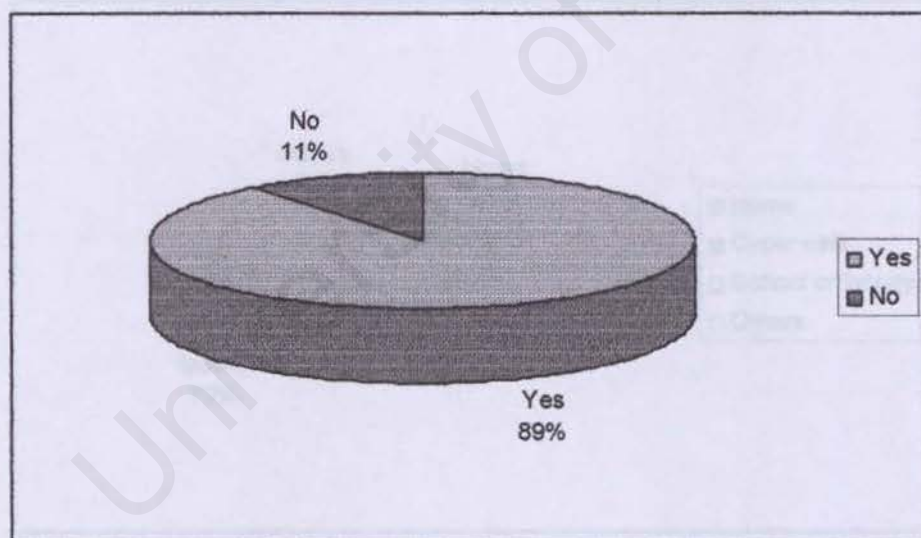**Question 5:** Do you have internet access at home?

Figure 4.16: Students' Questionnaire Analysis Question 5

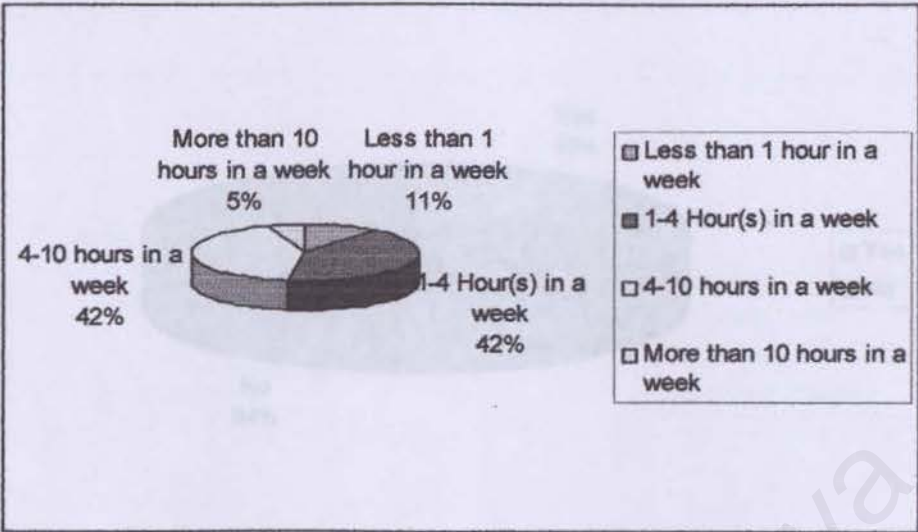**Question 6:** How often did you surf internet?

Figure 4.17: Students' Questionnaire Analysis Question 6

Question 7: Where do you surf internet most OFTEN?
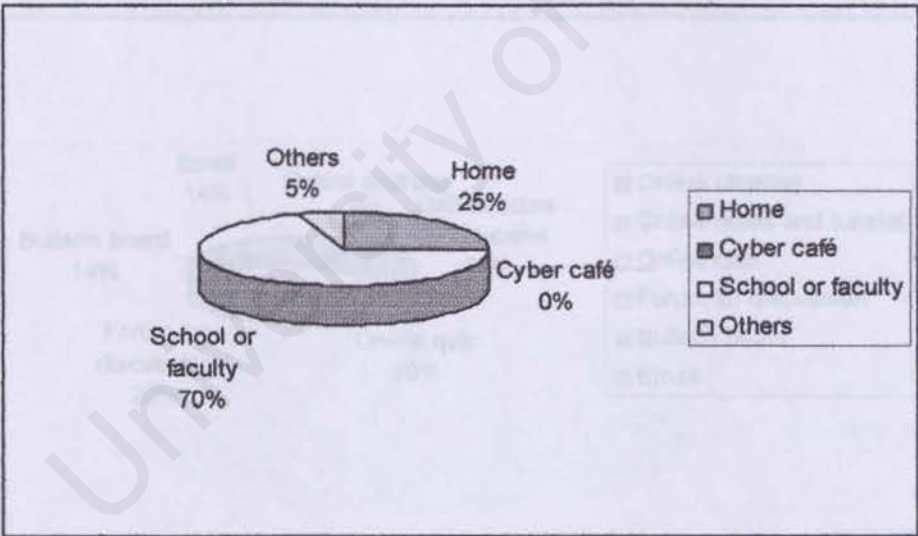

Figure 4.18: Students' Questionnaire Analysis Question 7

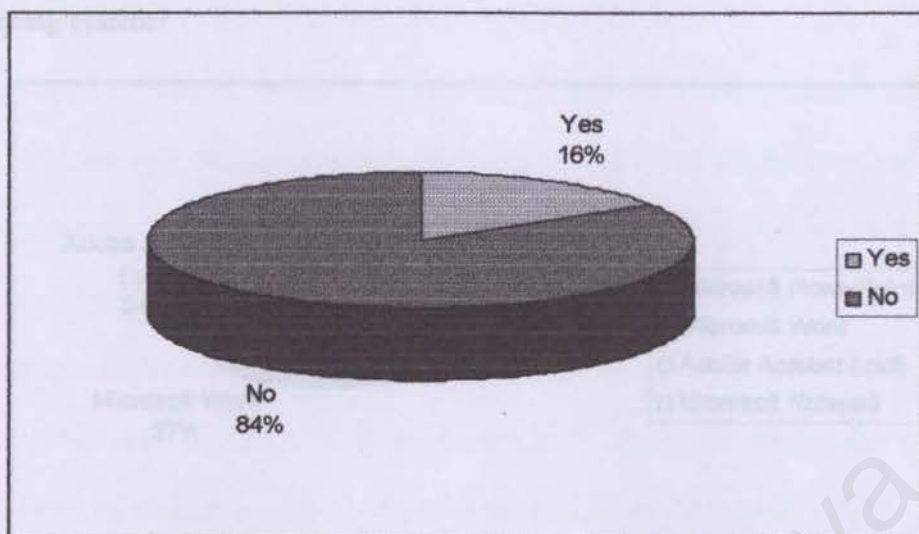**Question 8:** Have you used the E-Learning tools before?

Figure 4.19: Students' Questionnaire Analysis Question 8

Question 9: What do you expect in the Asynchronous E-Learning system?
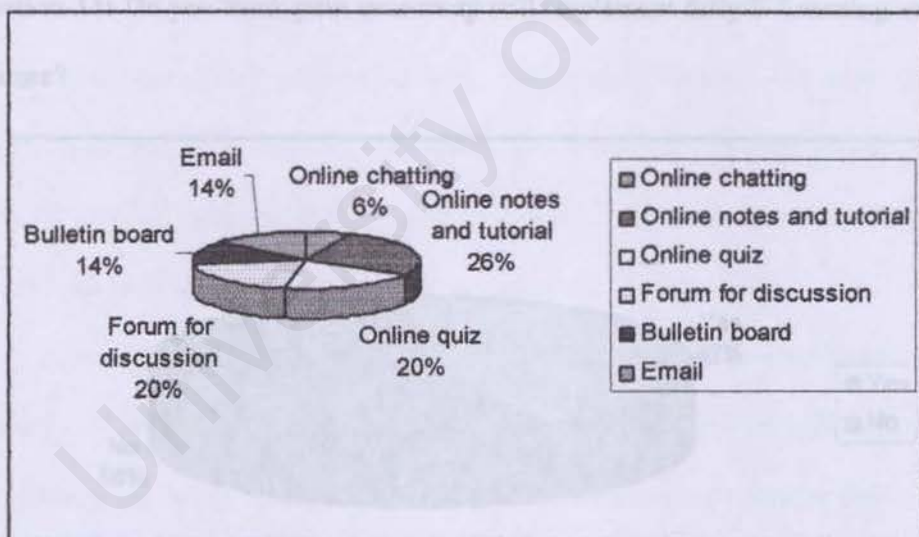
Figure 4.20: Students' Questionnaire Analysis Question 9

Question 10: Which learning tool(s) do you prefer in your lecture notes for E-Learning system?
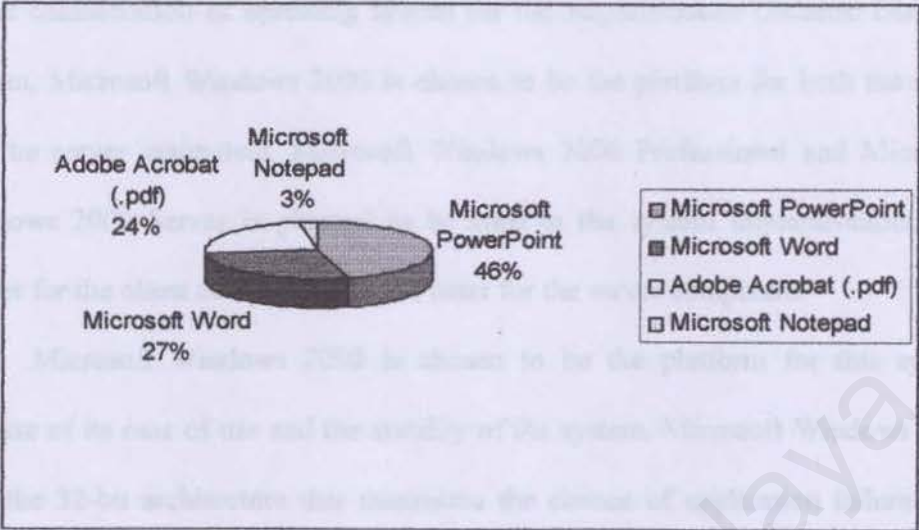

Figure 4.21: Students' Questionnaire Analysis Question 10

Question 11: Do you think your university will implement fully E-Learning method in future?
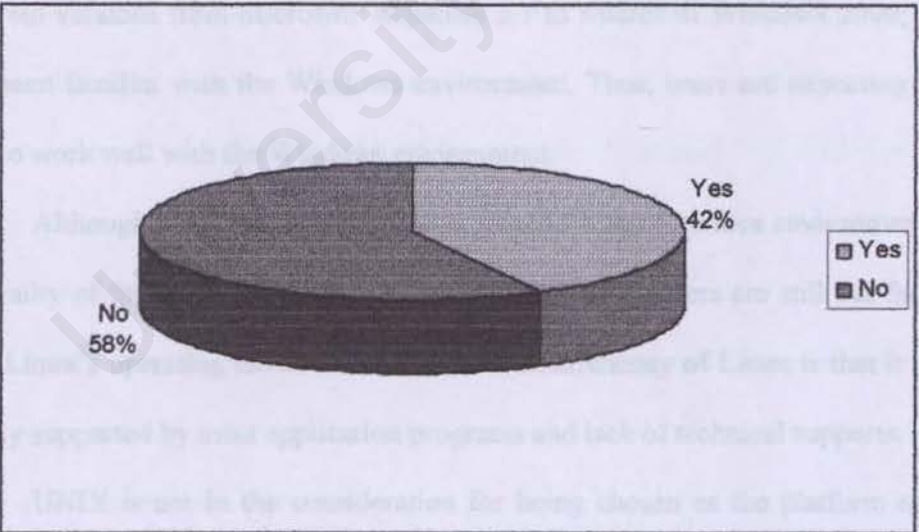

Figure 4.22: Students' Questionnaire Analysis Question 11

4.4 Technology Consideration

4.4.1 Development Platform – Microsoft Windows 2000

In the consideration of operating system for the Asynchronous Distance Learning System, Microsoft Windows 2000 is chosen to be the platform for both the client and the server computers. Microsoft Windows 2000 Professional and Microsoft Windows 2000 Server is planned to be used in the system implementation; the former for the client computers and the latter for the server computers.

Microsoft Windows 2000 is chosen to be the platform for this system because of its ease of use and the stability of the system. Microsoft Windows 2000 uses the 32-bit architecture that minimizes the chance of application failures and unplanned reboots. The stability of the system is an important feature that could affect the effectiveness and the fluency of the examination held.

Another important consideration for the platform is that it should be user-friendly and user should be familiar with. Microsoft Windows has gone through different versions from Microsoft Windows 3.1 to Microsoft Windows 2000; users had been familiar with the Windows environment. Thus, users are expecting to be able to work well with the Windows environment.

Although the Linux also provides a graphical user interface environment, but the frailty of the operating system is that most computer users are still not familiar with Linux's operating environment. Another insufficiency of Linux is that it is not widely supported by most application programs and lack of technical supports.

UNIX is not in the consideration for being chosen as the platform of this system because the command-based platform is not user-friendly and is difficult for novice users to learn. Another weakness in the operating system is the lack in central standardization of versions.

4.4.2 Development Web Server – Internet Information Services

The Microsoft Internet Information Server (IIS) is chosen for as the Web server in the development of the Asynchronous Distance Learning System. IIS is built on the Windows NT security model, which helps to protect the computer and its resources by requiring assigned user accounts and passwords. This security function is important and required in this system to prevent any unauthorized users from accessing resources.

Another reason for choosing IIS as the Web server is that Microsoft provides the Web server with its Windows 2000 products, which means that no extra installation is needed. Microsoft also provides full technical support for IIS that makes the Web server reliable. As a product of Microsoft, IIS is an easy to use Web server and provides a short learning period for the system administrator to familiarize with IIS. The most advantageous of IIS is the ability to support Active Server Pages (ASP).

Although, Personal Web Server (PWS), which is another product from Microsoft, also provides services and features similar to IIS is not in the consideration for this system. The reason for not choosing PWS that it is much simple and compact than IIS, thus it is more suitable for the use of developing simple personal Web pages rather than much-complicated pages.

Other Web server, such as the Apache, and Netscape Enterprise Server are commonly used as to support Java Servlet and Java Server Pages, thus not suitable in the development of this system.

4.4.3 Development Database System – Microsoft SQL Server 2000

SQL Server 2000 will be used as the database server for the development of Asynchronous Distance Learning System. The advantages of SQL Server 2000 over other database server are that it is the record-holder of important benchmark awards for scalability and speed. As the SQL Server 2000 is a fully Web-enabled database product; thus, it is generally suitable to be used in this system.

SQL Server 2000 features the ability to interactively tune and debug queries, quickly move and transform data from any source, and define and use functions as if they were built in to Transact-SQL. In such case, SQL Server 2000 is able to transfer information from current system to the new file system. This provides great ease and flexibility to handle and integrate the current student information system.

In addition SQL Server is outperformed than most other database server. This is because it includes a superset the ANSI standard SQL language elements that is not included in other database server.

4.4.4 Development Script Language

As a conclusion, the following scripting languages will be used in the development of Asynchronous Distance Learning System include ASP, VBScript, JavaScript and HTML.

HTML will be used for the general scripting language for the display environment, which is the graphical and the text-based contents.

Although JavaScript and the VBScript provides a common function in Web development but both the scripting languages have their own advantages over the others. JavaScript will be used in the client side programming as it integrates well

with most Web browsers. It is also able to integrate with the Microsoft Web browser, which is chosen as the Web browser for ADLS system.

ASP will be used to program the requests from client computers. It will be used to access the database to retrieve information from SQL Server 2000 through ODBC.

ASP is chosen over PHP and JSP because it is much easier to code using the former than the latter. This not only provide the ease of development in the ADLS system but also provides a long term planning for the future as ASP is much easier to maintain and modified by system administrators or other developers.

4.4.5 Web Application Development Tools

As a conclusion, the following authoring and development tools will be used in the development of Asynchronous Distance Learning System:

- ❖ Microsoft Visual Studio 6.0
- ❖ Adobe Photoshop 5.5
- ❖ Ulead GIF Animator 4.0

Microsoft Visual Studio 6.0 (Interdev) will be used during the development of ADLS system. This is because ADLS system will be develops by the ASP.

The other web application development tools like Abode Photoshop 5.5 and Ulead GIF Animator 4.0 will be use to draw or modify graphics picture when design the interface ADLS system. Abode Photoshop 5.5 is used to draw the JPEG format picture and the Ulead GIF Animator 4.0 is suitable for the GIF format animation picture.

4.5 Run-Time Requirement

4.5.1 Server Hardware Requirement

The minimum requirement for the server is:

- ❖ A server that with the processor power no less than 500 MHz.

- ❖ At least 256 MB RAM of memory.

- ❖ 2.0 GB of free hard disk apace.

- ❖ Network interface card (NIC) and network connection with recommended bandwidth at 10 Mbps or more.

4.5.2 Server Software Requirement

To host and run the system, the server needs to have various supporting software.

- ❖ Windows NT or Windows 2000 server function as Network OS.

- ❖ Internet Information Services (IIS) 5.0 function as Web Server Service.

- ❖ ASP function as Server Scripting Engine.

- ❖ Microsoft SQL Server 2000 function as database Server.

- ❖ Microsoft Internet Explorer 5.0 (as Precondition for ASP.NET Installation).

4.5.3 Client Hardware Requirement

The client hardware requirements are quite minimal as long as it has a reasonable amount of RAM and a reasonable quality dial-up connection line.

The recommended configurations are:

- ❖ Computer that the processor power not less than 300 MHz.

- ❖ At least 128 MB memory.

- ❖ Network connection either modem (at least 28.8 bps) or NIC with recommended bandwidth at 10Mbps or more.

4.5.4 Client Software Requirement

The client software requirements fall on the browser used by users. It requires Microsoft Windows family operating system that can run Microsoft Internet Explorer 5.0 and above or any other browsers that support ActiveX and VBScript. Besides, Microsoft Outlook should also present for mail application.

Chapter 5 System Design

5.1 Introduction of System Design

Design is a meaningful engineering representation of something that must be built. The system design phase is the phase in which requirements produced in the system analysis phase are translated into a representation of the system. This phase will be focused on architectural design, functional design, user interface design and database design. [25]

5.2 Functional Design

In this section, two subjects will be covered, that is the system structure and the process design.

5.2.1 System Structure

The system structure of ADLS is decomposed into three major parts, which are the Administrator Module, Lecturer Module and Student Module. Each module is further divided into sub-modules. The requirements of each module were describe in Section 4.2.1 previously. Below shows the structure charts for the three major modules. For ADLS, users are divided to the three main modules, which are the Administrator, Lecture and Student Module.
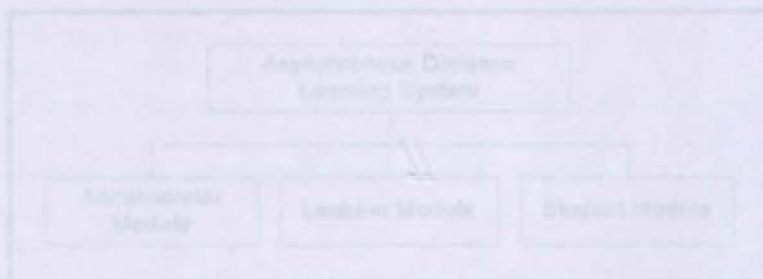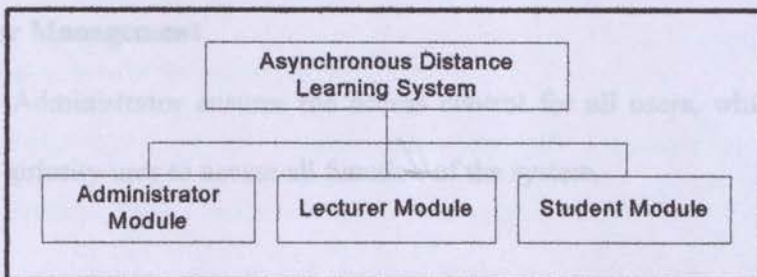

Figure 5.1: Module of Asynchronous Distance Learning System

Administrator Module

The following are description of the sub module for the administrator module:

❖ **Authentication & Authorization**

- Administrator must login before they access into the ADLS system with they user name and password.

- Administrator must logout before leaving the system. If not, the system will auto logout for the administrator.

- If administrator forget they password, system will remember the password to lecturer, which administrator must answer some questions that the questions are setup by administrator themselves.

- Administrator can change their record after they are successful login.

- Administrator can change their password after they are successful login into the system.

❖ **Registration**

- All ADLS system staff must sign up.

- UserID will create automatic by the system.

❖ **Bulletin Board**

- Administrator add, update, delete and view the notices at bulletin board.

❖ **E-Mail**

- Administrator can send e-mail.

❖ **User Management**

- Administrator ensures the access control for all users, which limit the priority user to access all function of the system.

❖ **Database Management**

• Administrator must manage or maintain the records and data in the database ADLS system.
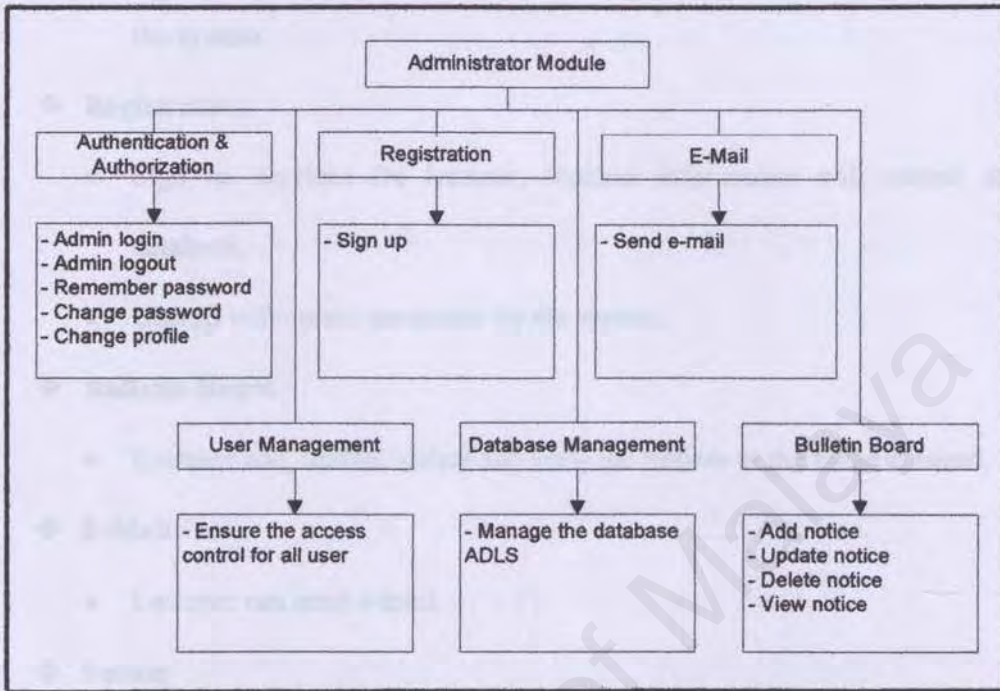

Figure 5.2: Administrator module of Asynchronous Distance Learning System

Lecturer Module

The following are description of the sub module for the lecturer module:

❖ **Authentication & Authorization**

• Lecturer must login before they access into the ADLS system with they user name and password.

• Lecturer must logout before leaving the system. If not, the system will auto logout for the lecturer.

• If lecturer forget they password, system will remember the password to lecturer, which lecturer must answer some question that the questions are setup by lecturer themselves.

- Lecturer can change their record after they are successful login into the system.

- Lecturer can change their password after they are successful login into the system.

❖ **Registration**

- Sign up services for lecturer, lecturer information will record into database.

- UserID will create automatic by the system.

❖ **Bulletin Board**

- Lecturer add, update, delete and view the notices at the bulletin board.

❖ **E-Mail**

- Lecturer can send e-mail.

❖ **Forum**

- Lecturer can post, reply, view and delete the forum topics.

- Search function is prepared to speed up for finding the relevant topics.

❖ **Asynchronous Teaching**

- Lecturer creates the lecture note using the existing template, which like the slide show of Microsoft Power Point.

- The template prepares a few effects such as graphics animation, blinking effect and so on.

- A few of templates are preparing for different courses or subjects, which different background color, layout design etc.

- Lecturer can hyperlink any relevant learning resources (teaching material such as web site, video, flash, graphics picture) to their lecture note.

- Lecturer also can upload the lecture note in other file format like .pdf, .doc, ppt, etc.

- Lecturer may upload the reference or appendix (such as e-book, hyperlinks, e-dictionary) in zip file format. Any upload file's size will be control by the system.

- Lecturer may add, update and delete course information, which any modification will inform to student using the auto sending e-mail function (optional).

❖ **Online Tutorial**

- Lecturer uploads the tutorial (question and answer).

❖ **Online Quiz**

- Lecturer creates the quiz using the existing template.

- Template supports the multiple choices and true-false questions.

- The multiple choices and true-false question will auto marked by the ADLS system, which the answer is prepared by lecturer already.

- All questions will store into a question bank that the question quiz test will choice from question bank randomly. So, the different question for quiz tests.

- System will auto classify the status student to very bad, bad, good and excellent according to their quiz result.

- The student's progress will auto analysis and present in a statistic graph.
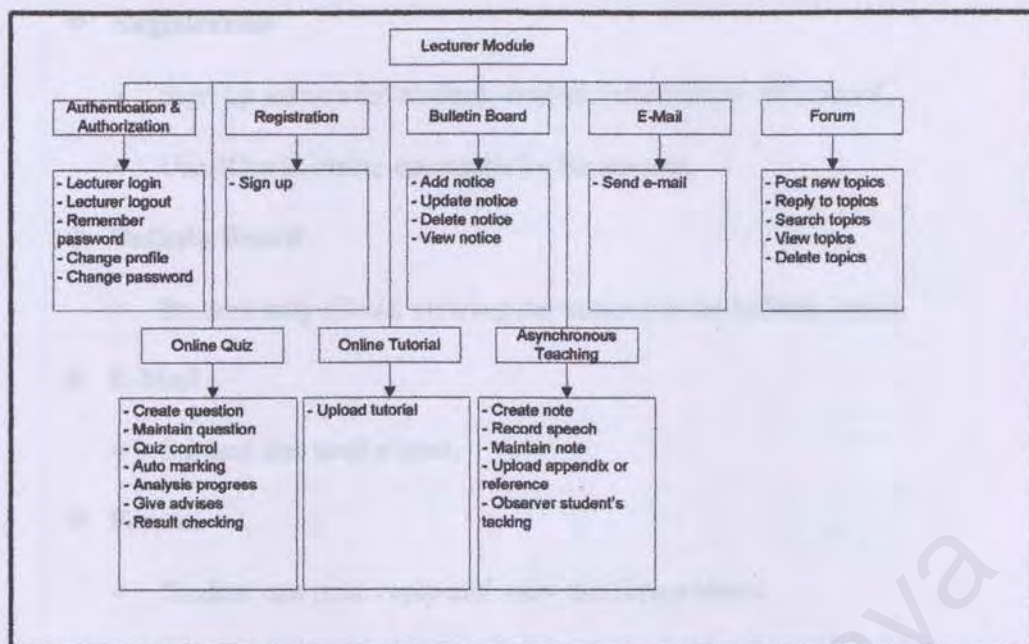
Figure 5.3: Lecturer module of Asynchronous Distance Learning System

Student Module

The following are description of the sub module for the student module:

❖ **Authentication & Authorization**

- Student must login before they access into the ADLS system with they user name and password.

- Student must logout before leaving the system. If not, the system will auto logout for the student.

- If student forget they password, system will remember the password to student, which student must answer some question that the questions are setup by student themselves.

- Student can change their record after they are successful login into the system.

- Student can change password after they are successful login into the system.

❖ **Registration**

- Sign up service for student, student information will record.

- UserID will create automatic by the system.

❖ **Bulletin Board**

- Student only allows viewing the notices at the bulletin board.

❖ **E-Mail**

- Student can send e-mail.

❖ **Forum**

- Student can post, reply and view the forum topics.

- Search function is prepared to speed up for finding the relevant topics.

❖ **Asynchronous Learning**

- Student attends the course lesson, which ready registered by the student.

- Student may visit any learning resources, which prepared by the lecturer using the hyperlinks.

- Student can download the note, reference/appendix from ADLS in the certain file format.

- Printing function is prepared; student can print out the lecture note in a standard format (The note must be created by the template).

❖ **Online Tutorial**

- Student can download the tutorial in a standard file format.

❖ **Online Quiz Test**

- Student must finish the quiz in a specific period. If students haven't done it, the system will stopped and submit the students' answer automatically.

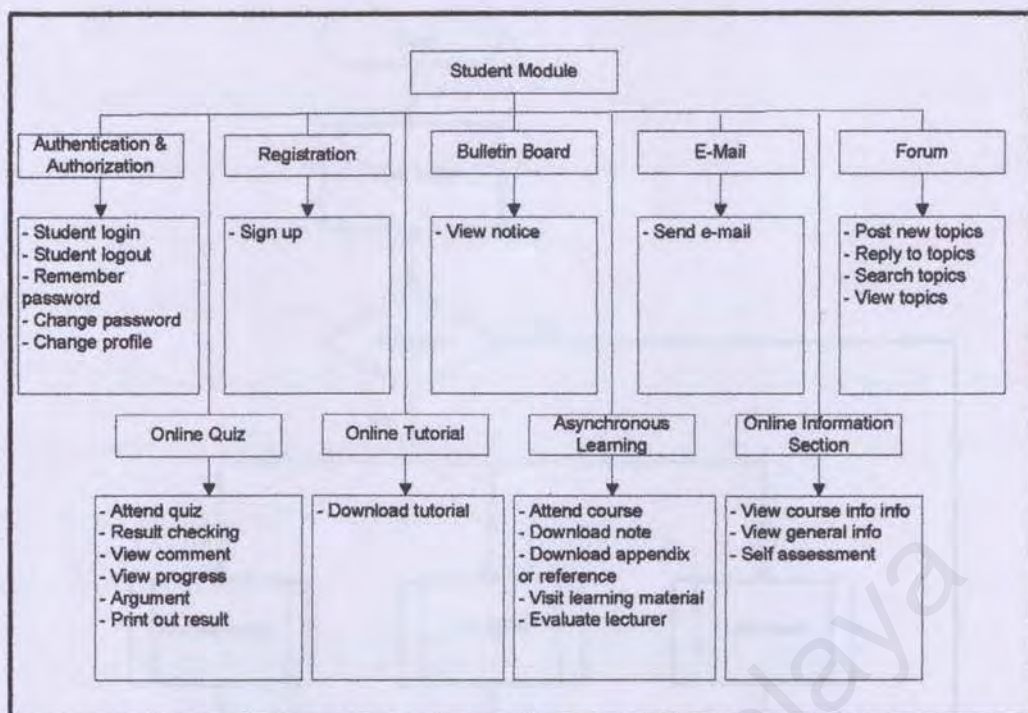- Student can check their result and progress.

Figure 5.4: Student module of Asynchronous Distance Learning System

5.2.2 Architectural Design

In architectural design, large systems are decomposed into sub-systems that provide some related set of services. This is the initial design process of identifying sub-systems and establishing a framework for sub-system control and communication. Besides, the sub-systems that make up the whole system and their relationships are identified and documented.

This project design is based on data flow oriented design. It is also called structured design. This type of design stresses on modularity, top-down design and structured programming.
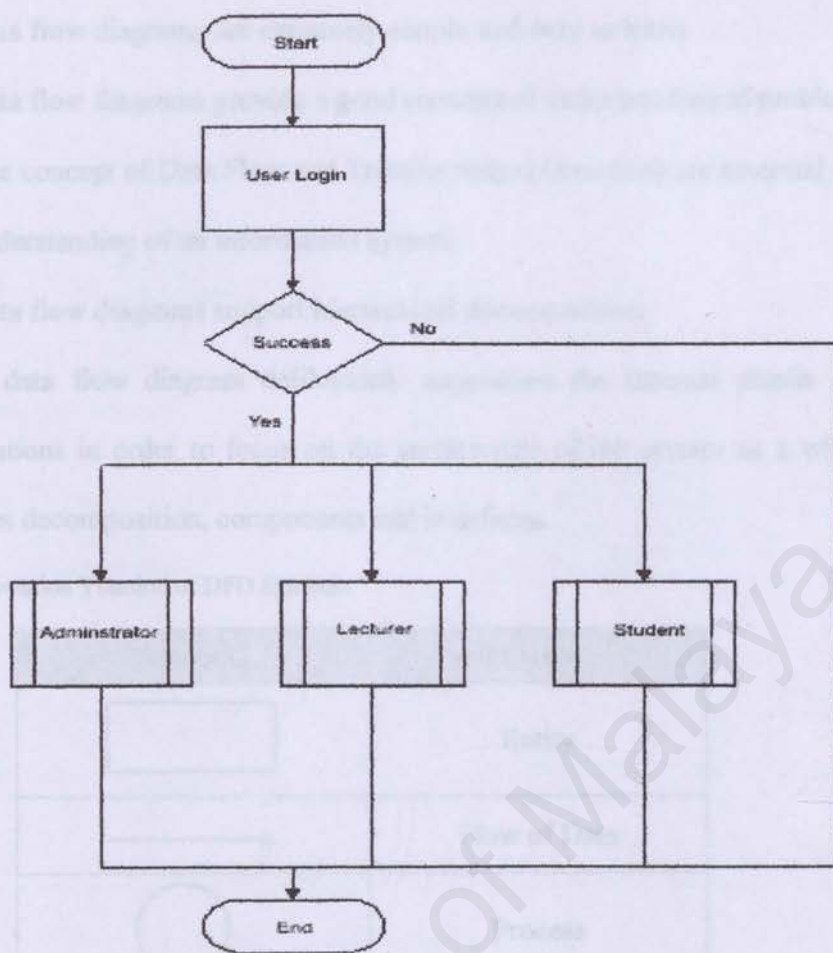
Figure 5.5: System flow chart of ADLS

5.2.3 Process Design

A data flow diagram (DFD) is a technique used to show graphical characterization of the data process and flows in the system. The DFD gives an overview of system inputs and outputs, processes and flows of data through each process. [25]
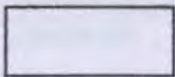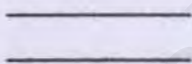
Data flow diagrams were promoted in 1970s by Yourdon, DeMarco, Gane and Sarson, and others. In the 1980s, Data flow diagrams were used alongside data models (ERDs).

The advantages of using Data flow diagrams as graphical notation are as stated below:

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- ❖ Data flow diagrams are extremely simple and easy to learn.

- ❖ Data flow diagrams provide a good conceptual understanding of problems.

- ❖ The concept of Data Flow and Transformation (function) are essential for the understanding of an information system.

- ❖ Data flow diagrams support hierarchical decomposition.

A data flow diagram deliberately suppresses the internal details of the transformations in order to focus on the architecture of the system as a whole. It emphasizes decomposition, components and interfaces.

Table 5.1: Notation Yourdon of DFD Symbols

Symbols	Attribute
▭	Entity
⟶	Flow of Data
◯	Process
═	Data Store

As seen above, two types of DFD notations that are usually used are the Gane and Sarson, and the Yourdon notations. Both the notations have the same function but a bit different in shapes. In the following data flow diagrams, the Yourdon notation will be used. The Yourdon notation is chosen over Gane and Sarson because the notation for process and entity are much distinctive in for the former than the latter.

Data flow diagrams usually are made after a context diagram has been created. The context diagram functions as the basis of a data flow diagram.

The following shows the context diagram for Asynchronous Distance Learning System. The diagram is drawing by using the Yourdon notation.
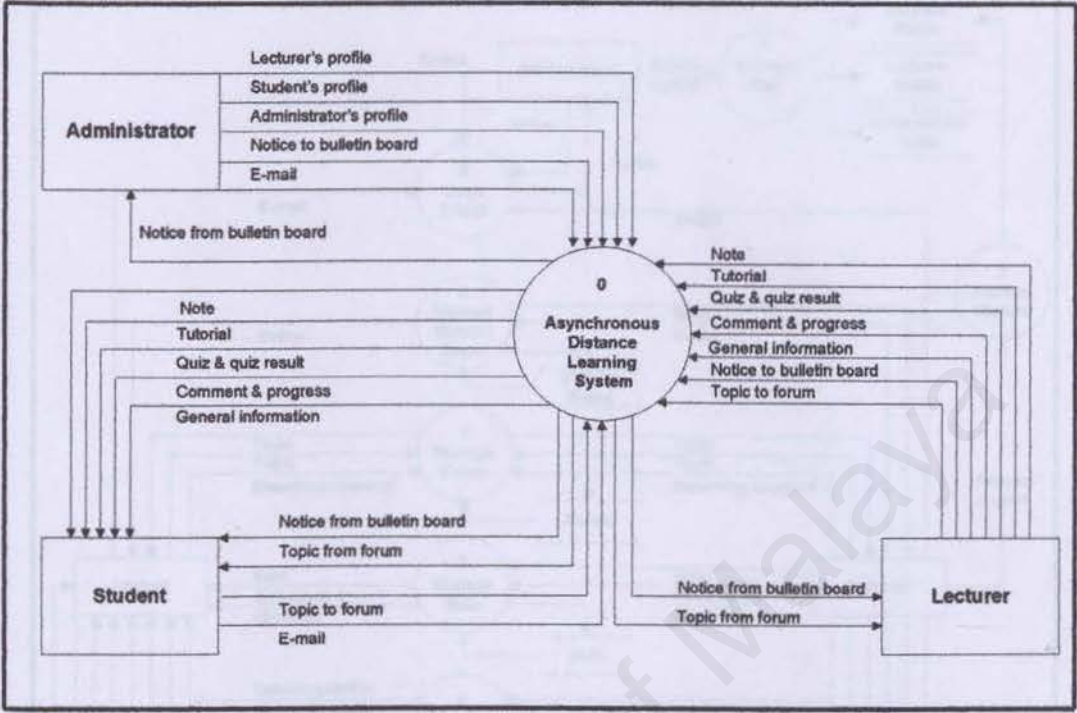
Figure 5.6: Context Diagram of ADLS

The following shows the data flow diagram in level 0 for Asynchronous Distance Learning System. The diagram is drawing by using the Yourdon notation.

Figure 5.7: Data Flow Diagram for ADLS in Level 0

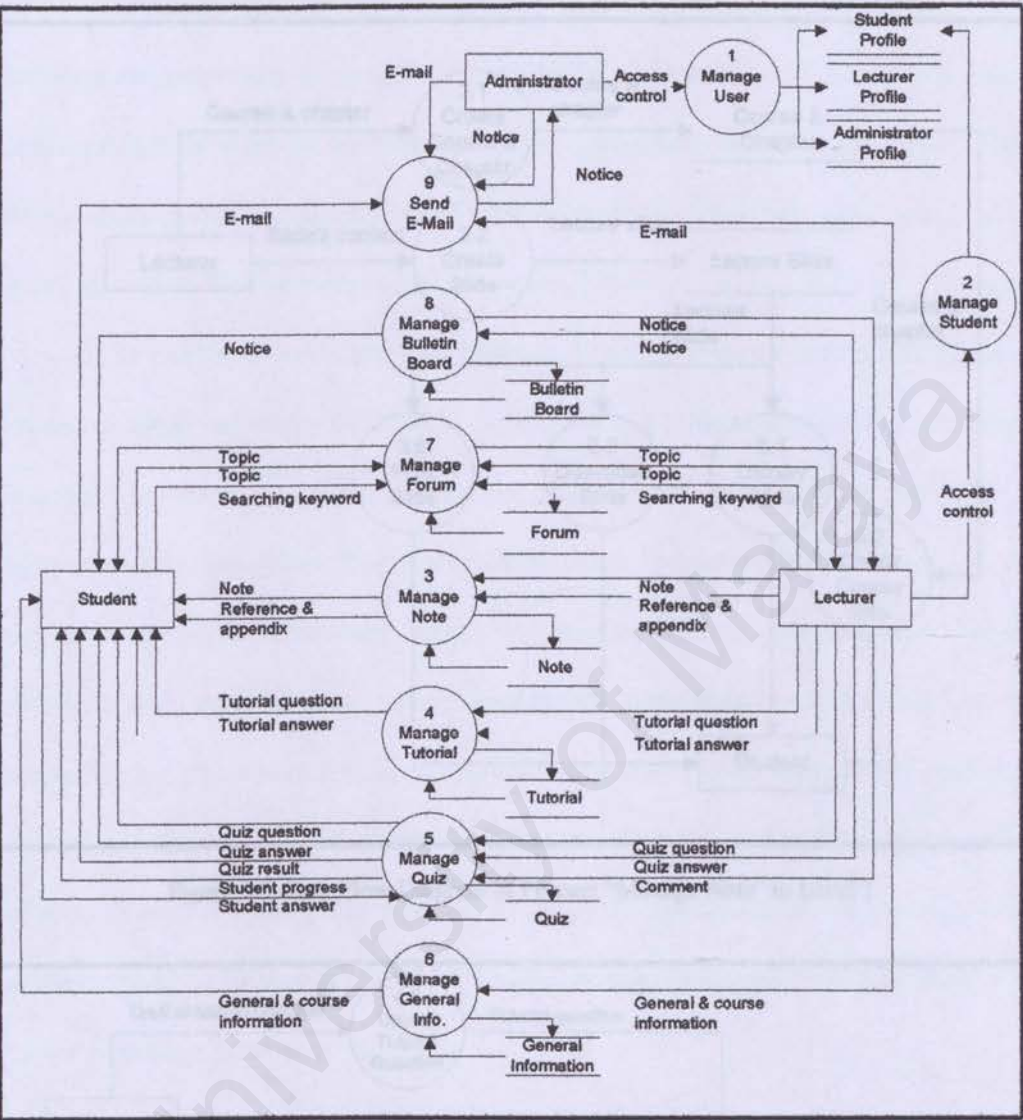Below are the data flow diagrams of process "Manage Tutorial" and process "Manage Note level 1 for ADLS system.
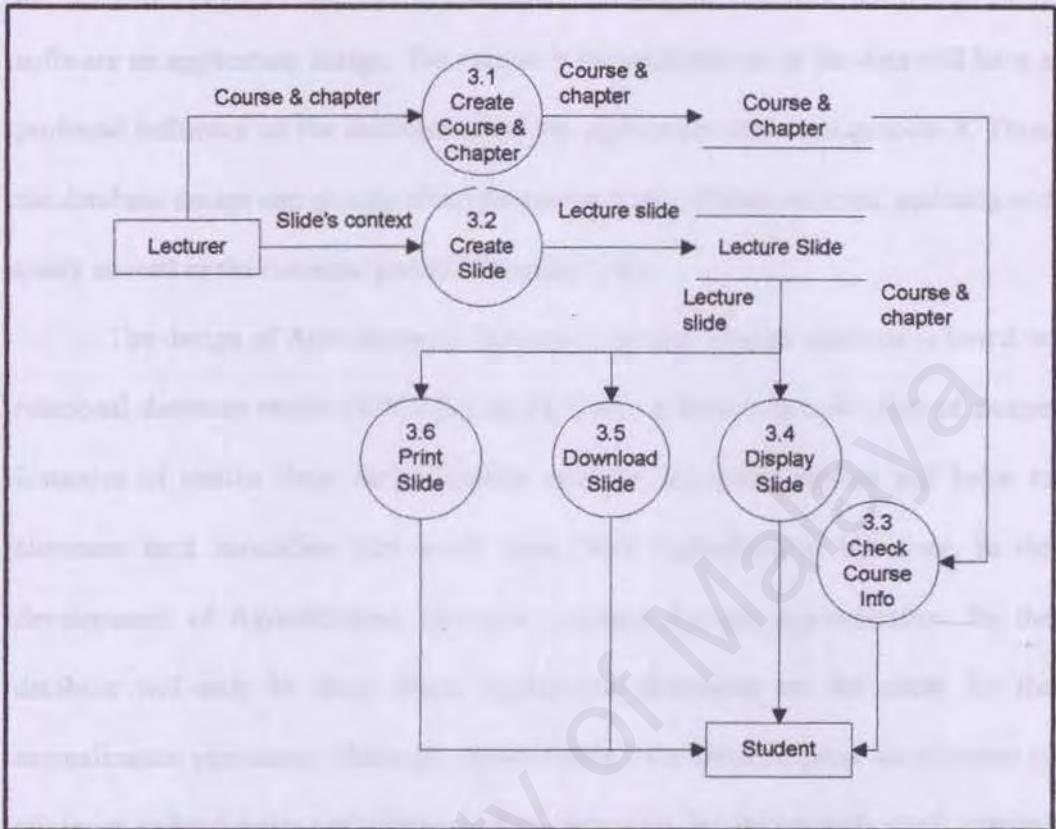

Figure 5.8: Data Flow Diagram of Process "Manage Note" in Level 1
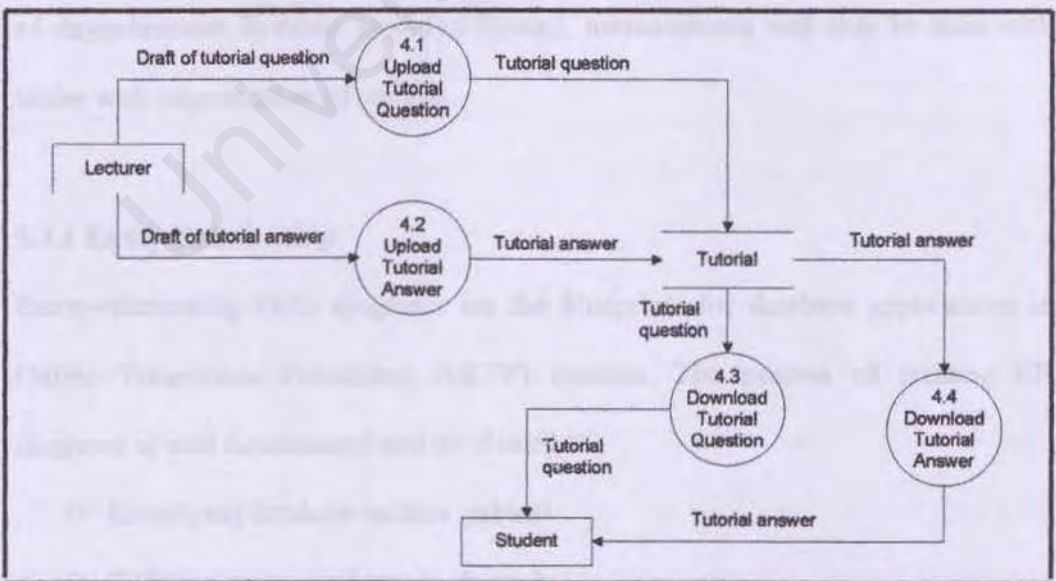

Figure 5.9: Data Flow Diagram of Process "Manage Tutorial" in Level 1

5.3 Database Design

How to store data and the format of data type is often a vital decision in the design of an information system. The structure of data has always an important issue of software or application design. The reason is the architecture of the data will have a profound influence on the architecture of the application that must process it. Thus, the database design can greatly affect the performance of data retrieval, updating and query as well in the run-time period of system. [26]

The design of Asynchronous Distance Learning System database is based on relational database model (RDBMS). In RDBMS, a table is a collection of unique instances of similar data. Normalization reduces data redundancies and helps to eliminate data anomalies that result from those redundancies. However, in the development of Asynchronous Distance Learning System, normalization for the database will only be done where appropriate depending on the needs for the normalization processes. Although normalization may serves a great contribution to minimize redundancies and eliminate data anomalies but tables with small number of records will be difficult to manage. Thus, in the consideration for manageability of Asynchronous Distance Learning System, normalization will only be done with tables with huge number of records.

5.3.1 Entity Relationship

Entity-relationship (ER) diagrams are the blueprints for database applications in Online Transaction Processing (OLTP) systems. The process of creating ER diagrams is well documented and involves: [27]

- ❖ Identifying database entities (tables)
- ❖ Defining entity attributes (columns)

- ❖ Identifying unique row identifiers (keys)
- ❖ Defining relationships between entities

The data model then goes through a process called normalization that includes three primary rules for efficient data storage. The rules produce the First Normal Form (1NF), Second Normal Form (2NF) and Third Normal Forms (3NF), which eliminate the anomalies and redundancies in the database. The following shows the Entity-relationship diagrams for the Asynchronous Distance Learning System.

Figure 5.10: Entity Relationship Diagram of ADLS

5.3.2 Data Dictionary

In the development of Asynchronous Distance Learning System, it is important to understand the data dictionary and data types used in SQL Server 2000 database. The data dictionary is a reference work of data about data, one that is compiled by system analysts to guide them through analysis and design. As a document, the data

dictionary collects and coordinates specific data terms. Data dictionary defines the field name, field type and descriptions of each table.

In the Asynchronous Distance Learning System, a database consist of 15 tables had been defined. The symbol ⬚ will be used to indicate the key of the table. The database name is ADLS, which the tables are as follows:

- ❖ users
- ❖ accesslevel
- ❖ LoggedInUsers
- ❖ loginHist
- ❖ persMsg
- ❖ department
- ❖ whatsnew
- ❖ Messages
- ❖ forum
- ❖ usercourse
- ❖ courses
- ❖ quiz
- ❖ quizresult
- ❖ faculties
- ❖ lecturerCourse

Table Name: users

Primary Key: numericID

Description: User Profile

Table 5.2: Table of users

Field Name	Data Type	Description
ID	int	User ID
FirstName	nvarchar	User First Name
Surname	nvarchar	User Surname
numericID	nvarchar	User Numeric ID
Title	nvarchar	User Title
Username	nvarchar	User Name
oldPassword	nvarchar	User Old Password
Email	nvarchar	User Email Address
Department	nvarchar	User Department
access_level	int	User Access Level
Active	bit	User Status
Logins	int	Number for Logins
Password	nvarchar	User Password
creationDate	datetime	Create Date
LastLoginDate	datetime	Last Login Date

Table Name: persMsg

Primary Key: ID

Description: Personal Message Details

Table 5.3: Table of persMsg

Field Name	Data Type	Description
ID	int	Message ID
senderID	varchar	Sender ID
recipientID	nvarchar	Recipient ID
Subject	nvarchar	Message Subject
Body	ntext	Message Body Contexts
Status	int	Message Status
[date]	datetime	Date of Sending Message

Table Name: accesslevel

Primary Key: accesslevel

Description: Status Access Level for User

Table 5.4: Table of accesslevel

Field Name	Data Type	Description
accesslevel 🖉	int	Access Level Status ID
Access	nvarchar	Access Level Status
description	ntext	Access Level Status Description

Table Name: whatsnew

Primary Key: id

Description: News's Details

Table 5.5: Table of whatsnew

Field Name	Data Type	Description
id 🖉	int	New Message ID
MsgTitle	ntext	New Message Title
createDate	datetime	Date of New Message Create
whoCreated	varchar	User Identity Create The New Message
Message	ntext	New Message Contexts
numericID	varchar	User Numeric ID

Table Name: usercourse

Primary Key: ID

Description: Information of course registered by student

Table 5.6:Table of usercourse

Field Name	Data Type	Description
ID 🖉	int	User Course ID
courseCode	nvarchar	Course Code
NumericID	varchar	User Numeric ID
registered	bit	Register Status

Table Name: Messages

Primary Key: MsgID

Description: Forum Message Details

Table 5.7: Table of Messages

Field Name	Data Type	Description
MsgID 🖉	int	Forum Message ID
ParentID	int	Forum Message Parent ID
ForumID	int	Forum ID
Author	nvarchar	Author Message
Title	nvarchar	Forum Message Title
Body	ntext	Forum Message Body Contexts
[Date]	nvarchar	Date of Forum Message Create
Notify	bit	Status

Table Name: LoggedInUsers

Primary Key: id

Description: Logged User Details

Table 5.8: Table of LoggedInUsers

Field Name	Data Type	Description
id 🖉	int	Log-in User ID
ip_address	varchar	Log-in User IP Address
sessionID	varchar	Log-in User Session ID
numericID	varchar	Log-in User Numeric ID
access_level	int	Log-in User Access Level
Username	varchar	Log-in User User Name
FirstName	varchar	Log-in User First Name
SurName	varchar	Log-in User Surname
Active	bit	Log-in User Status
Logins	int	Number for Logins
Email	nvarchar	Log-in User E-mail Address
WhenLoggedIn	datetime	Log-In Date & Time
WhenLastActive	datetime	Last Log-in Date & Time
isInvisible	bit	Status Visible
coursecode	nvarchar	Visible Course Code

Table Name: loginHist

Primary Key: ID

Description: User Login History Details

Table 5.9: Table of loginHist

Field Name	Data Type	Description
ID	int	Login History ID
numericID	varchar	User Numeric ID
LoginDate	nvarchar	Login Date

Table Name: departments

Primary Key: ID

Description: Department Details

Table 5.10: Table of departments

Field Name	Data Type	Description
ID	int	Department ID
department	nvarchar	Department Name

Table Name: forum

Primary Key: ID

Description: Forum Details

Table 5.11: Table of Quiz Question Answer

Field Name	Data Type	Description
ID	int	Forum ID
Poster	varchar	Forum Poster
Subject	ntext	Forum subject
LastPoster	varchar	Last Forum Poster
createDate	datetime	Create Forum Date
Replies	int	Forum Replier
Reply_ID	int	Replier ID
Message	ntext	Forum Message
Locked	Smallint	Status Locked
numericID	varchar	User Numeric ID

Table Name: courses

Foreign Key: ID

Description: Course Details

Table 5.12: Table of courses

Field Name	Data Type	Description
ID	int	Course ID
CourseCode	nvarchar	Course Code
theLevel	nvarchar	Course Level
CourseTitle	nvarchar	CourseTitle
Active	int	Status
About	ntext	Course Description
Faculty	int	Faculty ID
creatorNumericID	varchar	Course Creator Numeric ID

Table Name: faculties

Primary Key: id

Description: Faculty Details

Table 5.13: Table of faculties

Field Name	Data Type	Description
id	int	Faculty ID
Faculty	varchar	Faculty Name

Table Name: lecturerCourse

Foreign Key: ID

Description: Information of Course Create by Lecturer

Table 5.14: Table of lecturerCourse

Field Name	Data Type	Description
ID	int	Lecturer Course ID
courseCode	nvarchar	Course Code
NumericID	varchar	User Numeric ID

Table Name: quiz

Primary Key: ID

Description: Quiz Question Details

Table 5.15: Table of quiz

Field Name	Data Type	Description
ID	int	Question ID
Question	ntext	Context of Question
AnswerA	ntext	Context of Answer A
AnswerB	ntext	Context of Answer B
AnswerC	ntext	Context of Answer C
AnswerD	ntext	Context of Answer D
CorrectAnswer	varchar	The Correct Answer
courseCode	nvarchar	Course Code

Table Name: quizresult

Primary Key: ID

Description: Quiz Result Details

Table 5.16: Table of quizresult

Field Name	Data Type	Description
ID	int	Quiz Result ID
courseCode	nvarchar	Course Code
numericID	varchar	User Numeric ID
quizMarks	varchar	Mark of Quiz
Grade	varchar	Grade of Quiz

5.4 User Interface Design

The user interface design of a system is always a measure by which that system is judged. The goal of interface design is to provide the best way for the users to interact with the system. The interface will be the portal where users get the information they need in and out of the system.

However, an interface, which is difficult to use, will result in high level of faults and errors, and may cause some system to be discarded, irrespective of its functionality. Thus, it is important to take into consideration the user's needs and preferences in the design of user interface.

In the Asynchronous Distance Learning System, the user interface design will base on the Graphical User Interface (GUI) approach. The goals of using the GUI approach are to provide user-friendly, easy and faster way for the user to interact with the Asynchronous Distance Learning System.

5.4.1 Designing User Interface

In the design of user interface in the Asynchronous Distance Learning System, several guidelines have been used to develop a better user interface. The following guidelines will be followed during the development of the user interface for Asynchronous Distance Learning System: [27]

- ❖ Perform consistency in the building of user interface (the critical aspects) such as the texts, buttons etc.

- ❖ Define and follow a standard user interface.

- ❖ Design the user interface where both experienced and novice users can be supported.

- ❖ Follow that is dark texts is to be placed in front of bright backgrounds.

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❖ Where an item or object is not used for a specific time, the color of the item or the object should be grayed, that is cannot be clicked on. The item or object should not be eliminated.

The following are GUI interfaces design for ADLS system:
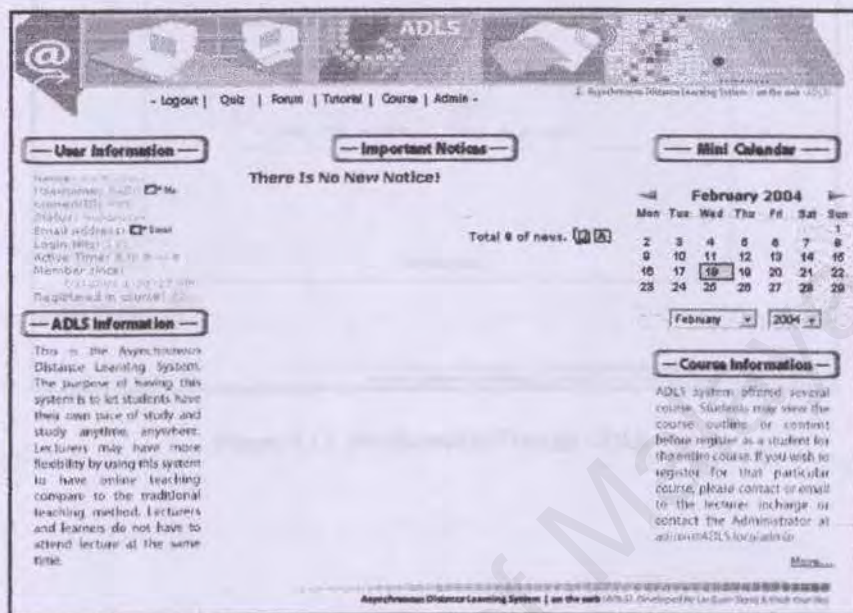
Figure 5.11: Interface of Main Page ADLS
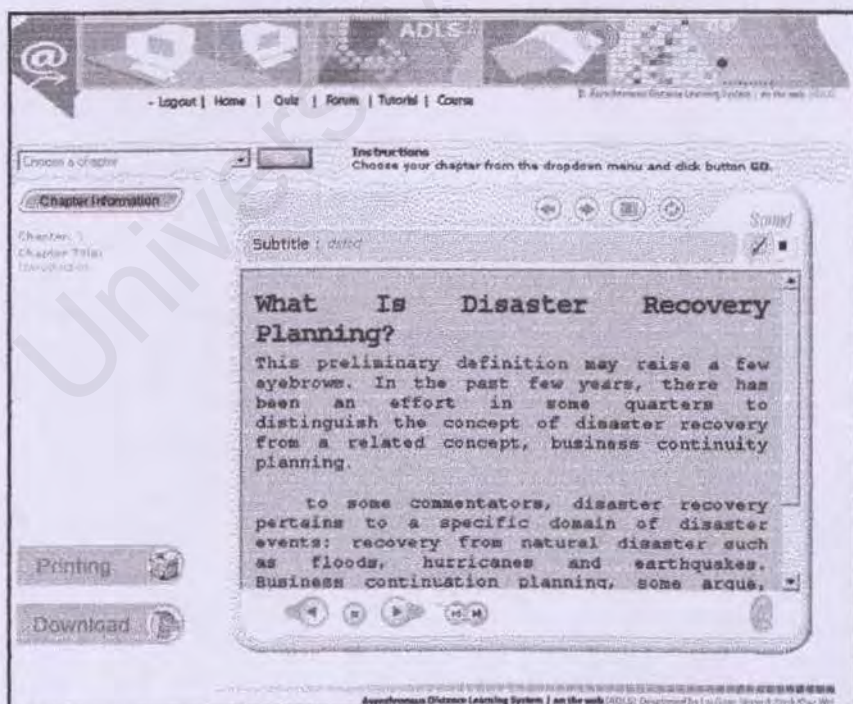
Figure 5.12: Interface of E-Course ADLS
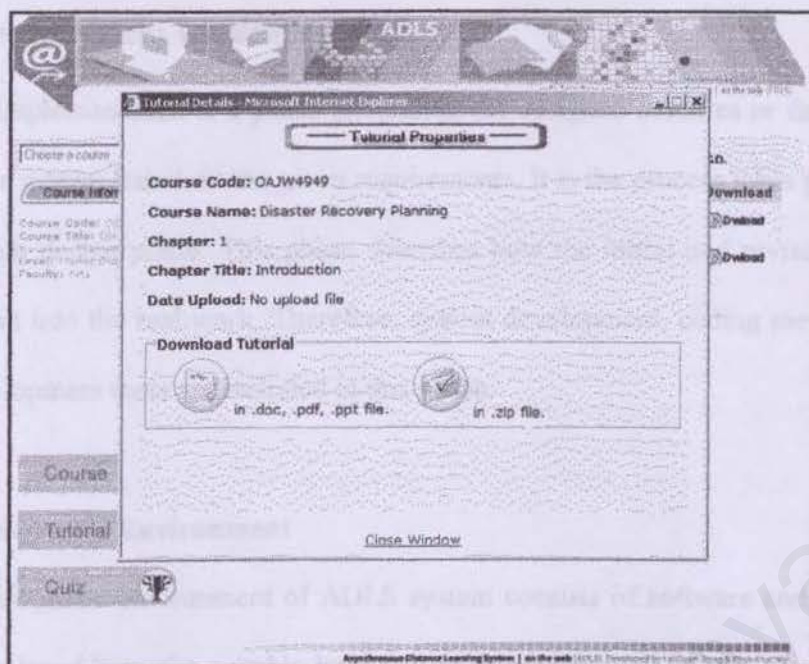
Figure 5.13: Interface of E-Tutorial ADLS

6.1 Dev... ...vironment

The dev... ...opment of ADLS system consists of software and hardware configuration ...

6.1.1 Hardware Requirement

The hardware configurations use... ...oping the system are:

A server with not less than 1... processor:

- At least 64 MB RAM
- 8 GB of hard disk space
- 1.44 MB floppy drive
- ... CD-ROM drive
- Network Interface Card (NIC)
- Other standard computer peripherals

Chapter 6 System Implementation

System implementation is a phase integrating the designed modules or functions to develop a system based on the given requirements. It is the process takes place after the system design phase. This phase describes how the initial and revised process design put into the real work. Therefore, system development, coding methodology and development tools are included in this phase.

6.1 Development Environment

The development environment of ADLS system consists of software and hardware configuration. Using the suitable hardware and software will help in speed up the system development. The hardware and software tools that used to develop and document the system will be discussed as below.

6.1.1 Hardware Requirement

The hardware configurations used for developing the system are:

A server with not less than 166Mhz processor;

- ❖ At least 64 MB memory
- ❖ 4 GB of free hard disk space
- ❖ 1.44 MB floppy drive
- ❖ 36X CD-ROM drive
- ❖ Network Interface Card (NIC)
- ❖ Other standard computer peripherals

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6.1.2 Software configuration

The software tools that have been used to develop ADLS are:

Table 6.1: Software Tools

Software	Usage	Description
Microsoft Windows 2000 Professional	System requirement	Network Operating System
Internet Information Service 5.0	System requirement	Web server service. Map local directory to virtual directory and create local web site.
Microsoft SQL Server 2000	System requirement	Database Server to generate, view and edit database tables.
Microsoft Internet Explorer 5.0	System requirement	Browser to surf the site
Mircosoft Visual Studio 6.0 (InterDev)	System development	AJSP editor to create and refine web pages for the whole system.
Microsoft Frontpage 2000	System development	Interface graphical design and HTML editor.
Macromedia Dreamweaver 4.0	System development	Interface graphical design and HTML editor.
Adobe Phototshop 6.0	System development	Graphics editing.
Microsoft Word	System development	Project documentation.

6.2 System Development

6.2.1 Starting Off

Servers and development tools installation are the first step before development work begins after gathering the entire required information. It is essential to know the sequence of product installation to ensure smooth execution without system errors.

The sequence of the installation process is shown below:

1. Firstly, install Windows 2000 Server

2. Configure Windows 2000 Server

3. Install Microsoft Internet Information Services(IIS) 5.0

4. Install Microsoft Agent Control

5. Install Lernout & Hauspire TruVoice Text-To-Speech(TTS) Engine

6. Install Microsoft Speech Recognition Engine

7. Install Microsoft SQL Server 2000

8. Install Microsoft Visual Studio 6.0 development tool

9. Install other graphical soft wares that are needed.

6.2.2 Setting up the Environment

Before can start to use the data in a database, connection to database must be established. This can be accomplished with a variety of methods, where enough information in order to code to connect a database will be provided.

6.2.3 Accessing Database

The database using by ADLS for both development and production stage is MS SQL Server 2000. By using this DBMS, database structure, validation rules, defaults, relationships and referential integrity could be done easily. The data structure of each table is declared, the primary key is set, and the relationship among each table is defined.

The connection to accessing database is opened as follows:

```
<script language="VBScript" runat="Server">
ADLSDbServer="PERSONAL-59KBPP"
ADLSDbUser="sa"
ADLSDbPassword="sa"
ADLSDbName="dbADLS"
ADLSImageThemeDir="iktheme"

' -- set up application connection string -- '
myCon="Provider=SQLOLEDB; Data source=" & ADLSDbServer & ";
        UID=" & ADLSDbUser & "; pwd=" & ADLSDbPassword & ";
        Database=" & ADLSDbName
Application("conString")=myCon
</script>
```

6.2.4 Web Server

In ADLS development, Microsoft Internet Information Server (IIS) 5.0 configured became a web server for users to request document. IIS is an enterprise-level web server that is included with Windows 2000 Server. It is an extremely fast Web server. It includes several protocols such as File Transfer Protocol (FTP) Server to upload and download files, Simple Mail Transfer Protocol (SMTP) for sending email and other protocols. For IIS to respond to requests, the server first strips the file extension from the filename before looks up the associated program and launches the program to return the file.

6.2.5   Microsoft Visual InterDev 6.0 As Development tool

Microsoft Visual InterDev 6.0 is an editing tool that provides visual tools that contribute to the developer's productivity while enabling them to work directly with the code for more precise layout control, greater design flexibility, and higher-performance Web pages.

In addition to its extensive array of tools for creating HTML code, Microsoft Visual InterDev 6.0 provides features that allow developers to extend the functionality of their sites by incorporating the latest Web technologies, including Active Server Pages, Cascading Style Sheets, Dynamic HTML, Java Server Pages, JavaScript, VBScript and others. Figure below are the working space will developing ADLS during the whole project.

6.2.6 Programming Language Used

6.2.6.1 HTML (Hypertext Markup Language)

In ADLS, the Web-based interfaces are created using HTML. HTML is the fundamental building stuff of the web. It is the *lingua franca* for publishing hypertext on the World Wide Web. HTML is the set of "markup" symbols or codes inserted in a file intended for display on a World Wide Web browser. It uses tags like <A> and </A> to structure text into tables, hypertext links interactive forms, headings, paragraphs, lists, and more. HTML is useful to create form based data entry for this application. Below are some HTML codes to create a form in this application.

Example of HTML Coding;

```
1)      <form name="frmAddCou" method="POST" action="save_course.asp"
        onsubmit="return FormValidator(this)"> ... < /form >
2)      <input type="text" name="txtTitle" size="30" maxlength="50" >
3)      <input type="radio" name="approach" value="1">
4)      <select size="1" name="cmbLevel" >
            <option selected>Under Graduate</option>
        < /select >
5)      < input type="submit" name="Submit" value=" Submit " >
```

Command 1 - Creates a form and post save_course.asp page to insert into database.

Command 2 - Creates a text field for the user to enter student Name.

Command 3 – A Radio button that allow user to click on the button to choose it.

Command 4 - Creates a combo box for the user to choose the level of course.

Command 5 - Creates a submit button to submit the form or data to the server.

6.2.6.2 JavaScript

JavaScript is a compact, object-based scripting language. The main roles JavaScript play in the web pages are form validation, responding to input, integrating with Java, basic graphics and dynamic HTML. JavaScript statements can be embedded directly

in an HTML page. If invalid data is detected or user does not enter any data, a dialog

box is displayed.
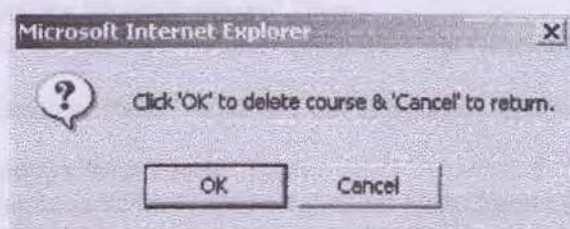
Figure 6.2: JavaScript Dialog Box for Data Validation

Example of JavaScript coding;

```
<script language="javascript">
var question = confirm("Click 'OK' to delete course & 'Cancel' to return.");

  if(question==true){
    frmCourse.action = "course/delete_course.asp";
    frmCourse.submit();
  }
</script>
```

6.2.6.3 Create Active Servers Pages (ASP) Scripts

By default, Active Server Pages (ASPs) is the chosen language for server scripting

language. But it is still perfectly legal to mix languages, as long as they are properly

specified for each section of code in the application's page (web page).

There are some unique ways to indicate that blocks of script are to be

executed on the server (that is the server-side code). It locates between the delimiter

<%-------%> in the HTML scripts. In this case, any text between these tags is treated

as server-side scripting (ASP) commands, based on the language defined at the

beginning of the Active Server Page.

Example 1 of ASP coding;

```
<font face="verdana" size="2"><b>Course Level: </b></font>
    <select size="1" name="cmbLevel">
    <%
      'Set the default value to the combo box
      If arrRecord(2)= "Under Graduate" Then
```

```
                Response.Write "<option selected>Under Graduate</option>"
        Else
                Response.Write "<option>Under Graduate</option>"
        End If
        If arrRecord(2)= "Post Graduate" Then
                Response.Write "<option selected>Post Graduate</option>"
        Else
                Response.Write "<option>Post Graduate</option>"
        End If
        If arrRecord(2)= "Non-Credit" Then
                Response.Write "<option selected>Non-Credit</option>"
        Else
                Response.Write "<option>Non-Credit</option>"
        End If
        %>
    </select>
```

In addition to specifying scripts to execute on the server, one can clearly indicate

variables that are to be replaced by actual values by using the <%= *variable* %>

syntax. .

Example 2 of ASP coding;

```
...
//LecturerName is a variable
<font color="#808000" size="1">Lecturer Name: </font>
 <font color="#FF9933" size="1"><%=LecturerName%></font>
...
```

6.2.6.4 Using Built-In Server Objects

There are several useful built-in server objects provided by ASP that will help the

application read requests form HTML forms, post results to the web browser,

control the server, etc. It is easy to include these server-side objects within the ASP

scripts and there is not need to declare them or initialize them.

These server-side objects are Request, Session and other. Their usages are

described in the following.

❖ **Request Object**

The excellent thing about handling the request object in ASP is that it does matter whether data is sent via GET or POST: the processing is same. When client browsers contact Server (such as IIS) via HTTP, they pass values to the server that includes server and state information. This object allows an application to request that information and bring it into the application.

For instance, please refer to below.

```
<%
.......
Dim itemQuery
itemQuery = Request.QueryString("query")
.......
%>
```

This coding show that value of userId2 is get from value of "query" in previous page

❖ **Session Object**

The session object is useful for application where several pages have to pass values between each another in order to make the application work. IIS automatically creates a Session object when a web page form the application is requested by a user who does not already have a session and destroys it when user closes the browser or when session expires or is abandoned.

```
<%
Dim Session("CourseCode")
Session("CourseCode") = courseCode
%>
```

6.2.6.5 SQL Statement (Structured Query Language)

SQL statements are used to insert, delete and retrieve information from database once connection with database has established. The following coding is the examples of the SQL statements.

Example 1: SELECT statement;

Select related data from table Courses

```
Dim mySQL, myRS
    ' link to table courses
    mySQL = "Select * FROM Courses WHERE creatorNumericID =" & numID &_
                " AND active=1 Order By " & itemQuery & " ASC"

    Set myRS = Con.Execute(mySQL)
```

Example 2: INSERT statement;

Insert related data into table courses

```
Dim mySQL, myRS
    ' link to table lecturer course
    mySQL= "INSERT courses ( courseTitle, courseCode, Level, CreatorNumericID)"
            & "VALUES('" & arrRecord(0) & "', '" & arrRecord(5) & "', '" &_
            arrRecord(1) & "', '" & arrRecord(3) & "')"
    Set myRS = Con.Execute(mySQL)
```

Example 3: UPDATE statement;

Update data to table courses

```
Dim mySQL
    'update the record with new record to table
    mySQL = "UPDATE courses SET CourseTitle ='" & arrRecord(1) &_
            "', about ='" & arrRecord(4) & "'" &_
            ", active ='" & arrRecord(5) & "'" &_
            "WHERE CourseCode ='" & arrRecord(0) & "'"
    con.execute(mySQL)
```

Example 4: DELETE statement;

Delete data from table usercourse

```
Dim mySQL
    'Delete a record in the table courses
    mySQL = "DELETE usercourse WHERE courseCode IN ('" & courseCode & "')"
    con.execute(mySQL)
```

6.2.7 Security Management

The level of security actually required is dependent on the user's level of access.

Security for web access is a critical issue in this case since the patient records is

private and confidential. Essentially, we just need to allow our users to access data they need, while protecting them from accidentally destroying or damaging it.

Besides, we need to verify that those accessing it have the right to do so. Fortunately, SQL Server 2000 supports several powerful security features. It offers three login security modes that are Standard Security Mode, Windows 2000/NT Integrated Security Mode and Mixed Security Mode. The Standard Security Mode is chosen for this project. It manages its own login validation process for all connections (except client applications that explicitly request integrated security over trusted connections).

Furthermore, ADLS also will provide the login page that required user to logging before can go to the important part of the system to enhance the system security.

6.2.8 Modules Implementation

During the development of modules in ADLS, firstly, the ADLS database is developed according to the database design.

Then is interface of the entire modules are designed. The interface is developed to have Graphical User Interfaces (GUIs). GUIs support high-resolution color screens and interaction using a mouse as well as a keyboard.

Thirdly, appropriate program coding is added to the user interfaces as functionality of the system. The coding is started based on Course Module and Tutorial Module.

The functionality of 3 major sections is:

i.   **Section 1 – Teaching Section**

- Create, Modify & Delete Course.

- Create, Modify & Delete Chapter.

- Create, Modify & Delete Lecture Slide using Template.

- Upload, Reload & Delete .doc, .ppt & .pdf File.

  In every sub-sections, there will be provide search engine for user to retrieve the record from database. For subsections like lecture, course, chapter & slide information and assign lecturer the function of insert, delete, and update also is coded.

ii.   **Section 2 – Learning Section**

- Display Course & Chapter Details

- Display Lecture Slide

  In every sub-sections, there will be provide search engine for user to retrieve the record from database. For subsections like lecture, course, chapter & slide information and also provide the printing & download function to student.

iii.   **Section 3 – Tutorial Section**

- Upload Tutorial

- Download Tutorial

  The same functions as like search engine in Course Module are applied in the section above. The tutorial can upload in .zip, .doc, .ppt & .pdf file by lecturer and download by student.

6.3 System Documentation

The process of development is documented since it is important to help developer to determine the progress of the project. The system documentation that provided in ADLS is:

6.3.1 User Manual

User manual is a reference or guide for system users. It wills explains and describes how the system can be use. So that can reduce the learning curves of the system users and save their time. *Please refer to Appendix A for more details.*

6.3.2 Setup tools

This information about how to setup the tools that are using for ADLS development will be included. Those include are:

- ❖ Install Microsoft Agent Control
- ❖ Install Lernout & Hauspire TruVoice Text-To-Speech(TTS) Engine
- ❖ Install Microsoft Speech Recognition Engine
- ❖ Installing SQL Server 2000

Please refer to Appendix B for more details.

6.3.3 Sample Coding

The sample of coding that have developed and deploy in this system will be shown. It is as references for the user to know how ASP coding looks like and how it work in ADLS system. Interview questions also included for reference as information resources. *Please refer to Appendix C for more details.*

Chapter 7 System Testing

System testing is a significant and critical phase that ensures the system fulfills the user's requirements and assures the quality of the delivered system. Testing provides a method to discover logical error and to test the system reliability. It is done throughout system development, not just at the end. This is because system that is failed after installation will result a waste in cost, time and effort. However successful testing will result in quality software with less errors and work according to specification.

Several testing stages that involve during the development of the system are:

- ❖ Unit testing
- ❖ Integration testing
- ❖ System testing

7.1 Unit Testing

In this stage, testing will be concentrated on the smallest component of the system for testing. Each individual component is tested independently without other system components, to ensure that they operate correctly. For example, this component might perform task like checking valid input value.

In ADLS, those units that were tested independently are:

- ❖ Open and close connection to the database
- ❖ Insert new record into database
- ❖ Retrieved data from database
- ❖ Edit the existing data in the database
- ❖ Search in database for particular record
- ❖ Form posting

❖ Validate of user input data before submission

❖ Execution of SQL statements

For ADLS unit level testing, there are three category types of testing were applied.

7.1.1 Ad Hoc Testing

Ad Hoc or ad lib testing means simply play with the functioning unit, trying whatever comes to their mind, in attempt to make it fail. This type of testing was a fast and efficient way of debugging code errors during the early development stage. The disadvantage of Ad Hoc testing is it usually finds many errors and never be sure what was or was not to be tested.

7.1.2 White Box Testing

White Box Testing basically involved analyzes the structure of the code and use knowledge about the structure of a component to derive test data. The advantage of white box testing is that an analysis of the code can be used to find out how many test cases are needed to guarantee a given level of test coverage. That code coverage that was tested under this phase including basic path testing, data flow testing, path testing and loop testing. It is focused on the idea of coverage. The main objective is to check for missing function.

For example, the loop testing was done on data retrieving function where there are extensive usages of loop like DO WHILE ... LOOP and NOT ... LOOP.

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7.1.3 Black Box Testing

Black Box Testing is concentrate on the functionality of code. The main objective is to uncover those wrong functions programmed correctly by feeding the input to the black box and take notes on what output is produced. The test object's behavior can only be determined by studying its inputs and the related outputs.

The advantage of this kind of testing is that a black box is free of the constraints imposed by the internal structure and logic of the test object. However the disadvantage is that it is not always possible to run a complete test in this manner. Those tests that tested during this phase including boundary value analysis, error guessing and domain testing.

7.2 Integration Testing

After all components have been unit-tested, the next step is ensuring that the interfaces among the components are defined and handled properly. This step is called integration testing, also known as module testing, which verifies that the all the components work together as described in the module or system design specifications.

During the integration testing, two or more units in which either unit that use output data from or provides input data for another unit were tested in collection. These unit that have related characteristics to perform a common function like search engine function that consists of SQL statement generating, query from submission and displaying query examples.

The order in which components are tested affects our choice of test cases and tools. The system is viewed as a hierarchy of components, where each component belongs to a layer of the design. In this system, the Top-down Integration approach

is used where testing begins from the top and works the way down. The process is continued until all the modules are tested.

7.3 System Testing

System Testing is the last testing procedure. It is performed to uncover its limitations, measure it capabilities and make certain that the entire system works according to users' specifications. Developers will join the users to perform this stage of testing where the system is checked against the users' requirements description.

System modification will be implemented if there is a need to change or do not met the users' requirements specifications. If the users are satisfied with the system's characteristics, the system is ready to be deployed for use. The testing result will show whether or not the entire system specifications and objectives are achieved.

7.3.1 System Test Considerations

In system testing, the behavior of the individual functions and functional tests also involved:

❖ **The Event List**

All the possible triggers are exercised and the expected results compared with the actual results. Every function is tested by one or more events in the event lists.

❖ **Error Message Testing**

The error message, which can be generated by the system during invalid data entry are checked for spelling, appropriateness and consistence.

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Acknowledgement messages also will also implement the same test. It is the message that informs the user about the state of a user request process. For instance, result of SQL query and submission of data. *The overall of the result was satisfactory although some modification had to make.*

❖ **Security testing**

In security testing, the system is tested for improper penetration and unauthorized access, to ensure that the implementation of the user login and the valid user checking procedures included in every authorized page are functioning accordingly and correctly. The test had show that the security function is working properly.

❖ **Documentation Testing**

All examples used in the user's manual is tested for correctness and for whether or not the manual gives the exact answers users will obtain when they run the examples.

❖ **Transaction Tracking**

During transaction tracking, a list of possible transactions is tracked through the system to ascertain that they function correctly from input to output. For example, every time a screen is reached which requires input or generates input, the appropriate functions are processed and lead to subsystem for processing and then the right output is retrieve. This test was implementing and all the function behaves according to the requirements specification.

7.4 Fundamental Tests (Product Verification Testing)

There are other tests fundamental to all software. Certain of these are difficult to measure accurately. Five of these fundamental tests are:

❖ **Usability**

The usability should be based in building user interfaces that have patterns already familiar to the typical user. The user then learns to use the software through pattern matching and paradigm shifts, exactly as they do in mastering any product.

❖ **Install Ability**

How easy is it for a novice to install the software correctly and easily without recourse to an expert?

❖ **Performance**

Performance tests are conducted to ensure that the system response time meet user expectations and does not exceed the specified performance criteria under heavy stress or volume. During these tests, response time and the transaction rate are measured, the purpose of performance tests is to test-run the performance of various functions of the software within a specified hardware configuration. The performance tests can couple this test with stress testing.

❖ **Reliability**

Reliability tests are conducted, according to mathematical models of software reliability, to ensure that the system can be probability of some function of the system failing within a specified time. Reliability testing is monitoring the mean time between failures. Reliability and consistency

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testing go hand in hand where the system behavior (inputs, outputs, response time) is measured for consistency.
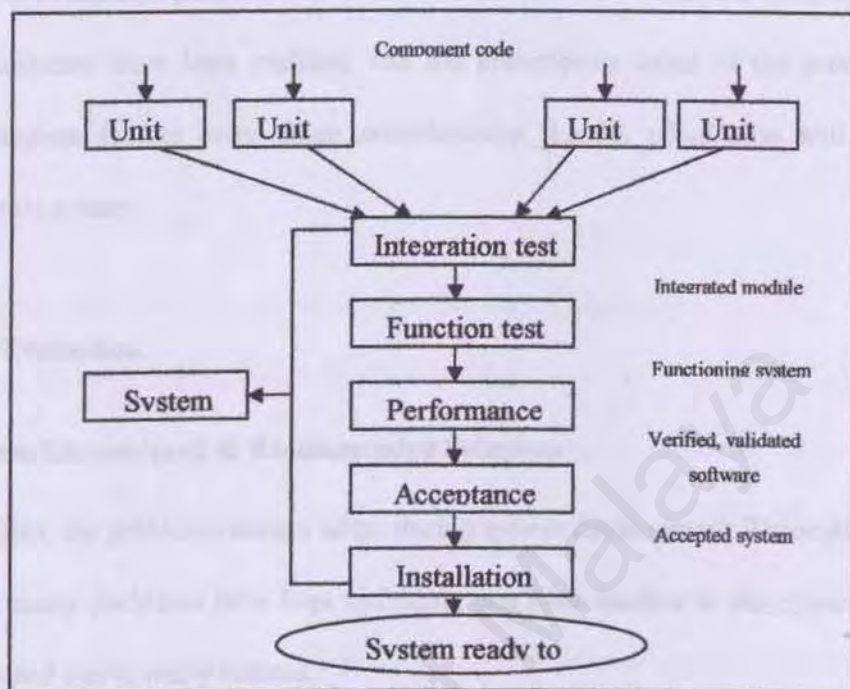
In conclusion, the testing steps are shown as below.

Figure 7.1 Testing Steps

7.5 System Maintenance

Usually in system develop, maintenace will be conducted once the system is finished or deliveryed. The maintenace servises will be make sure the system function propoerly, modify some application or add new functions in this system. Unfortunately, in this Ascyhronous Distance Learning System (ADLS) there will be no longer maintenance services. The reason is because TMS is not deploy in any organization except this system will be using by FCSIT in their ascyhronous distance learning system. Then only the maintenance services will be implemented.

Chapter 8 System Evaluation & Conclusion

Evaluation is a process that occurs continuously at all phases of the system development. Evaluation phase was to determine the extent to which the system the expected outcomes have been realized, and the prescriptive value of the process where extraneous factors were taken consideration. Lastly, conclusion will be making for this system.

8.1 System Evaluation

8.1.1 Problem Encountered & Recommended Solutions

In every project, the problems always occur during system development. Throughout this project, many problems have kept unfolding one after another as development work progressed due to many reasons.

During Analysis Phase

❖ **Determining Scope of the System**

Since there is less experience in developing system, it was hard to determine to which extent to define the scope of the system so that it can be completed within the given time frame. However, this was overcame by analyzing and studying all of the capabilities provide by ASP, Java Script, Microsoft Visual InterDev 6.0 and other technologies before determining the scope of the system.

During Design Phase

❖ **Time Constraint**

There was not enough time to study, learn and produce the best solution of design in Semester 1. Mainly, this was cause by inexperience and insufficient

knowledge of designing a system. Furthermore, time is needed to study and explore ASP language, HTML and SQL Server 2000 before knowing how to apply these technologies and languages in the process of developing and solving problems. Thus the best way is to study as many approaches used in senior and previous year students' documentation.

During Implementation Phase

❖ **No prior experience in the chosen programming languages**

There was a learning curve in understanding how the ASP works since inexperience in JavaScript and VBScript. Scripting in a new environment such as ASP requires some knowledge of what the ASP objects do and how to use the objects to build the required functionality of the web application. The best way of learning ASP scripting during ADLS project was refer to some of the ASP examples available in the ASP reference books and Internet.

❖ **Problems on Installation**

During implementation phase, there were a lot of problems on installing and configuring Windows 2000, IIS, Microsoft Agent Control and other tools before starting coding. Some of the needed software and tools were successfully installed only after a few times of formatting and reinstallation. From this I learn to know that, it is essential to know the sequence of products installations. This is to ensure smooth execution without system errors.

During Testing Phases

❖ **Not fully supported by different browser**

The appearance of web pages is different on Internet Explorer 5 and Netscape Navigator and Communicator during the testing phase, such as different positioning of graphics, text, and tables on these web browsers. The main cause of these problems couldn't be detected.

8.1.2 System Strength

This system although does not have powerful features to some extent, but still has some strength of its own when compared to some existing medical center web sites.

❖ **Online insert and edit function**

ADLS provides online insert, update and delete functions for the authorized users. So that they can login to add, edit or delete information about course, chapter and lecture slide.

❖ **Create lecture slide by lecture**

ADLS provides a template for lecturer create the lecture slide on web portal. In the template, lecturer allow to configure the slide's background, edit the slide's context with rich text component and also add any effect to the slide like hyperlink, attachment file etc. In ADLS system, upload function also provide for lecturer to upload the note in .doc, .ppt & .pdf file.

❖ **User-friendly system**

ADLS provide a few of simple and easy use function to the users. It is making the system more user-friendly and integration with users. For

example, the lecture slides shown by a player which the player provide the sound, printer, zoom, next/previous slide function and so on.

❖ **To speed up the data retrieved process.**

Each web page is designed to be lightweight. These pages loaded in a reasonable amount of time to ensure users need not wait too long to view the pages. Besides, the user can directly go to browser and search for the needed information within seconds or a minute only. Instead of, go to cabinets to find out the information.

❖ **Provide cost effective system**

ADLS is paperless environment. This can save the cost for generating many paper base documents. Besides, transferring on-line documents through Internet or Intranet takes only short period of time, avoid from suffer loss or damage of important documents. If the document transfer fails on the Internet, user can always try again since the cost will be same.

❖ **User-friendly interfaces**

ADLS could be evaluated as a simple and easy use application. Furthermore, the interfaces of the system are consistent where a standard and systematic web page design is given. It also provides graphical based and direct interface for the user to have the control of the system flow and deal with it by using buttons, select list and hyperlinks. So the user-friendly interfaces of ADLS will shorten the learning curves, reduces training costs and saves the times of the users.

❖ **System Transparency**

System transparency refers to the condition where users do not need to know where the database resides, how the system is structured, how to retrieve

from or insert records into the database. They are just need to know how to communicate with the user interface.

❖ **Search function**

Authorized users such as administrators, lecturers and students can search the course, chapter and related. Search engine is simple in the way of understanding how to use it but yet still powerful to some extent.

❖ **Reliable system with effective errors handling**

Input of the users will be validated and verified to prevent the errors caused by invalid input. If there is any error or invalid input occurred, an error message is generated and displayed to inform the user about the error. For example re-enter value to the form will be prompt out when users input the invalid value or forget to input.

8.1.3 System Limitations

Despite some of the system strengths mentioned previously, there are limitations, which cannot be researched and developed due to time constraint and the lack of resource such as SQL Mail and Microsoft English Query tool.

Those limitations are:

❖ **Form Maintenance**

All the form in ADLS is hard coded. It cannot be edit by the administrator if they wish to modify the way lecturer creates the lecture slide and so on. But if they really wish to do that they need to upload again those web pages.

❖ **Flexibility to customize to any other similar environment**

All the features in this ADLS project cannot be edit or change based on different situation. Thus it doesn't support adapted to any changes for other faculties, colleges, or universities.

❖ **Not fully supported by different browser**

ADLS is being developed using the Internet Explorer 5.0. Therefore, this has make some of the features or function may not being support, look differently or performed well by using lower version of Internet Explorer or using other browser.

❖ **Not support multiple languages**

The current developing system is only limited to one language (English) only. This is due to the time limitation. But it still can be enhance to support more languages to adapt to different environment will use different languages.

8.1.4 Future Enhancement

Here are some future enhancement's suggestions to the ADLS system.

❖ **Note Printing format**.

System should be able to generate standard note printing format for users, which may start/end with a header and footer for each page.

❖ **Support other browsers.**

Currently, this system requires Microsoft Internet Explorer 4.0 and above for execution. In future, it can be tuned to fulfill other browser requirements such as Netscape for execution.

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❖ **Add in "Announcement" feature.**

The "Announcement" feature can be added in to provide the latest information regarding the transaction for courses. It can save time for the users who seeking for the newest and related information.

❖ **Support multiple languages**

ADLS can be enhancing to provide two languages that are in Malay Version and English Version to fulfill the different users' requirements.

8.2 Project Conclusion

As a conclusion of this project, ADLS has fulfilled the requirement to deliver the system in time and achieved most of the objectives and requirements as determine during analysis phase. In the ADLS, I success to provide an effective and efficient learning and teaching platform between the lecturer and student.

Throughout this project, a lot of valuable knowledge and experience has learned and gained. During the period of system development, there are become clearer on how to establish the connection to database, how Intranet technologies work, ASP concepts, maintaining and configuring database and also IIS. Besides that, study and practically do the program in HTML, ASP, JavaScript and so on proved to be a valuable experience and knowledge. Besides, skills in using software such as Microsoft Visual InterDev 6.0 and Microsoft Agent Control, graphical software such as Macromedia Dreamweaver, Microsoft FrontPage 2000 and Adobe Photoshop have been acquired.

During the project development, programming skills and good practice on software engineering techniques are essential and must also be applied in efficient and efficiency way. Therefore, this project has provided the good chances to

experience using the method, techniques, paradigms, and approaches that learned from System Analysis & Design and Software Engineering courses in the second year and third year study respectively.

The scope of this system was defined through spiral model; this makes the system most expandable in terms of functionality. Thus, enhancement could still made to this system with more features added. Lastly, hoping that the features and benefits of this system will enable the thesis management to become more effective, secure, systematically and efficiency.

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Figure 1: Login Page