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LIBRARY ONLINE REQUEST FOR PURCHASING READING MATERIAL SYSTEM

by

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A Project Report Submitted to the

Faculty of Computer Science and Information Technology,

University of Malaya

Dissertation submitted in partial fulfillment of the requirement for the

Bachelor of Information Technology

Submission Date: 28 January 2002

ABSTRACT

Library Online Request for Purchasing Reading Material System (LORS) is a web-based application where lecturers from University of Malaya (UM) can make their requisition for purchasing reading material to the main library via the Internet. For the past few years, the requisition for purchasing reading materials has been done manually. Due to the inconvenience and time-consuming problems, it is worthy for us to develop a library online request service. The development of LORS is anticipated to include the use of Information Technology.

LORS is mainly divided into 2 sections, which are user section and administrator section. User section is a web-based application, which implements the tasks of lecturer requisition on the web. While administrator section is a windows-based application, which performing the tasks of the administrator. The objectives of this project are to provide a convenient and user-friendly online request system, to provide easier database maintenance for administrator and to reduce processing error due to level of human intervention.

This system's modules have been designed based on good and essential features identified from existing system available on the web. LORS hopes to meet the needs of both lecturers and administrators. They will be able to benefit from all the high-end features of this system.

LORS is developed using Active Server Pages technologies and rapid application development (RAD) on the Microsoft 2000 Professional platform. It is aimed to have a high-performance back-end database that is Microsoft SQL Server 7.0 for providing accurate information.

ACKNOWLEDGEMENT

First of all, I would like to express my deepest thanks and appreciation to my project supervisor, Puan Abrizah Abdullah for her continuing guidance, encouragement, and most of all, her persistent patience to all my shortcoming throughout the whole development stage of LORS.

Special thanks to Dr. Rosli Salleh, my project moderator for his suggestions and constructive comments during my project proposal presentation. Utmost gratitude to Puan Janaki Sinnasamy and Puan Mariah binti Abdullah, the librarians of UM library who have provided vital information on the requisition process through the interview.

I would like to acknowledge all the staffs of Faculty of Computer Science and Information Technology for their assistance and co-operation throughout the development of LORS.

Special thanks to all personals who are willing to spend their time on testing this system.

I also remember my parents, friends and course mates for sharing ideas and suggestions for the solutions to my project related problems.

I would not have successfully accomplished the completion of this project if not the in valuable assistance of the people mentioned above.

Thank you.

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INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1 Project Background

Library Online Request For Purchasing Reading Materials System (LORS)

In this project, an online request for purchasing of reading materials system is developed for the main library of University Malaya. Currently, many libraries in the world have implemented the library online request services where users can make their requests through the Internet. However, the request for purchasing reading materials processes are somewhat outdated because the library still employs the manual management process for lecturer to make their requisition. Lecturers have to undergo an inconvenient and time-consuming process for every requisition. The administrators have to key in records of requisition to the database manually. There is no computerized system available at UM library. With this online system, lecturers can access to the LORS at their own convenience and make their request for purchasing reading materials anytime and anywhere via Internet.

The Library Online Request for Purchasing Reading Materials (LORS) is a web-based application which implements the task of lecturer requisition on the web while performing the task of the administrator on a Windows-based application or known as client/server application. The lecturer section is implemented on the web for greater accessibility and offer conveniences to the lecturers. The administrator section is implemented as Windows-based application to increase the processing speed and to overcome the security problem encountered with the web-based architecture.

1.2 Purposes Of the Project

The main purpose of this system is to provide an electronic solution to the process of making request for purchasing reading materials in order to solve problems faced by the lecturers when doing requests. This system is purposely developing to implement a convenient and more efficient system for the lecturers to make requests for the reading materials from the library. This project is to automate the request processes using an Internet technology. The existing methods of making a request for purchasing reading materials are quite troublesome. Currently, there are four methods to make a request, but three of these methods are still using the manual system and another one is by sending email with a formal letter. With this online system, there is no more formal letter, no more wasting time and no more pain on making a request for purchasing reading materials. What lecturers should do is just using the Internet browser to access to the system and fill in a simple form by clicking on the button of the interface.

Apart from that, all information will be updated automatically to the database when lecturer submitted their requisition via Internet. This will certainly reduce the administrator's clerical work. They do not have to insert all the data one by one anymore. Thus, it can keep away from the man-made mistakes.

1.3 Aim and Objectives

The aim of this project is to provide a sophisticated system to all personnel involved in library request for purchasing reading materials. This system aims to implement an electronic solution to establish the library request services, which still employs the manual system.

Perhaps, it maybe a simple system but additional of some special features and functions make this system more unique.

To achieve this aim, the objectives hoped to be achieved by LORS:

i. To build a powerful, convenient and user-friendly Online Request for Purchasing of Reading Materials System
ii. Enables lecturers to make, view and cancel requests through the system without constraint of time and location.
iii. To provide easier database maintenance for administrator to view, update and analysis data.

1.4 Project Scopes

The target users of this online system includes all the UM lecturers who would like to make requests for purchasing reading materials and the administrators of UM library. The project scope is divided into 2 major sections, which are *User Section* and *Administrator section*.

1.4.1 User Section (Web-based Application)

The user section consists of the following characteristics:

i. Security module where all the lecturers will be authenticated before they can use the system. They have to key in their user name together with their password before they can access to the system.
ii. Lecturers are allowed to change their passwords.
iii. Lecturers are allowed to view and update their personal particulars.
iv. A simple and interactive web page will be created for the lecturers to make cancel a request. All the relevant data will be instantly updated into the database for records keeping and analyzing.
v. Lecturers are allowed to view or check for the status of their requisitions
vi. Lecturers are allowed to print out their requests to keep their own records.
vii. Lecturers will receive an e-mail confirmation after submit a request.

1.4.2 Administration Section (Windows-based application)

The administrator section consists the following characteristics:

i. Administration served as the back-end system where only authorized users with permissions will have accesses to the module.
ii. The administration module in this project includes maintenance of the user records. Administrators are allowed to view, add, edit and delete user profiles.
iii. Maintenance of the request record is included in this section. Administrator can view the request made by lecturers, update status of the requisition and keep track of all the requests in this module.
iv. Report writing is also part of this section. This module can generate statistical reports according to the administrator's need.
v. When the administrator has changed the request's status, an auto-generated e-mail will be sent to that particular lecturer to notify the changes.

1.5 Project Limitation

LORS does not link to the main database of the main library. As the result, lecturers are unable to search from the database to find out whether the reading material they want is available or not. So, there is a possibility that the requested reading material is actually available in the library.

This system is developed for request for reading materials. However, this system is limited to book request for the time being.

1.6 Importance Of Project

LORS has a great significant to both user and administrator. The importance of this project are stated as below:

1.6.1 User

Recent years, Internet has brought dramatic changes to the ways how people communicate, learn, work, study, think, play and live. LORS, as a web-based application system, provides a solution to the lecturers to make request for purchasing reading materials from the library with more convenient and more effective way. This online system serves as an alternative method for the user besides the existing methods. Lecturers can make their request anytime, anywhere at their own convenience. The process of making request will be simplified to a few clicks on the web.

1.6.2 Administrator

This system is provides the administrator with easier working environment. It is important to reduce the amount of routine clerical works. Routine works of processing the acquisitions and key in the request record can be reduced All information will be updated automatically once a lecturer has made or modified a request. Thus, problems like typing errors during data entry will not happen again. This will certainly improve the accuracy of the data in the database.

All information is stored in the database. So the administrator can easily access all the records for database management and maintenance purpose.

1.7 Hardware And Software Requirements

The hardware and software requirement for developing the system are stated below.

1.7.1 Hardware Requirements

The hardware requirements for running the system are:

i. Processor: Intel Pentium 133Mhz or higher (or equivalent)
ii. Hard disk: 5GB hard disk with at least 650 MB of free space (expand when system grows)
iii. Memory : Minimum 32 MB Random Access Memory (RAM) (64 MB is recommended)
iv. Others : Other standard computer peripherals

1.7.2 Software Requirements

The software requirements to develop the system are:

i. Operating system: Microsoft Windows 2000 Professional
ii. Web server : Internet Information Server (IIS) 5.0
iii. Web browser : Internet Explorer (IE) 5.5
iv. Database : Microsoft SQL Server 2000
v. Development tools: Microsoft Visual InterDev 6.0, Visual Basic 6.0, and Microsoft FrontPage 2000, Microsoft Office 2000

1.8 Project Schedule

A project schedule that consists of the whole development's activities is carefully planned out to achieve a systematic progress and ensure on-time delivery of the product. It is important to have a project schedule as it acts as a time management and control to the developer ensuring that he/she is in route of the direction of the project. Figure 1.0 below presents the project schedule of LORS.

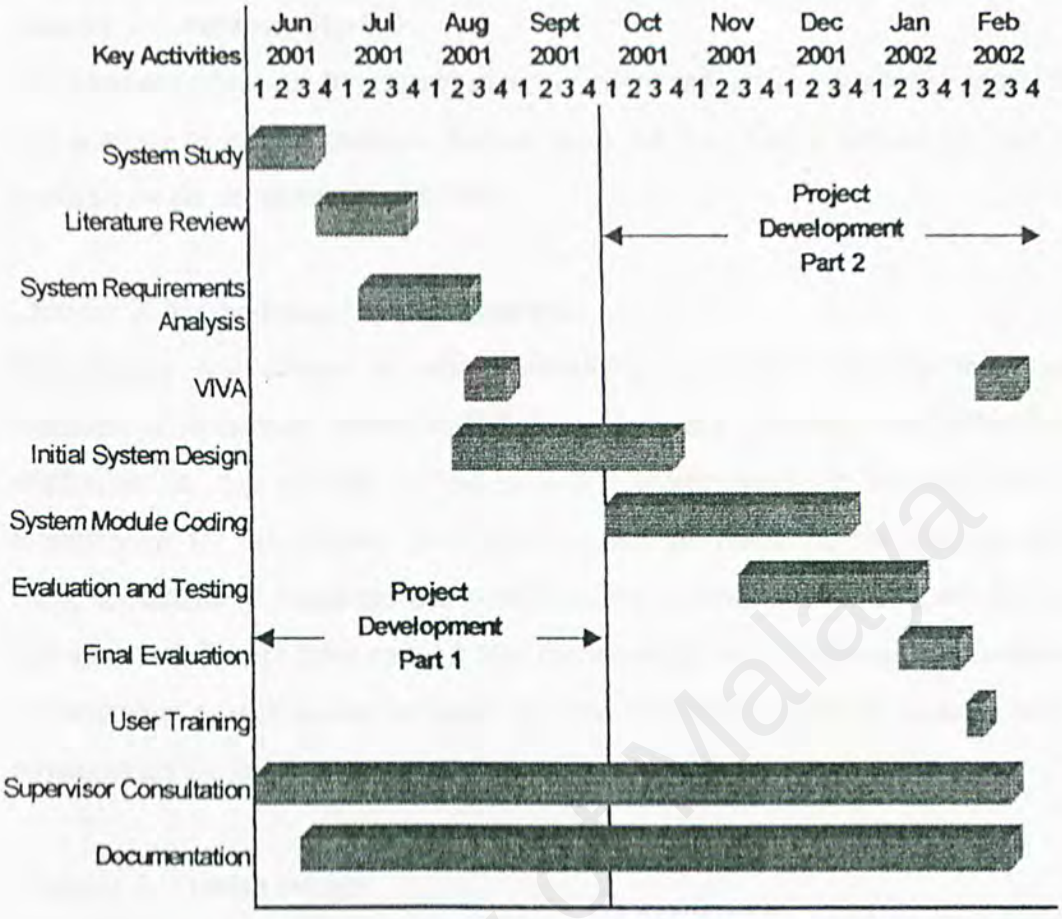


Figure 1.0 The Gantt chart for the LORS development schedule.

1.9 Organization of Report

The purpose of the report is to document all the essential information gathered and used to develop the LORS. This report is mainly divided into 4 chapters. A brief synopsis of each chapter is as follows:

Chapter 1: Introduction

This chapter serves as an introduction to the entire project. It overviews the background, purpose, aims and objectives of the project. Apart of that, the project scope and importance of the project are mentioned in this chapter too. Besides, it also covers the hardware and software requirements, project limitation and the project schedule.

Chapter 2: Literature Review

This chapter reviews on the current manual system and existing similar systems. This part consists of critical analysis, feature study on the existing similar systems and synthesis on the development of LORS.

Chapter 3: Methodology/ System Analysis

This chapter will discuss on what methodology is used to develop the system. Methods of collecting information will be included. Besides, this chapter will emphasize on the analysis of the project's requirements. It explains how the requirements for this project were acquired and the results of the analysis/survey. Here, the details of functional and non-functional system requirements are discussed and analyzed. Except from these, it also discusses the tools, language and technology consideration as well as the methodology used within the system. It explains how the requirements for this project were acquired.

Chapter 4: System Design

This chapter explains the conceptual and technical design of the system. It covers the system architecture design, system functionality design, database design and user interface design. The expected outcome is discussed in this chapter.

CHAPTER 2

LITERATURE REVIEW

CHAPTER 2 LITERATURE REVIEW

2.1 INTRODUCTION

Review of literature is background study about the knowledge and information gained to develop this project. A literature review of a project is important as it places in the context of others, which might have similar characteristics. It helps the developer to know some of the existing features offered by a similar system. Apart from that, the literature review also enables the developer to do comparison on the similar system and study the strength and weakness of it. The literature review is divided into 3 major parts: *reviews on existing systems*, *analysing of existing similar systems* and *synthesis of the proposed system*.

2.2 Reviews on Existing Systems

A research is done to study on the current system used by UM library and the existing similar system implemented in other libraries system.

2.2.1 Current System

The processes of request for purchasing reading materials are studied for both user and administrator. Methods available for the lecturers to submit their requests have been studied and reviews on how the administrator manage with the lecturer's requests has been carried out.

2.2.1.1 User Section:

Currently, there are 4 methods used by the lecturer to make a request for purchasing reading materials. These methods are:

1. Fill in a form

   Lecturers need to present personally to get the requisition form. They need to fill up that form manually and sent it back to the acquisition department.

2. Sending a formal letter

   Lecturer can write a formal letter to request the library to buy a particular reading material. The bibliographic information of that reading material must be included in the letter.

3. Through E-mail with a formal letter

   This is the most convenience way to make a request compare with others methods. However, lecturers still has to waste their time to write a formal letter but sending the letter through the E-mail.

4. Through the representative of each faculty

   Lecturers can summit their request to the representative of their faculty. All the representatives are the committee of the library. They will collect all the requests from the lecturers and summit to the library acquisitions.

2.2.1.2 Administrator Section:

When the librarian receives the requisitions from lecturers, they have spent their time on collecting and tidy up all the necessary information. They were forced to insert every data into database manually since the process is not computerized yet. They have to inform the particular lecturer if he/her request is being rejected or when the requested materials are available.

Problems Encountered:

One of the most disadvantages of the traditional methods is time consuming for both lecturers and administrators. Lecturers have to waste their time to get the form from the library and they need to present themselves at the library to summit the form within the office hour. They have to waste their time to write a letter if they wish to summit their request by sending mail. They also have to take the risk if the librarian does not receive their requisition or lost it. Apart from that, typing error might occur during the process of key in data to the database by the administrator due to lower level of human intervention. This will reduce the
accuracy of the data. Thus, the administrator will face problems when it comes to the process of data searching, reporting or analyzing data.

With the above problems in the current request system, it is clear that the current system is not efficient, trouble some and not user friendly.

2.2.2 Existing similar system

There are a lot of libraries that offer library online request service. A research has been done to find various existing system available on the Internet. It is found that most libraries abroad offer the library online request services. However, these systems are lacking at the national scene. Ten web sites are chosen for review purpose. All these sites, however, are not pure purchasing request sites. They also provide other services such as interlibrary loan, reference help, reserved room, renewal materials, database access request, etc. A survey was made focus on the purchasing request service. These ten sites studied during the research are as follow:

2.2.2.1 York University Library

URL = http://www.library.yorku.ca/

Access time = 21/7/2001 (10.30 pm)

York University Library accepts suggestion for purchasing reading materials through the Internet. Besides request services, other online services like interlibrary loan, video classroom reservation, reference help, feedback, in process request, storage request, request for e-mail notices and change of address request are available too.

The suggestion for purchase service is open to everyone. The patron has fill up the electronic form as shown in the figure 2.1 to submit their suggestion.

The **advantages** found in this system are:

i. The user interface design is simple and tidy. Users feel easy to fill in the form. Only a few fields need to be filled by the patron.
ii. User will receive a notification after submit the suggestion form. This is to confirm the acceptance of the suggestion.

However, there are some **disadvantages** found in the system. There are:

i. The user interface is lack of graphics or pictures. This will make users feel bore during the process of making suggestion.
ii. There is no error detection feature in this system. The patron can submit the suggestion form without entering any information. There is no required field to be filled up by the patron.
iii. This system is open to everyone. So, password is not required to access to this system. This will cause a lot of dummy suggestions made by somebody else and wasting the administrator's time to process all these suggestion.
iv. In this suggestion web page, there is no any link or search engine for user to find the related information.

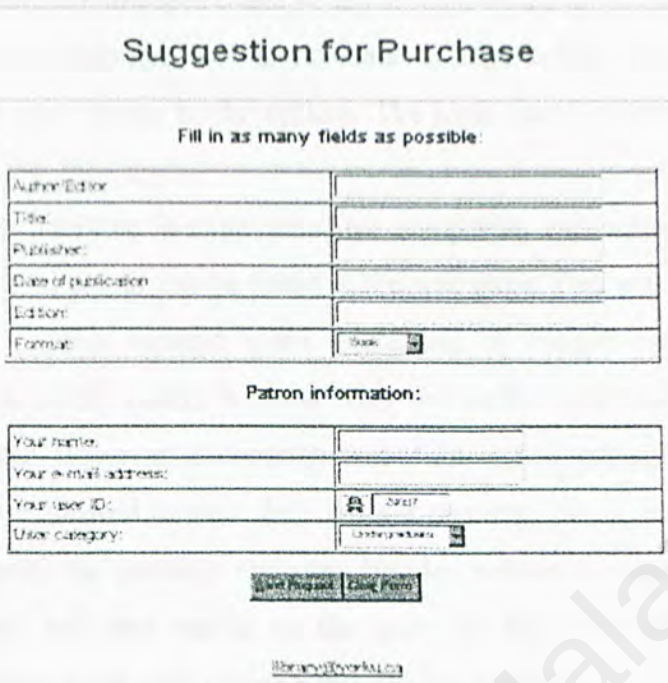


Figure 2.1 The York University Libraries Online Purchasing Request Form

2.2.2.2 Mississippi State University Libraries

URL = http://library.msstate.edu/services/forms.asp

Access time = 21/7/2001 (10.35 pm)

The library online system provided by Mississippi State University Libraries is the best among observed systems. This is not a request for purchasing reading materials service but an interlibrary loan service. It provides more functions rather than submitting a request only.

There are several **advantages** found in this system, which are as following:

i. This system requires user logon name and password. Thus, it prohibits non-member user access to the system. The login interface is shown in figure 3.2 below.

ii. The user interface is more attractive comparing with other systems. Usage of pictures and colour can be found in the web page. This will make the process of making request become more interesting. A simple explanation to give a overview of the system is given. This will let the users more understand about the system. However, the arrangement of the content can still be improved.

iii. Users are allowed to view their current requests, check status of their requests and cancel the pending requests, besides submit a request. All the addition functions are very useful to the users as they can always gat the latest information about their requests through the Internet.

However, others characteristics are not been studied because of the password protection feature in the system. Non- member users are not allowed to access to the system. Thus, the weaknesses of this system cannot be obtained.

The libraries provide others online services like library assignment alert notification, interlibrary loan, reserve classroom, research consultation and request library instruction session.

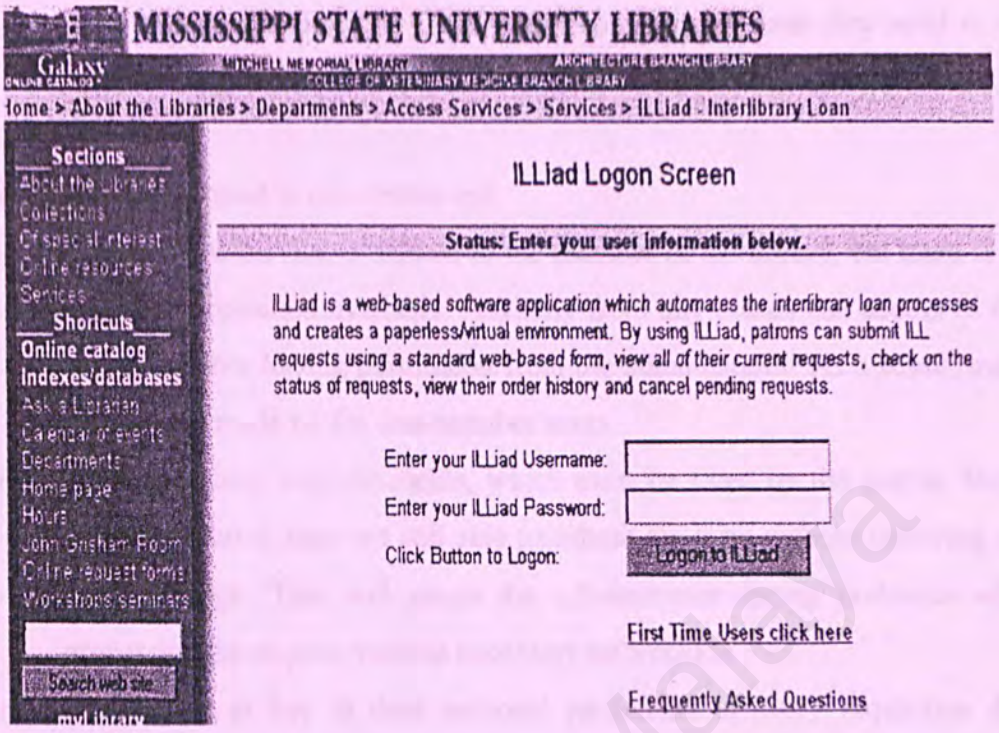


Figure2.2 The Mississippi State University Libraries iLLiad logon screen

2.2.2.3 Washington State University Library

URL = http://www.spokane.wsu.edu/studentservices/library.html
Access time = 21/7/2001 (11.42 pm)

This is not an online request for purchasing of reading material system but is a similar system, which allows user to order material from the library. Besides request for purchasing books, user can request for interlibrary loan, reserve book, ask an item for storage, ask reference question and so on.

The **advantages**, which can be found in the system Washington State University Library are:

i. It gives the explanation to the user regarding to the usage of the request form. The patron is asked to check the status of his/her request with library when the requested materials are not received within 7 working days.

ii. This system allows users to print out their request information. After users submit their request, a feedback confirmation will be give to the user and a list of all information about the request is written out. Users can print out

the information to keep as their own record, just in case they need to do report about their requisitions.

The **disadvantages** found in this system are:

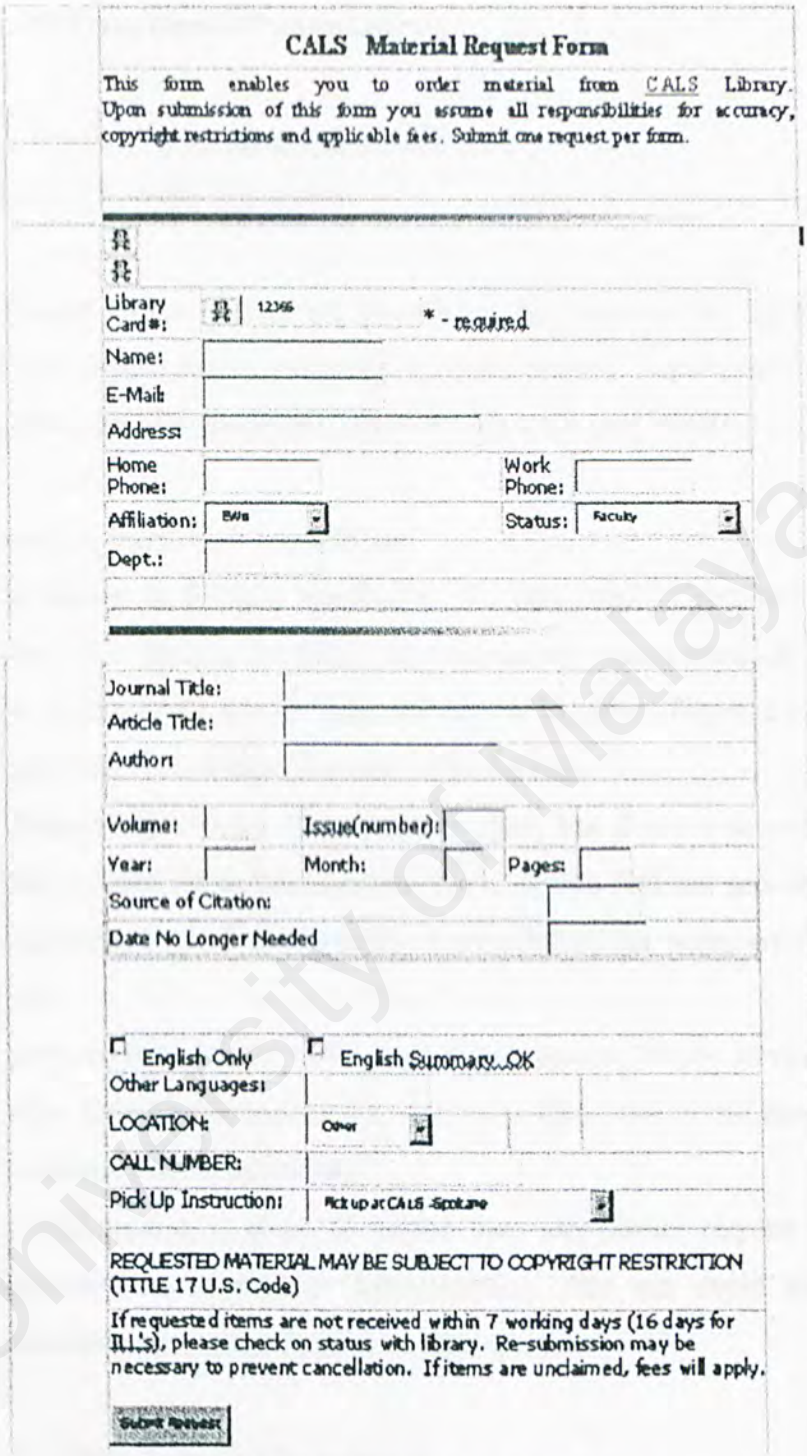
i. Although this service is offered to the member of the library, but there is no password protection available. Anybody from any places can access to this system without having permission from the administrator. As a result, many request will made by the non-member users.

ii. There are some required fields, which must be filled by the patron. But if the users omit it, they are still able to submit the form without receiving any alert message. This will cause the administrator facing problems when processing the request without necessary information.

iii. Users have to key in their personal particulars in every requisition they made. This is very troublesome as the administrator should have their personal record in the database. Thus, this system is considered not user-friendly.

iv. The user interface is considered simple but the sequence of the contents may need more improvements. Some pictures or fancy font can be added to make the appearance of this web page more attractive. The user interface is shown in figure 3.3.

v. No hyperlinks or search engine offered in this web page. Users are not linked to others web page in this system. So, it is not a user-friendly web page.



CALS Material Request Form

This form enables you to order material from CALS Library. Upon submission of this form you assume all responsibilities for accuracy, copyright restrictions and applicable fees. Submit one request per form.

Library Card#: 12345 * - required

Name:

E-Mail:

Address:

Home Phone: Work Phone:

Affiliation: Status: Faculty

Dept.:

Journal Title:

Article Title:

Author:

Volume: Issue(number):

Year: Month: Pages:

Source of Citation:

Date No Longer Needed

☐ English Only ☐ English Summary OK

Other Languages:

LOCATION: Other

CALL NUMBER:

Pick Up Instruction: Pick up at CALS -Spotsylvania

REQUESTED MATERIAL MAY BE SUBJECT TO COPYRIGHT RESTRICTION (TITLE 17 U.S. Code)

If requested items are not received within 7 working days (16 days for ILL's), please check on status with library. Re-submission may be necessary to prevent cancellation. If items are unclaimed, fees will apply.

Submit Request

Figure 2.3 CALS Material Request Form

2.2.2.4 William Russell Pullen Library

URL = http://www.library.gsu.edu/forms/
Access time = 25/7/2001 (11.43pm)

William Russell Pullen Library has provides online services like interlibrary loan, reference help, renew library materials, purchase request, request for e-mail notices and ask a librarian. The purchase request service is the one, which is studied.

The **advantages** found in this system are:

i. The design of the user interface is neat and simple. Users feel comfortable when fill in the request form. Instructions are clearly stated in the form and this makes confusion of users will not be occurred. Figure 2.4 presents the request form of William Russell Pullen Library.

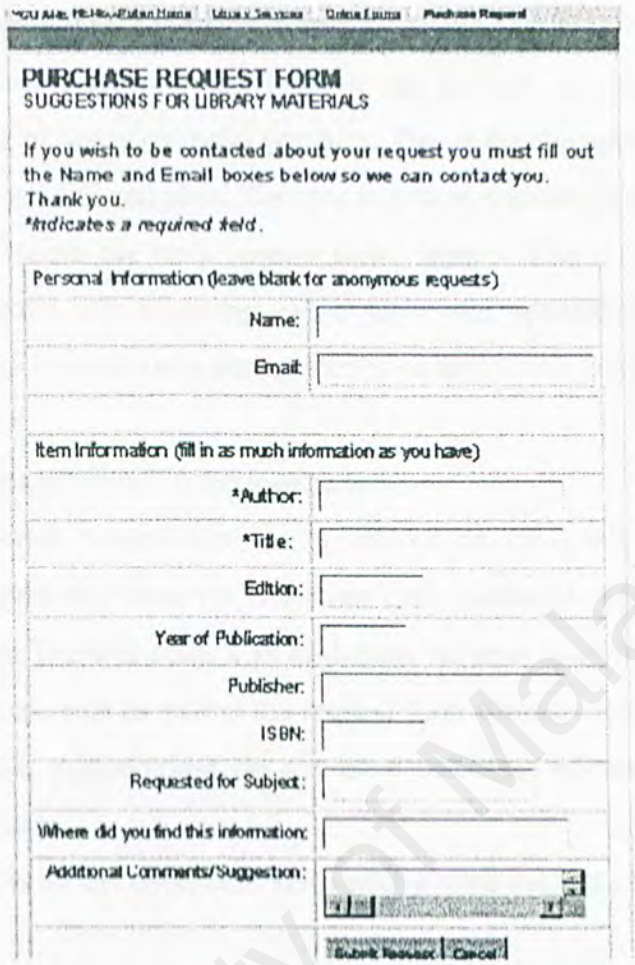
ii. Although there is no error message alert, but if users submit the request form without fill in the required fields, system will not process it and just stop at that page. This is good to ensure that all the necessary information is given.

iii. Users are linked to the home page of this system, library services and others online form by the hyperlinks. Users can flips between all these web pages by clicking on the hyperlinks.

iv. A confirmation is given to inform user that his/her request is successful forwarded to appropriate bibliographer. This can avoid the user from submitting the request form more than one time.

The **disadvantage** found in this system is:

i. The system function is limited to submit request form only. Users are unable to know status of their request through this system.



PURCHASE REQUEST FORM
SUGGESTIONS FOR LIBRARY MATERIALS

If you wish to be contacted about your request you must fill out the Name and Email boxes below so we can contact you. Thank you.
*Indicates a required field.

Personal Information (leave blank for anonymous requests)
Name:
Email:

Item Information (fill in as much information as you have)
*Author:
*Title:
Edition:
Year of Publication:
Publisher:
ISBN:
Requested for Subject:
Where did you find this information:
Additional Comments/Suggestion:

Figure 2.4 William Russell Pullen Library purchase request form

2.2.2.5 University of Pittsburgh Libraries

URL = http://www.library.pitt.edu/services/requests/
Access time = 26/7/2001 (12.25 am)

The online purchase request service offered by University of Pittsburgh Libraries is limited to the book purchase request only. Others reading materials such as journal, magazine, etc are not available. Besides request for purchasing books,

user can request for interlibrary loan, reserve book, ask an item for storage, ask reference question and so on.

The **advantages** found in this system are:

i. The user interface design looks simple and tidy. However, the web page is lacking of some colourful graphics. This make the appearance of this web-page look dull and plain. The user interface is shown in figure 3.5.

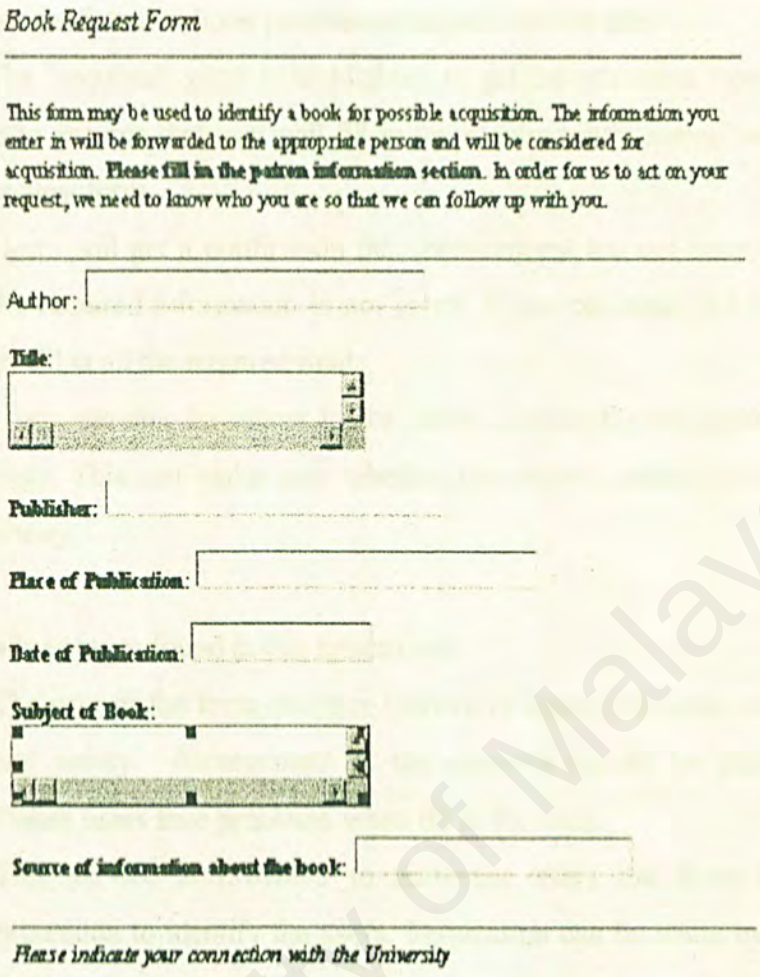
ii. After submit the book request form, there will be a conformation form to inform the user regarding to the successful submission. All information is listed to let users print out the form in order to keep their own record.

The **disadvantages** found in this system are:

i. This book request service is offered to the student and stuff of the University of Pittsburgh. But, there is no password required to access to this system. This will cause a lot of dummy requests made by the outsiders.

ii. Users are able to submit the request form without complete information. As a result, administrator do not have sufficient information to process the requisition.

iii. There is no any hyperlinks and search engine available in this web page.


Book Request Form

This form may be used to identify a book for possible acquisition. The information you enter in will be forwarded to the appropriate person and will be considered for acquisition. **Please fill in the patron information section.** In order for us to act on your request, we need to know who you are so that we can follow up with you.

Author:

Title:

Publisher:

Place of Publication:

Date of Publication:

Subject of Book:

Source of information about the book:

Please indicate your connection with the University

Figure 2.5 University of Pittsburgh Libraries book request form

2.2.2.6 The University of Edinburgh Library

URL = http://www.lib.ed.ac.uk/lib/services/requests.shtml

Access time = 26/7/2001 (1.15 am)

The University of Edinburgh Library has provides online services like suggestion for purchase, interlibrary loan, ask a librarian, access borrower record, contact the library, offprint and etc.

The **advantages** found in book purchasing request service are:

i. The 'required' word is highlighted to get the attraction from the user. This is to ensures that user will fill in the required information before submit the request form.

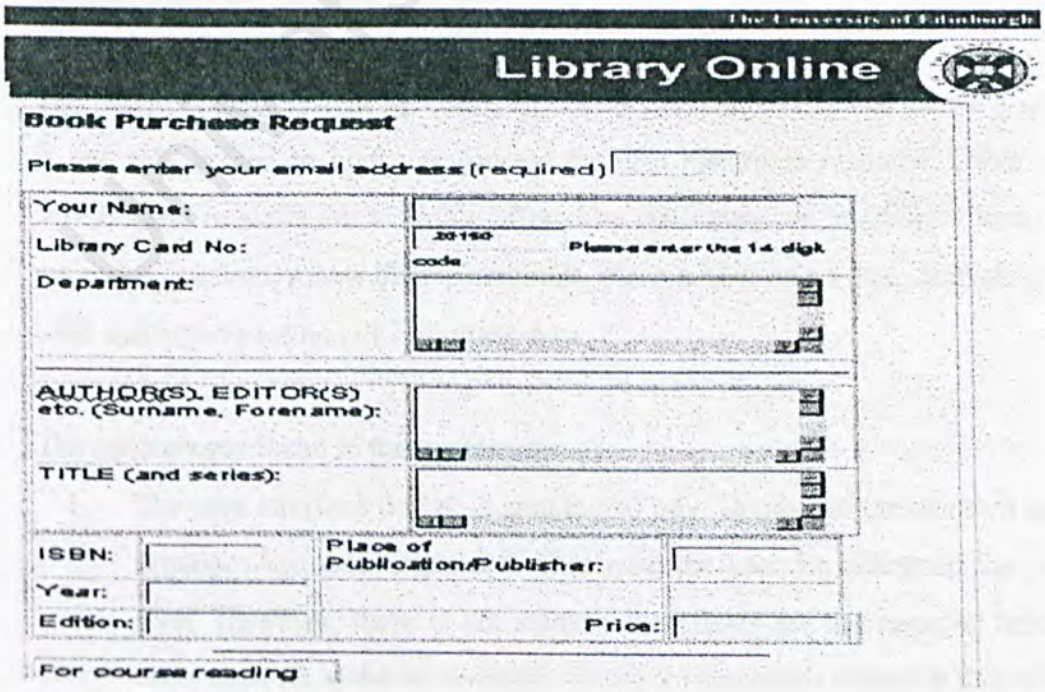
ii. Users will get a notification that their request has not been sent because of the required information is not given. Users can make the requisition again by fill in all the required fields.

iii. Users are able to access to the online catalog by the hyperlink in the web page. This can make sure whether the request material is available in the library.

The **disadvantages** found in this system are:

i. The user of the form interface (shown in figure 2.6) looks a little bit crowed and messy. Arrangement of the contents should be improved as it will makes users face problems when fill in the form.

ii. This service is provided to authorize users but there is no password protection to identify the users. Requisition can be made by anyone through the Internet.



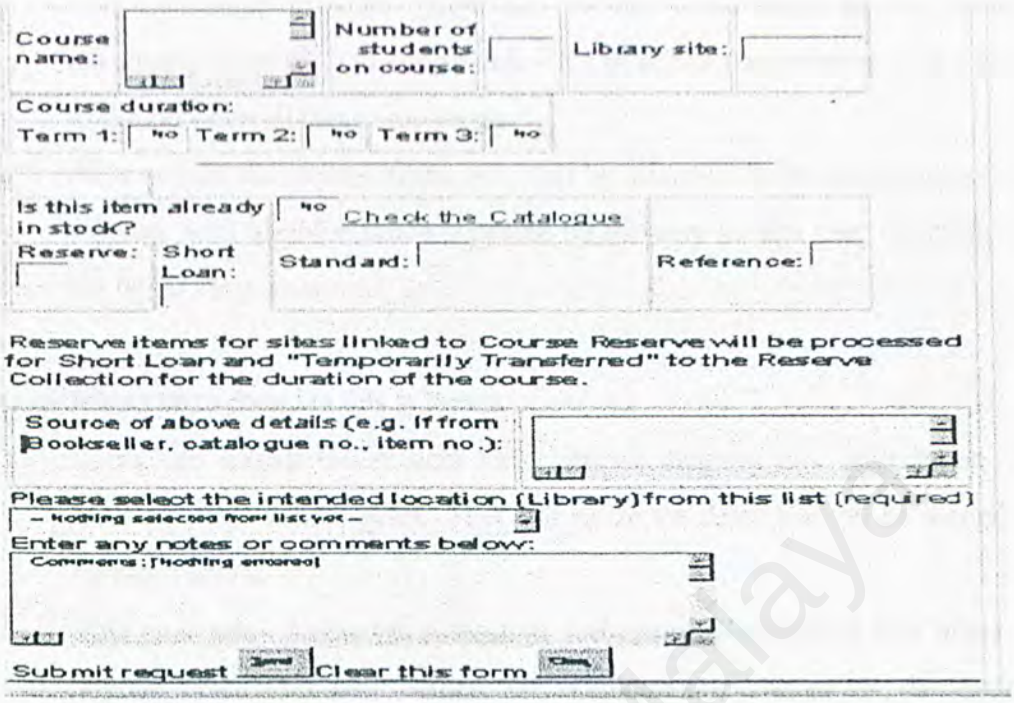


Figure 2.6 The University of Edinburgh Library book purchase request

2.2.2.7 University of Florida Health Science Center Libraries

URL = http://www.library.health.ufl.edu/forms/index.htm
Access time = 29/7/2001 (11.10 am)

The online request system by University of Florida Health Science Center Libraries is not only limited to books or journal but also electronic resource. Other online services and requests are available offered by the library are interlibrary loan, ask a reference question, renew library materials, place a hold on an item, activate gator 1 card and register for an HSC libraries class.

The **advantages** found in this system are:

i. The user interface design is simple and tidy. Display of the contents and the sequence are well organized. This ease the users in filling up the request form. However, there is not stated which fields are the required fields that users must fill in the information. The user interface is shown in figure 2.7.

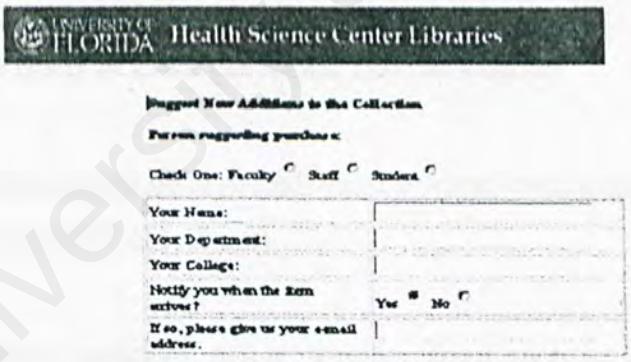
ii. The web page provides hyperlinks to the home page of the library, resources, help/tips, and site search. This provides convenience to the users to flip between all these web pages.

iii. After submit the request form, user will be informed by a confirmation form together with all information supplied by the user so that user can print out the list to keep a record.

The **disadvantages** found in this system are:

i. Users can submit the request form without entering any information. No error message will be given. This will cause the database will be loaded by dummy request.

ii. This is a non- password protection web page. Requisition can make by anyone else. This will burden the administrator chores by the dummy requests.



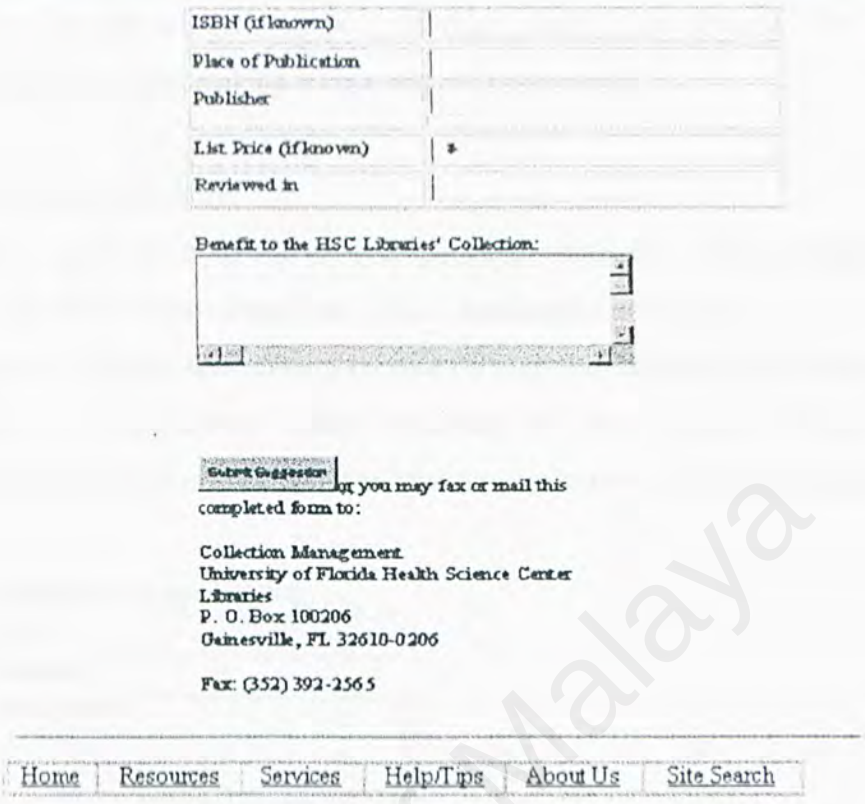


Figure 2.7 University of Florida Health Science Center Libraries suggestion purchase form

2.2.2.8 University of Iowa Libraries, Hardin Library

URL = http://www.lib.uiowa.edu/hardin-www/forms.html

Access time = 29/7/2001 (11.40 am)

The Hardin library provides online services form such as collection purchase request, interlibrary loan, book renewal, reference help, book on call, literature search request and etc.

The **advantages** of collection purchase request service are stated as below.

i. The design user interface is clear and simple, figure 2.8. Users can easily fill in the form without having many problems. Same with other system, this system is also lack of graphics and pictures on the web page. Putting some graphics in the page will certainly make the interface more eye-catching.

ii. Users will get a confirmation once they submit their request. This will prevent users from making a same request two times.

The **disadvantages** found are:

i. Again, users have to fill in their personal particulars when making the second, third and more requests. This is wasting the users time.

ii. Anyone else can also make a request through this system since there is no password requirement when accessing to this system. Then, the administrator has to differentiate all the dummy requests with real requests.

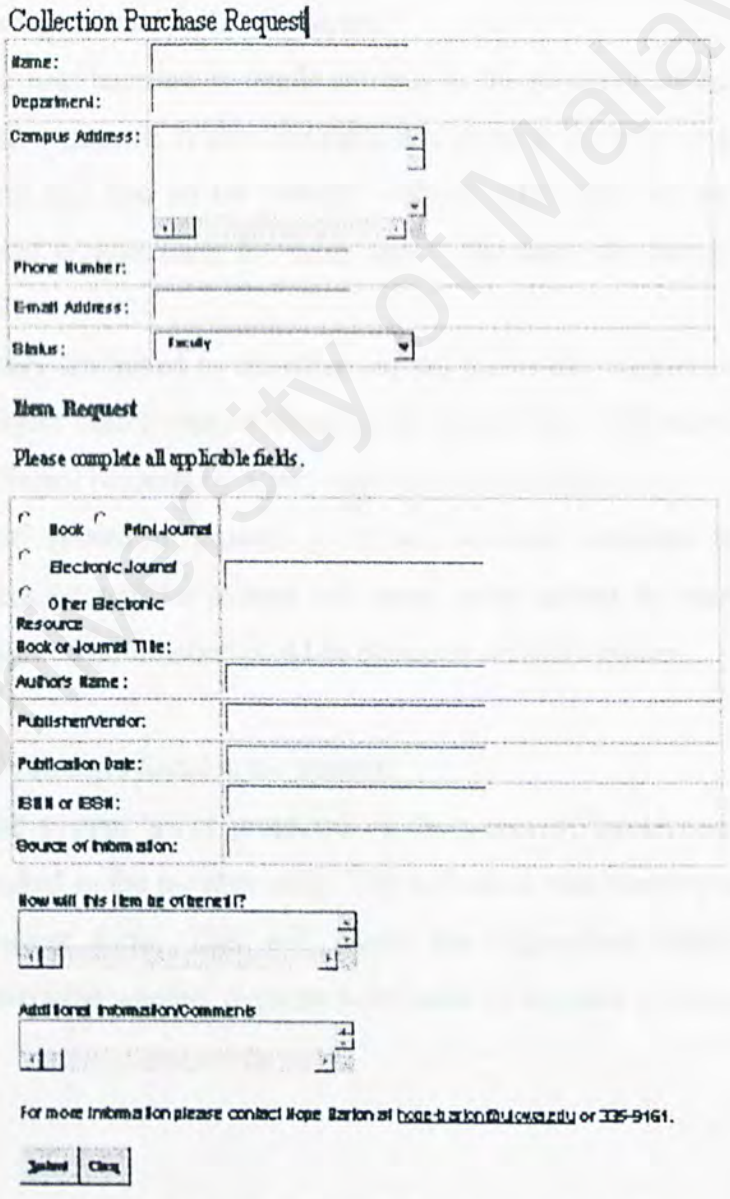


Figure 2.8 Hardin Library collection purchase form

2.2.2.9 Open learning agency library

URL = http://www.ola.bc.ca/ol/services/library/forms/requests.html
Access time = 29/7/2001 (12.45 pm)

Reviews are studied on the book request offered by the Open learning agency library. Besides request for book request, there are other services like book chapter request, article request, course video request form and opened account request available in the system.

The **advantages** found in the system are:

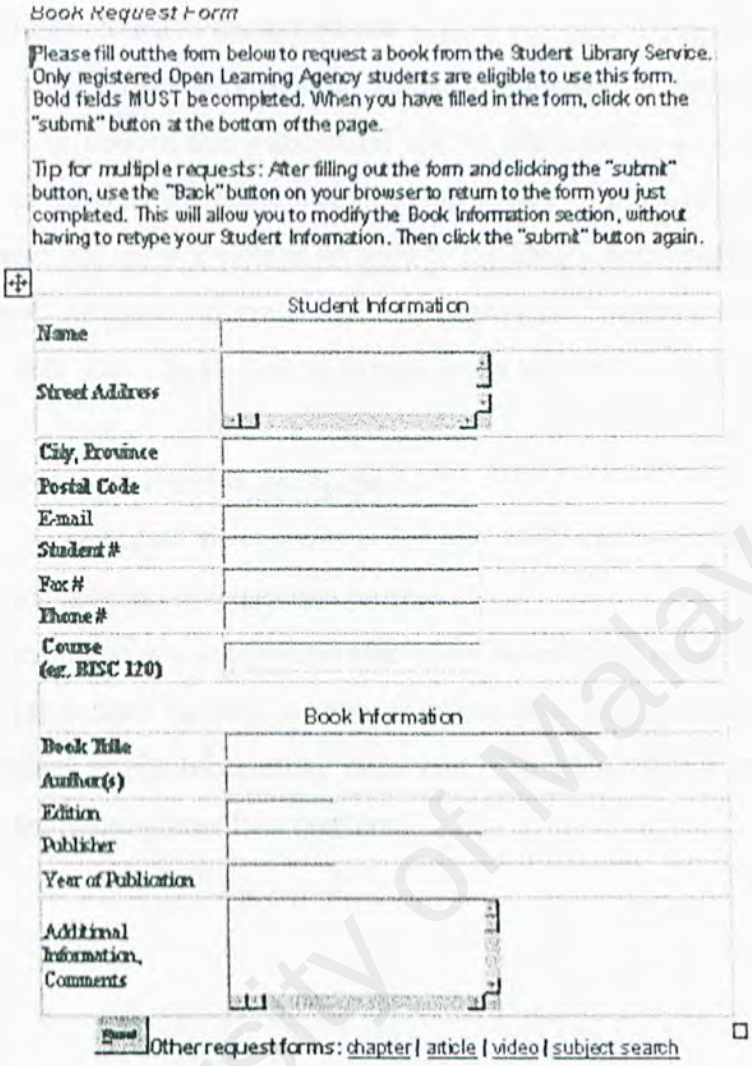
i. The user interface is simple and tidy as the sequence of the contents is quite well organized. A short instruction is given to the user on how to submit the form and also tip for multiple requests. This will safe the user's time and doing a same thing for many times. The user interface is shown in figure 2.9.

ii. Users are linked to the other request forms like chapter, article, video, and subject search request form by the hyperlinks. This makes users can make different requests by a very easy and convenience way.

iii. The system is process a request without complete information. Error message will be prompt out when users submit an incomplete form. All required information could be obtained with this feature.

The **disadvantages** found in the system:

i. The system is not protected by the password protection as the service is limited to the member only. This will allow non-member users to submit the request form. This will cause the appropriate bibliographer have to determine whether requests were made by member or non-member.


Book Request Form

Please fill out the form below to request a book from the Student Library Service. Only registered Open Learning Agency students are eligible to use this form. Bold fields MUST be completed. When you have filled in the form, click on the "submit" button at the bottom of the page.

Tip for multiple requests: After filling out the form and clicking the "submit" button, use the "Back" button on your browser to return to the form you just completed. This will allow you to modify the Book Information section, without having to retype your Student Information. Then click the "submit" button again.

Student Information

Name
Street Address
City, Province
Postal Code
E-mail
Student #
Fax #
Phone #
Course (ex. BISC 120)

Book Information

Book Title
Author(s)
Edition
Publisher
Year of Publication
Additional Information, Comments

Submit Other request forms: chapter | article | video | subject search

Figure 2.9 Open learning agency library book request form

2.2.2.10 Covenant Library System

URL = http://www.covlibrary.org/forms.html

Access time = 1/8/2001 (10.30 pm)

Covenant Library System provides services such as database access request, book purchasing request journal purchasing suggestion, document delivery request, literature search request. The research is carried out on the book request service only.

The **advantages** found in this system are:

i. If users submit their request without completing the required fields, users will be noticed that page could not be found because of the bad request. This certainly will make sure all the necessary information can be obtained.

ii. There are quite a number of links to the library home page, journal request form, database, reference tool and Convenant Corporate Website. Uses are able to access to all those web page easily by clicking on the hyperlinks.

The **disadvantages** found in this system are:

i. Te sequence of the contents is not very well organized. Users will feel dull when making the requisition process.

ii. There is no any notification after users submit their request. This will let the users submit the request more than one time because of thinking that their request is not successfully been sent. The administrator should handle the same request more than one time.

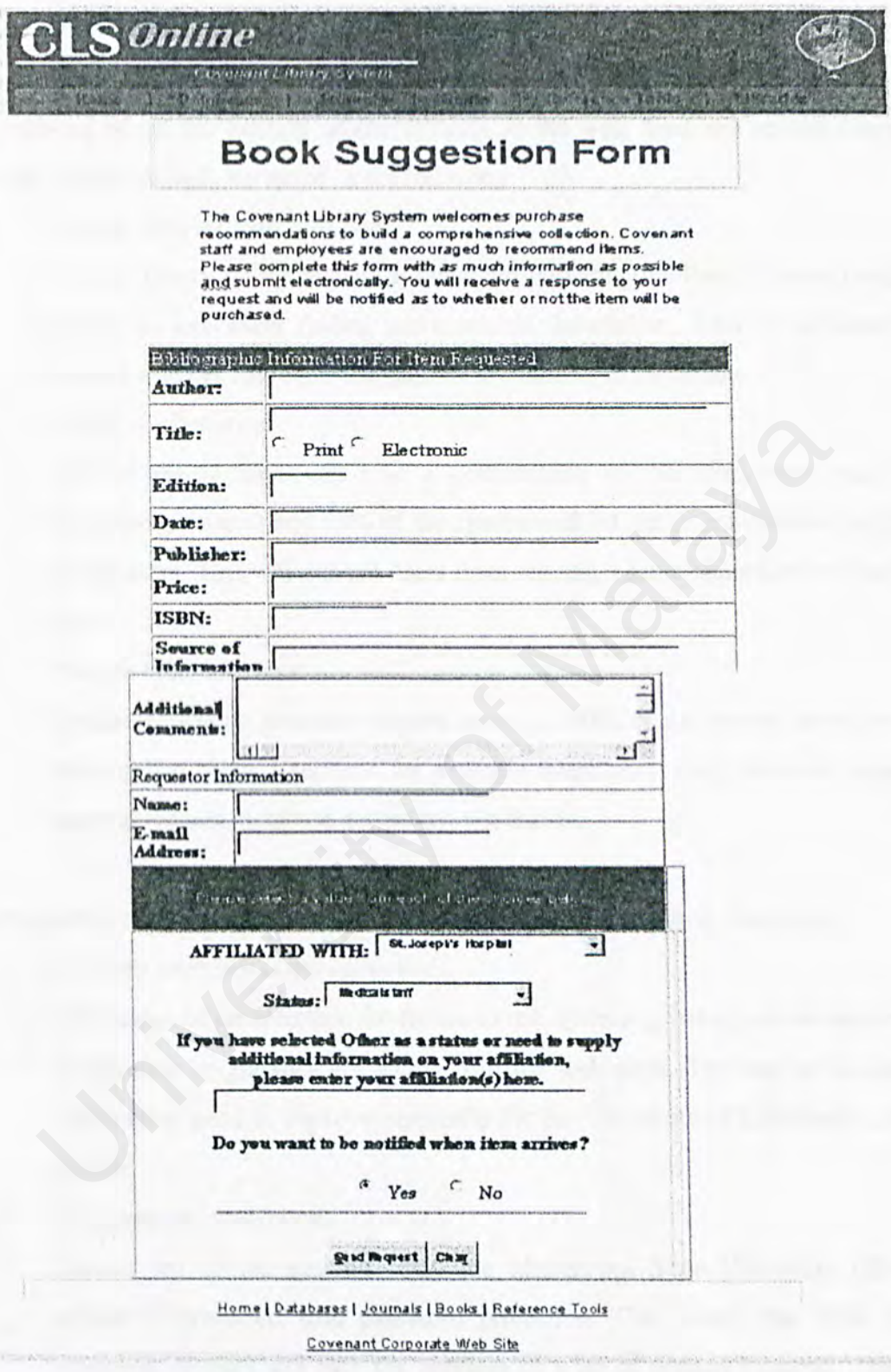


Figure 2.10 Covenant Library System book suggestion form

2.3 Analyzing of Existing Similar Systems

After reviewing of the ten existing similar systems on the web, there are several strength were found. These strength are stated as the following:

i. *Provide links or search engine.*

5 of the library online request systems are providing the links or search engine feature to lets users finding more related information. This is important to ensures whether the requested material is available in the library.

ii. *Giving confirmation.*

80% of the systems will give a confirmation to the users once user has submitted a request and 20% of the system will list out all information supplied by the users. This will prevent users from sending a same request more than one time.

iii. *Provide other services.*

Besides providing purchase request service, 100% of the system have provide other online request services for example interlibrary loan, reference request, renewal request, database access request and etc.

However, quite a number of weaknesses are found through the research. There are:

i. *The user interface is not attractive.*

The design of the interface for the observed systems generally is too simple and no pictures or graphics are included in the web page. The way of displaying information need to improve especially for the University of Edinburgh Library system.

ii. *No password protection.*

Among ten of the systems, only the Mississippi State University Libraries system is protected with password protection. This means that 90% of the surveyed systems will face the problem of a lot of dummy requests. This will burden the administrator's task by handling those invalid requests.

iii. *No error alert.*

Only 20 % of the systems will prompt an error message while user try to put in some invalid information or incomplete the electronic form. This will cause the database loaded by those incorrect data.

iv. *Few functions available.*

Except for the Mississippi State University Libraries system, 9 of the systems are only provide the functions of submit request and function of reset form.

v. *Send request by e-mail.*

All the systems are sending the requisition by forwarding the form to the appropriate bibliographer and not directly send to the database. This will burden the administrator to insert all the data into the database manually.

The table 2.1 below shows the features comparison among ten of the reviewed systems.

Features / Systems	Password requirement	Error alert	Links & search engine	Confirmation	Other Services
York University Library	×	×	×	√	√
Mississippi State University Libraries	√	√	N/A	N/A	√
Washington State University Library	×	×	×	√	√
William Russell Pullen Library	×	×	√	√	√
University of Pittsburgh Libraries	×	×	×	√	√
The University of Edinburgh Library	×	×	√	√	√
Health Science Center Libraries	×	×	√	√	√
Hardin Library	×	×	×	√	√
Open Learning Agency Library	×	√	√	√	√
Convenant Library	×	×	√	×	√

Table 2.1Features comparison of the existing systems

× - Not available

√ - Available

2.4 Synthesis of the Proposed System

As can be seen in the existing library online service request system, lots of the disadvantages and inconveniences are found in these observed systems. Due to all of the disadvantages and inconveniences, it is a good step to re-invent a library online request system that can improve those weaknesses.

More new features need to be added to support and improve the dynamic interaction between the users and the Web server. Besides that, it is also need to improve the way of displaying information and add in more graphics. This will result into being a user-friendly interface and more attractive to the user. The following features will be adopted in the proposed system.

i. *Interactive and user-friendly interface*

A user-friendly interface will be developed so that the users will not feel bore and awkward when surfing to this web page and performing an online request. Some images, graphics and pictures will be added for maximum attractions and entertainment for users while surfing the Web. However, usage of lots of graphic and animation will not be adopted for use in the proposed system as it needs more loading time that might decrease the system's performance.

ii. *Password protection*

This system is developing for the lecturers use. Only the authorized user are allowed to access to the website. Therefore password protection is a necessity to prevent a lot of dummy requests made by anybody else.

iii. *Error message prompt*

An error alert will be given to the user if he/she submits the electronic form without supplying the required information. Users are not allowed to submit their requests until all necessary information are given.

IV. *Contents*

The sequence of the contents will be well organized and properly arranged to make sure users are satisfied in getting the needed information. The usage of

attractive fonts and buttons will be widely applied in this system. Tips and simple explanation will provide to the users.

2.5 Summary

This chapter is mainly about the reviews on the current system implements by the UM library and the existing similar systems in the world. The problems faced by the users using traditional methods are defined. A research is carried out to find out the strengths and the weaknesses of ten existing similar systems. Some of the advantages found in the existing system will be adopted to the proposed system and the weaknesses of the existing system will be overcome in the proposed system.

The following chapter, chapter 3 is discussed on the topic of system analysis. The development methodology for this project is selected after reviews on several kind of existing methodology. Techniques of collecting information are mentioned in next chapter. All the functional requirements and non- functional requirements are defined. Consideration and selections of tools, programming languages, technologies have been done in the phase of system analysis. Hardware and software requirements for client and server side for running the system are also included in chapter 3.

CHAPTER 3

METHODOLOGY AND SYSTEM ANALYSIS

CHAPTER 3 METHODOLOGY AND SYSTEM ANALYSIS

3.1 Introduction

System analysis is an essential and important phase that is used to determine clearly of all the necessary requirements before proceeding into subsequent phase. This phase usually requires a certain period time to complete for a small-scale project such as this project. Installing a system without proper planning and analyzing leads to great dissatisfaction and frequently causes the system to fall into disuse [Pfleeger,2001].

In this phase, all information gathered, on development tools, technology and programming languages are analyzed. Then a decision is made to choose appropriate tools or technologies for this project.

Besides, a requirement analysis is also carried out as well as study on existing system. Lastly in this phase, an analysis on run-time requirement is made to ensure smooth development in later stages.

3.2 System Development Methodology

Normally when a developer develops a system, they will always follow a sequence of steps to fulfill a set of tasks. Before starting a new project on system design, it is recommended that the developers choose the most suitable methodology. There are several reasons why process modeling is needed, such as listed below [Pfleeger,2001]:

i. When a group writes down a description of its development process, it forms a common understanding of the activities, resources, and constraints involved in software development.
ii. The model should reflect the goals of development, such as building high-quality software, finding faults early in development, and meeting required budget and schedule constraints. As the model is built, the development team evaluates candidate activities for their appropriateness in addressing these

goals. For example the team may include requirements reviews, so that problems with the requirements can be found and fixed before design begins.

iii. Creating a process model helps the development team find inconsistencies, redundancies, and omissions in the process and in its constituent parts. As the problems are noted and corrected, the process becomes more effective and focused on building the final product.

iv. Every process should be tailored for the special situation in which it will be used. Building a process model will let the development team understand where that tailoring is to occur.

There are several choices of software development process model such as Waterfall model, Prototyping Model, V model, Spiral model, Transformation model, and etc.

After reviews on all the development models, the Waterfall with Prototyping model is chosen as the system development methodology.

3.2.1 Reviews on Waterfall Model

The Waterfall model is one of the oldest proposed process models. It was first put forward by Royce in 1970. Most of the newer models are modified from this model. Figure 3.1 illustrates the Waterfall model where the stages are depicted as cascading from one to another.

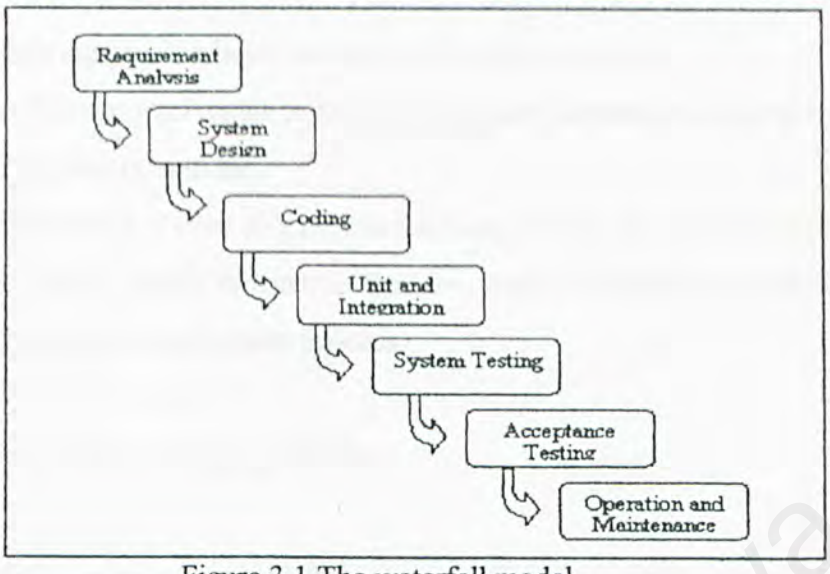


Figure 3.1 The waterfall model

As the figure implies, one stage should be completed before the next begins, which means the developer should develop the system step by step followed by the sequence. Thus, when all of the requirements are elicited from the customer, analyzed for completeness and consistency, and documented in a requirements document, then the development team can go on to the system design activities. This model will let the developer viewing of what is going on during their development phrase[Pfleeger,2001].

The advantages of using Waterfall Model are stated as following.

i. It lays out what developers need to do.
ii. It is easier for the explanation to a customer who are not familiar with software development.
iii. It makes explicit which intermediate products are necessary in order to begin the next stage of development

Despite having its advantages, the Waterfall model has a few drawbacks. McCracken and Jackson (1981) pointed out that the model imposes a project management structure on system development. "To contend that any life cycle scheme, even with variations, can be applied to all system development is either to fly in the face of reality or to assume a life cycle so rudimentary as to be vacuous." Some of the main drawbacks of the Waterfall model are listed as below:

i. Not showing how the basic coding is designed or created.

ii. Do not have any reference to refer to when any disaster or changes is happening to the product or activities

iii. Failed to treat software as a problem-solving process [Curtis, Krasner, Shen and Iscoe, 1987], which we notice that the waterfall model is actually modified from hardware development process.

3.2.2 Reviews on Prototyping Model

Prototyping Model is another type of effective process model, which allows all or part of the system to be constructed quickly to understand or clarify issues. Thus it will let the developer, user, and customer have a common understanding both of what is needed and what is proposed. One or more of the loops for prototyping requirements, design, or the system may be eliminated, depending on the goals of the prototyping. However, the overall goal is also to reduce risk and uncertainty in development [Pfleeger, 2001]. The prototyping model is shown in figure3.2.

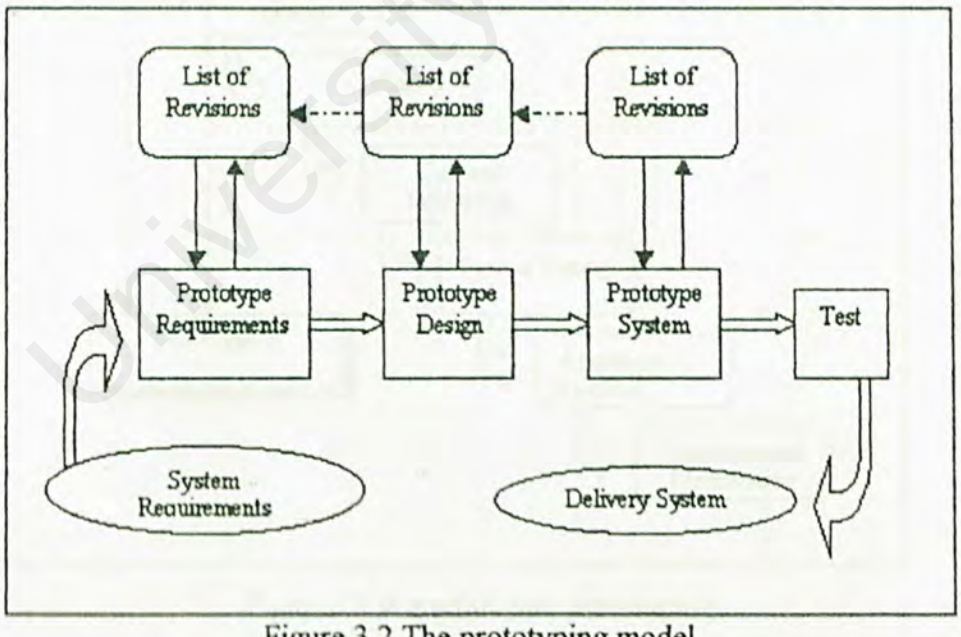


Figure 3.2 The prototyping model

The advantages of using Prototyping Model are:

i. Reduce risk and uncertainty in development

ii. Very user-centered and involves the users as much as possible

The disadvantages of using Prototyping Model are:

i. Produce the product within limited time will ignore the quality for the software. Thus, it needs more time to maintenance the system.

ii. The developer may develop the system within unsuitable platform or programs.

3.2.3 Implementing Waterfall Model With Prototyping

The waterfall model can be mended with prototyping activities to improve understanding as shown in figure 3.3.

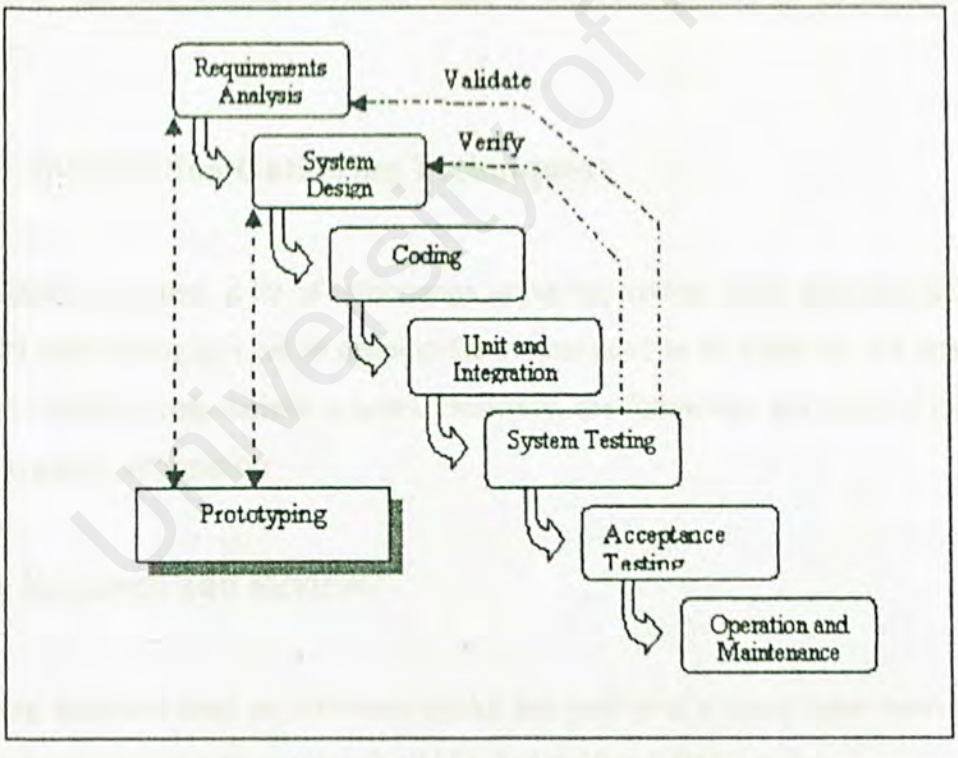


Figure3.3 Waterfall with prototyping

By adding prototyping element into the Waterfall model, it may solve a lot of the problems cause by the traditional model, which a software development will evolves lots of iteration processes as listed from the traditional Waterfall model. A prototype is a partially developed product that enables customers and developer to test the proposed system and

decide if it is suitable for the final product. Validation ensures that the system has implemented all of the requirements, so that each function can be traced back to a particular requirement in the specification. Verification ensures that each function works correctly [Pfleeger, 2001].

There are several advantages in using the Waterfall model with prototyping:

- Allows all or part of the system to be constructed quickly to understand or clarify the requirement.
- Understands the feasibility of a design or approach.

i. Reduces risk and uncertainty in the development process.

This model has gather the advantages of both traditional Waterfall model and Prototyping model, hence to improve the quality of the software life circle process and guarantee the quality of the final delivery system. Thus, it has been chosen to be implement into this project.

3.3 Information Gathering Techniques

To develop a system, a lot of information about the system itself, the procedures involved and the methodologies used to develop the system need to be gathered. All this information can be obtained from various sources. Basically, the followings are some of the techniques used to gather information:

3.3.1 Research and Reviews

Reading materials such as reference books and past year's thesis have been studied for a better picture on how the system should be designed and developed.

3.3.2 Surfing the Internet

Nowadays, Internet surfing is a very efficient way of gathering information. Many existing websites from various countries provide useful and expertise information. Internet provides the latest techniques and information about the development tools in this project.

The main objective of this activity is to analyze the features, characteristics, interfaces, and system design and user friendliness of the web applications.

3.3.3 Interview

Several informal interviews and discussions with the expected users have been carried out. These people include the librarian who involves in the process of purchasing reading materials and lecturer who makes the requisition. By interviewing, information can be gathered on how actually the requisition process run and the user's needs are identified.

3.3.4 Discussion

Meeting and discussion with the supervisor is crucial during information gathering to understand the needs of system.

3.4 Requirement 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. It is often helpful to separate requirements into there categories:

i. Requirements that absolutely must be met
ii. Requirements that are highly desirable but not necessary
iii. Requirements that are possible but could be eliminated

However, only requirements type (i) is listed and discussed in the following sections. Requirements describe not only the flow of information to and from a system and the transformation of data by the system, but also the constraints on the system's performance. Thus, the requirements can serve three purposes:

i. Allow developers to explain their understanding of how the customer wants the system to work.
ii. Tell designers what functionality and characteristics the resultant system is to have.
iii. Tell the test team what to demonstrate to convince the customer about the system being delivered is indeed what was ordered.

Requirements often have the following characteristics to ensure that the requirements be of high quality:

i. Requirements should be correct.
ii. Requirements should be consistent.
iii. Requirements should be complete.
iv. Requirements should be realistic.
v. Requirements should describe something that is needed by the customer.
vi. Requirements should be verifiable.
vii. Requirements should be traceable.

Requirements describe a system's behavior. The requirements express the system and object states and the transitions from one state to another. Requirements can be thought of in two ways, functional and nonfunctional..

3.4.1 Functional Requirements

Functional requirements are system services expected by the user [Sommerville, 1995]. Functional requirements are functions or subsystems that are mandatory to the system. It explain what the system will do, independent from the implementation of the solution. It describes an interaction between the system and its environment to determines functional requirement, a design has to be made on what states are acceptable for the system to be in [Pfleeger, 2001]. The absence of the functional requirement will make the whole system incomplete.

Generally, LORS is divided into two major categories, which are User Module (web-based application) and Administrator Module (windows-based application). The User Module consists of three main sub-modules and the Administrator Module consists of four sub-modules. Functions of these sub-modules are explained as following:

1. Requisition Processing Module

This module allows users to:

Add a new request – Users are allowed to submit a new request record to the database through the Internet. The amount of request is unlimited, so users can submit request as many as they need.

View requests – Users are allowed to view their current requests and check for the status of any request they have made.

Cancel requests – This function list out all the requests, which can be canceled by the user if he/she wishes to do that.

2. Requisition Management Module

This module allow administrator to:

View requests - Administrators are allowed to view all requests made by the use according to the status of request.

Update requests – Administrators can update the information of requests through this module.

Add requests – This function allows administrators to add request to the database.

Delete requests – Administrators are allowed to delete a particular request from the database.

Search requests - Administrator can search a particular request through this function.

3. Authentication & Authorization module

This module will make sure the users/administrators are entering the correct password correspondent with their user name before they access the system. After password authentication, users/administrators are allowed to:

Login – Login to the LORS system

Logout – Logout from the LORS

Change password – Users/administrator are advised to change their password frequently for security purpose.

4. Personal Profile Module

This module allows user to:

View profile – View personal profile

Update profile – Update personal profile.

5. E-mail Generating Module

This module will automatically generate E-mail for confirmation to the particular user after they have sent their request to the database. Besides, an auto-generated email will be sent to the user when the status of their request has changed.

6. Password Retrieval Module

This module is developed to provide the online user who forgot their login password. They are enquired to fill in their login name and email address and send it to the system. This module will then send their password to the provided email address.

7. User Control Module

This module will make sure that only the authorized administrator is permitted to login to the system. It allows the administrator to:

Add/Delete User – Add or delete user/ administrator record.

8. Report Generating Module

This module allows the administrator to generate statistics report writing such as weekly report, monthly report, annual report and others according to their needs.

3.4.2 Non-functional Requirement

Non- functional specifications are the constraints under which a system must operate and the standards which must be met by the delivered system [Somerville, 1995]. Non-functional requirements are as important as functional requirement. A non-functional

requirement describes the features that will be included in the system to provide a feasibility and ease of use to the users. The following states the non-functional requirements for the LORS.

1. User Friendly and Usability

The graphical user interface should be clear, concise and not cluttered. It is designed in a way that follows the logical flow of the thinking. It displays confirmation messages to assure the user of what has been done and also prompts warning or error messages to help users to correct the mistakes and proceed with the operations. All these are able to guide user better in operating the system.

2. Reliability

Reliability is the extent to which a system can be expected to perform its intended function with required precision and accuracy. Thus, the system should be reliable in performing its daily functions and operations. The system will not produce dangerous or costly failures when it is used in a reasonable manner. All the possible failures and errors, which could occur, are taken into consideration.

3. Maintainability and Expandability

To posses a high degree of maintainability and expandability, the system should be designed to be understood, corrected, adapted, and able to be enhanced without much difficulty. Architecture components, algorithm, data structure and procedures design should be able to extend and modify with ease. This is important so that any future enhancements and expansion can be done easily.

4. Modularity

Software architecture of the system should embodies modularity, that is, software is divided into separately named and addressable components, called module, which is integrated to satisfy problem requirements. This is done to isolate function codes from one another. Therefore, testing, debugging and maintenance can be done easily.

5. Response Time

The response time to retrieve the data and information should be in a reasonable interval time. This means that all desirable data and information should be available to users at any point in time.

6. Robustness

Robustness refers to the quality of the system that is able to handle or at least avoid disaster when faced with unexpected circumstances such as when given improper data. This system support robustness by developing program logic to process anticipated errors in the input of the data.

7. Efficiency

Efficiency means that the processes or procedures can be called or accessed in an unlimited number of times and will produce similar outcomes or output. There is no cause of delay in processing the user's request or in the midst of retrieving information.

3.5 Consideration on Web Application Programming Technology

Two web application has been considered as the web application programming technology, which are Active Server Pages (ASP) and Common Gateway Interface.

3.5.1 Active Server Pages (ASP)

ASP is a server-side scripting environment for creating dynamic Web pages or building other interactive Web applications. In fact, ASP is not an application. It is a VB script and Jscript interpreter that is integrated with IIS, together with and interface for other custom component [Homer, 1997]. ASP pages are files that contain HTML tags, text and script commands. They can call ActiveX components to perform tasks such as connecting to a database or performing a calculation. ASP lets developers add interactive content to Web pages or build entire Web applications that use HTML pages as the user interface. [http://iis3.activeserverpages.com/iasdocs/aspdocs/roadmap.asp]

ASP scripts give HTML authors an easy way to begin creating interactive pages.

ASP provides a relatively simple mechanism for

i. Collecting information from an HTML form.
ii. Personalizing an HTML document with a customer's name, or
iii. Using browser-specific HTML features.

If developer wanted to collect information from an HTML form, developer would typically use a programming language to build a common gateway interface (CGI) application. ASP lets the developers collect and analyze data from a form by using simple instructions embedded directly into HTML documents. So developer need not learn or use a full programming language or compile separate executables to create interactive pages.

Developers who already know a scripting language, such as Microsoft Visual Basic Scripting Edition (VBScript), JavaScript, or Perl, know how to use Active Server Pages. ASP can accommodate any scripting language installed with a scripting engine that follows the ActiveX Scripting standard. ASP comes with scripting engines for VBScript and Microsoft Jscript. ActiveX Scripting engines for Perl, RePython are also available from various vendors.

Developers who already know a programming language such as Visual Basic will find that ASP provides a flexible way to quickly create Web applications. By adding script commands to HTML pages, developers can create an HTML interface to an application. By creating ActiveX components, developers can encapsulate an application's business logic into reusable modules that they can call from a script, another component, or another program.

With ASP, Web pages content does not have to be tied to an HTML page. The information can be in a text file and the contents of Web page are easily updated without touching the HTML file. Besides, Web site of hundreds or thousands of pages can be reduced to just a handful of ASP files. Whenever the developer wants to change the design of the sites, he doesn't have to fix every single page.

ASP is an ecumenical programming environment. Its source code consists of either native ASP commands or scripting commands. Native commands are those that access the Active Server Engine objects and components. Its programming environment can be clearly understood in Figure 3.8.

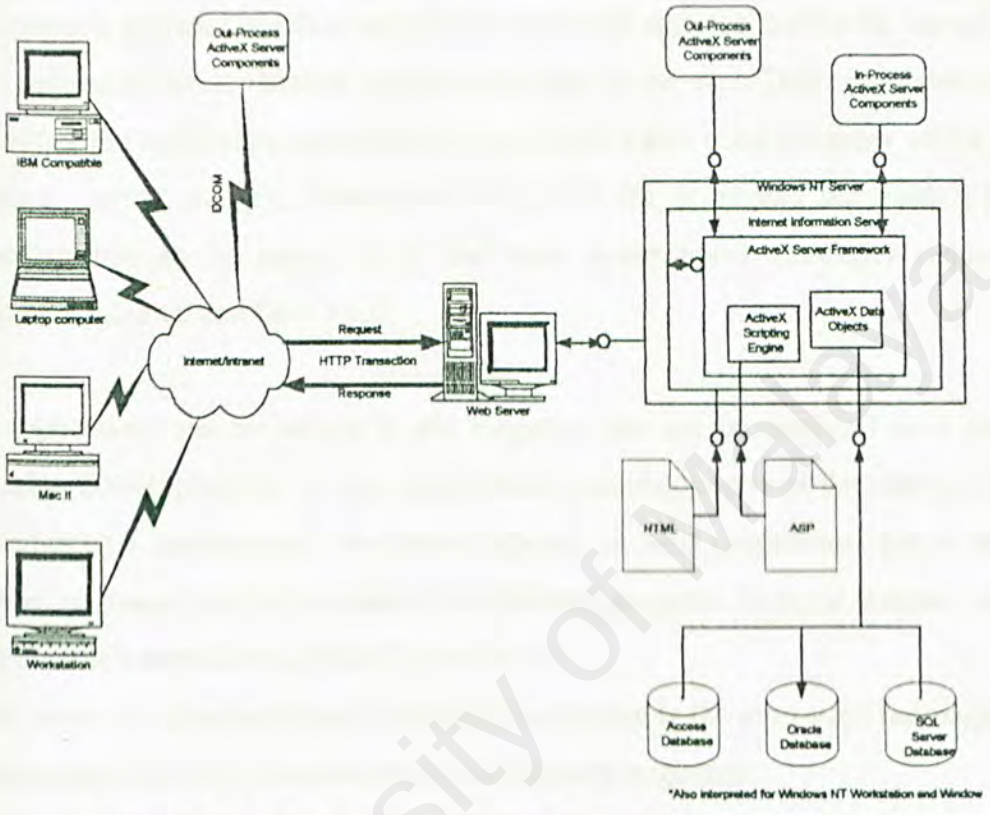


FIGURE 3.4 THE PROGRAMMING ENVIRONMENT OF ACTIVE SERVER PAGES

3.5.2 Common Gateway Interface (CGI)

CGI is the abbreviation of Common Gateway Interface, a specification for transferring information between a World Wide Web server and a CGI program. A CGI program is any program designed to accept and return data that conforms to the CGI specification.
[http://www.oreilly.com/openbook/cgi/ch01_01.html]

The common gateway interface (CGI) is a standard way for a Web server to pass a Web user's request to an application program and to receive data back to forward to the user. When the user requests a Web page (for example, by clicking on a highlighted word or entering a Web site address), the server sends back the requested page. However, when a user fills out a form on a Web page and sends it in, it usually needs to be processed by an

application program. The Web server typically passes the form information to a small application program that processes the data and may send back a confirmation message. This method or convention for passing data back and forth between the server and the application is called the common gateway interface (CGI).

The common gateway interface provides a consistent way for data to be passed from the user's request to the application program and back to the user. This means that the person who writes the application program can makes sure it gets used no matter which operating system the server uses (PC, Macintosh, UNIX, OS/390, or others). It's simply a basic way for information to be passed from the Web server about developer request to the application program and back again.

CGI applications can be written in any language that can be executed on a computer-in particular, a Web platform. In fact, programmer can choose any of the common languages for his/her CGI applications. The choice depends on what programmer has to do because different languages may be specialized for different purposes. Perl, for instance, is great for string and file manipulation, while C is better for

bigger, more complex programs. Perl and C are probably the most used languages for CGI programming. Feel free to choose from the following languages:

C ,C++ ,Perl ,Tcl ,Python ,Shell scripts (UNIX) ,Visual Basic and Applescript .

These languages, as well as many others, provide the programmer with the means to comply with the CGI specification and use it to its fullest potential.

Developer can use CGI whenever developer want to interact with those browsing developer's Web site, to get feedback from those browsing developer's Web site, or to provide dynamic content. The following lists a few applications of CGI that developer can use to enhance the capabilities of Web site:

i. Setting up a guest book
ii. Setting up a feedback form
iii. Adding a counter to a Web page
iv. Designing a database front-end for the Web
v. Allowing Web surfers to visit various Web pages via a pull-down list

vi. Enabling those browsing developer's Web site to e-mail comments

vii. Providing customized Web pages based on Web browsers being used by a client

viii. Enabling those browsing developer Web site to search developer Web site

3.5.3 Decision Making

After studies and reviews were made, a final decision is reached. ASP is chosen as the development approach for the LORS. The system will be developed on Windows 2000 Professional. The Internet Information Server 5.0 that came with Windows 2000 Professional is chosen as the web server. Microsoft SQL Server 7 is chosen as the database management system (DBMS) in ASP approach.

There are certain reasons why the ASP approach is chosen over CGI. The reasons are given as below:

- ASP can do virtually anything CGI scripts can and provides all the functionality of CGI applications in an easier-to-use and more robust environment, and with additional added components the power of ASP goes well beyond that of CGI scripts.
- With CGI, the server creates as many processes as the number of client requests received. The more concurrent requests there are, the more concurrent processes created by the server. However, creating a process for every request is time-consuming and requires large amounts of server RAM. In addition, this can restrict the resources available for sharing from the server application itself, slowing down performance, and increasing wait times on the Web. Active Server Pages instead runs in the same process as the Web Server, more handling client requests faster and more efficiently.
- The features of Windows 2000 and Internet Information Server 5.0 are exploited by the ASP approach. ASP can fit into Windows development environment better than CGI.

3.6 Consideration On Implementation Platform

A consideration has been done between Windows 2000 Professional and UNIX to chose a platform to develop the system.

3.6.1 Windows 2000 Professional

Windows 2000 (W2K) is a commercial version of Microsoft's evolving Windows operating system. Previously called Windows NT 5.0, Microsoft emphasizes that Windows 2000 is evolutionary and "Built on NT Technology." Windows 2000 is designed to appeal to small business and professional users as well as to the more technical and larger business market for which the NT was designed.

Windows 2000 provides an open, flexible environment for implementing powerful, highly customizable applications that share interfaces and other common elements that make them work together. It is an ideal platform for building custom applications because it contains strong Web services with Internet Information Server (IIS) 5.0.

Windows 2000 Windows 2000 Professional includes fundamental improvements—such as modifications to the operating system core to prevent crashes and the ability for the operating system to repair itself—that make it the most reliable desktop operating system Microsoft has ever produced. Reliability tests conducted by ZD Labs, the average system uptime of Windows 2000 Professional was over 50 times that of Windows 98 and 17 times that of Windows NT Workstation 4.0.

Windows 2000 Professional is easier to deploy, manage, and support. Centralized management utilities, troubleshooting tools, and support for self-healing applications all make it simpler for administrators and users to deploy and manage desktop and laptop computers [Microsoft SQL Server 7.0 Help Documentation].

Windows 2000 Professional provides comprehensive security features to protect sensitive business data, both locally on desktop computer and as it is transmitted over local area network, phone lines, or the Internet. Windows 2000 supports Internet-standard security features such as IP Security, Layer 2 Tunneling Protocol, and Virtual Private Networking.

Third-party studies that assess reliability from three different perspectives—lab-based testing, customer-site measurement, and user perceptions—conclude that Windows 2000 Professional is the most reliable desktop operating system. NSTL collected uptime data in the real-world environment of several customer sites and concluded that the average system uptime between failures of Windows 2000 Professional is 13 times more than that of Windows 98 and three times more than that of Windows NT Workstation 4.0. [http://www.microsoft.com/windows2000/professional/evaluation/business/default.asp].

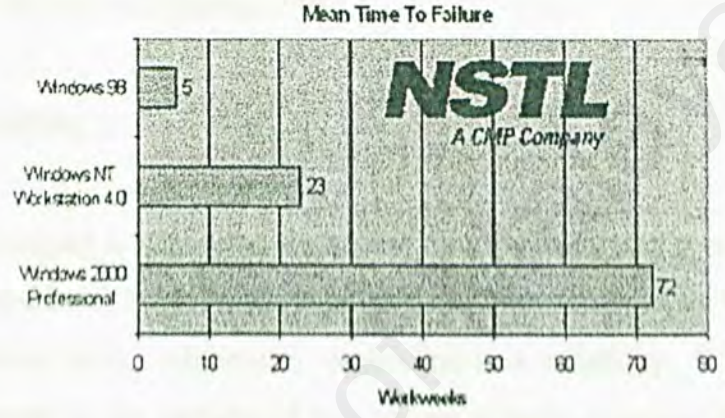


Figure 3.5 NTSL "Mean Time To Failure" Test

A single cross-platform API lets developers write code once and target many platforms. Users benefit from the easy-to-use Windows environment. Administrators can learn, use, and manage one system with powerful file and print services plus robust and reliable applications services.

The rich features of Windows 2000 make it an ideal network operating system but it also does much more. It is the ideal platform for enterprise computing, providing a unified, high-performance environment for the Web, for building applications, for streaming media and for communications and collaboration.

3.6.2 Unix

Unix is a layer between the hardware and the application that run on the computer. It has functions that manage the hardware and functions that manage executing application. The

UNIX system is actually more than strictly on operating system components. In addition, a standard UNIX system includes a sets of libraries and a set of applications.

The part of UNIX that manages the hardware and the executing processes is called Kernel. In managing all hardware devices, the UNIX system views each device as a file (called a device). This allows the same simple method of reading and writing files to be used to access each hardware device. It implements security controls to protect the safety and privacy of information. In executing processes, the UNIX system allocates resource and mediates accesses to the hardware.[Sams, 1998]

3.6.3 Decision Making

Windows 2000 Professional is chosen as a platform for developing the system. The main reason of choosing Windows 2000 Professional as a platform to deploy a Web server is due to its competitive price, robustness, scalability and reliability. Windows 2000 Professional is sufficient for the purpose of this project to build an online library request system. Microsoft Windows 2000 Professional gives developers their choice of languages, protocols, user interfaces and application architecture.

Besides, this platform is required for both Microsoft Internet Information Server 5.0 (IIS) and Microsoft SQL Server 7.0. Besides, Unix is extremely difficult to administrator, it's based on several text files, which are often maintained manually. Furthermore, UNIX are under constant attack by hacker.

3.7 Consideration On Database Implementation

Two database management systems are discussed below, they are Microsoft SQL Server 7.0 and Microsoft Access 2000.

3.7.1 Microsoft Access 2000

Microsoft Access 2000 is a Windows-based database management system. It is one of the programs in the Microsoft Office. It runs under the Windows 95/98/2000/NT operating systems. Access 2000 makes major strides in many areas. Microsoft Access is a desktop DBMS. The first version of this product was brought out by Microsoft in 1990. Since that time this DBMS has come to dominate the desktop DBMS market. Access forms an important element of Microsoft's Office suite of products.
[http://www.microsoftcom/catalog/display.asp?site=3&subib=22&pg=1]

Microsoft Access 2000 is flexible software where it is used as a database tool in developing systems. It provides relational database power to give users the information they need to make better decisions. With Microsoft Access 2000 you can enter, store and manipulate your personal or company data in a variety of ways. It integrates data from spreadsheets and other databases, and to share information over Intranet and the Internet, and build faster business solutions. It has several features that integrate network, Intranet and Internet features, allowing user to produce professional reports on paper, online or in HTML.

Microsoft Access is a DBMS designed for use on personal computers. Access provides facilities for creating tables, queries, forms and reports. Database applications can be created using the Microsoft Access Macro language or the Microsoft Visual Basic for application language. Access can be run as a standalone system on a PC or as a multi-user system across a network of PCs.

However, when used as a multi-user environment, Access suffers from some key limitations. For instance, it lacks a fully formed method of transaction management as available in such systems as Oracle, it has key limitations in terms of the volume of information it can manage and suffers from the lack of certain constructs essential for good database administration such as a system catalogue.

For these reasons, Access tends to be used mainly for low-volume, small to medium complexity systems with a defined set of no more than 20 users. When applications grow beyond these levels then many organizations prefer to use Microsoft's enterprise level DBMS, SQL Server, often in association with Access front-ends.

The facilities of Access can be divided into two groups: those devoted to data management (the database kernel), and those devoted to application development (the database toolkit). Access has proven popular as a rapid application development tool. Its ability to construct both database schemas and application components such as data entry screens quickly makes it an effective tool for prototyping information systems.

3.7.2 Microsoft SQL Server 7.0

Microsoft SQL Server is a scalable, high performance database management system designed specially for distributed client/server computing. It provides tight integration with windows and windows-based applications helping reduce the cost and complexity of deploying sophisticated applications.

SQL Server 7.0 is structured on several design philosophies that offer more intuitive data management, eliminate or dramatically reduce thresholds and limits, and improve database performance. Most changes such as auto-configuration, self-tuning, auto-upgrade statistics, improved statistic generation, and query plan auto-recompilation are automatic. Microsoft recommends the use of SQL server for high traffic sites with processor intensive queries. It is capable of supporting thousands of concurrent users, processing millions of transaction per day.

MS SQL Server is a suitable database engine for powering Web site. Combined with Microsoft Internet Server and the SQL Server Internet Connecter, customers have complete Internet database publishing capabilities. It supports for heterogeneous replication to non-SQL Server databases including Microsoft Access, ORACLE and so on. SQL Server's replication uses ODBC as the connection mechanism.

It's new assistant called Microsoft Management Console (MMC), which is the replacement for Enterprise manager in version 6.5. MMC gives developer the administrative access developerr need for developerr server. The MMC is also the new standard interface for all Microsoft server applications. The Enterprise Manager is now a snap-in to the MMC, which can also allow developer to administer developer's NT, IIS and MTS applications as well. Besides, it also has recursive triggers and this new feature lets developer manage more than one update to a given column. Developer can use recursive triggers when an update trigger would make a change that would in turn fire another trigger. [Wynkoop, 1999]

SQL Server 7.0 provides the following features:

1. Self-management

SQL Server 7.0 can automatically configure its memory usage, grow and shrink disk space usage, and repair itself. Developer can let SQL Server control memory usage, locks, connections, open objects, and so forth, or configure them selves

2. Maintenance

The SQL Server 7.0 DBCC command is dramatically faster, replaces the NEWALLOC option, and can actually repair data. In addition, SQL Server 7.0 incorporates a *fast failure* philosophy, where it's considered better to fail and repair as soon as an error occurs, rather than leave corruption in the database. Accordingly, SQL Server can automatically detect and repair some errors that would have crashed SQL Servers before.

3. Security and Backup

SQL Server 7.0 security is much more integrated with Windows NT. Database roles replace groups, and fixed server roles can be used to delegate system administrator (sa) tasks. SQL Server 7.0 now uses the industry-standard *fuzzy backup* strategy, which makes backups much faster and makes possible a new differential database backup option.

4. The Storage Engine

The larger page size of 8K seems to have had a ripple effect throughout SQL Server 7.0's storage structures. Extents are now 64K (eight pages), and a single row in a page can occupy 8,060 bytes, up from 1,962 bytes in prior releases. Character and binary columns can extend to 8,000 bytes, up from 255. Row locking is default in SQL Server, and SQL Server will automatically escalate to page or table locking depending on its analysis of the query.

5. Stored Procedures

Compilation of stored procedures in SQL Server 7.0 delays resolving the names of objects in a stored procedure until runtime (called *delayed name resolution*), so developer can compile stored procedures that reference objects such as tables and other stored procedures that don't yet exist.

3.7.3 Decision Making

SQL Server 7.0 has been chose as the database management system because of the following reasons:

1. It is the best solution to be used with Windows 2000 Professional.
2. It can handle more concurrent users as compared to Microsoft Access.
3. It is a suitable database engine for powering Web site.
4. SQL Server 7.0 is a scalable, reliable, flexible and high-performance database management system. It allows the use of a large and complex database, and will handle large volumes of traffic.

3.8 Selected Programming Languages

LORS is divided into the user section and the administrator section. The user section is a web-based application where interaction between users and LORS system undergoes. It handles the authentication of user access as well as the process of request submission. On the other hand, the administrator section is a Client/server application or Windows-based application. It provides certain features for the administrator to process request records without the need to access to the Internet.

3.8.1 Web-based Application

The programming languages chosen to develop this web-based application are:

3.8.1.1 Hyper Text Mark-Up Language (HTML)

HTML (Hypertext Markup Language) is the set of markup symbols or codes inserted in a file intended for display on a World Wide Web browser page. The markup tells the Web browser how to display a Web page's words and images for the user. Each individual markup code is referred to as an element (but many people also refer to it as a tag). Some elements come in pairs that indicate when some display effect is to begin and when it is to end.

HTML is a formal Recommendation by the World Wide Web Consortium (W3C) and is generally adhered to by the major browsers, Microsoft's Internet Explorer and Netscape's Navigator, which also provide some additional non-standard codes. The current version of HTML is HTML 4.0. However, both Internet Explorer and Netscape implement some features differently and provide non-standard extensions. Web developers using the more advanced features of HTML 4 may have to design pages for both browsers and send out the appropriate version to a user. Significant features in HTML 4 are sometimes described in general as dynamic HTML. What is sometimes referred to as HTML 5 is an extensible form of HTML called Extensible Hypertext Markup Language (XHTML).

HTML is a markup language. It is used to format text and information. This "marking up" of information is different from the intent of traditional programming languages, which is to perform actions in a designated order. In HTML, text marked up with elements, delineated by tags that are keywords contained in pairs of angle brackets [DEITEL, DEITEL & NIETO, 2000].

HTML is a simple enough format (at least currently) that typical computer users can generate HTML documents without the benefit of a special application. Creating a WordPerfect-format document would be rather difficult by hand (including all of the required text size, fonts, page breaks, columns, margins, and other information), even if it weren't a "proprietary"-that is, nonpublic-document format.

How HTML files are interpreted:

1. A web author writes a page composed of pure HTML, and saves it within an .htm file.
2. Sometime later, a user types a page request into the browser, and the request is passed from the browser to the web server.
3. The web server locates the .htm page.
4. The web server sends the HTML steam back across the network to the browser.

3.8.1.2 Scripting Languages

Scripting enables programmer to set and store variables, and work with data in HTML code. Many Web sites now employ scripting to check the browser a user is running, validate input, work with applets or controls, and communicate to the user.

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. Scripts can be used in harmony with controls or applets, too.

The scripting languages used to develop this web-based application are:

1. VB Script

Visual Basic Scripting is a lightweight scripting language that provides programming functionality based on the Visual Basic programming language. It is natively executed on the Internet Explorer browser and can be executed in the browser through plug-in technologies.
[http://asp-help.com/getstated/ms/aspdocs/roadmap.asp].

VBScript bring activity scripting to a wide variety of environment, including Wed client scripting in Microsoft Internet Explorer, Web Server scripting in Microsoft Internet Server and it is a default scripting language of ASP. VBScript lets the user interact with a Web page rather than simply view it. VBScript can take input from the user and check the data to make sure it is valid or meets certain criteria. Then, it can put an Internet server to work either by actually storing the data or causing some action to take place on the server based on the information given.

VBScript also play an important role in many ways, including validating data, pricing, providing impressive multimedia feedback, and initiating data storage. The user can use VBScript to sequence the questions based on responses.

2. Java Script

JavaScript is an interpreted programming or script language from Netscape. JavaScript is an easy to use object scripting language designed for creating live online applications that link together objects and resources on both clients and servers. JavaScript is designed for use by HTML page authors and enterprise

application developers to dynamically script the behavior of objects running on either a client or a server.

JavaScript gives developers the ability to do things such as check form contents, communicate with the user based on their actions, and modify the web page dynamically without the web page being re-loaded and without the use of Java, plug-ins or ActiveX controls.

What makes JavaScript special is the way it integrates with the Web. JavaScript code is included as parts of a standard HTML document, just like other HTML tags and elements. JavaScript scripts run on the browser and are portable across any browser that includes JavaScript support, regardless of the operating system. JavaScript resides inside the HTML file, and can provide levels of interactivity far beyond typically flat HTML pages.

JavaScript is easy-to-use and designed for creating live online applications. It is analogous to VBScript. A JavaScript-compliant Web browser, such as Netscape

Navigator and Microsoft Internet Explorer, is necessary to interpret JavaScript code. Like VBScript, JavaScript is based on a programming language, in this case Java, the Web darling. Unlike VBScript, JavaScript is completely object-based.

3.8.2 Windows-based Application

The programming language chosen for Windows- based application development is Visual Basic.

3.8.2.1 Visual Basic

Microsoft Visual Basic 6.0 programming language is excellent to be implemented as Windows based application, where it provides an environment for fast and easy development of applications through the use of Graphical User Interface (GUI). It is widely used in industry for developing rapid prototypes of new applications.

The following summarized the features of Visual Basic:

1. Event-driven programming

An event is an action of some type. For example, moving the mouse, selecting an item from a list, or clicking a buttons are events. As a newer programming language, Visual Basic uses a different approach: object-oriented programming and event-driven programming. In event-driven programming, programs do not follow a sequential logic like what traditional programming do. In other words, programmers do not take control and determine the sequence of execution. Instead, the user can press any keys and click on various buttons and boxes in a window. Each of these actions will cause an event to occur, which triggers a block of code to be generated.

2. Visual Basic uses a graphical user interface

Visual Basic is designed so that we can immediately see our creation. It uses two types of objects:

Forms are windows we create and customize

Controls are graphical objects appear on the forms, such as buttons, combo boxes, text boxes, etc.

3. Files used by Visual Basic

There are several types of files used by Visual Basic. Three most commons used are:

.mak Project File: contains a list of all the forms and codes in the particular project. One project can have a lot of modules, forms and classes. Different activities of the program can store in different modules. Classes contain of predefine functions, it can be treated as an object.

.frm Form File: contains all of the objects and codes associated with the particular form. It allows communication between the system and users by using the objects in the form.

.exe Executable File: a project is compiled into .exe format before it can really applicable. In other words, it compiles the program into a readable machine language.

Reasons why Visual Basic is chosen are stated as below.

1. Visual basic is one of the most popular programming language tools used in Windows environment due to its RAD (Rapid Application Development) capability.
2. Visual Basic using event-driven approach to program the system and not a procedural approach. An application developed using an event-driven model responds to event that occurs in computer environments.
3. Features of Visual Basic include multiple-document interface (MDI), object linking and embedding (OLE) and dynamic data exchange (DDED).

3.9 Selected Development Tools

The development tools which are considered to be used in developing the LORS are stated in the following statements.

3.9.1 Microsoft Visual Interdev 6.0

Visual InterDev 6.0 comes as part of Microsoft suite of professional programming tools, Visual Studio, and it is a tool for designing dynamic web application. Instead of using a programming language to create dynamic content, InterDev creates Active Server pages (ASPs), a new technology developed by Microsoft.

ASPs can contain embedded script logic that executes on an IIS server. ASPs appear to be HTML, or standard Web pages. But, they also have special tags and code created and inserted by Visual InterDev between the HTML. When a browser requests an ASP page, the server first processes the page, executes any instructions, and rewrites the original ASP page before sending it to the browser. This makes it much easier to produce dynamic content. For example, an ASP file can connect to a database using ODBC, perform a SQL query, and create a live report.

For advanced Web site development, Visual InterDev supports both client-side and server-side scripting. Currently, developer can write scripts in either Visual Basic Scripting Edition (VBScript) or Microsoft JavaScript (JScript). A Script Wizard enables developer to quickly generate client-side and server-side scripts with a point-and-click interface.

ActiveX controls and Java Applets can be embedded into pages as well as server-side components for Active Server Pages.

In addition, Visual InterDev boasts strong links with SQL Server, which makes it very easy to set up databases combining ASP and SQL Server. It also provides several useful web-based tools, which can check links, highlight the broken ones to developerr site, and allow developer to drag and drop pages from one location to another. Visual InterDev ships with ODBC drivers for Microsoft SQL Server, Oracle, and Microsoft Access (the Microsoft Jet database engine).

3.9.2 Microsoft Visual Basic 6.0

Microsoft Visual Basic 6.0 programming language is excellent to be implemented as Windows based application, where it provides an environment for fast and easy development of applications through the use of Graphical User Interface (GUI). It is an event driven language and supports some object-oriented programming. An application developer with an event driven model is more interactive compared to procedural language and responds to events that happen in the computer environments, such as clicking a mouse button. With Microsoft Visual Basic, class modules (all object-oriented concepts) can be written and reused or distributed.[http://microsoft.com/products/proref]

Some standard and features include:

1. The quick employment and access to data using the Microsoft Data Engine (MSDE).
2. The full compatibility with large Structured Query (SQR) Server database.
3. The Report Writer, which allows development of sophisticated, hierarchical reports with drag-and-drop ease.
4. The ability to view tables, modify data and create SQL queries for any Open Database Connectivity (ODBC).
5. The support for Microsoft universal data access using ActiveX Data Object.
6. The ability to visual design and modify data and create SQL queries and other object for Microsoft SQL and Oracle databases.

[http: //winplanet.com/winplanet/reviews/1433/1/]

Benefit of Microsoft Visual Basic 6.0 consists of:

i. Use the Visual Basic 6.0 integrated Visual Database and new Data Environment Designer To visually design Microsoft SQL Server databases and create reusable data access queries- all without leaving the visual basic environment.

ii. Build S\server-side Web applications that are easily accessible from any browser on any platform with Visual Basic 6.0 WebClasses. Program highly interactive web pages as easily as a visual Basic form with the new Dynamic HTML page Designer.

iii. Gain features for team development and scalability with Microsoft SourceSafe, IIS, Microsoft SQL Server and Microsoft Message Queue Server.

3.9.3 Microsoft FrontPage 2000

FrontPage 2000 is Microsoft's tool for creation and designing Web pages, and it lets developer do this without actually having to program the HTML. It allows developer to create Web pages in the same way developer would create documents in Word or spreadsheet in Excel. It generates the HTML 'underneath the covers' without developer having to raise a finger.

Using Microsoft FrontPage 2000 is the easy way to create and manage professional-quality Web site. FrontPage 2000 is capable of creating complex, interactive and creative website with just a mouse click.

FrontPage 2000 Web site creation and management tool gives users control of their Web sites. They can position elements exactly where they want them on the page, give their Web site a professional and consistent look across all of its pages, import and edit HTML just as they like, and use the latest in Web technology, all without HTML programming.

There are three tabs on FrontPage 2000, which correspond to three possible view of developer Web page. The first is 'Normal', which allows developer to put together a Web page, in the same way developer HAD type up a Word document. The second view is 'HTML', which let developer see the entire HTML that has been generated by any work

developer might have done in 'Normal' view. The final tab, 'Preview' lets developer preview the HTML pages.

Microsoft FrontPage provides of the following advantages:

i. Can set up and maintain their site as a whole, easily monitor the condition of their Web site and make updates.
ii. Easy database integration with the Web project.
iii. Supports the latest Web technology such as ASP, ActiveX, Hotbox and many more for form processing and form interaction.
iv. Easy to insert java Applet and ActiveX to an existing Web page.
v. FrontPage provides a range of scripting features that are compatible with JavaScript and Visual Basic Script.
vi. There is also The Navigation Bars automatically, saving users time and keeping current links.
vii. Give the user a choice to edit the HTML coding in different frames. For users who are experienced in HTML coding, this is an added advantage of the software where the user need not to modify the pages individually but in different frames where it shows more pages.

3.10 Web Server - Internet Information Server 5.0 (IIS)

Due to the ability to deliver high performance, easier management, and excellent security, Microsoft IIS is chosen to be Web server for this project. IIS is the best platform for integrating with existing solutions as well as for delivering a new generation of Web application.

Several Web servers from different vendors were available at the time of analysis. Internet Information Server 5.0 is chosen as the web server for running the system. IIS is the largest of the two Web servers available from Microsoft and it is the only World Wide Web server that is tightly integrated with Microsoft Windows NT Server operating system. [http:// slaertech.com/intranetting/tsld007.htm]

IIS provides the ability to provide Web services, not only for Web pages, but also for ftp sites (ability to transfer whole files from one site to another), nntp services (newsgroup services) and video and audio services.

One of the most important areas of focus for IIS is providing powerful access control functionality for Web access to files and applications on the server. It includes a built-in search engine, streaming multimedia capabilities, rich log file and analysis tools.

IIS includes security features and promises that it is easy to install. It works closely with the Microsoft Transaction Server to access database and provide control at the transaction level. It also works with Microsoft's Netshow in the delivery of streaming audio and video, delayed or lives.

However, IIS 5.0 needs torn on NT Server 2000, which is turn needs to be run on a large machine. Besides, it lacks of object-store, messaging, and collaborative computing components.

3.11 System Requirements

The hardware and software requirements for the server-side and client-side are stated as below:

3.11.1 Server-Side Requirements

Table 3.1 presents the server hardware and software requirements for developing the system.

Server Hardware Requirements	Server Software Requirements
• Intel Pentium 133Mhz processor or higher (or equivalent)	• Microsoft Window 2000 Professional
• 5GB hard disk with at least 650 MB of free space (expand when system grows)	• Microsoft Internet Explorer 4.0 or above, Netscape Navigator 4.0 or above
• Minimum 32 MB Random Access Memory (RAM), (64 MB is recommended)	• Microsoft Visual InterDev 6.0, Visual Basic 6.0, Microsoft FrontPage 2000 and Microsoft Office 2000
• Other standard computer peripherals	• SQL Server 7.0 or above
	• Internet Information Server (IIS) 5.0

Table 3.1 Server hardware and software requirements for developing the system

3.11.2 Client- Side Requirements

The hardware and software requirements for the client-side to run the system are shown in the table 3.2.

Client Hardware Requirements	Client Software Requirements
• Minimum 32MB of Random Access Memory (RAM)	• Microsoft Internet Explorer 5.0 or above, Netscape Navigator 4.0 or above
• Network connection through existing network configuration or modem	

Table 3.2 Client hardware and software requirements for running the system

3.12 Summary

In the process of the system analysis, the needs of the user are identified. An in-depth study and analysis of the system is carried out. The techniques used to gather information are research and reviews, surfing the Internet, interview and discussion. The Waterfall with prototyping model is chosen as the development methodology for the project. The functional and non-functional requirements for the system are defined. In this phase, the software development tools, web technology and programming languages are reviewed and decision is made to choose appropriate tools or technologies for this project. Lastly, the system requirements for both client and server side for running the LORS are identified too.

Chapter 4 is discussed on the system design phase. It gives an overview of architectural design, program design, input form design, user interface design, and database design as well as the expected outcome of LORS.

CHAPTER 4

SYSTEM DESIGN

CHAPTER 4 SYSTEM DESIGN

4.1 Introduction

Design is the creative process of the transforming the problem into solution; the description of a solution is called design [Pfleeger, 2001]. A design specification describes the features of the system, the components or element of the system and their appearance to user. System design is a plan to build a system that meets the requirements needed to deliver the problem solution and helps to achieve the organization's goal and objective. On the other hand, system design is a process to convert the conceptual ideas from requirement specification in system analysis into more technical specification [Pressman, Roger, 1997]. Good design is the key to successful project.

In the system design phase, information collected earlier will be used to accomplish the logical design of the system. The accurate data-entry procedures are designed so that data going into the system are correct. In addition, effective input is provided to the system by using techniques of good form and screen design [Kendall & Kendall, 1999].

System design is an iterative process. The process is iterative because, in actually, the designer move back and forth among activities involving understanding the requirements, proposing possible solutions, testing aspects of a solution for feasibility, presenting possibilities to the customers, and documenting the design for the programmers. Thus, the waterfall model with prototyping methodology is suitable for the proposed system's system design.

The LORS design issues that will be discuss later are program design, user interface design and database design.

4.2 Program Design

LORS is designed to leverage the traditional client/server architecture and extends it to the web. This large system is decomposed into sub-system that provides some related set of services. As part of the architectural design process, some of the designs such as system structuring and data flow are usually necessary.

4.2.1 System Structure Design

The system structure is used to depict high-level abstraction of a specified system. The system is structured into a number of principal sub-systems where a sub-system is an independent module. Communications between sub-systems are identified.

Decomposing a system into a set of interacting sub-system is an important phase. Structure chart is used to depict the high level extraction of a specified system. The usage of structure chart is to describe the interaction between independent sub-systems.

Library Online Request for Purchasing Reading Materials is divided into 2 major component : user section and administrator section. Each of the two components is further divided into many modules. An overview of the system structure of LORS is presented in Figure 4.1.

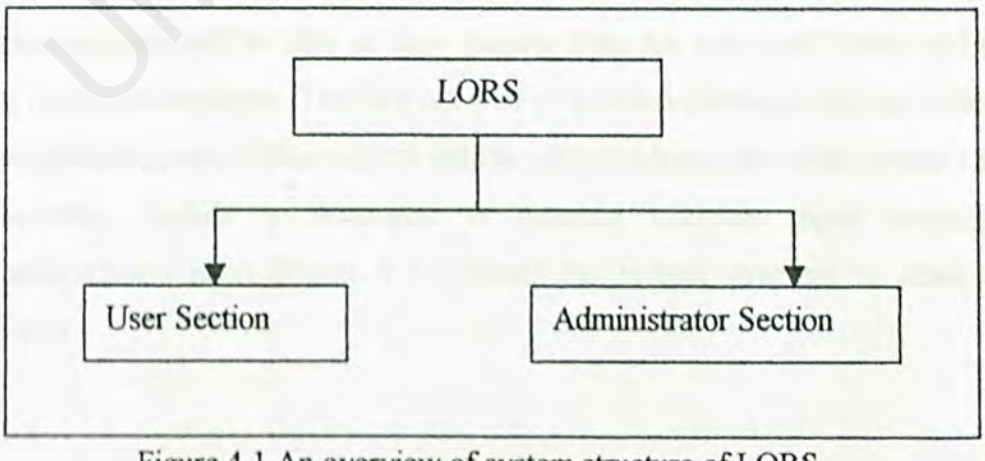


Figure 4.1 An overview of system structure of LORS

4.2.1.1 User section

Users are referring to the lecturers and academic staffs in University Malaya. They can submit, view and cancel requests through the system. Modules and functions of this section are shown in Figure 4.2.

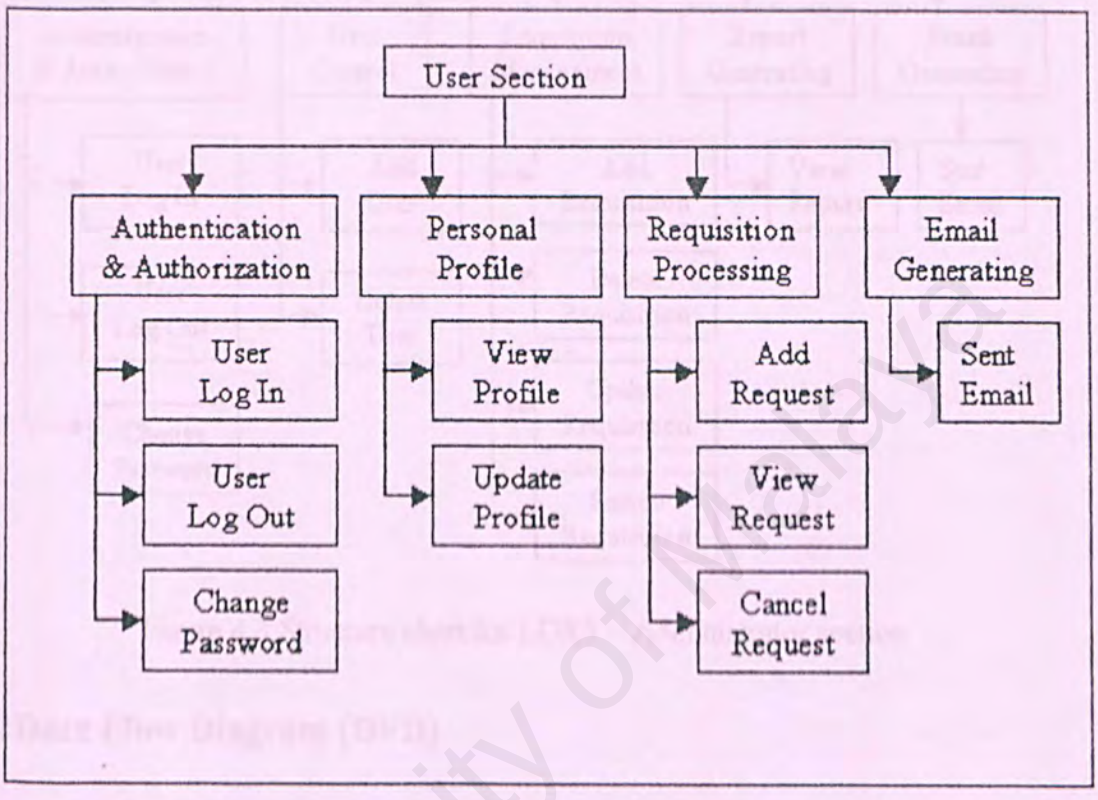


Figure 4.2 Structure chart for LORS – User section

4.2.1.2 Administrator section

Administrators refer to the librarians who in charge of acquisition task. Administrators will be able to view request from the user, add, delete and update the request information. They are allowed to search a particular request information through this system. They will be able to add or delete users in the system. Report generating module is developed to generate statistics report according to administrator's need. Figure 4.3 presents the system structure of administrator section.

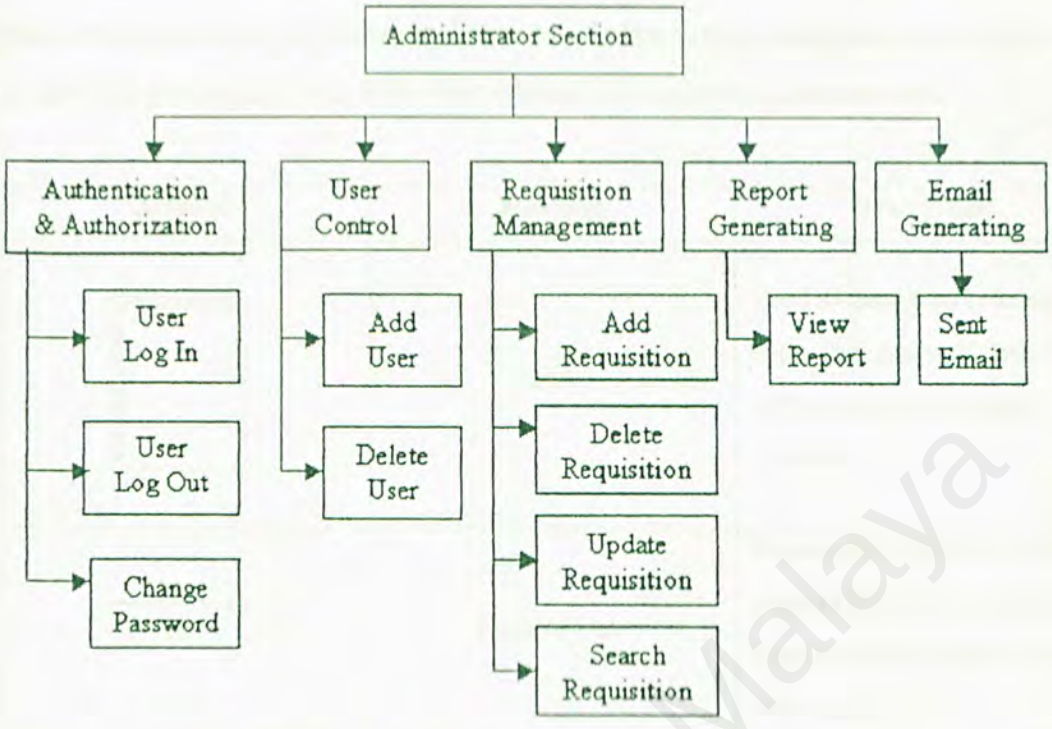


Figure 4.3 Structure chart for LORS – Administrator section

4.2.2 Data Flow Diagram (DFD)

Through a structured development and design called data flow diagrams (DFD), a graphic representation of data processes throughout the LORS can be put together. DFD is perhaps the most natural way to document processes. It has 4 chief advantages over narrative explanation of the way data moves through the system. The advantages are [Kendall & Kendall, 1999]:

1. Freedom from committing to the technical implementation of the system too early.
2. Further understanding of the interrelatedness of systems and subsystems.
3. Communicating current system knowledge to users through data flow diagrams.
4. Analysis of a proposed system to determine if the necessary data and processes have been defined.

A series of data flow diagrams are used to represent the input and out put of data and processes throughout the LORS. Four basic symbols are used to chart data movement on

data flow diagrams. They are double square, an arrow, a rectangle with rounded corners and open-ended rectangle, as shown in Table 4.1. Entire system and numerous sub-systems can be depicted graphically with these four symbols in the correct combinations

Symbols	*Meaning*	*Description*
	Entity	Used to depict an external entity that can send data to or receive data from the system
	Flow of Data	Movement of data from one point to another, with the head pointing towards the data destination
	Process	Show occurrence of a transformation of data
	Data Store	Used to represent a data store where the data is held within the system

Table 4.1 Description of symbols used in data flow diagram

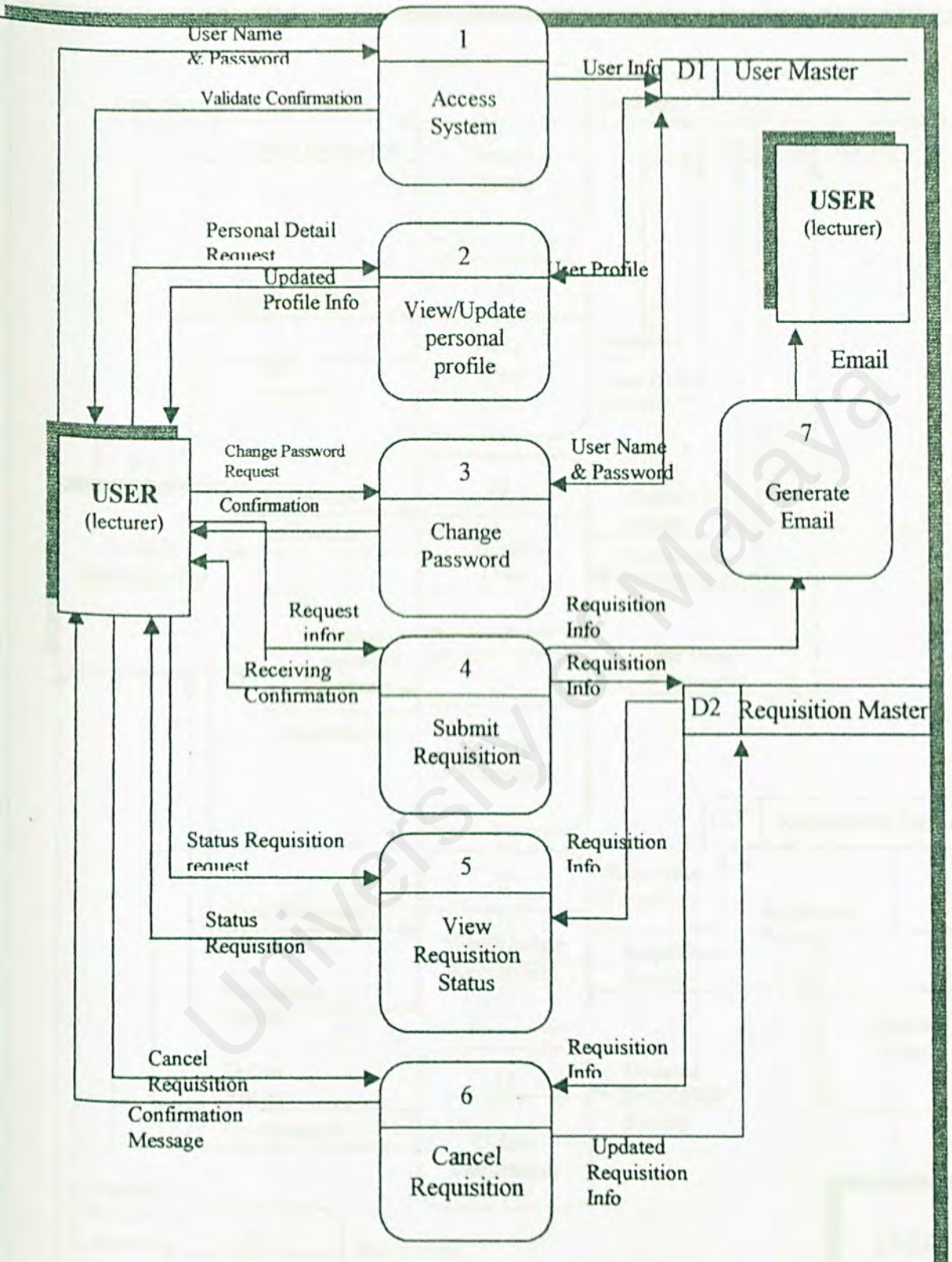


Figure 4.5 Diagram 0 for Lecturer Section

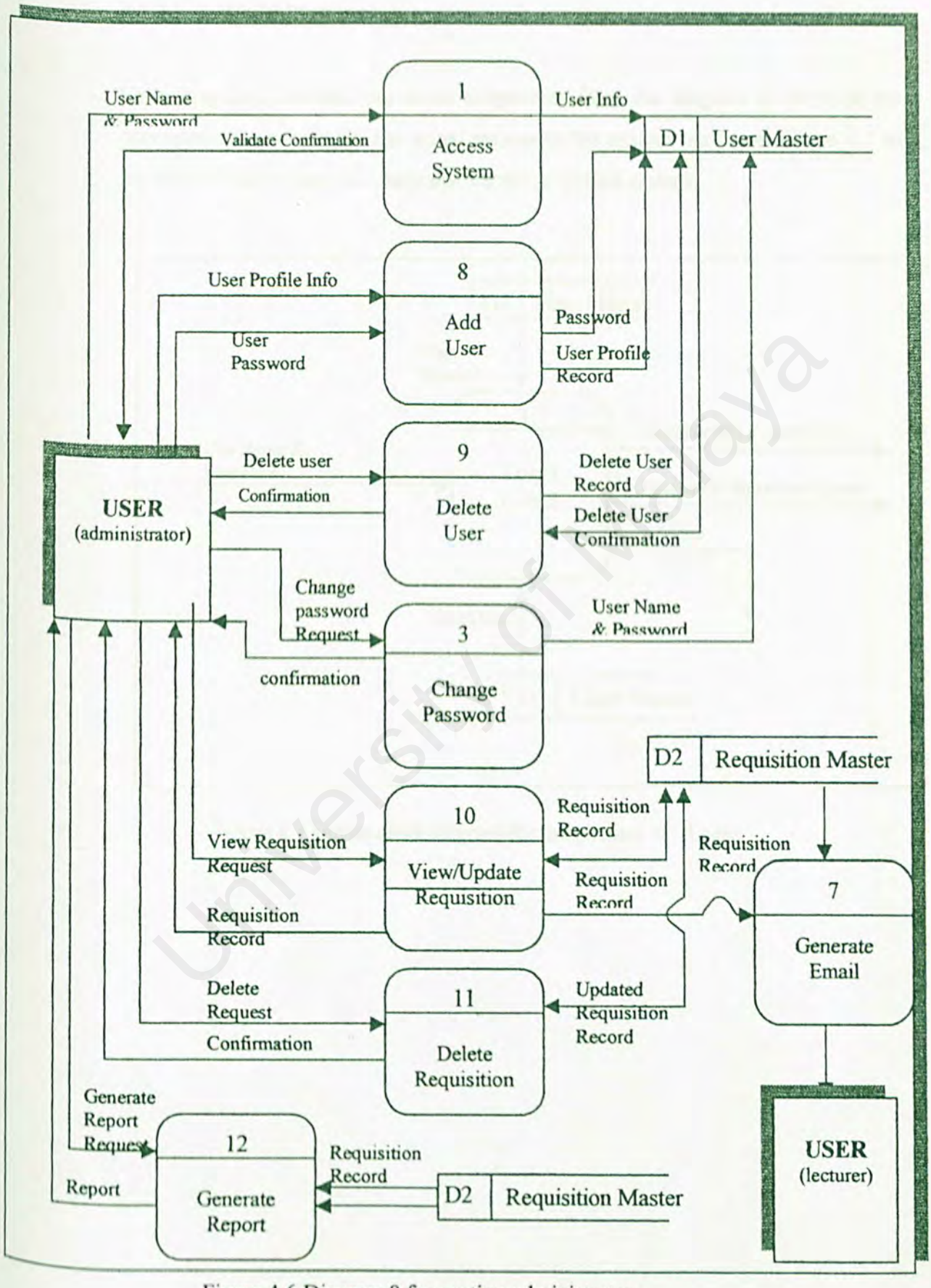


Figure 4.6 Diagram 0 for section administrator.

4.2.2.1 Child Diagram

Child diagrams illustrate the detail subprocess from the diagram 0. Most of the processes shown here are the actual processes the system performs. Figure 4.7 to Figure 4.18 shows the child diagrams for the proposed system.

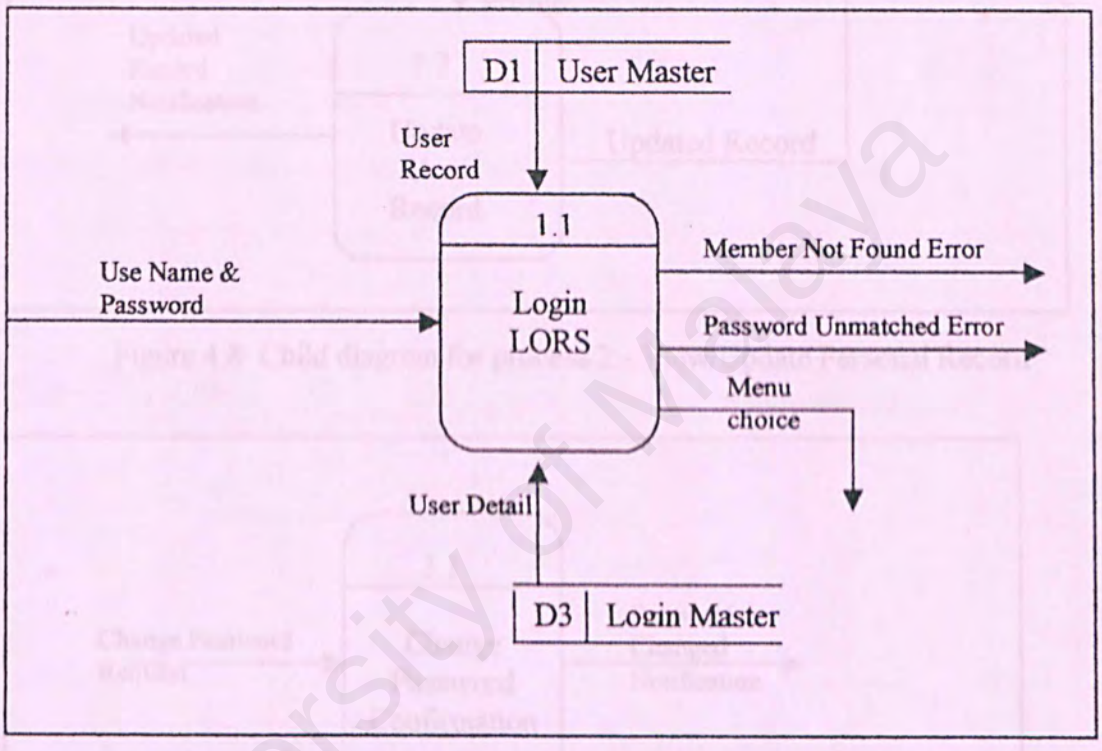


Figure 4.7 shows child diagram for the process 1. –Login

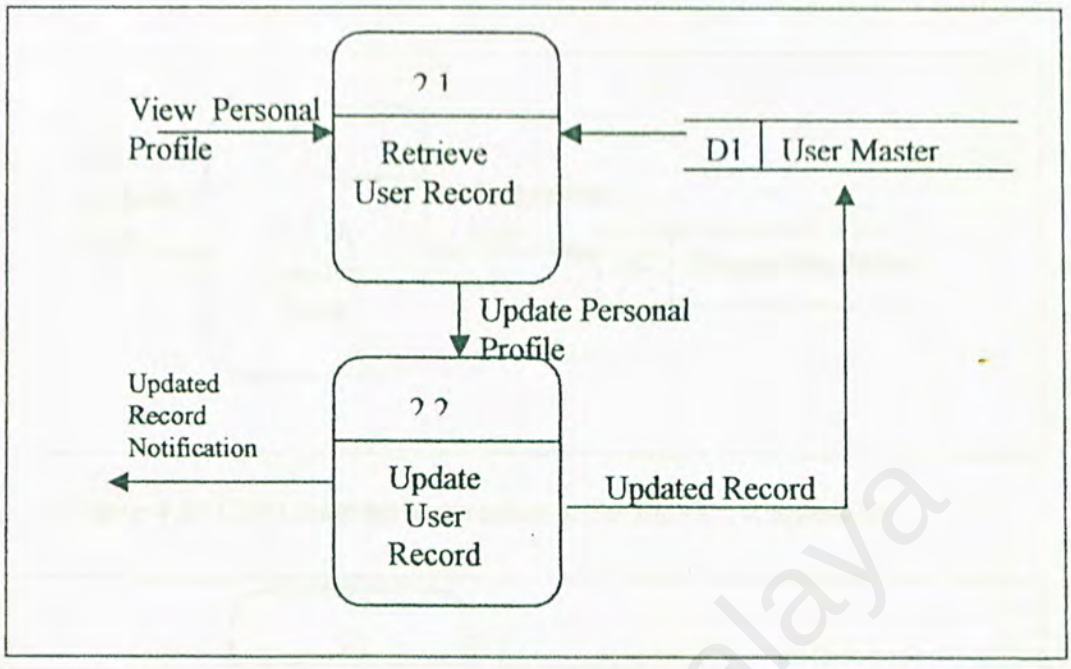


Figure 4.8 Child diagram for process 2.- View/Update Personal Record

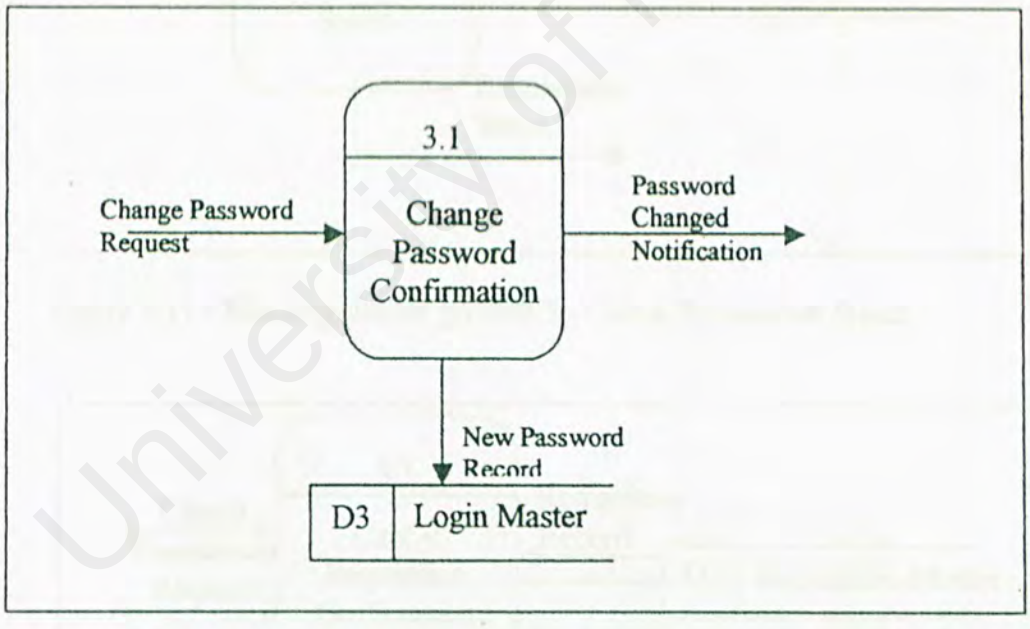


Figure 4.9 Child diagram for process 3.- Change Password

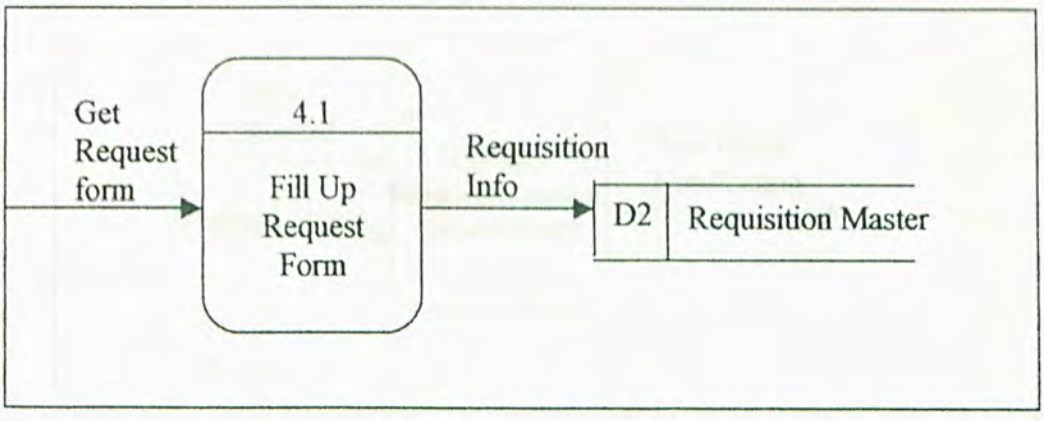


Figure 4.10 Child diagram for process 4. Submission Requisition

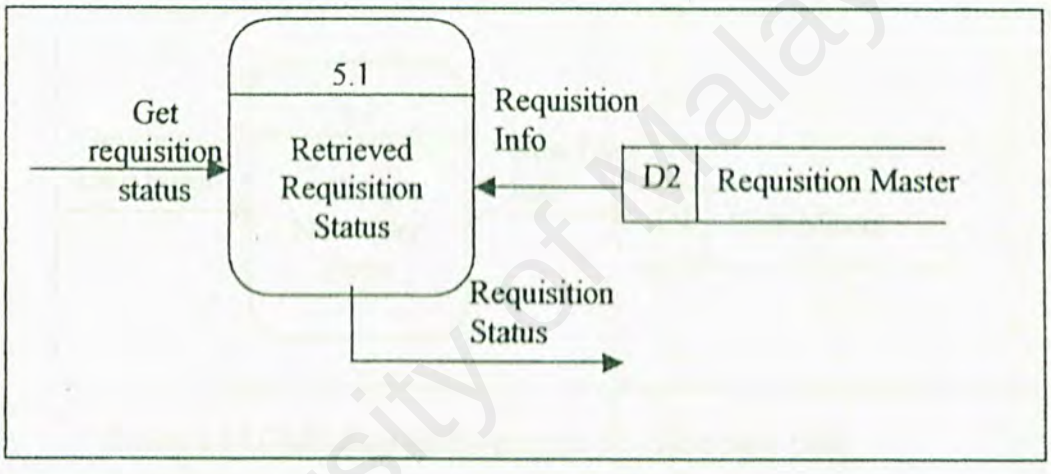


Figure 4.11 Child diagram for process 5.- Check Requisition Status

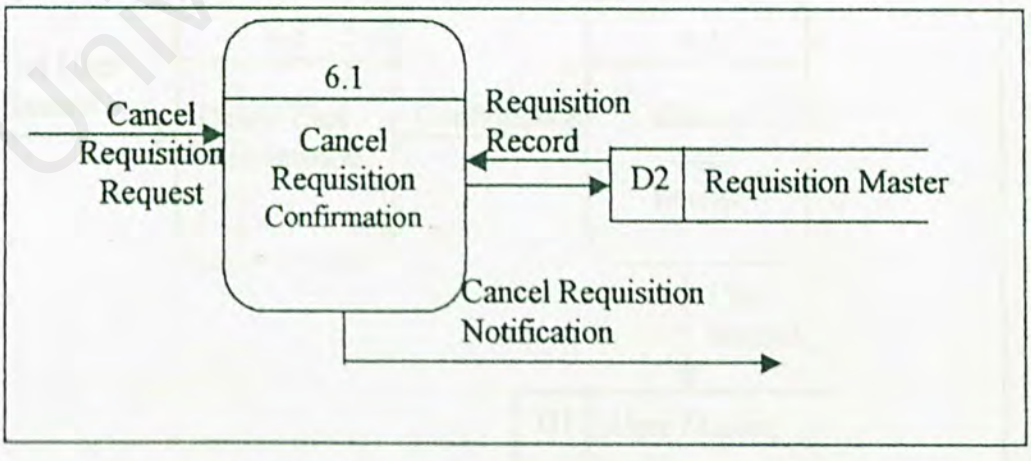


Figure 4.12 Child diagram for process 6.- Cancel Requisition

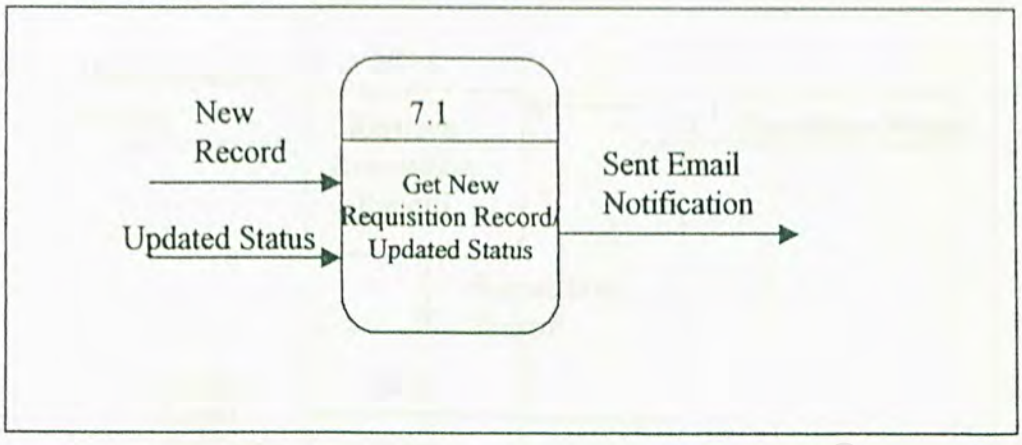


Figure 4.13 Child diagram for process 7. -Email Generating

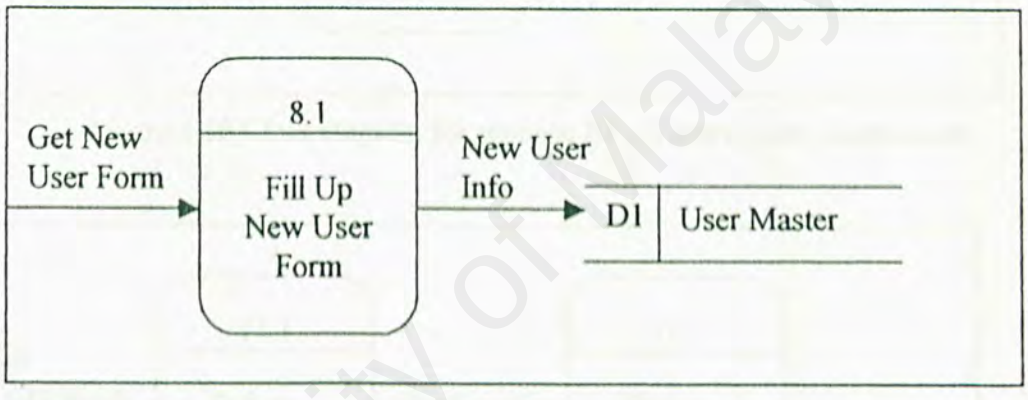


Figure 4.14 Child diagram for process 8. – Add New User

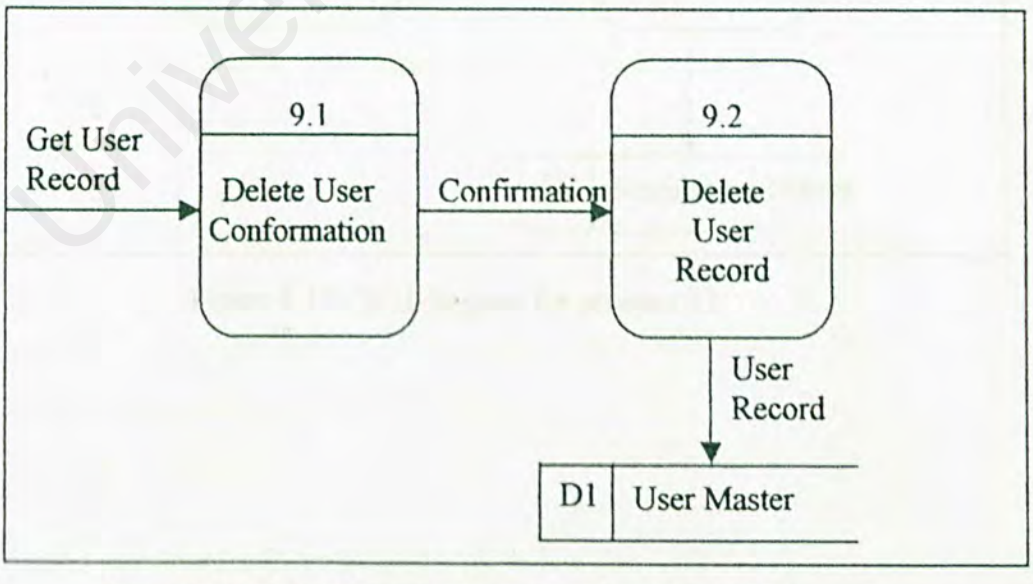


Figure 4.15 Child diagram for process 9. –Delete User

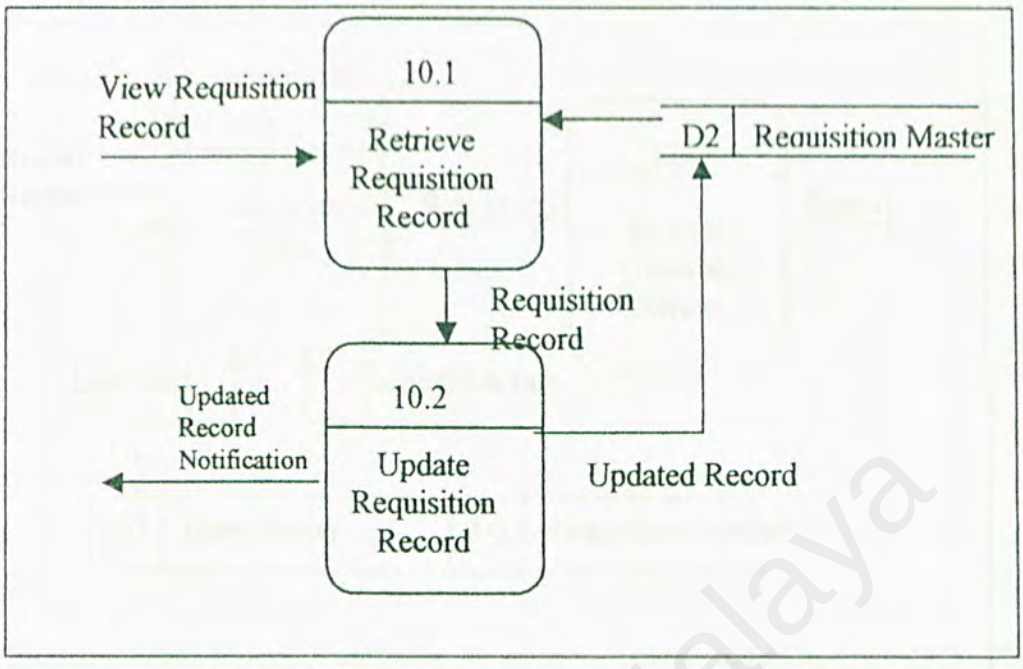


Figure 4.16 Child diagram for process 10. –View/Update Requisition

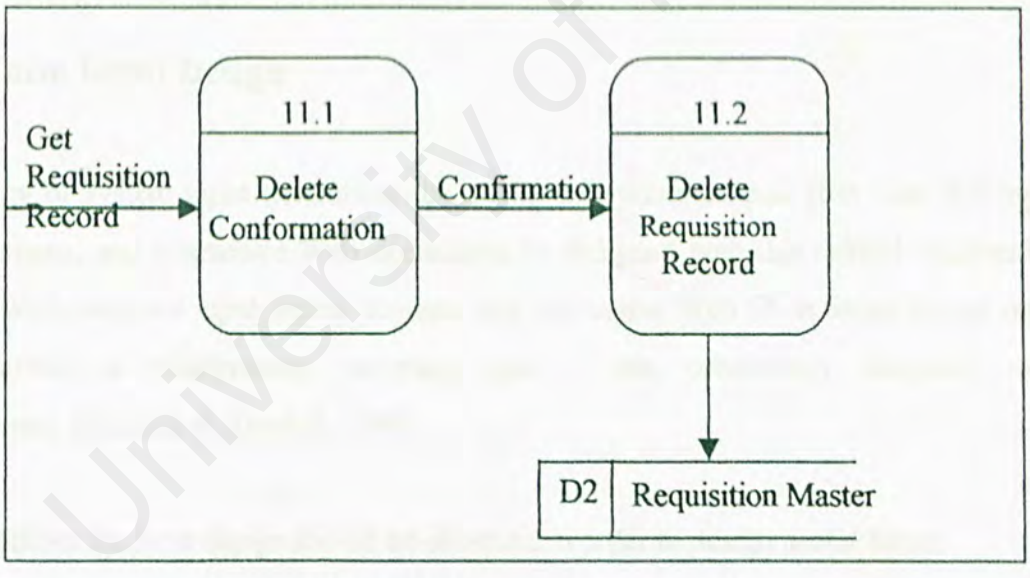


Figure 4.17 Child diagram for process 11.

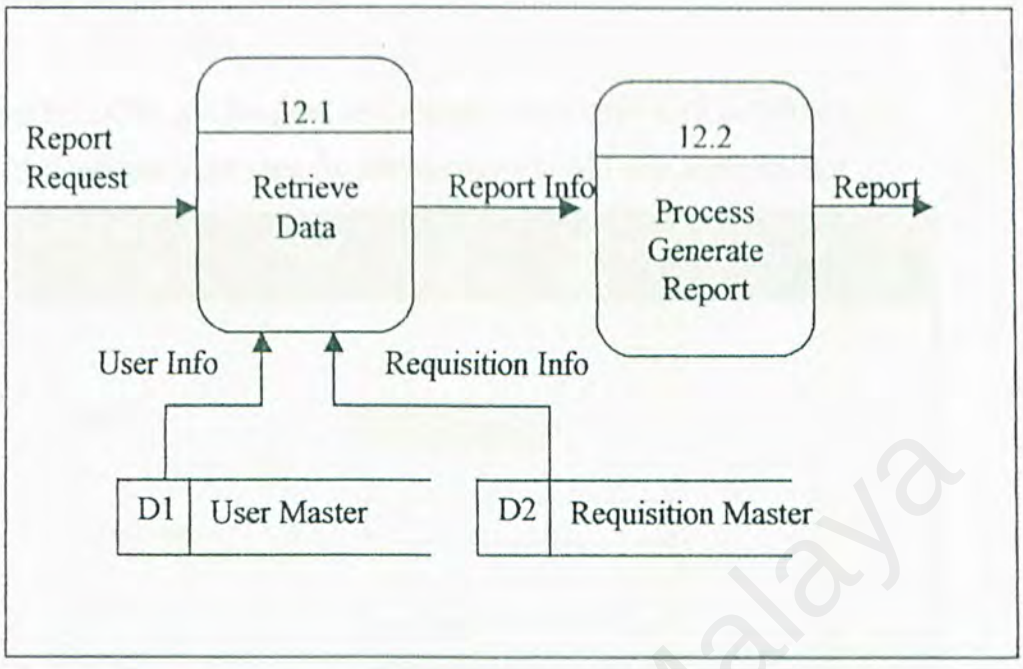


Figure 4.18 Child diagram for process 12.- Generate report

4.3 Form Input Design

The quality of system input determines the quality of system output. It is vital that input forms, screens, and interactive Web documents be designed with this critical relationship in mind. Well-designed input forma, screens, and interactive Web fill-in forms should meet the objectives of effectiveness, accuracy, ease of use, consistency, simplicity, and attractiveness. [Kendall & Kendall, 1999]

Four guidelines for form design should be observed in order to design useful forms:

i. Make forms easy to fill out
ii. Ensure that forms meet the purpose for which they are designed
iii. Design forms to assure accurate completion
iv. Keep forms attractive

4.3.1 Input Forms For LORS

Input forms for LORS are designed and shown in the Figure 4.19 to Figure 4.23.

Figure 4.19 shows the input form for administrator to add new administrator.

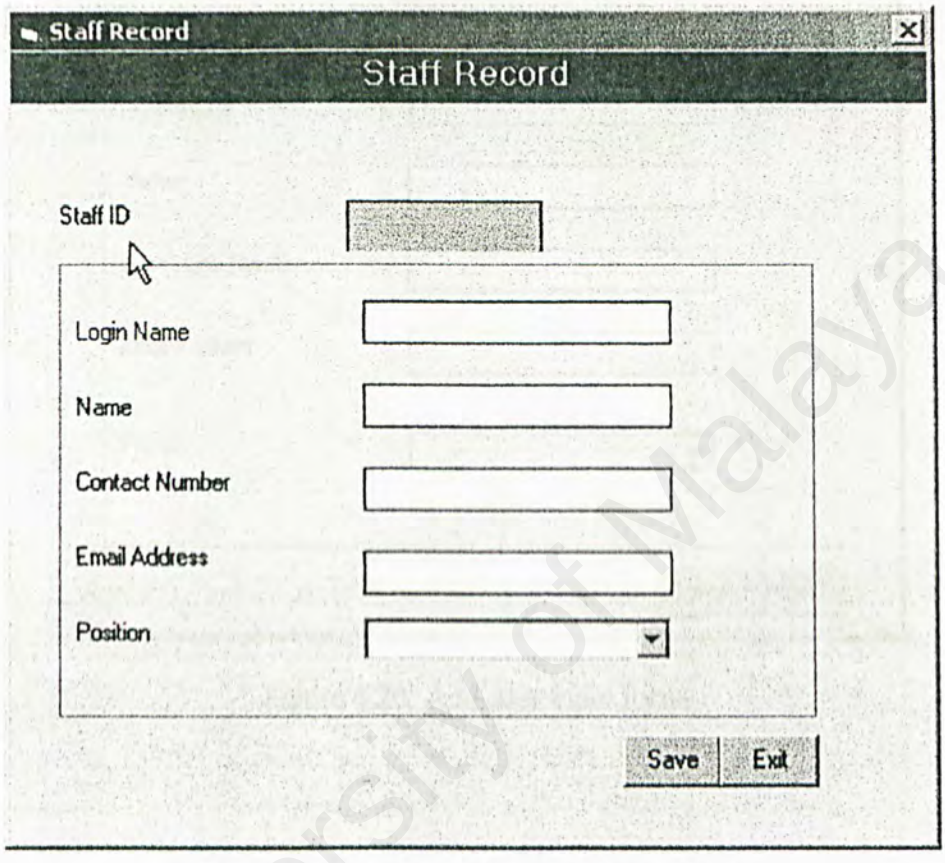


Figure 4.19. Add administrator input form.

The following input form allows administrator to add user to the LORS.

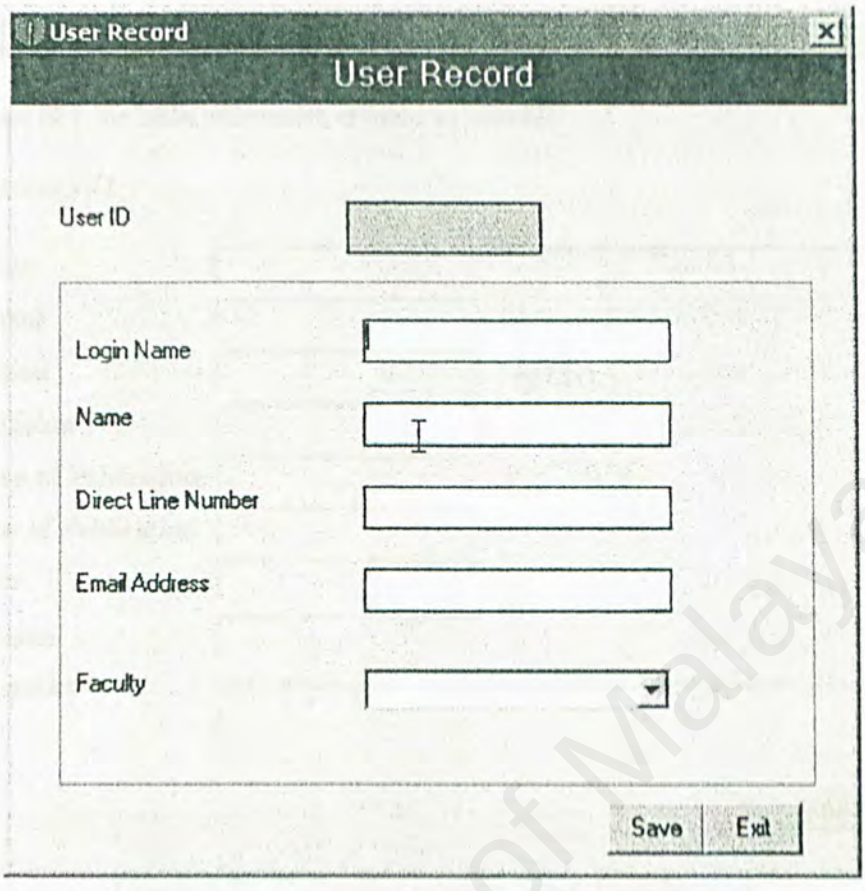


Figure 4.20. Add user input form.

Figure 4.21 shows the input form for login name and password.

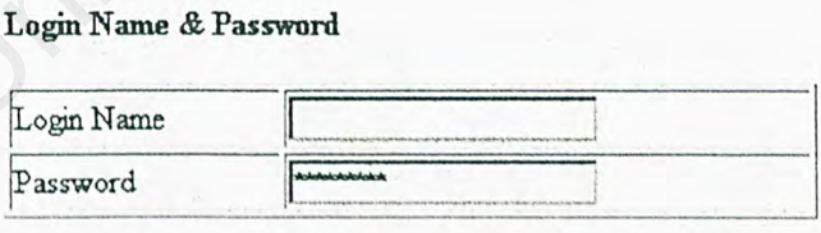


Figure 4.21. Login name and password input form.

Figure 4.22 shows the collection request form submitted by user via Internet and figure 4.23 shows the collection request form submitted by administrator trough the windows-based application.

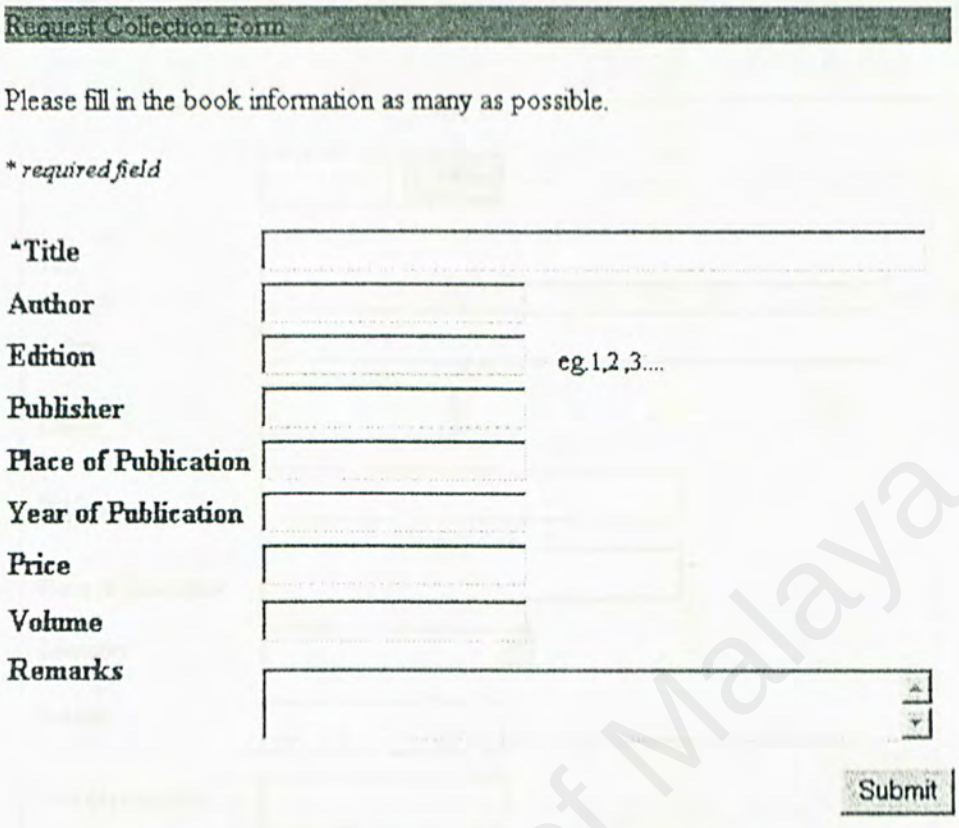


Figure 4.22. Collection request input form by user

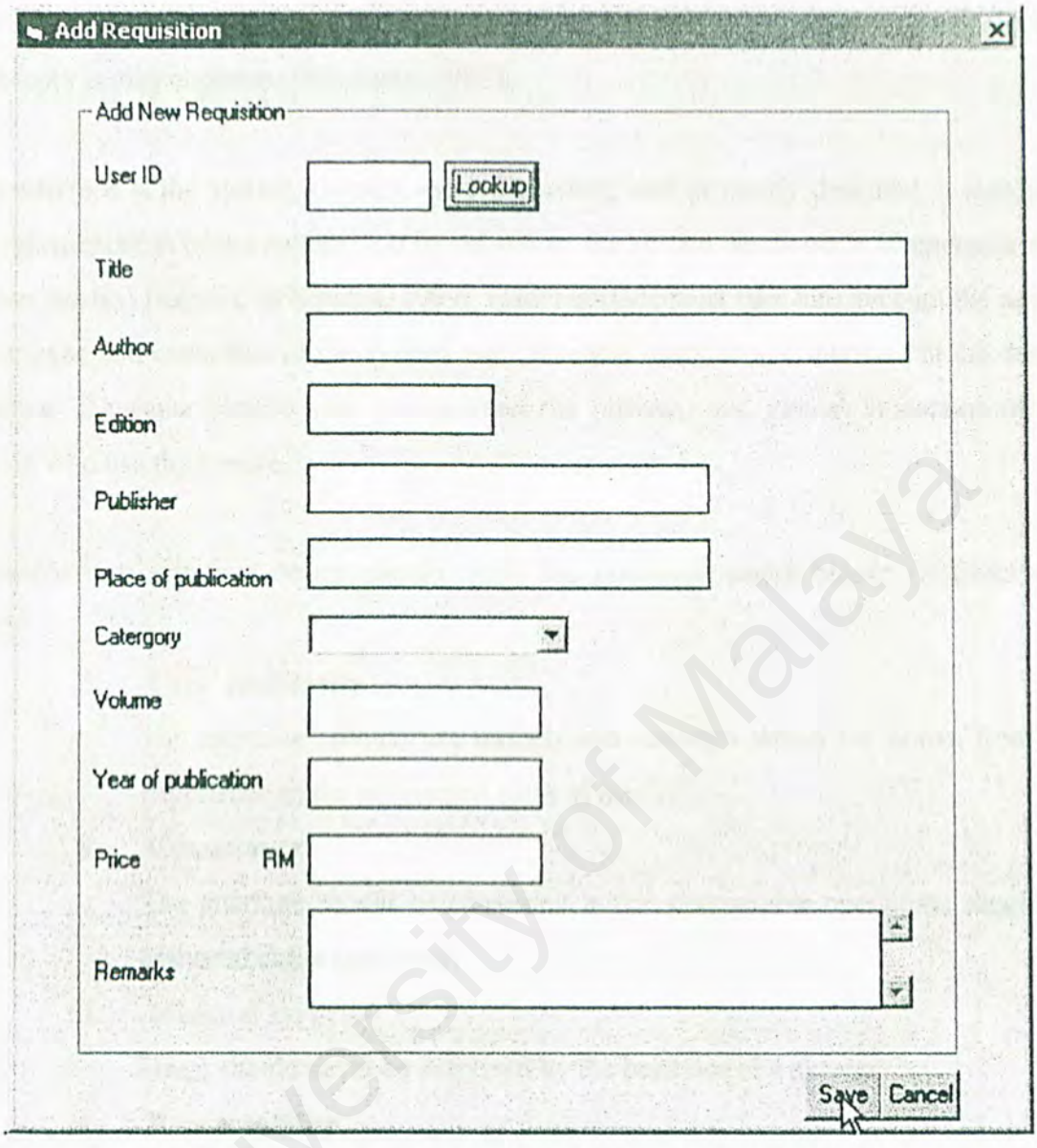


Figure 4.23. Collection request input form by administrator

4.4 User Interface Design

User interface design describes how software communicates with the human user who uses it. [Mundher, 1994]. The user interface of a system is often the yardstick by which that system is judge. An interface which is difficult to use will, at best, result in a high level of user errors. At worst, it will cause the software system to be discarded, irrespective of its functionality.[Sommerville, 1995]. A user-friendly (programmer-hostile, generally used by hackers in a critical tone, to describe systems that hold the user's hand so obsessively

that make it painful for the more experienced and knowledgeable to get any work done) data input is also important [Nilakanta, 1989].

The interface is the system for most users. However, well or poorly designed, it stands as the representation of the system, and by reflection, the system developer's competence as a system analyst [Kendall & Kendall, 1999]. User interface must take into account the needs, experience and capacities of the system user. Potential users should involved in the design process. Designer should take into account the physical and mental limitations of the human who use the system.

A usable user interface design should apply the principles stated below: [Sommerville, 1995]

i. **User familiarity**

The interface should use tern\ms and concepts which are drawn from the experience of the anticipated class of user.

ii. **Consistency**

The interface should be consistent in that comparable operations should be activated in the same way.

iii. **Minimal surprise**

Users should never be surprised by the behavior of a system.

iv. **Recoverability**

The interface should include mechanisms to allow users to recover from their errors.

v. **User Guidance**

The interface should incorporate some form of context- sensitive user guidance and assistance.

In short, usable interface fit in, simply and elegantly, with user's life and work's need. If not obvious to the users, they are quickly learnable.

4.4.1 User Interfaces in LORS

The user login pages for the user and the administrator are shown in Figure 4.24 and Figure 4.25.On the other hand, Figure 4.26 and Figure 4.27 show the main page interface for the user and administrator.

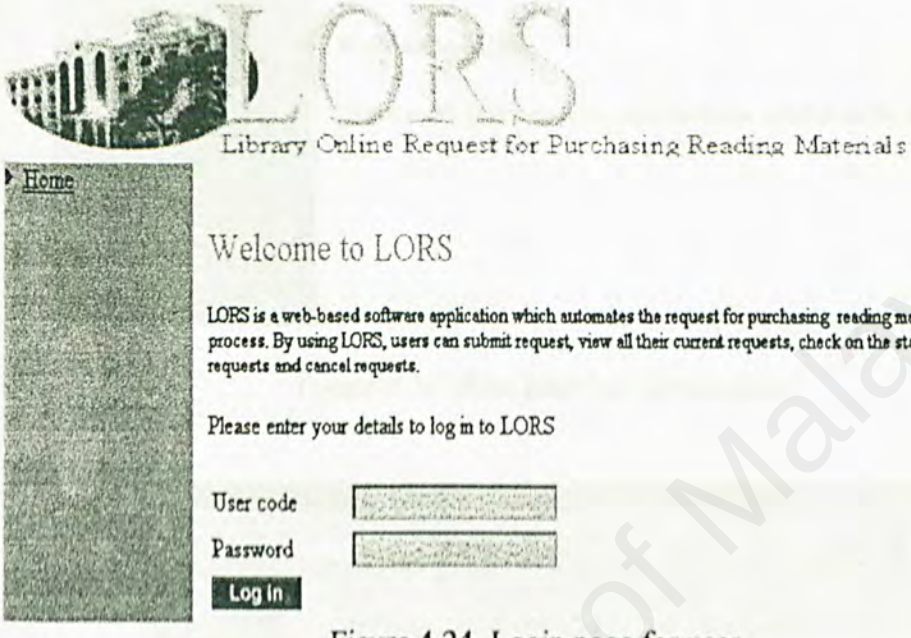


Figure 4.24. Login page for user.

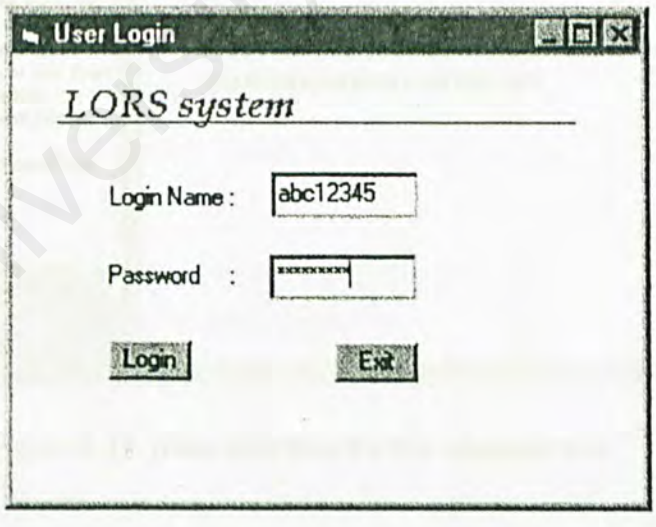


Figure 4.25. Login page for administrator.

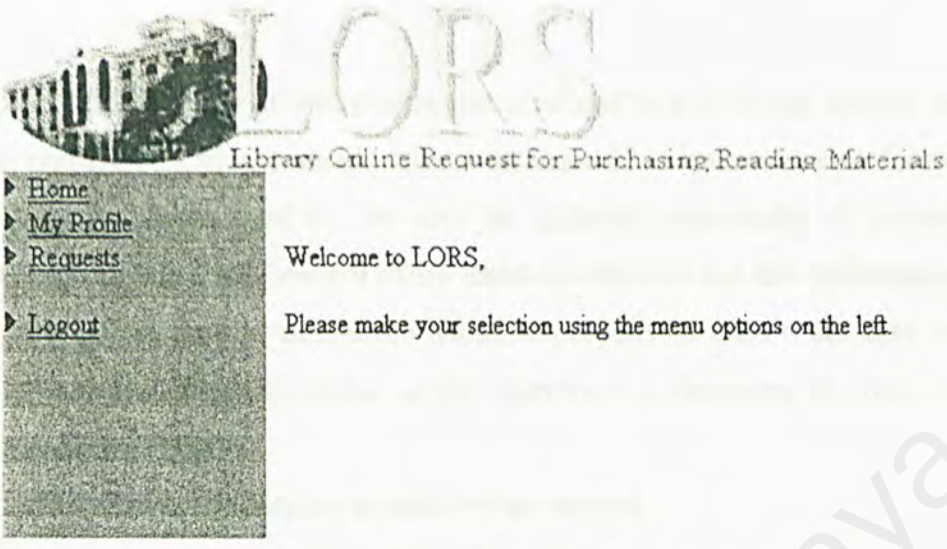


Figure 4.26 Main interface for the user.

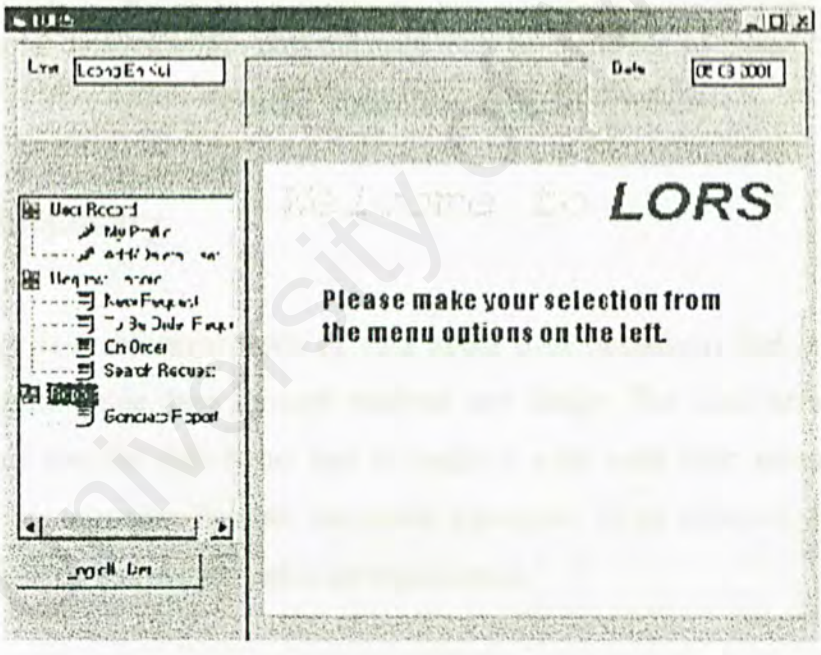


Figure 4.27 Main interface for the administrator

4.5 Database Design

A database is a collection of information that is related to a particular subject or purpose. Thus, all management system should have a database of its own to store information. This information can be retrieved or can also be updated occasionally. A properly design database can provide a total control of the database retrieval and the maintenance process. Therefore it is important to design the database properly to ensure the data are handled efficiently and systematically. Some of the objectives in designing the data storage are [Kendall & Kendall, 1999]:

1. Data availability – data are available when needed
2. Data integrity – data are accurate and consistent
3. Efficient data storage
4. Efficient updating and retrieval
5. Purposeful data retrieval – data obtained must be useful for managing, planning, controlling or decision making

4.5.1 Data Dictionary

Data dictionary is a reference work of data about data (metadata) that is compiled by system analysts to guide them through analysis and design. The data dictionary collects and coordinates specific data terms and it confirms what each term means to different people in the organization. It is an integrated repository of all types of data produced, managed, exchanged and maintained in an organization.

The data dictionary is used to provide detailed information of all tables found within the user/developer-created database. The data dictionary contains at least all the attributes and characteristics for each table in the system.

4.5.2 Database Tables

The proposed Library Online Request For Purchasing Reading Materials System uses the relational database model in the system database implementation. The database will be developing using Microsoft SQL Server 7.0. The database consists of 5 tables. All the attributes of the database tables are listed as follow. The '*' represent the primary key of table.

4.5.2.1 Authentication

This relation stores all users login name and password.

Table Name: Login

Field Name	Data Type	Length	Description
* Login Name	Char	15	Login name for user to login to LORS
Password	Varchar	8	Password

Table 4.2 The Login table

4.5.2.2 Lecturer

The lecturer personal profile is stored in this relation.

Table Name : Lecturer_Info

Field Name	Data Type	Length	Description
* LecID	Varchar	15	Lecturer's identification ID
LecName	Varchar	50	Lecturer's name
LecDirectLineNo	Char	11	Lecturer's direct line number
LecEmail	Varchar	50	Email address
Faculty	Char	50	Faculty
Department	Char	50	Department of faculty

Table 4.3 The Lecturer_Info table

4.5.2.3 Administrator

This relation stores the administrator's information.

Table Name: Admin_Info

Field Name	Data Type	Length	Description
* AdminID	Char	15	Administrator' identification ID
Password	Varchar	8	Password

Table 4.4 The Admin_Info table

4.5.2.4 Requisition Information

This table keeps all the requisition information.

Table Name : Requisition _Info

Field Name	Data Type	Length	Description
* ReqID	AutoNumber	10	Requisiton's identification ID
LecID	Varchar	15	Lecturer's identification ID
Author	Char	50	Author of the reading material
Title	Varchar	100	Title of the reading material
Edition	Int	2	Edition of the reading material
Publisher	Char	50	Publisher of the reading material
PlacePublish	Char	50	Place of publishing
DatePublish	Time	8	Date of publishing
Price	Double	3	Price of reading material
Volume	Int	2	Amount requisition

Status	Char	20	Status of requisition
Remarks	Varchar	100	Remarks by lecturer or administrator

Table 4.5 The Requisition _Info table

4.5.2.5 Purchase Order

This relation stores information of purchase order.

Table Name: PurchOrder

Field Name	Data Type	Length	Description
*PurchaseID	AutoNumber	10	Purchase identity ID
ReqID	AutoNumber	10	Requisition ID
Supplier	Varchar	50	Supplier of reading material
Amount	Int	2	Total order amount
Date	Date	8	Date of order reading material
Remarks	Varchar	100	Remarks by administrator

Table 4.6 The PurchOrder table

4.6 Output Expected

It is anticipated that LORS will be able to effectively and efficiently provides solution to all personnel who involve in the process of making request for purchasing reading materials by adopting an intelligent relational database, integrated process flow and a usable user interface design. Lecturers will be able to submit, view and cancel requests for purchasing reading materials without constraint of time and location. As for the administrator, much paper work will be eliminated because electrical form will be used to replace the manual form. Thus it will reduce processing error due to lower level of human

intervention. This system gives benefits not only to the lecturers but also the administrators of UM library.

4.7 Summary

This chapter is mainly about the system design of the proposed system. Some specific guidelines to design the system are discussed and the expected system outcome are issued. The system is divided into two main modules, which are administrator module and user module. Each module will be decomposed into sub-module.

The four main design factors, program design, input form design, database design and user interface design are illustrated by the help of structure charts, data flow diagrams (DFDs), database tables, entity relationship diagrams (E-R diagrams) and the user interface prototype.

CHAPTER 5

SYSTEM IMPLEMENTATION

CHAPTER 5 SYSTEM IMPLEMENTATION

5.1 Introduction

System implementation is a process of setting up the system into the actual environment. This section includes the system development environment and system coding. In this system implementation phase, the system requirements and design are converted into program codes.

5.2 Development Environment

The usage of dynamic and suitable hardware and software can help accelerate the development of a system and determine the success of the system. The following sections discuss the hardware and software tools used to develop and document the entire LORS.

5.2.1 Hardware Development Environment

The hardware configuration of LORS development environment is listed below

a. Intel®Pentium III 450MHz processor
b. 5 GB of free hard disk space.
c. 128 MB RAM.
d. Network Interface Card (NIC) and network connection with recommended bandwidth at 10 Mbps or more.
e. 4 Mb PCI display card.
f. Other standard computer peripherals like monitor, scanner, mouse, printer and etc.

5.2.2 Software Development Environment

During the LORS development phase, a vast array of software tools are used. The software tools used for design and report writing are summarized in table 5.1.

Software	Usage	Description
Microsoft Windows 2000 server	Development environment System Requirement	Operating System
Microsoft Internet Information Server	System Development	Web Server Host
Microsoft SQL Server 2000	Database Design	Database design, construction and implementation for data storage and manipulation
Microsoft Visual Interdev	System Development	VBScript and JavaScript coding
Microsoft FrontPage	User Interface Design	Webpage design
Internet Explorer 5.0	System Development	Viewing the webpage
Microsoft Visual Basic 6.0	System Development	Prototype module coding and interface design
Seagate Crystal Report	System Development	Generating report

Table 5.1 Development Software Requirements

5.3 Development Of The System

The system development includes setting up the system database and developing the system application and connecting the application to the database.

5.3.1 Database Development

The system database is developed using SQL Enterprise Manager that comes with installation of the Microsoft SQL Server 7.0. The database is based on the database design model during the system design phase. Database development is started by creating an empty database called *LORS* through SQL Enterprise Manager. Then creating all the tables that needed by specifying all the fields for each table and the field's property. Relationships between the tables are established after the tables have being created to

enforce referential integrity. The referential integrity is an important constraint on a relationship that ensures consistency between related tables. Figure 5.1 depicts the SQL 7.0 Enterprise Manager Environment – table object view while Figure 5.2 depicts the design of one of the tables in LORS database – the Requisition_Info table view.

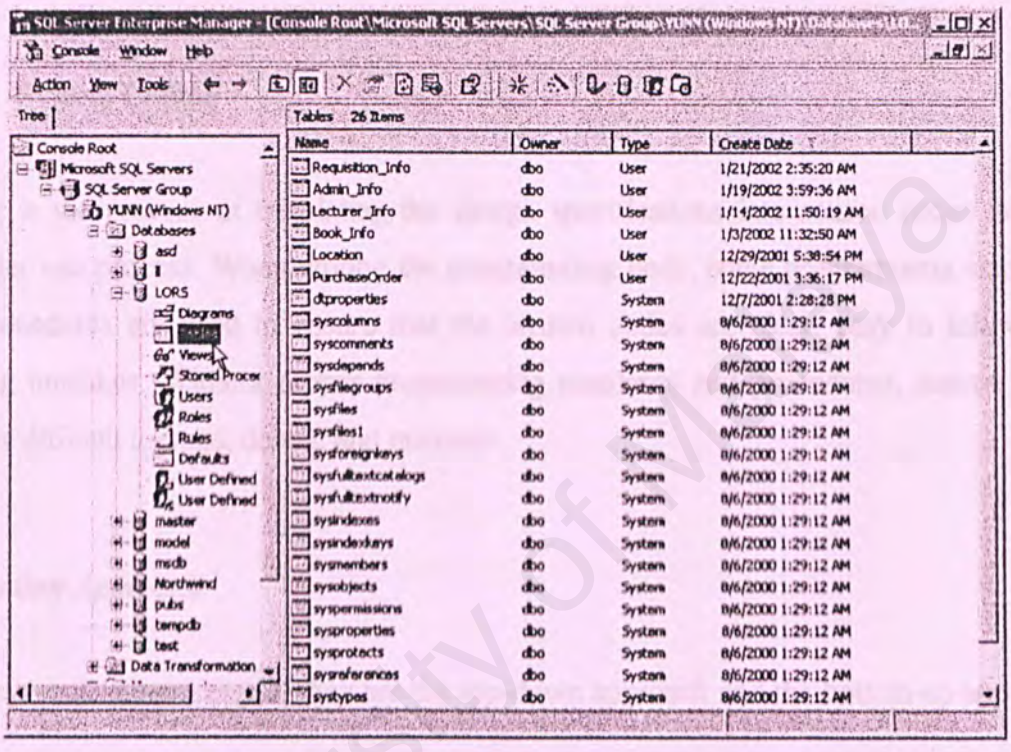
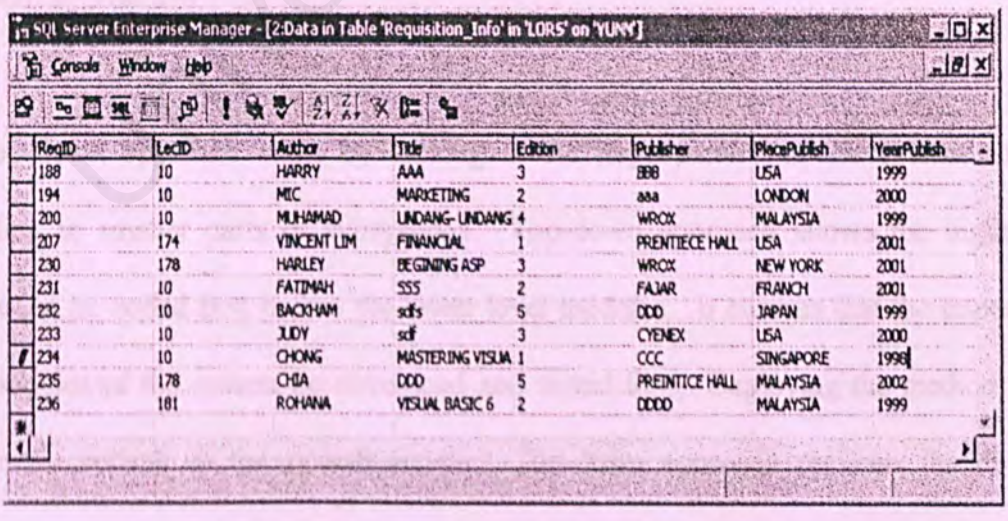


Figure 5.1 LORS SQL database – Table Objects View



ReqID	LecID	Author	Title	Edition	Publisher	PlacePublish	YearPublish
188	10	HARRY	AAA	3	BBB	USA	1999
194	10	MIC	MARKETING	2	aaa	LONDON	2000
200	10	MUHAMAD	UNDANG- UNDANG	4	WROX	MALAYSIA	1999
207	174	VINCENT LIM	FINANCIAL	1	PRENTIECE HALL	USA	2001
230	178	HARLEY	BEGINING ASP	3	WROX	NEW YORK	2001
231	10	FATIMAH	SSS	2	FAJAR	FRANCH	2001
232	10	BACKHAM	sdfs	5	DDD	JAPAN	1999
233	10	JUDY	sdf	3	CYENEX	USA	2000
234	10	CHONG	MASTERING VISUA	1	CCC	SINGAPORE	1998
235	178	CHIA	DDD	5	PREINTICE HALL	MALAYSIA	2002
236	181	ROHANA	VISUAL BASIC 6	2	DDDD	MALAYSIA	1999

Figure 5.2 LORS SQL database – Requisition_Info Table View

5.3.2 Application Development

Application development involves code generation that translates all the algorithms into VB Script language (ASP coding language) and Visual Basic instructions. A set of instructions forms a programme. Application is a set of functional programmes.

5.3.2.1 System Coding

Coding is the process of translating the design specifications into source codes that the computer can process. When writing the programming code, some programming standards and procedures are used to ensure that the written codes are clear, easy to follow and tracking mistakes. Without proper programming standards and procedures, source codes are very difficult to trace, debug, and maintain.

a. Coding Approach

Two approaches were used. They are the top-down approach and the bottom-up approach. Each approach is not only used on individual but also as a combination to gain the benefits from both approaches.

The top-down approach starts by looking at the large picture of the system and then exploding to smaller parts or subsystems. Top-down approach allows the higher level modules to be coded first before the lower level modules. It ensures that the important or core modules of the system be developed and tested first. Deploying the method gives a preliminary version of the system sooner. Top-down approach prevents the developer from getting too involved in the details that loosing track of what the system is supposed to do. This approach is also compatible with the general human mind thinking system.

In contrast with the top-down approach, the bottom-up approach starts coding at the lower level modules before the higher level modules. The higher level module act as an empty shell that calls these lower level modules. The completed lower level module will then be integrated with newly completed higher level module. This approach is used when many of the lower level modules are general-purpose utility routines that are often invoked by others, when the design is object-oriented or when the system is integrating a large number of stand-alone reused modules.

b. Coding Style

Coding styles and its convention rules is an important attribute to the source code and determines the intelligibility of a program. It should follow the convention rules of a good programming style that involve the following:

- Proper variables or field naming that does not against reserve names.
- Meaningful and understandable function and method declarations.
- Standard paragraph indentation for a neater look.
- Keep all complex or compound statement as simple as possible to avoid confusion.

A good programming style consists of the following benefits:

a. Maintainability – codes are well organized. Task-oriented codes are centrally located
b. Reusability – task-oriented codes are easily developed for reuse, specially for tasks that cross application boundaries
c. Testability – modules can be tested easily. Modularization breaks up the code coverage task into smaller and manageable units
d. Speed – module code can safely be optimized without affecting the calling procedures

c. *Scripting Language*

The primary scripting language used to develop the web-based application is VBScript. This language is used to develop all the main functions of the application. JavaScript is also been used in developing the web-based application. This language is used only for verifying inputs which are submitted from the user.

Example of VBScript written in ASP.

```
<%@ Language=VBScript %>
<%
  Dim rsUsers, strSQLSelect
  Set rsUsers = Server.CreateObject("ADODB.Recordset")
  strSQLSelect = "SELECT Password FROM Lecturer_Info " & _
                 "WHERE LoginName = '" & Session("LoginName") & "'"
  rsUsers.Open strSQLSelect, objConn, adOpenForwardOnly, adLockOptimistic,
adCmdText

  If strComp(Trim(rsUsers("Password")), Request.Form("OldPassword")) = 0 Then '
Passwords Match
     rsUsers("Password") = Request.Form("NewPassword")
     rsUsers.Update
     Set rsUsers = Nothing
     Response.Redirect "viewpassword.asp?passwdChanged=True&wrongPasswd=False"
  Else ' Password don't match
     Set rsUsers = Nothing
     Response.Redirect "viewpassword.asp?wrongPasswd=True&passwdChanged=False"
  End If
%>
```

Example of JavaScript written in ASP.

```
<SCRIPT language="JavaScript">
<!--
  function VerifyData()
  {

     var title      = document.frmRequest.Title.value;
     var edition = document.frmRequest.Edition.value;
     var year    = document.frmRequest.yrPublish.value;
     var volume     = document.frmRequest.Volume.value;


   if (title.length==0)
    {
      alert ("Please specify title of the reading material!");
      document.frmRequest.Title.focus();
      return false;
    }
   return true;
-->
```

5.4 Summary

This chapter is mainly about the implementation of the system. In the process of system implementation, a coding approach called "top-down approach" is used and the convention rules of a good programming style have also been defined. The hardware and software requirement for developing LORS are stated.

The following chapter, chapter 6 is discussed on the process of system testing. Some of the testing approaches that have been adopted along the process of developing the proposed system are states in the next chapter.

CHAPTER 6

SYSTEM TESTING

CHAPTER 6 SYSTEM TESTING

6.1 Introduction

Testing is a crucial phase that helps ensure the quality of the eventual system. The main purpose of testing is to find errors in the system. All of the system's newly written or modified application program-as well as new procedural manuals, new hardware, and all system interfaces must be tested thoroughly. Testing of a system does not actually come at the end of the system development, but should be carried out during the development phase.

Objectives of testing system are stated as follow:

a. Testing is a process of executing a program with the intent of finding an error.
b. To reveal different types of error with a minimum amount of time and efforts.
c. To checks that the system perform its functions as specified in the requirement.
d. To assure the customers that the system they requested is the system that was built for them.
e. To allow users to exercise system functions and document additional problems that result from being at the actual site.

Normally, the personal involved in the testing system are programmers, analysts and normal users. They all play different roles in the various aspects of testing. Such as:
Programmers – Program testing with test data
Analysts – Link testing with test data
End users – Full system testing with live data

However, the personal involved in testing this Library Online Request system are myself, some lecturers from FSKTM and some of my course mates who act as end users who are not familiar with this system. The end users are best qualified to evaluate issues dealing with appropriateness of audience, ease of use, and other human factors.

6.2 Types Of Testing

Except for small programs, systems should not be tested as a single, monolithic unit. Large systems are built out of sub-systems, which are built out of modules, which are composed of procedures and functions. The testing process should therefore proceed in stages where testing is carried out incrementally in conjunction with system implementation. In developing a system, testing usually involves several stages. LORS has gone through three stages of testing before it is completed. These three steps are:

a. Unit testing
b. Integration testing
c. System testing

Modification and correction are made along with the testing process to ensure the system runs properly.

6.2.1 Unit Testing

This is the basic testing necessity of any software. Unit testing has been done during the coding and development phase. The main objective of unit testing is to ensure program accuracy, data integrity, usability and efficiency at the module level.

Firstly, each program component is tested on its own, isolated from the other components in the system. Such testing is known as unit testing or component testing. This stage of testing verifies that the component functions properly with the types of input and output expected from studying the component's design. Unit testing concentrates on the smallest component of the system for testing. Every individual components developed in a system are tested independently, without other system components, to ensure that they operate correctly. The sub functions and input forms are verified and the flow from form to form is tested. It is following by the testing of the relation between pages and shared-data integrity.

The steps involved in unit testing of this system as listed as bellow:

1. First, examine the program coding by reading through it, trying to spot algorithm, data and syntax faults.
2. Then, compare the code with the specifications and design to make sure that all relevant cases had been considered.
3. After finished the coding of that module, then compile the code and eliminate remaining syntax faults or errors if exist.
4. Finally, develop the test cases to show that the input is properly converted to the desired output [Pfleeger,2001]

In the case of the development of LORS, unit testing is done for the web-based application and windows-based application. In this unit testing, each function was tested individually. Problems are solves before continuing to another function.

The following are some testing cases in web-based application of LORS:

1. Authentication

Case 1:

Login to the system with incorrect login name and password. Users are not allowed to sign in to the LORS when they click on the login button.

Case 2:

Login to the system with correct login name and password. User successfully login to the system after clicking on the login button.

2. Submit Request

Case 1:

Click on the submit button without fill in any field in the form. User received a notification message box.

Case 2:

Field in the field with invalid input and click on the submit button. User received a notification message box.

Case 3:

Field in all the fields with proper input and submit the request. Submission success.

3. View Request

Case 1:

Click on the **My Request** link after login to the system. All requests are displayed.

Case 2:

Click on the **My Request** link before login to the system. User unable to view his/her request.

The following are testing of cases in windows-based application of LORS:

1. Authentication

Case 1:

Login to the system with incorrect login name and password. Users are not allowed to sign in to the LORS when they click on the OK button.

Case 2:

Login to the system with correct login name and password. User successfully login to the system after clicking on the OK button

2. Add User

Case 1:

Click on the save button without fill in any field in the form. User received a notification message box.

Case 2:

Field in the field with invalid input and click on the save button. User received a notification message box.

Case 3:

Field in all the fields with proper input and save the request. User Added.

3. Searching Requisition Record

Case 1:

Click on the Search button without any input. User receives a notification message box from the system.

Case 2:

Enter an input and click on the search button. User receives a message box that tells the user that no record found.

Case 3:

Enter a different input. The particular requisition record displayed in a form.

4. Report Generating

Case 1:

Input the fromDate bigger than the ToDate and click on the preview button. User get a notification message box.

Case 2:

Input a correct date and click on the preview button. User can view the report.

6.2.2 Integration Testing

Integration testing begins after all objects, components and individual modules have passed the unit testing. When satisfied that individual components or modules are working correctly and meet the system objective during the unit testing, these modules then combined into a working system. While several independent modules combined into a single system, it will cause some unpredicted and unexpected errors that related to the integration of these modules. So, integration testing is used on this system for constructing its program structure while at the same time conducting tests to uncover errors associated with integrating. The objective is to take unit-tested modules and build a program structure that has been dictated by design..

In this integration testing, there are several approaches that can be considered, the Bottom-up Integration, Top-down Integration, the Big-bang Integration and the Sandwich Integration. Among these approaches, the Bottom-up Integration approach is used in the

LORS integration testing, where testing begins from each component or module at the lowest level of the system hierarchy. Then, the next components to be tested are those that call the previously tested ones. This approach is followed repeatedly until all components or modules are included in the testing.

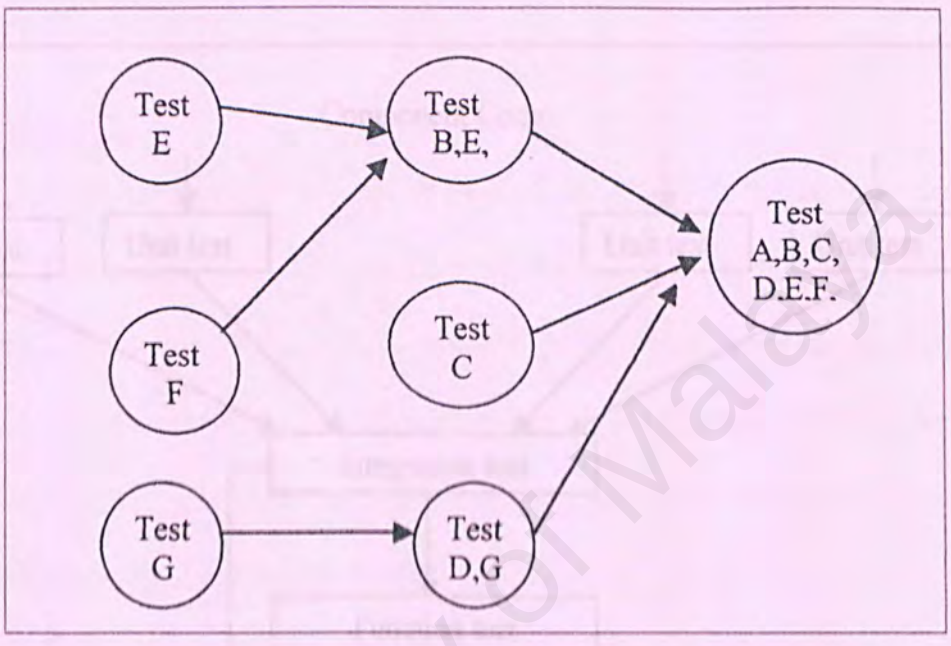


Figure 6.2 Bottom-up Testing

After the integration testing, the system is thoroughly run and executed to ensure the smoothness of the program and to detect any unexpected bugs and errors in the system. Bugs that are often detected are those related with connection and result set as well.

6.2.3 System Testing

The final step in testing procedure is the whole system testing. Prior testing the whole system, there are several other testing that need to be carried out. Its activities includes of system performance, stress, security, configuration sensitivity, usability, data integrity, error handling and recovery. System testing is very different from unit testing and integration testing. In this system testing, the primary objective is to make certain that the whole system works according to users' specifications and is functioning properly. In order to meet this objective, understanding where the faults in the system come is crucial.

The testing steps are shown as figure 6.3 below. However, there are 3 main steps taken in the LORS system testing process:

1. Function testing
2. Performance testing
3. Acceptance testing

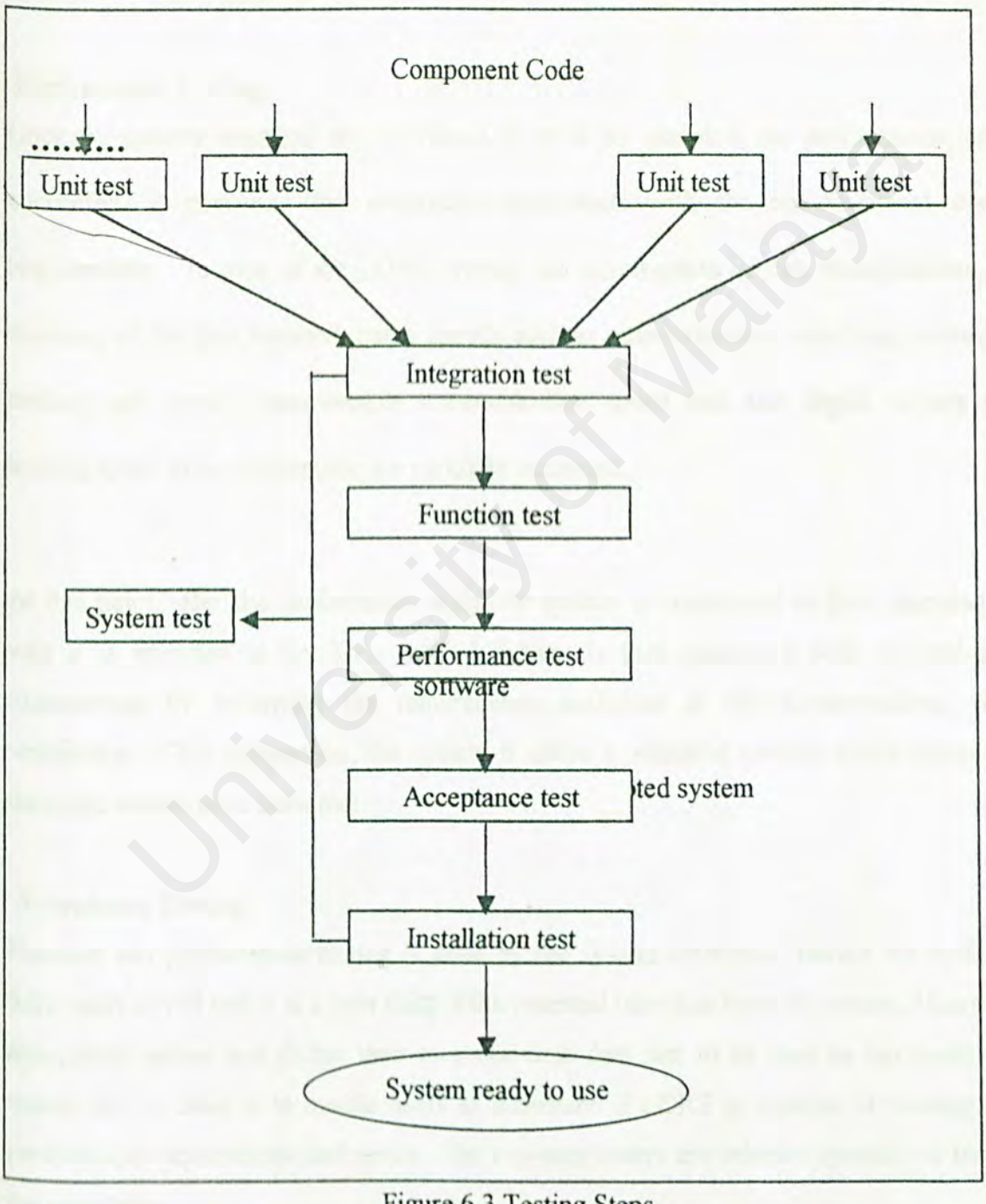


Figure 6.3 Testing Steps

System testing starts with function testing. Function testing is focus on the system's functional requirement. A function test checks that the integrated system performs its

function as specified in the requirements. Effective function test should have high probability of detecting a fault. LORS employs several guidelines for function testing:

i. High fault detection probabilities
ii. Know and anticipate expected actions and output
iii. Test all valid and invalid data types.
iv. Include stopping criteria.

Performance Testing

Once the system functions are convinced to work as specified, the performance test is conducted. It compares the integrated components with the non-functional system requirements. . In case of the LORS system, the effectiveness of data manipulations, the accuracy of the data retrieval, query speeds such as record retrieval, searching, retrieving, ranking and sorting, inter-module communication speed and also digital objects file-loading speed from the database are carefully examined.

At this point, after the performance tests, the system is considered to have operated the way it is intended to be. This verified system is then compared with the end-users expectations by reviewing the requirements definition in the documentation. Upon satisfaction of the comparison, the system is called a validated system, which means that the requirements have been met.

Acceptance Testing

Function and performance testing is done by the system developer. Before the system is fully ready to roll out, it is a best thing if the potential user also tests the system. Users lead acceptance testing and define their own real-time data sets to be used as test cases. The reason this is done is to enable users to determine if LORS is capable of meeting their performance expectations and needs.. The end-user testers are selected specially to test out the application.

6.3 Summary

The testing processes have been carried out throughout the development of the system. This system is considered zero-defect for both functional and non-functional requirements after passes all the types of testing such as unit testing, integration testing and system testing.

The next chapter is discussed on the topic of system evaluation. Problems encountered and solutions during development of the system are covered in the next chapter. Besides, the system strengths and constrains are stated in the next chapter too.

CHAPTER 7

SYSTEM EVALUATION

CHAPTER 7 SYSTEM EVALUATION

7.1 Introduction

This is the final phase in the life cycle of this project. During the period of coding and implementation, various problems were encountered. So, this chapter identifies the shortcoming encountered in the system development and steps to be taken in solving problems. Besides that, strengths and constraints, future enhancements of the system and knowledge and experience gained are determined.

7.2 Problems Encountered And Solutions

In the planning and developing phases, a lot of problems had arisen due to some unclear of the users' needs. These problems include:

7.2.1 Determining Scope Of The System

Since there was no prior experience in developing a 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. Besides, problem came across when the potential users for the windows-based application are not good at expressing what they really want from the system to do.

Solution: These problems were overcame after a research had been carried out and advise given by the supervisor.

7.2.2 Time Constraint

During the design phase, there was not enough time to study and produce the best solution of design in Semester 1. Mainly, this was due to inexperience and insufficient knowledge of designing a system.

Solution: The best way to learn is to read as many approaches used in previous year students' report documentation.

LORS is developed into two different kind of application. I have to start everything from scratch, including learning Visual Basic, ASP, VBScript, JavaScript, hardware configuration as beginner.

Solution: Speed up the developing process. Asking help from friends and course mates whenever problem encountered. This is the best way to save the time instead of study myself to solve the problems.

7.2.3 Difficulty In Choosing Development Tools And Programming Language

As there are many ways and tools available in developing a web-based application and windows-based application, choosing a suitable technology and tools proves to be a critical process as each tool has its strength and weakness. . There are many software tools available in the market today, for example: ASP, Java, C, Visual Basic and so on, not to mention the choices for other software such as database, report tools. Unfortunately, this wide range of tools available had raised the problems on making the decision in choosing the most suitable tools for the system needs.

Solution: The first step is to define the needs of the system. Then doing some research based on the type of software needed. In the mean time, Internet surfing and seeking advises from friends help clarify some doubts

7.2.4 Problem On Installation

There were a lot of problems on installing Windows 2000 Professional, IIS , SQL 2000 and other tools before starting coding. The needed software and tools were successfully installed only after a few times of formatting and reinstallation.

Solution: It is essential to know the sequence of products installations. This is to ensure smooth execution without system errors. This vital information about installation sequence is not provided in a user-friendly way to guide user.

7.2.5 Lack Of Mastery of The Chosen Programming Language Skills And Software Tools

As a new beginner for using ASP and Visual Basic, I am not very familiar with the programming syntax and all the built in object. Therefore, I had faced problem to convert the required function into source code.

Solution: The best way of solve this problem is going through some of the examples available on the Internet and also Microsoft's web site. Those examples are simple and easy to understand.

Although the software development tools used during the development of this project is quite user friendly. But because I am a first time user, a lot of functions provided by the software are not been used. I also face problem to use the software for debugging purpose.

Solution: Study the help file provided by the software.

7.2.6 Different Version Of Software Tools Used

The version of software used at home is different with the version used in faculty lab. Thus, some of the developed functions fail to run properly.

Solution: Do not use the built in function provided by the software which is not available in the faculty lab.

7.3 System Strength

LORS has the following strengths in its use:

7.3.1 User-Friendly

The interface of the LORS is simple and easy to use The system is considered as user friendly and data integrity. A lot of useful Graphical User Interface (GUI) such as combo box, list box and the data grid are provided to assist users in quickly data entry, manipulating action and searching. Clear, precise instructions guidance is given with each form to guide the user. It can avoid the error cause by user careless. Event if mistake is made, the user still can easily aware of the mistake through the message prompt out by the system.

7.3.2 Provide Easy To Use Functions And Tools

Besides the user friendly GUI, this system also provide some functions to make it more easy to use. These functions are the search key, tree- view window and also the lookup function.

7.3.3 Security features

This system also includes the security control that only allows the authorized user to access the system. It has an Authentication module that allows the administrator to control the user access list. Every user who wants to access the system needs to supply a user id and

password during the login process.

7.3.4 Different User Privileges

The windows-based application can be access by two different types of users; they are Staff and Administrator. These two groups user only can access the forms that they have the right to. Staffs are not allowed to access to the staff maintenance module.

7.3.5 Transparent

System is transparent as users do not need to know where the database resides, how the system is structured, etc. For example, users do not need to know how to retrieve from and insert into the database. All they need to do is submit data and click the specific function to view the result.

7.3.6 Fast Response Time

For the web-based application part, each web page is designed as simple as possible to allow fast loading. Large size graphical images are avoided. This consideration has also been taken into the scripting part where overhead of calling script are kept to a minimum. The data validations are also carried out at the client site to enhance fast response time.

7.3.7 Highly Integrated Modules

All modules In LORS are highly integrated, where data changes and updates in any one module can be detected and copied to other linked modules. This reduces entry and management time.

7.3.8 Multi- Criteria Search Modules

For the windows-based application part, LORS provides multi-criteria search modules, which are flexible and totally user dependent.

7.3.9 Self-Maintained System

This system is a self-maintained system seems it can generate email automatically to prospective users according to different situation. It provides password retrieval, confirmation and update notification to the user automatically.

7.4 System Constraints

As in other systems, there are also several constraints in LORS. These constraints can be addressed in future development and system enhancements.

7.4.1 Output Printing Function

For the windows-based application part, LORS does not provide users the ability to print search results directly from the application.

7.4.2 User Customized Report

The report generating functions provided by the system are not enough powerful. User has the limitation in choosing the field and style of report they preferred.

7.4.3 Purchasing Record

There is no function provided for user to continue working with the purchasing process. Users can only get the report of requisition from this system and the following process is not developed in this system due to the time constraint.

7.4.4 Online Users Added By The Library Administrator

At the mean time, the administrator through the windows-based application adds the online user. This increases the workload of the administrator.

7.5 Future Enhancement

Although a lot of efforts have been dedicated in developing this system, there still has a space for the future enhancement. The following list stated some suggestions for future evolution of the system, which are not covered in this project.

7.5.1 Output Printing Function

This function enables user to print out search result or other data management output directly from applications.

7.5.2 Provide Help Facility

Add a feature that can provide the help file for the users to guide them in using this system. The users can browse to the help module and search for the topic they needed in order to get the help information. This is very important for new users that without a user manual to getting started using the system.

7.5.3 Purchasing Module

A purchasing module to keep all the purchasing data and allows user to keep track with the data.

7.5.4 Online Register Module

This module is to allow the online users to register themselves rather than added by library' administrator.

7.5.5 Other Language Support

A successful system is the system that can support more than one communication language. This system can be enhancing to include more than one language such as Chinese, Malay and so on to broaden the usage of the system.

7.6 Knowledge And Experience Gained

Knowledge and experience gained throughout the development of LORS is really valuable. The experience and knowledge gained are listed below:

i. **Programming in HTML and JavaScript, VBScript and Visual Basic**
   - Gained a valuable experience from learning these programming languages and can be used as precious skill when searching for a job in future.

ii. **Internet Technologies**
   - Learned how to configure an IIS Web-Server

iii. **Managing Database**
   - Learned how to use SQL 2000 server to manage data.
   - Learned Structured Query Language (SQL), which is important in developing a system related to database.

iv. **Apply Theories and Knowledge Gained Throughout Studies**
   - Theories and knowledge gained throughout the course of Information Technology studies were literally put into practice.

v. **Exposure to the Software Development Tools and Web Programming Technology**

- Learned how to use Microsoft Visual Interdev 6.0, Microsoft Visual Basic 6.0, Microsoft FrontPage 2000 and internet tools like ASP to develop a system.

vi. Planning and Managing a project

- Learned how to plan a project and managing a project to ensure all the processes are in the right way and follow the schedule.

The most important, the process of doing this system has been an exposure to me on how to really plan and work on a project. This project has proved very beneficial for me when I step into the working environment in future.

7.7 Summary

This chapter is mainly about the evaluation of LORS system. Problems such as time constraint, lack of mastery of programming skills, and etc are defined and solutions of the problems are included. Besides, the system strengths, constraints and future enhancements are discussed in this chapter. Lastly, this chapter is mentioned about the knowledge and experience gained throughout the development of the system.

7.8 Conclusion

Building an application package is a challenging task. Not mention to develop two different applications in one time. A lot of research, time and effort have been involved in making this project successful and in fulfilling the tasks requirements.

During the whole period of this project, much new and exciting knowledge are gained, such as the rapid application development (RAD) methodology, Windows-based and Web-based programming techniques, advanced database manipulation and etc..

In conclusion, LORS is developed successfully in a limited period and successful in attaining its objectives and requirements as determined during system analysis phase. The

system is easy to learn and use and users can master it within a short learning time. It is hope that this version of LORS will be able to provide its features for the target group users.

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