ELECTRONIC BOOKSTORE

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LIST OF ABBREVIATIONS

1.	API	Application Programming Interface
2.	ASP	Active Server Pages
3.	CGI	Common Gateway Interface
4.	GUI	Graphics User Interface
5.	FTP	File Transfer Protocol
6.	HTML	Hypertext Markup Language
7.	HTTP	Hypertext Transfer Protocol
8.	IIS	Internet Information Server
9.	IT	Information Technology
10.	ODBC	Open Database Connectivity
11.	PHP	Personal Home Page
12.	URL	Uniform Resource Locator
13.	WWW	World Wide Web
14.	XML	Extensible Markup Language

ABSTRACT

The E-Bookstore is a web application of electronic commerce which simulates an electronic bookstore. This project will complement the traditional way of doing business in a bookstore. The University Bookstore in the University of Malaya will be the target client for this Project.

The E-Bookstore will enable university students and lecturers to have a more pleasant book shopping experience by leveraging on the benefits of the Internet to provide a virtual bookstore on the World Wide Web. Users of the web site will be able to conduct basic book shopping activities like book browsing, book searching, online ordering and placing orders for books currently physically unavailable in the University Bookstore.

Besides, the application will also enable the bookstore owner to understand the business better and to respond quickly to customers' needs. As an example, accurate and concise reports can be obtained easily whilst newsletters can be sent directly to the customers via electronic mail.

It is envisioned that the E-Bookstore will benefit the everyday users of the bookstore by saving considerable costs in terms of transportation, time and effort. It will also benefit the bookstore owner by providing up to date information on the business and its inventory system besides introducing latest Information Technology solutions for the business.

It is hoped that this project will demonstrate the benefits of conducting business via the Internet. Hopefully, it will serve as a platform whereby University of Malaya will lead the way in achieving some of the aspirations outlined in Vision 2020.

1.1 PROJECT DEFINITION

INTRODUCTION

This project aims at developing a web application of electronic commerce which simulates an electronic bookstore. The E-Bookstore will enable users in the University of Malaya to visit the web site and perform basic transactions of e-commerce simulating their experience in the bookstore.

The E-Bookstore will introduce new ways of conducting bookstore transaction using e-commerce initiatives. This will benefit both the customers and bookstore owners by inducing enormous potential of growth and improvements for the bookstore besides making book shopping a pleasant experience for customers in the University of Malaya. The E-Bookstore will complement the traditional way of doing business by the bookstore.

The following sections will describe briefly the functional requirements and non-functional requirements of the system. The entire system is broken into eleven distinct modules with all modules functioning together and working together to form a complete electronic bookstore system.

1.1.1 FUNCTIONAL REQUIREMENTS

a) Search Capability

Users will be able to search for books available in the bookstore by title, author, publisher, subject categories etc. The results will be displayed in a list. Further detailed description on a particular book will be available by a single click of the mouse.

b) Online Ordering

Users will be able to check for the availability of books at current time before proceeding to the bookstore to buy them. Users can also place reservations for available books for a specified number of days using shopping cart technology. The system will automatically release the book for general public purchasing if the above transaction fails to materialize.

c) Administration Features

Administrators' rights will be given to enable authorized users to change the database for promotional items, maintaining the mailing list and also performing necessary changes to the web site if necessary. There is also a feature enabling the cashier to log in as administrator and conduct day-to-day book selling transactions.

d) Order Placement

Using shopping cart technology, users can place orders for books which are unavailable/sold out at current time. The system will generate an electronic mail automatically notifying the customer regarding the arrival of the book. The customer could then proceed to buy the book in the bookstore or proceed to reserve the book via the Internet using *Online Ordering (module b).*

e) Feedback

There will be a page dedicated to feedback so that recommendations or comments by users can be recorded and improvements can be made.

f) Mailing List

Users can add their names to the mailing list. Particulars such as e-mail addresses and fields of interest need to be filled-in so that the administrator can send newsletters to specific user groups to notify them on the latest news. Users can also edit their particulars or unsubscribe from the mailing list by a simple procedure.

g) E-Bookstore Membership

The E-Bookstore will offer membership to privileged customers who meet a certain criteria. These members will be entitled to special membership discounts for certain books.

h) Sales Operation

The cashier will use this module to record sales transactions. The NRIC of customers would be required if they are members and if they have made reservations via *Online Ordering (module b)*. Relevant information and messages would be displayed on the user interface to assist the cashier to complete the sales transactions. This module will also update the database of the system immediately.

i) Report Generation

The administrator can access different report types by a series of clicks. Report generated will be regarding the business of the bookstore i.e. total sales done for a period of time, total online orders, quantity of books left in the bookstore etc. The system will also automatically send an electronic mail notifying the bookstore owner and related personnel regarding low inventory to prompt fast re-ordering of books from the suppliers.

j) Interesting Links

The web site will be linked to other interesting sites for the benefit of the users who are interested in issues like health, sports etc. Maintenance will be simple.

k) Newsletter Generation

This module is performed by the administrator. Simple querying is done to generate a newsletter recipient list. Newsletters regarding new books or promotions are then sent to the respective recipients.

The functional requirements shown above can clearly be depicted in the Systems Architecture (Figure 1-1) shown below.

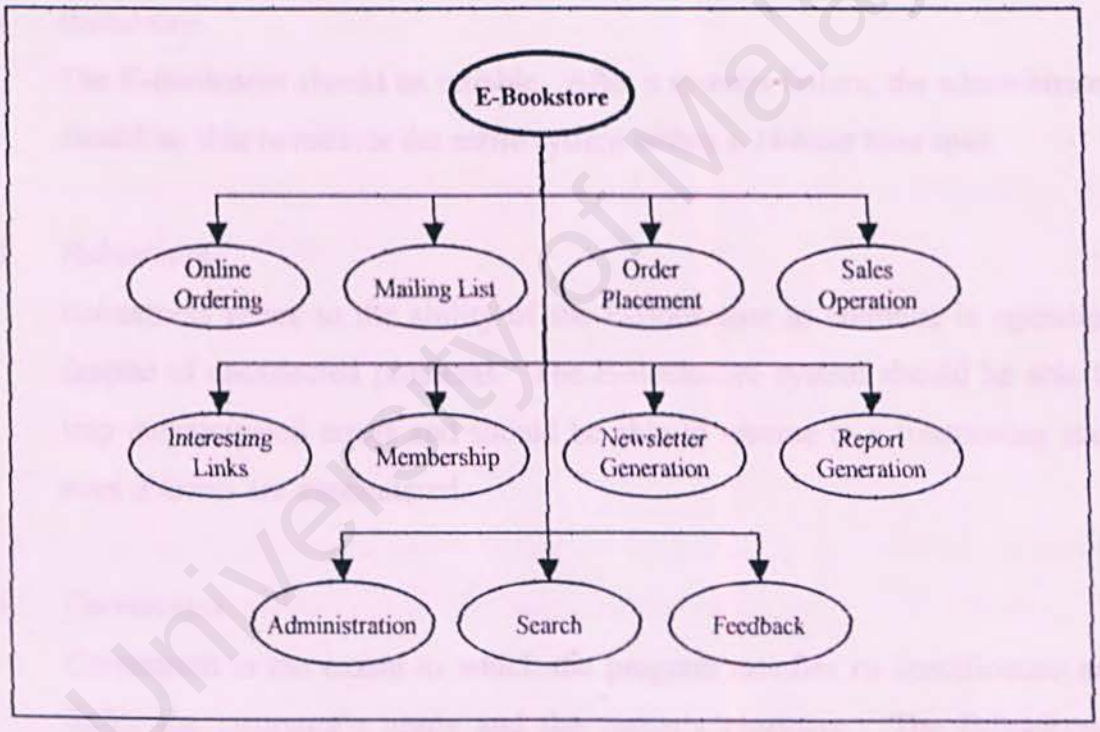


Figure 1-1 E-Bookstore Systems Architecture

1.1.2 NON FUNCTIONAL REQUIREMENTS

a) Learnability

The time required for training the system user to be proficient in the usage of the system must not exceed two working days.

b) Speed

In order to provide an efficient E-Bookstore system, it should at least process a transaction successfully within 30 seconds unless the entire network is down. Besides that, it should also produce at least one response within 30 seconds.

c) Reliability

The E-Bookstore should be reliable. After a systems failure, the administrator should be able to recover the entire system within a 24-hour time span.

d) Robustness

Robustness refers to the ability of the E-Bookstore to continue in operation despite of unexpected problems. The E-Bookstore system should be able to trap unanticipated errors and should be able to resume to a functioning state even if errors are encountered.

e) Correctness

Correctness is the extent to which the program satisfies its specification and fulfils the customer's needs and the owner's objective. The E-Bookstore system hopes to achieve a high level of correctness by careful implementation.

f) Interoperability

Interoperability is the ability of the system to interact with other system. The E-Bookstore is designed to be interoperable with other existing systems in the bookstore. It is hoped that the most common tools, technologies and web languages would be used so that interoperability issues would be at a minimal with other computerized systems.

g) *Usability*

An appropriate user interface and adequate documentation will enable usability of the system. The E-Bookstore will provide usability by designing a user-friendly interface. Necessary documents will be produced for the reference of the bookstore administrator when they are using the system.

h) *Modularity*

Modularity is a key factor to good program design. The internal workings of the system will be broken into modules so that distinct functions of objects could be isolated from one another.

i) *Maintainability*

Some sites of the E-Bookstore require frequent maintenance to provide updated information to the customers. The system administrator should perform the maintenance of web sites.

CONCLUSION

The requirements mentioned above define the project to be undertaken. As can be observed, the E-Bookstore consists of modules that fulfill the everyday needs of the everyday user in the university. These eleven modules will be developed independently, but they will ultimately be linked together to interact with one another. These modules will work in unison to provide the services of the E-Bookstore System.

The Project will also exhibit system properties which are invisible to the users. These system properties are important for the entire system to function properly as desired so by the developer and the bookstore owner.

The next chapter will discuss on the issues which inspired and motivated me to develop this E-Bookstore system.

1.2 PROJECT MOTIVATION

The E-Bookstore Project is a culmination of ideas and suggestions from many friends. It is based on the fact that many students currently studying in the University of Malaya faced fundamental and basic problems in their day-to-day bid to buy books from the University Bookstore. The factors which spurred me to develop the system will be discussed below.

Many students currently studying in the university face many problems and inconveniences during their book shopping experience. This is especially so during the beginning of each semester whereby many students rush to the bookstore to buy the limited number of books available in the bookstore. Those who fail to buy the books have to wait patiently until the next delivery. Even then, students are not assured that they will be able to obtain and purchase the books they want.

Some of these problems currently faced by users of the bookstore include difficulty in order placements for unavailable books, time wasted on journeys, difficulty in locating or finding books in the bookstore etc. These problems are unnecessary as Information Technology (IT) solutions can be implemented to solve the daily woes and meet the needs of students. This has led me to propose this E-Bookstore Project.

As I begin my journey into this web based Project, some of the most immediate benefits that come to mind are as follows :-

Benefits for the Bookstore :-

- The project allows the Bookstore to reach a wider range of customers without making heavy investments.
- The bookstore owner can have up-to-date and accurate information on the business anytime and anywhere if he/she has Internet access.
- The method of traditional book selling can be upgraded to enable the bookstore to keep abreast with the latest technologies.

Benefits for the customers :-

- The web-based application saves the customers invaluable time and transportation costs.
- Easier and better online book browsing capability for customers in comparison to traditional book browsing in the bookstore.
- Order Placement and Online Ordering transactions can be conducted anytime of the day.
- Attractive discounts can be made to frequent online users as a customer's purchases can be recorded and monitored easily.

It is my hope that this Project will serve as a platform whereby the students and lecturers in the University of Malaya will be able to simplify and make their book shopping experience a relaxing and satisfying one. There remain many features which can be enhanced for future developments. Nonetheless, I believe the Project has addressed some of the most fundamental problems faced by the everyday users of the University Bookstore.

1.3 OBJECTIVES

This section will list the objectives to be achieved in this E-Bookstore Project. The main objectives of this project are as follows.

1. To develop a web application of electronic commerce which will complement the traditional bookstore practice by leveraging on the Internet and introducing new ways of doing business.

2. To enable the University Bookstore to effectively and efficiently manage its book inventory system by providing timely and up to date records of its book inventory.

3. To provide a more pleasant book shopping experience to the students and lecturers in the University of Malaya by saving time and costs by effectively providing relevant information on the bookstore web site.

The objectives mentioned above are specific, measurable and realizable. The Project will focus considerably on improving process efficiency and introducing new ways of doing business in the bookstore.

1.4 SCOPE

Several considerations were made during the implementation of this E-Bookstore Project. As stated in the objectives of this Project (Section 1.3), the E-Bookstore will only complement the existing systems in the University Bookstore. Due to this, certain assumptions have to be made so that the project can be developed according to its pre-defined context.

The scope for the Project was deliberated thoroughly and the following assumptions were made :-

1.4.1 ASSUMPTIONS

- The targeted clients for this web application development include the students and lecturers in the fraternity of the University of Malaya and the bookstore owner.
- The bookstore has an access line directly linked to the Internet.
- There will only be a single computer acting as the Web Server and Database Management System Server. The entire system will operate from this computer.

1.4.2 LIMITATIONS

- The targeted clientele for the Project only consists of university students, lecturers and the bookstore owner.
- The system will only maintain a complete book inventory of the bookstore.

- The system incorporated will only take into consideration transactions between the clients and the owner of the bookstore.
- The web-based application will not include any electronic payment systems as it does not integrate or incorporate with any merchant accounts, nor does it have any relationship with banks.
- The Sales Operation Module incorporated will have limited capabilities as it records sales transactions and updates the book inventory database only.
- The Report Generation Module will assist the administrator and bookstore owner by providing several pre-defined report types to enable them to understand the business and their customers better. It is not a complete business analysis tool by itself and therefore has limited capabilities.

As briefly mentioned above, deficiencies and certain limitations are bound to exist and occur in every system. The E-Bookstore Project faces similar challenges in these aspects. However, it is evident that future enhancements can be made to improve and increase the number of features in this system and thus, extend the overall capabilities of the system.

For example, due to the fact that web applications are not time bound and physically borderless, the system can be made to include wider ranges of clients in the future without adding substantial costs. Electronic payment systems can also be implemented when it is financially feasible and justifiable.

1.5 PROJECT SCHEDULE

A project schedule describes the software development cycle for a particular project by enumerating the phases or stages of a project and breaking each into discrete tasks or activities to be done over a period of time. The schedule of this project is shown in the Gantt chart below (Figure 1-2).

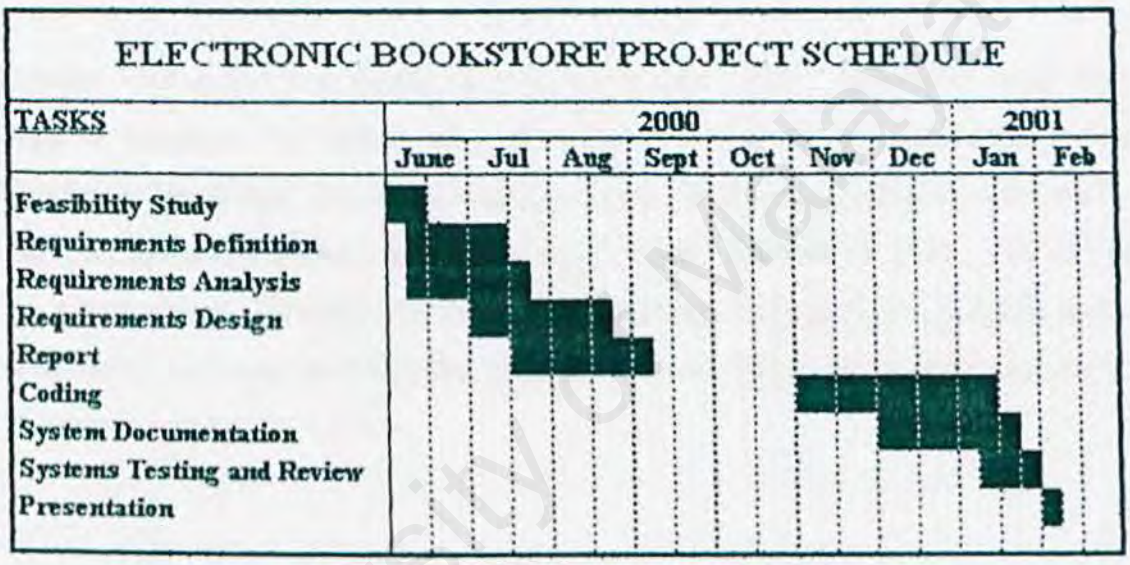


Figure 1-2 E-Bookstore Project Schedule

As listed in the Gantt chart above, a Feasibility Study was first conducted during the first two weeks of June. Shortly after this stage, the Requirements Definition was defined and discussions were held with the supervisor to determine the requirements that would fulfill the needs of the users in the university.

The next phase was that of the Requirements Analysis. During this phase, several algorithms and techniques were analyzed. Time was needed, as discussions had to be conducted to find out exactly which techniques would be incorporated when designing the system. Decisions were also made regarding the most effective way to develop the system. After this phase, the Requirements Design was carried out starting from the month of July. This phase basically required the user interface,

database and the system flow to be designed. This was of utmost importance as it helped in developing the system at later stages of the project implementation. A preliminary report was generated at the end of the Requirements Design phase.

Coding took the longest period of time as it extended from November till mid January. Systems Documentation was done almost simultaneously with coding. The documentation of the entire thesis lasted until a week after coding had finished. This was on the third week of January.

Systems Testing and Review was done for about three weeks. This phase enabled all bugs to be sorted out and it also allowed for fine-tuning of the system. The Supervisor previewed the web site at this stage and recommendations were made. The comments nonetheless contributed significantly in the successful completion of the entire system. In early February, a presentation of the project was made to the supervisor, moderator and all other parties who were interested in reviewing the E-Bookstore System.

1.6 REPORT ORGANIZATION

This chapter presented an overview of the entire E-Bookstore Project. To better understand this report, a brief summary of each chapter is given below :-

Chapter 1 Introduction

This chapter gives an overview of the system as a whole. It is intended to give the reader an overall perception and understanding of the E-Bookstore Project.

Chapter 2 Literature Review

This chapter basically consists of all the research done prior to the planning, design and implementation of the project. All decisions made were based on the research outlined in this chapter.

Chapter 3 Systems Analysis

The various modules, systems properties, architecture, decisions and summaries of software and hardware used to develop the bookstore system are discussed in this chapter. It consists of the decisions taken to proceed with the development of the E-Bookstore.

Chapter 4 Systems Design

This chapter describes the various designs used during project development. It consists of the Data Flow Diagram (inclusive of all child diagrams), the database design (ER Diagram and table designs) and also the user interface design.

Chapter 5 System Implementation

System Implementation describes how the whole E-Bookstore was implemented. It provides description on the development environment, tools, coding techniques and development of the individual modules.

Chapter 6 System Testing

The techniques and methods of testing are described in this chapter. Elaborate methods were described as all systems need to be tested before being deployed as a fully functional system.

Chapter 7 System Evaluation

System Evaluation is the final chapter whereby the entire E-Bookstore system is evaluated. This chapter lists down some of the problems faced during implementation of the project. Furthermore, the system strengths and weaknesses were evaluated before suggestions were given to enable future enhancements of the E-Bookstore system. Some of the experiences are also mentioned.

Report Conclusion

This is a conclusion on the entire report.

Appendix

The Appendix comprises the User Manual which provides instructions on how to use the E-Bookstore system via the web browser.

2.1 EXISTING BOOKSTORE SYSTEMS

INTRODUCTION

This chapter will describe in detail the various studies and research done on the topics of existing bookstore systems, e-commerce, the Internet, software and technologies. It is the objective of this chapter to outline systematically all these studies so that it will assist in the proper selection tools and development methods of the E-Bookstore Project.

In this section of Existing Bookstore Systems, it is evident that a study needs to be done with regards to bookstore systems before the task of developing a system for the University Bookstore is taken. This study will facilitate better understanding of the workings and functions of a bookstore system. These studies are outlined and described below.

2.1.1 MANUAL BOOKSTORE SYSTEMS

A bookstore operates in the same manner, regardless of whether it is using a computerized or manual bookstore system. The bookstore is basically an integration of the inventory control system and the transaction processing system or sales processing system.

However, for manual systems, all inventory control and transaction processing are done manually. The manual maintenance of inventory in a manual system proves to be difficult and time consuming. For example, whenever there are new stocks coming in, data of the new stocks are recorded onto paper documents or record cards. The same processes will occur in transaction processing. When a transaction takes place and is completed successfully, a record is made. At the end of every month, stock checking is made to determine whether the balance of physical stocks is

equivalent to the number recorded in the files. Although work is done, it remains inherently tedious, error prone and inefficient.

There are certain drawbacks with the manual system. Firstly, it is costly and it is also difficult to detect human mistakes at the time the mistakes are made. It would only be discovered at the end of the month when shortages exist. If an employee mistakenly recorded the quantity of goods sold larger than the real figure, the mistake would not be discovered until the end of the month.

A manual system is not a good way of providing sufficient information for the purpose of stock control. Again, it is only possible to check whether the stock currently available is enough to cater for the demand of customers in the next month when stock checking is done at the end of the month or in the event the physical stock itself finishes.

The manner in which records are kept are also vulnerable to threats such as fire and flood. Moreover, since no adequate controls are placed to avoid problems, unauthorized persons can always easily modify records for their own personal gain.

2.1.2 COMPUTERIZED BOOKSTORE SYSTEMS

For computerized bookstore systems, inventory control is easily done if the system is powerful enough to detect the quantity of stock when it reaches a certain level where it needs to be topped-up. Every transaction is recorded into the database or audit trail and this enables users to keep track of every transaction performed. Furthermore, the database will be updated immediately after a certain transaction has been completed. Therefore, the inventory is always kept up-to-date without extra work being done at the end of the month. Processing costs and manual work is also reduced significantly.

In spite of the efficiency of computerized systems over manual systems, it has several disadvantages. The physical quantity of books still might not tally with the

quantity recorded in the database for a number of reasons. Firstly, the system would not be able to detect any shortage in the event of theft. Secondly, human mistakes would still occur even if it would be less compared with manual systems.

If the system was not designed in a way that provides security to prevent unauthorized access, employees might have the opportunity to perform unlawful events that would undermine the efficiency of the system. As a result, adequate control or regulation should be imposed to the internal employees who will have the opportunity in using the system.

2.1.3 TRANSACTION PROCESSING

A transaction usually means a sequence of information exchange and related work (such as database updating) that is treated as a unit for the purposes of satisfying a request and for ensuring database integrity [1]. A transaction has to be completed in its entirety before a transaction is considered to be completed and database changes to be made permanent. A typical example of a transaction is a catalog merchandise order phoned in by a customer and entered into a computer by a customer representative. The order transaction involves checking an inventory database, confirming that the item is available, placing the order, and confirming that the order has been placed and the expected time of shipment. If we view this as a single transaction, then all of the steps must be completed before the transaction is successful and the database is actually changed to reflect the new order. If something happens before the transaction is successfully completed, any changes to the database must be kept track of so that they can be undone.

A program that manages or oversees the sequence of events that are part of a transaction is sometimes called a transaction monitor. Transactions are supported by Structured Query Language (SQL), the standard database user and the programming interface. When a transaction completes successfully, database changes are said to be committed; when a transaction does not complete, changes are rolled back.

The concept of transaction processing services evolved from the requirements of database applications [2]. A transaction is an update (i.e., change) made to information in a database. Many transactions involve a query as well. The database is queried, a decision made on the basis of the information obtained from the query, and then a change made to the database. An application maintaining a database on a server in a heterogeneous computing environment must be capable of managing transactions, which arrive virtually simultaneously from clients, in a manner which insures the integrity of the information.

In a heterogeneous computing environment, transaction processing services are provided in order to meet the special needs of distributed database applications. A transaction applied against a database on a server can cause the server to generate transactions against databases on other servers, and so on. The initial transaction generates a flow of transactions that may be depicted as a flow through a tree structure. Each leaf of the tree represents a server running an application maintaining a database. Transaction processing services help the server database application control and synchronize these transaction flows so that the information contained in all of the databases is reliable and up-to-date.

2.1.4 INVENTORY MANAGEMENT

Businesses require timely and accurate information on inventory location, movement and valuation. Therefore, precise control and safeguarding of inventory is an essential task for a successful, well-organized company [3]. For example, the MAS 90 Inventory Management module provides data pertaining to the receipt of goods, the movement of goods within or between locations, the sale, removal or other disposition of goods, and the precise valuation and status of goods remaining in inventory at any point in time. When used in conjunction with other modules, Inventory Management is the cornerstone of an effective Manufacturing or Distribution Solution. Inaccurate inventory counts can cost sales and delay shipments past the promise date. Out-of-stock items as well as overstocked items in

inventory can be devastating to a business. Additionally, an overstated or understated inventory valuation results in incorrectly reported profits within financial statements. The Inventory Management system should offer comprehensive reporting capabilities to keep a business on top of its inventory status. There should be generation of reports on item pricing, stock status, detailed sales history, backorder information, reorder points and recommendations, valuation, turnover, sales analysis and much more. Properly used, the Inventory Management module can help bring about the formulation of new or improved purchasing policies, sales policies, pricing methods, and even enhanced customer service. Inventory Management could also provide a company with an additional edge over competitors who are unable to access the same strategic information.

CONCLUSION

The understanding of how bookstores operate and the critical systems that should exist in a bookstore will benefit this project because better comprehension of the functions of a bookstore will minimize critical errors that might occur in the design of the E-Bookstore Project. It is also evident that an effective inventory control system is a significant advantage in any company. If reports can be generated easily to reflect the status of inventory, the business should perform better.

2.2 ELECTRONIC COMMERCE AND THE INTERNET

The E-Bookstore system is an e-commerce initiative which leverages on the Internet to provide the University Bookstore with modern business practices. The study that is mentioned in this section is conducted to better understand the meanings, implications, advantages, disadvantages and other related information with regards to e-commerce and the Internet.

2.2.1 THE INTERNET

The Internet, sometimes called simply "the Net", is a worldwide system of computer networks - a network of networks in which users at any one computer can, if they have permission, get information from any other computer (and sometimes talk directly to users at other computers). The Internet was conceived by the Advanced Research Projects Agency (ARPA) of the U.S. government in 1969 and was first known as the Advanced Research Projects Agency Network. The original aim was to create a network that would allow users of a research computer at one university to be able to "talk to" research computers at other universities. A side benefit of ARPANet's design was that, because messages could be routed or rerouted in more than one direction, the network could continue to function even if parts of it were destroyed in the event of a military attack or other disasters [4].

Today, the Internet is a public, cooperative, and self-sustaining facility accessible to hundreds of millions of people worldwide. Physically, the Internet uses a portion of the total resources of the currently existing public telecommunication networks. Technically, what distinguishes the Internet is its use of a set of protocols called TCP/IP (Transmission Control Protocol / Internet Protocol).

The most widely used part of the Internet is the World Wide Web (often abbreviated "www" or called "the Web"). Its outstanding feature is Hypertext, a method of

instant cross-referencing. In most web sites, certain words or phrases appear in text of a different color than the rest; often this text is also underlined. When you select one of these words or phrases, you will be transferred to the site or page that is relevant to this word or phrase. Sometimes there are buttons, images, or portions of images that are "clickable". If you move the pointer over a spot on a web site and the pointer changes into a hand, this indicates that you can click and be transferred to another site.

Using the Web, you have access to millions of pages of information. Web "surf" is done with a web browser, the most popular of which are Netscape Navigator and Microsoft Internet Explorer. The appearance of a particular web site may vary slightly depending on the browser you use. Also, later versions of a particular browser are able to render more "bells and whistles" such as animation, virtual reality, sound, and music files, than earlier versions.

In 1990, fewer than 1 million users were connected to the Internet. By mid 1995, the Internet had about 40 million users which connected more than 40,000 individual networks within organizations and almost 5 million host computers [5].

The number of Internet users worldwide continues to climb, up some 80 percent from 171 million in March 1999 to 304 million people in March 2000. And while the number of U.S. subscribers online increased by 40 percent, access in the rest of the world rose much more sharply, with most regions at least doubling the number of people with online access. And for the first time, North Americans (excluding Mexicans) account for less than 50 percent of the global online population [6].

Other sources of information, for example the Computer Industry Almanac, reports that the world projections for Internet population is expected to reach 259 million users worldwide by year end 1999. By 2000 the number is expected to reach 349 million, 490 million users by the year ending 2002 and over 765 million Internet users by the year ending 2005 [7].

2.2.2 ELECTRONIC COMMERCE

Electronic Commerce means leveraging information technology to conduct trade and business over computer networks, such as the Internet. It includes such electronic trades as Electronic Data Interchange (EDI), Electronic Mail (E-mail) and other Internet applications [8].

Electronic Commerce or e-commerce is actually defined as the conduct of financial transactions by electronic means. With the growth of commerce on the Internet, e-commerce often refers to purchases from online stores on the web, otherwise known as e-commerce web sites. They may also be referred to as virtual-stores or cyber stores. E-commerce can be business-to-business or business-to-consumer [9].

Normally, companies use their presence on the World Wide Web as a means to provide information to its customers, as a marketing tool, as a sales mechanism or as a support tool. A specific example is the recent introduction by Bank of America allowing financial data exchange transactions over the Internet. It is clear that the Internet will be used as a tool to continually fuel the evolution of innovative e-commerce models. E-commerce is a vision for bringing a whole range of services into the information age on a global scale. It can be seen as "the enabling of a business vision supported by advanced information technology to improve efficiency and effectiveness of the business relationships between trading partners."

As stated above, the typical forms of e-commerce are information distribution, electronic catalogs, EDI systems and electronic markets and stores. These are normally business-to-business (B2B) transactions. The other form of e-commerce which is the business-to-consumers (B2C) systems, interfaces directly with the end customer and is expected to grow divergently to $35 billion by the year 2000. In fact, Forrester Research reports that e-commerce in Asia-Pacific alone is expected to reach $1.6 Trillion by 2004 (April 2000 issue).

E-commerce can be divided into:

- E-tailing or Virtual Store and Virtual Mall.
- Electronic Data Interchange.
- Electronic Mail, Fax and Internet Telephony.

2.2.2.1 E-tailing or Virtual Store and Virtual Mall

The Internet is rapidly becoming a multi billion dollar source of revenue for the world's businesses as it becomes a place for direct retail shopping. Conducting e-commerce transactions on the Internet has its obvious advantages. Equipped with 24-hour availability, a global reach, the ability to interact and provide custom information and ordering, complete with multimedia prospects, a growing number of businesses already report considerable success. As an example, Dell Computers reported orders of a million dollars a day as early as in the middle of 1997. By early 1999, projected e-commerce revenues for businesses were in the billions of dollars and the stocks of companies deemed most adept at e-commerce were skyrocketing.

According to Forrester Research, online business-to-consumer transactions in America were worth some $20 billion in 1999. In fact, Forrester expects that figure to grow to some $184 billion by the year 2004 [10]. Another investment bank, Goldman Sachs, forecasts that by 2010, electronic shopping could account from 15%-20% of retail sales [11].

2.2.2.2 Electronic Data Interchange

Electronic Data Interchange (EDI) refers to the transmission and receipt of structured data by computer systems of trading partners, without human intervention. People apply the term 'paperless trading' to this process. The International Data Exchange Association defines EDI as 'the transfer of structured data, agreed message standards, from one computer system to another, by electronic means'. EDI is the

exchange of business data using an understood data format. It predates today's Internet. EDI usually involves data exchange among parties that know each other well and make arrangements for one-to-one connection, usually dial-up.

2.2.2.3 Electronic Mail, Fax, and Internet Telephony

E-commerce is also conducted through the more limited electronic forms of communication called electronic mail (e-mail), facsimile (fax), and the emerging use of telephone calls over the Internet (Internet telephony). Most of this is business-to-business, with some companies attempting to use e-mail and fax for unsolicited advertisements (usually viewed as online junk mail or Spam) to consumers and other business prospects.

For many Internet users, e-mail has practically replaced the postal service for short written transactions. Electronic mail is the most widely used application on the Net. You can also carry on live "conversations" with other computer users, using Internet Relay Chat (Internet Relay Chat).

Internet telephony is the use of the Internet, rather than the traditional telephone company infrastructure and rate structure, to exchange spoken or other telephone information. Since access to the Internet is available at local phone connection rates, an international or other long-distance call will be much less expensive than through the traditional call arrangement [12].

An increasing number of business web sites offer e-mail newsletters for subscribers. A new trend is 'opt-in e-mail' in which web users voluntarily sign up to receive e-mail, usually sponsored or containing advertisements, about product categories or other subjects they are interested in.

2.2.3 THE EVOLUTION OF ELECTRONIC COMMERCE

Since it first caught the imagination of the business world circa 1995-6, the concept of e-commerce has naturally been evolving in line with advancements in IT technologies.

Computers used to be seen as dumb machines that can only do what humans program them to do. However, those days are far behind us now. The advent of sophisticated software has endowed these machines with a level of intelligence like never before. Therefore, the functions of e-commerce have increased tremendously from its rather limited scope of creating a presence in cyberspace to many more strategic objectives. Naturally, the increasing sophistication of e-commerce comes with a price as the cost of doing it has been multiplying fast. Some experts have so far identified four distinct but overlapping stages in its evolution.

At the initial stage, the e-commerce value proposition was pretty much focused on using the available tools such as web sites to host corporate or marketing brochures. Businesses then tended to load information about themselves and their products onto their homepages, launch them into cyberspace and hoped for the best.

Then, came the second stage, which is where we are today. Business is about the need for interaction and the exchange of information between various parties. This need remains the same even if business is being done electronically. In this second stage of the e-commerce evolution, businesses focus on using the available electronic tools to interact with the target market. Many web sites and portals incorporate this element. You can now conduct searches by entering keywords and the relevant information that matches these keywords are then produced for your perusal. While most sites today are interactive, one feature increasingly demanded is personalization, which allows a site to respond to a particular customer's wants and needs. This is especially important in enhancing business-to-business e-commerce as it filters out unnecessary information that could slow down a process of transaction.

The third stage of the e-commerce evolution, some forms which can already be seen today, focuses on online transactional capabilities. Buying and selling of consumer goods online is becoming quite common although it still has not taken off in a big way. The exchange of business documents, payment and settlement electronically have been a boon, as human intervention has been drastically reduced or eliminated altogether.

Stage four of the e-business evolution would see the addition of new features. Businesses, equipped with a digital nervous system, would have the ability to gather, distribute and share market intelligence within the organization and with its business partners. This enables crucial decisions to be made to respond to changing market trends and demands. An organization would be better equipped to meet and manage its customer's requirements. This is the phase where mobile commerce or m-commerce will make its most impact [13].

2.2.4 ADVANTAGES AND DISADVANTAGES OF E-COMMERCE

There are several obvious advantages which e-commerce offers over traditional ways of doing business. E-commerce reduces the time and cost of doing business. Customers no longer need to physically visit a particular shop to do their purchasing of goods because the virtual shop is just a mouse-click away if they are shopping online. The shop owner would not have to hire additional staff to serve the customers who extensively visit their shop during peak hours. E-commerce reaches customers in an unprecedented manner, as there are no boundaries in the Internet world. Advertisements will reach the entire online community regardless of where they are physically located.

It is also a more convenient way of doing business. It offers a 24-hour virtual store in which customers can easily access anytime, anywhere. Furthermore, it can offer better customer service due to its ability to provide personalized service to each and

every customer. If implemented successfully, it also increases the profitability of the business because it opens the business to international clients, instantly removing physical boundaries to the business.

E-commerce also allows linkages to be established between branches, suppliers, distributors and even directly to customers. These linkages can help the companies to integrate their activities closely with suppliers, coordinate and monitor internal transaction such as stock control between branches. It also helps the business to communicate interactively with its customers.

In developing an e-commerce application however, several important drawbacks should be considered. The major disadvantage is that conducting business electronically is never 100% secure. It is always vulnerable to threats such as hackers, data losses, interception and other network threats. This is the main reason why many companies hesitate in incorporating e-commerce into their business.

The method of payment is another concern of the e-commerce site developer and the business owner. There are several methods like e-cash, digital cash, credit card payments, cheques and bank transfer and smart card-based payment. However, each of them carries certain risks. Therefore customers not feeling secured about the risks existing in each of these payment methods, will be doubtful when prompted to key their credit card number. This will result in the decrease in anticipated sales.

Privacy poses another problem for e-commerce. Customers are always sensitive and unwilling to reveal their personal information on the Internet. Some might be turned off when they are required to fill in forms containing the Identification Card number, addresses, phone number and other personal information while some others might give false information.

To overcome these problems, several steps have to be taken by any e-commerce site developers to include security control and encryption methods as well as regulatory issues which will be mentioned later in the chapter.

2.2.5 E-COMMERCE ISSUES

2.2.5.1 Security

Recognizing that security is a top concern for many web shoppers, merchants should make "reasonable efforts" to ensure the security of consumers' transaction information. Furthermore, these measures should be consistent with current industry standards and should include the use of password protection, encryption, or similar technologies to protect information about the consumer and the transaction. Besides that, merchants should adopt privacy policies that are consistent with existing industry standards and existing legal requirements [14].

Security risks can include theft of data (credit card numbers from your database), distortion of data (changes to payment files or invoices so that people appear to owe you more or less than they do), destruction of data, or broadcasting of data (showing visitors' real names instead of their nicknames in a chat room or forum). All of these cost money in terms of data recovery and goodwill recovery [15].

Generally, the concern on the web security is unfounded. Most web store owners offer Secure Socket Layer servers so that information cannot be intercepted by cyber-hackers. Another security protocol, Secure Electronic Transaction is also commonly used throughout the world. In fact, these are the two widely known security protocols, each providing a secure way to make payments over the Internet, thus enhancing security on the Net.

2.2.5.1.1 Secure Socket Layer (SSL)

There has been allot of hype about SSL and there is a common misconception that SSL is a complete Internet security system. SSL is a secure way of transferring information between two computers on the Internet using encryption. It is not an Internet security system but it is used in many Internet security systems. So when a

merchant adopts a system that is running SSL, it is securing communication but it is not completing the cycle by validating credit cards and transferring funds [16].

The SSL Handshake protocol was developed by Netscape Communications Corporation to provide security and privacy over the Internet. The protocol supports server and client authentication. The SSL protocol is application independent, allowing protocols like HTTP, FTP and Telnet to be layered on top of it transparently, which is to say that it runs in the background allowing these different forms of communication to take place securely. The SSL protocol is able to negotiate encryption keys as well as authenticate the server data before data is exchanged by the higher level application. The SSL protocol maintains the security and integrity of the transmission channel by using encryption, authentication and message authentication codes. It allows the merchant and the cardholder to communicate securely but the rest of the payment system is off-line.

SSL is in use (65,407 web sites) chiefly in the US (70%) and gives users the assurance that the information transmitted from their machine to the merchant is secure. This is the greatest of public concern. SSL does not however address the other concerns. When a merchant uses SSL, they are assuring their customers privacy but the merchant still does not know if the user is impersonating the card holder and the user cannot be sure that the merchant will ship.

If an Internet merchant wishes to use SSL, then their site needs to be installed on a secure server running software such as Netscape Commerce. When a system is situated on a secure server all information to and from the server is encrypted. When a user connects to the site, the server and the user's browser negotiate a common key protocol and from then on, the information is encrypted.
The highest level of encryption (128 bit) was only available in the United States before 1999 due to restrictions on the export of encryption technology imposed by the US Department of Defense. Thus should users use this system, both the user and the merchant will have to be in the US. However lower level encryption (40 bit) is available worldwide and this gives acceptable security. When a user outside the US

contacts a merchant using 128-bit encryption the communication reverts to 40-bit. However, since 1999, the Clinton Administration had relaxed the controls on the export of encryption technology. Therefore, users around the world will be able to use hard-to-break 128 bit encryption keys.

2.2.5.1.2 Secure Electronic Transaction (SET)

SET is nothing short of a revolution in terms of trading via the Internet. SET is a guarantee that easy, convenient shopping is also secure. People's interest in shopping via the Internet is increasing because it's fast, simple to use, and open 24 hours a day.

Up until now, there has been no way of guaranteeing that those communicating with each other were actually who they claimed to be, nor has there been any guarantee that messages would reach the recipient, or that they hadn't been altered somewhere along the way. SET conquers these problems. As a SET certified cardholder, one can now shop safely on the Internet, and use it as a secure international trading place.

SET has been developed by companies such as Euro Card, Master Card International and VISA in co-operation with leading technology suppliers such as IBM, Microsoft, and Netscape. The world's first SET pilot project took place in Denmark as a joint effort between PBS, Europay and IBM. In Denmark, PBS International A/S is responsible for the issuing and administration of SET certificates for Danish cardholders [17].

SET is an open-network payment-card protocol that provides greater confidentiality, greater transaction integrity, and less opportunity for fraud at all transaction points than any other secure payment system. The process involves a series of security checks performed using digital certificates, which are issued to participating purchasers, merchants, banks, and payment brands [18].

This is a brief description of how SET works when trading via the Internet :-

1. A customer chooses some goods in an Internet shop. These are placed in an "electronic shopping basket". The customer then selects which payment card to use. The order form is then sent to the shop.
2. When the purchase and payment information is safely received by the shop, it then forwards the payment information to the acquirer (e.g. PBS).
3. The acquirer decodes the customer's payment information and asks the card issuer (e.g. a foreign bank) for authorization – rather like today, when you purchase goods in a shop.
4. When the request for authorization is accepted, it is sent via the acquirer back to the shop, which then confirms the purchase to the customer.
5. The purchase price is then deducted as normally done from the customer's account. Even though the transaction process is complex it remains invisible to both the cardholder and the shop. A shopping transaction via the Internet can be completed in a matter of seconds.

SET has been developed to make trading via the Internet secure [19]. It ensures what previous Internet security systems had not been able to achieve:

1. The customer is protected against misuse of payment cards.
2. Companies are protected against bogus customers.
3. Alterations cannot be made to orders without being discovered.
4. Orders can only be read by the customer and the company concerned.
5. Payment information can only be read by the acquirer and the customer.

In comparison, SET specifications for credit card payment over the Internet can produce more security than SSL. Authentication and strong encryption of SET makes people feel comfortable with online shopping. In fact, SET provides merchants with assurance that transactions will not be fraudulently charged back. For consumers, SET also provides consumers with assurance that the merchant is legitimate, and that credit card numbers will not be stolen.

Because of SET's authentication capability, the fraud opportunity is lower. With this, merchants under SET based transactions will be charged a lower rate compared to SSL. Hence, everybody will benefits from SET. Banks and card associations also like SET because it lets them extend their brands into cyberspace, maintaining the strong position they have as payments start to move online. In any case, digital certificates issued for use on the SET payment gateway can also be used in web activities that have standardized on the SSL platform. The argument is that SSL will not be able to provide the same high levels of security as on a SET based system.

Nevertheless, SET does have it's own drawbacks. Firstly, it requires that software (e-wallet) be installed in the banking network, at merchants' location and on consumer's PCs. Forcing consumers and other parties to download multi megabyte-sized software and configure it has proven to be too big a barrier, analysts and executives admit. Secondly, SET also requires that certificates be issued to all parties.

Another thing is that the SET specifications for credit card payments over the Internet are cumbersome and slow to arrive. The rollout has proved to be slow. Furthermore, there are still some interoperability issues among SET compliant products and therefore, a lot of fine-tuning have to be done. From a business perspective, setting up a SET infrastructure is very costly. The e-commerce market in Malaysia is only picking up now. Many consumers and businesses are still not conducting transactions over the Internet. Therefore, it is still not viable to set up a SET facility.

An advantage of SET, though, is that it can be used in part or in whole. For example, some merchants are considering using SET on the back end, while keeping SSL communications with the customer. This sidesteps the need to deploy wallet software to consumers, but captures some of the SET benefits today. Most SET toolkit and software vendors are now moving to support both systems in their products.

2.2.5.1.3 Rivest-Shamir-Adleman (RSA)

RSA is an Internet encryption and authentication system that uses an algorithm developed in 1977 by Ron Rivest, Adi Shamir, and Leonard Adleman [20]. The RSA algorithm is the most commonly used encryption and authentication algorithm and is included as part of the web browsers from Netscape and Microsoft. It's also part of Lotus Notes, Intuit's Quicken, and many other products. The encryption system is owned by RSA Security and the company licenses the algorithm technologies and also sells development kits. The technologies are part of existing or proposed web, Internet, and computing standards.

The mathematical details of the algorithm used in obtaining the public and private keys are available at the RSA Web site. Briefly, the algorithm involves multiplying two large prime numbers (a prime number is a number divisible only by that number and 1) and through additional operations deriving a set of two numbers that constitutes the public key and another set that is the private key. Once the keys have been developed, the original prime numbers are no longer important and can be discarded. Both the public and the private keys are needed for encryption or decryption but only the owner of a private key ever needs to know it. Using the RSA system, the private key never needs to be sent across the Internet.

The private key is used to decrypt text that has been encrypted with the public key. As an illustration, if I send you a message, I can find out your public key (but not your private key) from a central administrator and encrypt a message to you using your public key. When you receive it, you decrypt it with your private key. In addition to encrypting messages (which ensures privacy), you can authenticate yourself to me (so I know that it is really you who sent the message) by using your private key to encrypt a digital certificate. When I receive it, I can use your public key to decrypt it.

2.2.5.2 Encryption

Computer-based encryption using the personal computer is capable of becoming sufficiently secure to prevent unauthorized access. However, the ability to encrypt messages is presently restricted by the requirements of nation states to have access to all written communications. Any company establishing encryption systems, which cannot be 'broken' by the nation's security services, is therefore subject to. prosecution. This inevitably limits the efficacy of encryption.

A protracted legal wrangle is going on between RSA Data and the US government's rival digital signature technology, Clipper. A number of software companies are presently developing encryption software, some of which are based on patented algorithms developed by RSA. Encryption has become a key element in discussions concerning commerce on the Internet. Public-key cryptography, for example, makes it possible to 'sign' a document so that the recipient can assure that the source of the message is authentic as well as to 'seal' a document, ensuring that no one except for the recipient can open it. Encryption facilitates services that require privacy, such as home-banking and electronic money-transfer between businesses.

2.2.5.3 Payment Methods

2.2.5.3.1 Non –Electronic Payments (Cheques and Bank Transfers)

Despite the development of electronic payment methods, business-to-business (B2B) payments are still predominantly made using non-electronic funds transfer (cheques or telegraphic transfer) [21]. In the US, despite the development of automated systems, most businesses continue to bill their customers with paper invoices and to make payments to suppliers using paper cheques. The Federal Reserve estimated in 1993 that only 3.8% of B2B payments by transaction volume were made electronically using either Clearing House Interbank Payments System or Fedwire of Automated Clearing House (ACH) transfers. Although US businesses issued 59.4 trillion cheques in 1993, in aggregate these only represented 12.5% of the total value of payment transactions, which amounted to US dollars 547.5 trillion only.

Important institutional barriers still stand in the way of reforming existing payment systems. Furthermore, individual businesses have also been reluctant to move to electronic methods, preferring instead to focus on automating internal administrative processes and in some cases, capitalizing on the float benefits which accrue as a result of payment in transit. Although cheques are still popular in some of the countries, it should be eliminated due to its high cost and possibility of fraud. Paper-based payment systems are an increasingly costly anachronism in an age that permits cost-effective global electronic communications systems. Cheques are easily stolen and people can impersonate the owner easily by using an imitated signature. Rather, electronic payment methods, such as credit card based system using SET protocol should be practiced because it reduces the time used to make actual payment and enhance a cost-effective paperless environment of doing business.

2.3 SOFTWARE AND TECHNOLOGIES

This section will attempt to describe in detail the software and various technologies taken into consideration when building the system. The main areas of research are the platforms, web languages, technologies, and database management system. These are duly discussed below.

2.3.1 PLATFORM

With reference to computers, a platform is an underlying computer system on which application programs can run. On personal computers, Windows 95 and the Macintosh are examples of two different platforms. On enterprise servers or mainframes, IBM's System/390 is an example of a platform.

A platform consists of an operating system, which is the computer system's co-ordinating program, and a microprocessor which is the microchip in the computer that performs logic operations and manages data movement in the computer. The operating system must be designed to work with the particular microprocessor's set of instructions. As an example, Microsoft's Windows 95 is built to work with a series of microprocessors from Intel Corporation that share the same or similar sets of instructions. There are usually other implied parts in any computer platform such as a motherboard and a data bus, but these parts have increasingly become modularized and standardized.

Historically, most application programs have had to be written to run on a particular platform. Each platform provided a different application program interface for different system services. Thus, a PC program would have to be written to run on the Windows platform and then again to run on the Macintosh platform. Although these platform differences continue to exist and there will probably always be proprietary differences between them, new open or standards-conforming interfaces

now allow some programs to run on different platforms or to inter-operate with different platforms through mediating or "broker" programs. A platform is any base of technologies on which other technologies or processes are built [22].

All major computer platforms require, and most of the time, include an operating system. UNIX, Windows 95/98, VMS, OS/2 and OS/390 are all examples of operating systems. An operating system is a program that needs to be loaded into the computer in order for it to manage all the other programs in a specific computer. It is loaded by using a bootstrap program. The other programs are called applications. The applications make use of the operating system by making requests for services through a defined Application Programming Interface (API). In addition, users can interact directly with the operating system through an interface such as a command language or more popular nowadays, through a graphics user interface like those of the Windows 95/98/Me or Windows NT.

An operating system performs a lot of services for applications. In multitasking operating systems where multiple programs can be running at the same time, the operating system determines the sequence of the applications that should run. It also manages the sharing of internal memory among multiple applications.

Operating systems can offload the management of batch jobs. It can even handle input and output, to and from attached hardware devices such as hard disks, printers, and dial-up ports. On computers that can provide parallel processing, an operating system can even manage how to divide the programs so that it runs on more than one processor at a time. Besides that, it sends messages to the applications or users about the status of operations and any errors that may have occurred [23].

2.3.1.1 Windows 95, 98 and Millennium Edition

One of the most popular Operating Systems (OS) of late is the Microsoft's family of Windows operating systems. The Windows family of OS is basically divided into two categories. The Windows 95, 98 and Millennium Edition (Me) are mostly used by home users while the more stable category of operating systems, consisting the Windows NT and Windows 2000, are mostly used by corporations.

Windows 95/98/Me are widely installed products in the market place and remain the dominant operating system for personal computers. Most home users prefer Windows as it revolutionized the way in which the general public used computers. The relatively easy process of installation, ease of use and the user friendly Graphics User Interface (GUI) improved the penetration and usage of the personal computer since its first product, Windows 95 was launched in 1995.

Starting with Windows 98, Microsoft began to integrate tightly web technology into its operating system. In Windows 98, Microsoft's Internet Explorer (IE) became an integral part of the operating system. Using the Active Desktop of Windows 98, users can view and access desktop objects that reside on the Internet as well as local files and applications. The Windows 98 desktop is in fact, a web page with HTML links and features that exploit Microsoft's ActiveX controls. With IE5 packaged together Windows 98 (or with IE4 in Windows 95), news and other content could be set up to be pushed to the user from specified web sites [24]. Windows 98 also provides better system performance along with easier system diagnostics and maintenance. Besides that, Windows 98 also introduced Internet Connection Sharing that allows a single Internet connection to be shared over multiple networked computers.

Windows 98 also provides a 32-bit File Allocation Table (FAT32) that allows a single partition for a disk drive larger than 2 Gigabytes. The other features in Windows 98 include support for Universal Serial Bus (USB), which makes it easy to plug in new peripheral devices such as the Digital Versatile Disc (DVD). Windows 98 also supports a new industry-standard form of power management called

Advanced Configuration and Power Interface (ACPI) [25]. If Windows 98 is used as a web server, Personal Web Server (PWS) can even be installed so that the Windows system can serve web pages through the Internet.

Windows Millennium Edition, or Windows Me was launched in 2000 and remains to be the newest operating system launched by Microsoft. Windows Me claims to bring the richness and convenience of the digital world to the home of consumers. Windows Me is designed specifically for the home PC user. It represents the first major milestone towards advancing the vision of the Windows Division to further simplify the computing experience for consumers. Windows Me aims to deliver in 4 keys areas which are to provide the best in digital media, to give improved user experience, to enhance home networking capabilities and to provide users with a rich Internet experience.

As with previous versions of Windows 9x, Windows Me offers the broadest support for consumer hardware and software [26]. It improves on Windows 95 and 98 by providing a more stable architecture and comes packaged with Microsoft's Internet Explorer 5.5. Windows Me also includes some features that are only found in the Windows 2000 operating system which is the newest OS used by corporations.

Some of the newest addition in Windows Me include features like System Restore, Windows Image Acquisition, System File Protection. It is also packaged with the Windows Media Player 7 and Windows Movie Maker.

2.3.1.2 Windows New Technology

Windows New Technology or better known as Windows NT is the operating system designed for users mainly from businesses and corporations that need advanced capabilities and a stable operating system. Windows NT comprise of two components, which are the Microsoft NT Workstation and Microsoft NT Server. The NT Workstation is designed for users, especially business users, who need faster performance and a system more fail-safe than Windows 95 and Windows 98. The

NT Server is designed for business machines that need to provide services for LAN-attached computers. The server is required, together with an Internet server such as Microsoft's Internet Information Server (IIS), for a Windows system that plans to serve web pages.

According to Microsoft, two computers having the same amount of Random Access Memory (RAM) will have different performance levels depending on whether the Windows 95/98/Me or the Windows NT Workstation OS was used. Microsoft reckons that 32-bit applications will run 20% faster on the NT Workstation compared to Windows 95. The Workstation has the same desktop user interface as Windows 95 but provide many more security and management features. Since older 16-bit applications run in separate address space, one can crash without crashing other applications or the operating system [27].

The system requirements differ from the server and the workstation. Assuming Windows NT 4.0 is installed with the Option Pack, the system requirements for Windows NT 4.0 Workstation will be as stated below.

Intel Processors	:	Intel Pentium or faster;
RISC Processors	:	Alpha AXP, MIPS R4X00 or PowerPC Processors
Hard Disk Space	:	110 MB of hard disk space minimum
Memory	:	16-32 MB RAM recommended
Drive	:	CD-ROM Drive or access to CD-ROM drive over a computer network
Display	:	VGA or higher resolution display adapters
Peripherals	:	Mouse or compatible pointing devices [28]

The system requirements for Windows NT Server 4.0 will be as stated below.

Intel Processors	:	486/66 MHz or higher; Pentium or Pentium Pro processors
RISC Processors	:	150 MHz Alpha processor or any other compatible processors
Hard Disk Space	:	175 MB of hard disk space minimum (35 MB more HDD for RISC Processors)
Memory	:	32 MB RAM or higher recommended
Drive	:	CD-ROM Drive
Display	:	VGA, Super VGA or video graphics adapter compatible with Windows NT Server 4.0 [29]

Microsoft releases upgrades or better known as Service Packs to registered users of its operating systems. Those who buy new systems do not have to worry about upgrades as the OS will come packaged with its releases of Service Packs. These are called Option Packs. For example, Windows NT 4.0 Option Pack will be packaged together with either Service Pack 3 or Service Pack 4. It will also include Microsoft IE 4.01 to enable users to run Internet Information Server 4.0 (IIS), which is Microsoft's web server.

In terms of networking, Microsoft Windows NT Server 4.0 works with Microsoft LAN Manager, AppleTalk, DEC Path Works, IBM LAN Server, IBM SNA networks, NFS networks, Novell NetWare. Remote Access Services by way of ISDN, X.25, standard phone lines and TCP/IP networks.

Clients supported by Windows NT 4.0 include the Windows 3.*x* operating system, Windows for Workgroups, Windows 95/98/Me operating system, Windows NT Workstation, Apple Macintosh, MS-DOS operating system, OS/2 and UNIX (Requires Open Database Connectivity client software from Visigenic Software, San Mateo, California).

2.3.1.3 Window 2000

Windows 2000 is the latest version of Microsoft's evolving Windows operating system and was 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.

The initial Windows 2000 product line consists of four products:

- Windows 2000 Professional, aimed at individuals and businesses of all sizes. It includes security and mobile use enhancements.
- Windows 2000 Server, aimed at small-to-medium size businesses. It can function as a web server or a workgroup server. It can be part of a two-way symmetric multiprocessing (SMP) system. Windows NT 4.0 servers can be upgraded to this server.
- Windows 2000 Advanced Server, aimed at being a network operating system server and an application server, including those involving large databases. This server facilitates clustering and load balancing. Windows NT 4.0 servers with up to eight-way SMP can upgrade to this product.
- Windows 2000 Datacenter Server, designed for large data warehouses, online transaction processing (OLTP), econometric analysis, and other applications requiring high-speed computation and large databases. The Datacenter Server supports up to 16-way SMP and up to 64 GB of physical memory.

Early reviews of Windows 2000 report that it is more stable than Windows 98/NT systems. It is less apt to clash. A significant new feature is Microsoft's Active Directory, which enables a company to set up virtual private networks, to encrypt data locally or on the network, and to give users access to shared files in a consistent way from any network computer [30].

The other features of the Windows 2000 are its fully customizable administrative console that can be based on tasks rather than files, applications, or users. It also

integrates a dynamic Domain Name Server (DNS), which replicates changes in the network using the Active Directory Services, the Dynamic Host Configuration Protocol (DHCP), and the Windows Internet Naming Service (WINS) whenever a client is reconfigured.

Besides that, it also has the ability to create, extend, or mirror a disk volume without having to shut down the system and to back up data to a variety of magnetic and optical storage media. In addition, it also has close integration with and supports for Microsoft's Message Queue Server, Transaction Server, and Internet Information Server (IIS). Some other changes to the Windows 2000 family when compared to Windows NT 4.0 are the taskbar availability as in Windows 98 and more personalized menus such as those in MS Office 2000 [31].

2.3.1.4 UNIX

UNIX is an operating system that originated at Bell Labs in 1969 as an interactive time-sharing system. Ken Thompson and Dennis Ritchie are considered the inventors of UNIX. In 1974, UNIX became the first operating system written in the C language. UNIX has evolved as a kind of large freeware product, with many extensions and new ideas provided in a variety of versions of UNIX by different companies, universities, and individuals. UNIX became the first open or standard operating system that could be improved or enhanced by anyone, partly because it was not a proprietary operating system owned by any one of the leading computer companies and partly because it was written in a standard language and embraced many popular ideas.

A composite of the C language and shell (user command) interfaces from different versions of UNIX were standardized under the auspices of the Institute of Electrical and Electronics Engineers as the Portable Operating System Interface (POSIX). In turn, the POSIX interfaces were specified in the X/Open Programming Guide 4.2 (also known as the "Single UNIX Specification" and "UNIX 95"). Version 2 of the

Single UNIX Specification is also known as UNIX 98. The Open Group, an industry standards organization, which certifies and brands UNIX implementations, now owns the UNIX trademark.

UNIX operating systems are used in widely sold workstation products from Sun Microsystems, Silicon Graphics, IBM, and a number of other companies. The UNIX environment and the client/server program model were important elements in the development of the Internet and the reshaping of computing as centered in networks rather than in individual computers [32].

The UNIX operating system has three important features: a kernel, the shell and a file system.

The kernel is at the core of each UNIX system and is loaded in whenever the system is started up - referred to as a boot of the system. It manages the entire resources of the system, presenting them to you and every other user as a coherent system. You do not need to know anything about the kernel in order to use a UNIX system [33]. Amongst the functions performed by the kernel are:

- Managing the machine's memory and allocating it to each process.
- Scheduling the work done by the CPU so that the work of each user is carried out as efficiently as is possible.
- Organizing the transfer of data from one part of the machine to another.
- Accepting instructions from the shell and carrying them out.
- Enforcing the access permissions that are in force on the file system.

Whenever you login to a UNIX system you are placed in a program called the Shell. You can see its prompt at the bottom left of your screen. To get your work done, you enter commands at this prompt. The shell acts as a command interpreter; it takes each command and passes it to the operating system kernel to be acted upon. It then displays the results of this operation on your screen. Some shells provide more

facilities than others [33]. However, the basic shell provides you with one or more of the following features. You can:

- Create an environment that meets your needs.
- Write shell scripts.
- Define command aliases.
- Manipulate the command history.
- Automatically complete the command line.
- Edit the command line.

A file system is a logical method for organizing and storing large amounts of information in a way, which makes it easy to manage. The file is the smallest unit in which information is stored. The UNIX file system has several important features. These are listed as follows :-

- Different types of file
- Structure of the file system
- Your home directory
- Your current directory
- Pathnames
- Access permissions

Linux, a UNIX derivative available in both "free software" and commercial versions, is increasing in popularity as an alternative to proprietary operating systems.

2.3.1.5 Linux

Linux is a UNIX-like operating system that was designed to provide personal computer users a free or very low cost operating system comparable to traditional and usually more expensive UNIX systems. Linux has a reputation as a very efficient and fast-performing system.

Linux was started as a learning project by a computer science student, at the University of Helsinki, Finland, named Linus Torvalds (hence the name Linux). There were two reasons why Linus created Linux. First, he wanted to learn more about the microprocessor he was studying at that time, and what better way to learn than by creating an operating system to talk to it? The second reason was that a failing version of Unix, Minix, didn't have the functionality or the features that Linus wanted. To purchase it would cost too much for a student, so he started Linux [34].

Linux is a remarkably complete operating system and includes a graphical user interface, X Window System, TCP/IP, the Emacs editor, and other components usually found in a comprehensive UNIX system. Unlike the other proprietary systems, Linux is publicly open and extendible by contributors. Because it conforms to the POSIX standard user and programming interfaces, developers can write programs that can be ported to other operating systems, including IBM's OS/390 running UNIX.

Linux is sometimes suggested as a possible publicly developed alternative to the desktop predominance of Microsoft Windows. Although Linux is popular among users already familiar with UNIX, it remains far behind Windows in the numbers of users [35].

Some features of Linux include the ability to run a GUI application on one machine and display it on another, having a maximum file size of 2 Gigabytes (GB) while the maximum system file size is 16 Terabytes (TB) and the ability to boot diskless from a networked boot server. It can also have memory protection. Linux is usually used for network servers, low-end, midrange or high-end workstations or workstation replacements, database servers, thin clients and embedded systems [36]. Linux has upsides and downsides to it. The advantages of Linux are that its Open Source, free, secure, virus free, stable, powerful, fast and more flexible than other operating systems like Windows. However, it can be difficult to learn, set up, install, and some software may not be available yet [37]. This could prove to be a barrier for non computer literate customers to deploy and use the system.

2.3.2 WEB LANGUAGES AND TECHNOLOGIES

2.3.2.1 Web Application Languages

2.3.2.1.1 HTML

The documents you distribute on the World Wide Web and what your human clients actually see is the HyperText Markup Language (HTML). HTML is the language used to prepare web hypertext documents. HTML contains commands, called. elements or tags, to mark text as headings, paragraphs, lists, quotations, and so on. It also has tags for including images within the documents, for including fill-in forms that accept user input, and most importantly, for including hypertext links connecting the document being read to other documents or Internet resources such as anonymous File Transfer Protocol (FTP) sites. It is this last feature that allows the user to click on a string of highlighted text and access a new document, an image, or a movie file from a computer thousands of miles away. This can be accessed through a Uniform Resource Locater (URL), which is included in the HTML markup instructions and is used by the user's browser to find the designated resource.

The URL may be points to other HTML documents, pictures, sound files, movie files, or even database search engines. They can be downloadable programs in Java or other languages. They can also be located on the user's computer or anywhere on the Internet. In fact, they can be accessed from HTTP servers or from FTP, Gopher or other servers. The URL is an immensely flexible scheme, and in combination with HTML, yields an incredibly powerful package for preparing a web of hypertext documents linked to each other. This image of interlinked resources is in fact the vision that gave rise to the name, World Wide Web [38].

Writing good HTML documents involve both technical issues and design issues. Technical issues include proper construction of the document while design issues ensure that the information or content is clearly presented to the user. HTML can be used to create web pages without any specialized software in less time than it takes to schedule and wait for an appointment with a highly paid HTML wizard. It is a fact that this language can be learned very fast by example.

There are three kinds of HTML pages:

- First-generation pages use old-fashioned HTML 1.0, and are mostly text with a hockey picture or two stuck in the middle. They were the best you could do in 1989, but having a first-generation page today marks you as more technologically backward than having no web page at all.
- Second-generation pages use a few HTML 2.0 tricks, such as putting a pretty, (or garish) background behind a page, arranging text in tables, and offering an online order form. They can look nice, but rarely match the quality that people have come to expect from paper documents.
- Third-generation pages are what the world is talking about, now that HTML 3.2 is the standard. They use creative layout, custom color, fast graphics, fonts, and interactive feedback to make web sites more engaging than anything on paper [39].

2.3.2.1.2 Dynamic HTML

Dynamic HTML (DHTML) is not a scripting language (like VBScript, Jscript or JavaScript), but merely a browser feature or enhancement that gives your browser the ability to be dynamic. DHTML is the combination of several built-in browser features in fourth generation browsers that enable a web page to be more dynamic. It is a collection of features that together, enable your web page to be dynamic. "Dynamic" is defined as the ability of the browser to alter a web page's look and style after the document has loaded.

The technology of DHTML is currently at its development stage, with Netscape 4 and IE 4 differing quite greatly in their implementation of this great technology. One DHTML is impossible to function in both browsers properly. Furthermore, the two browsers are at different stages in their development of DHTML. However, it seems that DHTML in IE 4 is far more powerful and versatile than Netscape 4 [40].

2.3.2.1.3 XML

The Extensible Markup Language (XML) is a subset of the Standard Generalized Markup Language (SGML) and is designed to make it easy to interchange structured documents over the Internet. XML isn't a language but rather a system for defining other languages. XML files always clearly mark where the start and end of each of the logical parts (called elements) of an interchanged document occurs. XML restricts the use of SGML constructs to ensure that fall back options are available when access to certain components of the document are not currently possible over the Internet. It also defines how Internet URLs can be used to identify component parts of XML data streams.

By defining the role of each element of text in a formal model, known as a Document Type Definition (DTD), users of XML can check that each component of a document occurs in a valid place within the interchanged data stream. An XML DTD allows computers to check, for example, that users do not accidentally enter a third-level heading without first having entered a second-level heading. That is something that cannot be checked using HTML.

However, unlike SGML, XML does not require the presence of a DTD. If no DTD is available, either because all or part of it is not accessible over the Internet or because the user failed to create it, an XML system can assign a default definition for undeclared components of the markup [41].

Content is normally intimately tied to how it is displayed. A common illustration is a disclaimer saying that the page is "best viewed at 800-by-600-pixel resolution". XML will help solve that problem because, rather than specifying where to display something, web builders will be able to specify the structure of the document. For example, you can specify the document's title, its author, a list of related links, and so on. Then any device with an XML browser--a palm-top computer, a set-top box, or a high-powered workstation, for example, will be able to render a version of the document specifically tailored to that device.

Perhaps XML's best feature, though, is its inherent extensibility. Companies and organizations will be able to extend XML to meet new challenges and applications. One XML-based language already in use is Microsoft's Channel Definition Format (CDF). More are on the way, including the Resource Definition Format (RDF) and the Open Software Description (OSD) [42].

As a summary, XML allows users to:

- Bring multiple files together to form compound documents.
- Identify where illustrations are to be incorporated into text files, and the format used to encode each illustration.
- Provide processing control information to supporting programs, such as document validaters and browsers.
- Add editorial comments to a file.

It is important to note, however, that XML is not a predefined set of tags of the type defined for HTML. XML was not designed to be a standardized template for producing particular types of documents. In fact it is impossible to devise a single coding scheme that would suit all languages and all applications. Instead XML is a formal language that can be used to pass information about the component parts of a document to another computer system. XML is flexible enough to be able to describe any logical text structure, whether it is a form, memo, letter, report, book, encyclopedia, dictionary or database.

2.3.2.2 Technologies

The technologies being discussed in this section refers to web server technologies in which scripts are run on the server instead of on the browsers. When scripts run on the server rather than on the client, the web server does all the work involved in generating the HTML pages that are sent to the browsers. There are no worries whether a browser can process a web page or not as the web server does all the processing for it. Below, we analyze the different technologies for server side scripting.

2.3.2.2.1 Personal Home Page (PHP)

Personal Home Page (PHP) is a server-side scripting language for creating dynamic web pages, and is currently used on over 1.4 million web servers. When a visitor opens a page, the server processes the PHP commands and then sends back the results to the visitor's browser, just as with ASP and Cold Fusion. However, unlike ASP or Cold Fusion, PHP is open-source and cross-platform. PHP runs on Windows NT and many UNIX versions, and it can be built as an Apache module or as a binary that can run as a CGI. When built as an Apache module, PHP is especially speedy. A downside is that you have to download PHP separately and go through a series of quite complex steps to install it and get it working on your machine. There are also instructions on the PHP web site for set up with Microsoft's Internet Information Server (IIS) and Netscape's Enterprise Server.

In addition to manipulating the content of the pages, PHP, like IIS, can also send HTTP headers. Features like setting cookies, managing authentication, and user redirection can be done. It offers good connectivity to many databases and also integration with various external libraries that enables generating PDF documents to parsing XML.

PHP's language syntax is similar to C and Perl. It will be a barrier to people with no prior programming experience but not the other round. PHP also has some

rudimentary object-oriented features, providing helpful aids to organize and encapsulate the code [43].

PHP has proven to be a viable and stable solution for everything from personal to corporate e-commerce web sites. Part of the simplicity of learning PHP is in the function names. When facing problems with the function name, we can always refer to the PHP Manual [44].

2.3.2.2.2 Active Server Pages (ASP)

Microsoft's Active Server Pages (ASP) is a server-side scripting environment, which can be used to create and run dynamic, interactive, high-performance web server applications. ASP is free and already built into Windows 2000. It is also free for Windows NT4 or Windows 95/98/Me when the NT4 Option Pack is installed. The code inside ASP is mixed-in with standard HTML and will not be seen by the browser. ASP pages run in major browsers unless the person making the page uses HTML or browser commands outside of the ASP portions [45].

An Active Server Page is an HTML page that includes one or more scripts (small embedded programs) that are processed on a Microsoft web server before the page is sent to the user. ASP is similar to the common gateway interface (CGI) application in that all involve programs that run on the server, usually tailoring a page for the user [46].

ASPs are server-generated pages, which call other programs to do things like access databases, serve different pages to different browsers etc. Basically it could do anything CGI is capable of doing. Typically, the script in the web page at the server uses input received from the user's request for the page to access data from a database and then builds or customizes the page on the fly before sending it to the requestor (Figure 2-1).

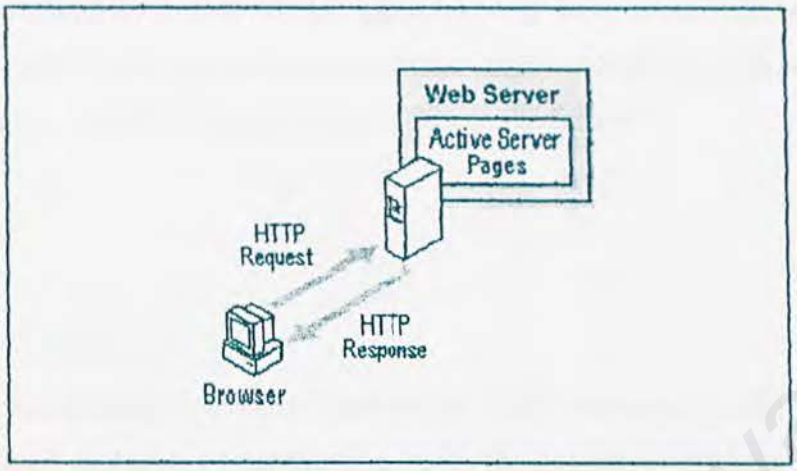


Figure 2-1 ASP Request Response Diagram

ASP is almost as efficient as writing code directly to the server's application program interface, and it's a lot more efficient than CGI because it runs as a service and can take advantage of multi-threaded architectures. According to the Microsoft site: "Active Server Pages is an open, compile-free application environment in which you can combine HTML, scripts, and reusable ActiveX server components to create dynamic and powerful web-based business solutions. Active Server Pages enables server-side scripting for IIS with native support for both VBScript and Jscript".

ASP has evolved into an "open technology framework," meaning that it is not necessary to use Microsoft products to create code in it. Nowadays, developers can create ASP pages using whatever language they want. ASP can also take advantage of COM and DCOM (Component Object Model and Distributed Component Object Model) objects with minimum effort.

Windows NT server comes bundled with it's own copy of the IIS Web Server, which is a full powered web server that will handle almost anything developers can throw at it. On a smaller scale using a home PC or an NT workstation, access to a smaller version of the IIS, which is the Personal Web Server (PWS), is needed. It has most of the functionality of the full version, but is designed for fewer hits [47].

With ASP, the code can be simply written in an HTML page. The HTML tags and the code are side by side. No compiling and no complex interfacing is needed. ASP has made it much quicker and easier to create highly interactive web sites. It also makes web pages easier to maintain and update in the future.

2.3.2.2.3 Cold Fusion

ColdFusion is a product by Allaire Corporation. ColdFusion is a sophisticated set of products, which includes comprehensive tools for building web sites and is quite popularly used to serve pages to users. With ColdFusion, a content database can be built by using input templates and combined with application programs to create web sites in which its pages are developed dynamically as they are served. ColdFusion is designed to deliver on the key requirements of e-commerce and enterprise web applications. These requirements are rapid development, scalable deployment, open integration and complete security [48].

ColdFusion consists of ColdFusion Studio, which is used to build a site, and ColdFusion Server, which serves the pages to users. ColdFusion Server is described as "a deployment platform". The most valuable feature for ColdFusion is the ability to build web sites as "piece parts" that can be stored in a database and then re-assembled for web pages, e-mail newsletters, and other uses. ColdFusion provides a visual interface for building web pages directly or for building the "piece parts". For example, a newspaper with a web site can have a reporter enter a story, dateline, author, and other information, using a text entry form free of all web page formatting and structure details or language tags. The content entered by the reporter is later gathered and formatted into a web page when it is requested. The reporter is free from having to understand HTML and other details.

ColdFusion Markup Language or CFML is ColdFusion's own page markup language. CFML encompasses the HTML and XML. A just-in-time (JIT) compiler turns the CFML into the pages that get served. ColdFusion is open and "extensible".

Applications can access databases using Microsoft's OLE DB, ODBC, or drivers that access Oracle and Sybase databases. ColdFusion can be coordinated with distributed applications that use Microsoft's DCOM to interact with other network applications.

For large web sites, multiple ColdFusion servers can be run together as a cluster. This is so because ColdFusion is scalable, allowing both the size of a database and the number of users that can be served to grow.

2.3.2.2.4 Common Gateway Interface (CGI)

Before ASP, ColdFusion and other technologies, the standard of developing homepages with interactivity was by using Common Gateway Interface (CGI). The communication for static HTML works only one way, there is no way to send information back to a web server. To fix this problem, forms and CGI were created. Forms are HTML tags that allow web page creators to include controls like check boxes, and radio buttons in their web pages. That way, the user can enter information. It also provides a Submit button that sends the information off to the server. But now, the server can't just get requests for pages and send out pages, it has to know what to do with the information when it gets it. That's where CGI comes in.

CGI stands for Common Gateway Interface. CGI makes it possible for the web server to talk to another application that can handle the form information when it is sent back. Often these CGI applications are written in a language called Perl. When the CGI application receives the form information, it can save it to a text file or store it in a database. This system works great for simple guest books, but if a developer wanted to make his/her web pages really interactive, there will be trouble.

The problem with CGI is that if five people are submitting form information at the same time, five different copies of the CGI application have to be running on the server to handle them. Therefore, it is not very scalable.

2.3.2.3 Scripting Language

There is no definitive definition of a scripting language. Sometimes the term is used to make a distinction from compiled languages. However, some languages like C or C++ can be used for scripting as well as full applications. The term scripting is also used because a language will react to, control, or "script" a series of events. Even macro languages built into PC applications like spreadsheets, databases, word processors, and multimedia applications are now often called scripting languages. The purpose of most scripting languages is to extend the capabilities of applications. This section will describe the different scripting languages that are most popular today.

2.3.2.3.1 JavaScript

JavaScript is an object-based scripting language created by Netscape Communications Corporation for developing Internet applications. JavaScript is considered lightweight in that there isn't a great deal to learn and a user can be productive with it very quickly, in contrast to much more complex languages such as Java. As a scripting language, JavaScript is meant to tell an application what to do. Unlike languages used to create applications, it cannot do anything without the application. Server applications or client applications can be developed with JavaScript. Server refers to the computer where web pages reside while the term client refers to the browser application that loads and displays web pages.

JavaScript statements can be embedded in web pages, which are written in HTML. JavaScript is an extension to HTML that allows creation of more sophisticated web pages than ever could be done with HTML alone [49]. JavaScript is supported by Netscape Navigator 2.01 and its later releases. It is supported on several architectures like Windows, Macintosh and UNIX.

JavaScript offers much more expressive power than HTML alone. JavaScript can do things such as create multi part documents, build dynamic documents that take users

through a web site from one document to another, and generate documents that interact with the user. JavaScript confers an even greater ability to create a spectacular document, and an even greater ability to create a hideous page that no one will want to read. Using JavaScript, a user can even crash the browser.

2.3.2.3.2 JScript

JScript is one of the scripting languages that are used for web development. The producer of JScript is Microsoft Corporation. Jscript is actually Microsoft's implementation of JavaScript, which is created by Netscape. The word "implementation" is used instead of "version" because JScript's syntax and functionality is identical to JavaScript's. JScript is a programming language that allows scripting of events, objects, and actions to create Internet applications. It is very easy to learn; yet it is no more difficult to learn than HTML. People without knowledge of programming language can also write Jscript for the web pages.

JScript brings dynamic and powerful capabilities to web pages. With JScript, new dynamic elements let you go beyond the simple click-and-wait. Users will not just read the pages but also interact with them. The pages come alive for any user, even with the slowest Internet connection. Users will get quick responses, because the interaction does not need to involve the server but can take place in the user's browser. This interaction can change web pages into an application. For example, it is easy to put together a few buttons, a text box, and some code to produce a JScript application that resembles a calculator. Users will be able to save the Jscript enhanced pages to use the application again and again.

JScript enables web pages to respond to the requests of the audience beyond a simple click here or there. Many more interactive elements are available for exciting design and layout. Users will interact with the documents, not just read them. Users can even interact with forms, change the look and feel of web documents, and use multiple windows.

JScript code is embedded in the HTML code. It can instantly provide a user with information without waiting for the server or the Internet connection. A JScript enhanced page makes this new information visible by updating the contents of a form or by generating an entirely new document. The browsers run these applications by reading code embedded in the HTML page. The code you write in JScript is the code that the browser executes. There is no intermediate step of creating executable code from the source code and therefore people can look at the source code of the HTML page and read JScript code embedded in the HTML code.

Like most other scripting languages, JScript works only within an application. Currently, it works with Microsoft's Internet Explorer and Netscape's Navigator browsers and the LiveWire server environment. But JScript applications will not function independently.

JScript is an open, cross-platform scripting language. This means that any publisher can use it as his or her scripting language. It also works in any version of Internet Explorer or Netscape Navigator on any platform it supports. Obviously, this is also a substantial part of the Internet audience. All it takes to write a JScript program is a JScript compatible browser and a text editor. However, JScript is limited by security and privacy concerns of its environment [50].

2.3.2.3.3 VBScript

VBScript is a subset of the Visual Basic Programming language. VBScript, the newest member of the Visual Basic family of programming languages, brings active scripting to a wide variety of environments, including web client scripting in Microsoft Internet Explorer version 3.0 and web server scripting in Microsoft Internet Information Server version 3.0. For people who are already know Visual Basic or Visual Basic for Applications, VBScript will be very familiar.

VBScript is designed to work with an interpreter that comes with a web browser, that is, at the user or client end of the web client/server session. It is also designed for use with Microsoft's Internet Explorer browser together with other programming that can be run at the client, including ActiveX controls, automation servers, and Java applets. However, it is important to note that Netscape does not support VBScript. For this reason, VBScript is best used for Intranet web sites that use the Internet Explorer browser only [51]. In fact, non-IE browsers don't support VBScript because much of the power of VBScript comes from its ability to control the thousands of ActiveX controls that are available in IE browsers only.

VBScript talks to host applications by using ActiveX Scripting. With ActiveX Scripting, browsers and other host applications do not require special integration code for each scripting component. ActiveX Scripting enables a host to compile scripts, obtain and call entry points and manage the namespace available to the developer. With ActiveX Scripting, language vendors can create standard language run times for scripting.

Microsoft provides binary implementations of VBScript for the 32-bit Windows API, the 16-bit Windows API, and the Macintosh. VBScript and ActiveX Scripting can also be used as a general scripting language in other applications.

2.3.2.4 Web Application Development Tools

This section will attempt to describe the various tools considered for use during implementation of the E-Bookstore Project. Web application development tools are basically editors used to write and develop web pages. There are many types of web application development tools in the market today; however, the study below will only take into account several of the more popular tools in the market.

2.3.2.4.1 MS Visual InterDev 6.0

Visual InterDev (VI) is a project management software for high-end web development. VI comes as part of Microsoft's suite of professional programming tools, known as Visual Studio. It integrates many of the existing tools for designing dynamic web applications and provides two ways for developers to edit HTML. One way is through a special version of MS FrontPage for WYSIWYG (What You See Is What You Get) editing and the second way is by providing a nice color code text editor.

Microsoft knew that no matter how efficient the Front Page editor was, programmers would still insist on being able to get into the HTML code directly, so they took pains to include a text based source editor that really helps along. Users could click on the tabs easily and switch between text and WYSIWYG views.

VI 6.0 is the tool that Microsoft is promoting as their favored ASP editing tool. The text-based editor mentioned briefly above is a really useful feature of VI 6.0. This is because it is color-coded and helps format programming blocks by automatically indenting text to the level of the line above it. Best of all, the text editor includes context-sensitive help for HTML tags and script commands, this useful feature will help tremendously especially during debugging of codes.

There are three possible views of web pages :-

- The Design View, is a WYSIWYG interface. This allows developers to put together a web page in much the same way as might be done when creating a document in Microsoft Word. Developers can insert picture, links, and sound without having to write a single line of HTML.
- The Source View, let developers see the HTML generated by any work that had been done in the design view.
- The Quick View tab is used to preview the HTML pages in advance.

The Design and the Quick View are not able to process ASP. Both are limited to viewing HTML only. However, if the ASP file in the Source View is contained within a project, there's an ASP-friendly alternative. A selection can be made to view the browser to see what the processed ASP will look like.

In addition, VI boasts of seamless integration of databases into web pages that had long been a Holy Grail for web development tools. Microsoft's ODBC connectivity and visual SQL design form the centerpiece of VI and this makes it very easy to set up databases combining ASP and SQL servers [52]. It also provides useful web-based tools for doing things like checking links, highlighting the broken ones on the web site, and allowing developers to drag and drop pages from one location to another.

Visual InterDev is for programmers, but it is designed so that graphic designers, writers, editors and programmers should all be able to work together using their own tools on the same project. To this end, VI integrates with version management software such as Visual Source Safe, and provides flexibility in deciding which external tools to launch to work with various file types. VI also comes with some useful tools for web development like the Microsoft Image Composer, Microsoft Music Producer, and Microsoft Media Manager.

Visual InterDev is a major piece of software, both in the number of things it does and the amount of external things it tries to pull together. The result is a powerful but undoubtedly one of the most complex and difficult editors to master. But having said that, it's undoubtedly also the most powerful of editors as it offers many tools and features to the developer [53].

2.3.2.4.2 MS FrontPage 2000

The Microsoft FrontPage 2000 web site creation and management tool gives users everything they need to easily create and manage great web sites. FrontPage 2000 allows users to easily create web sites exactly the way they want to. It is easy to update sites quickly and it is easy to flexibly manage Internet or Intranet web sites. FrontPage 2000 allows users to work together with Microsoft Office to save time and in fact was designed to function more like Microsoft Office so that users can get up and running with FrontPage more quickly than ever [54].

MS FrontPage 2000 offers a WYSIWYG view. A WYSIWYG editor or program is one that allows an interface or content developer to create a graphical user interface or page of text so that the developer can see what the end result will look like while the interface or document is being created [55].

MS FrontPage 2000 provides many easy to use features for both experts and novices of web page creations. Among the features that come with FrontPage are its availability of more than 60 business-ready customizable themes, cross browser Dynamic HTML features, easy database integration features, automatic hyper-link fix ups and many others more. The most compelling factor that encourages developers of web sites to use MS FrontPage 2000 is its similarities with the MS Office suite. However, there are developers who dislike the usage of the WYSIWYG feature in Microsoft FrontPage because many unnecessary lines of codes are automatically added into the HTML code.

2.3.2.4.3 HomeSite 4.5

Allaire's HomeSite is an HTML editor. The intuitive WYSIWYN (What You See Is What You Need) interface enables the necessary site-building tools right at the fingertips [56]. The latest release of Allaire's HTML editor is the HomeSite 4.5. This release feature increased user productivity, enhanced project management, extended site deployment, and added support for the latest web technologies. Along with a dazzling array of productivity enhancements, HomeSite 4.5 gives total control over the look and layout of the web pages, as well as over the quality and performance of the entire site. Web sites can be built in less time while maintaining pure HTML.

HomeSite helps to maximize the productivity by having project management, quality control, and site deployment features. The timesaving features are as follows:

- Collapsible Code – Improved page readability by collapsing any size section of text in the main editing window.
- Auto Completion – Edit away as user-defined strings are automatically completed.
- Function Insight – Provide automatic function arguments for ColdFusion as dropdown menu items.
- Split Window Editing – Work with long pages more easily by viewing two different sections of the same page at once.
- Universal File Resource Pane – Quickly move remote and local files between locations from within HomeSite by working in a single view.
- Customization – Float, dock or hide the Resource Tabs and QuickBars.

Besides all the factors mentioned above, HomeSite 4.5 enables web developers to build sites quickly. The HomeSite WYSIWYN interface increases user productivity by providing the developer with the required tools for the task at hand.

The quality of web sites can be ensured by using the features provided by HomeSite 4.5. These features include link verification, estimation of page performance using Document Weighing, checking the HTML syntax by using the built-in HTML Validation, spell checkers and many others more. HomeSite can also conform to the web development style of the developer by extending the functionality and customizing the interface.

Managing multiple development projects is a challenge for every web developer. HomeSite 4.5 helps to enhance project management by featuring a flexible project management system. These are done by creating Virtual Folders, Auto Inclusion and Source Control features.

2.3.2.4.4 ColdFusion Studio 4.5

ColdFusion Studio is a web development tool used to build a site. ColdFusion Studio is described as an editor complete with programming and database tools, extensive wizards, and an intuitive editor working together to offer a highly productive Integrated Development Environment (IDE).

The ColdFusion Studio is built on top of Allaire's HomeSite and therefore consists of some similar features like flexible color-coding support for numerous scripting languages such as Allaire's own CFML (ColdFusion Markup Language) and Microsoft's ASP. The Studio is actually the visual tool component of the ColdFusion Web application server. It is designed to work with ColdFusion Server for both remote development and application deployment [57].

ColdFusion Studio has many features. An example of these useful features is the Collapsible Code. If a developer puts its cursor on a tag, be it HTML, CFML, or something else, and then right-click. The selection of the Collapse Tag from the menu that pops up will result in everything enclosed by that tag to be collapsed into a single gray button. Developers can hover the mouse over the gray button to get a

pop-up window that shows the full code, or double-click the button to expand the code back to normal. This feature is very useful when trying to wade through very large templates. Other features of the ColdFusion Studio include Interactive Debugger, Function Insight, Wireless Markup Language (WML) support, process encapsulation and many others more.

However, a major setback for ColdFusion Studio is its performance. This web application tool seem to consume much resources, which is especially bad for Windows 95/98 users because about 20 percent of system resources is lost to the Studio. This problem can sometimes cause sluggish system performance when a number of other programs are being run simultaneously [58].

2.3.2.4.5 Dreamweaver UltraDev 1.0

Dreamweaver UltraDev 1.0 is a product from Macromedia. It is in fact an integration from two different products namely the Dreamweaver and Drumbeat 2000. The new Dreamweaver UltraDev enables developers to build impressive sites and enables a site to connect to any other site or to a database. In fact, developers could rapidly develop web applications from ground up.

Dreamweaver UltraDev is a very capable WYSIWYG web site design solution. Worth noting are two additional palettes which are the Data Bindings and Server Behaviors palettes. Once a data source has been bound, it is very easy to drag data fields into a web site. The page will then be updated dynamically from the data source. The Server Behaviors are a set of commonly used scripts designed to manipulate data on a page. These scripts can perform basic database publishing functions, such as repeating a set number of records per page, moving to the next or previous set of records, and so on.

Dreamweaver UltraDev cuts down on some of the serious programming needed to create dynamically generated pages. UltraDev's Live Data mode lets developers

preview data as it will appear in the pages that are being designed. And although Drumbeat could build only Active Server Pages with ODBC-compliant databases, UltraDev can also build Java Server Pages and ColdFusion pages and use Java Database Connectivity (JDBC) connections. Dreamweaver UltraDev's extensible nature also allows third-party developers to create add-ons, such as a PHP extension.

Overall, the interface is generally comfortable, although the Data Bindings palette could work better with other Dreamweaver palettes and objects. A drawback is that any troubleshooting will require knowledge of ASP, JSP, or ColdFusion, so for die-hard design fanatics and GUI users, the technical challenges of UltraDev might be areas to tackle [59].

2.3.2.5 Browser

A browser is an application program that provides a way to look at and interact with all the information on the World Wide Web. The word "browser" seems to have originated prior to the Web as a generic term for user interfaces that let you browse text files online. By the time the first web browser with a graphical user interface was invented (Mosaic, in 1992), the term seemed to apply to web content, too.

A web browser is technically a client program that uses the Hypertext Transfer Protocol (HTTP) to make requests of web servers throughout the Internet on behalf of the browser user. A commercial version of the original browser, Mosaic, is in use. Many of the user interface features in Mosaic, however, went into the first widely used browser, Netscape Navigator. Microsoft followed with its Internet Explorer.

Today, these two browsers are highly competitive and the only two browsers that the vast majority of Internet users are aware of. Although the online services, such as America Online, CompuServe, and Prodigy, originally had their own browsers, virtually all now offer the Netscape or Microsoft browsers. Lynx is a text-only browser for UNIX shell and VMS users. Another recently offered browser is Opera [60].

2.3.2.5.1 Microsoft Internet Explorer

Microsoft's Internet Explorer (MS IE) is the graphical World Wide Web browser that is provided with the Microsoft Windows 95, 98, Me, NT and 2000 operating systems. The MS IE browser competes closely with an earlier browser, Netscape Navigator.

Internet Explorer 4.0 is an open, integrated suite of Internet software that includes the industry's premier Internet client and basic collaboration solution for end users, IT managers, and developers.

Microsoft's IE include standard features like web casting of sites, auto complete, offline reading, content advisor and many others more. However, with consideration to scripting languages, VBScript works best on Internet Explorer. Besides that, Internet Explorer also supports ActiveX [61].

2.3.2.5.2 Netscape Navigator

Netscape Navigator is the other web browser that's considered the most popular browsers. Netscape Navigator is a product by Netscape Communications, now owned by America Online (AOL). Currently, almost all Internet users use either Netscape's browser or Microsoft's Internet Explorer browser, and many users use both. Although Netscape Navigator was initially the predominant product in terms of usability and number of users, Microsoft's browser is now considered superior by many users (although many other users see them as roughly equivalent) and has taken a slight lead in usage.

Netscape's browser is called Navigator and is packaged in a suite of software called Communicator. Navigator was developed in 1995 by a team led by Marc Andreessen, who created Mosaic, the first web browser that had a graphical user interface, at the University of Illinois' National Center for Supercomputing Applications (NCSA) in 1993 [62].

With consideration to scripting languages, it is important to note that Netscape Navigator supports JavaScript but it does not support VBScript, which is the scripting language developed by its main browser rival, Microsoft Corporation.

2.3.2.5.3 Lynx

Lynx is a text only web browser and is keyboard oriented. It was developed at the University of Kansas primarily for students who used UNIX workstations. It has also been rewritten to run on VMS operating systems for users of VT100 terminals.

When using the UNIX Shell interface, it is interesting to know that it has a succinct key driven user interface but not mouse driven user interface [63]. Lynx 2.8.3 runs on UNIX, VMS, Windows 95/98/NT but not on Windows 3.1 or 3.11, DOS (386 or higher) and OS/2 EMX. Ports to Mac are in the beta testing stage [64].

Lynx does not support tables or images. It probably does not support many other quirks and features of other browsers. However, it loads web pages at incredibly fast speeds and lets us get straight to the author's thoughts and purpose. Lynx allows downloading much of the content that it can't load inline. This allows the images to be viewed in a separate application.

There is no difficulty in getting the Lynx browser. People who get access to the UNIX computer will probably already have Lynx. Another advantage of using Lynx is that it only takes up under 1MB of storage and runs a minimal 1MB RAM [65].

2.3.2.5.4 Mosaic

Mosaic was considered to have been the software that introduced the World Wide Web and the Internet to a wide general audience. It is the first widely distributed graphical browser or viewer for the World Wide Web. Once Mosaic was available, the web virtually exploded in number of users and content sites. Of course, the software depended on the recent invention of the Hypertext Transfer Protocol or HTTP, by Dr. Tim Berners-Lee.

Mosaic arrived in 1993. Marc Andreessen, then in his early 20's, is credited with inventing or leading the development of Mosaic. He developed it at the National

Center for Supercomputing Applications (NCSA) at the University of Illinois in Urbana, Illinois. Andreessen and others went on to become part of Netscape Communications, originally called Mosaic Communications, that developed one of today's most popular browser, Netscape Navigator.

The original Mosaic, now in a later version, has since been licensed for commercial use and is provided to users by several Internet access providers [66].

2.3.2.5.5 Opera

Opera is a web browser that provides some advantages over the two most popular browsers, Internet Explorer and Netscape Navigator. It is much smaller in size, so it takes only a few minutes to download. A menu or "hot list" serves as both a directory to the web and a bookmark file. The hot list can be easily removed and the full viewing space is available to look at multiple web sites at the same time, either by tiling or cascading the windows. The site that was last looked at can be restored the next time you open the Opera browser.

Opera seems to offer all the capabilities of the more popular browsers except full-featured mail facilities. Opera offers keyboard as well as mouse control of its features. The tool bar icons are however somewhat difficult to read. Plug-ins such as RealAudio, RealVideo, and Shockwave can be added. Support is also provided for Java applets.

The web browser Opera was developed by 11 employees in a Norwegian software company and is available for Windows and OS/2. A Macintosh version is reportedly being developed and a new version is being planned to support cascading style sheets [67].

2.3.3 Database Management System

A Database Management System (DBMS) allows for storing, retrieving and manipulating of information. There are basically four types of database management systems, which are the hierarchical, network, relational and object oriented models.

Hierarchical Model	- A hierarchical DBMS represents data as tree structures, and is composed of a hierarchy of data records.
Network Model	- A network DBMS represents data as records linked together, forming intersecting sets of data.
Relational Model	- But even the most complex hierarchical and network databases can be represented as a simple collection of two-dimensional tables, otherwise known as a relational DBMS.

In a relational system, only one type of data structure exists which is the table. This uniformity gave rise to a new type of high level database language. A relational language produces new tables by sub-setting and/or combining existing tables. By issuing a single language command, an entire set of records (called rows) can be retrieved from one or more existing tables into a new table (called a result table) that can be operated on again.

A relational system provides automatic navigation to the needed data. There is no need to acknowledge how data is represented in storage to get information in and out of a relational database. More than any other feature, it has automatic navigation that makes data readily accessible to end-users.

The object-oriented model allows for directly storing and managing of objects through standard language interfaces, including C++, Java, Smalltalk and SQL, using traditional programming techniques and tools [68].

It is important to note that database servers are different from desktop databases because they do not have a graphical front that allows a user to build forms, queries and reports. Most database servers do have separate applications that can be used for

these tasks, such as Oracle Developer 2000, but they are not integrated into the database server system. You can even use MS Access, Paradox, FoxPro and other desktop database applications to connect to database servers.

Database servers typically use some type of a monitor application to do system administration. This application can be character based, or graphical and the administrator will most likely use both since each has its strengths in different areas of system administration. Examples of desktop databases are like MS Access, Paradox or FileMaker whereas database servers are like Oracle 8i, MS SQL Server 7.0, MySQL etc.

The various types of DBMS are listed and discussed below.

2.3.3.1 MySQL

MySQL is a Structured Query Language (SQL) database server. It is true multi-user, multi-threaded SQL, which is the most popular database language in the world. MySQL is a client/server implementation that consists of a server daemon `mysqld` and many different client programs/libraries.

The main goals of MySQL are speed, robustness and ease of use. The base upon which MySQL is built is a set of routines that have been used in a highly demanding production environment for many years. While MySQL is still in development, it already offers a rich and highly useful function set. A limited number of examples of the main features offered by MySQL are listed below.

- Fully multi-threaded, using kernel threads, which means that multiple CPUs can be used if needed.
- Works on many different platforms.

- SQL functions are implemented through a highly optimized class library and should be as fast as they can get.
- In the same query, it allows query from mix tables from different databases.
- A privilege and password system which is very flexible and secure. Allows host based verification.
- Secure passwords since all password traffic on the net is encrypted.
- Open Database Connectivity (ODBC) for Windows 95, all ODBC 2.5 functions and lots of others. For example, Access can be used to connect to the MySQL server.
- Handles large databases, it can contain fifty million records.

2.3.3.2 Microsoft SQL Server Version 7.0

MS SQL Server is the database management system that is developed by Microsoft Corporation. It is a client/server relational database management system (RDBMS) that is highly integrated with the Window NT operating system. By using MS SQL Server, modern applications can be developed by separating the client application and the database service. SQL Server Transact-SQL supports the ANSI SQL-92 standard and provides extensions to the SQL language [69].

Microsoft SQL Server supports a set of features that result in the following benefits:

- Ease of installation, deployment, and use.
- MS SQL Server includes a set of administrative and development tools that improve the ability to install, deploy, manage, and use the MS SQL Server across several sites.
- Scalability.
- The same database engine can be used across platforms ranging from laptop computers running Microsoft Windows 95/98/Me to large, multiprocessor servers running Microsoft Windows NT Enterprise Edition and Windows 2000.

- Data warehousing.
- MS SQL Server includes tools for extracting and analyzing summary data for online analytical processing (OLAP). MS SQL Server also includes tools for visually designing databases and analyzing data using English based questions.
- System integration with other server software.
- SQL Server integrates with e-mail, the Internet, and Windows.

MS SQL Server 7.0 runs on Windows NT 4.0 or Windows 2000. SQL Server 7.0 Enterprise Edition builds on the established strengths and broad functionality of SQL Server, extending its already extensive scalability, interoperability, availability, and manageability. Enterprise Edition provides the means for building and deploying large-scale distributed applications, making it the best platform for the largest and most mission-critical database applications. MS SQL Server Enterprise Edition provides clustering support and can expand to use up to 3 GB of memory. SQL Server 7.0 Enterprise Edition runs on Windows NT 4.0 Enterprise Edition or Windows 2000 Advanced Server.

With the best of breed data warehousing solutions, SQL Server includes OLAP Services, Data Transformation Services, and English Query, and works with over 45 Independent Software Vendors (ISV) that form the Data Warehousing Alliance. MS SQL Server is also the first database to scale from the laptop to the enterprise using the same code base, offering 100% code compatibility. By using Windows 2000, MS SQL Server scored as the fastest database for SAP, based on the SAP Retail benchmark.

The MS SQL Server is so popular that the International Data Corporation (IDC) estimates that SQL Server has captured 44 percent of all database license shipments, compared to 28 percent for second-place Oracle. IDC's latest figures also show SQL Server license sales growing at more than 100 percent annually [70].

2.3.3.3 Oracle 8i

Oracle is one of the largest and most popular vendors in the RDBMS industry. They have the honor of being the first company to offer an RDBMS for commercial use. Oracle's portability to practically every major hardware and operating system platform is impressive. This means that Oracle code written on a VAX/VMS platform can easily be ported to run on a Macintosh platform. Currently, Oracle supports over 80 different hardware platforms [71].

Oracle supports SQL commands. Examples are commands to add new tables to a database, add new columns to existing tables, and make existing columns wider. All of these operations can be performed with a single command. The change takes place immediately because no database reorganization is required. In order to prevent the existing programs from becoming obsolete when revising the structure of the database, Oracle allows old and new "views" of the same data to exist simultaneously. Multiple views of the same data enables the existing programs to continue to run without modification by using the old views of your data, while your new applications take advantage of the new view of the data. This insulation between what can be seen and how your data is stored is known as data independence. Data independence has always been a key objective of all DBMS but was never fully attained until RDBMS became available.

Oracle 8i is an Internet-based computing model, which renders expensive technology experts unnecessary, to install, upgrade, and maintain every PC in an organization. With Oracle 8i as the foundation, Internet computing lets IT experts focus their efforts on managing important business data from a centralized server, freeing them to invest their time and skills where they add the most value to the organization. And with all data professionally managed and safely stored in centralized servers, employees will have access to the most up-to-date information and applications to make the smartest business decisions. All users can access the information they need to do their jobs from any computer equipped with a standard web browser [72].

2.3.3.4 Microsoft Access 2000

Microsoft Access 2000 is a desktop database. It has powerful new tools for managing data for example enabling sharing of database among co-workers over the Internet, searching and retrieving the information quickly. It takes advantage of automated, pre-packaged solutions to quickly create databases. MS Access 2000 also has features that can be used to convert data between Microsoft Access and your favorite spreadsheet, database or statistical package [73]. Besides that, data in Microsoft Access can be migrated to Microsoft's SQL Server.

MS Access 2000 offers many features, which include conditional formatting, drag and drop functions to MS Excel, integration of shared components, Unicode support and others more. Particularly interesting to non-DBMS experts are the Project Wizards which help users manage and control their databases better.

Access 2000 is actually meant for the lower end market especially for home users or small office users who do not need the powerful features of the MS SQL Server. It is much cheaper than MS SQL Server and is much easier to install.

2.4 SUMMARY

This chapter outlined and described in detail the various issues and topics researched throughout the project. The information was derived mainly from books and web sites, which were both popular and reliable.

The research was important because it enabled better understanding of the different products. This allowed the best combination of platform, software and technologies to be selected to design, develop and implement the E-Bookstore Project. However, it is to be mentioned that there remain many more products and technologies that were not covered in the Literature Review. The topics covered in this chapter were only some of the more popular products. Nevertheless, the research done was sufficient for the purpose of choosing the appropriate tools to develop and implement this project.

The next chapter, Systems Analysis will explain in detail the various functional and non-functional requirements of the E-Bookstore. It will also explain the methodology and time schedule for this project. Last but not least, it will summarize the final decisions made with regards to the software's selection and also the justifications behind those selections.

3.1 FUNCTIONAL REQUIREMENTS

INTRODUCTION

This chapter on Systems Analysis describes the functional and non-functional requirements of the E-Bookstore Project. It will also explain the methodologies used to develop the system. The planned project schedule will be discussed and lastly, a summary of the software used to build the E-Bookstore Project and the reasons for using those products will be duly explained.

This section on Functional Requirements will attempt to describe in detail the four modules that will contribute to the E-Bookstore Project. These modules will be linked to the other modules of the project and will be mentioned when necessary.

3.1.1 ORDER PLACEMENT MODULE

This module enables users to place orders for books which are unavailable at current time. Once the physical quantity of a book has been sold out in the bookstore, web site users will still be able to search for the book. However, a status displaying the "unavailable" message will indicate that the current book is out of stock.

If the user decides to place an order for the book, a single click of the mouse will bring the user to a new page whereby the title and relevant details of the book will be filled into a table or cart. The whole process can repeat for a maximum of three times using the shopping cart technology. This is a safety procedure to disallow the same user from placing orders for too many books. When the order placements are complete, the user will be required to fill in relevant particulars for example name, e-mail address, contact number etc.

The bookstore owner or the personnel in-charge of book purchasing will check the inventory levels of books occasionally using the Report Generation Module (section

3.1.4), he/she will subsequently order the books from the suppliers according to his/her discretion. Once the physical books arrive at the bookstore and the data is entered into the database. This module will automatically check the database and generate e-mails to the customers who had placed orders for the books. The e-mail will notify them that the specific had arrived at the bookstore, and will advise the customers to purchase the books promptly or to *Online Order* the book via the Internet. (*Online Order* is another module of the system. This module will request the E-bookstore system to reserve the specific book for a limited period).

3.1.2 MAILING LIST MODULE

The E-Bookstore will consist of a Mailing List Module to enable the bookstore owner to send newsletters to subscribers when there are sales promotions or news that the bookstore owner wants to send to its subscribers. Customers who visit the web site and choose to receive newsletters from the bookstore will have to go to the Mailing List Module and fill in relevant particulars for example name, e-mail address, categories of news interested etc. After filling and submitting the relevant information, the customers' information will be added into the database. Subsequent newsletters will be sent to the subscribers of the newsletter according to their fields of interest.

Subscribers who wish to unsubscribe from the mailing list can do so by selecting the "Unsubscribe from Mailing List" link. The system will subsequently delete his/her name from the mailing list database. Similarly, by clicking on the "Edit Mailing List Profile" link, subscribers will have the liberty to change their profiles when necessary. An example would be a change in e-mail address or a change in the fields of interest.

3.1.3 SALES OPERATION MODULE

This module will be used primarily by the cashier to log sales transactions. The module will consist of a user interface of which the cashier will use very often. If a customer had online ordered or is a member of the bookstore, his/her identification card number will be needed so that it can be entered into the system to be verified, (just as supermarkets swipe member's card to record any sales transactions by that member).

The identification card number entered will be used to query the *Online Ordering Module* database whereby if the customer had previously made an online ordering within the past few days, the books that were reserved would be displayed on the user interface. The objective of this is to ensure that books that were reserved and subsequently purchased are recorded into the database. Updating the database will enable the system to "release into circulation" books that "were reserved, but not purchased" so that other customers can purchase the books. If no identification card number is entered, the system will assume that the purchaser is not a member and did not online order.

After a sales transaction has concluded, the whole transaction will be recorded into an Electronic Journal Database as a record. The number of remaining books in the bookstore will also be updated correspondingly.

3.1.4 REPORT GENERATION MODULE

This module is aimed at enabling reports to be generated for the purpose of better administration, better control over the bookstore and to enable the bookstore to promptly respond to the needs of its customers. The bookstore owner will use this module. However, personnel with administrator privileges can also view the reports. The user can click on a couple of selection lists to generate reports regarding the

business of the bookstore i.e. total sales done for a period of time, total online orders, quantity of books left in the bookstore etc.

The system will also automatically send e-mail notifying the bookstore owner and related personnel regarding low inventory so that there can be prompt re-ordering of books from the suppliers. This module will enable more efficient usage of available resources for better management of the bookstore.

CONCLUSION

The modules mentioned above describe in detail the tasks and functions of each module. It is evident that these four modules are distinct from one another and are relatively huge modules. As stated above, it is important to enable these modules to "talk" and "communicate" with one another. Every module must be able to integrate seamlessly with the other modules.

The other seven modules in the Project as briefly mentioned in Chapter 1 are developed by two other team members of the Project.

3.2 NON FUNCTIONAL REQUIREMENTS

The non-functional requirements or otherwise known as system properties shall be discussed in this section. Non-functional requirements will define the constraints imposed upon the E-Bookstore. It will place restrictions on the freedom of design as requirements such as response time, memory requirements and so on will be specified. Besides that, it will also list the product and process standards which must be followed. Non-functional requirements have to be defined as it will clearly affect the operations of the E-Bookstore.

a) Learnability

It should be easy to learn to use the E-Bookstore. The time required for training the system user to be proficient in the usage of the system should not exceed two working days. On the front end, it should be easy for the customers to understand the web site so that the services provided by the web site can be fully utilized by the customers.

b) Speed

In order to provide an efficient E-Bookstore system, it should at least process a transaction successfully within 30 seconds. Besides that, it should also produce at least one response within 30 seconds. It is obvious that unnecessary interaction between the server and the client will increase the response time. Therefore, to have a faster response time, it is important to balance the load between the client and the server to conserve precious server resources. This reduction in the server load would enable higher performance by the system.

c) *Reliability*

The E-Bookstore should be reliable. It should set out an acceptable failure rate, which is that the system should be recoverable within a 24-hour time span. While the system is in downtime, the operation should be recorded manually in order to update the database after the downtime.

d) Robustness

Robustness refers to the ability of the system to continue in operation despite facing unexpected problems. The E-Bookstore should be able to process unanticipated errors by having validation for the input field on the client side before it is sent to the server. For example, users might accidentally key in alphabets instead of numeric numbers for a date; the system should validate this input before sending it to the server. When the error is detected, the system will prompt an error message and the cursor will focus on the field where the error had occurred. Similarly, validation must also be performed on the server side so that systemic errors do not occur.

e) Correctness

Correctness is the extent to which the program satisfies its specification and fulfils the customer's needs and the bookstore owner's objective. The E-Bookstore Project hopes to achieve a high level of correctness by practicing proper coding techniques, careful planning and implementation, and proper system testing.

f) Interoperability

Interoperability is the ability of the system to interact with other systems. The E-Bookstore is designed to be interoperable with other existing systems in the bookstore. The most common tools, technologies and languages would be used so that interoperability issues would be minimal with other computerized systems. The E-Bookstore should also easily integrate with existing manual bookstore systems.

g) Usability

An appropriate user interface and adequate documentation will enable usability of the system. The E-Bookstore will provide usability by designing a user-friendly interface and an easy-to-use, easy-to-understand user manual for the customers or administrators using the system. The system will minimize text-based commands to perform various tasks but instead maximize on the usage

of hypertext linkages to launch commands using the mouse. Messages and prompts are displayed as guidance during the operation of the E-Bookstore. It is envisioned that this would allow for greater usability for both the bookstore owner and for its customers.

h) Modularity

Modularity is a key factor to good program design. The design of the system was broken into modules so that distinct functions of objects could be isolated from one another. These characteristics make testing and maintenance much easier. In this E-Bookstore Project, modularity was emphasized from the beginning as this will enable easier modifications in the future.

i) Maintainability

Some of the sites of the E-Bookstore need maintenance from time to time to provide updated information for the customers. An example is the requirement to update information on new releases and promotions on the default page. This can be done through the administration module whereby only authorized administrators are allowed to maintain the web pages. Modifications will be easy, as the Administrator's module will be user friendly.

As listed and described above, the non-functional requirements will clearly place constraints on the design of the system. These requirements can sometimes be more difficult to achieve than that of functional requirements. However, it is of great importance to strive to achieve those requirements set above.

3.3 DEVELOPMENT METHODOLOGY

Methodology is the science of how a system is developed. This section will describe the methodology used while developing the E-Bookstore Project.

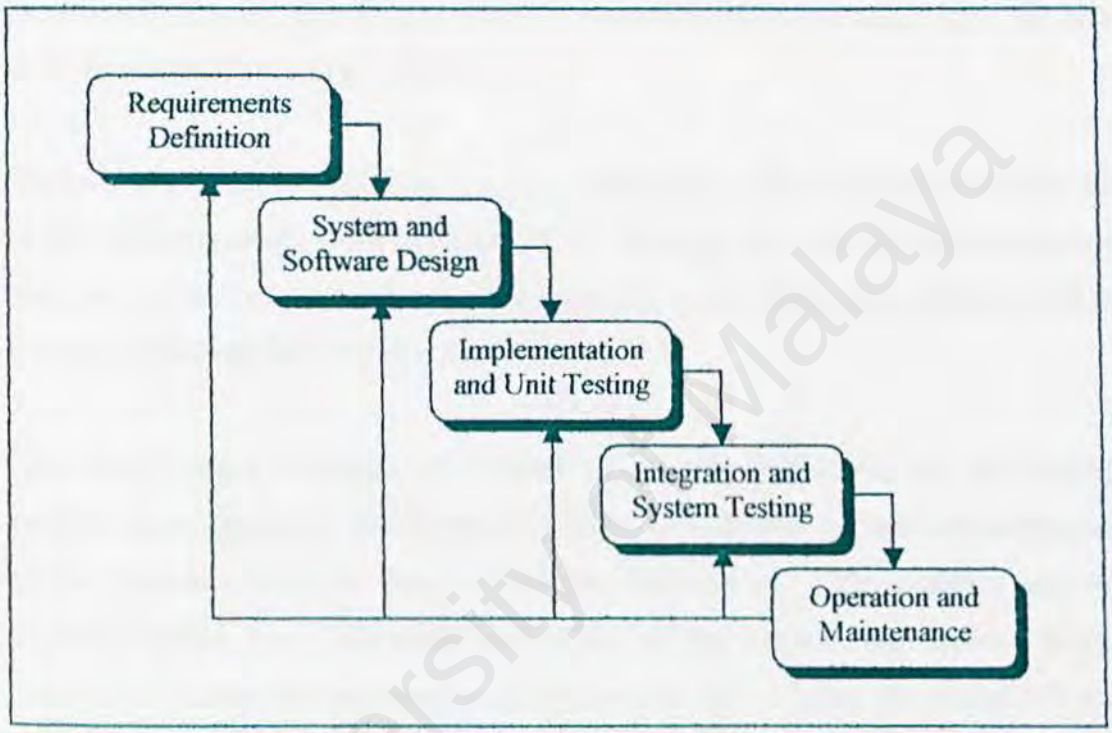


Figure 3-1 The Waterfall Model

The Waterfall Model (Figure 3-1) was chosen as the development model of choice as it offered distinct advantages which were relevant to the E-Bookstore Project.

The objectives and the requirements for the E-Bookstore Project are clear. As the project team members consist of students, the problems faced and solutions needed by everyday users are fully understood by the team members. This enabled the objectives and requirements to be fully understood. Therefore, this abolished the need to use the Evolutionary Model, which renders frequent iterations as necessary for discovering the requirements of the system.

Prototyping was not the favored methodology to use in this project for two main reasons. Firstly, the scarcity of project team members did not permit frequent iterations as suggested by the prototyping model. Furthermore, the limited time frame of one academic year did not encourage prototyping as well. The clear and distinct phases in the Waterfall Model enabled greater visibility compared to the Evolutionary Model and thus offered an advantage. Good visibility and distinct phases also enabled the project team to generate documentation easily as each activity produced some deliverables.

However, the Waterfall Model has its own drawbacks. One of these drawbacks are its inadequate procedures for dealing with the social system as it does not adequately take into account what impact a system might have on its users via a changed job or changed organizational structure design [74].

The project team members also faced some inflexibility due to the distinct partitioning of phases in the Waterfall Model. This reflects the concern mentioned by Ian Sommerville in his book of Software Engineering. "The problem with the waterfall model is its inflexible partitioning of the project into distinct stages. Delivered systems are sometimes unusable as they do not meet the customer's real requirements" [75].

Each methodology researched for example the Evolutionary Model, Formal Transformation Model etc. have its own merits and problems. However, after considering the various factors namely the clear understanding of problems and requirements, the clear separation of phases, the time constraints including other advantages, it was decided that the Waterfall Model best served our objectives.

3.4 PROJECT SCHEDULE

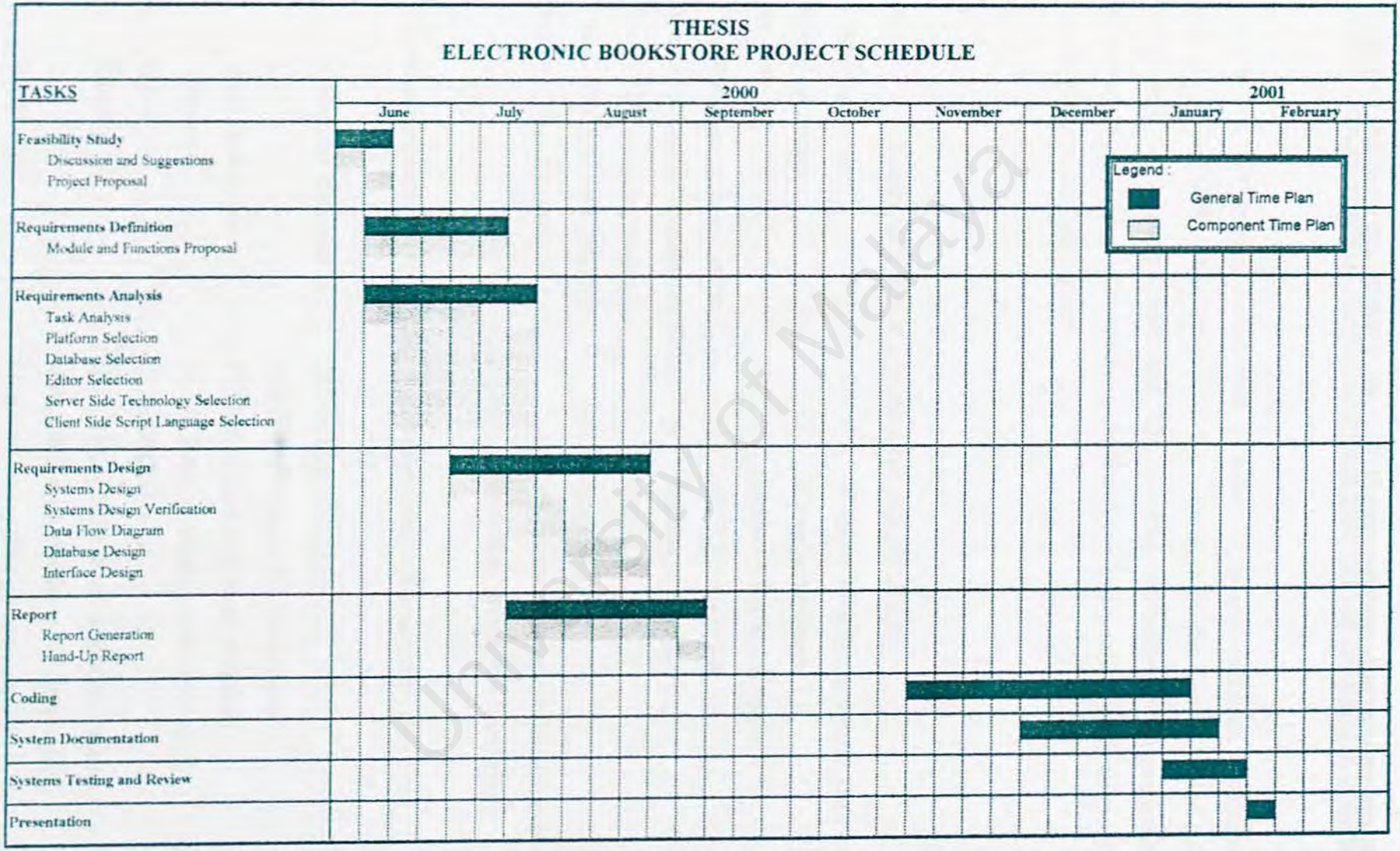
The Gantt Chart (Figure 3-2) in the following page contains detailed breakdowns of every activity that was conducted during the design and implementation of the E-Bookstore Project.

The Gantt chart shown is actually a more detailed version of the Project Schedule in Chapter 1. Again, the Feasibility Study was first conducted during the first two weeks of June. Shortly after this stage, the Requirements Definition was defined, followed by the Requirements Analysis Phase.

Requirements Design was the longest process as the Systems Design, Data Flow Diagram, Database Design etc. of the E-Bookstore Project took roughly seven weeks to complete. The Report phase was the last phase conducted during the first part of this Project.

The second part of the Project consisted of Coding, Systems Documentation, Systems Testing and Review and Presentation of the Project. Coding took the longest period of time as it lasted from November till mid January. Systems Documentation was done simultaneously with coding. The documentation of the entire thesis lasted until a week after coding had finished. This was on the third week of January.

Systems Testing and Review was done for about three weeks. This phase enabled all bugs to be sorted out and it also allowed for fine-tuning of the system. There were changes made even at this stage and it contributed significantly in the successful completion of the entire system. In early February, the project was presented to the supervisor, moderator and all other parties who were interested in reviewing the E-Bookstore System.


THESIS
ELECTRONIC BOOKSTORE PROJECT SCHEDULE
TASKS
2000
2001
June
July
August
September
October
November
December
January
February
Feasibility Study
Discussion and Suggestions
Project Proposal
Requirements Definition
Module and Functions Proposal
Requirements Analysis
Task Analysis
Platform Selection
Database Selection
Editor Selection
Server Side Technology Selection
Client Side Script Language Selection
Requirements Design
Systems Design
Systems Design Verification
Data Flow Diagram
Database Design
Interface Design
Report
Report Generation
Hand-Up Report
Coding
System Documentation
Systems Testing and Review
Presentation
Legend :
General Time Plan
Component Time Plan

3.5 SOFTWARE SUMMARY AND JUSTIFICATION

This section will describe the summary of software and hardware used to develop and operate the E-Bookstore Project. It will also describe the reasons behind the selection of each of the software used. The following combination of software was chosen among the many other options as the choice for the operation, application and development of the E-Bookstore.

3.5.1 SUMMARY OF HARDWARE / SOFTWARE

Operating System	:	Windows NT4 Server Option Pack 4
Web Technology	:	Active Server Pages 2.0
Web Server	:	Internet Information Server 4
Database Management System	:	MS SQL Server 7.0
Web Application Development Tools	:	MS Visual InterDev 6.0
Server Side Scripting Language	:	VBScript
Client Side Scripting Language	:	JavaScript
Preferred Web Browser	:	MS Internet Explorer 4.0 and above Netscape Navigator 4.0 and above

The minimum hardware specifications corresponding to the summary above is:

Computer Processor	:	486/66 MHz or higher; Pentium or Pentium Pro processors
Hard Disk Space	:	175 MB of hard disk space minimum
Memory	:	32 MB RAM or higher recommended
Drive	:	CD-ROM Drive
Display	:	VGA, Super VGA or video graphics adapter compatible with Windows NT Server 4.0
Peripherals	:	Mouse or compatible pointing devices

3.5.2 JUSTIFICATION

Operating System

Windows NT was selected as the operating system of choice due to several distinct advantages when compared to other operating systems. One of the main reasons for choosing Windows is that Windows currently enjoys a dominant position as the preferred operating system by most corporations. In the consumer market, Microsoft's Windows enjoys a penetration rate of almost 90% of the overall market which makes it almost the *de facto* choice for operating systems.

Windows comprise of a user friendly Graphics User Interface (GUI) which makes it easy for both consumers and computer professionals to use. Although Linux also provides a user friendly GUI, it is undoubtedly more difficult to install compared to Windows. Furthermore, it has a much lower usage percentage in the market. Therefore, the possibility of the bookstore owner knowing Linux is much lower than that compared to Windows. This prompted us to choose the more popular Windows NT over Linux. Unix on the other hand does not provide a user friendly GUI.

Windows 2000 is the latest operating system introduced by Microsoft. However, due to its relatively new release, doubts remain on whether all system bugs had been fixed. We therefore chose to use the proven Windows NT4 operating system.

Web Technology

Active Server Pages was chosen over other web technologies due to several reasons. The main reason is that ASP comes free with Windows NT4 Option Pack 4. This eases the financial burden for any bookstore owner when considering whether or not to implement this web initiative. Furthermore, ASP provides confidentiality for specific codes from users of the Internet, as the code written in ASP will only be displayed as pure HTML when viewed using a browser. The display of pure HTML as an output is also a benefit by itself as it makes output from ASP compatible to all major browsers.

Web Server

The Internet Information Server 4 (IIS 4) was chosen as it comes packed with the Windows NT operating system and therefore is tightly integrated with it. As Active Server Pages (ASP) was chosen as the technology for implementing the E-Bookstore, it was obvious that IIS was chosen as ASP runs on the IIS.

Financial burden is again considered. As IIS comes together with Windows NT4 Option Pack 4, no extra costs need to be incurred to purchase a license for the web server.

Database Management System

A Relational Database Management System was chosen over the hierarchical, object oriented or network models, as relational databases seem to be the standard during the implementation period of this project.

Microsoft's SQL Server 7.0 was chosen as the RDBMS of choice as SQL Server 7.0 offers many features and functionalities. Most importantly, it is tightly integrated with the Windows NT environment which is the platform used to develop this project. It boasts of extensive scalability, interoperability, availability, and manageability.

Web Application Language

Hypertext Markup Language remains the default selection for developing web pages. Some web pages achieve its desired objectives of information dissemination although it may be static. HTML thus plays its role as the web application language to publish static information on the Internet.

Web Application Development Tools

Microsoft's Visual InterDev 6.0 is the recommended web application development tool for ASP. Although MS Visual InterDev 6.0 is considerably more difficult over other tools like Notepad, it offers considerable advantages as it is very powerful and has many features which makes it exciting for web developers to use. Furthermore, Visual InterDev boasts strong links with SQL Server, which makes it very easy to set up databases combining ASP & MS SQL server.

Server Side Scripting Language

Due to the fact that ASP was chosen as the technology to implement the Electronic Bookstore, there was undoubtedly an inclination to use VBScript as many books and sources of information tend to suggest and promote the use of VBScript as the scripting language of choice when coding using ASP.

As ASP processed its codes on the server side, the usage of VBScript or any other type of scripting language had no effect whatsoever on the outcome displayed on web browsers. Due to the preceding two facts, VBScript was chosen as the scripting language of choice.

Client Side Scripting Language

The selection between JavaScript, JScript and VBScript for client side scripting was easy. JavaScript became a firm choice as both MS Internet Explorer and Netscape's Navigator could understand JavaScript, whereas only Microsoft's Internet Explorer could understand JScript and VBScript. Users using Netscape's Navigator thus are unable to fully utilize the web page as the codes in JScript or VBScript would be skipped.

Preferred Web Browser

The browsers recommended for use are the MS Internet Explorer 4.0 and above or Netscape's Navigator 4.0 and above. This is due to the fact that these two browsers are the most widely used and the most popular amongst the Internet community today. Furthermore, these versions include the features of Cascading Style Sheets, thus making visual effects a pleasant treat for customers.

3.6 SUMMARY

This chapter described the functional requirements of the system. Explanation was given on four of the modules namely the Order Placement Module, Sales Operation Module, Report Generation Module and the Mailing List Module because I would develop these modules. Besides that, the non-functional requirements that must exist in the system were also elaborated at length.

The Waterfall Model was chosen as the methodology for implementing the E-Bookstore Project and the time frame was depicted in the project schedule. Proper selection of methodology and the time frame of implementation enabled the project to be planned and implemented systematically and according to schedule. Lastly the summary of software and hardware and the justifications for choosing those tools were described in detail. Basically, the OS, technology, web server, DBMS, web application development tool and browser were products from Microsoft. The selection was based on the merits and advantages offered by these products over other competing brands and tools as described in section 3.5.

The next chapter will move on to discuss issues regarding the System Design. It will revolve around the three major design issues of Data Flow Diagram, Database Design and User Interface Design.

4.1 DATA FLOW DIAGRAM

INTRODUCTION

Chapter 4 will describe the Systems Design of the E-Bookstore Project. Three main sections will be discussed in this chapter which is the Data Flow Diagram, the Database Design and the User Interface Design.

The Data Flow Diagram (DFD) outlined in this section consists of three main parts namely the Context Diagram (Figure 4-1), Diagram 0 (Figure 4-2) and the Child Diagram. Only Child Diagram 4 (Figure 4-3) and Child Diagram 8 (Figure 4-4) will be shown here as they are among the main modules that will be developed by me in the E-Bookstore Project. It is to be mentioned here that process 6 and process 11 in Diagram 0 was not exploded into Child Diagram 6 and Child Diagram 12 respectively because the necessary data flows in the Diagram 0 were adequately depicted.

4.1.1 DEFINITION OF DATA FLOW DIAGRAM

A Data Flow Diagram graphically characterizes data processes and flows in a system. This graphical representation is of utmost importance as it enables better understanding of the inter-relatedness of the system and its subsystems. The Context Diagram is an overview of the system which includes only the general system, together with basic input and output. Diagram 0 is the explosion of the context diagram and may include many more processes compared to the Context Diagram. As can be seen in Figure 4-3, the Diagram 0 has numberings in each of the processes. Each of these processes may in turn be exploded to create a more detailed Child Diagram. The Child Diagram is given the same number as its parent process in Diagram 0. For example, process 4 in Diagram 0 would explode into Child Diagram 4.

The usage of DFDs in the systems design of the E-Bookstore Project is due to its advantages over narrative explanations of the way data moves through the system. These advantages include freedom from committing to technical implementation of the system too early, communicating current system knowledge to users through DFDs and the analysis of whether the necessary data and processes have been defined.

4.1.2 CONTEXT DIAGRAM

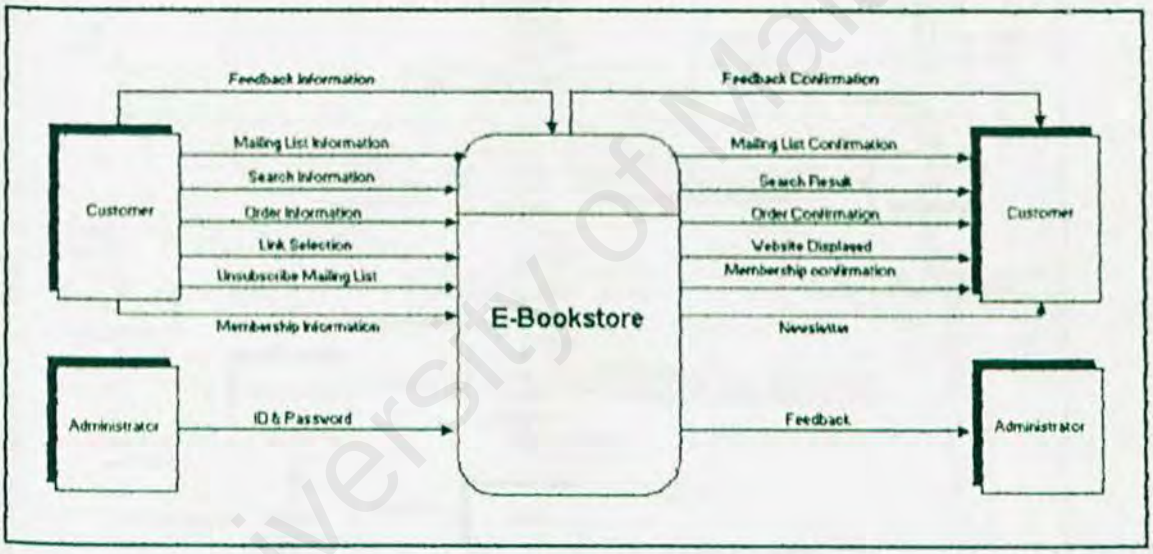


Figure 4-1 Context Diagram

4.1.3 DIAGRAM 0

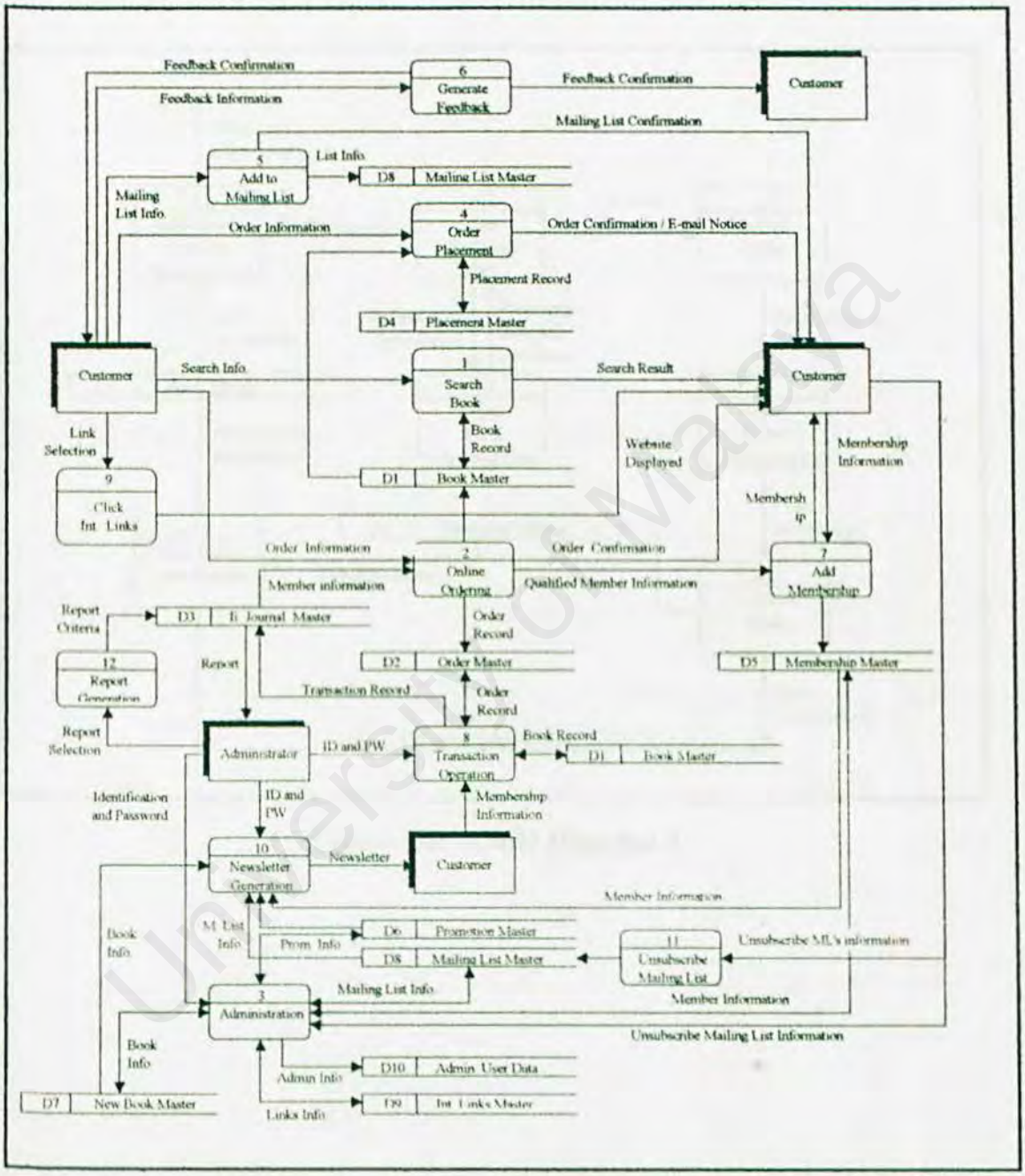


Figure 4-2 Diagram 0

4.1.4 CHILD DIAGRAM 4

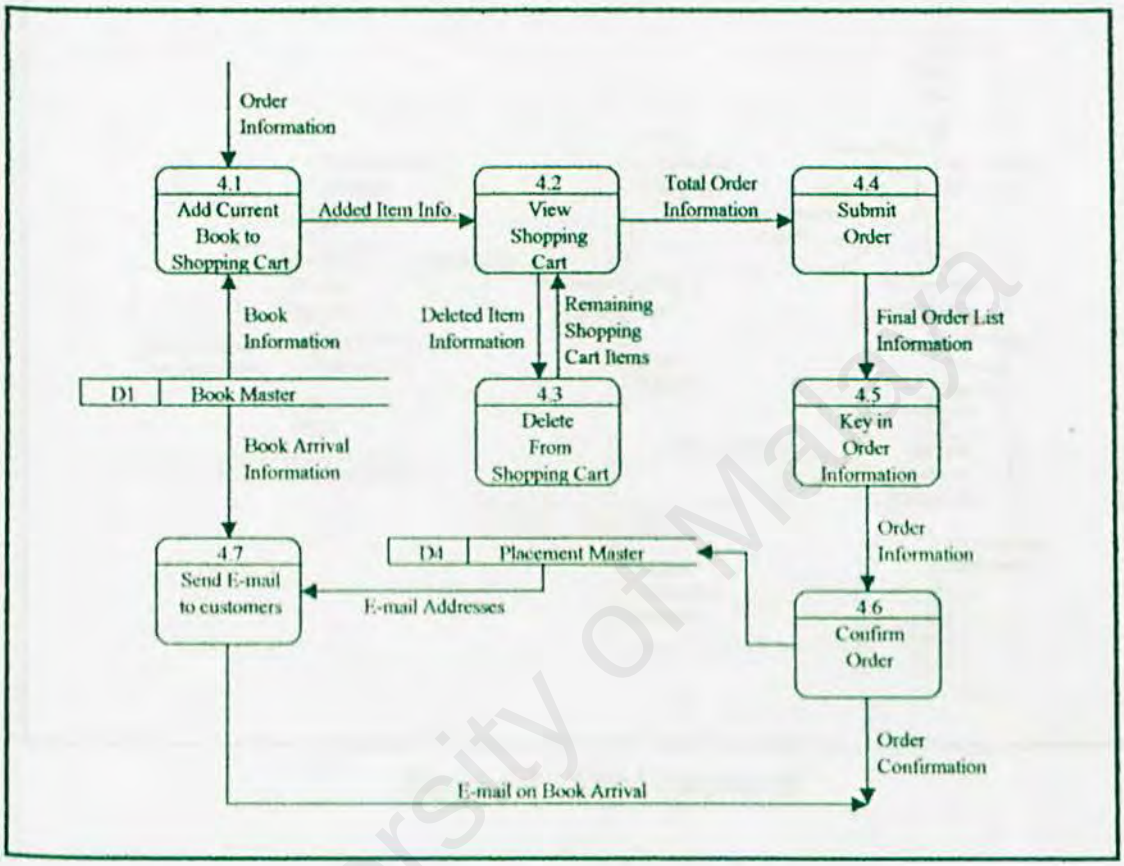


Figure 4-3 Child Diagram 4

4.1.5 CHILD DIAGRAM 8

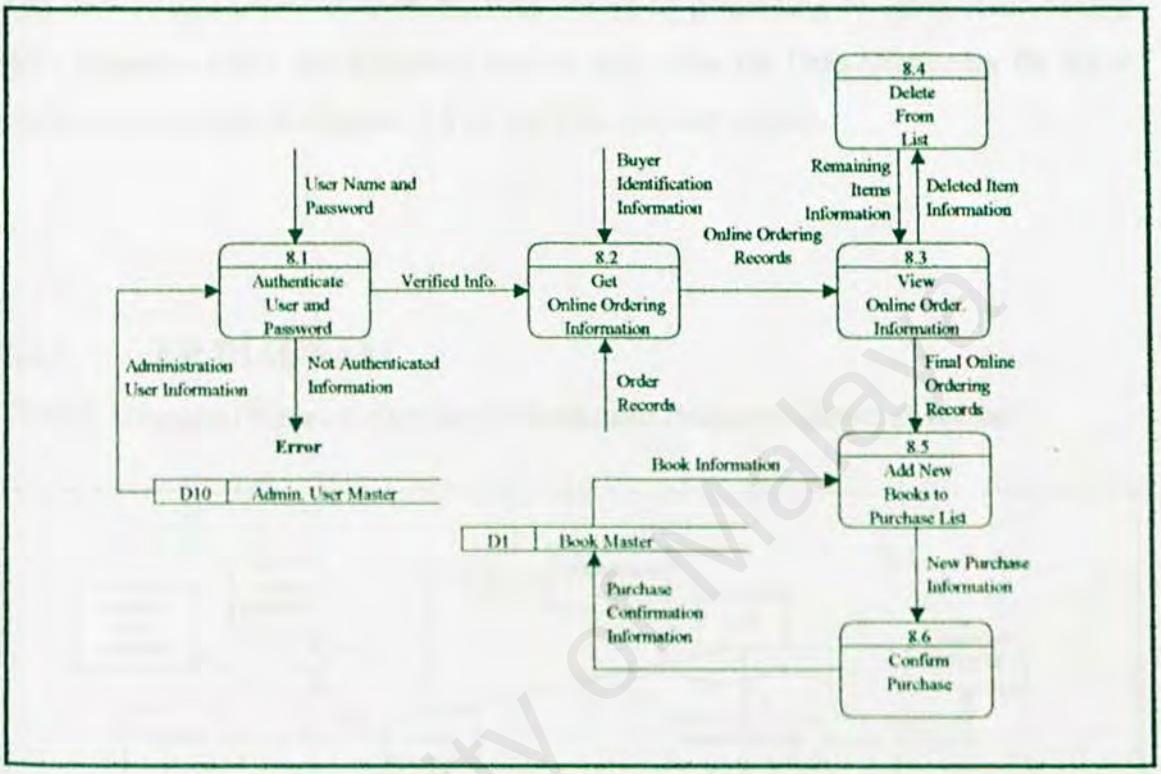


Figure 4-4 Child Diagram 8

4.2 DATABASE DESIGN

This section will concentrate on database design by presenting an Entity Relationship (ER) Diagram whilst the following section will show the Data Dictionary for the 4 modules mentioned in Chapter 3.1 of the E-Bookstore project.

4.2.1 ER DIAGRAM

The ER Diagram (Figure 4-5) of the E-Bookstore Project is shown as below.

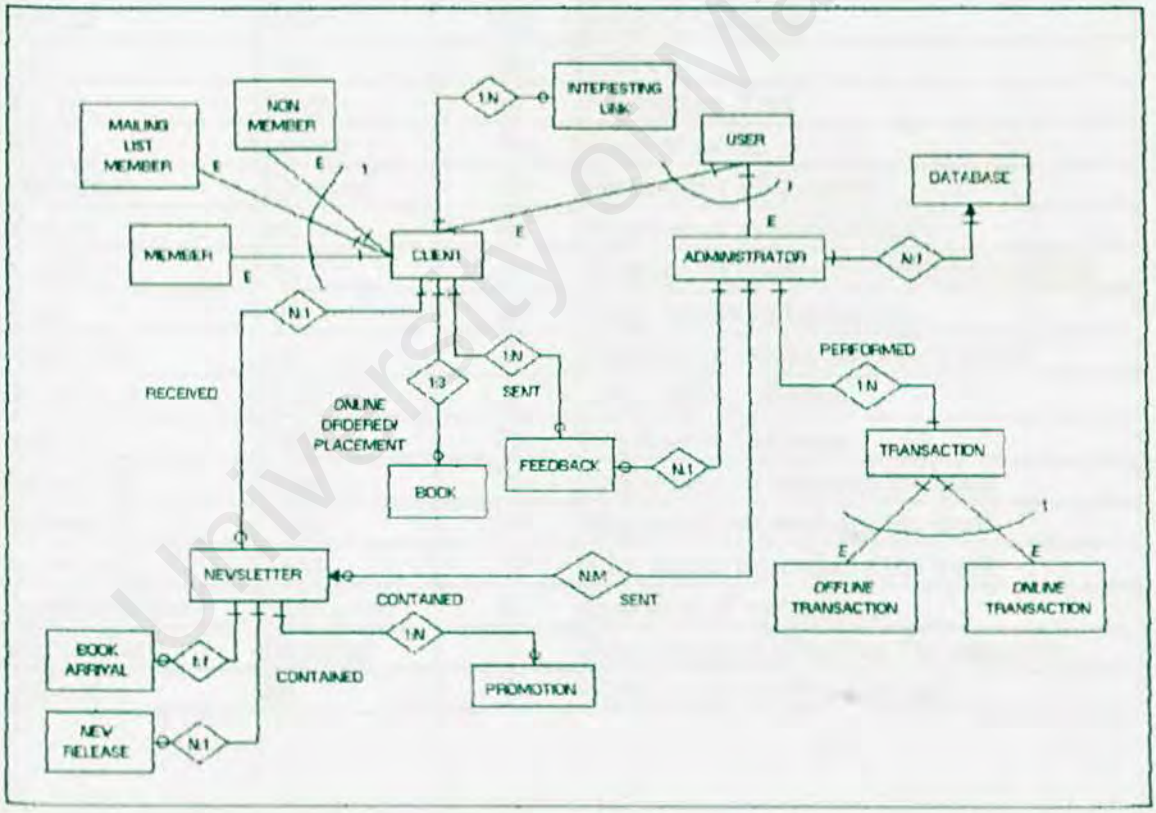


Figure 4-5 ER Diagram

4.2.2 DATA DICTIONARY

The Data Dictionary is a specialized application of the kinds of dictionaries used as references in everyday life. The data dictionary is actually a reference work of data about data (metadata), one that is compiled to guide systems design. The data dictionary listed below are those used in the E-Bookstore Project.

Table 4-1 Book Table

Field Name	Data Type	Length	Description
ISBN	Char	10	ISBN number of book (key)
Title	Text	16	Title of book
Author F_Name	Char	16	First name of author
Author L_Name	Char	16	Last name of author
Publisher	Text	16	Publisher
SubCat	Char	10	Subject Category
Ed	Text	16	Edition
YrPub	Text	16	Publishing Year
Price	Money	9	Price of book
DisPerc	Decimal	9	Percentage of discount
NoAvb	Int	4	Number of available books
NoOrder	Int	4	Number of books for Online Ordering
Total	Int	4	Total books in bookstore
NoPlaced	Int	4	Number of books placed on order
BookDesc	Text	16	Description of book
Icon	Text	16	Book icon file name
Keyword1	Text	16	Key words describing the book
Keyword2	Text	16	Key words describing the book
Keyword3	Text	16	Key words describing the book
PromEndDate	DateTime	8	End date of promotion
MbrDisPerc	Decimal	9	Percentage of discount for members
NoSold	Int	4	Total number of books sold

Table 4-2 Preference Table

Field Name	Data Type	Length	Description
ID	Int	4	Unique Identification Number (key)
SelectID	Text	16	Identification of selection criteria
Choice	Text	16	Selection choice
UsedBy	Char	3	Initials of user
Description	Text	16	Description of selection criteria

Table 4-3 Mailing List Table

Field Name	Data Type	Length	Description
ICNo	Char	12	Identification number (key)
CustName	Text	16	Name of customer
MtrcNo	Text	16	Matrics number of customer
EmailAdd	Text	16	E-mail address
JoinDate	DateTime	8	Date and time when joining the mail list
HTML	Bit	1	Select HTML or text e-mail format
Comp	Bit	1	Fields of interest (Computer)
Arts	Bit	1	Fields of interest (Arts)
Engine	Bit	1	Fields of interest (Engineering)
Busi	Bit	1	Fields of interest (Business)
Sci	Bit	1	Fields of interest (Science)
Econs	Bit	1	Fields of interest (Economics)
Fict	Bit	1	Fields of interest (Fiction)
Law	Bit	1	Fields of interest (Law)
Islam	Bit	1	Fields of interest (Islam studies)
Malay	Bit	1	Fields of interest (Malay studies)
Sports	Bit	1	Fields of interest (Sports)
Medic	Bit	1	Fields of interest (Medical Studies)

Table 4-4 Order Placement Table

Field Name	Data Type	Length	Description
PlaceNo	Numeric	(Autofill)	Placement number (key)
ICNo	Char	12	Identification Number
CustName	Text	16	Name of customer
MtrcsNo	Text	16	Matrix number of customer
EmailAdd	Text	16	E-mail address
ISBN1	Char	10	ISBN number of book (foreign key)
ISBN2	Char	10	ISBN number of book (foreign key)
ISBN3	Char	10	ISBN number of book (foreign key)
DatePlaced	DateTime	8	Date of placement

Table 4-5 Electronic Journal Table

Field Name	Data Type	Length	Description
TrxNo	Int	4	Transaction number (key)
TrxDate	DateTime	8	Transaction Date
ICNo	Char	12	Identification Number
ISBN1	Char	10	ISBN number (foreign key)
QtySold1	Int	4	Quantity Sold
PriceSold1	Money	8	Sale price of book
ISBN2	Char	10	ISBN number (foreign key)
QtySold2	Int	4	Quantity Sold
PriceSold2	Money	8	Sale price of book
ISBN3	Char	10	ISBN number (foreign key)
QtySold3	Int	4	Quantity Sold
PriceSold3	Money	8	Sale price of book
ISBN4	Char	10	ISBN number (foreign key)
QtySold4	Int	4	Quantity Sold
PriceSold4	Money	8	Sale price of book
ISBN5	Char	10	ISBN number (foreign key)
QtySold5	Int	4	Quantity Sold
PriceSold5	Money	8	Sale price of book
ISBN6	Char	10	ISBN number (foreign key)
QtySold6	Int	4	Quantity Sold
PriceSold6	Money	8	Sale price of book
ISBN7	Char	10	ISBN number (foreign key)
QtySold7	Int	4	Quantity Sold
PriceSold7	Money	8	Sale price of book
TotPrice	Money	8	Total price of books sold

The data dictionary listed above is used in conjunction with the data flow diagram in the previous section to analyze the systems design and to detect flaws and areas that need clarification. It assists in designing the E-Bookstore Project.

4.3 USER INTERFACE DESIGN

The User Interface Design is discussed in this section. Many users and developers feel that the user interface design is very important because it is the first reflection of a system.

The user interface design must achieve certain goals. These objectives are:

1. Effectiveness is achieved by allowing users to access the system in a way that is congruent with their individual needs.
2. Efficiency is demonstrated through the interface by both increasing the speed of data entry (for instance searching for a particular book) and reducing the errors that might occur.
3. Productivity is measured by ergonomically sound principles of design for user interfaces.

Of all the different kinds of interfaces that can be designed, a Graphical User Interface (GUI) is selected as the choice for the E-Bookstore Project. The GUI will allow for direct manipulation of the graphical representation on the screen, which can be accomplished with a mouse.

The design of the user interface is very important. Due to icons, hyperlinks and context sensitive help that are present in web sites, efforts need to be put in to aid the attainment of overall input design goals of effectiveness, accuracy, ease of use, simplicity, consistency and attractiveness. The user interface design should work toward these goals. The GUI of the E-Bookstore is shown in Figure 4-6.

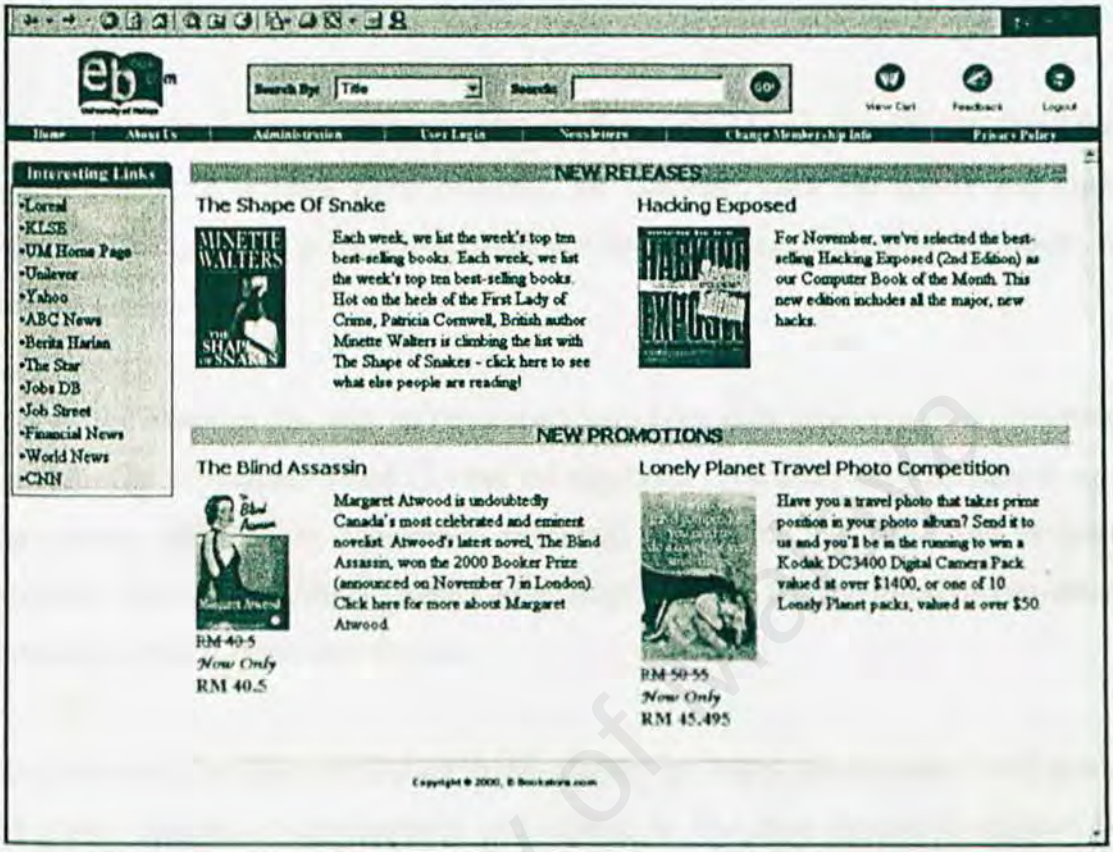


Figure 4-6 User Interface Design

4.4 SUMMARY

This chapter showed many tables and figures that outlined and described in detail the system design. The Data Flow Diagram, ER Diagram, Data Dictionary and User Interface Designs were shown here because it depicts the essence of the E-Bookstore systems design.

Four of the modules that will be developed have been duly shown in Child Diagram 4 and 8. Child Diagram 6 and 11 were not exploded from Diagram 0 because it was unnecessary and that the Diagram 0 explained sufficiently the data flows in those modules. The other modules (other Child Diagrams) will be developed by two other members of the E-Bookstore Project.

The three main sections mentioned in this chapter are important because it will guide the whole process of development and coding so that each module completes its various functions. It will also assist in a later stage of the development of the system, which is the systems integration whereby the different modules of the E-Bookstore Project will be combined to function as a single system with seamless integration.

5.1 DEVELOPMENT ENVIRONMENT

INTRODUCTION

This chapter focuses on the implementation methods of the Electronic Bookstore. Considerable explanation will be given with regards to the development environment, the development tools and the development of the various modules in the E-Bookstore itself. Lastly, focus will be given on the methods, styles and techniques of coding used in the implementation of this project.

5.1.1 SOFTWARE

The final implementation environment in terms of software usage is stated below. Most of the software used are the same as planned and no major problems occurred during the installation process.

Operating System	:	Windows NT4 Server Option Pack 4, Service Pack 5
Web Technology	:	Active Server Pages 2.0
Web Server	:	Internet Information Server 4
Database Management System	:	MS SQL Server 7.0
Web Application Development Tools	:	MS Visual InterDev 6.0
Server Side Scripting Language	:	VBScript
Client Side Scripting Language	:	JavaScript
Default Browser	:	MS Internet Explorer 5.5

5.1.2 HARDWARE

The hardware configuration for the server used to host the application is stated below. It is worthy to note that the hardware used is relatively advanced and much better than the minimum requirements needed to use the software. The modern hardware supplied is a very positive development as there is assurance that extra resources are available if and when needed. The configuration of the hardware used as the server is listed below.

Computer Processor	:	Pentium II Processor, 266 MHz
Hard Disk Space	:	4 GB of hard disk space minimum
Memory	:	128 MB RAM
Drive	:	Dell CD-ROM Drive
Display	:	S3 video graphics adapter
		15" Dell monitor
Peripherals	:	Dell Mouse, Dell Keyboard

5.2 DEVELOPMENT TOOLS

5.2.1 ACTIVE SERVER PAGES

Active Server Pages or ASP was used as the main development engine of the modules in the E-Bookstore. ASP scripts enables dynamic generation of web content and therefore was used extensively throughout every module in the E-Bookstore. The four main modules accomplished by me are namely the Sales Operation Module, Mailing List Module, Report Generation Module and the Order Placement Module. All these modules were developed using mainly ASP scripts to generate dynamic content and only 5% were developed using pure HTML code.

The Report Generation Module for example, constantly used ASP scripts to query the database and to display the results. As the data was queried only when the scripts were requested by the web page, the reports generated were therefore accurate by the second. The moment transactions were complete, the database would be updated and the results would be displayed immediately based on data in the updated database. The results will be accurate because the ASP script queried the database as and when the web page generation was needed, therefore the latest results could be obtained.

Similarly, the Sales Operation Module required ASP scripts to be used extensively. The following section shows a short section of ASP code. The function of this code is to display the results of the individual books bought by users in the Sales Operation Module.

```
'To add a book to the purchase list in the Sales Counter
objRS2.Find "ISBN = '"& objRS ("ISBN") &"'"
If objRS2.EOF Then
    objRS2.AddNew
    objRS2 ("Title") = objRS ("Title")
    objRS2 ("ISBN") = objRS ("ISBN")
    intQtyPur = Cint (intQtyPur)
    objRS2 ("QtyPur") = intQtyPur
    objRS2 ("Price") = objRS ("Price")
    If blnMember = TRUE Then
```

```
                If objRS ("DisPerc") = "0" Then
                    objRS2 ("DisPerc") = objRS ("MbrDisPerc")
                Else
                    objRS2 ("DisPerc") = objRS ("DisPerc")
                End If
            Else
                objRS2 ("DisPerc") = objRS ("DisPerc")
            End If
        Else
            objRS2 ("QtyPur") = objRS2 ("QtyPur") + intQtyPur
        End If
```

As can clearly be seen in the example above, the values assigned to the variables are not static and will be based on the values in the recordset during time of query. This will enable dynamic generation of web content as opposed to static assignment of values in the codes.

5.2.2 HYPERTEXT MARKUP LANGUAGE

HTML is still used in most parts of the codes that were generated. This is for the purpose of design and easier formatting of certain text and images on the web page. The most commonly used HTML commands were the formatting tags, the table tags and the form tags.

Formatting like <B>, <U>, <I> were used to bold, italize and underline certain words. The <TABLE> tag on the other hand was used for accurate placement of certain content within the web page. For example, to list the results of a query in a formatted table in the center of the web page, the <TABLE> tag below is used.

```
<TABLE WIDTH=100% ALIGN=CENTER BORDER=1 CELLPADDING =3
CELLSPACING=0 color=#e6e6fa>
    <TR><TD WIDTH=20% ALIGN=CENTER>ISBN</TD>
        <TD WIDTH=40% ALIGN=CENTER>BOOK TITLE</TD>
        <TD WIDTH=20% ALIGN=CENTER>QTY AVAILABLE</TD>
        <TD WIDTH=20% ALIGN=CENTER>PRICE</TD>
    </TR>
</TABLE>
```

The <FORM> tag was also used extensively to enable users or administrators to key in or select data. All these can be done by using HTML's form tag because data held by the HTML form could be passed to the ASP script or another HTML web page by either using the GET method or the POST method. For example, the following <form> tag written enables the administrator to select a particular criteria for report generation. The criteria selected will be passed to the results page where the report will be generated. This section of code can be seen in the Report Generation Module.

```
<FORM ACTION = "ReportPt2.asp" NAME = "Form1" METHOD = GET>
    <SELECT NAME = "List1" SIZE=1 ONCHANGE = "setOption1
    (this.form, this.selectedIndex)">
        <OPTION VALUE = "A" selected>Sales Transactions
        <OPTION VALUE = "B">Online Orders
        <OPTION VALUE = "C">Order Placements
        <OPTION VALUE = "D">Mailing List
        <OPTION VALUE = "E">Membership
        <OPTION VALUE = "F">Book Information</OPTION>
    </SELECT>

    <SELECT NAME = "List2" SIZE = 1>
        <OPTION VALUE = "1" selected>
        <OPTION VALUE = "2">
        <OPTION VALUE = "3"></OPTION>
    </SELECT>
    <INPUT TYPE = SUBMIT VALUE="Submit Query">
</FORM>
```

The code displayed above is used when the Administrator or Bookstore owner would like to view the various reports of the E-Bookstore. It displays two sets of drop down list for user selection. As can be seen, a set of JavaScript Code can be seen on the third line of code. The usage of JavaScript in the implementation of the E-Bookstore is discussed in the following section.

5.2.3 JAVASCRIPT

JavaScript was used mainly for two purposes. Validation was the most important function whereas the other function was mainly for beautification purposes.

There were choices of whether validation should be done on the server or on the client side. However, it was evident that validation using JavaScript on the client side had the distinct advantage of saving computer resources. Input by users needed to be checked and validated. Substantial time and resource was saved when the validation was done on the client side, rather than sending data back to the server for validation, before sending everything back to the client side again.

Forms which require user input need JavaScript functions to be embedded into the coding of the web page. When the user clicks on Submit, the button would invoke the embedded function and validation would begin. Whenever a user fills in the form field and the data isn't within the required range, a window will pop up and display an error message. The message display is spontaneous and immediate as no interaction is needed with the server. An example of the JavaScript validation function is as below:

```
<SCRIPT LANGUAGE=JAVASCRIPT>
    function ValidateForm()
    {
    if (document.Form1.CustName.value == "")
        {
        alert("Please fill in Full Name before submitting the form!");
        document.Form1.CustName.focus()
        return false;
        }
    }
</SCRIPT>
```

Another function of JavaScript is for beautification purposes. The following function actually changes the style displayed when a user moves his/her mouse over a text. The OnMouseOver actually invokes the launch of the JavaScript function "RollOn". The function in return check's if the criteria is correct before launching another function named "LitUp". The example is listed below.

```
<SCRIPT LANGUAGE=JAVASCRIPT>
function RollOn()
   {
    if( window.event.srcElement.tagName != "A" ) return;
    if( window.event.srcElement.className == "" )
      window.event.srcElement.className = "LitUp";
  }
</SCRIPT>
...
```

The usage of JavaScript is very useful as no extra burden is put on the server resources. This is very important as efficient use of computer resources is important in every application.

5.3 DEVELOPMENT OF E-BOOKSTORE

5.3.1 ORDER PLACEMENT MODULE

This module is a background process. A background process is a process which occurs without the knowledge of a user. An Order Placement can only be made if and when a book is not available at the bookstore. The development of this module thus functions as a mechanism to identify when books have arrived at the bookstore and to automatically send electronic mails to the relevant users who have placed an order with the bookstore for the unavailable books.

Much consideration was made to identify the most suitable event to invoke the automatic checking of the database and subsequent sending of e-mails to the users. It was finally decided that once an administrator login is authenticated and verified, the event would be invoked. However, a check would be done only the first time an administrator log's in on any one day. A second check would only be done the next day and so forth. This is for efficiency purposes.

If a book arrives at the bookstore and the quantity of books is updated into the database, this module would notify the customers who have placed an order. Notification would be done via e-mail and the user would be requested to proceed to the bookstore to purchase the book or to place an online order for that particular book so that it can be reserved for three days.

5.3.2 MAILING LIST MODULE

This is a relatively simple module. Visitors of the website could register themselves as subscribers of the E-Bookstore newsletter. New subscribers only need to fill in their particulars and click on the relevant fields of interest. Newsletters would be sent to these users based on their fields of interest.

This is one module where two types of validation exist. The first validation occurs on the client side when new subscribers fill in their personal particulars. The JavaScript function embedded into the web page would require the users to fill in the form properly and not leave any important information to be blank fields. The second validation occurs on the server side and checks whether or not a customer had already previously subscribed to the newsletter. No two identical users are allowed to register to the system. Thus a two-prong validation occurs in this module.

Subscribers can also change the particulars in the Mailing List Module by entering their identification card number. This is a simple process as the steps to edit the subscriber's particulars are almost identical to the steps when they first entered their particulars into the Mailing List Module.

New subscribers to the newsletter service or current subscribers of the newsletters will each be sent verification e-mails to ascertain that they are indeed the valid users. For an example, once a user submits his/her particulars, an electronic mail will be sent to that user to verify that he/she did intend to join the mailing list. Newsletters will only by sent after the subscriber follows the simple steps stated in the e-mail. This will prevent unauthorized users from exploiting this service to send spam mails. The procedure for editing subscription information is the same as the above. This will make sure that only authorized subscribers can change their subscription information.

5.3.3 SALES OPERATION MODULE

Development of this module was difficult as all different possibilities of sales transaction needed to be taken into account. For example, would the sales be allowed if a user online ordered only one book but intended to purchase more than one book? What happens if the remaining books had been online ordered by other people? Substantial consideration was needed to ensure a full proof system which took into account all possibilities of purchase.

This module will enable an efficient sales record system to be implemented in the E-Bookstore. This is because all sales done are updated into the database immediately, enabling reports to be generated based on the latest information.

The user interface of the Sales Operation Module consists of an input field for the unique ISBN Number for each book, an input field for the quantity of books purchased and finally, an input field for the entry of a purchaser's identification card number. The ISBN number of the book to be purchased is first keyed into the first input field, followed by the quantity of books bought. The last field is actually non-compulsory. Only members who wish to get discounts or purchasers who have ordered the books online need to produce their identification. The NRIC entered will verify that the purchasers are indeed members or that they indeed online ordered the books via the Internet.

The cashier just has to key in the ISBN number as the checking of online orders or the authorization of membership discounts is done by the system automatically. Not much training is needed to operate this module either.

5.3.4 REPORT GENERATION MODULE

This module was done to enable reports to be generated for the purpose of better administration and better control over the bookstore. It is aimed primarily at the bookstore owner but can be viewed by personnel with administrator privileges also.

The different report types that were available for the administrator or bookstore owner were hard-coded into the module because the purpose of this module is to facilitate better understanding of the bookstore business, not to takeover completely the task of analyzing the business from the bookstore owner. Therefore, the most common reports which would enable the bookstore owner to better understand his business were hard-coded into this module.

This module has an automated alert system. An automatic alert system would prompt critical news for the knowledge of the bookstore owner or the administrator. For example, when the total quantity of book for a particular title reaches below 1 book, news would be prompted at the first screen of the Report Generation Module. In addition to that, an e-mail of the news would be sent to the bookstore owner and the employee who is in charge of purchasing books.

The criteria to send e-mails and to prompt news can be changed by the administrator if thought necessary. For example, if the administrator would like an e-mail to be sent once the quantity of a particular book reaches below 5, a click of a link in the module would facilitate this change. Change is both easy and user-friendly.

The list of reports that could be generated by this module is listed below.

i) Cash Turnover for sales of books
ii) Quantity of books sold
iii) Popularity of books sold
iv) Cash Turnover for all online orders for the valid period (3 days)
v) Quantity of books on online orders for the valid period (3 days)
vi) Popularity of books that were online ordered
vii) Quantity of books that were put on order placements
viii) Popularity of books that were put on order placements
ix) Fields of interest for all mailing list subscribers
x) Additions to the mailing list for a certain period
xi) Fields of interest for all E-Bookstore members
xii) Member additions for a certain period
xiii) Books on promotion
xiv) Range of promotions for all books with discounts
xv) Physical quantity of books left for different book titles

5.3.5 OTHERS

Some of the work done in the E-Bookstore was not gazetted as functions or modules, rather, they were necessary in order to enable a system to be smoothly implemented. An example of this was related to the book discounts.

Once a book is placed on promotion, any online orders or sales of the book would have to be automatically counted based on the promotion price. Subsequently, after the promotion period ends for a certain book, the normal price will be counted. Therefore, an event needed to be invoked in order to facilitate resumption of the original price once the promotion period was over. The event would convert all promotion prices back to the original price without any administrator interaction. This would lighten the burden of the system administrator.

5.4 CODING TECHNIQUES

5.4.1 CODING METHODOLOGY

In developing the E-Bookstore system, the top-down approach was used as the coding methodology. A top down approach is easy to visualize as it looks at the overall picture of the system and subsequently exploding and dividing it into smaller parts or subsystems. The specific task to be accomplished is broken down into subtasks, and each of the subtasks is then further decomposed into smaller subtasks and so forth.

The top-down approach provides desirable emphasis on synergy or interfaces that systems and their subsystems require. Furthermore, it ensures that the most important modules are developed and tested first.

5.4.2 STRUCTURED PROGRAMMING

Structure programming is a disciplined approach to programming that results in programs that are easy to read and understand and less likely to contains errors. This type of programming style is clear and readable compares to object-oriented programming. Although it is easier to develop using structure programming, it is very hard to maintain because the program is not modular and takes time to make modification. Hence, some of the sections that can be modularized are being modularized to reduce the problems of long term maintenance. However, readable codes are also easier to be maintained and enhanced in the future by other programmer.

The elements of style of programming include internal documentation, methods for data declaration and approach to statement construction. Some of the style of coding is selection of meaningful identifier (variables) names, such as, strAdminName is a variable to store a string for administrator name. Besides, comments are written in

source code to describe the codes, so that to make maintenance an easier job. Also, the indentation of codes are put to increase the readability of source codes.

5.4.3 DEBUGGING TECHNIQUES

The debugger used during development is the Microsoft Script Debugger, together with Internet Explorer. Debugging enables the developer to accurately pinpoint the exact location of error and the types of error which caused the bug or bugs in the code. Usage of the Microsoft Script Debugger enables the developer to trace all errors with minimum effort and time compared to developing the application without using a debugging tool at all. An example of an error message is as below.

```
Microsoft OLE DB Provider for SQL Server error '80040e21'
The requested properties cannot be supported.
/EBook/cwy/Report Module/ReportPt2.asp, line 202
```

As can be seen clearly, the error message gives an idea of the error by stating that the requested properties cannot be supported. The code line number is also given to facilitate exact location of the error in the code. This is important for the developer to debug the codes.

5.5 SUMMARY

This chapter explained in detail the development of the E-Bookstore Project. The planning and research done in prior chapters proved to be useful as the development was smooth. The various phases of development were according to schedule and there were no problems during the installation of the software. The tools used to develop the E-Bookstore were adequate and coding could progress smoothly.

Section 5.3 described in detail the progress and accomplishments of the modules. The Sales Operations Module, Report Generation Module, Order Placement Module and the Mailing List Module were all developed according to specifications and no major problems were encountered. Again, the planning assisted in the smooth transition from plans (Chapter 4) to codes.

The modules were coded using an approach known as structured programming. This minimized the errors and also enabled codes that were easier to read. Debugging was also discussed. Basically, the Microsoft Script Debugger was used. The debugger enabled speedy and exact identification of errors, which eased the burden of manually finding errors in the codes.

The next chapter will discuss a bit on the testing methods used to ensure that the E-Bookstore functions accordingly to its specifications.

6.1 SYSTEM TESTING

INTRODUCTION

Systems' testing is required to ensure that the system runs smoothly and is according to its specifications. Testing is necessary to ensure that the final system delivered is in line with the user's requirements and expectations.

In general, the E-Bookstore underwent three general stages of testing which is the component testing, integration testing and the user testing. These three stages consist of five types of tests. These are described in detail below.

6.1.1 UNIT TESTING

Individual components in the Electronic Bookstore, such as single procedures or functions are tested to ensure that they operate correctly in a module. Unit testing focuses the verification efforts on the smallest unit of software design. Each component is tested independently, without other system components [76]. For example, the Report Generation Module consists of many units, including the generation of different reports. Each of these reports was tested individually to verify that the correct report type was generated, that the report was within the limits set by the user, and that the results were accurate.

In the same Report Generation Module, an example of another unit which was independently tested was the sending of electronic mails to the bookstore owner. The sent e-mail was checked to determine whether or not the correct subject was placed, whether or not it was sent when the pre-determined criteria was met, and whether or not the correct reports were sent.

6.1.2 MODULE TESTING

A module is a collection of dependent components. A module encapsulates related components only and therefore can be tested without other system modules. Using the same example mentioned in Unit Testing, the Report Generation Module was tested as a collection of independent reports and other components like the sending of e-mails, the News Alert component etc. All of the different units which made up the Report Generation Module were tested as a module to make sure that it could function together seamlessly without any problems.

Another example is the Order Placement Module. This module was tested to ensure that the various components could work together. One component ensured that books that were physically unavailable were put on order placement, and not detected as books that were online ordered. When the books arrived, another component would then send e-mails automatically to the customers. After the e-mails had been sent to the customers, another component would then delete the records from the database. All these components had to work together seamlessly in the Order Placement Module.

6.1.3 SUB-SYSTEM TESTING

This phase involves testing collections of modules in the Electronic Bookstore, which had been integrated into sub-systems. Sub-systems may be independently designed and implemented. The most common problems that arise in large software systems are sub-system interface mismatches. The sub-system test process should therefore concentrate on the detection of the interface errors by rigorously exercising those interfaces.

In some of the E-Bookstore sub-systems like the Mailing List sub-system, some testing was needed to enable three different parts to work together, namely the module to add users to the mailing list, the module to enable editing of subscriber

information, and the module to unsubscribe from the mailing list. These parts had to work together to ensure that it was indeed possible for users to successfully subscribe, edit information or unsubscribe from the mailing list as and when they wanted to.

6.1.4 SYSTEM TESTING

The sub-systems are then integrated to make up the entire system. The testing process is concerned with finding errors which result from unanticipated interactions between sub-systems and system components. It is also concerned with validating that the system meets its functional and non-functional requirements.

System testing had to be wholesome to ensure that the objectives set out early in the requirements definition stage had been met. This is because it is easy to lose sight of the overall achievements of the system when so much work had been put into developing the individual modules.

The system testing was also the only place where the non-functional requirements could be tested and validated to see if they had met their overall objectives.

6.1.5 ACCEPTANCE TESTING

Acceptance testing, or sometimes called as alpha testing is the final stage of testing whereby the Electronic Bookstore system is tested before being accepted by the user for operational use. Acceptance testing reveals errors and omissions in the system requirements definition because the acceptance testing involves testing from the user. During the acceptance test, the functionality of the system is demonstrated to the users and the users may experience the system hands on.

This stage of testing helps to reveal the requirement problems that exists where the functions provided by the system do not really meet the user's need or requirement.

The different types of testing are drawn in the diagram below to depict the exact stages of testing.

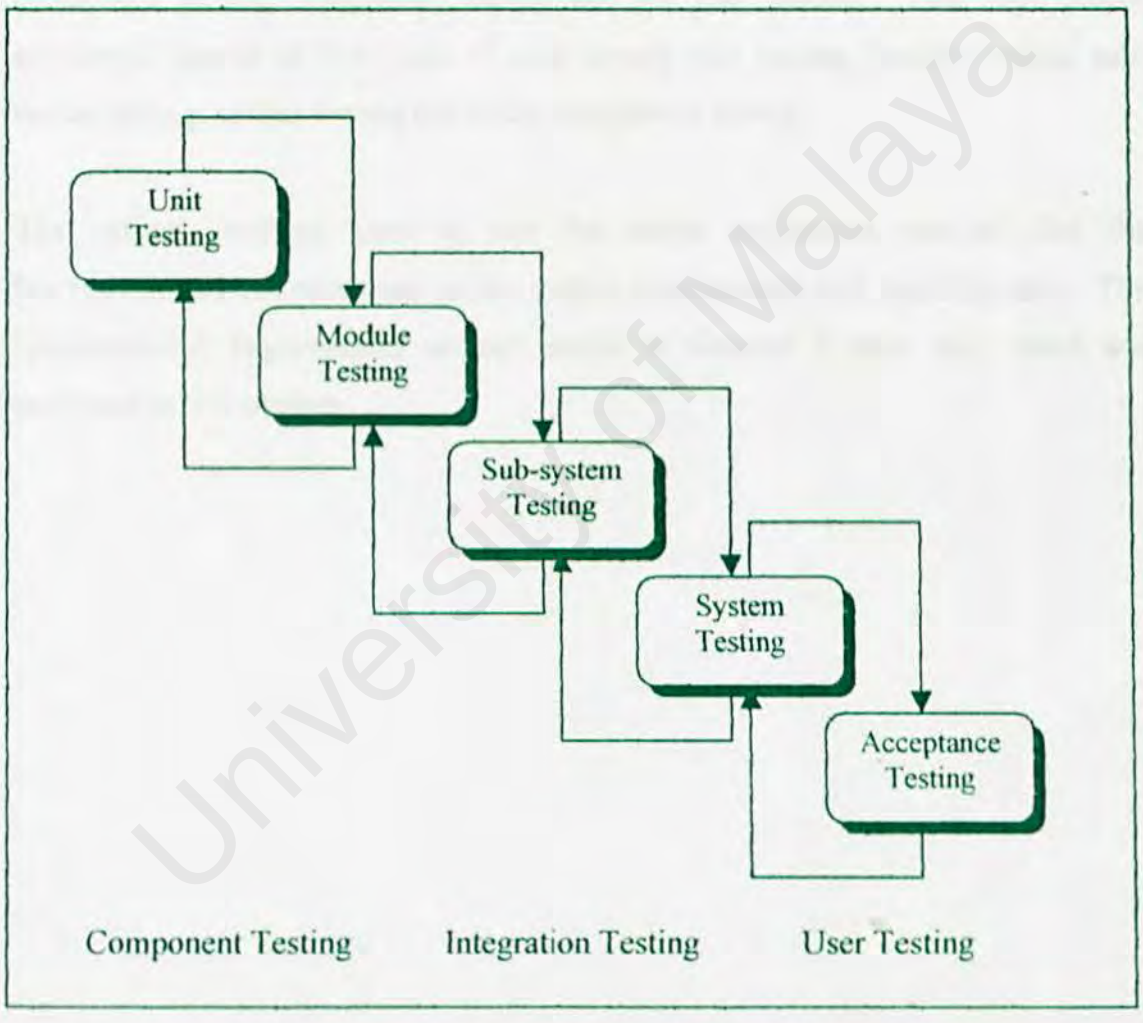


Figure 6-1 The Testing Stages

6.2 SUMMARY

This Chapter explains in detail the various testing techniques and methods used to evaluate the E-Bookstore system.

The E-Bookstore underwent three general stages of testing. These were the component testing, integration testing and the user testing. The three stages mentioned consist of five types of tests namely unit testing, module testing, sub-system testing, system testing and lastly, acceptance testing.

The various methods used to test the entire application ensured that the functionalities were congruent to the system requirements and specifications. The non-functional requirements set out earlier in Chapter 3 were also tested and evaluated in this chapter.

7.1 PROBLEMS ENCOUNTERED

INTRODUCTION

The objective of this chapter is to identify the various problems faced during the implementation of the E-Bookstore and also to evaluate the E-Bookstore system as a whole. System Evaluation is done by assessing the strengths, the weaknesses and to assess which features could be enhanced in the future.

7.1.1 ACTIVE-X DATA OBJECT 2.0

The connectivity issue with the database using ActiveX Data Object or ADO was quite complex. The usage of ADO in database connectivity was necessary as it was of essence in creating, deleting, updating and querying records from the database to manipulate data. Each instance of access to the E-Bookstore web page would invoke the code to access the database.

However, during coding of the Sales Operation Module, there were problems with updating and deleting records from the database when a specific code was executed. One of the problems encountered was a run-time error. Although the code had been checked and verified, the error message constantly appeared in the browser when the codes were run.

```
Run-time error '-2147217885(80040e23)':
A given HROW referred to a hard- or soft-deleted row
```

After much checking and validation, it was discovered and confirmed that this was due to a Microsoft ADO 2.0 bug, which could only be corrected by installing ADO 2.5 or above. The error which occurred from the Sales Operation Module ceased to appear after ADO 2.5 was installed.

7.1.2 CHALLENGES IN LEARNING ASP

Learning ASP from scratch was somewhat of a challenge. Furthermore, the task of learning JavaScript and HTML while coding simultaneously was daunting. As an example, we did not know whether functions existed for the conversion of text to date fields. The existence of functions could only be hypothesized until we read through the documentation and tutorials of ASP to discover the exact commands.

Although ASP is very much similar to Visual Basic, coding a standalone application is very different from coding a web application, as many users could access web pages simultaneously whereas a standalone application serves only one user at a time. This kind of web programming style and concept was difficult to comprehend at first as we did not know how to identify the different users who visited the E-Bookstore website at any one time. Again, the functions were identified when there were substantial knowledge gained in ASP functions. For example, ASP provided session objects that facilitated the ability of the E-Bookstore application to identify different sessions when a user accessed a web page, therefore it was possible to keep track of each individual user of the application via the sessions object. All in all, the problem lies in lack of mastery in the usage of ASP functions.

7.2 SYSTEM STRENGTHS

7.2.1 USER FRIENDLINESS

The operation and interface of the E-Bookstore is designed in a way that promotes user friendliness. The design is easy to understand and buying or ordering books via this web-based application will be easy. This is due to the ease of navigation, the clear pictorial concept of the web pages and also availability of clear text to help customers better understand the messages and the instructions of the E-Bookstore.

7.2.2 AVAILABILITY AND CONVENIENCE

As with all web-based application, the E-Bookstore is available for users to visit 24 hours a day, 7 days a week. The availability is always there unless the server is down. Convenience is also an advantage. The website is always accessible and you can visit the website when and as it is convenient to you.

For the users, searching for books can never be easier. Newsletters are sent to customer's user accounts and online ordering or order placements can be done via the Internet. No more hassle with traveling and no more time wasted on book shopping.

As for the administrators and the owner of the bookstore, discounts can be put via the Administrator's module and the Sales Operation module will record sales transaction into the database immediately. E-mails sent will notify the administrators or owner immediately when there is a shortage of books. Reports can also be generated easily to better understand the operations of the business. Efficient and accurate information on the business of the bookstore will enable the bookstore owner to respond to the needs of the users more effectively. This will enable better operations of the bookstore.

7.2.3 ACCURATE AND RESOURCEFUL REPORTS

The Report Generation Module provides a way in which the administrators or the bookstore owner can actively query for reports to evaluate the day-to-day operations of the bookstore. This report is very useful and is very easy to use, as the user would only need three mouse clicks to generate any report. The ease in which reports are generated enables anyone to use the module without any proper training once they have logged in as system administrators.

The reports generated are also up to date as the database is queried at the time the user clicks on the mouse. The latest information will be included into the report and this is important. An example is the book availability report. If the quantity of books for a particular title has run out, the administrator or bookstore owner would be able to know about it immediately either through e-mail or through the news alert which displays the news at the first page of the Report Generation Module. This would enable speedy re-ordering of the books. Compared with the old system whereby a manual physical count of the book is needed, the new web-based system works much more efficiently.

7.2.4 WEB-BASED SALES OPERATION TRANSACTIONS

The Sales Operation Module offers distinct advantages over the current system in the university bookstore. This is so because the E-Bookstore system provides a simple interface whereby sales recorded by the cashier can immediately be recorded into the database. Immediate updating of the database enables the bookstore staff to lessen their burden to manually count the physical books left in the bookstore. Total sales volume and cash turnover for the day can also be automatically calculated as no manual count of receipts are needed. This is a much more efficient and simpler system compared to the manual system now existing in the bookstore.

7.3 SYSTEM LIMITATIONS

7.3.1 LIMITED CLIENTELE

The clients targeted for this web application include university students, lecturers and the bookstore owner. This is a limitation as web based applications are borderless; it is accessible to users around Malaysia and even around the world. Therefore, the limited client base of around 20,000 people will discourage growth to the business. Besides, the limited client base actually undermines the potential of the application.

However, for the bookstore to open its customer base to users around the Klang Valley, around Malaysia or even around the world, enhancements are needed as the system has limitations. Some of the limitations are discussed below.

7.3.2 NO ELECTRONIC PAYMENT METHOD

Currently, the bookstore only accepts cash as payment method. No cheques are allowed and no other electronic payment method is available for the choice and convenience of the customers. The same concept has been incorporated into the application. This is actually a limitation where web based applications are concerned. Non-availability of electronic payment methods would discourage long distance customers, as payment of cash would be difficult for those who are not around the vicinity of the bookstore.

Although security is a concern when electronic payment methods are used, the potential for the company to attain exponential growth is tremendous when it opens its client base to customers from around the world. The bookstore might receive many more orders for its books if there is an easy-to-use electronic payment method available.

7.3.3 NO DELIVERY SYSTEM

Perhaps, the limited client base is due to the fact that there is no delivery system. The bookstore does not provide delivery of books to the customers. It is understandable if the targeted clients of the business are users in the University of Malaya only. However, if the bookstore intends to expand its business, it must do so by setting up a delivery system. The bookstore would then be able to cater to customers from a much wider geographical area.

7.3.4 MANUAL INPUT OF ISBN AND NRIC NUMBER

The Sales Operation Module which records sales transactions by the cashier currently incorporates a manual system of input for all user identification (NRIC) and ISBN number for the books.

The manual input of these particulars would greatly lengthen the time of each transaction because the cashier would have to enter the ISBN number for every single book. Besides that, manual transactions are known to be more error prone because of human interaction with the system. The input of a series of 10 numbers for each book purchased can be tedious work, especially so when the cashier is tired.

7.3.5 UNAVAILABILITY OF CUSTOMIZED PRINT FEATURE

Although accurate and timely reports could be generated with only a few clicks, no customized print features are available. The facility to enable administrators or the bookstore owner to print the reports would greatly improve the usability of the Report Generation Module as the reports could be printed and kept physically for record keeping and for offline report analysis purposes.

The unavailability of a customized print feature also greatly undermines the functionality of the Sales Operation Module, as receipts cannot be printed for the customer. Although many customers do not require receipts, it is only professional and appropriate for any sales transaction to be accompanied by an official receipt. With the current system, the manual issuance of a receipt is needed.

The browser does include a print function, but the entire screen, together with the navigation menu, links and icons would be printed together with the desired report or desired receipt. Keeping reports and printing receipts with icons is not appropriate for an official document.

7.4 FUTURE ENHANCEMENTS

7.4.1 ELECTRONIC PAYMENT SYSTEM

Affiliations can be set up with credit card companies or established banks in Malaysia to enable payment via electronic means. An electronic payment system would enable the business to reach a potentially wider range or customers, thus increasing its sales volume and potentially increasing its profits.

An important criterion in the electronic payment system is security. Customers must feel secure with the electronic payment system before they are willing to purchase books online. A secure system is vital in securing customer confidence.

7.4.2 DELIVERY SYSTEM

To cater to a wider customer base, the bookstore should consider setting up a delivery system. An example would be to form an alliance with the Pos Malaysia office, which is located just above the bookstore. The guaranteed next day delivery service of Pos Laju will enable customers to receive their books the very next business day, if the payment has been made. An efficient delivery system will encourage customers across Malaysia to purchase books from the bookstore. This is a vital component in catering to customers outside the vicinity of the university.

7.4.3 BAR CODE SCANNER

The E-Bookstore system will benefit from a bar code scanner. The cashier will use the bar code scanner to scan a student's matrics card number. Furthermore, the ISBN number of each book can be scanned into the system. The introduction of a bar code scanner has distinct advantages over manual input of data.

Firstly, less user interaction with the system will enable accurate data to be entered into the system. Errors can be reduced significantly.

Secondly, efficiency is improved as the time needed to record a book purchase would be reduced. The cashier only needs to open the first page of the book and scan the ISBN number into the system. The transaction would be completed and recorded into the system with minimal user interaction.

7.4.4 CUSTOMIZED PRINT FEATURE

Another future enhancement is to incorporate a customized print feature into both the Sales Operation Module and the Report Generation Module. The Sales Operation Module can be improved if it could print an official receipt once a sales transaction is complete.

The report printed using the Report Generation Module can be used as official statements if the print feature is incorporated. Currently, printing can only be done via the browser's print command. This will print the entire screen, inclusive of graphics, the navigation menu etc, which is inappropriate as an official document. The new print feature should print the queried data only, together with the bookstore logo, so that the printouts are more professional.

7.5 KNOWLEDGE AND EXPERIENCE

I have learnt many valuable lessons during the planning and execution of the entire web application. I now understand common web technologies, I have gained valuable web programming skills, understand better the benefits and implications of the Internet, and most importantly, I truly realize the importance and strength of working as a team.

Functioning as a team requires commitment and sharing of thoughts by every member of the team. Everybody has to work together so that the outcome will be synchronous and that all modules can be easily integrated into a whole system. Working together enables sharing of knowledge as we learn from the experties of another team member.

Besides, the theoretical lessons from Systems Analysis and Design, Software Engineering, Database Management Systems, Programming etc was put to use. Everybody learnt to apply the theories of computing into workable applications.

In a nutshell, the whole year spent on this project has been a wonderful experience for me. I truly enjoy each and every moment of it.

7.6 SUMMARY

This chapter evaluates the E-Bookstore Project. The first section of this chapter describes in detail the problems encountered during the implementation of the project. This includes problems with the ADO and the challenges of mastering web technologies in a short span of time.

Next, the system strengths were discussed. Due to the nature of a web-based application, the project naturally inherited the benefits of the Internet which include 24-hour availability, a borderless reach, a simple to use application etc. The weaknesses of the system on the other hand were due to the fact that the application was catered for university customers only. Therefore, the potential of the application was not fully utilized.

The future enhancements that will improve the system were mentioned in this chapter too. The main idea was that the bookstore should plan to increase its customer base. This will require an electronic payment system and an efficient delivery system to be put in place. With a wider customer reach, the potential for the bookstore business to grow will be tremendous.

Finally, some of the experiences and valuable knowledge gained was mentioned in the final section of this chapter. Good teamwork was of essence in the success of this project.

REPORT CONCLUSION

The E-Bookstore Project is indeed a very interesting and challenging project as it introduces a new realm into the everyday business conducts of the University Bookstore.

This report has addressed important issues with regards to definition, planned implementation methods, development manner which includes software, hardware and the design of the E-Bookstore system. Prior research conducted had revealed that the web technology implemented was viable and proved to be both challenging and interesting for the developers. It is expected that the system would substantially benefit the users of the system, which are the bookstore owners and the students in the University of Malaya. A pleasant shopping experience will be enjoyed by all in the near future.

This Project had also increased my knowledge tremendously. I can now better understand some of the theories learnt from the various courses attended. This deeper understanding of theories has also enabled me to further develop my practical skills in design and teamwork. As a whole, it has been a very satisfying and enchanting experience for me to be part of the team that developed this E-Bookstore Project.

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