Mobile Bookstore (m-Bookstore)

by

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3610

Final report submitted in partial fulfillment of
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Bachelor of Technology (Hons)
(Information Communication Technology)

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CERTIFICATION OF APPROVAL

Mobile Bookstore

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Aman Zenni Bin Roslan

A project dissertation submitted to the
Information Technology Programme
Universiti Teknologi PETRONAS
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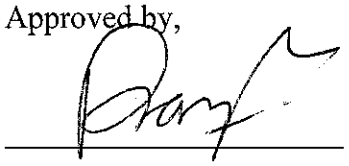
Approved by,



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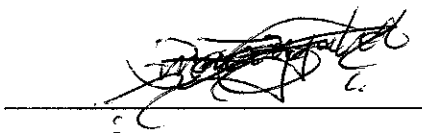
UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK
May 2006

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project/assignment, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.



AMAN ZENNI BIN ROSLAN

ABSTRACT

Mobile technologies and computing are evolving and expanding each day, demanding and creating a much more ubiquitous computing environment. This research project proposes the development and implementation of the Mobile Bookstore – a mobile solution for bookstore businesses. This report presents the final research and study of the development of the Mobile Bookstore as a solution to the problem statements stated in the project proposal as well as in this report, which is considered as the main objective of the study. The Mobile Bookstore will address to the four problem statements, which are the geographical problems, the advancing mobile technologies, ubiquitous demands in computing and large bookstore information requests. These objectives help in answering the question to why this research is done and why would we need a mobile bookstore? With the mobile bookstore, companies can reach out to more customers, anywhere and everywhere using mobile devices. This concept allows for a more ubiquitous business and computing. Major bookstores need to compete and to be on top, implementing the latest technologies to serve its customers, and the mobile technology is one that should be taken advantage of. Browsing the large database of a bookstore can be time-consuming and difficult using expensive kiosks that come in limited numbers. A wireless environment can create wireless networks allowing those with mobile devices to browse through the bookstore database with ease. With this report, the basis for the research of this project will be underlined in detail, including the technologies, means, methods and study of recent researches related to the study. The result of this research project will be the software solution, a system (the Mobile Bookstore), which consists of two modules: the outdoor WAP-based module and the indoor Wireless Network module.

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ABBREVIATIONS

WWW

World Wide Web

W3C

World Wide Web Consortium

HTML

Hypertext Markup Language

XML

Extended Markup Language

WAP

Wireless Application Protocol

SOAP

Simple Object Access Protocol

WPAN

Wireless Personal Area Network

PDA

Personal Digital Assistance

WSE

Web Service Enhancements

J2ME

Java 2 Micro Edition

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worldwide and it is the single medium of which we agree on to be the main source of education and knowledge.

1.1.2 The World Wide Web (WWW)

According to [19]

> The World Wide Web ("WWW", "W3", or simply "Web") is an information space in which the items of interest, referred to as resources, are identified by global identifiers called Uniform Resource Identifiers (URIs). The term is often mistakenly used as a synonym for the Internet, but the Web is actually a service that operates *over* the Internet.

The vast growth and evolution of the Internet has affected our lives in many ways we would have never imagined 20 years ago. The Internet, as we know it, is a collection of interconnected networks that link and connect people from all over the world under a common standard and protocol. The World Wide Web provides vast resources of information in web pages sent to the users' computers, almost instantly. The advancements in technology have provided us with better network managements and hardware, resulting in better and faster network performance. This increases the speed of information transfer within the Internet to allow a much faster use of the World Wide Web.

The World Wide Web has spawned many new features and applications for our daily lives. As we can see today, businesses are competing to provide its products and services *online* or through the World Wide Web. E-commerce and e-business are emerging in today's advanced and modern environment. Online sales of products and services are increasing and are becoming crucial to most businesses. As the Internet and the World Wide Web provides new opportunities for businesses, it also provides new opportunities for the dissemination of knowledge and education to a wider audience, worldwide. The Internet and the World Wide Web have also made it possible for online

collaborations and work to be done among parties from different regions of the globe without them having to travel far.

1.1.3 Mobile Technologies

Mobile devices are very popular in today's world. Mobile phones allow us to communicate with others almost everywhere. Before, telephones were only to be used at homes and offices, but not on the go. Now, mobile phones can be used almost anywhere, providing us with mobility in our daily communications with others. Mobile devices are advancing each day, providing more and more features to its users, besides communication. Mobile phones nowadays allow users to perform more functions than ever, such as running applications, games and many other useful features.

According to [13]

> Mobile personal devices such as Palm Pilot devices, web-enabled cellular phones, and Personal Data Assistants (PDAs) have been the darlings of consumers from businessmen to students alike. The decrease in price of the mobile devices due to market competitiveness and the established open standard for wireless application development is fueling this hyper growth of m-commerce. According to a recent market study, it is estimated that there will be 500 million wireless subscribers by the end of year 2001, and this number is expected to grow to more than a billion by 2004. (p. 199)

Today, we talk about mobile phones with capabilities to run powerful applications and also to join networks as well as the Internet. Web services are extended to mobile devices, making way for the existence and advancements of mobile web technologies. Nowadays, the mobile device market is growing rapidly and this can be seen even in Malaysia alone. Mobile device companies such as Nokia, Panasonic, LG, Samsung, Sony Ericsson and Motorola are competing in the mobile device industry, providing us with all the latest mobile gadgets especially mobile phones. The

growth of the mobile device industry itself acts as a catalyst to the growth of mobile applications and also mobile commerce.

1.1.4 Web Services

The W3C definition of Web Service [18] is:

> '... a Web Service is a software system designed to support interoperable machine-to-machine interaction over a network. It has an interface described in a machine-processable format (specifically WSDL1). Other systems interact with the Web Service in a manner prescribed by its description using SOAP2 messages, typically conveyed using HTTP with an XML3 serialization in conjunction with other Web-related standards.'

According to [4]

> Web Services provide a technology for expressing the interactions between customer and business partners, as part of their business processes. Over the last ten years, Internet growth has been phenomenal, fuelled by consumer browsing and shopping. Businesses have been creating trading partnerships electronically, and in recent years more of these have been created using Web Services to enable interoperability between partners. Web Services have seen early adoption and rapid growth, and many businesses are now offering Web Services access to their business systems for their trading partners. (p. 202)

The principal goal of Web Services is to provide interoperability between typically distributed application components [4]. When we talk of Web Services, we are referencing to the use of the World Wide Web on the normal desktop or personal computer systems. But of course, Web Services extend to more features besides the plain HTML. However, Web Services are more concerned with web applications that are meant for the everyday normal computers, whether used at home, work or for special-purpose computer systems.

1.1.5 Mobile Web Services

According to [4]

> Mobile Web Services apply Web Services technology to the mobile environment, enabling exciting new services to be offered to consumers on their mobile telephones, wireless-LAN-enabled PDAs and laptop computers. Mobile Web Services are the application of Web Services technology to the mobile environment. Standard Web Services technology could be directly applied to applications on mobile devices, for instance a shopping application on a mobile telephone could invoke an operation on a Web Service using SOAP, to purchase a music CD, and provide payment information. However, this application of Web Services technology is unlikely to meet the full requirements of the mobile application and its user. A mobile Web Service application will typically differ from a more traditional Web Service application because of the following factors: (a) the portability of the device; (b) the association of the device with a particular user; (c) the personalization of the application to the user; (d) the constraints imposed by the limitations of the device, in terms of limited user interface, small form factor, low processing power and often poor bandwidth. (p. 203)

According to [9]

> WAP is an enabling technology that bridges the gap between the mobile world and the Internet. The integration of WAP and Web components allows end-to end services between information providers and mobile clients. With the coming 3G systems and mobile IP, WAP and similar technologies will continue to play an important role in the development of information services. (p. 329)

As seen from **Figure 1** [4], with mobile web services, people can view web pages and applications (hosted using Web Services) on their mobile devices, especially their mobile phones. A common question in today's world is "why do we need mobile web services?" and "what are the benefits of building a framework that will support the

convergence of mobile communications and PC networks, and why are Web Services a good solution for this?" [4]. It is important that we understand the rationale behind implementing mobile web services as solutions to many online problems and as a step forward to the future. Farley and Capp (2005) [4] states that there are two major criteria that explains the rationale of implementing mobile web services as a solution: (a) the ability of mobile networks to allocate a single and specific identity to a single user with the use of their current SIM cards, improving security on networks and allowing better implementation of mobile web services through the mobile network; and (b) the high availability of mobile devices to consumers that lends itself to the integration in a larger, more complex and multi-device system (p. 204).

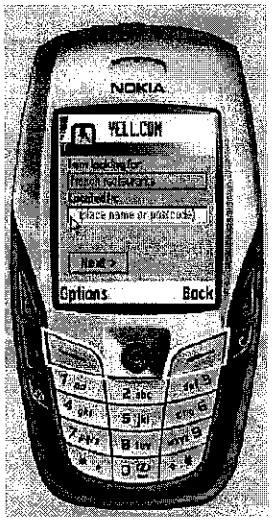

Figure 1: An Example of Mobile Web Services

Figure 2 shows a simple diagram of the process of capability sharing [4]. Through capability sharing, a multi-device environment is created, and the implementation of Mobile Web Services will be a catalyst for such a process to run and operate smoothly. With the Mobile Web Services implemented and integrated with the current Web Services, a centralized system is created connecting everyone, everywhere. The World Wide Web can be said to be accessible to all users no matter where they are, just as long as they have their mobile devices with them.

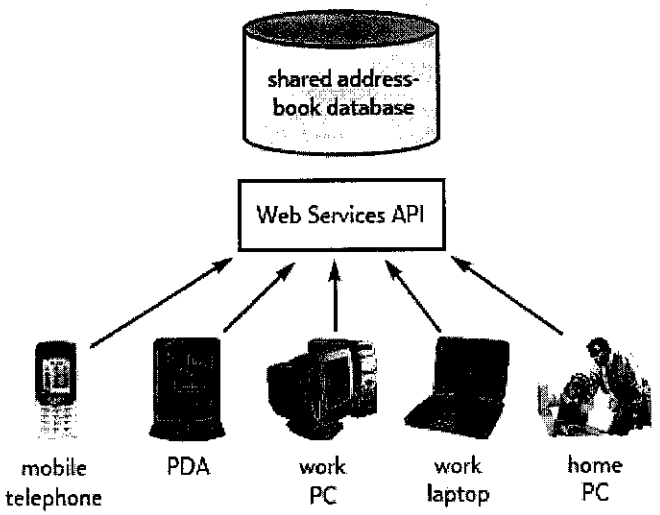

Figure 2: Capability Sharing

1.1.6 Mobile Web Developments from Microsoft Corporation

Many software companies today are competing to produce the best Software Development Kits or SDKs to its customers (programmers). Companies such as Sun Microsystems and Microsoft Corporation are in the leads developing the best Mobile Web Service SDKs to allow for a much better and reliable development environment for all mobile web programmers worldwide. As the computing world knows, Microsoft Corporation is one of the largest software and development toolkit providers in the world today. Complementing the Microsoft Windows Operating System family, Microsoft has released the .NET Framework, a framework to allow for better compatibility amongst many programming platforms (to be developed and run on Microsoft Windows platforms).

In the areas of Web Services, Microsoft is famous for its ASP and ASP.NET web programming platforms running under the Microsoft Internet Information Services (IIS). Microsoft has actively integrated its .NET Framework, ASP.NET and IIS to with Mobile Web Services enhancements, through the introduction of its latest installment, the Web Service Enhancements. Web Services Enhancements for Microsoft .NET (WSE) is a supported add-on to Microsoft Visual Studio .NET and the Microsoft .NET

Framework providing developers the latest advanced Web services capabilities to keep pace with the evolving Web services protocol specifications [11]. The WSE is known to support for Mobile Web Services development.

The Mobile Internet Toolkit is also another add-n installment introduced by Microsoft Corporation to further increase its support for Mobile Web Services development.

1.1.7 Simple Object Access Protocol (SOAP)

There are many definitions of the Simple Object Access Protocol or SOAP found on the Internet. But no matter what, these definitions are all based on a single idea and are similar in defining what SOAP is. SOAP provides a simple and lightweight mechanism for exchanging structured and typed information between peers in a decentralized, distributed environment using XML [3]. SOAP does not itself define any application semantics such as a programming model or implementation specific semantics; rather it defines a simple mechanism for expressing application semantics by providing a modular packaging model and encoding mechanisms for encoding data within modules [3]. The Simple Object Access Protocol (SOAP) is a novel protocol which supports information exchange in a decentralized, distributed environment, which brings flexibility and extensibility to the communication and invocations among remote hosts [10]. The SOAP framework can be used and integrated with mobile web applications to act as a middleware for all clients accessing the mobile web services. The implementation of the SOAP framework can also be considered as a proxy for mobile web services. However, SOAP requires a high performance for collaboration such as delivery and invocation [10].

1.1.8 Bluetooth Technology on Mobile Devices

Bluetooth is a wireless, small, cheap and power efficient communication technology [20]. Bluetooth is an open industry standard that can provide short-range radio communication among small form factor mobile devices [23]. Bluetooth has been designed to provide a cable replacement technology with emphasis on robustness and low cost [23]. Bluetooth is becoming more commonly used in many mobile devices produced in the world today. Companies like Nokia and Sony Ericsson are focusing on integrating Bluetooth technology in their mobile products especially their mobile phones. Bluetooth provides better connectivity with many other devices and is slowly becoming a standard for many mobile devices. With the use and integration of Bluetooth, many more features can be added to the mobile devices such as the ability to connect to personal computers, other mobile devices and also join wireless networks using the Bluetooth network.

1.1.9 Wireless PANs and Bluetooth Networks

Wireless personal area networks (WPANs) are short to very short-range (from a couple centimeters to a couple of meters) wireless networks that can be used to exchange information between devices in the reach of a person [22]. WPANs may be deployed to replace cables between computers and their peripherals to establish temporary or permanent short-reach connections as an enabler of pervasive computing as well as to institute ad hoc networks [22].

The best technology example representing WPANs is the recent industry standard Bluetooth [22]. Bluetooth appears to be a candidate for building ad hoc networks [20] and also Personal Area Networks. In the ad hoc Bluetooth networking area, some problems still have to be investigated, especially with respect to the ad hoc routing scheme to be used in these networks [20]. The Bluetooth networks are frequently being used as extensions to the Internet and end-users are exploiting them to

access wireless Internet services from different types of handheld devices [23]. One of the key features of Bluetooth that makes it a preference in the mobile industry is its cheap price.

According to [22]

> Companies developing Bluetooth chips claim, that in the near future complex one-chip solutions of the Bluetooth specification will be available in the $5 price range. With this target price it is predicted that not only will most PDAs, phones, laptops include such technology but that the number of small WPAN enabled devices (e.g., pens, cameras, headsets, and various sensors) will soon outnumber the computers on the Internet. (p. 7)

1.1.10 Ubiquitous Mobile Computing

Modern technological changes have allowed the computing environment to become increasingly pervasive, ubiquitous, and mobile [10]. The availability and adoption of a wide range of mobile computing devices (e.g., laptops, Personal Digital Assistants (PDAs), wearable computers) of varying sizes and processing capabilities, along with the emergence of Wireless Local Area Networks (WLANs) such as IEEE 802.11 and Personal Area Networks (PANs) such as Bluetooth and HomeRF, are catalysts enabling the ubiquitous access of information anywhere, anytime [23].

Realizing truly ubiquitous mobile computing requires innovative theories, paradigms and applications in various research areas including algorithms, networking, and software architectures and data management [12]. Ubiquitous and mobile web applications are typically very autonomous in nature, because they rely on additional information about the user's context [1]. The credo of ubiquitous computing is that hardware and software in everyday life should "disappear", and be as autonomous as possible [1].

1.1.11 Online Bookstores to Mobile Bookstores

Bookstores play a major role as a source of information provider, as it provides the service of selling books and other educational materials. There are many major bookstores in the world today selling huge amounts of books and educational materials. Examples of some of the large bookstore chains available in Malaysia are MPH and Kinokuniya. These two bookstore giants provide us with huge collections of books, magazines and many other formats of information for sale.

To improve the selling of books to a wider range of customers, many companies have expanded their bookstore business to the online method, which is through the World Wide Web. Companies like Amazon has opened sites (such as www.amazon.com), providing e-commerce and e-business functions to those who wish to purchase books and other products online. However, we have yet to come across major companies investing in mobile bookstores, where customers can browse and actually buy books and other educational materials through their mobile phones.

1.1.12 Internet and Mobile Phone Users in Malaysia

Internet and mobile phone users in Malaysia are increasing each year. Statistics from the Malaysian Communications and Multimedia Commission (MCMC) website clearly shows this growth of usage and this can be directly related to the society's awareness towards the advancing technology. The tables below show the current statistics of mobile phone users, broadband Internet users and dial-up Internet users in Malaysia, as taken from the MCMC site (http://www.cmc.gov.my/facts_figures/stats/index.asp).

Table 1: Statistics of Mobile (Cellular) Phone Users in Malaysia

Telefon selular
Cellular phones

Tahun	Suku	Telefon selular						Perkhidmatan pesanan pendek	
		Pasca bayar	Pra bayar	Jumlah ('000)	Kadar pertumbuhan (%)	Kadar penembusan	% digital	Jumlah (juta)	Per langganan
Nota				1				2	
1998		...	...	2,150	-12.6	9.7	74.5	...	...
1999		...	...	2,717	26.4	12.0	83.7	...	...
2000		2,599	2,523	5,122	88.5	21.8	91.8	...	...
2001		3,069	4,316	7,385	44.2	30.8	95.6	...	...
2002		2,961	6,092	9,053	22.6	36.9	97.9	3,605.9	398
2003		2,566	8,558	11,124	22.9	43.9	98.9	6,163.5	554
2004		2,555	12,057	14,611	31.3	56.5	99.8	9,532.1	652
2005	1	2,628	13,201	15,829	8.3	60.9	99.9	3,406.9	215
	2	2,787	13,764	16,551	4.6	63.3	99.9	4,953.0	299
	3	2,896	14,655	17,551	6.0	66.8	99.9	6,085.5	347
	4	2,925	16,620	19,545	11.4	74.1	99.9	7,553.6	386
2006	1	2,983	17,607	20,590	5.3	77.7	99.9	7,458.5	362

Year	*Qtr*	*Cellular phones*						*Short message services (SMS)*	
		Postpaid	*Prepaid*	*Total ('000)*	*Growth rate (%)*	*Penetration rate*	*% digital*	*Total (million)*	*Per subscription*

Table 2: Statistics of Broadband Internet Users in Malaysia

Bilangan langganan jalur lebar mengikut teknologi
Estimated number of broadband subscriptions by technology

Tahun	Suku	Bilangan langganan					
		ADSL	SDSL	*Wireless*	Lain-lain	Jumlah	Penembusan
2002		18,511	542	...	249	19,302	0.08
2003		108,173	1,931	...	302	110,406	0.45
2004		247,802	2,834	...	1,865	252,501	0.98
2005		477,685	3,712	5,914	14,391	490,630	1.86
2006	1	539,617	3,942	7,260	24,797	575,816	2.17

Year	*Qtr*	*Number of subscriptions*				
		ADSL	*SDSL*	Wireless	*Others*	*Total*

Table 3: Statistics of Dial-Up Internet Users in Malaysia

Langganan Internet 'dial-up'
Internet dial-up subscriptions

Tahun	Suku	Internet 'dial-up'			
		Jumlah ('000)	Kadar pertumbuhan (%)	Kadar penembusan	Anggaran bilangan pengguna ('000)
1998		405	97.6	1.8	1,215
1999		668	64.9	2.9	2,004
2000		1,659	148.4	7.1	4,977
2001		2,113	27.4	8.8	6,345
2002		2,614	23.7	10.5	7,842
2003		2,881	10.2	11.4	8,643
2004		3,293	14.3	12.7	9,879
2005	1	3,439	4.4	13.2	10,317
	2	3,570	3.8	13.7	10,710
	3	3,621	1.4	13.8	10,863
	4	3,672	1.4	13.9	11,016
2006	1	3,692	0.5	13.9	11,076

Year	*Qtr*	*Internet dial-up*			
		Total ('000)	*Growth rate (%)*	*Penetration rate*	*Estimated number of users ('000)*

As can be seen from these tables, mobile phone and Internet users are increasing each year, up to 2006. Broadband Internet users are also increasing, and this covers other Internet access methods such as WAP and Wireless.

1.2 Problem Statements

1.2.1 Geographic Problems

Bookstores (take for instance MPH and Kinokuniya in Malaysia) have vast amount of books to be sold to millions of readers. One of the main problem statements is that these very large bookstores sell a wide range of books, but are located only at urban

areas (too far for some). Some of these readers might be out of reach or as we are, some are just lazy and prefer everything to be done at home. Small bookstores near their living areas will never match up to the range of books sold at these bookstore giants. We have heard of online bookstores (Internet) but what about those that travel a lot? What about those that do not prefer to hook up to the Internet using their personal computer? Or even, what about those that prefer to perform these functions easily and remotely using nothing but their mobile devices?

1.2.2 Competition Due to Technology Enhancements

We have heard of online bookstores, but today the world is hyped with the advancements in mobile technology. WAP or mobile Internet (on hand phones, PDA's) is becoming more popular amongst consumers nowadays. Companies nowadays compete with each other by providing the latest form of service and products, making use of the latest technologies available in the world. Those companies that fail to meet with the latest technological requirements will face hard times in their businesses.

Today, mobile technologies are advancing and the need to make use of the technologies is important to both businesses and consumers. The question now is what if you can choose books, read the summaries, read reviews and purchase these books by only using hand phones or PDA's?

1.2.3 Meeting with Ubiquitous Demands in Computing

Another problem statement related to the one mention above would be if there exists such a system (mobile bookstore), how can we make it such an easy process for the users (customers/readers)? How can the users easily browse through the huge bookstore database by only using their hand phones? How can we reduce the amount of data transfer to allow the users to perform all their book shopping needs faster and more

reliable? Most of today's mobile communications company charge customers for connecting to Internet through their hand phones or PDA's (GPRS) according to the amount of data they download (usually at a certain charge per kilobyte downloaded). The more data downloaded, the more customers pay.

These issues are concerned with the ubiquitous demands in today's computing world. Applications, especially web and mobile web applications require a lot of ubiquitous functions adapted in order to provide better navigation and also better network bandwidth usage. One of the limitations or drawbacks in the ubiquitous mobile computing especially in the areas of Mobile Web Services, however, is the need to limit the information retrieved and shown on the screen of the mobile device due to certain factors such as the small size of the mobile device and the limited bandwidth of the mobile device.

One of the most critical technologies in a variety of application services of ubiquitous computing is to supply adequate information or services depending on each context through context-awareness [8]. An increase in the information transferred can lead to information overload and proper solutions need to be developed in order to solve this problem when facing with ubiquitous forms of computing.

According to [8]

> Applications of ubiquitous computing are increasingly leveraging contextual information from several sources to provide users with behavior appropriate to their environment. The method of information retrieval is one of the most fundamental research issues in ubiquitous computing. Applications where user's contexts change continuously over time require prompt retrieval of relevant information. (p. 167)

As seen in **Table 1** and **Table 2** on page 12, mobile phone and broadband Internet users in Malaysia are increasing by each year. This indicates a high probability

of the increase in the use of mobile Internet access through WAP. WAP can be accessed by either GPRS or 3G, so costs are becoming lesser each year.

1.2.4 Large Bookstore Information Requests

The final problem statement would be on browsing the bookstore itself. One may not complain of the large number of books sold at these large bookstores, but admire them. However, searching manually through thousands of books can be a hassle. In Kinokuniya (located at KLCC), the bookstore provides its customers with at least one kiosk, allowing them to browse through the bookstore's large database. However, this can be problematic considering that the bookstore receives hundreds of customers per day. Will customers eventually have to put up with lining up just to use the kiosk? Imagine a bookstore where those who own mobile devices can search through the bookstore's database, read summaries and reviews, check for prices and availability, and also locate books in the bookstore.

1.3 Objectives and Scope of Study

1.3.1 Objectives of the Study

The objective of the study is mainly to perform the necessary research on issues related to the problem statements identified in the above section, in order to formulate a suitable solution to solve the problems stated - the Mobile Bookstore, a mobile web application. This solution is usually a combination of a few methods and techniques in fields related to the study, often compiled in a system. Since this research will be performed according to the nature of the programme taken (Information Technology), the solution will be compiled in a system – an application that is usable, testable and verifiable.

The functional objective deriving from the base objectives is to develop or produce a software system in order to meet all the base objectives. This software system is a requirement of the research project. The system proposed is the Mobile Bookstore. The scope of the system will be covered under *Scope of Study*.

The objectives of this study can be summarized (briefly but concisely) in the following phrases:

- The first objective of this study is to perform a thorough research on matters related to the problems statement discuss, which in detail will cover two wide areas of IT – the study of developing a mobile web application system to cater for a mobile bookstore system and the study of the implementation of a wireless Bluetooth network in a bookstore to provide users with better book browsing and shopping capabilities.
- The second objective will be to make use of the analyses done on the research subjects to fully implement all studies and to develop the appropriate systems in order to provide a solution to the problem statements.

1.3.2 Scope of Study

The scopes of study will mainly be concerned with all the problem statements stated as the main objective of the research is to come up with solutions to the problem statements. These objectives will be integrated and used as the main requirements in developing or producing the software system as a solution. The software system proposed for this research project is of course the Mobile Bookstore. Therefore, the scopes of study can be summarized into four areas.

The first scope would be to satisfy the objective of solving the first problem statement – geographical problems. Studies will be done to research on methods,

techniques and issues in developing a mobile web application. Research will also be done to decide on a suitable platform to develop the mobile web application. This project will produce a product that will allow readers and bookstore customers to browse the bookstore through their mobile devices, using WAP – a mobile bookstore. This allows customers to search for books, locate stores where these books are available, and even order these books through their mobile devices. This product will be a micro site for a large bookstore.

The second scope would be to satisfy the objective of solving the second problem statement – competition problems due to technological advancements. This scope can be combined with the first as it involves the same contents and research processes as the first scope, which is to produce a mobile web application for the bookstore.

The third scope is to satisfy the third objective of solving the second problem statement – problems in meeting with the ubiquitous demands in today's computing. Research will be done on how to apply techniques and methods to allow for a better mobile application environment meeting with the ubiquitous needs in today's mobile web surfing environment. The mobile bookstore will be smart in a sense that it will remember users' book preferences to allow it to show results of related books. The mobile bookstores can recommend similar books instead of showing everything. The mobile bookstore will ensure ubiquitous data processing whereby if users were to browse away from their search queries and then go back, the results will still remain. The system will also try to reduce the amount of data transfer to ease the browsing process, allowing faster transactions.

Last but not least, the fourth scope will satisfy the objective of solving the fourth problem statement – problems in spreading and handling large bookstore information requests from customers. Studies and researches will be done in developing methods to implement a wireless network in an indoor bookstore environment to allow users to use their mobile devices to browse through the bookstore database. The mobile

bookstore will contain another module used in the bookstore itself. This module will make use of Bluetooth technology to allow users to search for books and locate these books in the bookstore itself. Multiple Bluetooth signal readers or ports will be placed at strategic locations in the bookstore to allow users to locate their present location in the bookstores as well as books. This is an alternative to WAP, for those who are physically in the bookstore. This will eliminate the problem of customers having to line up and use the kiosk (usually provided in very little numbers) to search for books in the bookstore – marking the birth of a wireless bookstore browsing environment.

1.3.3 Scope of Practical Work of Study

The system proposed for this project will hold the title '*Mobile Bookstore*' or '*m-Bookstore*'. The system consists of two major or main modules, which are the Mobile Web Application module and the Indoor Wireless Bookstore module. As agreed with the supervisor for this project, Mr. Anang Hudaya, the practical work (the implementations) of the project will focus more on the first module, which is the Mobile Web Application Module. This module will focus on the development of a mobile web application for the bookstore, allowing anyone with WAP-enabled mobile phones to access the system.

If time permits, work on the second module will be done. This will also depend on the approval and suggestion of the supervisor, Mr. Anang Hudaya.

CHAPTER 2: LITERATURE REVIEW

The proposed solution for this research project is the development of a Mobile Bookstore system, to cater both the mobile commerce and wireless bookstore environment modules. Before explaining the basis of this proposed system, a thorough literature review must first be done. Information Systems are becoming a standard in many organizations and businesses all over the world. Many web applications are based on Information Systems, and this has led to the growth of e-commerce and e-business. Online shopping and online banking are examples of the applications of such advancements in Information Systems. The growth and evolution of Mobile Web Services has made it possible to implement WAP-Based Information Systems [9]. What is meant by this term is that Information Systems as what we see and use on the World Wide Web can now be used and accessed on mobile devices especially mobile phones. This implementation has given birth to new mobile web technologies and services, such as mobile commerce and mobile management systems, extending the use of mobile devices themselves. Mobile commerce (m-commerce) refers to an ability to conduct wireless commerce transactions using mobile applications in mobile devices [13]. M-commerce applications can range from as simple as an address book synchronization to as complicated as credit card transactions [13].

An assumption is made that there are probably too little to none mobile bookstore or library systems exists, although there are many other implementations of mobile commerce available in the world today. There are two specific current applications and implementations that will be discussed as a relevance to the study, which are the SmartLibrary [1] and the m-Mall [5]. Related information on the study is limited as the technology is still new and not much companies and businesses have ventured into the m-Shopping or m-Commerce area.

The SmartLibrary [1] is a location-aware mobile library service that provides map-based guidance to books and collections on a PDA [1]. The SmartLibrary is a completely software-based solution, which can be provisioned atop a WLAN installed for wireless Internet access, without any additional hardware [1]. Using the SmartLibrary, users can search for books in the library using their PDAs and locate the location of the book in the library on a user-friendly map, as well as providing the shortest path possible to that location. The m-Mall [5] is a system where its users are walking individuals that shop in stores nearby, or interact with the stands in an exhibition [5]. The m-Mall servers will know user location in real time, by means of an auxiliary Bluetooth network, and push information into user handhelds, regardless of their technology. A simpler explanation of this system is where users with Bluetooth-enabled mobile devices will accept offers, advertisements and other shopping information on their mobile devices once they have entered the mall implementing the m-Mall system.

The Mobile Bookstore will be implemented both using the WAP and mobile web service technologies as well as on a Bluetooth network. The focus for the implementation of the project is more on the first module, which is the mobile commerce for the bookstore focusing on ubiquitous features and site navigation. From my research, I could not find anything solid on any current research or implementation of mobile bookstores or even mobile commerce applications. I will assume that my research is a process of developing or creating a new solution that can be used by major bookstore companies, as their mobile business solution. The development, however, will make use as many e-commerce and online business applications as reference, never to reinvent them. The first module will be a mobile Internet solution, employed using mobile web services. The indoor wireless bookstore module will be developed after the completion of the first module. The SmartLibrary and the m-Mall are perfect references for pursuing the research and development of the second module, but however it is important to note that my research is different and not an update, modification or mere reinvention of any researches done. The Mobile Bookstore Indoor

Module will use some concept and ideas from the two researches (SmartLibrary and m-Mall) but only minor and basic ones. The Mobile Bookstore will be unique in its own way. Current kiosk systems (in bookstores) may be used as a good reference and major enhancements will be made to deploy a similar application to the mobile.

CHAPTER 3: METHODOLOGY

3.1 Introduction to Project Methodologies

As stated earlier in this report, one of the main objectives of this research project is to come up with a software solution for the problem statements and to develop the software system to meet the requirements of the project. In dealing with the design of the software solution, the design methodologies play an important role in determining the success of the project. Proper design methodologies need to be implemented in order to produce the best quality product with less defects and meets all the objectives and scopes of the study. The design methodologies of the project can be classified according to three classifications, which are:

- Development Process Model – Waterfall Model
- Process Iteration – Incremental Development
- Prototyping – Evolutionary Prototyping

3.2 Development Process Model – Waterfall Model

Figure 3 below illustrates the processes involved in the waterfall model of software development. The design methodology for the software solution in this project will follow the common waterfall model approach in its development. The requirements for the software system will first be defined from its problem statements, scope and objectives. The next process would be to design the Mobile Bookstore software system (database and software design). The following process would be the implementation

and testing of the software. Process iteration models will be used to allow the iteration of the waterfall model to further refine the software accordingly to changes in the requirements.

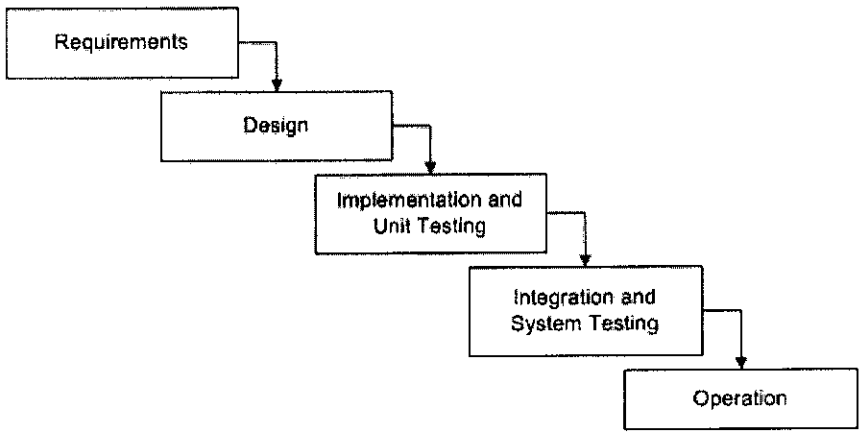

Figure 3: Waterfall Model

3.3 Process Iteration – Incremental Development

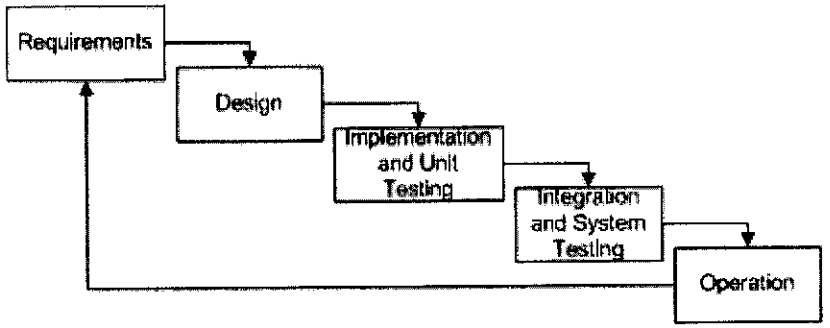

Figure 4: Incremental Development Model

To allow iteration of the waterfall model, the design methodology will implement the incremental development model of process iteration. A diagram of the common processes in the incremental development is illustrated in **Figure 4** above. The waterfall model is a simple management model and it separates the design and implementation phases, leading to more robust systems which are amendable to change. To allow the robust development, the incremental development is used with the

waterfall model. This allows of an iterated development environment, whereby once testing shows of defects or need for enhancements, the waterfall model can be restarted or reiterated to perform the changes. This is crucial in the development of the Mobile Bookstore as the early requirements that can be gathered may be too small to allow for a good software design.

3.4 Prototyping – Evolutionary Prototyping

In developing the software solution (Mobile Bookstore), the main concern is producing prototypes that can be assessed, tested, evaluated and verified. The best way to do so is to implement the evolutionary prototyping approach to development. With this approach, prototypes are created beginning with a basic set of requirements. The prototypes will be tested and verified of its functionalities. The prototypes can be enhanced and modified according to newer requirements added or modified, creating a new prototype. All prototypes will evolve into bigger and better prototypes, until finally becoming the last version of prototype for the system. This final prototype can be further tested, verified and enhanced to be used as the final system itself.

CHAPTER 4: DISCUSSION

4.1 Scope of Discussion

This section of the report will discuss on how to implement and develop the software solution for the research project. This section will mainly discuss on how the technologies discussed in the *Introduction: Background of Study* section can be used and integrated in order to develop and implement the software solution for this research project. The discussion will be done according to the two modules proposed for the software solution. This section will be divided according to the following sections:

- Target Users
    - Outdoor (WAP) Module
    - Indoor Module
- Outdoor Module: Mobile Web Bookstore Application
    - Technologies Used
    - Preferred Development Platform
    - How the First Module Works
    - Overall System Flow
    - Module Features
- Indoor Module: Wireless Bookstore Application
    - Technologies Used
    - Preferred Development Technologies and Methods
    - How the Second Module Works
    - Overall System Flow
    - Module Features
- Administrative Users

- Current Progress
    - User Login and Sessions
    - Main Menu for Browsing
    - Enhanced Mobile Search Functions
    - Book Information Page
    - Book Availability Tracking
    - User Carts Function
    - Book Ownership Tracking Function
    - User Rating Function
    - Database Design

4.2 Target Users

4.2.1 Outdoor (WAP) Module

The main target users for this solution (first module) can be anyone – it can be you and it can be me. But to summarize the users to specific groups, then the target groups of users are book readers, students, educational institutions or universities, schools and libraries. Those who wish to the solution to browse and shop for books through their mobile phone will be the main targeted users for this solution. These users will require mobile phones equipped with GPRS and WAP access in order to use the Mobile Bookstore System. Besides these users who are considered customers, another question raised is who will be hosting the solution or who will sell these books? The solution is proposed to be implemented by book companies who want to sell their books through the mobile medium hence reaching more customers.

To ease in the explanation of the system the two groups will be classified as common User and Administrator terms in the system. The target users are considered as

the Normal User of the system while the bookstore companies or solution implementers are known as the Administrators of the system.

The requirements for the users in this system consist of three basic and necessary ones, which are:

- Mobile phones (preferably any latest models or WAP-enabled models).
- GPRS access provided by telecommunications network.
- WAP access (comes with GPRS).
- *Broadband access (optional).*

4.2.2 Indoor Module

Basically, the target users for the indoor module are similar to the outdoor (WAP) module. The target users are the customers of the solution implementer (bookstore), who owns a mobile phone, but in this case requiring Java or any other mobile application platform enabled applications to be run on the mobile phone. The users will use their mobile phones to access to the Mobile Bookstore system under a local wireless network (preferably Bluetooth networks) implemented throughout the bookstore. This replaces the needs for a kiosk and users can use their mobile phones to browse the Mobile Bookstore system, free-of-charge.

To summarize, the requirements for the users are listed below:

- Mobile phones supporting Java or any application platforms (preferably Smart phones).
- Bluetooth (integrated to mobile phones).

4.3 Outdoor Module: Mobile Web Bookstore Application

4.3.1 Technologies Used

Basically, the technologies used in developing and implementing the first module of the software solution (the outdoor mobile web application module) will be based around a single development framework, which is the Microsoft .NET Framework (version 1.1, to be exact). To develop a web application, Microsoft has released an extension to its .NET framework to integrate the web development ability into the framework, which is the Web Service Enhancement or the WSE. To further include the ability to author and develop mobile web pages, Microsoft has released the Mobile Internet Toolkit to allow for mobile web authoring.

To develop the first module (outdoor module) of the Mobile Bookstore, I will implement the use of the .NET framework, equipped with the WSE and Mobile Internet Toolkit. The .NET framework provides high compatibility in mobile web programming. The programming language used in developing the first module will be the mobile ASP.NET programming platform. ASP.NET is a well known web programming platform, supporting languages such as VB, C# and C++. The mobile ASP.NET allows the use of ASP.NET platform to develop mobile web applications for mobile devices. The SOAP approach will be used in the implementation of the first module, acting as a proxy for the mobile bookstore web system. The .NET framework allows the SOAP framework to be implemented with high compatibility. The .NET framework also allows easy connection and integration with database systems such as the Microsoft SQL Server, allowing a better web application development environment.

4.3.2 Preferred Development Platform

The preferred programming platform will of course be the ASP.NET Mobile programming platform used on the .NET Framework 1.1, by Microsoft. The ASP.NET Mobile will support most of the functions supported in a normal ASP.NET platform for web programming and it will ease the programming functions as well as increase the functionalities of the system. The ASP.NET Mobile will allow integrations and connections to many SQL servers or databases, and the preferred database platform will be the Microsoft SQL Server 2000 database platform, supporting stored procedures that will be implemented in the system. Stored procedures allow for a more robust database programming and scripting, allowing for a more robust system to be developed.

4.3.3 How the First Module Works

Users will use their WAP-enabled mobile device to open the mobile bookstore mobile web application. The address opened will link to the SOAP server that will retrieve the required methods from the proper mobile web server. Surfing the mobile web application is similar to any other WAP site, but the mobile bookstore is equipped with features such as the ubiquitous features and the mobile commerce features. This will ensure that surfing the mobile web application will be easy and efficient.

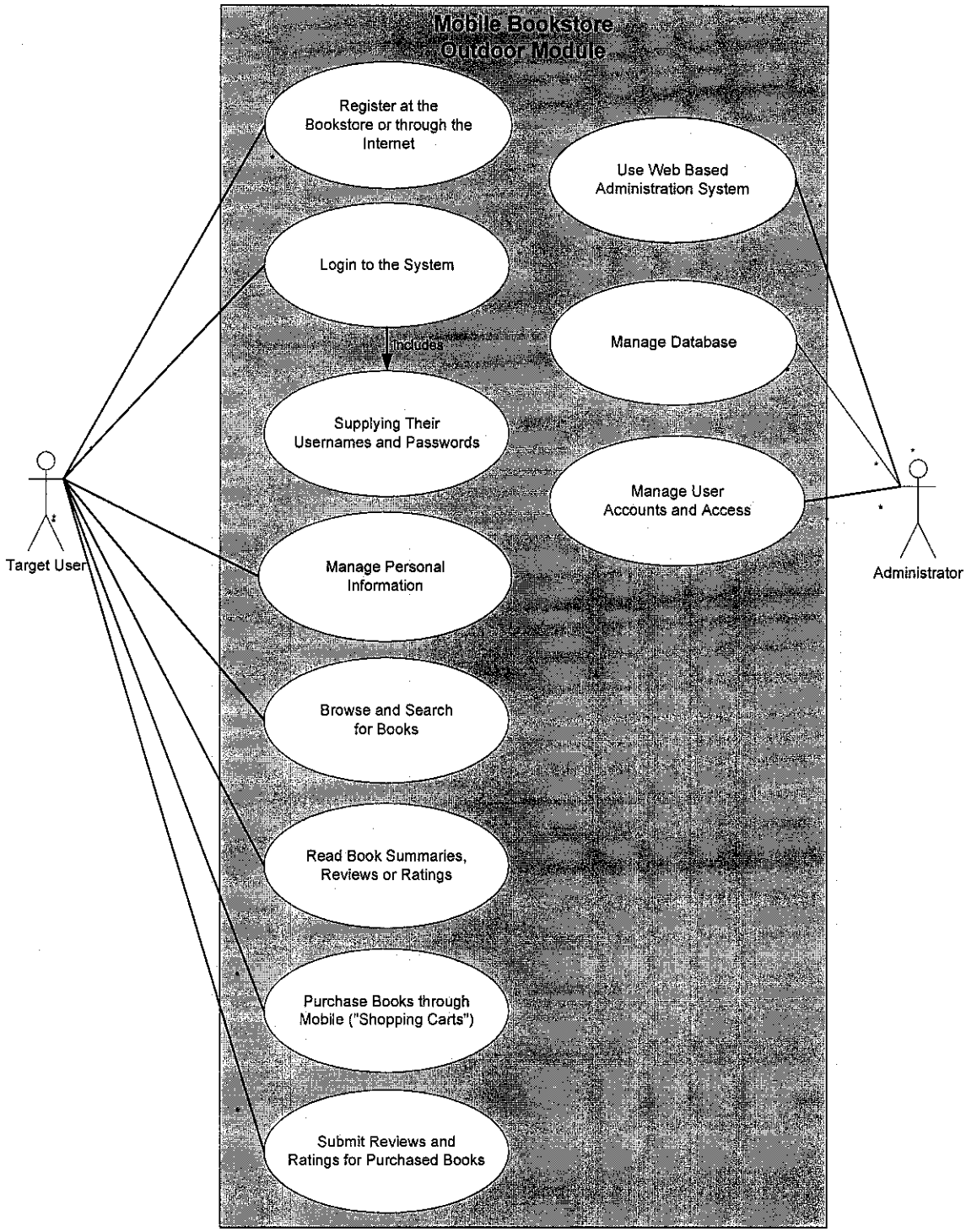

Figure 5: Mobile Bookstore Outdoor Module Use Case Diagram

4.3.4 Overall System Flow

The overall flow or depiction of the system can be seen in **Figure 5** above. The use case diagram depicts the two user types of the system, which are the Target User and the Administrator. The functions that the target user can be performed are explained in the following:

4.3.4.1 Target Users (Normal Users)

The target users or the normal users will first have to register with the bookstore to open up a mobile account in order for them to access the Mobile Bookstore system. This can be achieved through a manual cum computerized account registration system. The user must first visit the bookstore itself to fill up a form at the bookstore in order to register their particulars and start up an account. The bookstore employee (considered an Administrator in this case) will register the users' information and start up accounts for the users through the web based administration system. Another alternative for registering would be to include a "Register for Mobile Bookstore" section in the company's own web site. Through this method, users can register themselves for an account (to access the Mobile Bookstore) through the Internet. Users will be given a username with a default password (or chosen password) and then the user is able to log on to the Mobile Bookstore application on their mobile phones.

Once users have access they can log on to the Mobile Bookstore system. Users are able to manage their personal information including their passwords, meaning users can change their password through mobile. Users can also use the system to browse and search for books. The system will be equipped with a preference-based search functions or engines, meeting the needs for a ubiquitous mobile surfing environment (more to be explained in later sections). Once found a suitable and desired title, users can read summaries, reviews or even ratings for the book (if any is available). Users can place to-be purchased books in their own "shopping carts". This shopping cart will be stored

in the database according to each login and if a disconnection happens, the cart is still saved and users can resume shopping when logging in the next time. As an addition, users can submit reviews and ratings for already purchased books (this function is optional).

These are basically all of the functions that the target users can perform using the Mobile Bookstore system.

4.3.4.2 Administrators

In the outdoor module, the administrators will use the web based administration module (that will be designed for the system) to perform administrative functions such as managing the system database and also managing the user accounts and access to the Mobile Bookstore system.

4.3.5 Module Features

The module features can be summarized in the points below:

- Normal Users
    - Login sessions are provided for each unique user.
    - Search function designed to cater for mobile accessibility and ubiquitous environment. When users search for a book, a list of results will normally appear. But the system will detect user's preferences and display the results based on the user's preferences.
    - Personal information management.
    - Read and submit summaries, reviews or ratings.

- Place books in a shopping cart and continue shopping at a later time, meaning the cart is saved for each user. The system will provide a Cart Management sub-module to manage shopping carts.
- Purchase books through mobile.

- Administrator
  - Web based administration system.

4.4 Indoor Module: Wireless Bookstore Application

4.4.1 Technologies Used

To develop and implement the second module of the mobile bookstore (indoor module wireless bookstore module), Bluetooth technology will be used. A wireless Bluetooth network will be developed and used in order to create a wireless bookstore environment for Bluetooth-enabled mobile devices. To develop this module, the possible programming platform for development and implementation would be the Java programming platform for mobile devices, such as the J2ME. Other alternatives are still under consideration for this module. This module is considered optional as the main focus for the software solution is on the first module.

4.4.2 Preferred Development Technologies and Methods

The preferred technologies and platform will be a localized web based system. This means that when the users are connected to the local wireless Bluetooth network, they can access a local mobile web application (the indoor Mobile Bookstore module) without the needs for a WAP connection. The Java J2ME can be used to achieve this, but a simpler approach will be researched as this outdoor module will not be the main

focus of the project solution. This module will be developed if time permits. A simpler approach will allow Bluetooth-enabled mobile phones to connect to the servers located in the bookstore and connect to an intranet Mobile Bookstore site.

4.4.3 How the Second Module Works

This module will make use of Bluetooth technology to allow users to search for books and locate these books in the bookstore itself. Multiple Bluetooth signal readers or ports will be placed at strategic locations in the bookstore to allow users to locate their present location in the bookstores as well as books. The Bluetooth readers can be setup to represent a wireless Bluetooth network inside the bookstore, giving access to the indoor bookstore system to those with Bluetooth-enabled mobile devices. This is an alternative to WAP, for those who are physically in the bookstore. This will eliminate the problem of customers having to line up and use the kiosk (usually provided in very little numbers) to search for books in the bookstore – marking the birth of a wireless bookstore browsing environment.

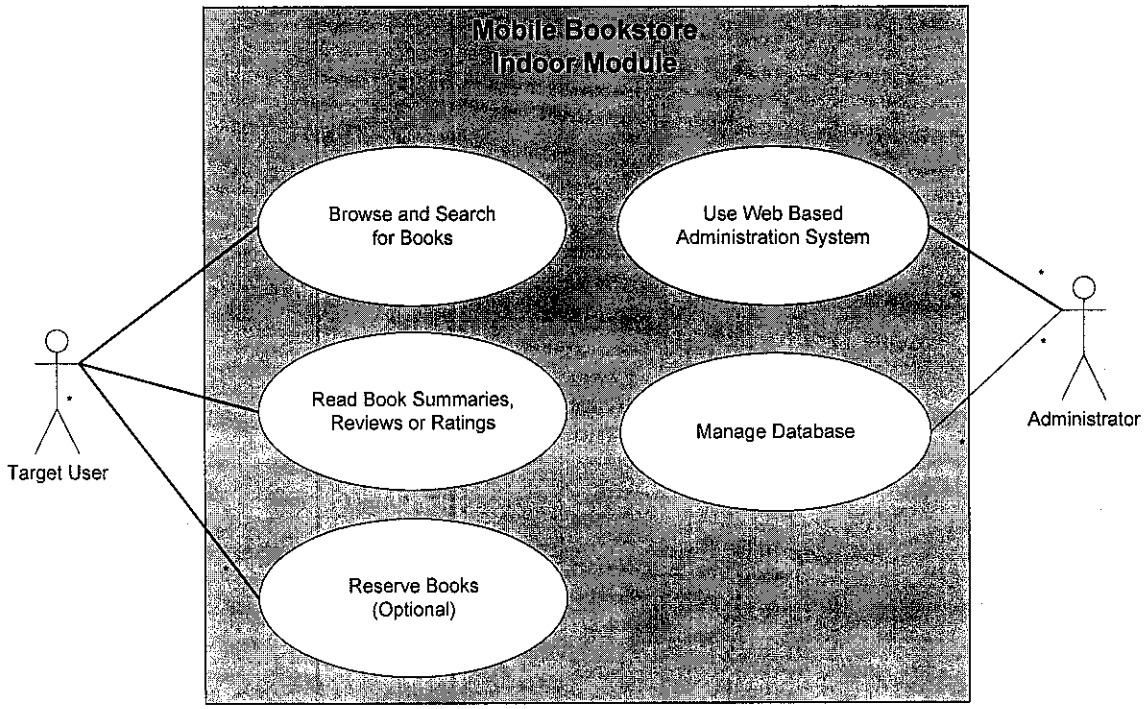

Figure 6: Mobile Bookstore Indoor Module Use Case Diagram

4.4.4 Overall System Flow

The overall system flow can is depicted by the use case diagram shown in **Figure 6** above. The system flow is similar to that of the Outdoor Module, except for some differences whereby the indoor module has fewer functions as it focuses more on browsing and searching features. The normal users can browse and search for books within the bookstore using the system and retrieve information such as where the book is located in the bookstore. Users can read book summaries, reviews and ratings. An optional feature would be to allow users to reserve books that they want to buy. The administrators will be able to perform administrative functions such as managing the system databases through the web based administration module.

4.4.5 Module Features

The module features can be summarized in the points below:

- Normal User
    - Search function designed to cater for mobile accessibility and ubiquitous environment. When users search for a book, a list of results will normally appear. But the system will detect user's preferences and display the results based on the user's preferences.
    - Read summaries, reviews or ratings.
    - Reserve books.
- Administrator
    - Web based administration module.

4.5 Administrative Users

Administrative users are further classified to two types, which are administrators and normal users, whereby there will be a difference in the access and authorities in administering the system. Administrators will have extra functions of managing all user access to the administration module.

4.6 Current System Discussion

The system implementation is focused on the first module of the system, which is the outdoor or WAP module. A system was completed to showcase the early and basic functions of the Mobile Bookstore. This section will detail on this system according to the important functions or features that have been completed, which are:

- User Login and Sessions
- Main Menu for Browsing
- Enhanced Mobile Search Functions
- Advanced Search
- Book Information Page
- Book Availability Tracking
- Personal Information/Account Management
- User Preferred Branch Function
- User Carts and Function
- Book Ownership Tracking Function
- User Rating Function
- Second Hand Function
- Book Purchase Function
- Purchase Transactions Status and History
- Web Administration Module

- Automatic Purchase Receipt Printing Module
- Database Design

4.6.1 User Login and Sessions

For this prototype, I have developed and enabled user sessions for the use of the mobile bookstore. This allows the web server (hosting the mobile bookstore) to store session information on each users connected to the Mobile Bookstore application. This can be used to allow the system to track and know who is currently accessing the system, sending the user his or her own profile. When browsing in session, users will be able to browse according to their profile, view history of purchased books and many other functions to be included in the full system.

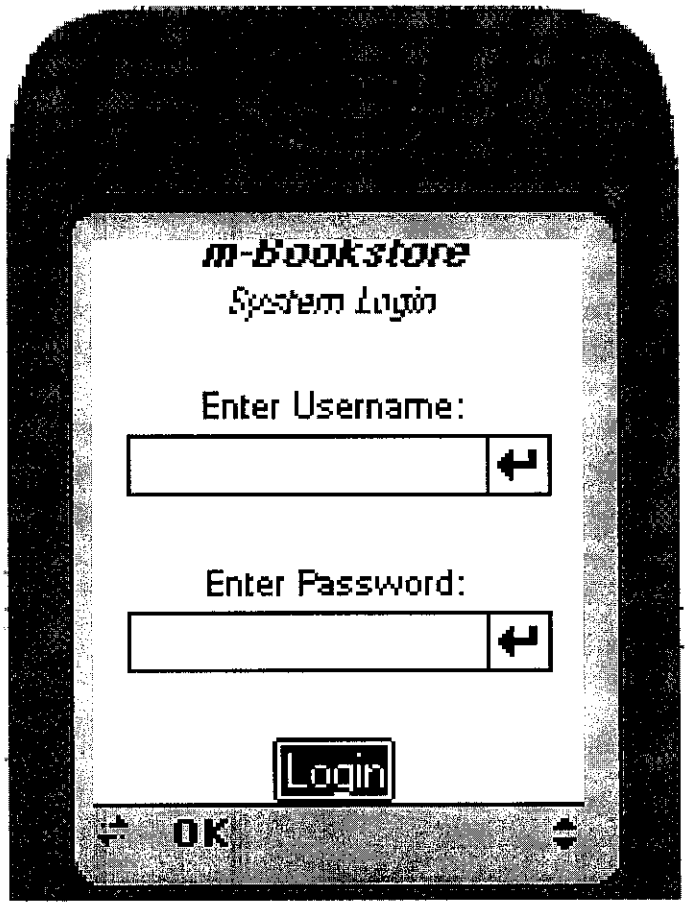

Figure 7: Login Screenshot

The prototype tests ASP.NET mobile capabilities by integrating the User Sessions features into the prototype application. This feature will be kept and used in the final system. A simple user login page (please refer to **Figure 7** above for a screenshot of the login page) acts as the welcome page for the prototype although the full system only requires users to log in if they wish to browse according to their own profiles. Once the user logs in to the prototype application, the system will check for the validity of the login information. If valid, the system will redirect the user to the main menu of the prototype application, else, asking the user to enter a valid login information. Once logged in, the server keeps track of the user with its unique session, allowing the system (and the server) to differentiate each user connected to the Mobile Bookstore application. To verify that user sessions work perfectly, the system will search the database for user records and load it into the system. To confirm such processing, the system will display the full name of the user logged in to the system.

Another feature that the user sessions provide is the ability to allow only logged on users to access certain areas, pages or functions of the system. In this prototype, I have made the whole application to require authentication and logging. This requires the users to log in to the application before being able to access any of the pages or functions of the prototype application. Sessions will enable to track whether the user has logged on to the system or not by carrying a unique session for each user. If users attempt to go to a page without logging in first, then the system will detect the user access to for a login session and since no login session can be found, the system will not allow any access to the page (redirecting the user to the login page). This can provide some levels of security to the mobile web application.

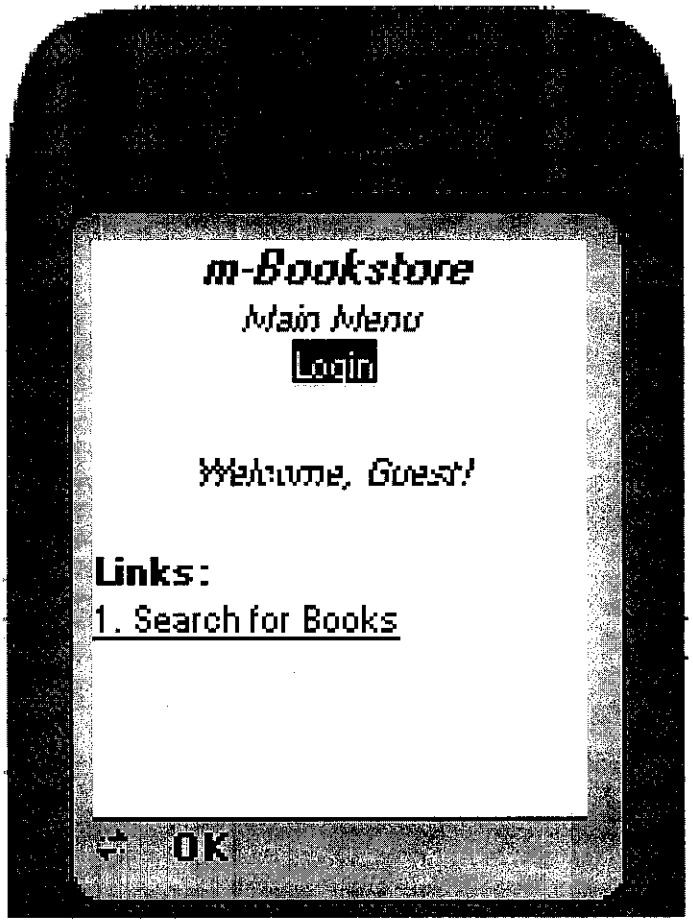

Figure 8: Guest (Non-Members) Main Menu

4.6.2 Main Menu for Browsing

The main menu of the application serves as a landing page for the whole application. Users who are not logged on (guests) can browse the Mobile Bookstore application with limited functionalities. Guests can only perform basic functions such as searching for books and reading books' information. In order to engage in the full Mobile Bookstore shopping experience, users must have a membership with the company (in this case Mobile Bookstore represents a company entity) and log in to the system. **Figure 8** above shows a screenshot of the main menu that will be displayed to guests (non-members) when browsing the Mobile Bookstore.

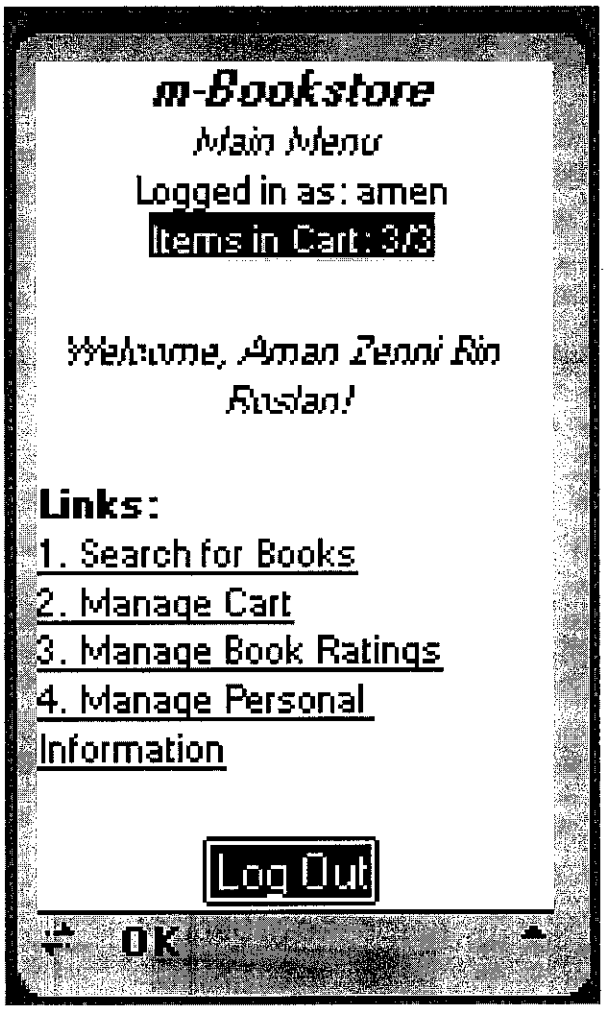

Figure 9: Members Main Menu

After successfully logging in to the prototype application, the system will redirect the user to a sample main menu. This main menu represents a center of navigation where users will have choices on the functions and features to use in the Mobile Bookstore application. The full name of the user will be displayed in the main menu corresponding with the user session given to the particular logged-in user. This is to ensure that the user sessions integrated into this prototype is working. In this prototype, however, there is only one (1) link available in the main menu, which is the link to the enhanced search function for the Mobile Bookstore. A log out option is available to the users in the main menu. Please refer to **Figure 9** above for a screenshot of the members' main menu.

4.6.3 Enhanced Mobile Search Functions

As mentioned, the WAP module will include an enhanced search feature that allows better functionality in mobile web browsing. The search function implements the Freetext search smoothly as this service is provided by Microsoft SQL Server. This allows for a much better and efficient searching with less programming required. The Freetext searching approach is much more powerful and efficient compared to normal searching methods. For the current prototype development, the search function will only search for book titles. Making use of the Freetext search function, book titles can be retrieved from the database and displayed to the user. For example, searching for the term "program" will return any phrase that contains "program". Words detected may include "programming", "programs" and many others. This allows a wider search.

But of course, a better search comes with a price of heavier data transfer across the mobile networks. Users inputting a lengthy search text may receive fewer results as the scope of the scope is more specific. However, if the database is large, containing thousands of book records, a simple query can lead to hundreds of possible results. This will surely burden the searching process, but it is unfortunately inevitable. Any search function will have to suffer this disadvantage as it is the only way to perform a search function. To help reduce the transfer load as well as to ease the search function performed by the user, a technique of reducing the search results to interested category can be used. In the Mobile Bookstore, the advanced searching feature does not only include the Freetext search, but also a custom algorithm that will track a user's category preference from the first search.

To better explain this function, consider a search scenario whereby a user searches for a text. A user will enter a search query and the Mobile Bookstore will perform the Freetext function, returning a set of results, from all book categories. The user will eventually find a book he/she is interested in and selects the particular book to perform other functions. When the user selects a particular book, the system will keep

track of the user's selection and determines the category of the book from the database. When the user goes back to the Search Results page, the system will only filter the search results according to the selection category that has been determined. This will reduce the amount of results shown on the results page, showing only books within the user's preference or selection. But, of course, the system will provide a function that allows the user to reset the results, showing back all the original set of search results. **Figure 10** below summarizes the search function in a flowchart.

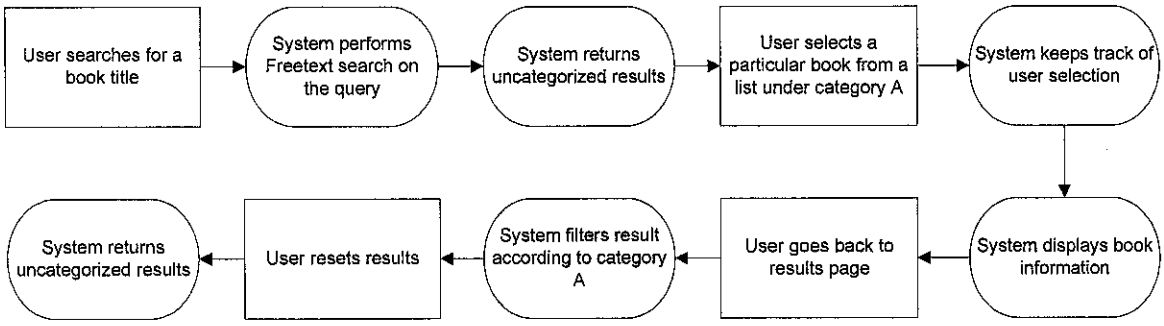

Figure 10: Search Function Flowchart

Figure 11 below shows a series of screenshots that demonstrates the mobile search function in action. The user searched for the query "programming" and a list of uncategorized results were returned. Once the user selected a particular book and returned to the results page, the results were then filtered according to the chosen book category.

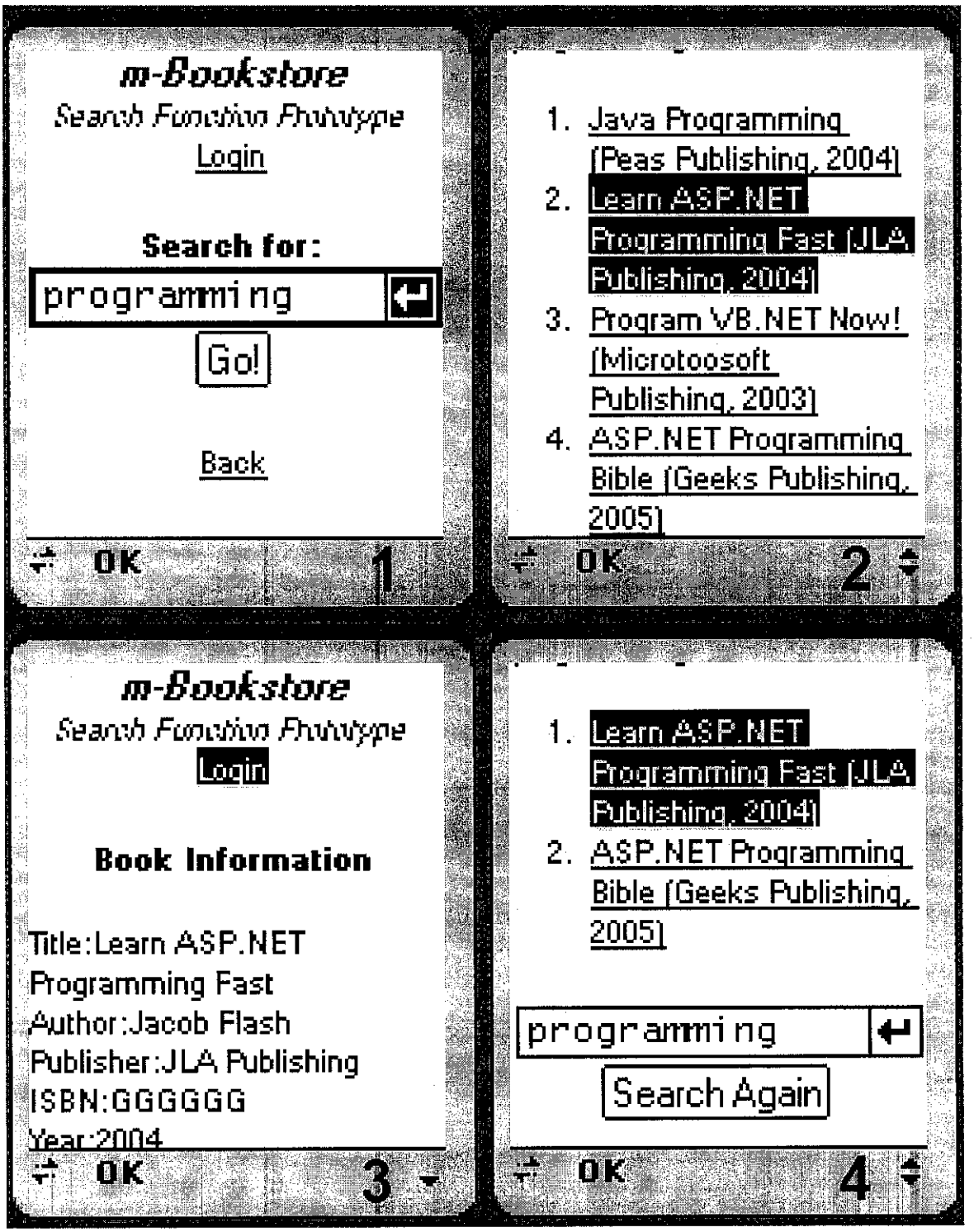

Figure 11: Screenshots of the Search Function

4.6.4 Advanced Search

An advanced search function is also integrated into the system, whereby the user is able to search by more than one search criterion, which is by default the book title. Users are allowed the flexibility of choosing among several search criteria. The first criterion is by default set to book title. Users can opt to change the criterion from a drop down list. The criteria available are book author and book publisher. Users can choose whether or not they wish to have a second query. The second query must be of a different criterion from the first one. For example, the first query can be according to book title while the second query can be according to book author. As mentioned, users can choose not to include a second query just by not ticking the second query option.

Users are also given the option to filter the search results by year, if they wish to. A year option is available whereby the users can choose a year from a range of book years available in the database. This range automatically changes according to the available year range in the database. Another criterion under this option is the Radius criterion. This criterion allows user to input a year radius. The default value is 0. If a user chooses the year 2001 with a radius of 0, the search results returned will be filtered according to books published within the year 2001 plus/minus 0 or 2001. If the user selects 2001 with a radius of 2, the results will be filtered according to books published within the year range of 2001 plus/minus 2, or 1999 (2001-2) to 2003 (2001+2). Of course, similar to the second option, users can opt not to use this option if they do not need it.

The last filter option is the Filter by Category option. This allows users to choose a category filter according to the categories available in the database. If this option is chosen, results will be filtered according to the selected category only. Of course, similar to the other options, users can opt not to use this option if they do not need it. All of these options can be chosen at the same time. This is totally up to the searching preferences of the users.

This function is an enhancement of the enhanced mobile search function (as explained in the section above), and therefore it inherits all the features integrated in the enhanced mobile search function. The only difference is that this function allows an advanced search to be performed instead of the normal search.

4.6.5 Book Information Page

When a user queries for a book title, the system will display all of the book's information on a Book Information page. This can be seen in screenshot 3 in **Figure 11**. The Book Information page will contain many other functions such as Add Book to Cart, Remove Book from Cart, Add Rating and Remove Rating. These extra functions, however, will only be available to members who are logged on to the application.

4.6.6 Book Availability Tracking

This function will allow the Mobile Bookstore application to track the amount of copies (of any books in the database) available at the store or in stock. This function is useful to other functions especially the User Carts Function. If a book is out of stock, then the system will unable functions that allow the users to add the particular book to their carts. The available amount will be shown in the Book Information page.

4.6.7 Personal Information/Account Management

Registered members are provided with a personal information or account management function, whereby users are able to edit their personal information as they wish. Personal information is crucial in this system as the system uses the information saved by the users for further payment or purchase processing. Users are required to enter valid information to avoid any problems in the future when they try to purchase books

using the mobile bookstore application. The information that the users can manage through the mobile web application are:

1. Full name.
2. Mailing address.
3. Email address.
4. Home telephone number
5. Mobile telephone number.
6. Preferred bookstore branch (explained in later section).
7. Password management (change personal password).

Users are allowed to manage and modify these entries at any time that they wish. The mailing address is very important, especially in the purchasing function (explained in later sections). The bookstore branch will be explained in the next section. Password management allows users to change their login passwords at any time, as a means of increasing the security of users' accounts.

4.6.8 User Preferred Branch Function

This function is integrated in the whole system, whereby its function is to allow the system to recognize each user's preferred bookstore branch to be used in the purchases. This function is created as most businesses have several operating branches and some customers may prefer to choose the ones closer to them. An indicator is placed on every pages of the mobile bookstore application, as a reminder to the user's of their current preferred branch.

Figure 12: Branch Indicators

Figure 12 above shows a screenshot of the indicator on a page. The preferred branch can be changed in the Personal Information Management section of the system. Users are free to change their preferred branch at any time. This function can be vividly seen when the users search for books using the application. When a user has selected a preferred branch, the search function performed will only be performed according to the books available in the current selected branch only, and not others. This ensures that the users will only browse and select books that are available at their preferred bookstore branch.

This feature is particularly important in the Purchasing function, whereby the purchases made will be processed according to specific branches, which the purchases are made from. This feature is important in other features as well as the whole system. This will be explained further in later sections, especially concerning with the Purchasing function.

4.6.9 User Carts and Function

The user carts function is similar to an online shopping cart functions found in most e-shopping applications. The difference in this application is that it is implemented in a mobile web environment. A mobile Internet connection is more unstable in a sense that the connection is always lost or broken. If a carting function only relies on session variables or form-level variables, a disconnection will cause the variables to be

disposed or in other words, the user's cart is not saved and will be lost upon reconnection. To provide a solution to this problem, the Mobile Bookstore will implement a database-level User Carts function, or easier known as the carting function. This carting function, however, is only available to members who are logged on to the Mobile Bookstore application only.

Any transactions or changes made to the user's shopping cart will immediately be stored in a database to allow all updates to the cart to be saved. If the user was to be disconnected prematurely, the system will still recognize the user's latest cart information, and load it back once the user reconnects to the Mobile Bookstore. **Figure 13** below shows a screenshot of a Member's Main Menu, highlighting a small cart information link on top of the main menu. This link will appear on every page as a reminder of the current state of the user's cart.

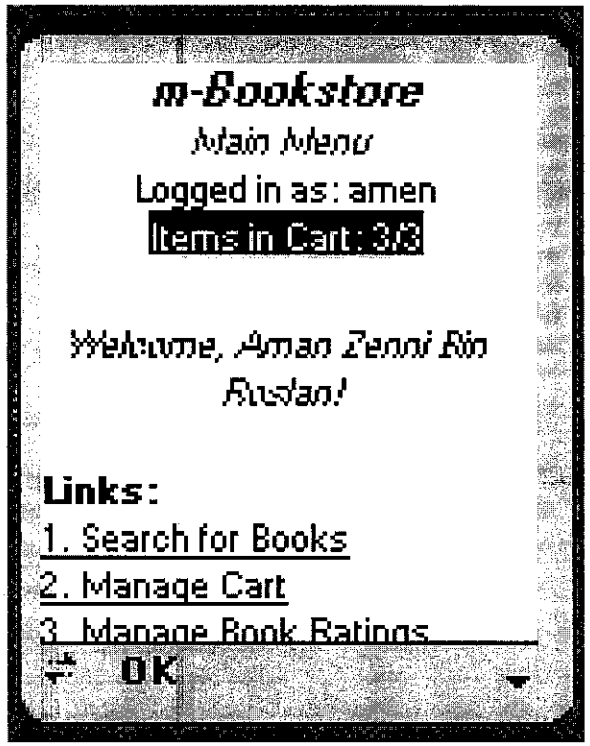

Figure 13: User Cart Information Link

This shows that the cart is saved in the database and can be loaded every time the user logs on to the Mobile Bookstore application. The cart has dynamic limit,

meaning that Administrators of the system can set the maximum amount of book titles that a user can add to his/her cart. This maximum value is stored in the database. **Figure 14** below shows a simple table diagram depicting the table that stores the maximum value or limit for each user's cart. A full database relationship diagram will be shown and discussed in further sections of this discussion. As seen in **Figure 13**, the current maximum value or limit of a cart is 3.

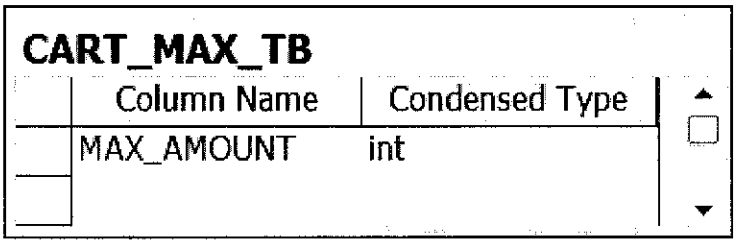

Figure 14: Simple Maximum Cart Value Table Diagram

Users can add book titles to cart and also remove them from their carts in the Book Information page. Users are allowed to add any amount of copies of a single book title into his/her cart, as long as the book is available. If the book is available, users are able to add any amount of copies of the book (to a maximum amount of the available amount) to his/her cart through the Add Book to Cart function. If the user already has at least 1 copy of a book title in his/her cart, then the Remove Book form Cart function is available to allow the user to remove any amount of copies (of that book) from his/her cart. **Figure 15** shows a screenshot of the two functions.

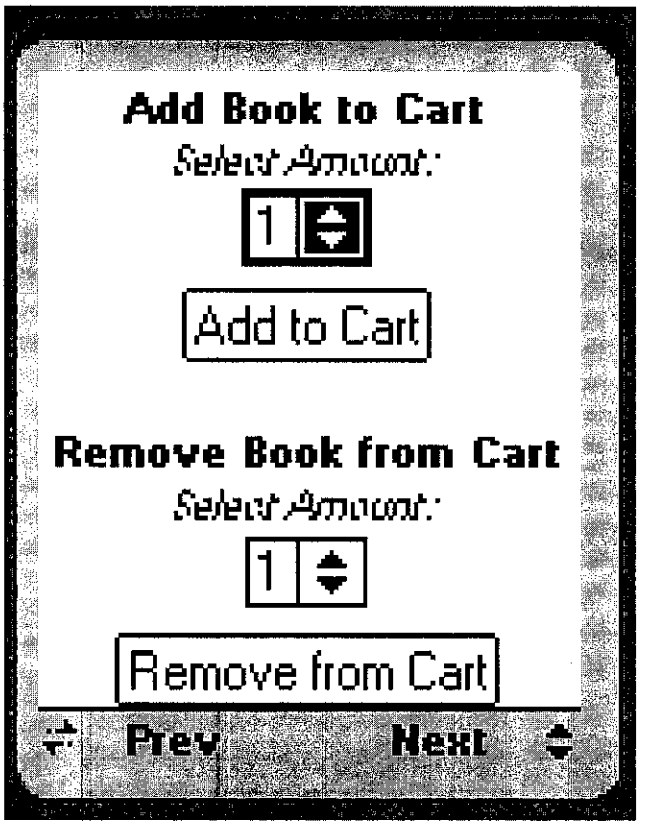

Figure 15: Add Book to and Remove Book from Cart Functions

The Mobile Bookstore also has a Manage Cart function built for each user to allow the users to manage their carts. The Manage Cart page will list down all of the book titles that are in a user's cart, as well as information on the total price of all the books in the cart. This price is calculated according to all copies added to the cart. If the user selects any book from the cart, the Book Information section will be displayed, displaying information on the particular book as well as the Remove from Cart function and/or Add (More) Book to Cart function. **Figure 16** below shows a screenshot of the Manage Cart page. The link to this page can be found in the Main Menu.

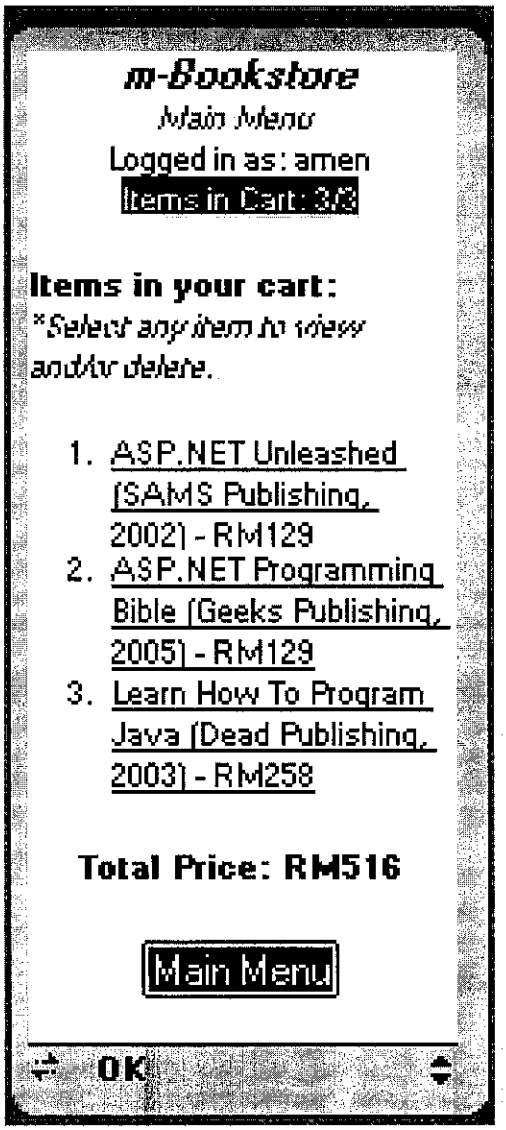

Figure 16: Manage Cart Page Screenshot

Figure 17 shows a partial screenshot taken from the Book Information section, highlighting information of the amount of copies of a book a user has added to his/her cart.

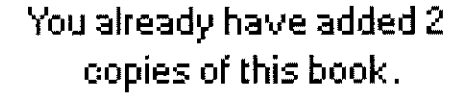

Figure 17: Cart Information in Book Information Page

4.6.10 Book Ownership Tracking Function

The Book Ownership Tracking function is a function developed into the Mobile Bookstore application that allows the system to track each book owners. Book owners can be identified from the members that have bought the books through the Mobile Bookstore application. Information on book owners will be stored in the database to allow for ownership tracking to be used by other functions of the application. The book ownership function is not directly visible on any interfaces, but it is an algorithm that runs in the application. **Figure 18** below shows the table diagram used in this function. The table BOOK_OWNER_REC_TB stores records of all book owners and is useful in the ownership tracking function.

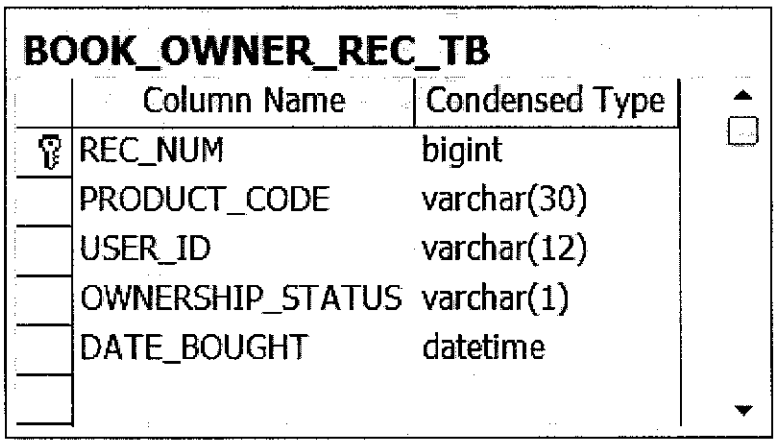

Figure 18: Book Owner Records Table Diagram

4.6.11 User Rating Function

The User Rating function is a function developed in the Mobile Bookstore application that allows members who are logged on to the application to post up their own ratings to all the books in the database. All members (either they own or they do not own the book) can add their own ratings to each book, but each user can only submit ONE rating for ONE book title. The system will store each user's rating information and this can be used to better calculate the average ratings. This function is called the User

Ratings Tracking, whereby the system stores each user's ratings in the database. The User Ratings function will divide user ratings into two (2) main categories, which are: (a) ratings from book owners; and (b) ratings from non-book owners. This will help to reduce bias in calculating the average ratings from the users. This function will make use of the Book Ownership Tracking function in order to calculate ratings according to the two categories.

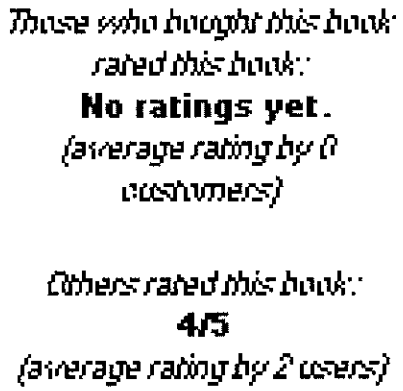

Figure 19: Book Rating Information

Figure 19 shows a partial screenshot of a book rating information located in the Book Information section. This information is directly calculated from the database before it is displayed on-screen to the users. If a user has not yet rated a book, a Rate This Book option will be available to the users (refer to **Figure 20** below). If a user has already rated a book, a Remove Rating option will be able to the users (refer to **Figure 21** below). Once a user submits a new rating, the system will immediately store the user's rating into the database and calculate the ratings on-the-fly every time the user accesses the Book Information page of a particular book. Removing a specific book rating will remove the user's book rating from the database. Since the book ratings are calculated on-the-fly when the information is requested, updated average book ratings will be displayed when requested.

The system also looks in advance on matters regarding ratings based on book ownership tracking. If a user rates a book that he/she has not yet owned, the system will

store this information in the database. The information stored will only include the book title, the user id and also the rating submitted. The system will then perform necessary links and queries to determine whether the user owns the particular book or not and will calculate average ratings for the book on-the-fly, when any user requests for it. Let's say that the user then buys the book a few days later. Any requests or queries on the average ratings for the book will automatically register or categorize the user's rating as a rating by an owner of the book. This shows the use of the Book Ownership Tracking function much more clearly.

Figure 20: Rate This Book Function

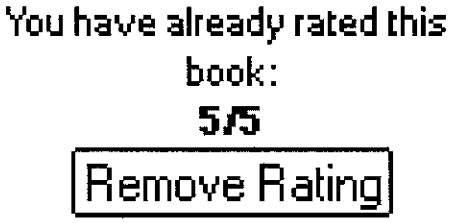

Figure 21 Remove Rating Function

For this function, a user rating management page was developed. This Manage Book Rating user is developed and will be available for each logged on user. Through this management page, users can view a list of their rated books, and delete ratings if they wish to do so. The link to the Manage Book Ratings page can be found in the Main Menu. **Figure 22** below shows a screenshot of the Manage Book Ratings page. If the user selects a book rating from the list, the system will remove the book rating from the list or in other words removing the user's rating for the particular book.

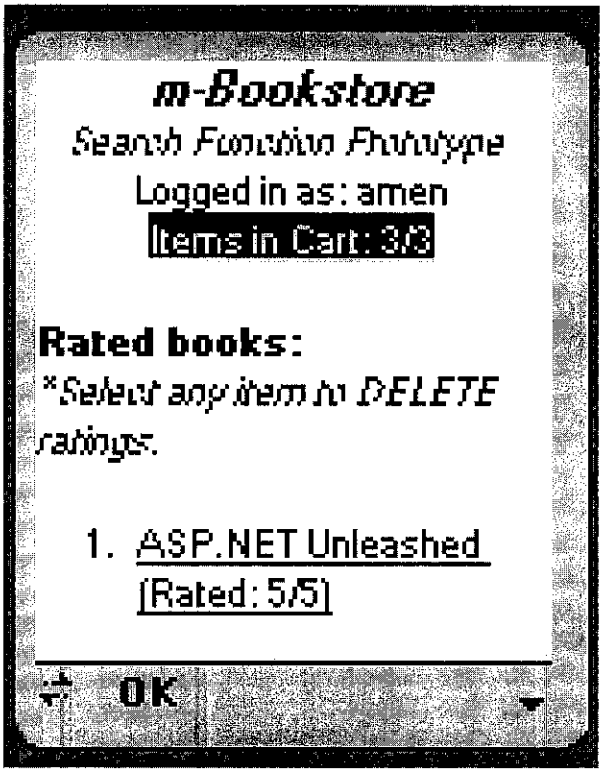

Figure 22: Manage Book Ratings Page Screenshot

4.6.12 Second Hand Function

The second hand function makes use of the Book Ownership Tracking function. This feature allows book owners to sell their books back to the bookstore at a certain price and allow this book to be re-sold to other customers at lower prices (depending on the book quality). This feature will require the cooperation of the Administration module to allow administrators to buy books from book owners to be re-sold at the bookstore and of course through the mobile bookstore as well. The administration side of this function will be discussed later. These books can be browsed from in the Used Books List section of the application. This section's link is available within the main menu of the application, and is available to both registered users and guests. This section will list down all used books' titles, according to the entries in the database. **Figure 23** below shows the screenshot of the Used Books List page.

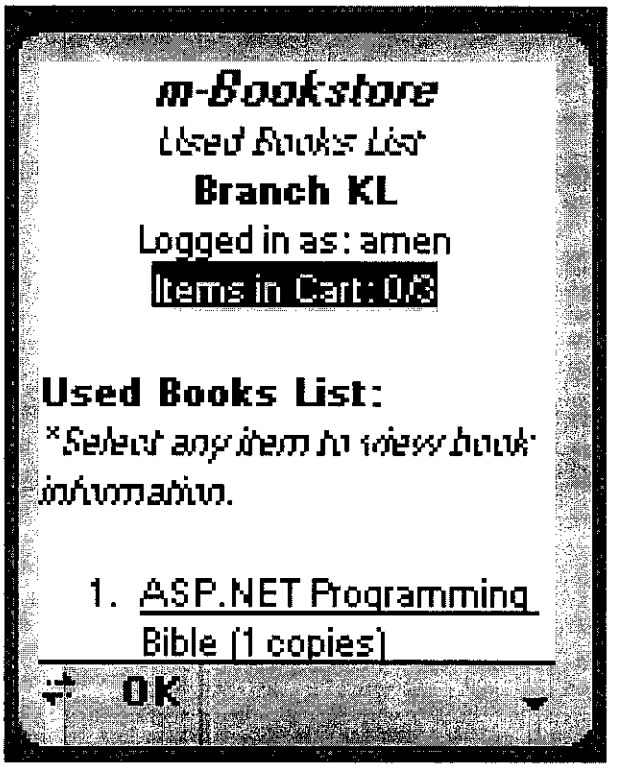

Figure 23: Used Books List Screenshot

Users can also identify second hand or used copies of books under the Book Information pages of each book viewed. The upper section of the page indicates whether there are any used books available or not (for the current title). Users can add used books to their carts, similar to adding normal books to carts. However, there are differences between the two methods, whereby when adding used books to carts, users have the options of whether to add according to the cheapest prices or best quality. This feature was developed due to the fact of varying prices and quality of used books as well as the tendency of users to add more than one used books to their carts at a time.

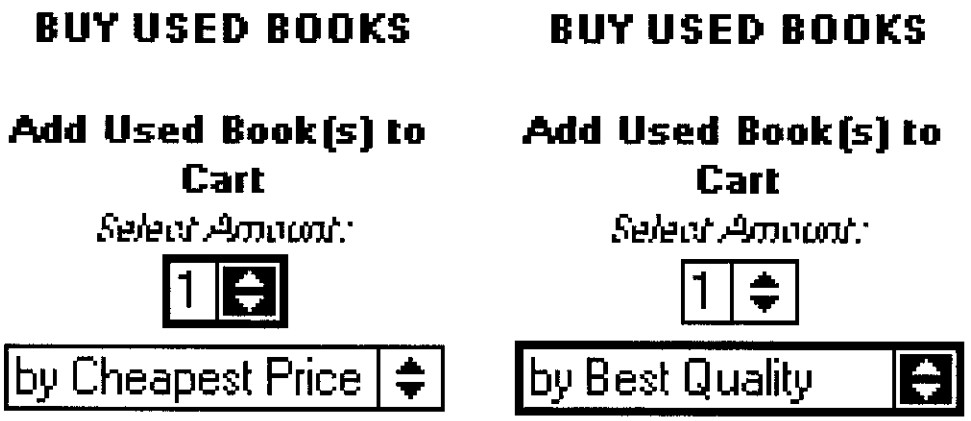

Figure 24: Adding Used Books to Cart

Figure 24 above shows the screenshots of the function that allows users to add used books to cart either by cheapest price or by best quality. If the user chose to add more than 1 used book to their cart with the option 'by cheapest price', then books with the cheapest prices will have higher priorities to get selected. If the user chooses 'by best quality' then those books with better qualities (according to a Quality Rating, which will be discussed in the Administration section) will have higher priorities to get selected. Once added to cart, users are able to buy the used books.

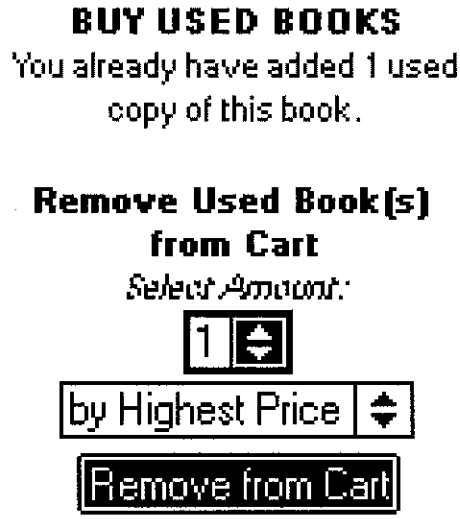

Figure 25: Removing Used Books from Cart

As can be seen in **Figure 25** above, used books can be removed from cart separately from the normal books. Users can also choose to remove according to a

specific amount (maximum value is the maximum amount of the current used books in their carts). Users can also choose to remove books either by highest price or by lowest quality.

4.6.13 Book Purchase Function

After the users have added all the books that they wish to buy in their carts, they can now proceed to the purchasing step. This option is available in the Manage Cart section. Once the user decides to confirm purchase, this link can be activated from the Manage Cart section leading to a confirmation page. A disclaimer is shown to the users, asking them to reconfirm their settings and carts before continuing (refer to **Figure 26** below).

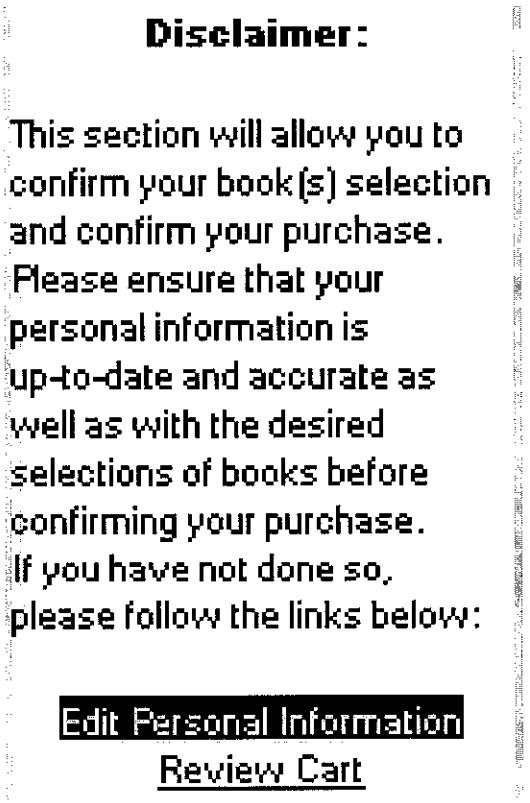

Figure 26: Purchase Disclaimer

Figure 27 below shows the screenshot of the payment options available to the users. Users can choose either to purchase by pickup or by postal delivery. Either way, payments are required to be settled within a specific amount of time before the request is cancelled.

Figure 27: Purchase Method Options

Once a user confirms the purchase, a purchase number or batch number is assigned to the current batch of purchase, and the user will be directed to a purchase successful notification page. The user must settle the payment within a certain amount of time (can be set by administrators) before the purchase request is automatically cancelled. If the user chose to purchase by postal delivery, the user has to send either a cheque or money order to the preferred bookstore branch. The address of the preferred branch will be displayed in the notification page. At this point, further purchase processing takes place at the administration side, which will be discussed later.

4.6.14 Purchase Transactions Status and History

The members are given an extra function which is the My Transactions section. This section is accessible via the main menu of the application. This section allows users to view all the purchase transactions status as well as the history of transactions made by the user according to three criteria: pending transactions, successful transactions and failed transactions.

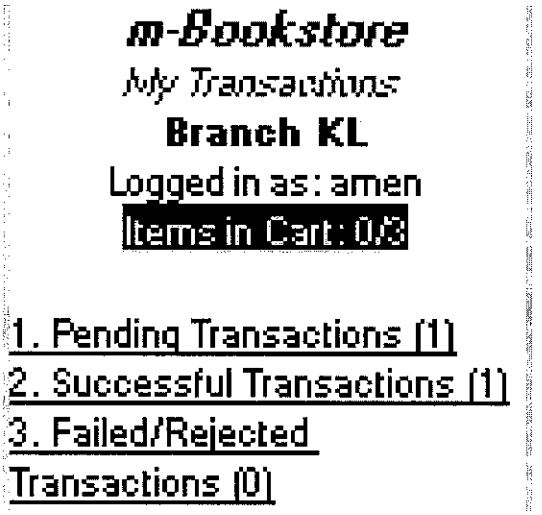

Figure 28: My Transactions Page

Figure 28 above shows the screenshot of the My Transactions page menu. Users can select each of the options to view any purchase batch pending, completed or failed. **Figure 29** below shows the screenshots of the detailed pages of the transactions made. The screenshots show the pending transaction made by the user. This means that the transaction is yet to be approved by the administration side. If the batch is ready, then a READY notification is available on the particular batch.

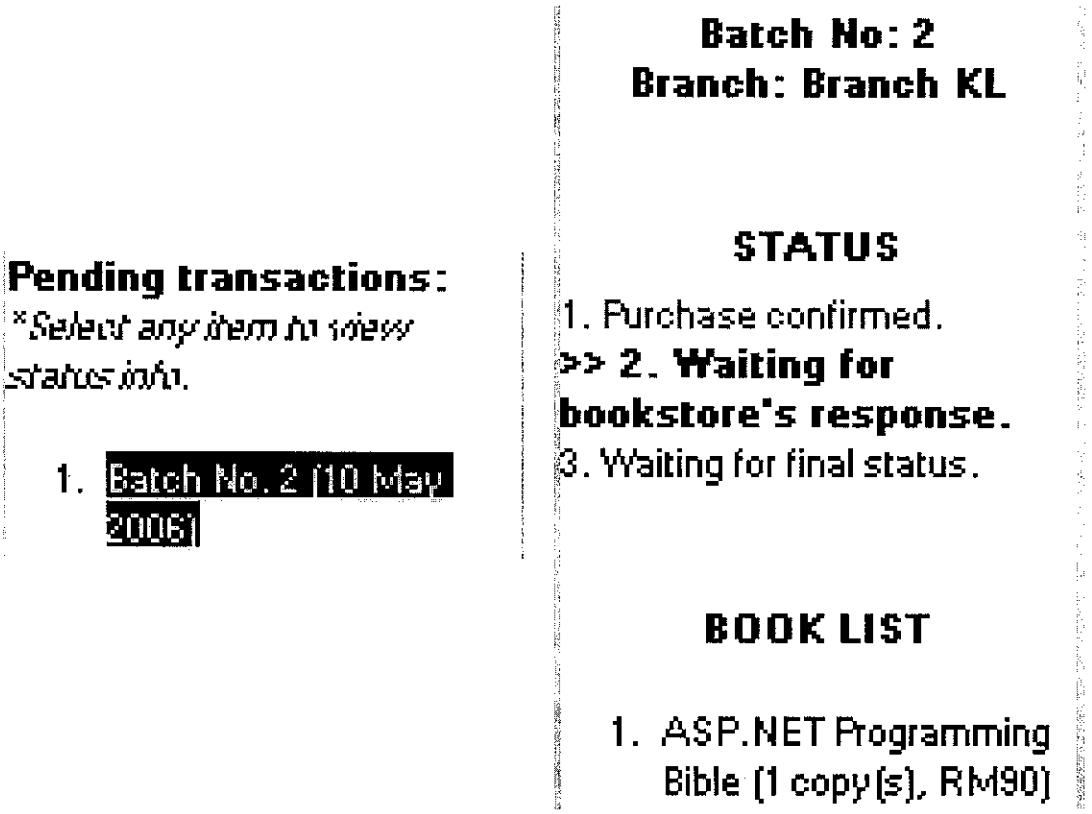

Figure 29: Batch Status Details

4.6.15 Web Administration Module

4.6.15.1 Introduction

The administration module for the Mobile Bookstore is developed as a normal web application accessible via HTTP protocol on the Internet. The discussion on the administration module will be based on the functions below:

- Staff Login According to Branch
- Basic Administration Functions
- Transactions Management
- Book Ownership Management

4.6.15.2 Staff Login According to Branch

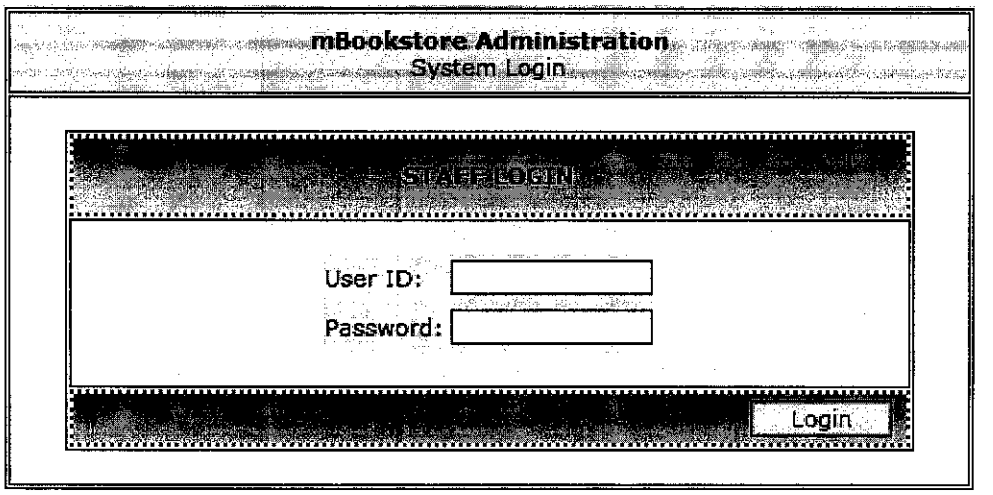

Figure 30: Staff Login Page

Figure 30 above shoes the screenshot of the staff login page. The administration system is integrated with a Branch Tracking function, similar to the WAP client module. This means that if a staff is assigned to a particular branch, that staff will be logging onto the particular branch administration, not others. He or she will administer his or her assigned branch only.

4.6.15.3 Basic Administration Functions

The administration module includes basic administration functions such as Members Management, Books Management and Staff Management. These are the basic management functions included in the administration module. Administrators will be able to manage certain values within the database, for example the size limit of each user's cart as well as the period given to the users to settle their purchase payments before the request is automatically cancelled or rejected.

4.6.15.4 Transactions Management

This section of the administration module allows administrators to manage the purchase transactions or requests made by the customers through the Mobile Bookstore client application. **Figure 31** below shows a screenshot of the Transactions Management section.

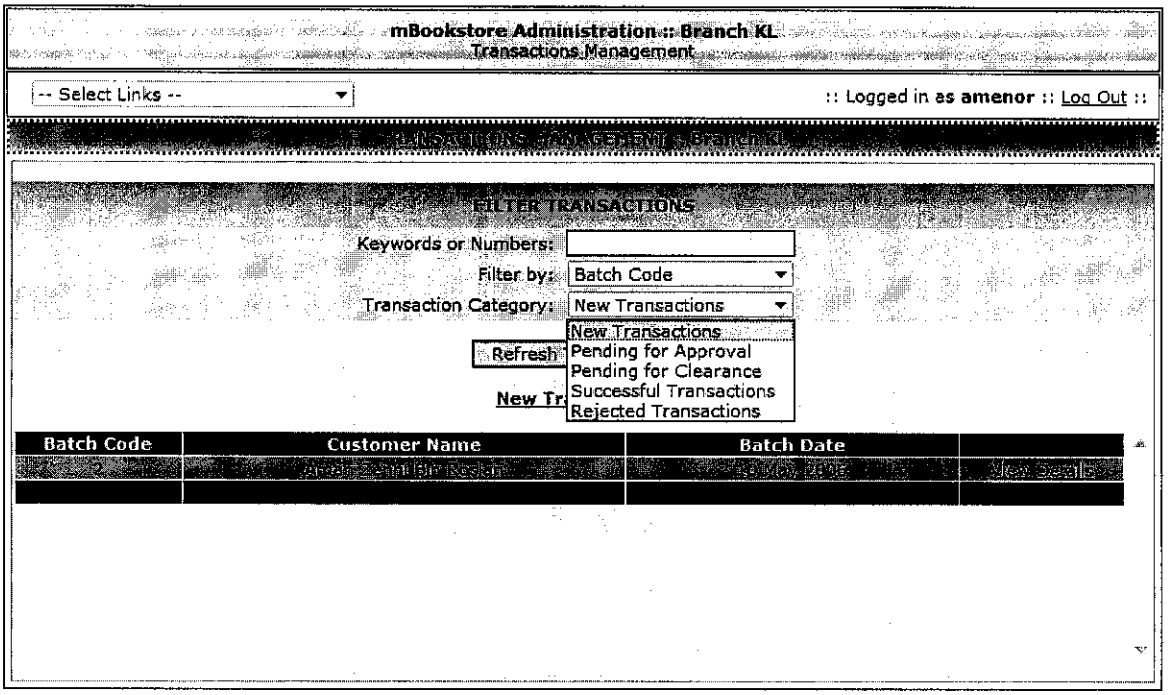

Figure 31: Transaction Management

This section consists of four sub-sections or procedures, which are New Transactions, Pending for Approval, Pending for Clearance, Successful Transactions and Rejected Transactions. New purchase requests will appear under the New Transactions procedure. Once an administrator enters this page, the system will check if there are any new transactions. If there are new transactions available, then a list of the new transactions will be shown first as they have higher priorities. If not, then other procedures will be shown. In order to move the requests to the next procedure, which is 'Pending for Approval', the administrator must view the details of the purchase request. This ensures that the request details are read and processed.

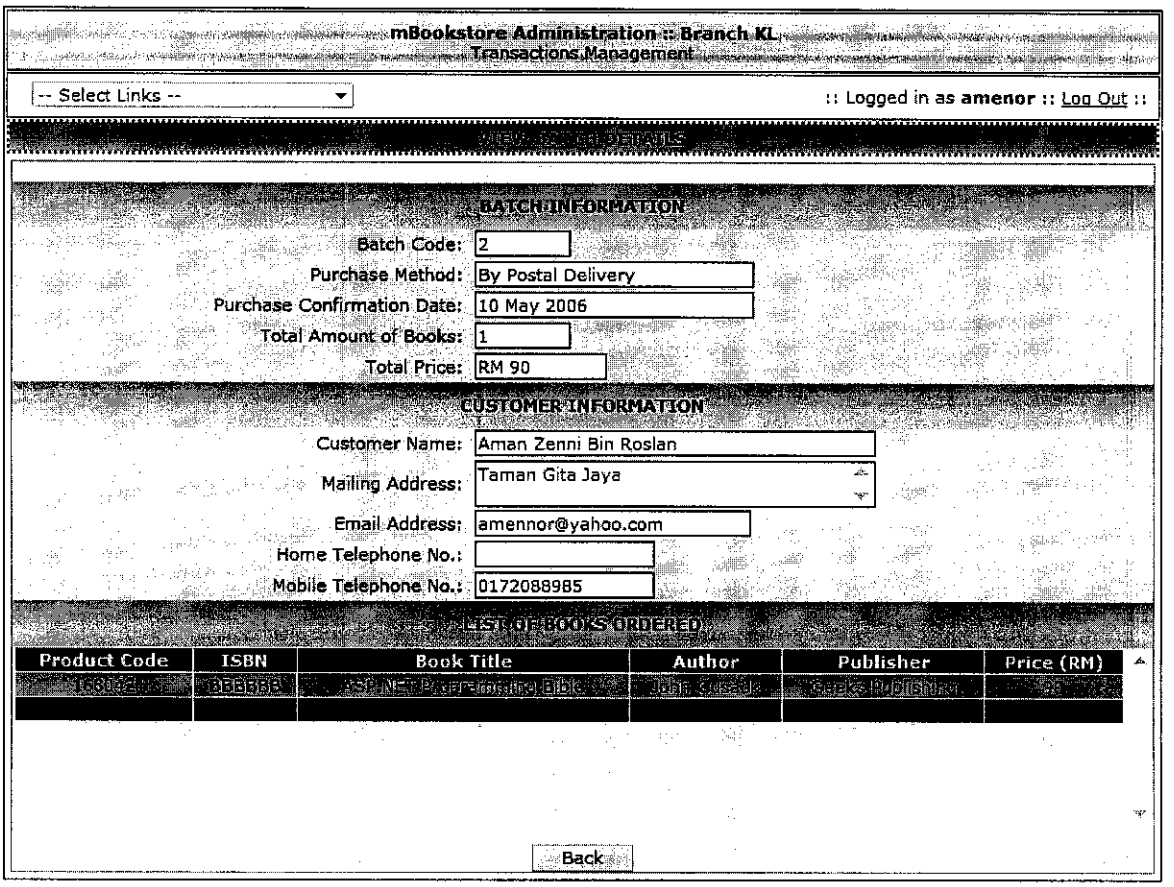

Figure 32: Request/Transaction Details

Figure 32 above shows a screenshot of the details of a transaction made by a customer. Once the details have been viewed, the transaction automatically moves to the Pending for Approval step. If the transaction made is under the purchase method 'by pickup', then once the books are prepared by the bookstore (according to the proper branch) the administrator can proceed in approving the request. If the transaction made is under the purchase method 'by postal delivery', then once the payments are received and the books are prepared by the bookstore, the administrator can proceed in approving the request.

Once the request is approved, it is now pending for clearance. This means that once the books have been picked up by the customer or the books have been sent to the customer, then the request is ready for clearance. Approving for clearance will

complete the request, moving it under successful transactions. Those transactions that are not completed within the given period will automatically be rejected or cancelled.

4.6.15.5 Book Ownership Management

This section allows administrators to buy books from customers to be re-sold to other customers at a lower price, depending on the book quality. **Figure 33** below shows the screenshot of this sub-module.

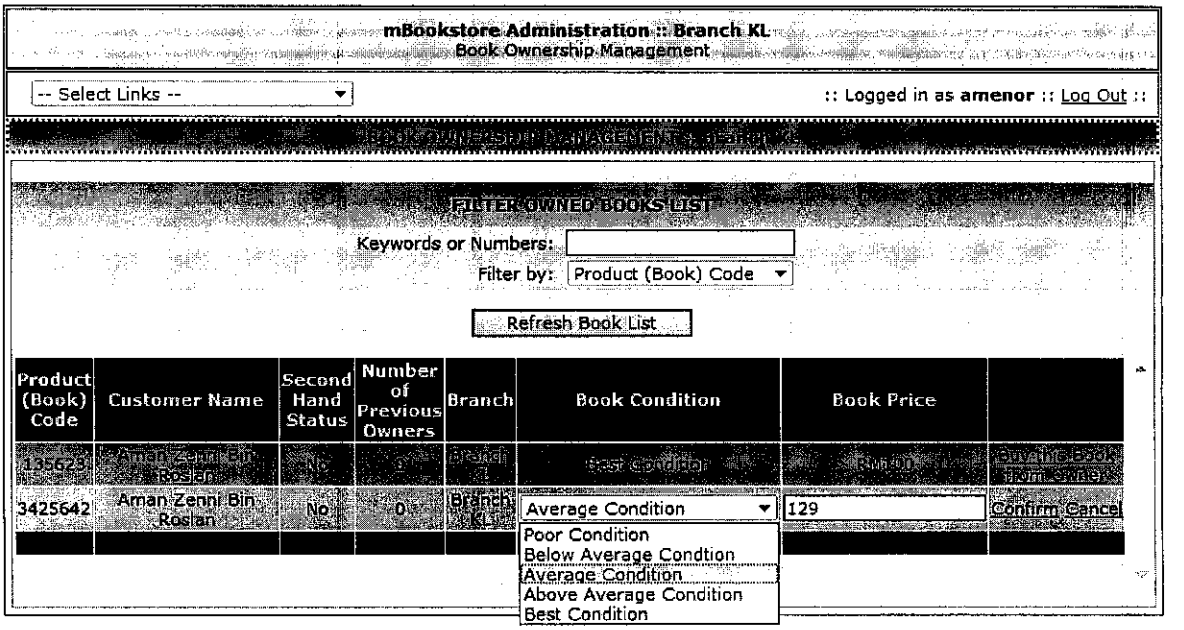

Figure 33: Book Ownership Management

The book's new condition and price can be set by the administrators in this section. Once purchase from the customer is confirmed, the book will be available to other customers as a used book, with its updated condition, price and latest branch.

4.6.16 Automated Purchase Receipt Printing Module

This module is specially developed for the administration side as a solution to keep the administrators alert of new requests coming in. This application is a Windows executable application to be run on any local machines on each branch. This application will connect directly to the central database. Administrators logging into the application will have to use their current login account and each branch requires only one application to be run (refer to **Figure 34** below). Administrators logging in to the application will log in according to their specific branch, allowing the application to receive requests to the current branch only.

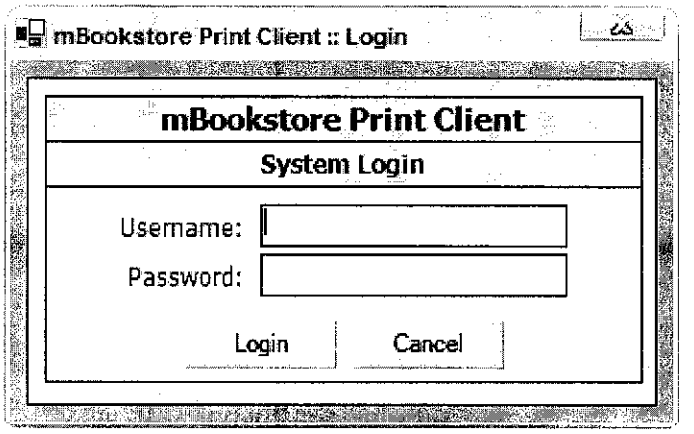

Figure 34: Administrator Login

Once logged in, administrators can set up the network printer connection first before starting the request listening process. Administrators can test printer connection before saving the printer connection settings to the database. A correct setting will provide a connection successful message during connection test, while an incorrect setting will provide a connection failed message. Once these settings are okay and connection test is successful, the administrator are then able to save the settings to the database and proceed with request listening. **Figure 35** below shows the screenshots of setting up the printer connection.

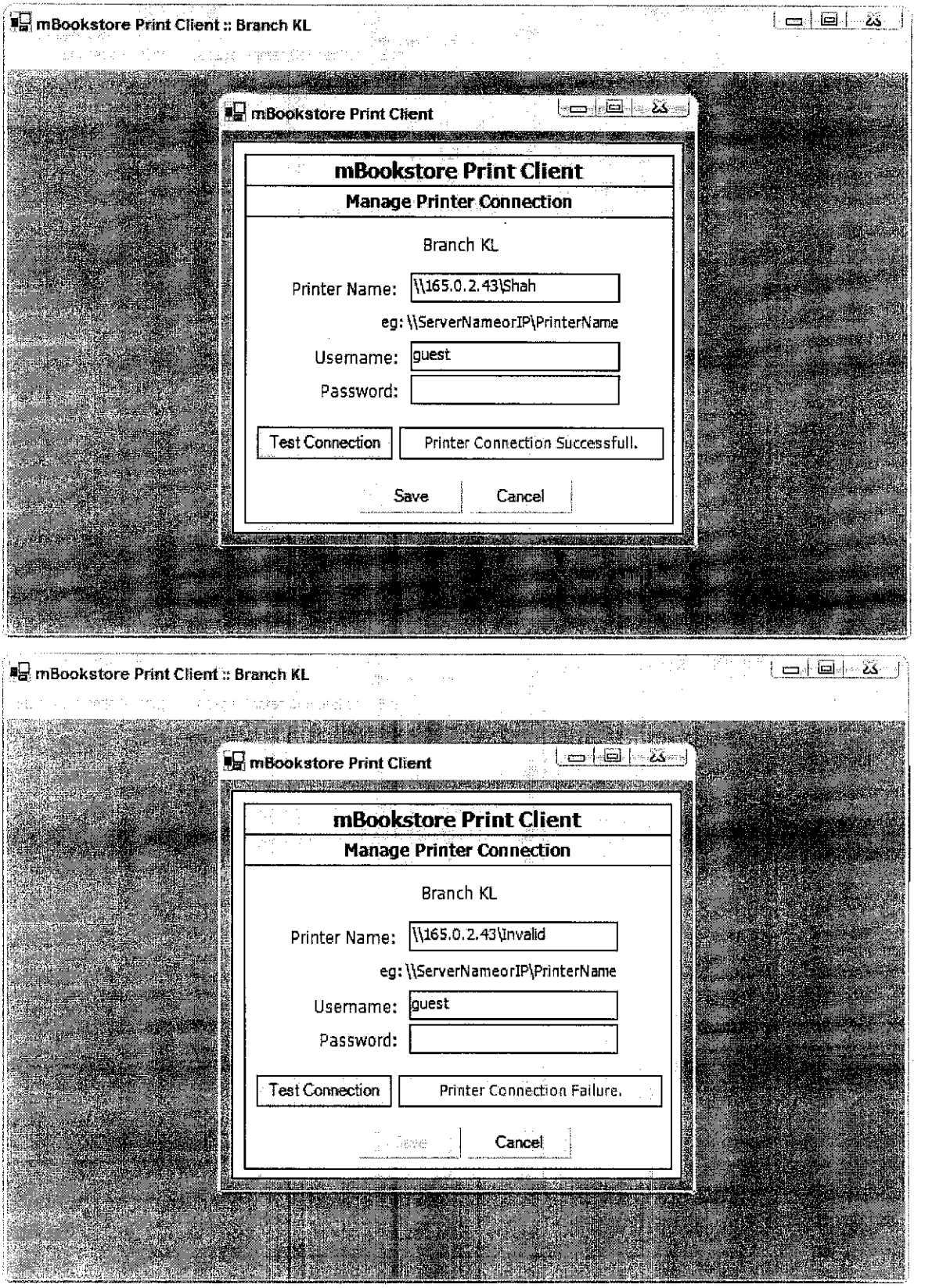

Figure 35: Setting up Printer Connection

Once printer settings are saved, the request listening process can be started. This process allows a looping of request listening procedures to be run by the application. Each new requests received will be printed out as purchase receipts on the configured network printer automatically, as long as the application is kept running in the background. **Figure 36** below shows a screenshot of the request listening process.

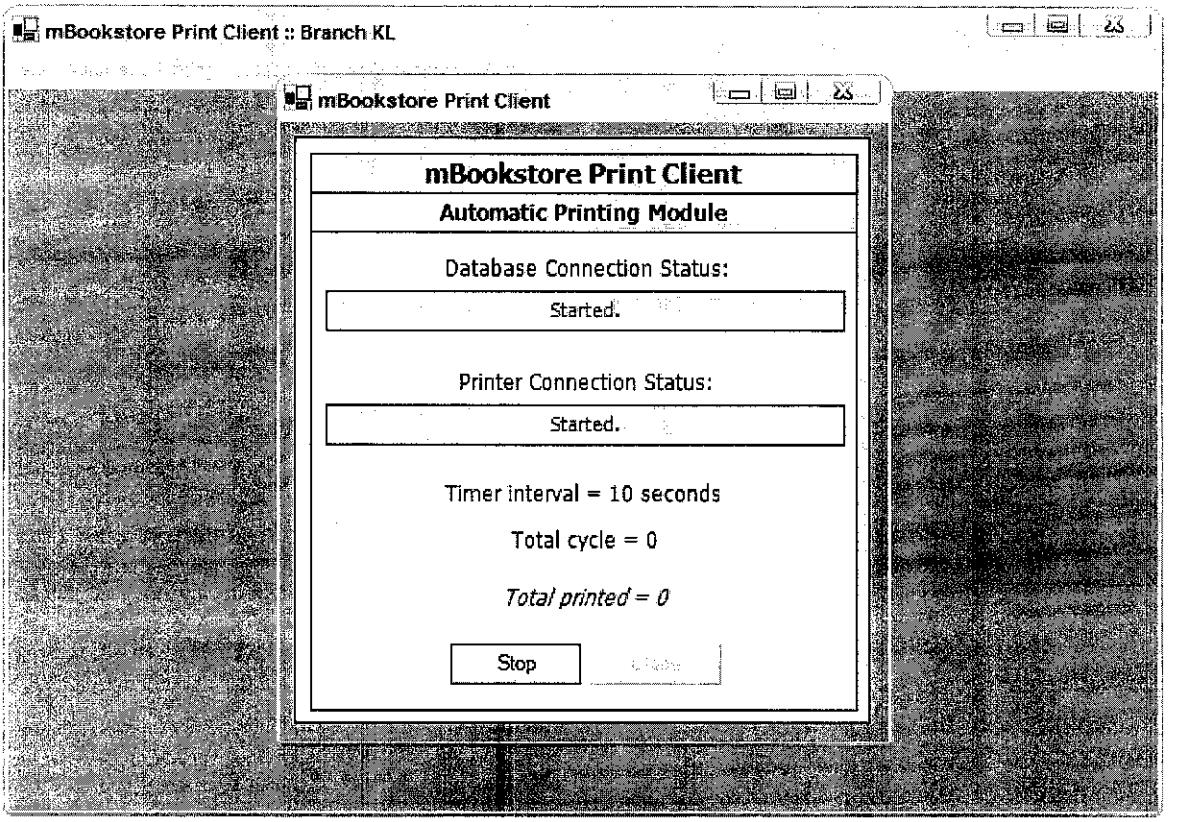

Figure 36: Automated Request Listening and Printing

This automated printing feature is helpful as it allows the administrators to always be alert of new requests coming in to the particular branch. The system also marks those requests that are already printed so there are no duplicates of receipts. This also will mark new requests as printed requests. A sample printout format of the receipt is shown below in **Figure 37**.

M-BOOKSTORE AUTO PURCHASE PRINTOUT

Batch Information

Batch Code: _____
Purchase Method: _____
Purchase Confirmation Date: _____

Customer Information

Full Name: _____
Mailing Address: _____
Email Address: _____
Mobile No.: _____

Books Purchased

Book No. 1

Book Title: _____
ISBN: _____
Product Code: _____
Price: RM_____

...

Book No. n

Book Title: _____
ISBN: _____
Product Code: _____
Price: RM_____

Total Price: RM_____

Figure 37: Receipt Printout Format

4.6.17 Database Design

Figure 38 below shows the diagram for the Mobile Bookstore database design, including all the relationships between the tables of the database.

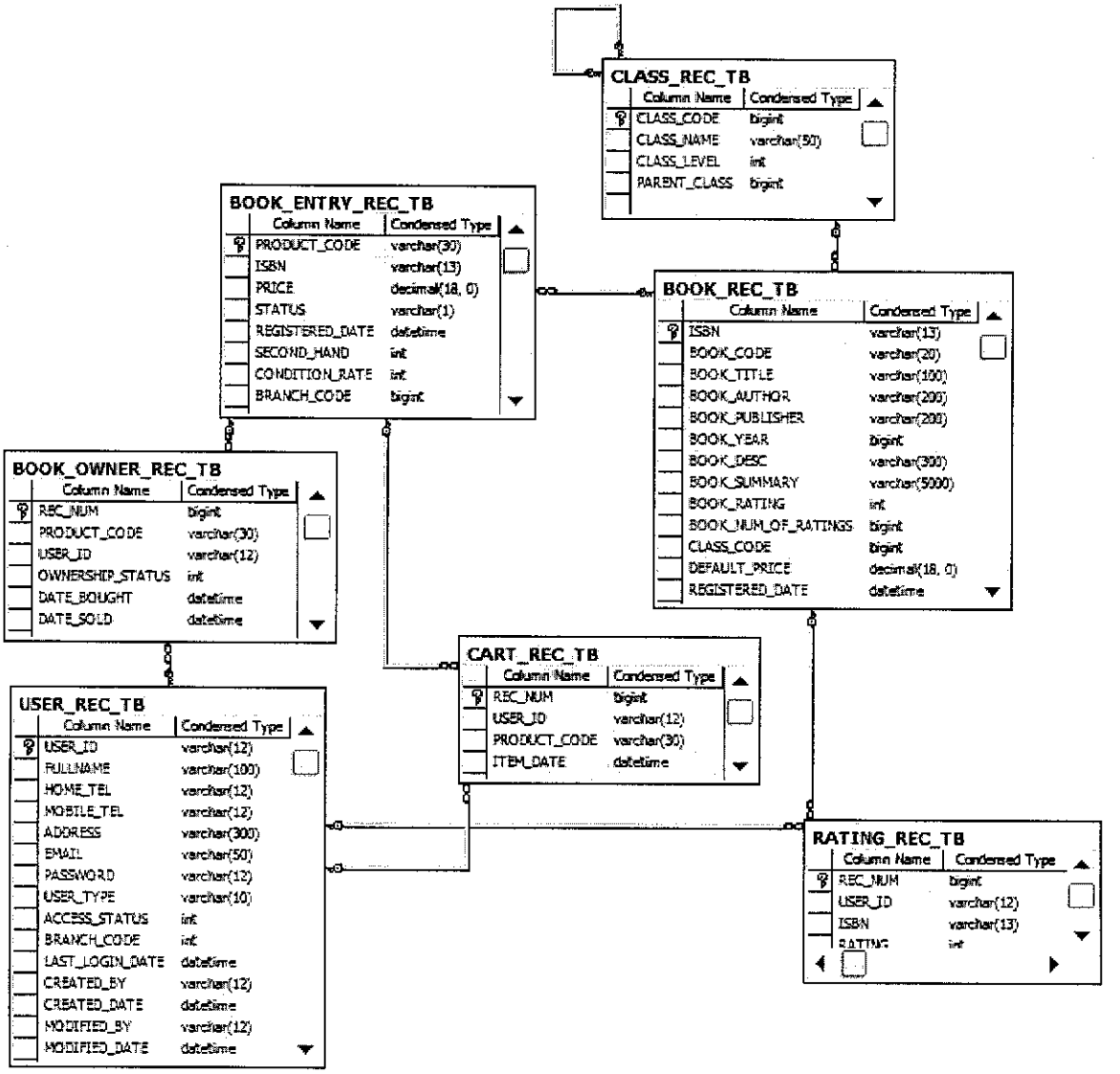

Figure 38: Mobile Bookstore Database Relationship Diagram

CHAPTER 5: CONCLUSION AND RECOMMENDATION

5.1 Conclusion

This report presents the final study and research on pursuing the development of the Mobile Bookstore research project, as a solution to the problem statements stated for this research. The objectives and scope of study need to address all the four problem statements mentioned in this report: (a) geographical problems, (b) the advancing mobile technologies, (c) ubiquitous demands in computing, and (d) large bookstore information requests. The Mobile Bookstore is a software solution that was proposed for this research project as a main solution to the problem statements above. The technologies that will build the foundation and basis of formulating the solution design and coding are such as the Microsoft .NET Framework development toolkits, Microsoft Mobile Internet Toolkit Extension, Microsoft SQL Server for databasing, SOAP framework for reference to implementation, Bluetooth technology and the Bluetooth networks. These technologies will help build the software system, consisting of two modules, which are: (a) the outdoor module - Mobile Web Bookstore Application, and (b) the indoor module - Indoor Module: Wireless Bookstore Application. The design methodologies proposed for the design and development of the software system (solution) are: (a) the waterfall model as a basic software development process model, (b) the incremental development as a process iteration model, and (c) the evolutionary prototyping as a software prototyping model. Let me stress once again, that the research and development of the Mobile Bookstore solution has *no* intentions, whatsoever, to "reinvent the wheel" or reinventing other existing applications or researches. This is not the purpose or even the motives behind this research. The Mobile Bookstore research and development is a unique research, proposing of a mobile-based bookstore business environment, making use of the recent mobile technologies, and referencing to some

existing researches and systems as a guide (but never to imitate), such as the SmartLibrary [1], the m-Mall [5], and online commerce sites such as Amazon.com and the likes. Mobile Bookstore is the solution for tomorrow's ubiquitous bookstore business.

5.2 Recommendations

The main focus of this research is to propose a solution to the problem statements and to address them in an effective matter. However, as agreed with the supervisor, Mr. Anang Hudaya, the development of the software system will focus mainly on the first module, which is the outdoor module - Mobile Web Bookstore Application, and the second module (the indoor module - Indoor Module: Wireless Bookstore Application) will only be developed once the first is complete, as both modules are equally large in scope and time-consuming to develop. The recommendations for this research project can be summarized below:

1. If only the first module is completed, then the obvious recommendation would be to further expand the software solution to include the second module of the software system.
2. A more detailed study and research on the security measures in developing the software solution should be done to increase the security of such a ubiquitous system.
3. A more detailed study on the SOAP framework should be done to develop and implement a fully functional and perfect SOAP framework as a middleware.
4. After the completion of the development, it is highly recommended for the solution to be tested thoroughly before being implemented.
5. The solution is recommended as a solution for major bookstores to implement mobile businesses in the future.

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APPENDICES