MOBILE-BASED APPLICATION FOR BUS TICKETING SERVICES (MBTS)

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ABSTRACT

Mobile technology has been considered as a viable alternative for developing applications to be used in all our life activities. This proposal proposed to utilize such technology for booking tickets of MARA Liner to make this service available anywhere and anytime. The main objective of this study will be to develop and evaluate a prototype mobile-based Bus Ticketing Services (MBTS). This study aims to provide an effective utilization of WAP technology for bus transportation companies. The literature regarding to the mobile technology and its aspects has discussed to get the knowledge base for such mobile technology. This proposal has discussed the methodology of the research. It will guide to develop and evaluate the prototype. The methodology was adopted from SDRM and it includes four steps: Information Gathering, Prototype design, Prototype Development, and Evaluation. Results of user evaluation on the MBTS indicate that it has good usability in terms of Usefulness, Ease of Use and Outcome and Future Use. The results also indicate that there is a significant difference between two groups, first group of users who have mobile phone and other group of users who have not; for Usefulness Outcome/Future Use, while no significant difference for Usefulness and Ease of Use.

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TABLE OF ABBREVIATIONS

WAP	Wireless Application Protocol
MBTS	Mobile-based Bus Ticketing Services
RDMS	Relational Database Management System.
EU	European Union
PDA	Personal digital assistants.
WWW	World Wide Web
IEC	International Engineering Consortium.
OMA	Open Mobile Alliance.
GSM	Global System for Mobile Communications.
GPRS	General Packet Radio Service.
OSI	International Standard Organization.
WAE	Wireless Application Environment.
WSP	Wireless Session Protocol.
WTP	Wireless Transaction Protocol.
WTLS	Wireless Transport Layer Security.
WDP	Wireless Datagram Protocol.
WML	Wireless Markup Language.
WTA	Wireless Telephony Application.
WSP	Wireless Session Protocol.
WTP	Wireless Transaction Protocol.
UDP	User Datagram Protocol.

OSI	International Standard Organization
WTLS	Wireless Transport Layer Security.
WDP	Wireless Datagram Protocol.
HTML	Hypertext Markup Language.
URL	Uniform Resource Locator.
XML	Extensible Markup Language.
GIF	Graphic Interchange Format.
JPG	Joint Photographic Experts Group.
PNG	Portable Network Graphics.
SMS	Short Message System
TCC	Trusted Credential Centre.
U-Payment	Ubiquitous Payment.
U-Receipt	Ubiquitous Receipt.
SDRM	System Development Research Methodology.
IDE	Integrated Development Environment.
UML	Unified Modeling Language.
PUEU	Perceived Usefulness and Ease of Use.

CHAPTER 1

INTRODUCTION

1.1 Background

Mobile technologies are rapidly growth; it has facilitated our daily life's activities. Moreover, it has played an important role in the management of relations between people, whether social or economic relations, or the everyday life (Goh, Kim, Lavanya, Kim, & Soh, 2006; Muller, Lenhart, Henrici, Hillenbrand, & Muller, 2004). Moreover, the evolution and relevance of this technology gave a new face of communication between people and opening up great prospects for continuing them. Indeed, the wide spread usage of mobile technologies for the past decade revolutionize the way people think and communicate.

The emergence of the Wireless Application Protocol (WAP) technology has brought a lot of changes to the way through which people conduct their operations anywhere and anytime. Nowadays, mobile services are considered as a new technology age that provides user interfaces for basic telephony and messaging services, as well as for more advanced and entertaining experiences. Therefore, Mobile-based Application for Bus Ticketing Services can improve people's life, make it simpler and allows peoples faster and efficient travelling anytime regardless the place.

1.2 Problem Statement

The transportations media have grown to be one of the main life activities. The conventional tickets booking system provided by the MARA Liner Company require the passengers to go to the bus stations or through a computer to do any booking. These services have limitations whereby they require users to go to the station themselves. However, through online, passengers can only access the services via computers connected to the internet. A new form of technology has to be introduced to overcome the limitations. Mobile technology has been considered as a viable alternative for developing applications to be used for booking of MARA Liner tickets anywhere and anytime.

1.3 Research Questions

This study aims to investigate the following:

i. How to help the passengers to book tickets anywhere and anytime?
ii. What are the criteria to be used for usability evaluation of the Mobile-based Bus Ticketing Services (MBTS)?

1.4 Research Objectives

This study utilizes mobile technology for ticket booking of bus services. The objectives of the study are:

i. To develop a prototype Mobile-based Bus Ticketing Services (MBTS).
ii. To conduct user evaluation on the Mobile-based Bus Ticketing Services (MBTS).

1.5 Scope of the Research

This study focuses only on MARA Liner bus Company, Malaysia. It is intended to provide the facility for passengers to access online ticket booking operations through mobile devices. Ticket payment is out of this study scope. A mobile prototype will be developed based on Wireless Application Protocol (WAP) using Microsoft Visual C#.Net as the programming language and Microsoft SQL Server 2005 as the Relational Database Management System (RDMS).

1.6 Significance of the Research

The significance of this study are as follows:

i. The MBTS offers numerous opportunities for passengers to accomplish their tasks more quickly and efficiently.
ii. Introduce a new concept in the ticket booking services which enables users to access it anywhere and anytime.
iii. The MBTS based on effective utilization of WAP technology for bus transportation companies.
iv. The prototype utilizes the existing mobile interface and database infrastructures, thus MBTS does not require extra cost to take advantage of the mobile technology.

1.7 Summary

This chapter discussed a general background of the study and the research problem that need to be solved. The objectives stated and formulated regarding the research questions. The limitation of this study mentioned and determined.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The background of this research and brief description of the study settings were introduced in the previous chapter. This section will continue on the discussion and ideas in previous work and knowledge related to mobile technology and its aspects.

2.2 Mobile Technology

Mobile technologies potentially create a wide variety of uses and limitations that differ significantly from desktop and laptop technologies. Figure 2.1 shows the infrastructure for mobile computing (Turban, Leidner, McLean, & Wetherbe, 2007). However, today most people are equipped with mobile devices and most of them already have good knowledge and experiences in using mobile devices to access internet applications (Dankers, Garefalakis, Schaffelhofer, & Wright, 2002). As an example, The total number of remote workers in European Union (EU) has grown from six to thirteen percent in the period from 1999 to 2002 (Veksttrend, 2002).

The number of subscribers of mobile phones has also increased in the same period in Norway. Even though, the number of subscribers was already substantial, it grew approximately 30 percent. In 2001, 3,201,554 people were mobile phone subscribers. That is 71% of the population, with comparison, only approximately 30% of the

population in the USA has mobile subscription (Schei & Fritzner, 2002). Moreover, China has 206 million subscribers in 2002, which is 16.19% of China's population (Chen & Kinshuk, 2005). One reason for this growth can be the expansion of mobile devices like smart phones, personal digital assistants (PDAs) and mobile phones in the market.

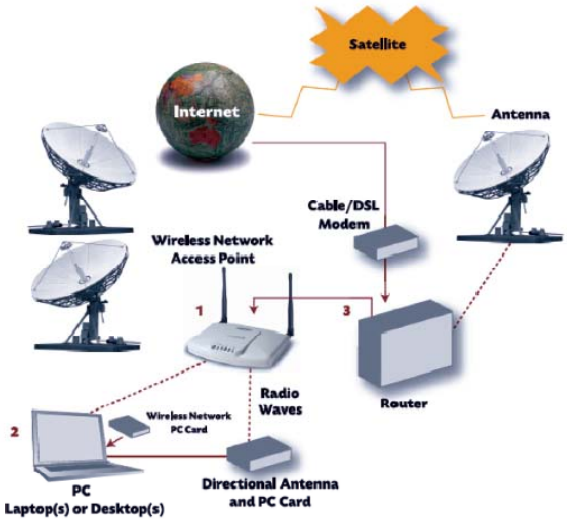

Figure 2.1: Computing Mobile Infrastructure (Turban, et al., 2007)

A smart phone is a mobile device with both PDA and mobile phone capabilities (Chen & Kinshuk, 2005; Nilas, Sueset, & Muguruma, 2004; Schei & Fritzner, 2002). It is a handheld computing device that contains applications like word processor, calculation program, calendar and perhaps some communication possibilities (What-Is.Net, 2006). The number of mobile phones has increased rabidly.

In Norway, 78,000 PDAs were sold in 2000 and 60,000 in 2001. In 2002, the sales were much lower (Schei & Fritzner, 2002). Worldwide in 2001, 13.1 million units were sold (McDonough, 2002), and according to Intel Developer Update Magazine in 2002, there

were approximately 1 billion cellular phones used, with 1.8 billion in 2006. Market penetration is approaching 50 percent in the U.S., and has reached 70 percent in Western Europe, Japan and Korea (Deshpande & Keskar, 2002).

2.2.1 Mobile Applications

Mobile applications increasingly affect the diffusion of information as well as business activity. They gain broad acceptance due to the increased need in supporting the mobile workforce and the rapid improvement in the devices and wireless technologies for communication. Many mobile applications provide personal services such as sending and viewing email, browsing the world wide web (WWW), viewing traffic and weather reports , watching movies and chatting with others (El-Alfy, 2005).

Mobile services appear to be an obvious choice for travel and tourism as the travelers are on the move, which is the first criterion for mobile services to be relevant. Nevertheless, based on a study conducted by (Carlsson, Carlsson, & Walden, 2005) in 2003; few users have expressed their desire to use their mobile phone whenever possible. The travel and tourism industry have been undergoing many dramatic changes during the last decade, due to the possibilities offered by Internet technology.

Based on a study by (Kalkbrenner & Nebojsa, 2001) which focuses on the improvement of organizational infrastructure for campus and student needs, it indicates that there are still many weaknesses in the current version of Wireless Application Protocol (WAP) that require in-depth investigation, since every new technology arriving on the market has to

be investigated of its benefit for daily use. At present, mobile phones have been popular worldwide. Mainly it is ubiquitous and customers can make calls anywhere for transaction. Mobile phone market shares have grown up dramatically. Mobile commerce (m-commerce) attracts various relative companies such as mobile handset manufacturers to develop technologies to generate added values for their mobile sphere (Amor, 2002).

Research study that conducted by Carlsson, et al. (2005), has investigated mobile services for the hospitality industry. It has found that mobile services is the obvious choice for travel and tourism as they are one of the largest and most rapidly expanding industry in the world and one of the significant users of ICT. It seems to be an apparent choice as all travelers are on the move. However, the available mobile services are not as many and as value adding as expected. The study is done by contrasting the problems with travelers' attitude and expectation in order to improve productivity of some key routines in the hospitality industry.

2.2.2 WAP Concept and Definition

Wireless Application Protocol (WAP) is a collection of wireless application protocol and specification standard that allows mobiles devices to communicate with the web server using the WAP browser and display the contents back on the mobile devices screen, basically, it is the protocol that allow mobile devices to access the internet (WapForum, 2002a). International Engineering Consortium (IEC) has introduced another definition: Wireless application protocol (WAP) is an application environment and set of communication protocols for wireless devices designed to enable manufacturer, vendor,

and technology independent access to the Internet and advanced telephony services (International Engineering Consortium, 2007).

In the early day of wireless web, several companies produced their own proprietary application protocol, this made the wireless web developed that followed one company communication protocol standard can only be viewed by mobile phone that use that standard (Nylander, 2004). Lacks of standardization hinder the growth of wireless web, users were confused, and developers were screaming for standardization.

One of the most important aspects of wireless communications is standardization. WAP is intended primarily for Internet enabled digital phones, pagers and other handheld devices. It is designed to standardize development across different wireless technologies worldwide. In 1997, the Wireless Application Protocol (WAP) was developed by Nokia, Ericsson, Motorola and others to foster the emergence of the wireless Internet. It is designed to standardize development across different wireless technologies worldwide (Computing, 2000). Moreover, in June 2002, 350 member companies –involved WAP forum companies- joined together and formed the Open Mobile Alliance (OMA). They represent the world's leading mobile operators, device and network suppliers, information technology companies, application developers and content providers (Open Mobile Alliance (OMA), 2004).

According to analysts at Lehman Brothers Inc (Kustin, 2002), the number of wireless Internet access devices being utilized worldwide is expected to double annually from

approximately 50 million units in the year 2000 to approximately 600 million units in the year 2004. Based on this data, recognizing the upcoming need to have pricing information and purchasing opportunities available for users of handled Internet access devices is essential for companies looking to become the most preferred suppliers of consumer goods on the Web. Moreover, IEC (International Engineering Consortium, 2007) believes that the future for WAP will be bright; based on 75 percent of the world company's stand behind the mobile telephone market and the huge development potential of WAP.

2.2.3 WAP architecture

WAP has a client and server approach that compounds wireless network and internet technology. In fact the motivation for developing WAP was to extend Internet technologies to wireless networks, bearers and devices (Wapforum, 2002b).

The First specification of WAP (WAP 1.0) released in 1998 by WAP Forum. Followed by WAP 2.0 which is a next-generation set of specifications that utilized and supported enhancements in the capabilities of the latest wireless devices and Internet content technologies, also WAP 2.0 provides managed backwards compatibility to existing WAP content, applications and services that comply to previous WAP versions.

It was designed to work on any mobile network standard whether Wireless LAN (IEEE 802.11 protocol), Bluetooth, Infrared (IR) or cellular networks such as Global System for Mobile Communications (GSM), General Packet Radio Service (GPRS) (Antovski, 2003;

Cervera, 2002; Kalliola, 2005). WAP has a layering concept like the internet; each of the layers of the architecture is accessible by the layers above, as well as by other services and applications. Figure 2.2 shows the WAP layer stack (centre) and internet OSI (International Standard Organization) layer stack (left). WAP stack consist of Wireless Application Environment (WAE), Wireless Session Protocol (WSP), Wireless Transaction Protocol (WTP), Wireless Transport Layer Security (WTLS) and Wireless Datagram Protocol (WDP).

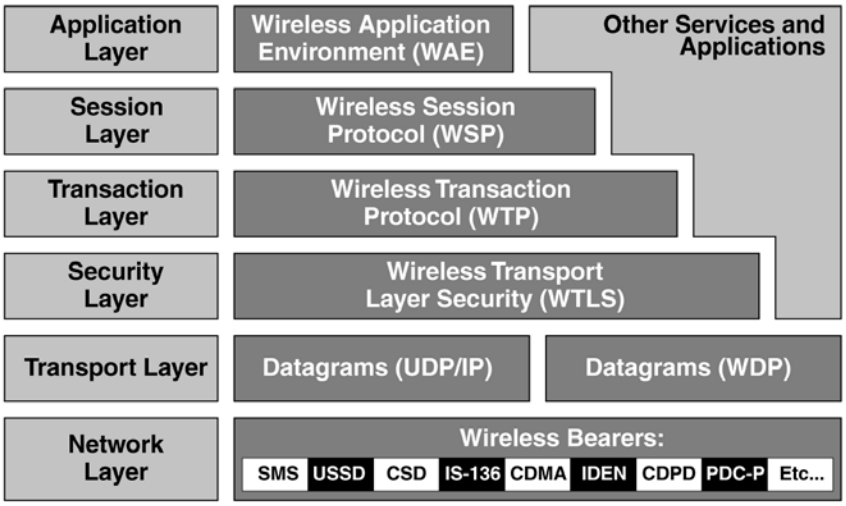

Figure 2.2: WAP Protocol Stack (WapForum, 2002a)

i. Wireless Application Environment (WAE)

The WAE layer is where the protocol for the user interface resides, WAE interact with Wireless Markup Language (WML), and WML is equivalent to the HTTP in the internet, WML Script and Wireless Telephony Application (WTA) to display content on the screen.

ii. Wireless Session Protocol (WSP): Compose of two protocols:

    1. Work with WTP to make connection oriented session.
    2. Allow server to make connectionless oriented session (PUSH technology).

iii. Wireless Transaction Protocol (WTP)

    WTP layer responsible to manage a transaction, WTP employed the User Datagram Protocol (UDP) on the internet OSI (International Standard Organization) model; WTP offers three classes of transaction service: unreliable one way request, reliable one way request and reliable two way request respond.

iv. Wireless Transport Layer Security (WTLS)

    WTLS layer deal with security, data integrity and authentication protocol.

v. Wireless Datagram Protocol (WDP)

    WDP is data transport protocol that manages the transmission; WDP allows WAP protocol to adapt any data communication protocol from network standard, thus allowing WAP to communicate with any network standards.

2.2.4 WAP Session

WAP session consists of interaction between mobile phone, Telco, WAP gateway and web server. WAP gateway is a software that acts as an intermediary between mobile phone and internet, it process request from micro browser, forward the request to the corresponding web server, encode the content in WML if the content not in WML format and divided the content into smaller chunk to be transmitted back to the micro browser.

The WAP gateway performs two main functions (WapForum, 2002a):

i. Protocol Gateway: Translates WAP protocol request to the WWW protocol request (HTTP and TCP/IP) and vice versa.

ii. Content Encoders and Decoders: Translate Web content into compact encoded formats to reduce the size and number of packets traveling over the wireless data network.

WAP phone cannot communicate directly with the web server due to the different markup language and protocol used; web server normally uses HyperText Markup Language (HTML) while WAP phone uses WML. One of the reasons why WAP phone cannot use the available internet protocol such as TCP/IP and HTML was the limited amount of information that can be transfer by the wireless network, WAP was primarily design to minimize bandwidth use (Foo, Hoover, & Lee, 2001), therefore WAP phone require WAP gateway to perform all the conversion and synchronization. Figure 2.3 shown the process flow, it assumed that the user is already connected to the internet (Andersson, Greenspun, & Grumet, 2005).

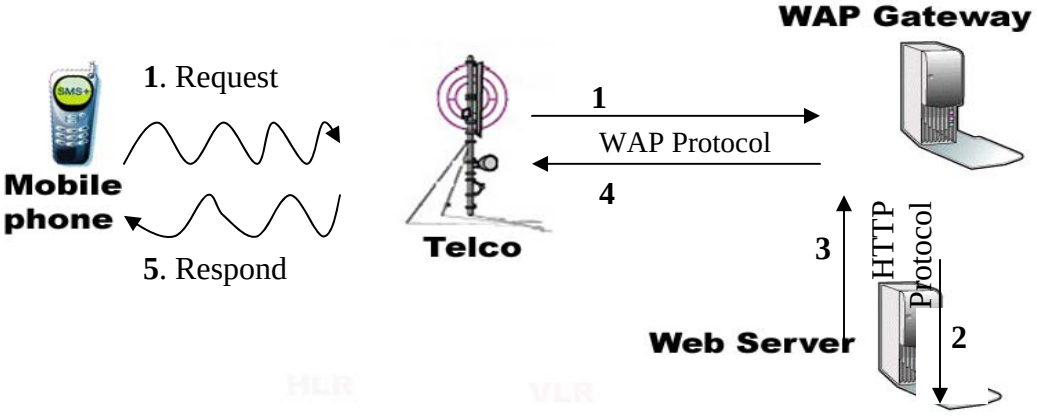

Figure 2.3: The WAP Process Flow (Ghani, 2005)

WAP process flow described briefly in the following points:

1. An Uniform Resource Locator (URL) request for a WAP site is send out by micro browser reside in user's mobile phone to a WAP gateway.
2. The request will be processed by the WAP gateway, WAP gateway will query the requested URL for the content, the requested URL (web server) will reply back by sending the content to the WAP gateway.
3. If the requested content is WML format, the requested content is directly send back to the micro browser, but if the requested content is written in HTML language, WAP gateway will translate the content to WML format before transmitting it to the micro browser.
4. The requested content is send back to the micro browser.
5. Micro browser will display the content on the mobile phone screen.

Despite TCP/IP might be the efficient method to transfer data between internet and computer, large amount of data can be transmit by the network and displayed back on the computer monitor screen. However unlike the computer, mobile phone has many limitation such as small display, low storage capacity and processing power and limited input capabilities, furthermore the amount of data that can be transmit by wireless network is limited, due to the limited bandwidth. The WAP protocols were specifically design to address all of these limitations (Andersson, et al., 2005).

2.2.5 Wireless Mobile Markup Language

WML is an official markup language endorsed by the WAP forum (WapForum, 2002a). It is an XML based scripting language for creating content for wireless system (Turban,

et al., 2007). As mentioned in WAP session section the relation between WAP and WML is: The Wireless Application Protocol (WAP) enables different kinds of wireless devices to communicate and access the Internet using the Wireless Markup Language (WML) (Deitel, Deitel, Nieto, & Steinbuhler, 2001).

The page written in the WML language can be displayed back on any WAP phone using a micro browser, WML language is based on Extensible Markup Language (XML), a markup language that conform to the stricter standard, can be shared across different systems, and also the language that recommended by the World Wide Web Consortium(W3C).

A WML document is called a deck and contains one or more sections called cards. Each card consists of text content and/or navigational controls for user interaction. Only one card can be viewed at a time, but navigation between cards is rapid because the entire deck is stored by the micro browser (Deitel, et al., 2001).

A Deck is the smallest unit of WML that can be transmitted by a WAP gateway, when user request for URL, WAP gateway will send deck to the mobile phone, micro browser will the display the first card as defined by the deck. However due to limitation of mobile phone, WAP gateway will not send compiled WML deck larger than 1,429 bytes to the mobile phone to avoid data overwhelming (Foo, et al., 2001).

WML like HyperText Markup Language (HTML) supports several basic features (Deitel, et al., 2001):

1. Formatted text such as bold, italic, larger or smaller and other tags.
2. Hyperlink, just like HTML hyperlink, can be linked to a card on the same deck or a card on another deck.
3. Selection, user can select from series of option.
4. Input, user can be requested to enter data.
5. Soft button, soft button can be programmed to execute specific command.
6. Wireless bitmap (wbmp) images.
7. Flash screen, this function will display a card for period of 1 to 5 seconds, then a new card is displayed.
8. Event handling, can handle interrupt from other application, for example accepting incoming call while browsing the internet.

2.2.6 Image support

WML only support images in the wbmp format (Bullbrook, 2001; Dutoit, 2000; Foo, et al., 2001) with the following characteristics: no compression; one bit color (white=1, black=0); and Depth: I bit deep (monochrome)

While the XHTML MP has greater support for image format such as: GIF (Graphic Interchange Format), Animated GIF, JPG (Joint Photographic Experts Group), PNG (Portable Network Graphics) and Wbmp (Developershome.com, 2005)

However, the support is depend primarily on the wireless devices that displaying it, if the wireless device (e.g. mobile phone) does not support the image format, then the WAP browser will replaced the image with the supplied text, For example the XHTML MP syntax to display an image is

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If the mobile phone does not support the image format, then the text ***logo*** will be displayed instead of the image.

2.3 Mobile Bus Tickets

The idea of mobile based bus ticketing system is supported by the availability of access point in almost all public places such as bus terminal, airports, hotels and schools therefore, designing a mobile based system to accommodate people on the go is one of the today business priorities. However, most of cell phones currently equipped with Micro browsers which allow the user to browse the internet from any internet connected access points. Additionally, BBC news reported that Nokia is planning to try out a wireless ticket system on German buses. Early next year travelers in the city of Hanau, near Frankfurt, will be able to pay for tickets by passing their phone over a smart-card reader already installed on the buses. Nokia argued that the system would reduce queues and make travelling easier (BBC News, 2004).

Several attempts were reported to design a mobile based system to serve special purpose of transportation and facilitate passengers using the mobile technologies.

2.3.1 Austrian mobile and rail operators develop

Austrian mobile and rail operators develop VDV-based NFC ticketing (Clark, 2009) and the mobile bus ticket system in Spain (NeoMedia Technologies, 2008). The paperless ticket booking concept that enables the passenger to book the ticket without need to go to counter by using online ticket booking (Guillaume, 2009). Consequently, the passenger only needs to send a Short Message System (SMS) code to special number and receive the reply in a few second. On the bus entrance the passenger required to show the SMS in the cell phone to the bus driver. Moreover, such mobile technology works well and saves time and significant reduction of delays in limited geographical area where the company handles the transaction via pre registration for the system users. The payment is settled along with the phone bill.

2.3.2 Ticket-based mobile service system

Wang, Huang, and Dodda (2006) proposed and implemented a ticket-based mobile service system for mobile users via SMS system, (see Figure 2.4). The Trusted Credential Centre (TCC) Approach was utilized issues tickets for the users. The ticket-based mechanism is implemented allowing the user to identify the service providers' effort when they pay them. Moreover, the study concluded that tickets provide a flexible and scalable mechanism for mobile access. The main contributions of study are that the scheme is a global ticket-based solution for mobile service, an anonymous and dynamic system, and new users and new service providers can join at anytime. It is also scalable and users can check charges at anytime.

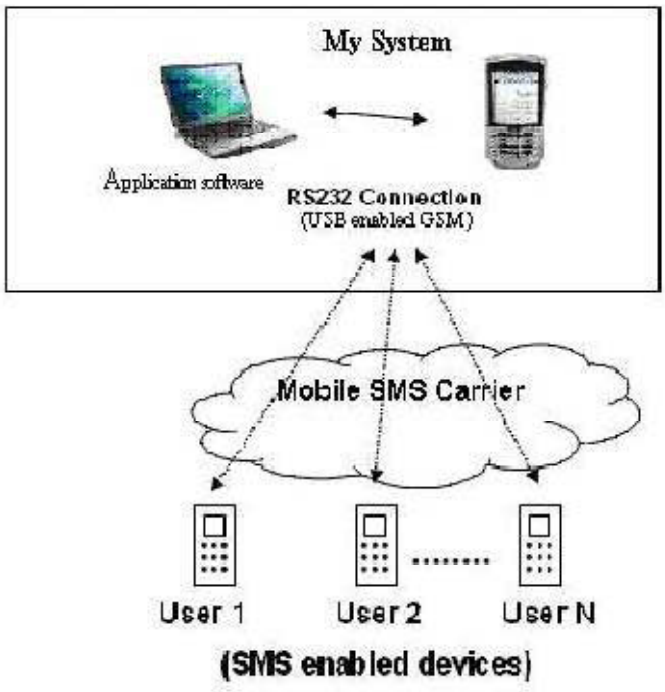

Figure 2.4: Framework of Ticket-based Mobile Commerce System (Wang, et al., 2006)

2.3.3 A Payment and Receipt Business Model in U-Commerce Environment

Lee, Ju, & Jeong (2006) explained Ubiquitous Payment (U-Payment) and Ubiquitous Receipt (U-Receipt) business model (see Figure 2.5). The model designed to improve privacy protection while promoting the seamlessness between economic entities. Even more, the U-Payment environment opens a new business opportunity. To intensify the understanding of this business model, they showed scenario, system architecture, business process, and models. Their business model is an experimental model of U-commerce which is possible in a seamlessness environment and increase of the

computing power and this will work as a great medium to connect transaction business model and marketing model.

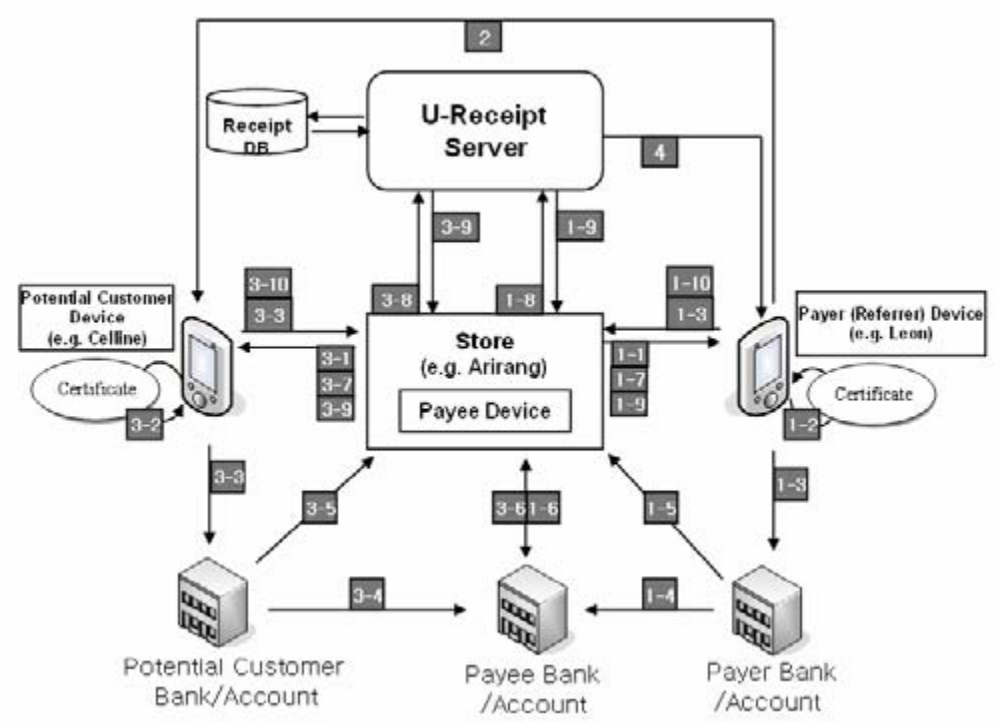

Figure 2.5: U-Payment and Receipt System Architecture (Lee, et al., 2006)

2.3.4 Mobile ticketing service adoption in public transportation

(Mallat, Rossi, Tuunainen, and Oorni (2008) presented the empirical findings from analyses of a survey data suggest that compatibility of the mobile ticketing service with consumer behavior is a major determinant of adoption. Mobility and contextual factors, including budget constraints, availability of other alternatives, and time pressure in the service use situation were also found to have a strong effect on the adoption decision. The study findings suggest that contextual and mobile service-specific features are important

determinants of mobile service adoption and should thus be integrated into the traditional adoption models.

2.4 Summary

This chapter discussed a background of the research that did about mobile web applications are a successful example in mobile bus booking services. That has identified the approaches to be used for developing a Mobile WAP interface to help user to do his work everywhere and every time rather than anywhere and anytime.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

The research methodology is more than just a collection of method to perform a research; it presents the research phases. Usually, research methods refer to the methods and techniques that researchers use in conducting their researches. This section elaborates the research methodology which is adopted from System Development Research Methodology (SDRM).

3.2 Research Design Methodology

Methodology is used to ensure a consistent approach is applied to all phases of a project (Hoffer, George, & Valacich, 2002). Methodology also facilitates project accomplishment by structuring the related processes according to the phase defined.

The methodology for this study was adopted from the System Development Research Methodology (SDRM) (Nunamaker, Chen, & Purdin, 1991). The prototype was developed with .NET Framework using ASP.NET 2.0 as the Integrated Development Environment (IDE). Microsoft SQL Server 2005 was used as Database to store and retrieve all information.

The design of the prototype took into account the status quo to make moderation of a new set of abilities and limitations brought forth by small and lower-fidelity screens, small amounts of memory and storage, slow network connectivity, and alternative forms of input. The adopted methodology as shown in Figure 3.1 consists of four phases: Information Gathering, Prototype design, Prototype Development and Evaluation. Details of these phases are as following:

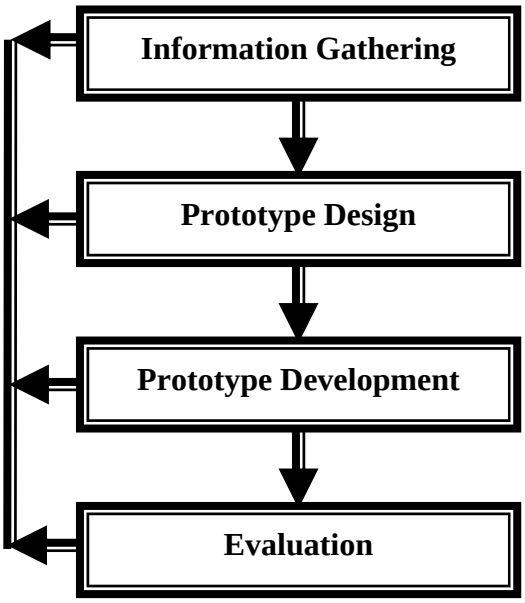

Figure 3.1: System Development Research Methodology (SDRM)

(Nunamaker, et al., 1991)

3.2.1 Information Gathering

The first phase of the methodology involves information gathering through interviews with the officers of MARA Liner Company. According to Hoffer et al. (2002), gathering of information could be done through direct interview. Besides that, literature survey from the available sources such as books, proceedings, journals, white papers, reports and

news are reviewed in order to gather and collect the relevant information. Focus was given on studies related to mobile bus services using WAP interface.

3.2.2 Prototype Design

This research proceeded with the design of the prototype based on the information gathered in the previous phase. The MBTS infrastructure is illustrated in Figure 3.2. Passengers can access MBTS via wireless network through their mobile devices. They can also access the service via Wi-Fi through access points as well as via GPRS network through the respective WAP provider.

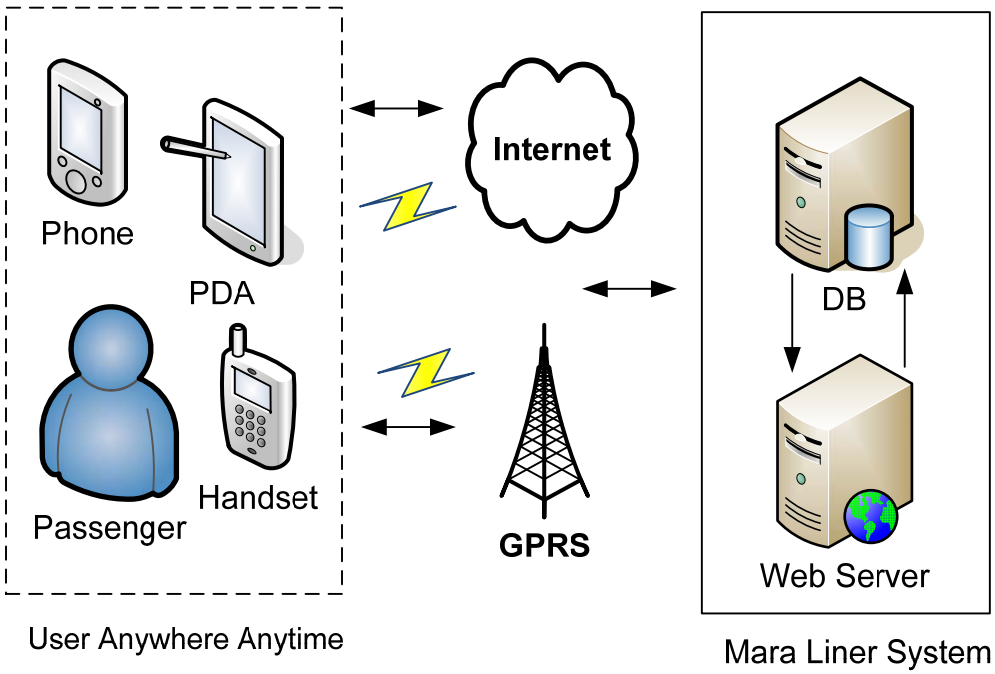

Figure 3.2: The MBTS Infrastructure

Unified Modeling Language (UML) used to design the Use case and Sequence Diagram to determine the main roles of MBTS and how user has to deal with it.

However, Figure 3.3 shows the UML Use Case Diagram, which describes the passenger as an Actor. MBTS prototype provides two services for the passenger, he/she can book ticket(s) and he/she can check the ticket, as well.

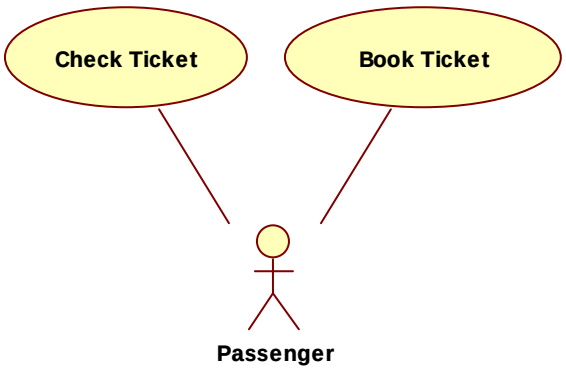

Figure 3.3: MBTS UML Use Case Diagram

UML Sequence Diagram illustrates the interaction between the actor and the interface of MBTS through navigation. Figure 3.4 shows the basic flow of the sequence diagram of the book ticket. After passenger key-in the MBTS URL, he/she navigates through the following sequence:

- The passenger has two choices that are booking and check ticket.
- Passenger has to hit Booking hyperlink to show booking Interface.
- Passenger should select the trip date.
- MBTS will display the trips' stations that available on that date.
- Passenger has to the select the start and the target stations.
- Based on the stations, the departure times will be displayed.
- Passenger can select which time that meets his/here needs.

- After that, the passenger should select the number of adults and Children who will be involved in the trip.
- After complete the trip info, Passenger has to press Book button to submit all info to the database.
- The successful message will be inform the passenger the Reference No of his/here booking, which will be used to pay the ticket price.

Figure 3.5 shows the basic flow sequence diagram of the check ticket. After passenger key-in the MBTS URL, he/she navigates through the following sequence:

- The passenger has two choices which are booking and check ticket.
- Passenger has to hit *Check Ticket* hyperlink to show the check ticket Interface.
- Passenger has to key-in the *Reference No* of his/here trip booking.
- MBTS will display the full information of the trip that meets the *Reference No*.

For each screen of the MBTS, there are navigation buttons such as *Back* and *Home*. The navigation buttons enables passenger to move smoothly through his/here MBTS session. Consequently, each screen has a Title that keeps the passenger on the purpose of that screen.

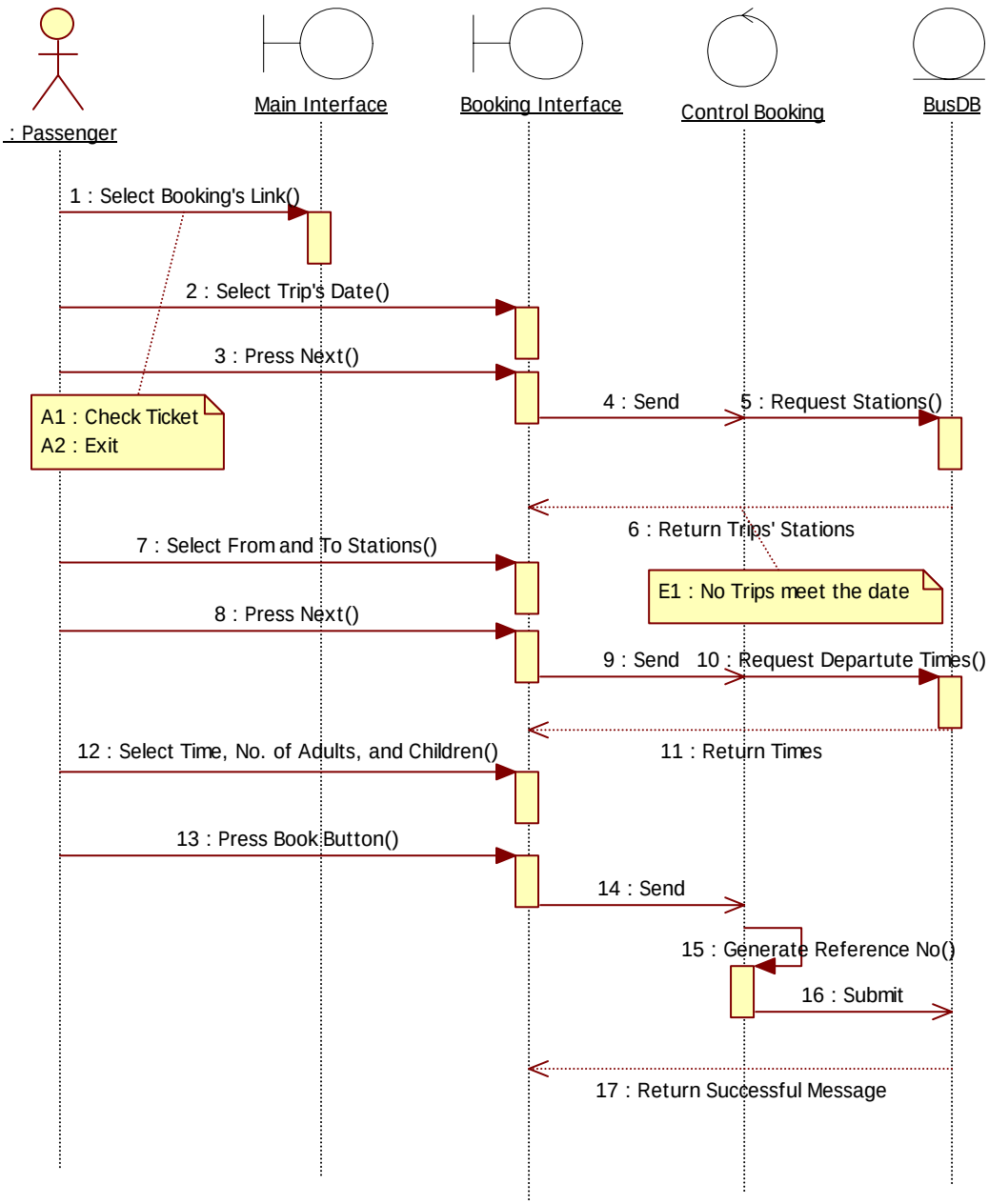

Figure 3.4: Booking Trip Sequence Diagram

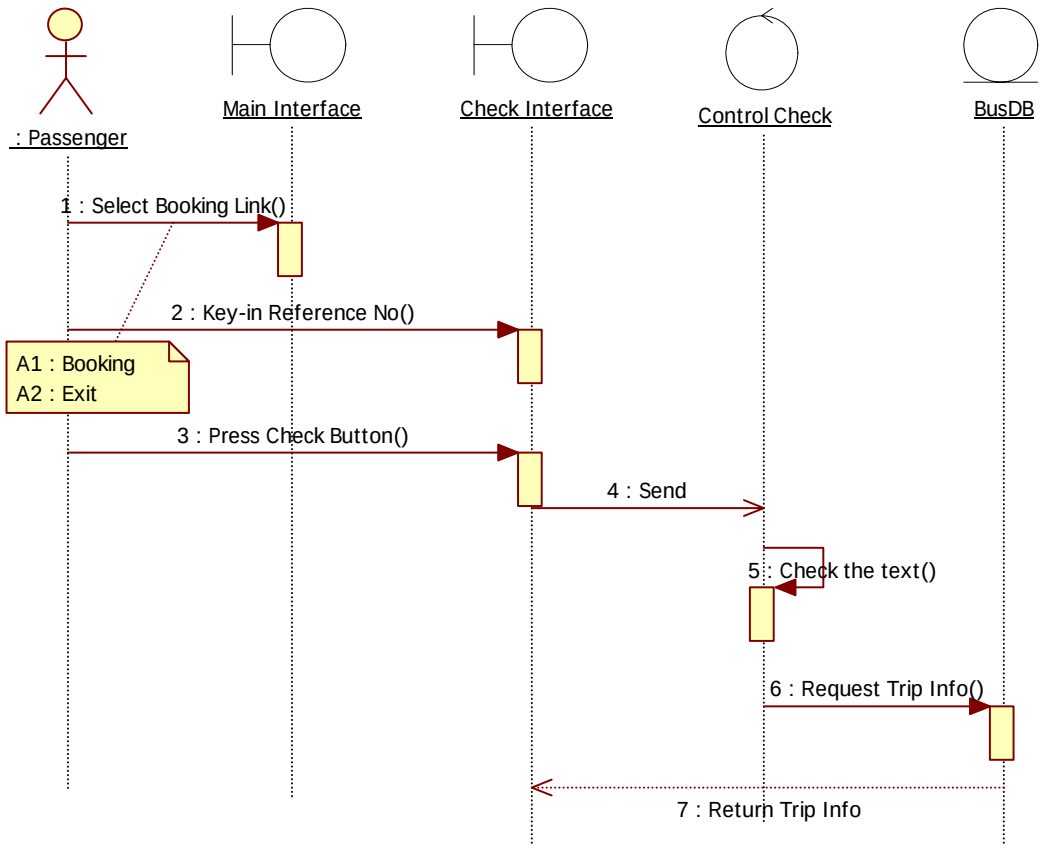

Figure 3.5: Check Trip Sequence Diagram

3.2.3 Prototype Development

The third phase involves the development of the prototype MBTS. The design was translated into program code. Microsoft Visual C#.NET was used for coding. It was completely developed with .NET Framework using ASP.NET 2.0 as Integrated Development Environment (IDE). Microsoft SQL Server 2005 was used as the Database to store and retrieve all information. The development of the prototype follows the Prototyping Approach methodology.

The prototyping process comprises of three steps which are adopted from Prototyping Process (Laudon & Laudon, 1995), as shown in Figure 3.6. Prototyping provides end users with artifacts that allow them to gain insight into the behavior of the system before the final delivery.

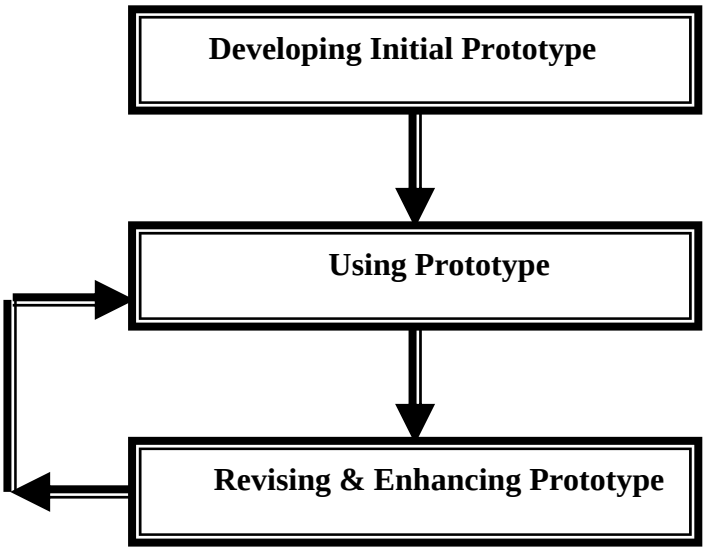

Figure 3.6: Prototyping Process (Laudon & Laudon, 1995)

MBTS provides two services, which are book ticket and check ticket. Figure 3.7 shows the main interface of MBTS. Main page enables passenger to select between the MBTS services that are *Booking* and *Check Ticket*.

Figure 3.7: Snapshot of the Main Interface of MBTS

Figure 3.8: Snapshot of the Booking Services

Figure 3.8 shows the snapshot of the first window of *Booking* Services. This window enables passenger to select the date that meet his/her needs. Passenger has to select day, month, and year of the date through three steps, because not all phones support the pickup calendar tool. However, MBTS shows the information of trips that already scheduled by the conventional system of the company. Passenger has to press *Next* Button to move to next step.

Figure 3.9: Snapshot of Available Trips' Stations

Figure 3.9 shows the snapshot of the available trips' stations. MBTS displayed the available stations that meet the passenger date in the previous window. Passenger has to select the departure (From) and destination (To) stations then press *Next* button to move to next step. Consequently, Figure 3.10 shows the snapshot of the passengers. This window enables passenger to select the departure time that meets his/her needs; and select the number of passengers whether they are adults or children. To finalize the

booking steps and submit the ticket transaction, passenger has to press *Book* button. *Reference Number* will be generated after the MBTS check the information that selected during the booking's steps. As showing in Figure 3.11, successful message will be displayed on the successful window. Successful window comprises the reference number and a message informs passenger that he/she should pay cash the ticket price to the closes MaraLiner Office.

Figure 3.10: Snapshot of Passengers

Figure 3.11: Snapshot of Successful Window

In terms to *Check Ticket* service, passenger has to have the *Reference Number*. As Figure 3.12 shows, passenger has to key-in the reference number then press *Check* button. MBTS will check the transactions that meet this reference number then display the ticket information in deferent window (see Figure 3.13).

Indeed, MBTS has been developed to facilitate MARA Liner passengers and give them a vital alternative to book ticket and/or check their tickets anywhere and anytime using their mobile phone via Internet using WAP interface.

Figure 3.12: Snapshot of Check Ticket

Figure 3.13: Snapshot of Ticket's Information

3.2.4 Evaluation

The last phase of the methodology is user evaluation. It was conducted to determine users' perception on the usability aspect of the prototype. The instrument will be developed based on previous studies. However, Davis (1989) concluded that the Perceived Usefulness and Ease of Use (PUEU) is a strong correlate of user acceptance

and should not be ignored by those attempting to design or implement successful systems. All questions in the Questionnaire will be measured using the Likert Scale format ranging from 1 to 5 as in Table 3.1 (Best & Kahn, 2000).

Table 3.1: Likert Scale Classification

	Strongly	Disagree	Neutral	Agree	Strongly
Score	1	2	3	4	5
Categor	Disagree		Neutral	Agree	

3.3 Summary

This chapter discussed the methodology of the research. It was guided to develop and evaluate the prototype. The methodology was adopted from SDRM and it includes four steps: Information Gathering, Prototype design, Prototype Development, and Evaluation.

CHAPTER 4

DATA ANALYSIS

This chapter discusses the evaluation of the MBTS prototype. Descriptive statistics and reliability analysis were used in this study. SPSS version 14 for Windows was used to analyze the data. Results from the descriptive and reliability analyses will be discussed in the following section.

4.1 Usability Evaluation

The evaluation is a very important stage of system or prototype development to judge on the outcome of development. This research used the summative evaluation which occurs after the prototype development. The MBTS user evaluation was conducted on thirty three (33) respondents (Nielsen, 2006). Each of them was given brief explanation regarding the usage and the user interface of the prototype. Each user was allocated ample time to learn and explore the content of the prototype. Once they were done, users were given a questionnaire for user evaluation that shown in Appendix A.

4.2 Instrument for User Evaluation

User evaluation was conducted to determine users' perception on the usability aspect of the MBTS prototype. The instrument was adopted from (Davis, 1989) and (Lewis, 1995). The instrument covers three dimensions: *Usefulness, Ease of Use* and *Outcome/Future Use.* For user evaluation, a set of questionnaire which comprises of General Information

and User Evaluation sections was used. The General Information section functions as a mechanism to collect users' demographic data and mobile applications experience. The User Evaluation section is intended to collect data on users' opinion regarding the MBTS prototype usability aspects. A 5-point Likert scale anchored by "Strongly Disagree" (1) and Strongly Agree (5) was used.

Questionnaire was used to rate the *Usefulness, Ease of Use* and *Outcome/Future Use* of MBTS prototype from the user respect. Descriptive statistics and reliability analysis were used in this study. SPSS version 14 for Windows was used to analyze the data.

Table 4.1: Demographic Data summary

Demographic Data	Frequency	Percentage (%)
Gender		
1. Male	20	60.6
2. Female	13	39.4
Age		
1. Less than 20 years old	1	3.0
2. 20-25	9	27.3
3. 26-30	10	30.3
4. 31-35	7	21.2
5. More than 35	6	18.2
Education Background		
1. Diploma	5	15.2
2. Degree	13	39.74
3. Master	10	30.3
4. Ph.D.	5	15.2
Own mobile Phone		

Demographic Data	Frequency	Percentage (%)
1. Yes	31	93.9
2. No	2	6.1
Mobile Application Experience		
1. Has no Experience	2	6.1
2. Less than 10 years	21	63.6
3. More than 10 years	10	30.3

As shown in Table 4.1, 20 (60.6%) of the respondents were males and 13 (39.4%) were females. 5 (15.2%) of them have diploma, 13 (39.74%) of them have degree, 10 (30.3%) have master, and 5 (15.2%) have Ph.D. from various ages. Most of the respondents were less than 40 years old. While 1 (3.0%) less than 20 years old, 9 (27.3%) were between 20 to 25 years old, 10 (30.3%) were between 26 to 30 years old, 7 (21.2%) were between 31 to 35 years old. The remaining 6 (18.2%) were aged more than 35 years old. Majority 31 (93.9%) of the respondents have own a mobile phone. 21 (63.6%) of them has no mobile application experience before, 10 (30.3%) have less than 10 years experience, and only 2 (6.1%) respondents have more than 10 year experience.

4.3 Validity And Reliability

Both validity and reliability were addressed for the usability evaluation questionnaire. The validity of a questionnaire is the degree to which the questionnaire is actually measuring or collecting data about what the researcher thinks it should be measuring or collecting data about. One of the most commonly reliability coefficient used is Cronbach Alpha Coefficient (Coakes, 2005). The reliability of a questionnaire is the ability of the

questionnaire to give the same results when filled out by like-minded people in similar circumstances. It is usually expressed on a numerical scale from zero (very unreliable) to one (extremely reliable).

Thus, Cronbach alpha Coefficient values were calculated using SPSS 14.0 to determine the data inter-item reliability which assesses the degree of internal consistency between multiple measurements of a dimension. Table 4.2 presents the Cronbach alpha value for each measure. The *Usefulness, Ease of Use* and *Outcome/Future Use* measures have Cronbach alpha of greater than 0.7, thus, these measures satisfy the internal reliability criterion (Pallant, 2007).

Table 4.2: Cronbach Alpha Values for All Dimensions

Measure	Number of items included	Mean	Cronbach Alpha
Usefulness	6	3.854	0.808
Ease Of Use	6	3.848	0.816
Outcome/Future Use	5	3.855	0.854

Usability evaluation from users' perspective is important in obtaining users' opinion towards the usability of the MBTS. An independent sample t-test was conducted to compare the *Usefulness*, *Outcome and Future* Use, and *Ease of Use* for two groups, first group is participants who have a mobile application experience and other group who have no mobile application experience. A significant Levene's Test values for *Usefulness* is greater than the cut-off .05 (Pallant, 2007). This means that the assumption of equal

variance has not been violated. However, a significant Levene's Test values for *Outcome and Future Use; and Ease of Use* are less than the cut-off .05

As shown in Table 4.3, despite the bolded value of Sig. (2-tailed) for *Outcome and Future Use* is less than .5, so there is a statistically significant different in the mean *Outcome and Future Use* for each of the two groups (Pallant, 2007); values of Sig. (2-tailed) for *Usefulness* and *Ease of Use* are greater than .5, so there is no statistically significant different for each of the two groups.

Table 4.3: Independent Sample Test

	Levene's Test for Equality of Variances		**t-test for Equality of Means**	
Measure	**F**	**Sig.**	**Std. Deviation**	**Sig. (2-tailed)**
Usefulness	3.148	.086	.44192	.130
Ease of Use	5.237	.029	.11309	.097
Outcome / Future Use	12.381	.001	.14019	**.000**

Table 4.3 shows descriptive statistics for all the items. While three items with means more than 4.0 are bolded, all items have means more than 3.5 which indicate that most of the participants are almost agreed on these items. Overall, the results indicate that the participants are almost agreed that MBTS has good usability.

Table 4.4: Descriptive Statistics for All Items

Item	Mean
PERCEIVED USEFULNESS	
1. Using MBTS would enable me to accomplish tasks more quickly.	**4.06**
2. Using MBTS would improve my performance.	3.85
3. Using MBTS would increase my productivity.	3.79
4. Using MBTS would enhance my effectiveness.	3.91
5. Using MBTS would make it easier to do my tasks	3.94
6. I would find MBTS useful in my everyday tasks.	3.58
PERCEIVED EASE OF USE	
7. Learning to operate MBTS would be easy for me.	3.70
8. I would find it easy to get MBTS to do what I want it to do.	3.64
9. My interaction with MBTS would be clear and understandable.	3.85
10. I would find MBTS to be flexible to interact with.	3.67
11. It would be easy for me to become skilful at using the MBTS.	3.97
12. I would find MBTS easy to use.	**4.27**
OUTCOME / FUTURE USE	
13. I was able to complete the transaction quickly using MBTS.	3.76
14. I could effectively complete the transaction using MBTS.	3.97
15. I was able to efficiently complete the transaction using MBTS.	3.70
16. I believe I could become productive quickly using MBTS.	**4.00**
17. From my current experience with using MBTS, I think I would use it regularly.	3.85

4.4 Summary

This chapter discussed the analysis of data obtained by questionnaire. It was described and summarized the respective of participants toward MBTS. The result of user evaluation showed that the participants are almost agreed that MBTS has good usability.

CHAPTER 5

DISCUSSION, FUTURE WORKS AND CONCLUSION

This chapter discusses the finding of the study; it presents the problems and limitations of this study; and the highlights the direction of the future works that suggested by the researcher. The overall conclusion is presented.

5.1 Discussion

Mobile-based Bus Ticketing Services introduce a new channel for passengers to book tickets using a WAP application through their mobile phones anywhere and anytime. As have been described in the introduction chapter, the aim of this study is to design a mobile based system for ticket booking of bus services. Moreover, the MBTS has been developed to facilitate MARA Liner passengers and give them a vital alternative to book ticket and/or check their tickets anywhere and anytime using their mobile phone via Internet using WAP interface. The methodology for prototype development used in this research was adopted from System Development Research Methodology (SDRM) and it had four steps: information gathering, prototype design, prototype development and evaluation.

The user evaluation was conducted to determine the users' perception on the usability aspects of the MBTS prototype. Thirty three participants were involved in the evaluation. The usability evaluation involved measures such as *Usefulness, Ease of Use and*

Outcome/Future Use. The results indicate that all the users agreed that MBTS had good usability in terms of *Usefulness, Ease of Use and Outcome/Future Use* and all the measures were highly rated.

5.2 Problems and Limitations

Although this system provides the passengers with an easier manner for booking, there are some significant disadvantages to the mobile-web based system which include the following points:

i) The cost of the service: when the passengers want to book tickets using the mobile devices it will costs them money for this service, but when they make their reservation by the traditional way it don't cost them money just the cost of the ticket.

ii) The developing of mobile web system is more complex than developing pages for standard web browser because of the limitation size of mobile screen space and internal memory in mobile devices. In development phase, developer need to concern about screen size.

iii) The WAP prototype was developed using the Microsoft Mobile Explorer 3.0 as simulator with internal WAP gateway and built in mobile phone browser.

iv) The WAP prototype and web prototype were tested using localhost server, namely IIS. However with limited financial resources no actual web server can be employed in testing the prototype.

5.3 Future Works

Hence for future development and expansion of this research, the followings are suggested:

i) The scope of this research is limited to the reserving and searching. Thus, further developments have to be made to cover other services of the bus ticketing.

ii) Inform users about their reserve transaction by SMS or Push mobile technology.

iii) Make integrating between booking services and other Bus Company services via mobile technology.

iv) Integrate the payment part using mobile payment (m-payment) technology.

5.4 Conclusion

Mobile-based Bus Ticketing Services (MBTS) prototype was developed to help passenger to book their ticket via mobile devices. The prototype was evaluated and the results confirm that it is useful for users and it is capable to help them to make their transactions easy, direct and successful regardless of location and time. It is hoped that the findings of this study will encourage bus companies to incorporate MBTS into the existing bus services in order to improve and enhance the transportation services so that it is available to users at any place and any time.

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APPENDIX A: QUESTIONNAIRE

Mobile-Based Application for Bus Ticketing Services (MBTS)

Prototype Evaluation

This questionnaire is divided into four (4) sections (Section A, B, C, and D). Section A addressing respondent general information; Section B measuring the Perceive of Usefulness of MBTS; Section C measuring the Perceive of Ease of Use; and section D measuring the outcome and future use of MBTS. Respondent are required to answer all the questions in order to complete the session.

,

ABKDA MOHAMMED ALI
College of Arts and Sciences (CAS)
Universiti Utara Malaysia (UUM)

A. Respondent General Information

This segment is about your background information. *Please fill up the blanks and mark [√] where appropriate.*

1. Gender: [ ] Male [ ] Female
2. Age: _____ Years.
3. Education background

   [ ] Diploma [ ] Degree [ ] Master [ ] Ph.D.
4. Do you own a mobile Device [ ] Yes [ ] No
5. Your mobile applications experience _____ years

For the next segments, please check or shade the answer to the following questions using the scale below.

1	2	3	4	5
Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**

B. PERCEIVED USEFULNESS						
1.	Using MBTS would enable me to accomplish tasks more quickly.	1	2	3	4	5
2.	Using MBTS would improve my performance.	1	2	3	4	5
3.	Using MBTS would increase my productivity.	1	2	3	4	5
4.	Using MBTS would enhance my effectiveness.	1	2	3	4	5
5.	Using MBTS would make it easier to do my tasks	1	2	3	4	5
6.	I would find MBTS useful in my everyday tasks.	1	2	3	4	5

C. PERCEIVED EASE OF USE						
7.	Learning to operate MBTS would be easy for me.	1	2	3	4	5
8.	I would find it easy to get MBTS to do what I want it to do.	1	2	3	4	5
9.	My interaction with MBTS would be clear and understandable.	1	2	3	4	5
10.	I would find MBTS to be flexible to interact with.	1	2	3	4	5
11.	It would be easy for me to become skillful at using the MBTS.	1	2	3	4	5
12.	I would find MBTS easy to use.	1	2	3	4	5

D. OUTCOME / FUTURE USE						
13.	I was able to complete the transaction quickly using MBTS.	1	2	3	4	5
14.	I could effectively complete the transaction using MBTS.	1	2	3	4	5
15.	I was able to efficiently complete the transaction using MBTS.	1	2	3	4	5
16.	I believe I could become productive quickly using MBTS.	1	2	3	4	5
17.	From my current experience with using MBTS, I think I would use it regularly.	1	2	3	4	5

Thanks for Your Participation

APPENDIX B: LETTERS

BAHAGIAN KENDERAAN MARA
PEJABAT PENGURUSAN EKSPRES MARALINER ZON UTARA
HENTIAN MARALINER, 239 JALAN SHAHAB 2,
TERMINAL BAS SHAHAB PERDANA,
LEBUHRAYA SULTANAH BAHIYAH, 05150 ALOR SETAR,
KEDAH DARUL AMAN

Tel : 04-7203342/343 (Pej)
Fax : 04-7203343

Abkda Mohammed Ali
(801125/A081)
Faculty Of Information Technology,
University Utara Malaysia

Bil.Kami: EML/WU/PT-2
Tarikh : 6 Julai 2009

MOBILE – BASED APPLICATION FOR TICKETING BUS SYSTEM

Thank you for having chosen our company for your research.

Congratulations ! It's my pleasure to welcome you as a consultant for the bus ticketing system in the future. We believe that your system can make easiest way to the customer to get ticket. We hope that your system can make customer much pleasure than now.

Thank you.

"BERKHIDMAT UNTUK NEGARA"
"CEMERLANG, GEMILANG, TERBILANG"

MAHATHIR BIN HJ. AHMAD
Operation Manager,
Ekspres MARALiner Zon Utara,
Kedah

"MARA Terus Mara"
"Keusahawanan Kerjaya Pilihan"

BAHAGIAN KENDERAAN MARA

PEJABAT PENGURUSAN EKSPRES MARALINER ZON UTARA

HENTIAN MARALINER, 239 JALAN SHAHAB 2,
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Faculty Of Information Technology,
University Utara Malaysia

Bil.Kami: EML/WU/PT-2

Tarikh : 8 Oktober 2009

MOBILE – BASED APPLICATION FOR TICKETING BUS SYSTEM

Thank you for having chosen our company for your research.

I'm agree for this application can make easiest way to the customer to get ticket. We hope that your system can make customer much pleasure than now and will be helpfull for all customer can access their system to booking service.

Thank you.

"BERKHIDMAT UNTUK NEGARA"
"CEMERLANG, GEMILANG, TERBILANG"

MAHATHIR BIN HJ. AHMAD
Operation Manager
Ekspres MARALiner Zon Utara,
Kedah

"MARA Terus Mara"
"Keusahawanan Kerjaya Pilihan"