

MOBILE – BASED BUS TICKETING SYSTEM IN IRAQ

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ABSTRACT: *The use of bus in traveling is a large growing business in Iraq and other countries. Hence, bus ticketing system deals with maintenance records of each passenger who had reserved a seat for a journey. Moreover, the ticketing system includes maintenance of schedule, fare and details of each bus traveling. However, there are many bus operations, which were operated manually. The manual or traditional system takes a lot of time and causes many errors of the operation. Due to this, lot of problems occur and they were facing many disputes with customers and each branch works separately. To solve the above problem, and further maintaining records of items, seat availability for customers, and the price of per seat, bill generation and with the emergence of mobile devices are rapidly increasing among users, bus travel companies a chance to improve their business' performance by adopted mobile-based application. A prototype of mobile bus ticketing system (MBTS) is developed by using agile software development approach and Unified Modeling Language (UML) for designing the MBTS. The prototype is evaluated on its usability to ensure the successful implementation of the MBTS in the real environment.*

KEYWORDS: Bus Ticketing System, Electronic Ticketing System Mobile Application Development, Online Reservation System, Agile Methodology.

INTRODUCTION

Public transportation has been classified as an essential mode of travelling. In older days, human travels from one location to another takes months and years, with less support of technology and communication tools. Currently, with the effective and efficient mode of transportation, one could travel thousands of miles with hours and days and communicate across the globe within split of seconds. Public in many countries, especially in the third world, prefer to use buses and train services to travel from one location to another. “Electronic ticketing system is the ticketing system which uses self-service technology as a base of application helping the user to book a ticket by themselves” (Ferreira, Porfírio, Cunha, & Silva, 2013).

Recently, with the introduction and evolution of smartphones applications, the consumers' behavioral habits have changed in the goods and services purchasing power. Consumers' on-line purchases using mobile application had increasing globally, without boundaries. Consumers' or the public population, in current age, can purchase their transport ticket through mobile phone and pay on-line to book, validate and retrieve tickets using simple mobile applications (Ceipidor et al., 2013). The consumer's application and usage of mobile phones have expended tremendously from a single purpose usage, namely communication purposes, to multiple usage such as gaming, music, navigating and many more. Approximately, there are around 370 thousand mobile phone application that can be utilized by consumers' and 425 thousand Android platform application available for Apple customers (Böhmer, Hecht, Schöning, Krüger, & Bauer, 2011). People start to spend more time on

mobile devices than desktop and laptops (Meeker, 2015). Indeed, mobile devices (e.g., smartphone and tablet PC) are increasingly becoming an essential part of Iraqis' as the most effective and convenient communication tools not bounded by time and place (Jarad, 2014).

Many people in Iraq do not carry their PC outside the office, but mobile phones are with them at all time. Nowadays, mobile phones and smartphones become very popular for a large number of users (Ketmaneechairat, 2014). Using a mobile phone for making reservation systems is the easiest and convenient way to perform this task. The online booking, in general, gives the customer extra information regarding the company, availability of the services, ticketing structure, prices, online payment and booking structure and other services rendered. Besides that, in certain company, handheld mobile communication may bring similar better closer partnerships between a company and its customers (Paper, 2012).

The Problem

All public transportation modes in Iraq, except air transportation still use the traditional ticket system, which use a paper based ticket. The problem with the traditional ticket bus system (manual ticket) is when users have to stand up in a long queue to buy a bus ticket or asking information for buses schedule (Al-hijaj, Jabbar, & Kh, 2013). The main issue with manual system is each branch work separately, communication must be made by each branch's front-officer to the head office for each customer's enquiry in order to get the latest update on schedule, seat availability and other reservation-related information; as well as to avoid duplicate bookings or over-capacity (Alaya, 2014). Moreover, there is also a physical limit to the reservation availability as each branch only operates during certain hours and reservations can only be made on-the-spot. These limitations are not the only issues the company is currently facing. In addition, that create problems include human errors (e.g. miscalculations in ticket price, mistakes in noting passenger data, etc.). Furthermore, manual booking system the paper works can be easily lost the storage space and costs (Lu, 2007).

According to survey by Al-hijaj et al., (2013), travelers at the Garage Baghdad bus station in Basra city in Iraq shows an average 97 % of passengers are not happy with the transportation system. Besides that, the result presents the registration operation in the Iraqi garage stations the majority of drivers suffer with their work. Therefore, a practical and workable of system is required to overcome this problem.

A mobile bus ticketing system (MBTS) can help and solve these kinds of problems. By using this system will help the company employees (e.g. Admins or drivers) in daily work by making their work more arranged and more connected to other company branches. Besides that, MBTS will be easier for employees to control and check the operations of the company. However, customers just from their mobile phone will be allowed to check for ticket availability anytime and anywhere. Furthermore, the system will reduce the customer's fear of losing a physical ticket, and allows vendors to significantly reduce ticket queues (Eicher, Nh, Eicher, & Us, 2012). Indeed, there are many similar systems in the different countries, but the operation of the system in Iraq is different due to the transportation system environment and geographical structure.

LITERATURE REVIEW

Tourism has demonstrated as one of the most successful sector in optimizing the mobile application. According to Buell, Campbell, & Frei, (2010) about 50% of existing tourism recommender systems is designed for mobile devices. The Mobile application grouping accessible in the tourism industry as mentioned, there are four main mobile travel application categories “Online Booking”, Information Resource”, “Location Based Services”, and “Trip Journals”. The “Online Bookings” category (Smirnov, Kashevnik, Shilov, Teslya, & Shabaev, 2014). These applications allow a tourist to make online reservations for different services (e.g., Bus travel, car rental, hotel, airplane ticket booking). Usually the tourists demand applications from this category before the trip. According to (Gunduz & Pathan, 2013), online purchases of flight tickets represented 32 percent of overall online purchase business, Hotel and Tours represent 26 percent and event management tickets sold represent 20 percent of global online purchases. Approximately 79 percent of United State mobile phone uses the device for online shopping convinces and needs.

Consumers depend on their applications for more commercial dealings, social corresponding and community interaction. Results derived from these surveys show that airline, bus liners and travel agents, being the goods and service provider, should expand the ticketing services through mobile shopping. In addition, when the customer deliver the service independently through the use of technology will simplify and increase efficiency of service delivery, this technology called self-service technology (SST). Self-service technology replacing the traditional service encounter which in the process, there is a communication between customer and employee become the customer deliver the service by themselves (Wang, Harris, & Patterson, 2012). Moreover, the customer unnecessary to visit a firm office to ask about banking transaction, tickets information and bill payment, through this service firms give simplicity for the customer to fulfill their needs, and customer can reduce money, time, and effort to fulfill their needs.

Second purpose of providing self-service technologies is transacted, this technology enables the customer to make a transaction buy, pay, or order stuff from the internet without direct interaction with an employee. The third purpose of self-service technologies is to self-help. Through these SSTs, enable the customer to learn, receive information, train them, and provide their own service. Furthermore, Self-service technologies indeed have a benefit for both companies and consumer. SSTs are cost effective to escalation the benefit of accessibility, pervasive obtainability, and time and money savings and reduce anxiety.

Nowadays electronic ticketing systems (e-ticket system) are particularly famous for the traveler in the whole of the world. Electronic ticketing system is shift traditional ticketing system because a lot of advantages which customer can get from e-ticketing system for example avoid queuing in ticket box. Electronic ticketing system begins in accordance with the development of the internet, before electronic ticketing system begins there is several ticketing system which use paper based or smart card based. All kinds of ticketing system have the advantage and disadvantage, and already classify the advantage and disadvantage of several kinds of ticketing system in the Table 1. (Jakubauskas, 2010):

Table 1: Type of Ticket

Type of ticket	Advantage	Disadvantage
Paper tickets	Cheap to produce. Easy to use.	Weak protection. Risk of falsification. Not multifunctional. Not effective for underground urban transport.
Paper daily, weekly, monthly, quarterly, tourist passes	Simple, easy to make	Falsification
Paper / plastics cards/tokens with magnetic strip single use and passes	Better protected than those made of paper, more durable. Very thick and light.	Need for contact. Risk of dis functioning or failure on readers, magnetic strip becomes vulnerable to stronger crease or other contact.
Smart Cards	Very convenient validating. Gives data of passenger Useful for optimization of routes according data received. Very multifunctional application of smart cards.	Expensive to introduce. Risks of fake smart cards-ticket still exist. Transaction time of contact smart cards is longer than those of contactless data
Electronic Ticket (E-ticket): e.g. SMS ticket, WAP page ticket.	No cash payment. Safe payment. Convenient use.	System should be well organized and maintained. Expensive to introduce. Lots of specific technical requirements both for passenger and transport operators.

The existence of e-ticketing system can reduce time to purchase the ticket and increases the convenience of travellers, because a customer can buy the ticket anywhere and anytime without time limitation and limitation of place. Beside the advantage of customer, e-ticketing system also gives an advantage for service provider or public transport authority in monitoring the actual traveler's behavior. Electronic ticketing system which famous for travelling in urban transportation are divided in to two kinds of e-ticketing system, mobile-ticketing system and internet ticketing system.

Mobile Ticketing (M-Ticketing)

Mobile ticketing (m-ticketing) can be broadly defined as ordering, purchasing, delivery and usage of a product or service using mobile technology such as Wireless Application Protocol (WAP) (Skarica, Belani, & Illes, 2009). The mobile ticketing industry is a relatively recent and up-and-coming portion of the fast-growing e-commerce industry. According to some estimates, approximately 400 million mobile subscribers global networking system will use their mobile phones for ticketing by 2013, with total gross mobile ticketing transactions reaching \$92 billion by 2013 (Eicher et al., 2012). The mobile ticketing predictions are being the research domain for several years.

M-ticketing permits a customer to purchase a valid and legitimate ticket through mobile phone application. The value added services provided by the application allows users of the mobile ticket to store digital tickets on the phone. By doing so, the consumer is less likely to lose his ticket, eco-friendly, durable, cost effective and paperless. Generally, the mobile ticketing process can be defined in the following steps (Ceipidor et al., 2013):

- **Registration:** Online ticketing requires a company to register with all the business and services information.
- **Provisioning:** Allow mobile phone application to interact with customers, allowing the purchase to take place.
- **Validation:** Validating and legitimate the ticket via electronic validation system between the company and the customer.
- **Ticket check:** Controller to verify and accept the sales and display of the mobile ticket as a valid ticket for the passenger, according to the terms displayed on the ticket.

Indeed, mobile bus ticketing system (MBTS) is the most noteworthy prospects in Iraq to reduce expenditures and increase traveler's accessibility. This project will reduce ticket processing flow, reduce usage of paper and allows greater convinces and flexibility to the traveler in Iraq cities and allow travel agent to make alterations to the journey. There are other important issues from the use of this technique such as the mobile ticket cannot be lost or stolen on the contrary of sending the ticket by mail also there is a probably of sending it to the wrong address. MBTS will make customers' lives easier, and can get the service by himself in anytime, anywhere and any devices.

The Proposed System

Mobile Bus Ticketing System (MBTS) will have four actors who will interact with application. Firstly, passengers who will book the ticket, application will allow passenger to access, search and check bus ticket availability over the internet 24 hours a day, 7 days a week in them mobile after install the application. In addition passengers can book the bus ticket. Secondly, Admin who will control and check whole the system, admin can add/edit/delete bus, route, destination and so on. However, admin can distribute accounts for the driver to allow them access to the system and for the guards as well. Thirdly, driver who will drive the bus, his privilege less than the admin. Driver can only check his trip, the bus number that it will ride it, beside that he can see the passenger's lists for a specific trip. Lastly, guard his privilege same with the driver only check the trips and see the passenger's lists. However, the MBTS prototype will work for smartphone for Android platform.

METHODOLOGY

The aim from this project is to develop a prototype mobile bus ticketing system (MBTS). In order to design and develop mobile application for the ticketing bus system, and to ensure the success of the mobile application of the ticketing bus system. This project is divided into three main phases of planning and execution as shown in figure 1

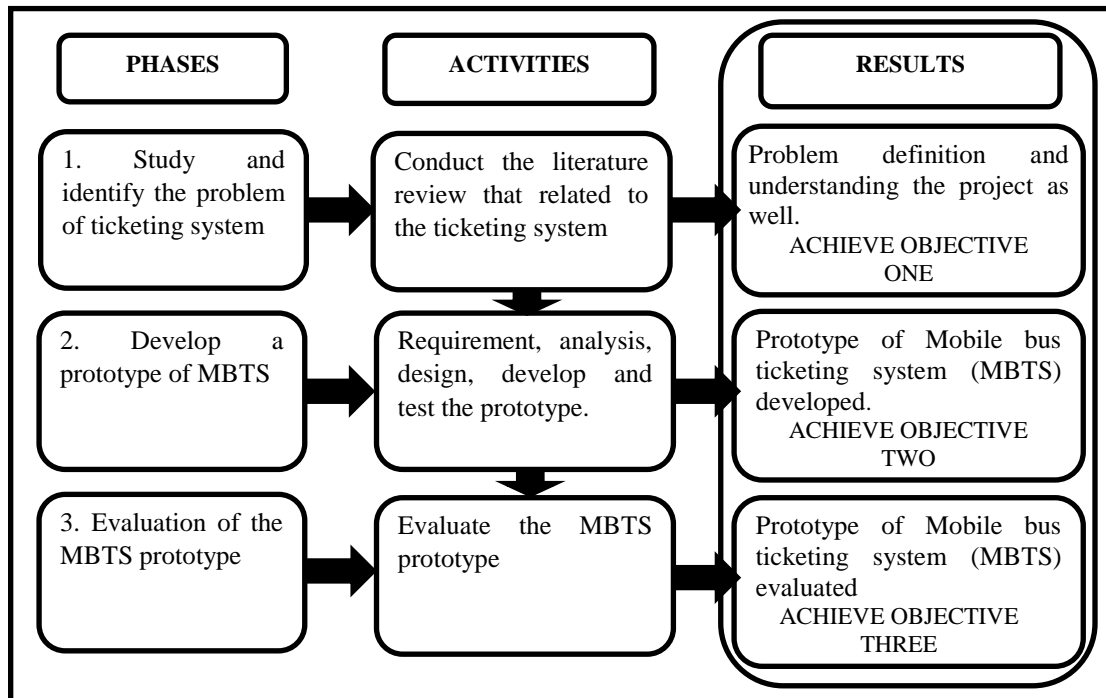


Figure 1: Flowchart of Research Activities

Phase one: Study and identify the problem

First phase focused on how to understand the objectives and give a clear definition of the problem of ticketing system in order to create MBTS applications. The outcome for this phrase is the project awareness of problem which gives the clear and full view about the detail problem, especially in a manual system.

Phase two: Develop a MBTS prototype

Second phase aims to develop the MBTS prototype through identifying the requirement, analyze, design, develop and test the prototype, agile will use as a method. The outcome of this step is gathering the requirements, design the entity relationship diagram (ERD) for database and analysis the system using unified modeling language (UML) as well as to develop the prototype of MBTS. The step for system developments of this system as following:

Requirements gathering

The task started with requirement collecting to develop bus reservation prototype Table 1 and 2 shows the result below which is the functional requirements and non-functional requirement of the system. In the priority column, the following short hands are used:

- M: mandatory requirements (something the system must do).

- D: desirable requirements (something the system preferably should do).
- O: optional requirement.

Table 2: MBTS Non-functional requirements

Functional Requirements			
#	Requirement ID	Requirement Description	Priority
	MBTS_1	Explore system	
1	MBTS_1_1	User can search about ticket availability by selecting date, and from where to where.	M
2	MBTS_1_2	The User must fill all the information fields before press book button, otherwise the system will show an error message.	M
	MBTS_2	Login to the system	
3	MBTS_2_1	User must enter his valid username and password to access to the system, otherwise the system will show an error message.	M
	MBTS_3	Manage Timetable	
4	MBTS_3_1	Admin can create a new timetable (include all the trip details)	M
5	MBTS_3_2	Admin can manage (update, edit and delete) timetable	M
7	MBTS_3_3	User can check the timetable schedule	M
	MBTS_4	Edit Bus	
8	MBTS_4_1	Admin can create a new bus (include all the bus details)	M
9	MBTS_4_2	Admin can manage (update, edit and delete) buses	M
	MBTS_5	Edit Route	
10	MBTS_5_1	Admin can create a new route (include all the route details)	M
11	MBTS_5_2	Admin can manage (update, edit and delete) routes	M
	MBTS_6	Edit Station	
12	MBTS_6_1	Admin can create a new station (include all the station details)	
13	MBTS_6_2	Admin can manage (update, edit and delete) stations	
	MBTS_7	Edit Garage	
14	MBTS_7_1	Admin can create a new garage (include all the garage details)	M
15	MBTS_7_2	Admin can manage (update, edit and delete) garages	M
	MBTS_8	Edit Staff	
16	MBTS_8_1	Admin can create a new staff (include all the staff details)	M
17	MBTS_8_2	Admin can manage (update, edit and delete) staffs	M
	MBTS_9	Manage Profile	
18	MBTS_9_1	User can update username and password	M
Non-functional Requirements			
	MBTS_1	Usability	

1	MBTS _1_1	The system should be user friendly and efficiently	M
2	MBTS _1_2	The system must be easy and understandable	M
3	MBTS _1_3	The system should be expandable	M
	MBTS _2	Reliability	
4	MBTS _2_1	System should be able to perform its required functions under stated conditions for specific period of time.	M
5	MBTS _2_2	The system should stay working smoothly without any interruption	M
	MBTS _3	Security	
6	MBTS _3_1	Only Admin will be able to log in to the system to make maintenance	M
	MBTS _4	Availability	
7	MBTS _4_1	The system should have high up time.	M
	MBTS _5	Performance	
9	MBTS _5_1	The system must have a high speed of manipulation data and reply to the user requests.	M

Software Advanced Analysis Techniques

In this study we highlight the use of UML to design MBTS prototype. We design both sequence diagrams which is used to show the dynamic behavior of application design and use case diagram as well. The sequence diagram present interactions between the objects that arranged in a time sequence.

A) Use-Case Diagram

Use case diagram in UML used to represent functional requirements, however, is familiar model artefact helping for specify the requirements of computer based systems in the early phase of development. Figure 2 which describe the main overall interaction between MBTS and (Passenger, Admin, Driver and Guard), as showing in figure.

B) Sequence Diagram

A sequence diagram is a kind of interaction diagram that shows how processes operate with one another and in what order. It is a construct of a Message Sequence. Figure 3 illustrate the interaction process between the user and the system in order to book ticket.

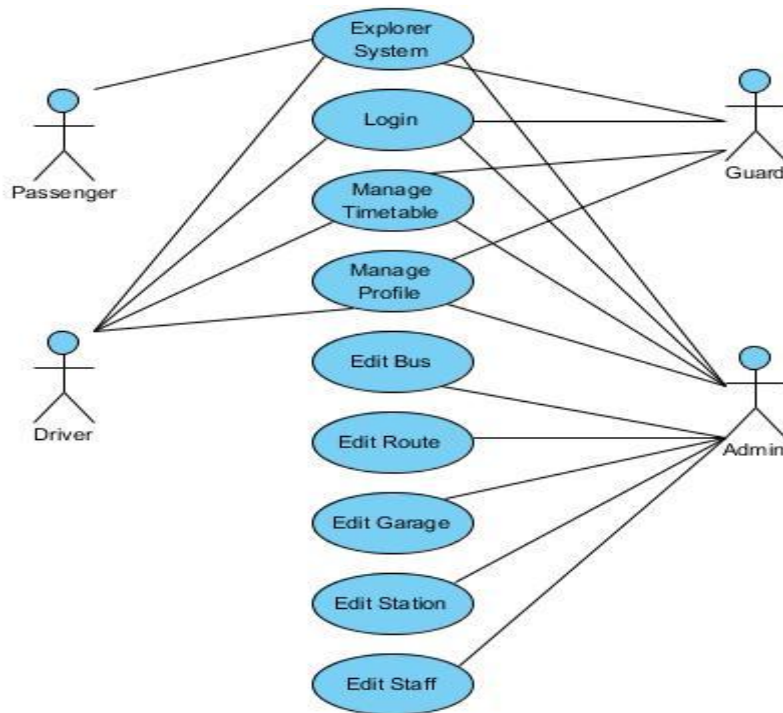


Figure 2: Use-Case of MBTS

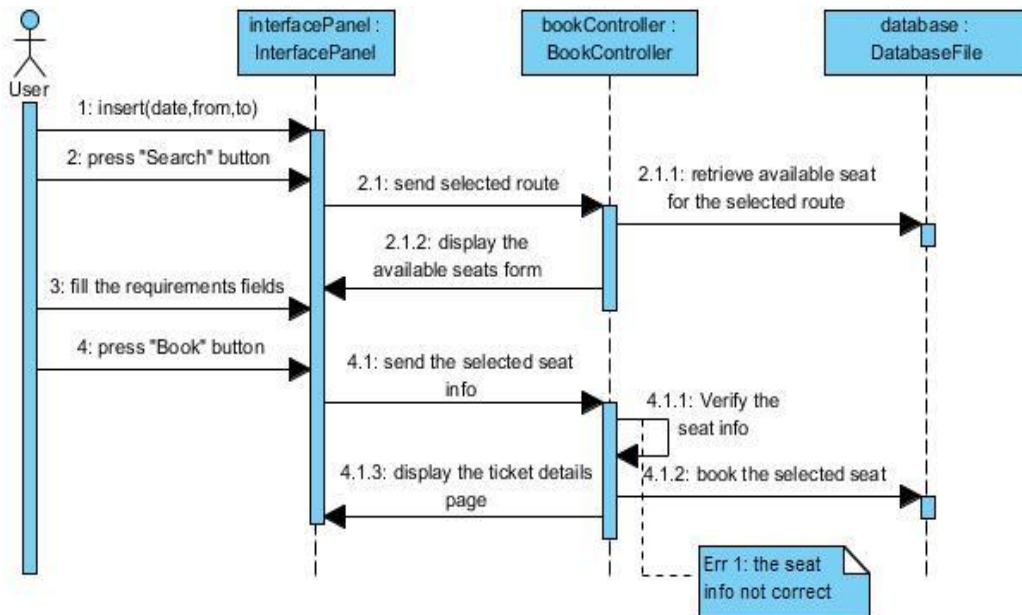


Figure 3: Sequence Diagram for user booking

Class Diagram

ERD is a kind of graph for presenting visually the entity set, attribute and the relationships between entities in a database. ERD is top down approach to database design that begins by identifying the important data called entities and relationships between the data that must be represented in the model. We design ERD if figure 4 of MBTS by using the technique of

normalization. Normalization is formal technique of analyzing base on their primary key. At the end of ERD design we validate and check the model to ensure it is capable to support the required transaction given in the user requirement specification.

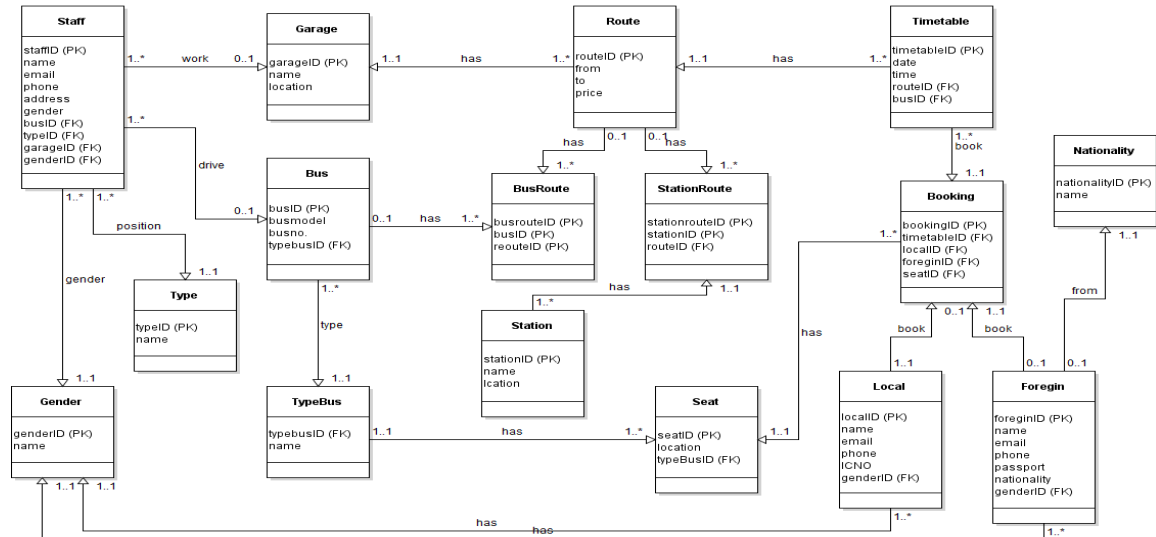


Figure 4: Class Diagram of MBTS

System Development

System development is implementation of the MBTS prototype. The prototype has been developed by using Phonegap framework to work in different OS (Operating System) (e.g. IOS, Android, Windows phone). In addition, JavaScript, jQuery mobile, HTML5, and CSS3 on mobile side also will be applied. Besides that, MySQL Database and PHP on the server side with RESTful will be used to serve a mobile application request. System meets all the functional requirements which have been collected in the requirement gathering step. Figure 5a-5c shown the MBTS interfaces:



Figure 5a: MBTS Interface

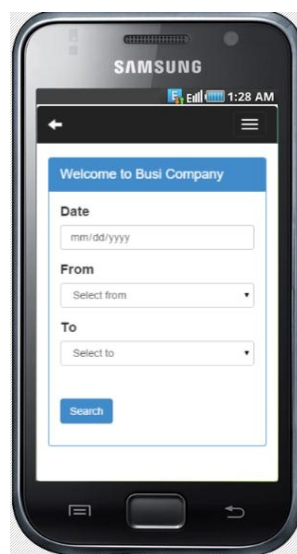


Figure 5b: Booking Page

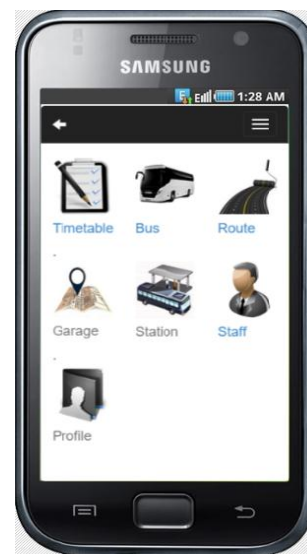


Figure 5c: Admin Dashboard

Figure 5a shown the first page for MBTS application when the user open the application, figure 5b shown the booking page for user in order to do booking and figure 5c shown the dashboard for Admin.

Phase three: Evaluation of the MBTS prototype

This part explains the analysis of the evaluation that has been done for MBTS prototype. After the prototype development is finalized, The System has been tested by the actual users and through Usability Questionnaire adopted from (Davis, 1989) and (Lewis, 1995) as cited by Akouni (2009) which measures usability (easy to use, usefulness and future use). It contains of 17 questions (6 for usefulness, 6 for easy to use and 5 for future use). All questions in the Questionnaire will be measured using the Likert Scale format ranging from 1 to 5 (1-strongly disagree – 5-strongly agree) (Best & Kahn, 2000). However, the respondents were 33 Iraqis student in UUM, Sintok Malaysia. The result of the study was analyzed by using SPSS software, version 20.

FINDING

A usability testing is one of the most accepted methods that used in the evaluation phase, because the users are asked to use the real application. The users are usually asked to use the application before answer the questioners. The questionnaires have two section, general information and existing practice on using statistical analysis functions. The prototype was assessed through a statistical analysis that distributed of questionnaire for a sample of 33 respondents. Descriptive analysis was choose because it can summarize a data set, rather than use the data to learn about the population that the data are thought to represent.

Demographic Data

The first section of the questionnaire focuses on general information about the respondents. The gender chosen based on 23 (69.7%) of the respondents were male and 10 (30.3%) were female. The age ranges between 20-25 years old with 7 (21.2%), 26-30 years old with 18 (54.5%), 31-35 years old with 6 (18.2%) and 35 years old and above were 2 (6.1%). The education level are 6 (18.2%) of the respondents were degree. 21 (63.6%) of the respondents were Master and 6 (18.2%) were Ph.D.

Statistical Analysis Functions

According to the Figure 6 there is no questions that has disagree as the highest rate, the majority of the rate fall into agree scale .The data analysis result has been showed a positive result in usability with how easy it is to use this system. Finally, descriptive mean and Std. Deviation statistics for related questions to our application shows in figure 6.

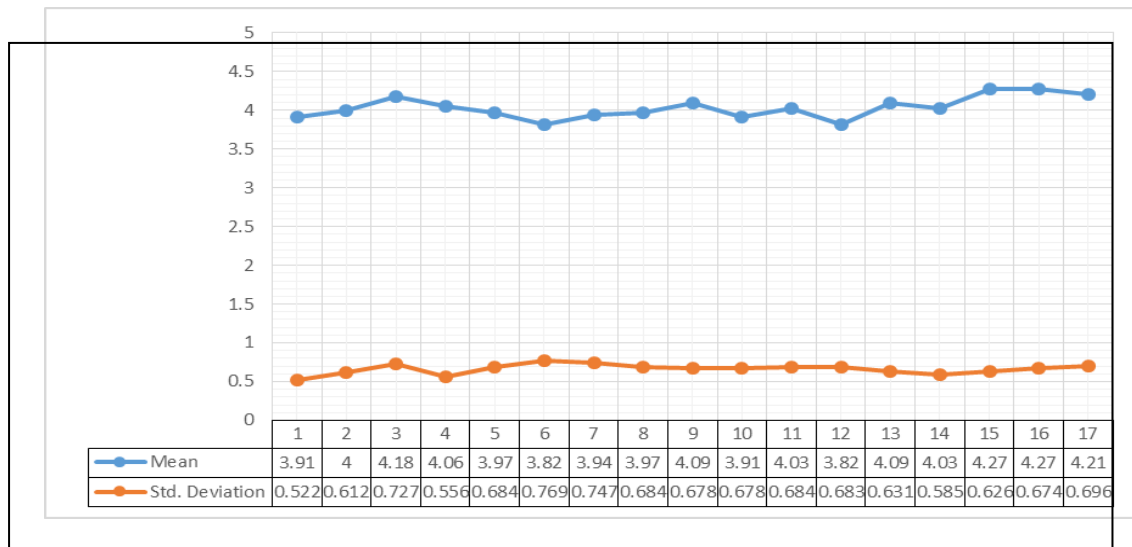


Figure 6: Evaluation Rate

Based on the findings, the results confirm the system was accepted by the users. The respondents were satisfied and strongly agree with the MBTS in terms of easy to use and usefulness and the future use as well.

DISCUSSION

Mobile-based Bus Ticketing Services introduce a new channel for passengers to book tickets by using the 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 passengers and give them a vital alternative to book ticket and/or check their tickets anywhere and anytime using their mobile phone via Internet. In addition MBTS will help the Admin and driver as well in them daily work to make their job more organized and easily to handle. The methodology for prototype development used in this research has three phases firstly, study and identify the problem of ticketing system to conduct the literature review that related to the ticketing system. Second phase is develop the prototype of MBTS by give the requirements, analysis, design, develop and then test the prototype. The third phase is the evaluation the MBTS prototype. 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.

FUTURE WORK

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

1. Inform users about their reserve transaction by SMS or Push mobile technology, not only be email.

2. Integrate the payment part using mobile payment (m-payment) technology.
3. Make integrating between booking services and other Bus Company services via mobile technology.

CONCLUSION

Mobile-based Bus Ticketing Services (MBTS) prototype was developed to help passenger to book their ticket via mobile devices and to help Admin and driver for their daily work. The prototype was evaluated through Iraqis and the results confirm that it is useful to use in Iraq 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, anytime and any devices.

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