Design and Implementation of web-based Smart Campus Bus Transport Management System with Real-Time Display of Arrival Time

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Abstract— **In this paper, design and implementation of web-based smart campus bus transport management system with real-time display of arrival time is presented. A modified Waterfall software development model was used to develop the web application. The modified Waterfall consists of five cascaded stages such that one development stage is completed before the next one begins; starting from the requirements elicitation and analysis to system design, to implementation and unit testing, to integration and system testing and finally, to deployment and maintenance. According to the design, the web-based smart campus bus transport system comprises of four main modules, namely, the login module, the Administrator's module, the passenger's module and the driver's module. Also, Use Case diagrams are used to present high level design of the system with respect to the key system user, namely; the System Administrator, the Drivers and the Passengers. In addition, Level 0 data flow diagram of the system was presented. The web application was implemented with PHP, MySQL database system, Apache web server and Windows operating system. Also the HTML and CSS were used in the system coding. Adobe Dreamweaver software was used for editing the web application source code. The developed web application was hosted locally on a WAMP server. The screenshots of selected webpages were used to demonstrate the effectiveness of the developed web application in accomplishing the various user requirements for the smart campus bus transport system.**

1. Introduction

In the early days of communication networks twisted pair was the main transmission medium which was later related to the background due to the superiority of fibre optic cable [1,2,3, 4,5,6, 7,8,9, 10,11, 12,13, 14,15, 16,17, 18]. However, wireless communication has overshadowed both wired and fibre optic networks [19,20,21,22, 23,24, 25,26, 27,28, 29,30, 31, 32, 33]. The rapid advancement and diversification of wireless applications has brought about the Internet and the attendant Internet of Things, web application and various Internet-based solutions [34,35,36,37,38,39,40,41,42,43,4445,46,47,48,49,50,51,52, 53,54,55,56]. Notably, since the emergence of Internet, the world has witnessed widespread application of web-based solutions in different areas of human endeavour [57,58,59,60]. Some solutions are purely software solutions, some are mobile applications with internet interfaces whereas some are embedded and network solutions. In any case, Internet component of the solution is to provide global access and coverage [61,62,63].

Particularly, in this paper, the focus is on the development of a web application for the management of campus transport system [64,65]. The solution is a web portal with requisite functionalities to interface the campus transport vehicle drivers and the passengers and coordinate the booking, loading, and timing, as well as the payment components of the transport system. The solution is a web application with browser-based user interface to enable bother the drivers and passengers to register to the system in order to access the registered users' functionalities of the system. The system provides the vehicle routes, loading points, departure time schedule, payment options, ride history and other essential functionalities that makes it easier for the drivers and the passengers to manage their trip to the campus and out of the campus. The web-based solutions makes it easier for the users to access and interact with the system and the other users of the system from any location across the globe. The architecture of the system along with the software development methodology, the

detailed design and implementation aspects of the web application are presented.

2. Methodology

2.1 The description of the software development methodology

A modified Waterfall software development model (Figure 1) was used to develop the web-based smart campus bus transport system. As seen in Figure 1, it consists of five cascaded stages such that one development stage is completed before the next one begins, starting from the requirements elicitation and analysis to system design, to implementation and unit testing, to integration and system testing and finally, to deployment and maintenance.

Requirements elicitation and analysis stage: The requirement elicitation and analysis stage phase is where all the functional requirements of the web-based smart campus bus transport system are acquired from the various system users and stakeholders, the requirement constraints and goals are also established in conformity to the needs of the users.

System Design: System design phase is next, and it is based upon the requirements established in the requirement elicitation and analysis stage. At this stage a prototype system of the web-based smart campus bus transport system is developed. The prototype is a workable system that has the screen design with requirements and features included as stated in the requirement definition phase.

Implementation and Unit Testing: The implementation and unit testing is the next phase after designing the software; at this point selected focus group consisting of different categories of users of the software which include passengers, drivers and administrators are used to perform unit testing on the different modules to ensure that he modules work according to the user requirement specifications.

Integration and System Testing: The integration and system testing phase is where the different individual program modules are integrated together as one functional software and then tested to ensure that the different modules are compactable with each other and that as a single software the system meets the stated users requirements.

Deployment and Maintenance : The deployment and maintenance phase is the last phase of the project development model; it is where the tested software system is deployed for use by the end users and also where modification and enhancement of the software is carried out in line with either changes in users requirement or need to effect corrections due to bugs discovered in the system. In this phase, continuous correction of errors which were not discovered in earlier stages is done to and testing is carried out at any stage amendment is conducted on the system.
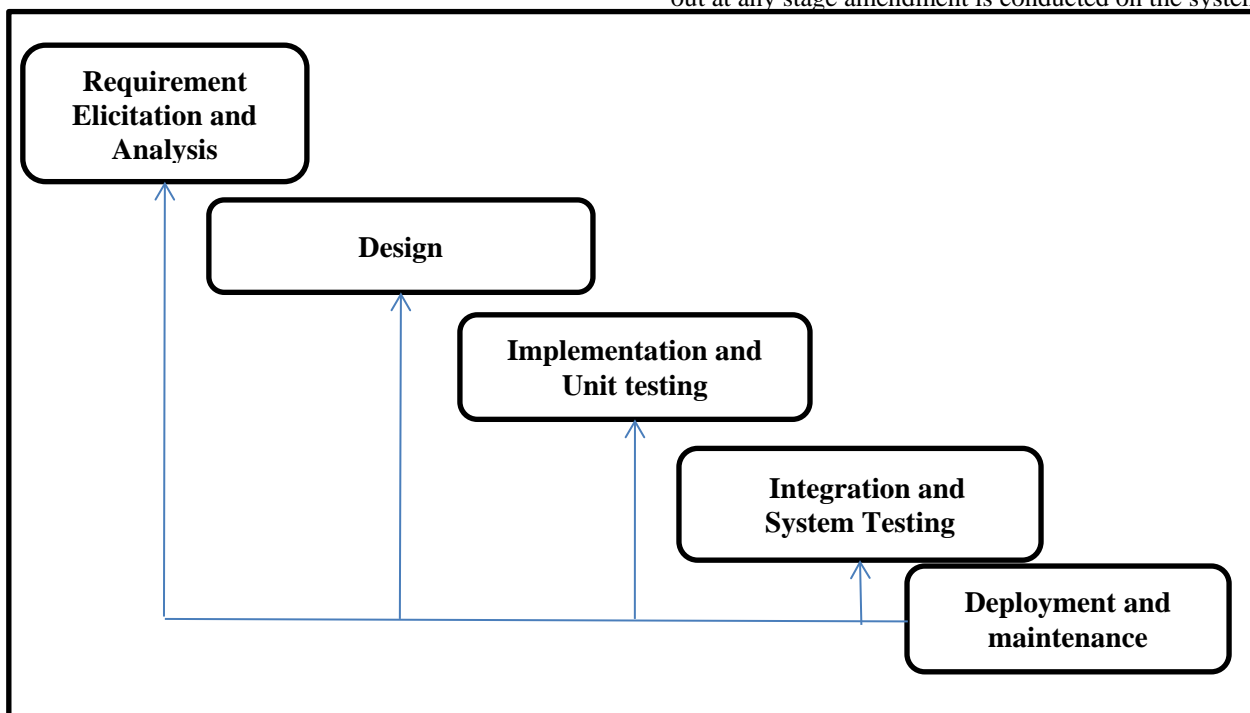

Figure 1: The modified Waterfall software development model

2.2 Description of the System

The web-based smart campus bus transport system comprises of four main modules, namely, the login module, the Administrator's module, the passenger's module and the driver's module. The block diagram of the system is shown in Figure 2. The login module grants registered users of the system access to the any of the other three modules. It also, enables registered members to reset their password, if forgotten and guest users to register in the system.

The administrator module has 4 subpages the dashboard page, add drivers page, view drivers page and view passenger's page. The admin dashboard page shows statistical usage of the system, such as the recent reservations made by passengers and the number of registered passengers, drivers and buses. It also enables the admin to set a uniform transportation price, set the maximum number of allowable passengers per bus and send notification message to both drivers and passengers. The add driver subpage allows admin to register new drivers, while the view drivers subpage generates and list all registered drivers, edit driver details , delete a driver from the system and suspend or unsuspend a driver. These

same functions in the view driver's page are extended to the view passenger subpages.

The passenger's module is accessed only by passengers upon registration or login and has 4 subpages as seen in Figure 2. The passenger dashboard displays the list of available shuttle buses and the details of each bus, such as the bus number, driver's name, route information, schedule departure time, number of available seats and real time information of arrival time and distance. The passenger can make reservation in any of the listed buses and choose between the optional payment methods, either cash or wallet balance. The fund transfer subpage let passengers transfer their wallet balance between themselves, the ride history subpage shows a list of reservations done by the passenger, while the profile subpage displays the passenger's information and allows the passenger to edit

this details. The login button exits the passenger from the system.

The drivers module also has four subpages as seen in Figure 2, the driver selects the route to run from the dashboard, sends his position data to the server, get notification from the admin and sees his scheduled departure time, arrival time and distance in real time, from the driver's dashboard. The fund transfer subpage let drivers transfer their wallet balance between themselves as well as to fund the wallet balance of passengers. The trip history subpage shows a list of trips gone by the driver and allows the driver to generate manifest of this trips, while the profile subpage displays the driver's information and allows the driver to edit this details. The login button exits the driver from the system.
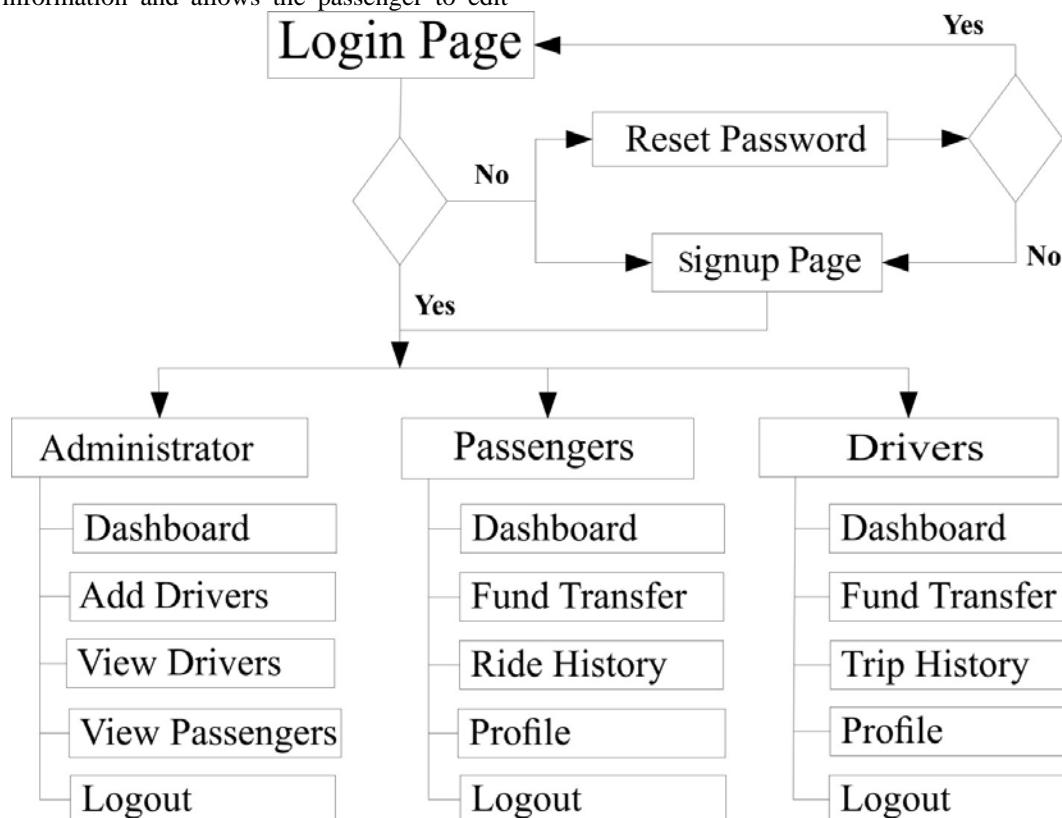

Figure 2 The block diagram of the system

2.3 System Design

2.3.1 Use case diagrams for the key system users

Use case diagrams are used to present high level design of the system with respect to the key system user, namely; the System Administrator, the Drivers and the Passengers.

Administrator Module: The administrator is a super user that has the overall control of the system. The system

administrator can add, view, edit and delete passengers, drivers and bus details, as shown in Figure 3. The system administrator also sets and controls the price of transportation and the maximum seat capacity of each bus, generate records of the system and send out notification message to both passengers and drivers.
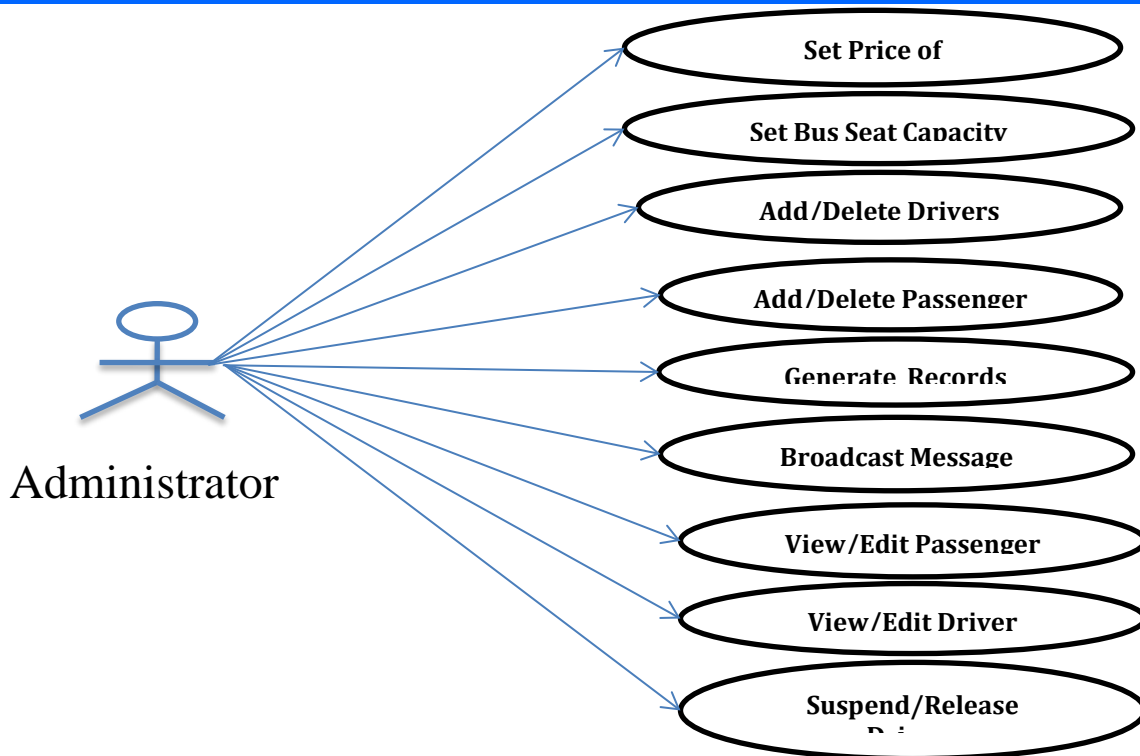
Figure 3: Use Case Diagram for the system Administrator interaction with the system

Drivers Module: Drivers are responsible for adding their bus details, generating manifest for each trip, updating their availability status, which is used by the system for scheduling, as shown in Figure 4. They can also view their trip history, wallet transaction history as well as fund passenger's wallet.
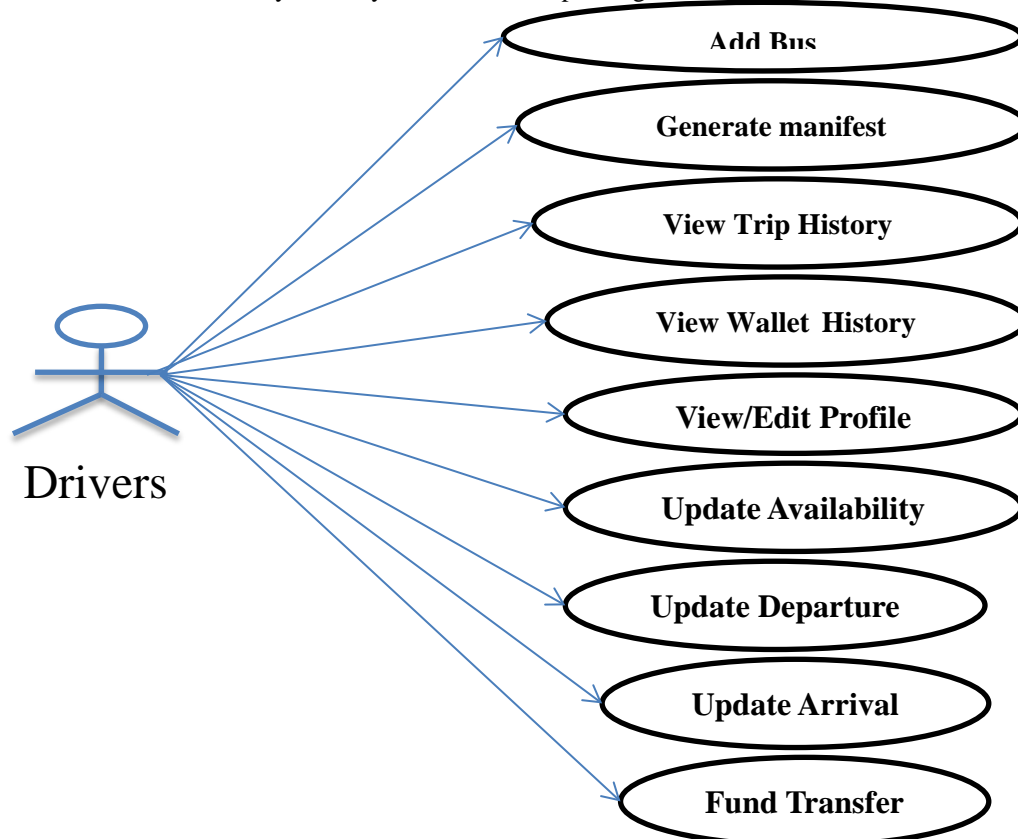
Figure 4: Use Case Diagram showing Drivers Interaction

Passengers Module: Passengers are required register to use the system, as shown in Figure 5. The passenger can also see the list of available buses with their departure times, as well as expected arrival time, make seat reservations, interact with the payment options to pay for their reservations, print out receipt of their reservation payment, transfer funds to a friend, view ride and transactions history as well as view and edit their profile details.
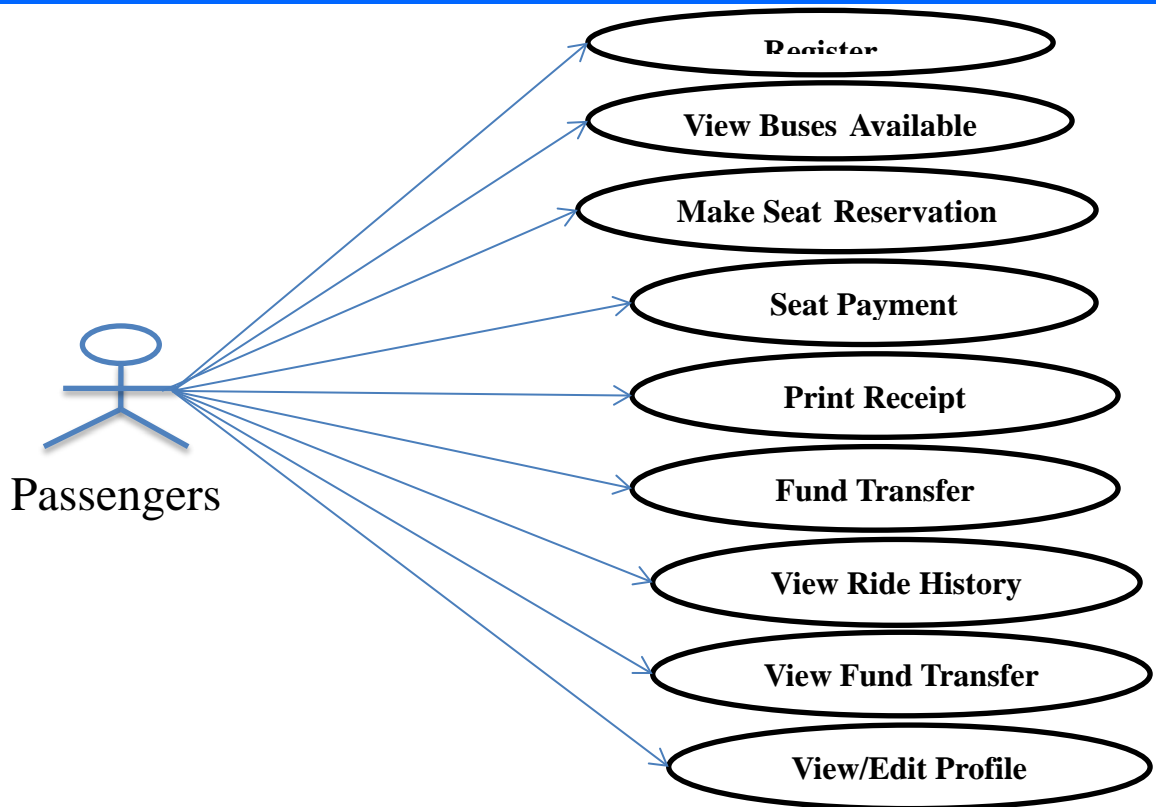
Figure 5: Use Case Diagram showing Passengers Interaction

2.3.2 Data Flow Diagram

Data flow diagram (DFD) shows the flow of data from external entities into the software system. The DFD presents both the physical and logical area of the software system, covering all the processes, as well as the data storage area, which takes place during any transaction in the system. The DFD representation of a system is always done in levels starting from Level 0. The Level 0 data flow diagram representation of the Web-based smart campus Bus transport system is given in Figure 6. The Level 0 data flow diagram of the system shown in Figure 6 shows how data flows within the system. According to the DFD in Figure 6, the system Administrators update the system with the transportation fare and bus seating capacity, while querying the system database for statics about the system usage. Passengers on the other end query the system database for list of available buses and update the system about his/her reservations. Drivers update the system on their pickup location and drop-off location as well as their position data, while querying the system database for statistical data on passenger's reservations.
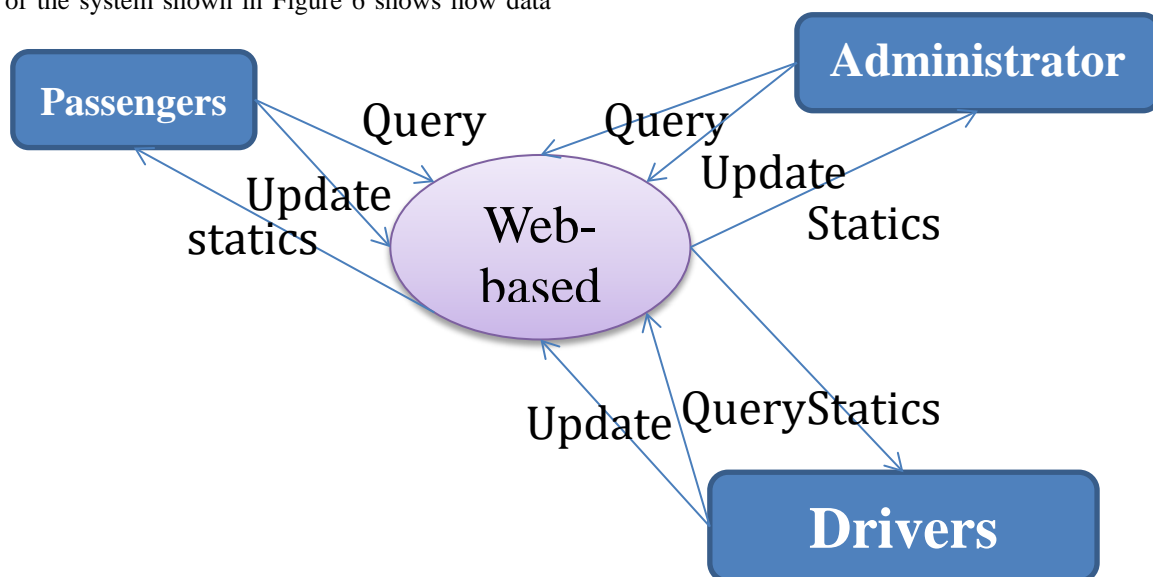

Figure 6: The Level 0 data flow diagram of the system

3. Results and discussions

The web application was implemented with PHP, MySQL database system, Apache web server and Windows operating system. Also the HTML and CSS were used in the system coding. Adobe Dreamweaver software was used for editing the web application source code. The developed web application was hosted locally on a WAMP server. The web-based smart campus bus transport system comprises of

four (4) main modules namely; registration/login, admin, driver and passenger modules and the results are presented in respect of the four modules.

3.1 Registration/Login Module

Any user without username and password cannot access the system and has an option to register as a passenger in the registration page shown in Figure7. However, the user that has registered before can login using the Login page shown in Figure 8. The Login page is the first page that opens when the application is launched and it is accessible to all the user categories. It contains a select option for specifying the category of the user and two textboxes for entering username and password and a login button. When a user successfully logs in, the Login page directs the users to the other modules, based on the user category. It also contains a textbox and button for password recovery as well as a link to the registration page.

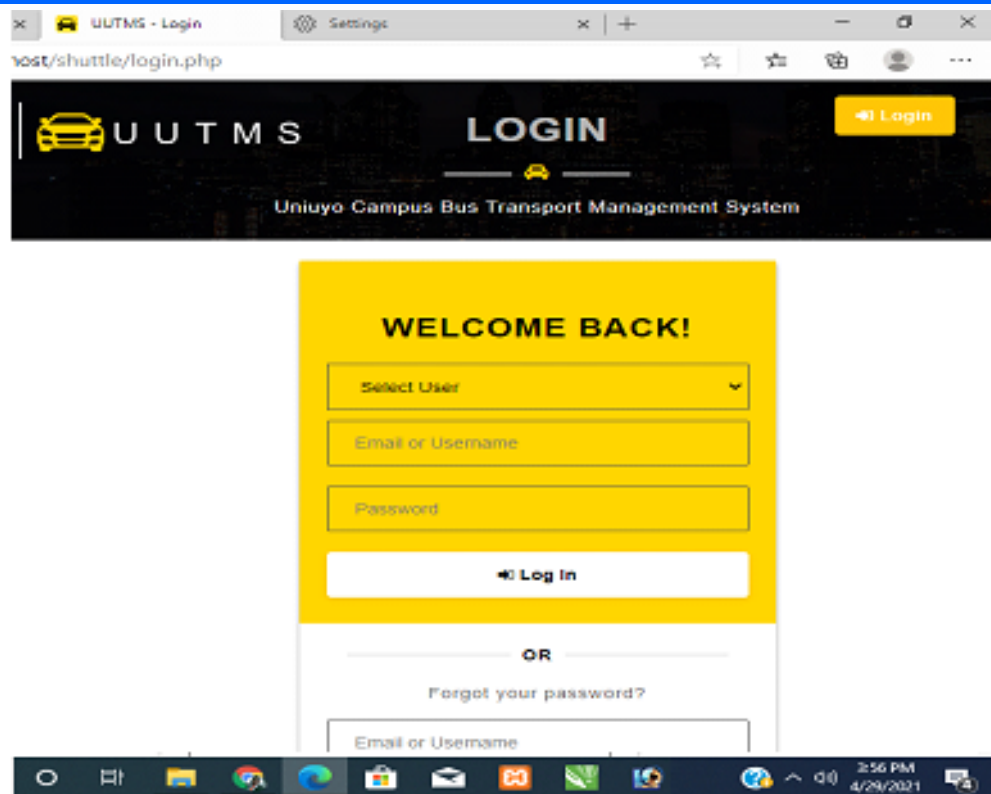
Figure 7: The User Registration Page

Figure 8 The User Login page

3.2 Admin Module

The admin module (Figure 9) is designed for the system administrator or the school transport management officer. The module enables the admin to set a fix transportation price, set the maximum number of passengers per bus, send a broadcast message to both drivers and passengers, monitor recent reservation transactions, generate records, keep track of the number of registered passengers, drivers and buses. The admin module (Figure 9) contains navigation links to 4 submodules which are; add driver (Figure 10), view driver (Figure 11), view bus and passengers (Figure 12). These subpages allows the admin to add a new driver, see detailed list of all the drivers, edit driver details , delete a driver from the system and suspend/unsuspend a driver. These same functions are extended to the passenger and view bus submodules.
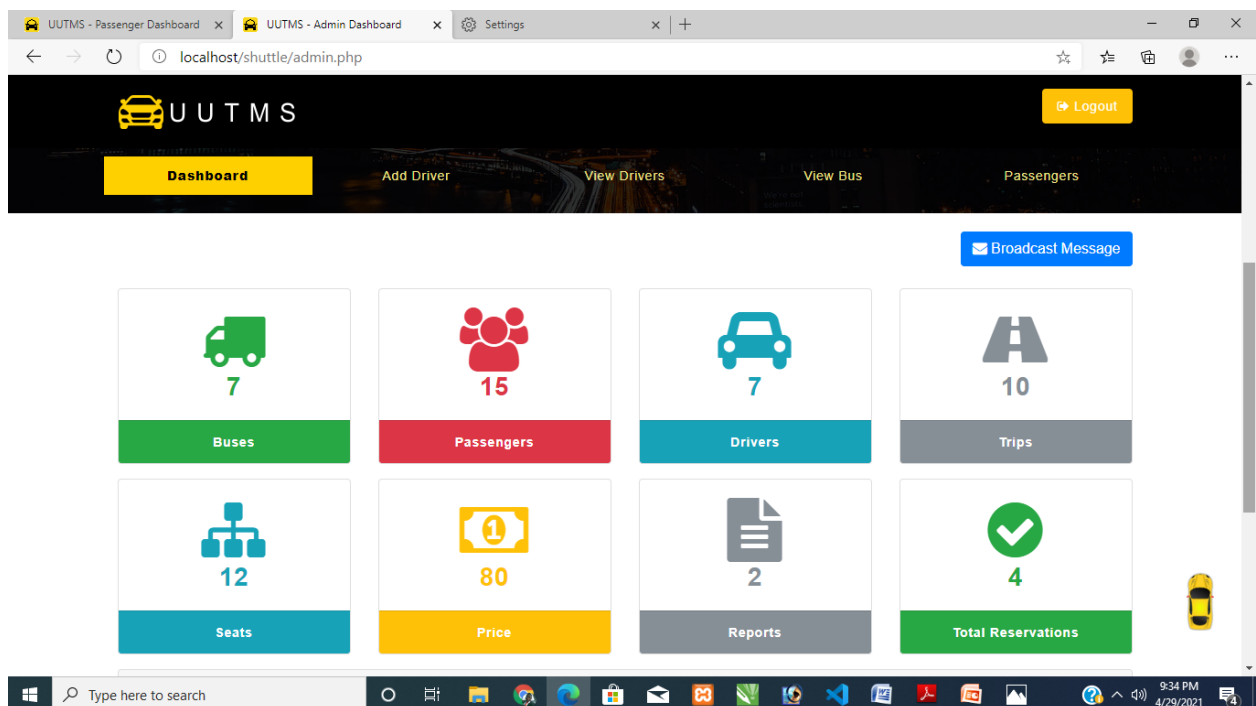

Figure 9: Admin module dashboard

Figure 10: Admin module add driver

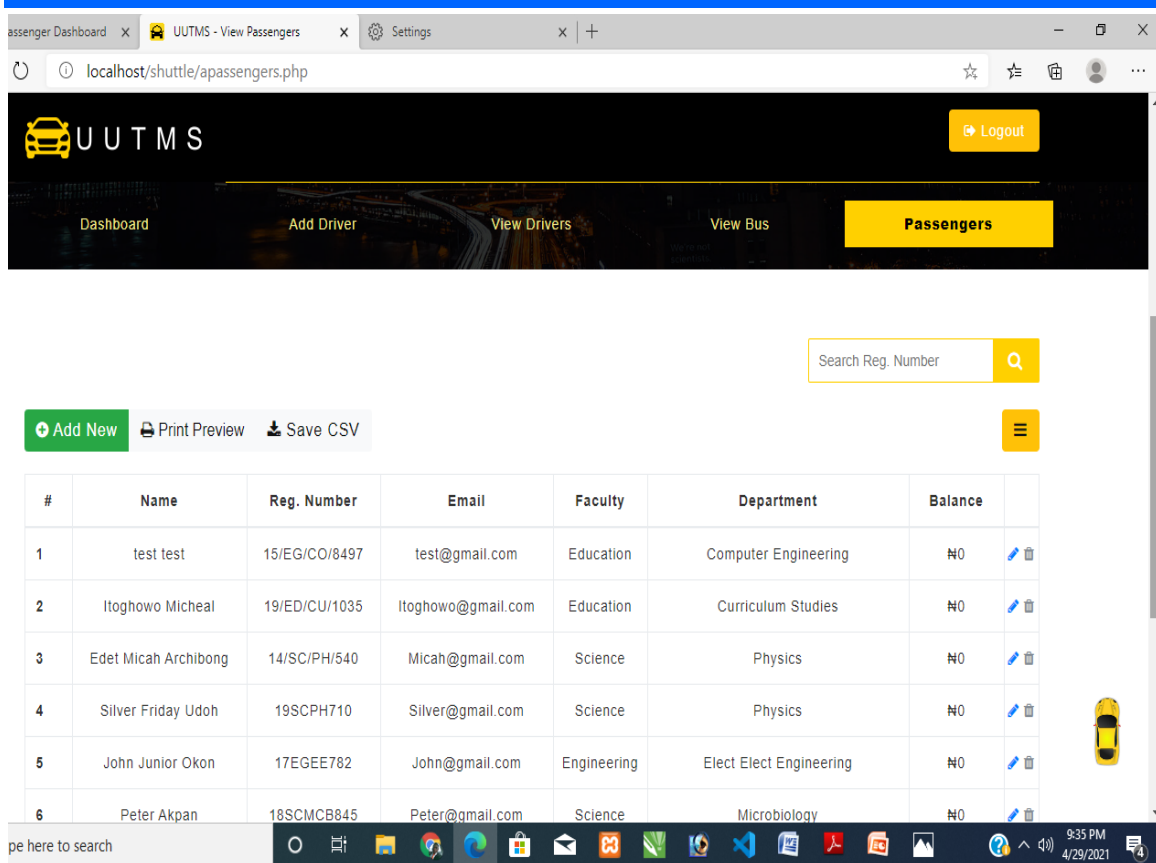

Figure 11: Admin module view driver

Figure 12: Admin module passengers

3.3 The Driver Module

The driver module is handled by the shuttle bus driver (Figure 13). According to the driver module design, the driver logins to the system to indicate his availability to start work, generates manifest of passengers that had reserved seats in his bus for verification, fund the wallet of passengers and transfer funds to a fellow driver as well (Figure 14), view/edit his profile details, view wallet transaction history and trip history (Figure 14).
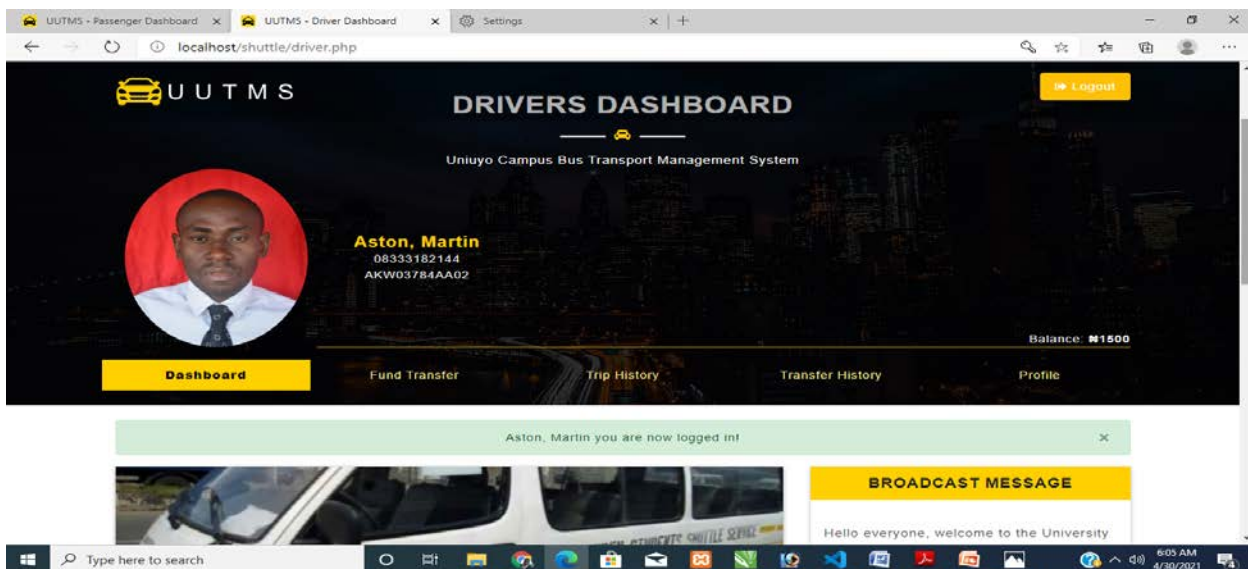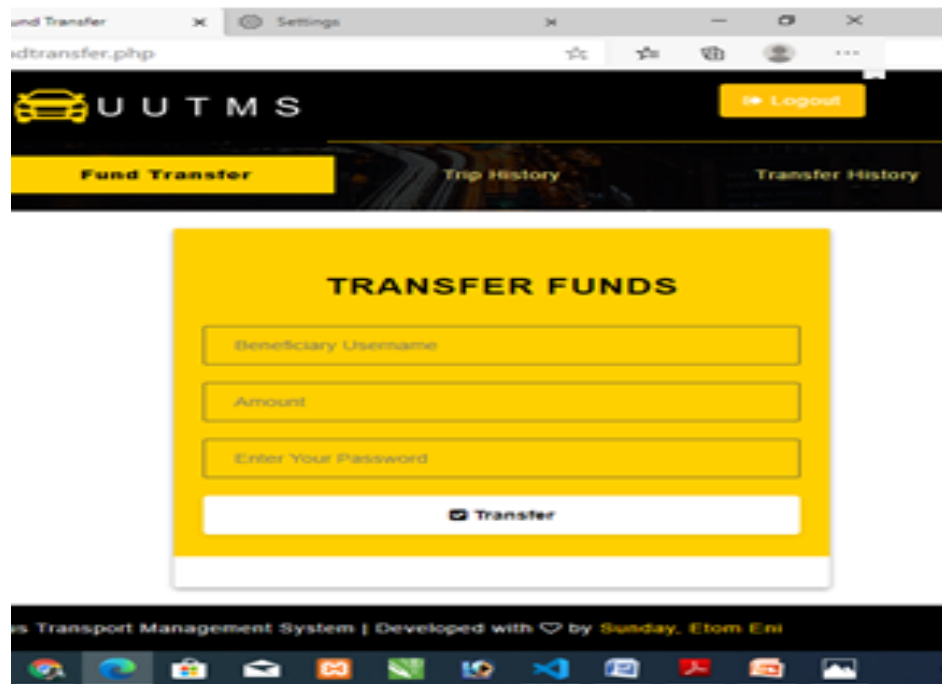

Figure 13: Driver module dashboard

Figure 14: Driver module Wallet fund transfer

Figure 15: Driver module wallet transaction history

3.4 Passenger Module

The passenger's module is accessed only by passengers upon registration or login as shown in Figure 16. The passengers get access to the list of available shuttle buses at their pick up location (Figure 17) and those coming to their location; know in real time the time it will take for the shuttle bus to get to their location and the distance between them and the shuttle bus. The passenger can choose between the optional payment methods either cash or wallet balance for each seat reservation, transfer wallet funds to a friend, view/edit his/her profile details, view wallet transactions history and reservation history. The passenger can also view ride history (Figure 18) and access the passenger's profile details (Figure 19).
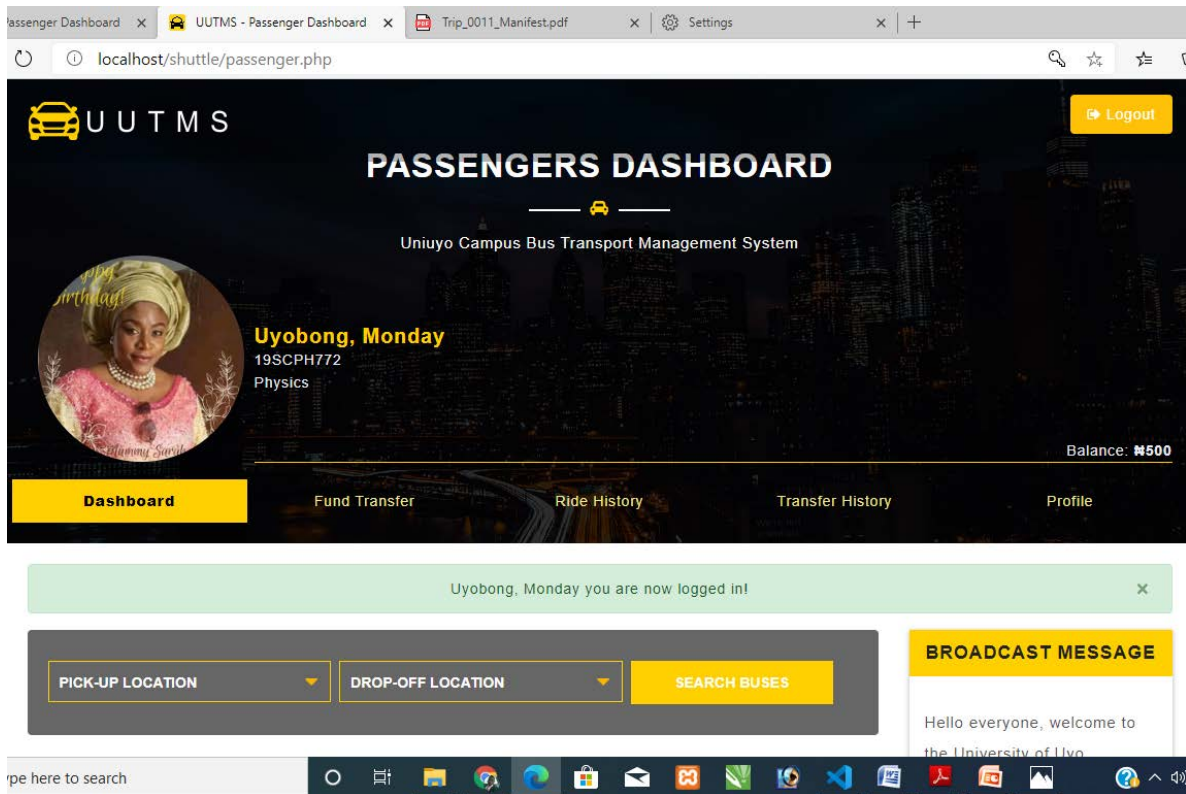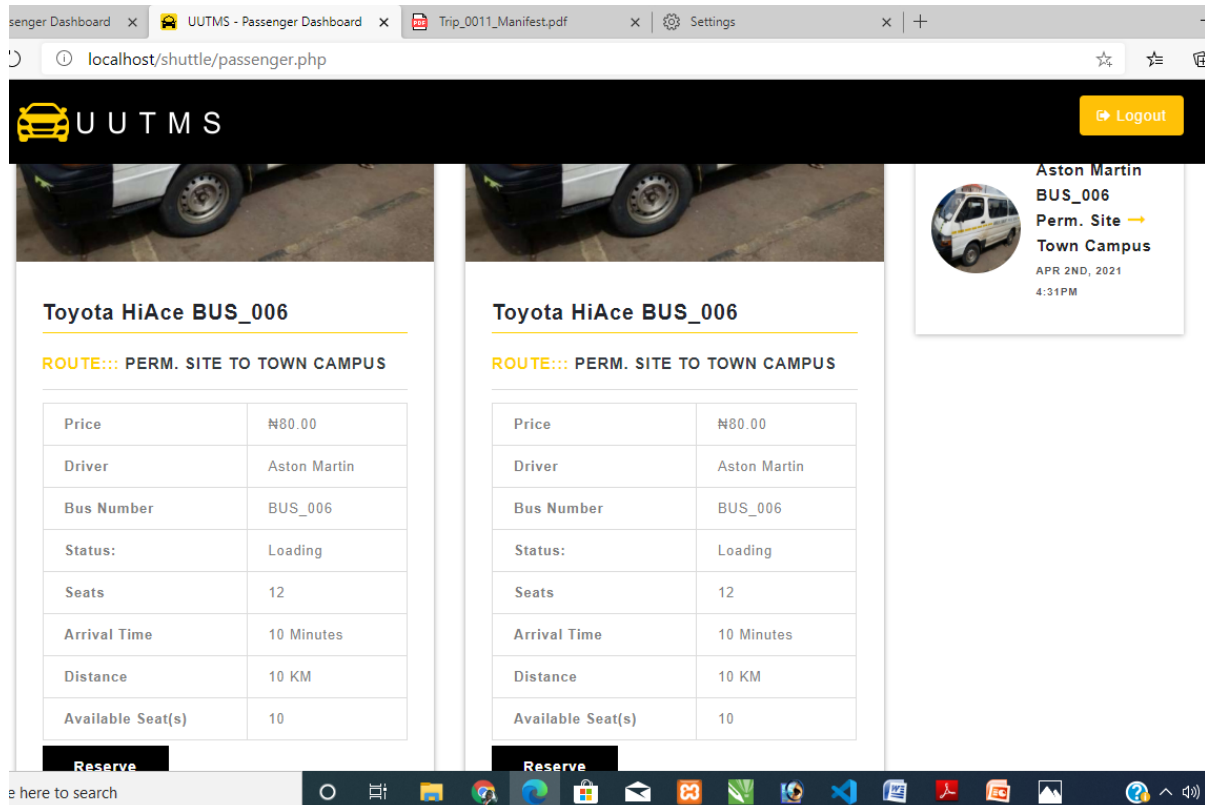
Figure 16: Passenger module dashboard

Figure 17: Passenger module list of buses

Figure 18: Passenger module ride history

Figure 19: Passenger module profile details

4. Conclusion

The development of the web application that is used for the management of smart campus bus transport system is presented. The key system users includes he system administrators (who I the super user), the drivers and the passengers. The system design was presented using use case and data flow diagrams. The web application was implemented with PHP, MySQL database system, Apache web server and Windows operating system. Also the HTML and CSS were used in the system coding. Adobe Dreamweaver software was used for editing the web application source code. The developed web application was hosted locally on a WAMP server. The screenshots of selected webpages were used to demonstrate the effectiveness of the developed web application in accomplishing the various user requirements for the smart campus bus transport system.

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