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A Mobile Application to Enable Users to View Bus Schedules and Extend Bus Booking and Reservation Services

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ABSTRACT

The research focused on creating a mobile and web-based application to enable people to access reservation services for the Gagga bus company. This shall help people avoid wasting time as they could plan their journey well without risking missing a seat on a particular bus. Constant missing of buses travelling to distant places across East Africa due to poor timing of the passengers was the major problem that led the researcher to conduct this project. The researcher created the Traveller mobile application that would help in solving the problem of providing transport services. In this project, the researcher used Waterfall Methodology, in this methodology, the researcher used techniques such as Dataflow diagrams, UML Techniques and prototyping, to come up with the system requirements. The requirements analysis, testing and modelling techniques such as Use cases, ER Diagrams and sequence diagrams were used by researchers to model the functionality of the system. In the testing of the system, the researcher used unit testing, system integration testing and usability testing. The researcher used Android as the platform to develop the Mobile application and also researcher used Web application development tools and languages such as PHP, My SQL, and Query to develop the web application.

Keywords: Mobile and web-based application, Reservation services, Journey, Passengers, Traveller mobile application.

INTRODUCTION

In the past years up to date, travelling by bus has proved difficult due to the problems paused during the booking and reservation procedures undertaken as the current system (system on the ground) These problems people are facing range from lack of knowledge of bus information and poor coordination and management. And include the following among others; Lack of access to travel information about buses by travellers, [1]. Lack of knowledge of the bus schedules and hence, making most people travel long distances to the bus booking stations only to find that there are no available buses intending to travel at that particular time and thus, people incurring a lot of expenses and having a big expenditure trying to check for time frame suitable for them to travel. The current booking and reservation service also causes a lack of knowledge on the updates made to the bus schedules and bus fares and thus, making some people in shock (taken by surprise) by the abrupt bus schedule and fare changes. The tiredness of people who come to book buses due to lining up in very long queues [2-4]. At times some people can faint due to standing especially when there are not enough seats to cater for all the people intending to book. Overcrowding of passengers leads to reduced aeration, which intern affects the health of the passengers especially the Asthmatic patients and also loss of property due to congestion. To the bus officials, the booking procedure on the ground causes overcrowding and its related problems, increased stress levels due to working for long hours and the work being tiresome due to many people being attended to. The [5]. Traveller Application is therefore intended to solve the following problems by enabling people with this application installed on their phones to book a bus and reserve seats via their phones and hence prevent overcrowding and its associated problems and also prevent the associated effects of lining in the long queues, Ability of users to view announcements of what occurred to a particular bus in-case of any delays on the way. A mobile application is a software that can run on a mobile device such as a cell phone. According to [6], he defined mobile applications also called mobile applications, as applications that run on smartphones and other mobile devices. Mobile applications usually help users by connecting them to Internet

services more commonly accessed on desktop or notebook computers or help them by making it easier to use the Internet on their portable devices. A mobile application may be a mobile Web site bookmarking utility, a mobile-based instant messaging client, Gmail for mobile, and many other applications. Mobile application development is the process by which application software is developed for low-power handheld devices such as personal digital assistants, enterprise digital assistants or mobile phones [7]. These applications are either pre-installed on phones during manufacture, can be downloaded by customers from various mobile software distribution platforms, or are web applications delivered over HTTP which use server-side or client-side processing (e.g. JavaScript) to provide an "application-like" experience within a Web browser. In recent years we have seen the rise of mobile users with PDAs, laptops and particularly mobile phones.

Statement of the Problem

In Uganda, there is a general lack of access to simple, reliable travel information about bus and public transport services. Here people are experiencing many difficulties in having access to reliable information about transport services. This has been caused by a lack of adequate information on bus schedules, inadequate knowledge of the bus stations' location, and status of travelling buses, lack of access to updated information on updated bus schedules or abrupt changes in bus fares. Lack of information on how to send packages via bus transport, un availed announcements to people who are waiting to travel on a bus whose journey might have been interrupted by unavoidable circumstances like accidents.

Aim

To design, develop, and test a mobile application "Traveller". The application consisted of four major components (Mobile Application, Client, Database, and Web browser-based client Application). The application was to be used in accessing bus transport information services that include bus schedules, fares and making reservations/bookings.

Specific Objectives

- To design, a mobile and web-based application that will allow members of the community to access various transport services such as bus schedules and costs for various destinations.
- To develop the mobile application, web application and database for the travel system.
- To test and implement the application.

Research Questions

I. What type of mobile application, web application and database should be developed for the travel system?
II. What type of application should be implemented and tested?
III. What type of mobile and web-based application should be designed to allow members of the community to access various transport services such as bus schedules and costs for various destinations?

METHODOLOGY

Area of Study

The geographical scope of this project was defined by having a mobile application and a web application (Traveller) with the following area coverage features: This application allows usage by users who have the Traveller application installed on their machines, from all places in Uganda to access bus transport services.

Questionnaires

The researcher designed a questionnaire to be filled out and used to capture responses from different people who have used bus transport.

Advantages	Disadvantages
Practical enough to carry out the research. I Got a lot of input from users, supervisors, customers and management of bus services.	It was inadequate to understand some forms of information -like changes in emotions, behaviour, and feeling, among others.
Its result was quickly and easily quantified through the use of software packages like Microsoft Excel.	It was hard to tell how much thought the respondents had put in.
Large amounts of information were collected from a big number of people in a short period of time and in a relatively cost-effective way.	The respondents were forgetful and did not think within the full context of the situation.
Analysis was done more 'scientifically' and objectively.	It was difficult to tell how truthful the respondents were.

Table 1: shows the advantages and disadvantages of using a questionnaire as a requirement collection technique.

Observation

This involved collecting data about the job or performance of employees by directly observing them at work. During observation, the researcher observed some of the ways the services in booking offices were conducted by visiting different bus booking offices. The visited booking offices include KK Travellers, Gaga Coach, and Kampala Coach among others.

Advantages	Disadvantages
No wastage of money since I just went to the booking office and had to observe the whole process of a client booking a bus.	It took me lots of time. Since I had to be observant to see what I wanted to see.
Better opportunity to see and learn only relevant information needed to build the system.	It was not practical enough to carry out the research. Input from users, supervisors, customers and management was not clearly obtained.

Table 2: shows the advantages and disadvantages of using observation as a requirement collection technique

Interviews

This is a method used to collect a variety of information from a job holder by asking him/her to describe the duties & tasks performed. During the Interview sessions, the researcher asked some of the bus officials in booking offices the challenges they face while attending to customers and some of the reasons were; overcrowding in booking offices, Customers are usually taken by surprise when the bus fares are adjusted and so, they begin bargaining over the bus fares, among others, Some officials said they get fatigued due to working for very long hours since customers come to book at any time of the day. On the other hand, Customers complained that they don't usually know whether buses are available or not thus making them waste a lot of money to travel at a loss. This method is useful because it gives the researcher the good opportunity to interact directly with both the customers and the Bus company management, hence helping the researcher to know the necessary input, relevant to the system to be produced.

Advantages	Disadvantages
Allows the monitoring and evaluation of interpersonal skills, Nonverbal and paralinguistic behaviours.	Potential to cue, bias or distort responses from the respondents.
Allows greater flexibility in wording, sequence and direction.	Time and cost. The interview session needed more time and money so as to gather more information about the current booking system.
The interviewees took questions more seriously.	Confidentiality between the researcher and the interviewees was lacking.

Table 3: shows the advantages and disadvantages of using interviews as a requirement collection technique

Requirement analysis Techniques

Requirements Analysis involves understanding what you need to design and what its functions and purposes are. A number of requirements were captured as elaborated in the chapter This should include the following highly iterative activities: Domain Understanding-Analysts must develop their understanding of the application domain. Therefore, the concepts are explored and the client's requirements are elicited. The Problem domain was therefore to design and develop a mobile application to enable users to view bus schedules and extend bus booking and reservation services.

Requirements capture- The analyst had to capture the user's requirements which included;

- Ease of Navigation from screen to screen
- Ease of use on mobile handsets by using features such as inbuilt phone dialling capability, date picker, drop-down list and auto-complete lists.

Classification-This activity takes the unstructured collection of requirements captured in the earlier phase and organizes them into coherent clusters, and then prioritizes the requirements according to their importance to the client and the users. Validation- This was to check if the requirements are consistent and complete, and to resolve conflicts between requirements. Feasibility study- This was to estimate whether the identified requirements would be satisfied using the software and hardware technologies and to decide if the proposed system would be cost-effective.

UML as a Requirement Analysis Technique

According to [8] UML stands for "Unified Modeling Language". It is an industry-standard graphical language for specifying, visualizing, constructing, and documenting the artefacts of software systems. Some of the types of UML in this were Use Cases Diagrams, Sequence Diagrams, and Conceptual Models. The illustrations and explanation of these techniques are shown in Chapter 4.

System design Methodologies

In the system design phase, the researcher used the Waterfall methodology which has several stages like requirement capture and analysis, system design and development, testing and implementation. After the specification was produced through requirement analysis, the requirement specification underwent two consecutive design processes. The first is the architectural (or logical) design in which the requirements were partitioned into components [9-10].This resulted in an architectural design document which described what each component must do and how they interact with each other to provide the overall required services. Then each component in turn was designed; this process is termed detailed (or physical) design.

Data Flow Diagrams

Data Flow Diagrams are graphic organizers in the form of illustrations or images displayed in sequence for the purpose of pre-visualizing a motion picture, animation, motion graphic or interactive media sequence. The dataflow diagram tells if the interactive experience of the user interface is usable to the developer, designer, project manager and any other 3rd parties who are involved in the project. It tells about each use case and the step-by-step process of the application. Dataflow diagrams show login c and meaningful navigation between screens of the pages. The illustration of the screen navigation (dataflow) is shown above.

UML technique

The researcher used a number of Unified Modeling Language techniques to model the system. Some of the techniques used in this project are Use Cases, Use Cases Diagrams, Sequence Diagrams, and Conceptual Models.

Prototyping

Here, the objective of the development was to understand the customer's requirements, and hence develop a better requirements definition for the mobile Application "Traveller". [11] The prototype concentrated on experimenting with those parts of the client's requirements which were poorly understood. For example; Ease of Navigation from screen to screen, ease of use on mobile handsets by using features such as date picker, drop-down list and auto-complete lists, notification of user in case of anything (Success / Failure / unexpected situation) and Portability in Web application (Platform free. Run on various operating systems).

Implementation Tools

Android

In developing the mobile application, the researcher used the Android development environment.
Android SDK revision 18 was used. The Android platform used by the researcher was 2.2and the Android API level used was 8(minimum SDK used was 8(Android 2.2)).

PHP and My SQL

In developing the web application, a WAMP server was used. All the PHP scripts developed at this stage were uploaded to the local testing server for the purpose of seeing how they worked. The database was also created using My SQL and the connection between the database and the web app as well as the mobile app was done using PHP. For example; For a passenger to submit the booking credentials, there was a PHP code to connect from the Application interface to the database.

Testing and Validation Techniques.

Testing was done according to the requirement specification and test cases were designed to cover all the crucial services required. The different tests done included; unit testing, system integration testing and usability testing.

Unit testing

This tests the internal structures or workings of an application. Each Activity was tested individually to ensure that it was working for example; The Application interface, which was to enable a user to book a bus by submitting his credentials,[12] Application interface to enable a passenger to send comments on the customer care services of the bus officials where all tested individually.[13] The internal perspective of the system, as well as programming skills, are used to design test cases. The tester chooses inputs to exercise paths through the code and determines the appropriate outputs.

System Integration testing

The individual program units (Application interfaces) representing the components of "Traveller mobile Application" were combined and tested as a whole to ensure that the software requirements had been met. The mobile application was then tested by the client (*acceptance testing*). For example; if A user was to be able to navigate

from the home screen to Book a bus and Back, View bus schedules and perhaps Exit the application case he never needed any further interactions with the application.

Usability testing.

This phase starts with the system being installed for practical use after the product is delivered to the client. The client then practically interacts with the application interfaces like say sending a comment, submitting booking details to the database respectively and viewing bus schedules from the database.

RESULTS

System Architecture

Traveller has three (3) major components

I. Mobile app

- Android will be used to create this app
- Use the internet to communicate with other components of M-Vigour.
- For Mobile device users- Individuals & Families.
- For sending requests and getting responses.

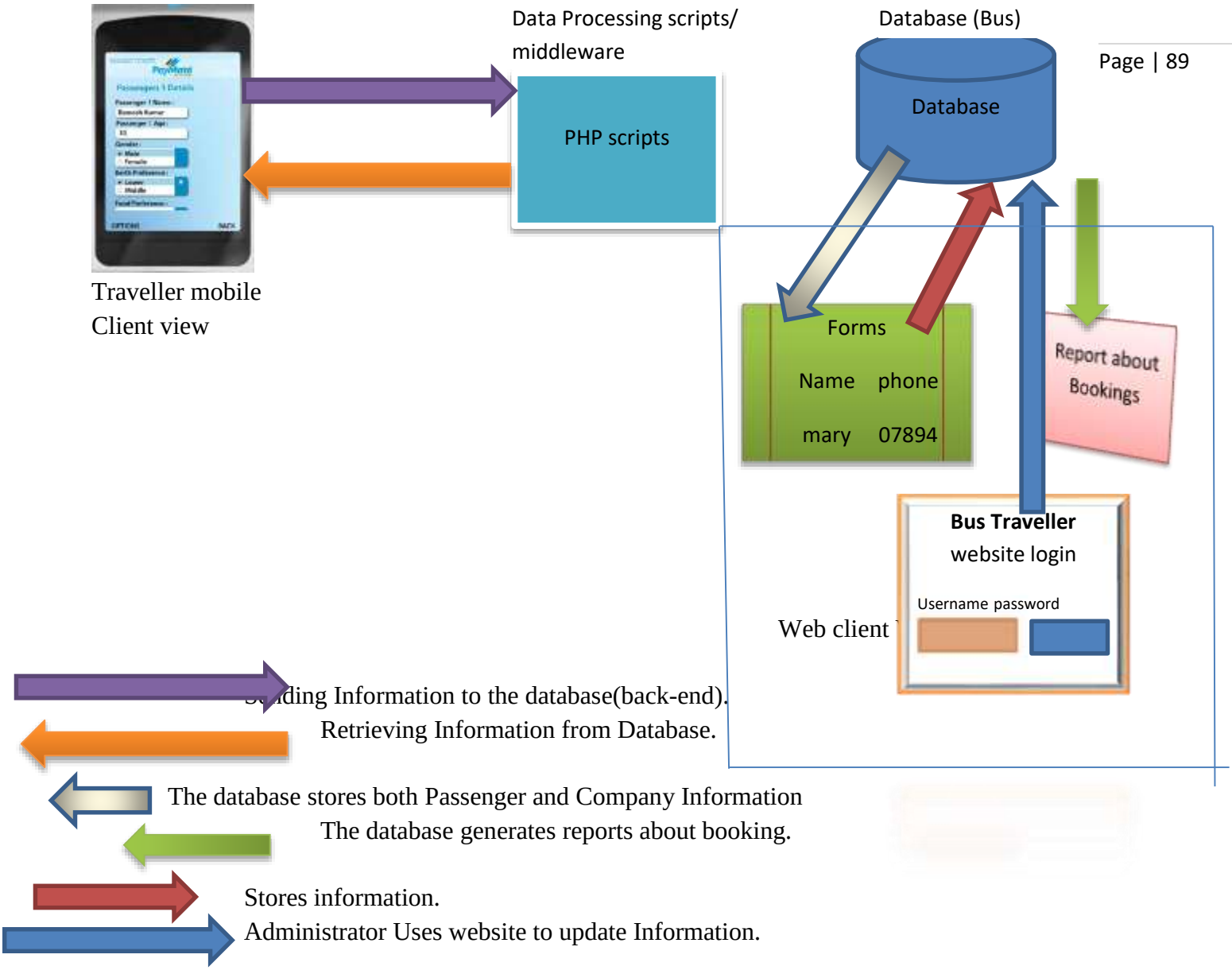
II. Database

- Relational DBMS (My SQL) will be used to create it.
- Server-side scripting language PHP will be used to provide a connection with the Android app.
- Database will be for accepting, storing, processing and reporting users' requests
- Database will use the Internet to communicate with other components of Traveller

III. Web app

- Client-side scripting language such as CSS will be used to design this web app.
- Server-side scripting language PHP will be used to provide a connection with the Database.
- This is the administrative area for the entire Traveller system.
- Used by Bus companies' management and System Administrator to respond to user Requests and update the database.
- Web app will use the Internet to communicate with other components of Traveller.

Figure 1: Shows the system Architecture for Traveller Application



System Requirements

Given the objectives specified in chapter one section 1.4, a number of requirements for this project were captured. With regard to the design, implementation and functionality of this project, the list of requirements obtained was categorized into Functional Requirements, Non-Functional Requirements, user requirements, Hardware requirements and Software requirements as shown in sections 4.2.1, 4.2.2,4.2.3, 4.2.4 and 4.2.5 respectively.

Functional Requirements

The application has the following functions

- Allow users to view the updated bus schedules for the company.
- Provides information about bus travelling details like the date and time.
- System produces reports about booking.
- Allows users to book buses via their mobile phones.

- Ability to allow individuals and families to get assistance from the bus companies in case of any query by providing contact information about the company's services.
- Users receive daily updates about the bus fare, bus schedules and information about any changes.
- Users' ability to post comments about the service they have received on their journey after travelling.

Non-Functional Requirements

i. Both mobile and web clients should validate data before submitting it to the database.
ii. The web user pages should be password protected.

User Requirements.

i. Easy Navigation from screen to screen
ii. Should be easy to use on mobile handsets by using features such as date picker, drop-down list and auto-complete lists.
iii. Should notify the user in case of anything (Success / Failure / unexpected situation)
iv. Portable in a Web application. Platform free. Run on both operating systems.
v. Users should be able to make calls to bus officials using the application.

Hardware Requirements

Traveller Mobile application is supported on hardware that is running Android operating.

Software Requirements

i. Web applications must run on any PHP-enabled server.
ii. The database can be any Relational database management system. In this case, I used MySQL and JSON.
iii. IDE.
iv. SDK.

Use Cases

Given the objectives of this project, a number of use cases for the Traveller systems were found. The use cases highlight the desired functionality of the Traveller and all necessary user interactions with the system.

Figure 2: Use a case diagram showing how the user interacts with the system

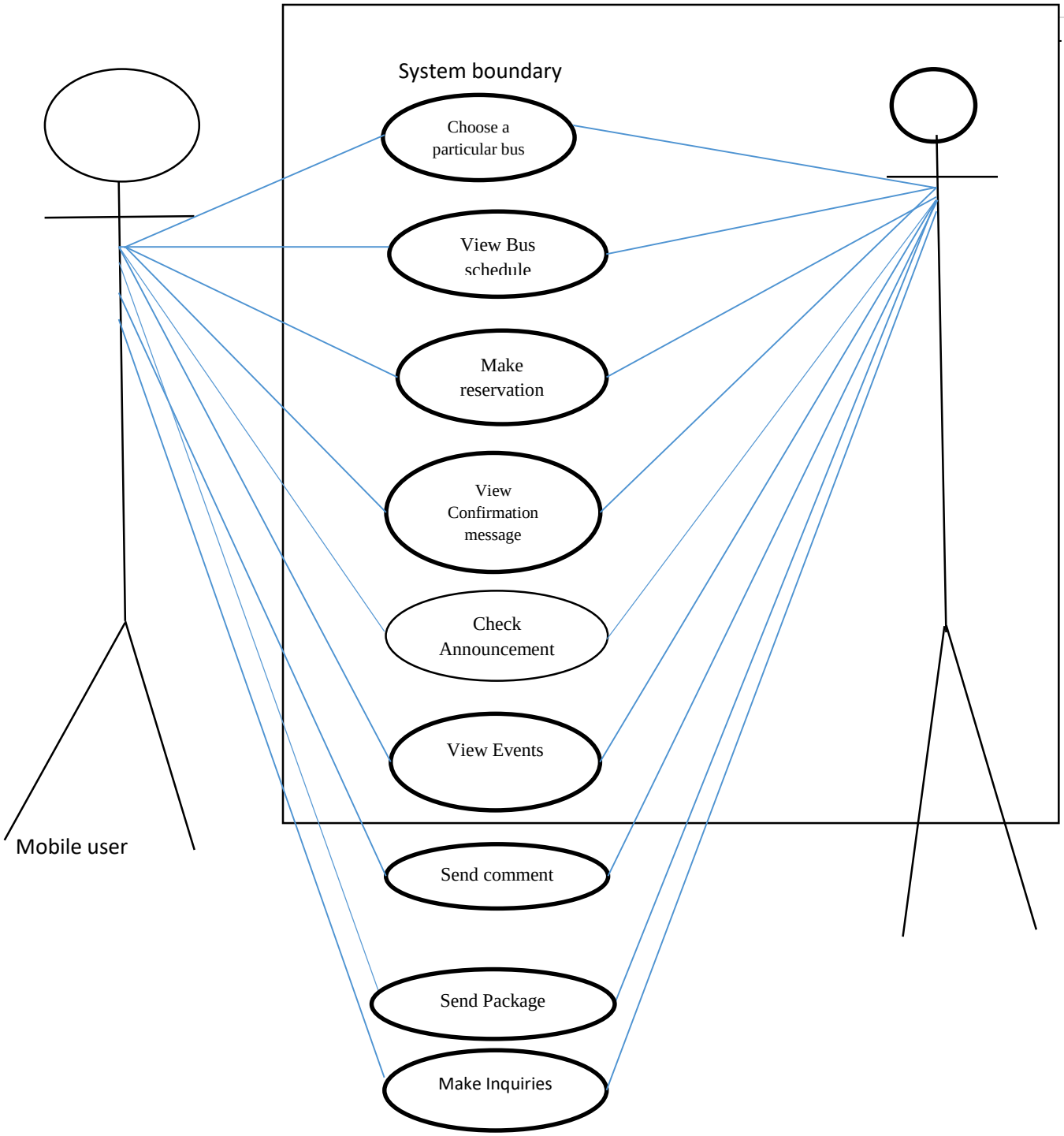


Table 4: Use Cases

Use Case 1 **User to view bus schedules from the system** Bus official	
Actor(s)	Community members (Individuals and families)
Pre-condition	System is up and running; Community members can access it in the Network.
Scenario/Description	Users should be able to view bus schedules. The user opens the application and chooses the menu icon for Buses and chooses a bus from a list of available buses whose bus schedule she wants to view.
Post-condition	Bus officials are ready to interact with the community

Use Case 2 **User to book a bus**	
Actor(s)	Bus officials
Pre-condition	The system is up and running; Community members can access it in the Network.
Scenario/Description	Users should be able to book a bus and receive a confirmation message. The user opens the application and chooses the menu icon for Buses and chooses a bus from a list of available buses whose bus she wants to book and travel with
Post-condition	Bus officials are ready to interact with the community

Use Case 3 **User to view the Confirmation message**	
Actor(s)	Mobile users.
Pre-condition	The system is up and running; Community members can access it in the Network.
Scenario/Description	The user opens the application and chooses the menu icon for Buses and chooses a bus from a list of available buses whose bus she wants to book and travel with and receives a confirmation message.
Post-condition	Bus officials are ready to interact with the community

Use Case 4 **User to view Announcements**	
Actor(s)	Mobile users.
Pre-condition	Community members are ready to use the Traveller services.
Scenario/Description	The Bus official should update Announcements to the system for users to view
Post-condition	Bus officials are ready to provide announcements and updates to the system.

Use Case 5 **User to send a comment about bus service**	
Actor(s)	Mobile users, Bus officials
Pre-condition	The system is up and running; Community members can access it in the Network.
Scenario/Description	Users should be able to send comments about the services offered to them by the buses/bus company. The user opens the application and chooses the menu icon for the Service comment
Post-condition	Bus officials are ready to interact with the community

Use Case 6 **User to make Inquiries**	
Actor(s)	Mobile, Bus officials
Pre-condition	The system is up and running; Community members can access it in the Network.

Use Case 7 **Bus officials should be able to make Updates.**	
Actor(s)	Bus officials
Pre-condition	Community members are ready to use the Traveller services.
Scenario/Description	The Bus official should update the information to the system(update bus schedules, Announcements plus upcoming events and package sending information when necessary)The bus official should provide a response to the user request as well.
Scenario/Description	The user opens the application and chooses the menu icon for Help and Support. Users should be able to make view help and support information and perhaps make telephone calls to the Helpline using the application.
Post-condition	Bus officials are ready to respond to the community
Post-condition	Bus officials are ready to provide responses and updates to the system.

Figure 3: An Activity Diagram showing the operations that take place when the mobile user is interacting with Traveller Mobile Application.

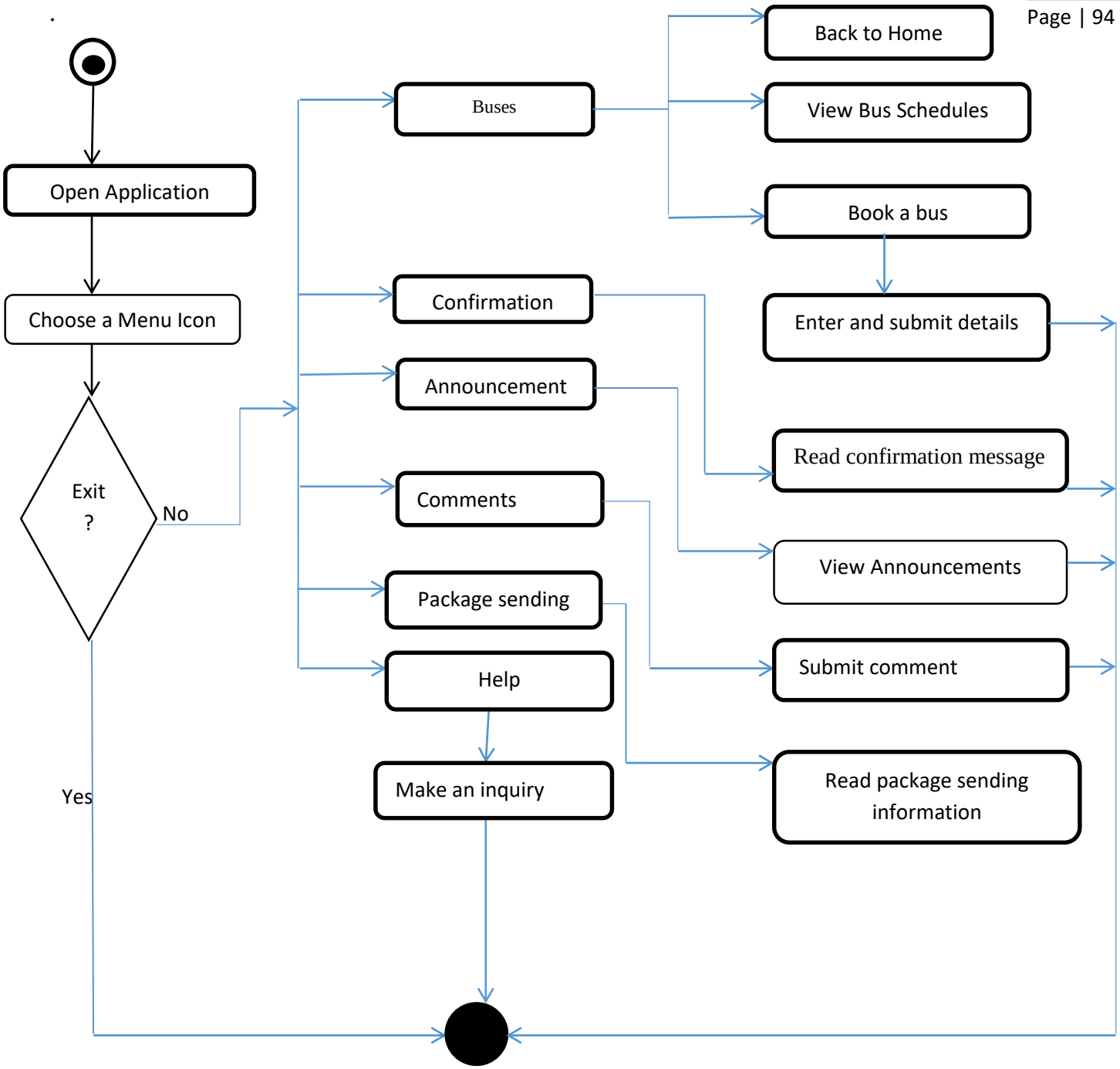
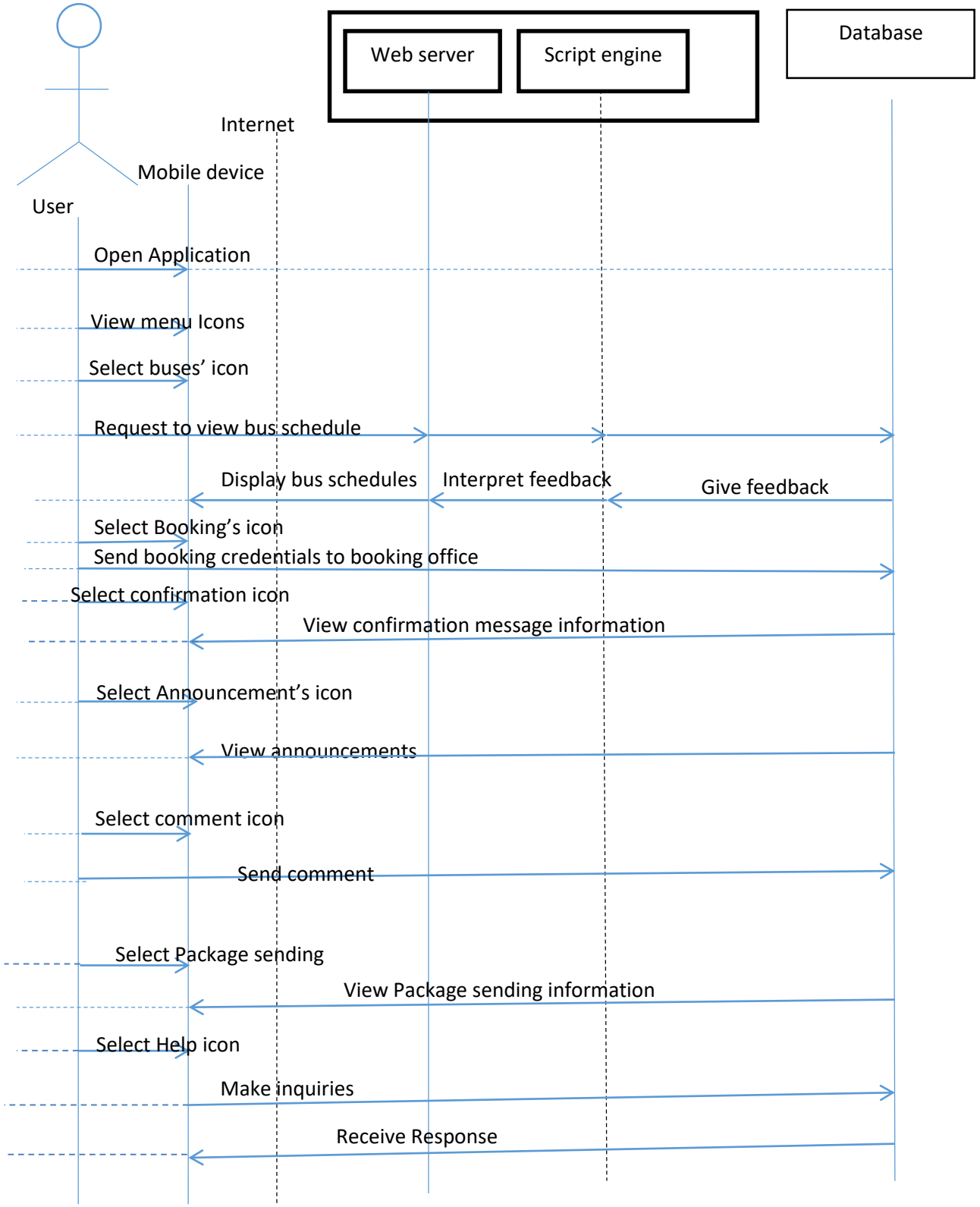


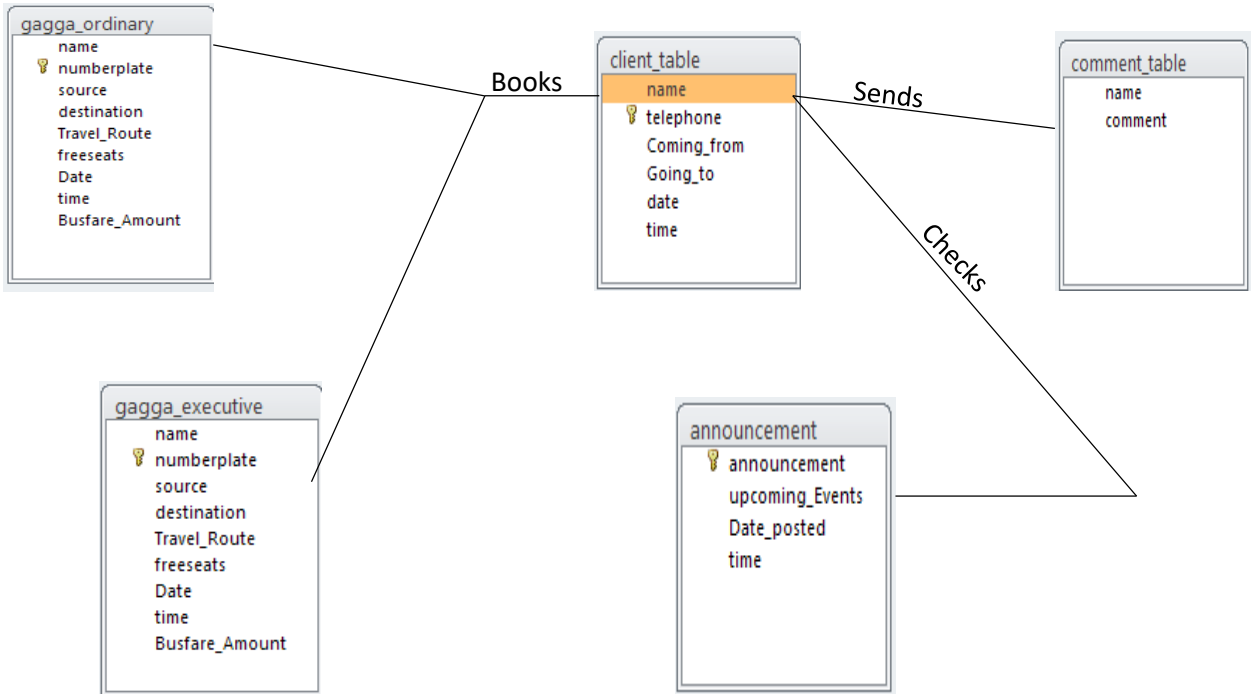
Figure 4: Sequence Diagram for Traveller mobile Application.



Data Modelling

In data modelling, researcher used the Entity Relationship (ER) Techniques to analyse and relate the entities in the database. In this section researcher is showing the ER Diagram used
as well as the overall database design (Database Schema).

Figure 5: shows ER Diagram for Traveller System.



Database schemas
Database name: Traveller
Table name 5: client table

Column name	datatype	Size
name	varchar	30
telephone	int	15
coming from	Varchar	30
Going to	Varchar	30
date	varchar	15
time	varchar	13

Table 6: Gagga ordinary

Column name	datatype	Size
name	varchar	30
Number plate	varchar	30
Source	Varchar	30
destination	Varchar	30
Travel Route	Varchar	100
Free seats	Varchar	100
date	varchar	15
time	varchar	13
Busfare Amount	int	11

Table 7: Gagga executive

Column name	Datatype	Size
name	varchar	30
Number plate	varchar	30
Source	Varchar	30
destination	Varchar	30
Travel Route	Varchar	100
Free seats	Varchar	100
Date	Varchar	15
Time	Varchar	13
Bus fare Amount	Int	11

Table 8: announcement

Column name	Datatype	Size
announcement	varchar	200
Upcoming Events	Text	100
Date posted	date	
time	varchar	13

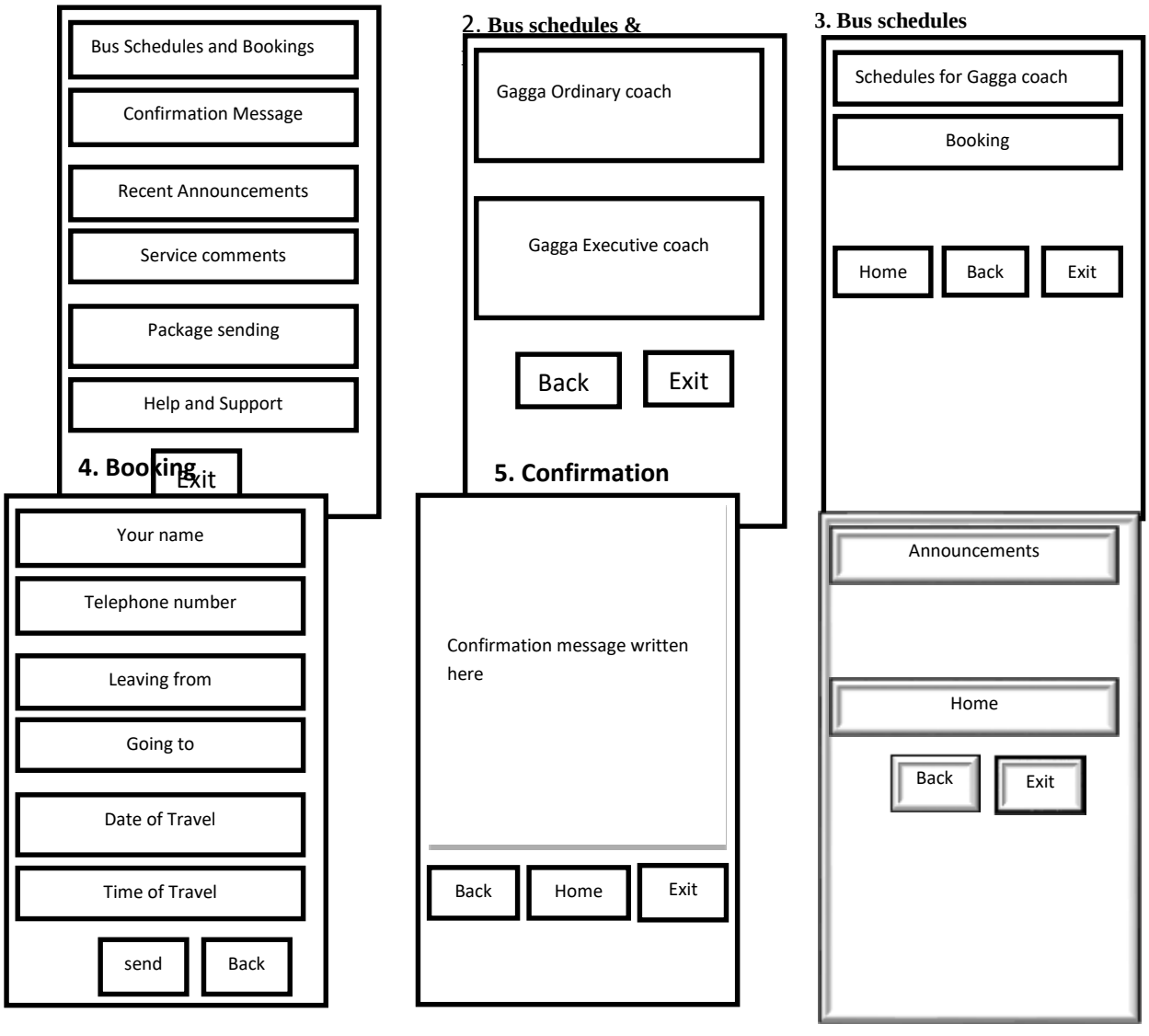
Table 9: comment

Column name	datatype	Size
Name	varchar	30
Comment	Text	150

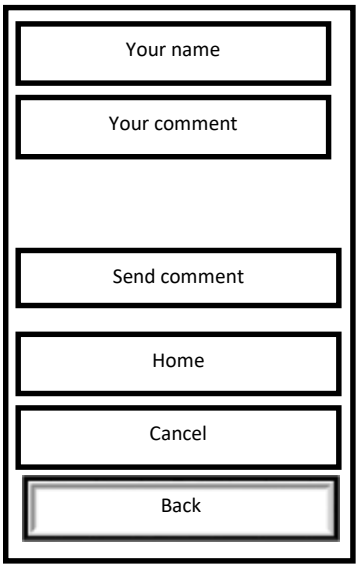
Table 10: Login

Column name	Datatype	Size
name	varchar	30
Password	varchar	30

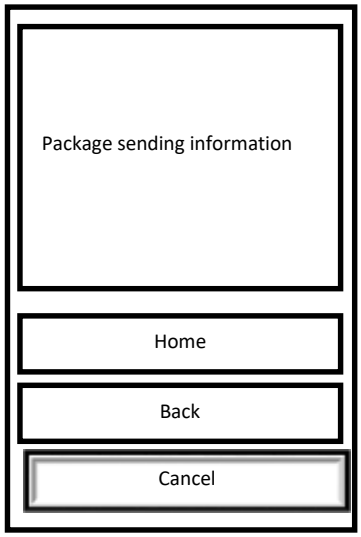
Figure 6: User interface design prototypes.



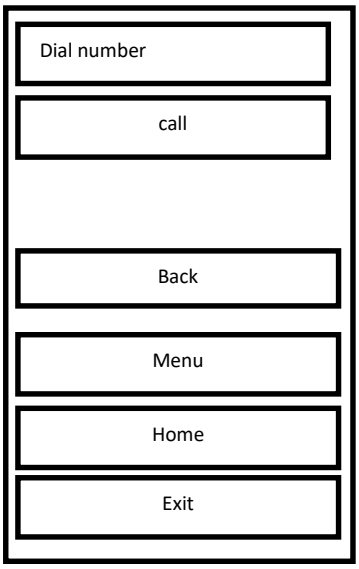
7. Service comment



8. Package sending



9. Help and Support



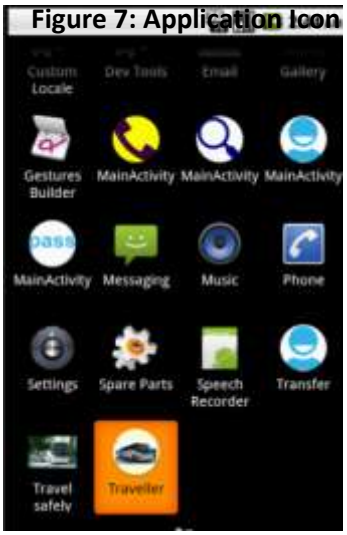
DISCUSSION

Screen shots for Traveller Mobile Application

Here researcher illustrated some important parts of the system basing on the design of the application main areas and the general app features.

Screen shots for ,Traveller Mobile application main areas of the input screens.

Figure 7: Application Icon

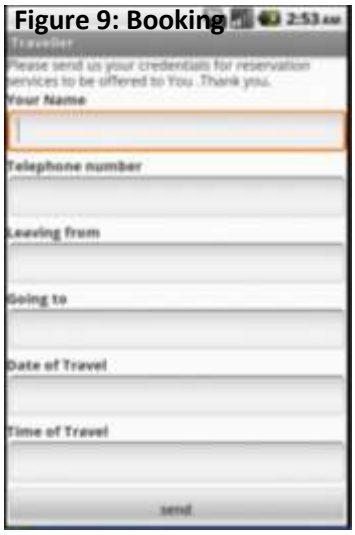


Application Icon

Figure 8: Home screen

Home screen containing main menus.

Figure 9: Booking



Booking form for the mobile user to fill when trying to reserve a bus seat.

Figure10: Shows comment screen for sending the customers' comment about the bus service

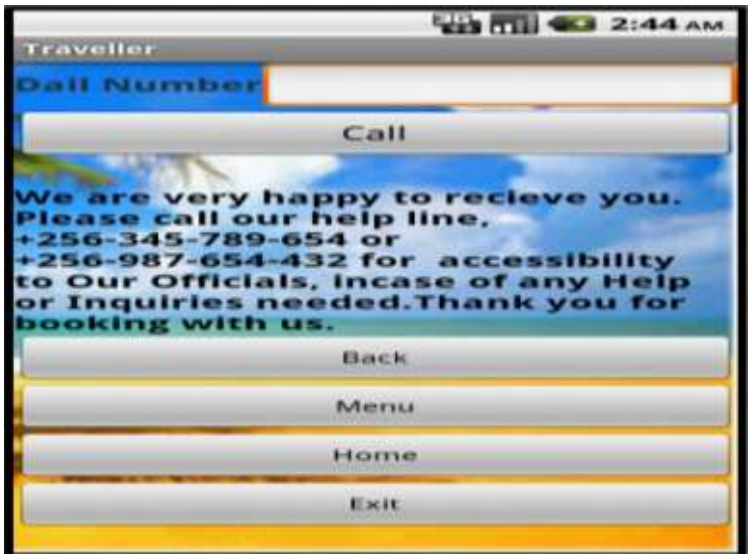


Figure 11: shows help screen for a user to make inquires.

Figure 12: Traveller System ReportHaving made a call, the user can be able to view the call log as showed below

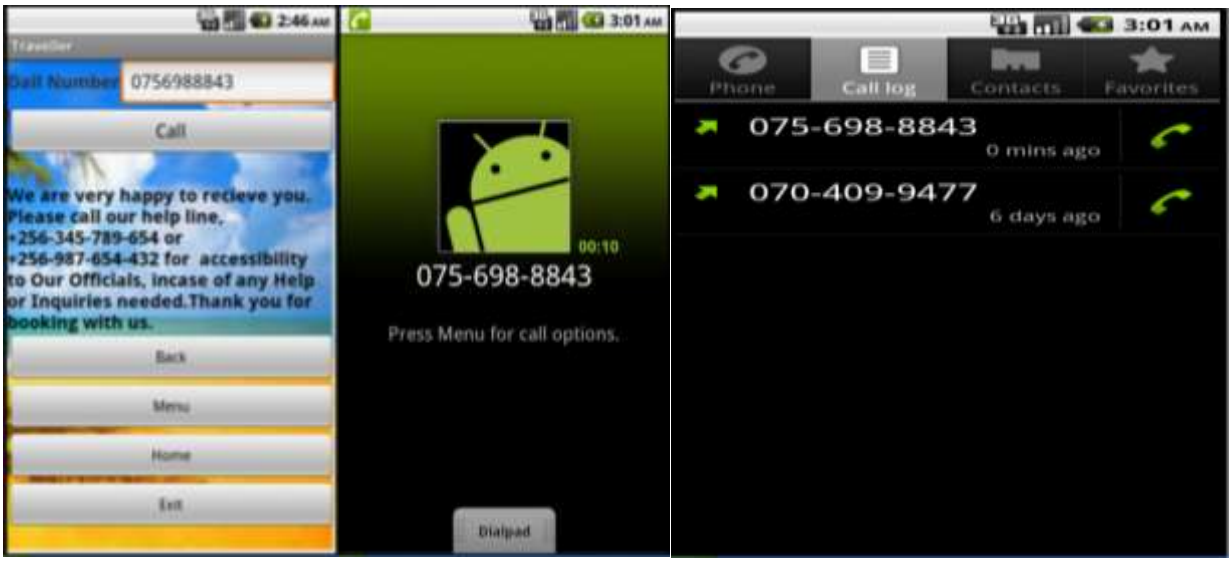


Figure 13: Screenshots for Traveller Web application

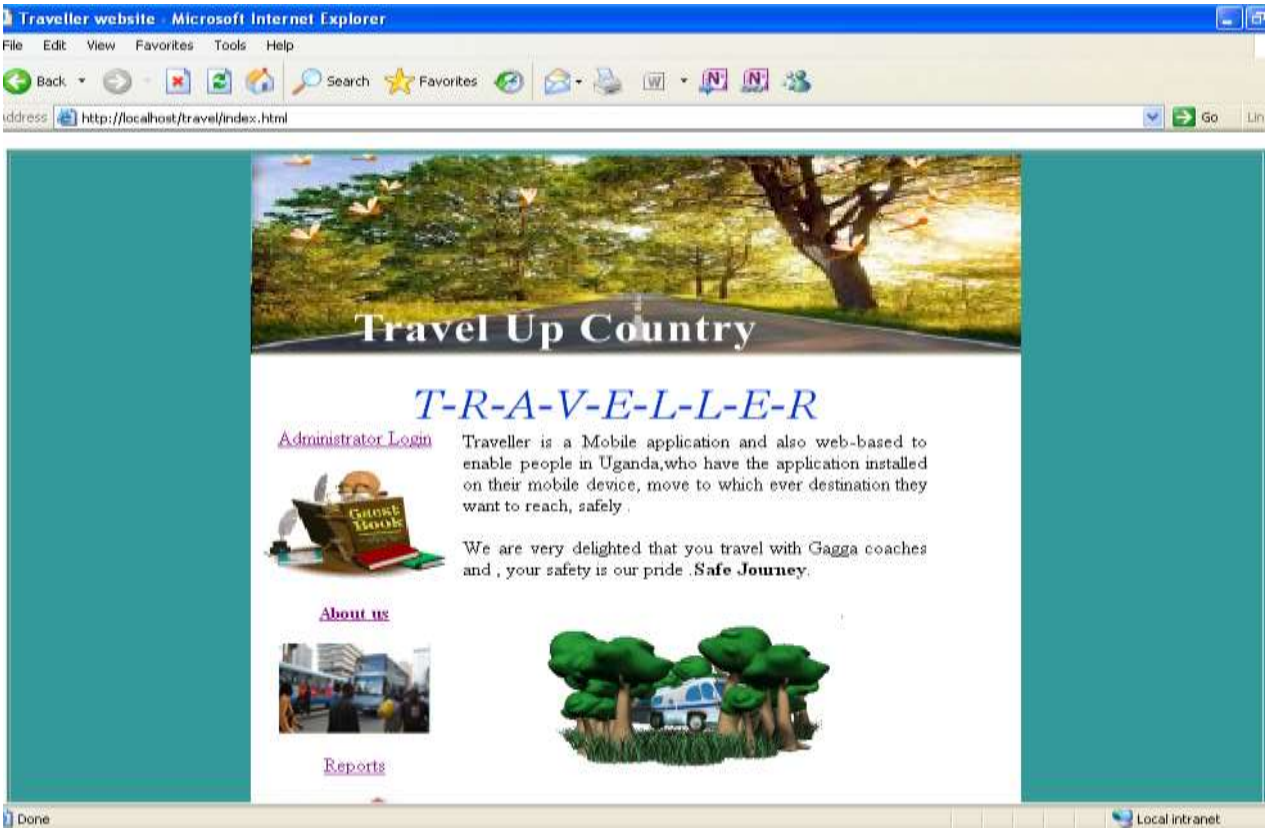
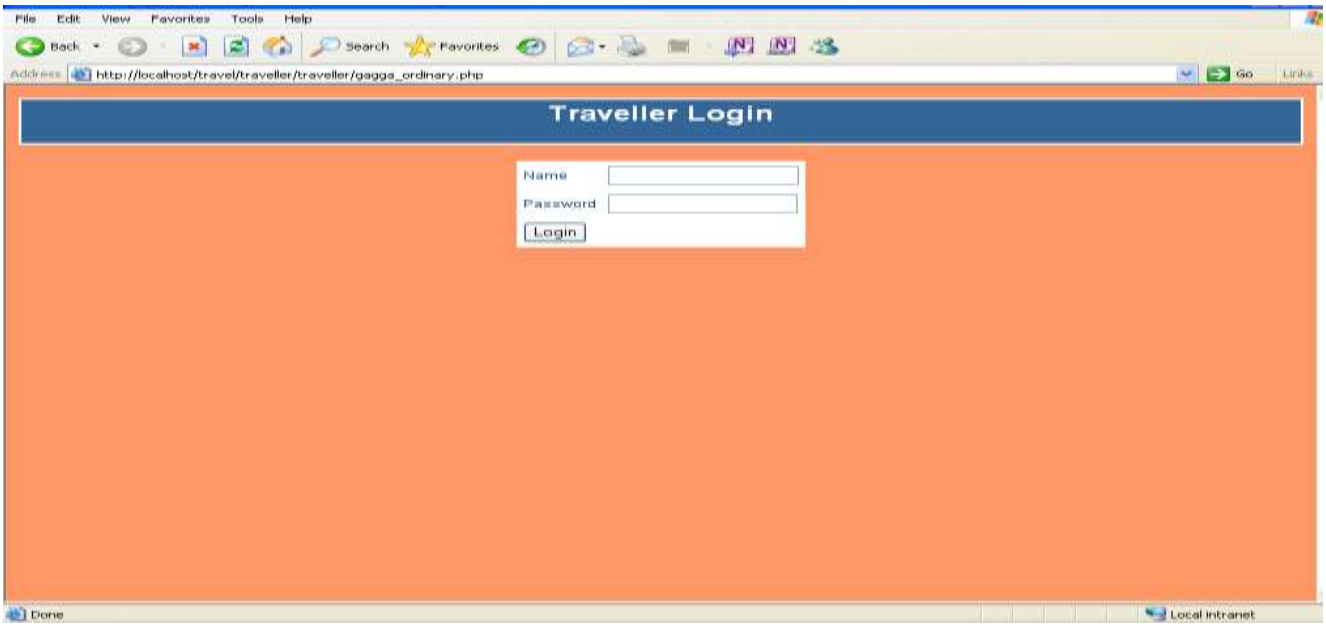


Figure 14: shows the Administrator Login Page



Use Case Test Results

These tests set out to establish if the desired functionality of the system matches the functionality of the implemented system. In this project, the researcher tested the use cases described in Chapter 4 to see if the functionality of the system has been implemented.

Table 11: Shows Use case testing of Traveller System

Use case	Description	Implemented
•	Users view bus schedules from the system	Yes
•	User Books a bus	Yes
•	User to view confirmation message	Yes
•	User to view Announcement	Yes
•	User to send a comment about bus service.	Yes
•	User to make inquiries.	Yes
•	Bus officials should be able to make updates.	Yes

Requirement Test Results

Testing that the requirements of the specification have been met requires that evidence is produced to support this claim that each requirement has been met. The evidence takes either the form of documented design details that correlate with the implemented system. It is assumed that Appendix A: Evidence of System Functionality will tell the requirements have been met. In Appendix A there is the correct implementation of the design and evidence of the correct functionality of the system via screen-shots of the functioning system. Requirement 1: The application has to allow users to view bus schedules from the system. Evidence: The Final Traveller system has the ability to allow users to view bus schedules. Requirement 2: The application has to allow the user to book a bus he wants to travel with. Evidence: Through the use of a booking form, the user can submit his booking details for a reservation to be made. Requirement 3: The application has to allow community members to view confirmation messages. Evidence: The Final Traveller System has this Functionality that allows users to view confirmation messages on how and who sends the confirmation message including the relative importance of that confirmation message. Requirement 4: The application has to allow community members to view the recent announcements and upcoming events posted. Evidence: In the Traveller System this feature is implemented and users are now able to view the recent announcements and upcoming events posted. Requirement 5: The application has to allow individuals and families to send comments regarding the service the bus officials (company) offer. Evidence: In the Traveller application this feature is implemented and the users are now able to send comments regarding the service the bus officials (company) offer. Requirement 6: The mobile application has allowed individuals and families to view Package sending procedures. Evidence: In the final Traveller system developed this feature is implemented and community members send packages using the procedures that have been provided to them in the application. Requirement 7: The application has to allow individuals and families to request Help and Support. *Evidence:* In the Traveller application this feature is implemented and the users are able to make inquiries by making telephone calls using the application directly. Requirement 8: The application has allowed Bus officials to respond to different users' requests about the service comments obtained from customers and also their inquiries. Evidence*:* In the final Traveller system developed this feature is implemented and Bus officials respond to different users' requests about the service comments obtained from customers and also their inquiries. Requirement 9: The web application has to allow Bus officials to update bus schedules. Announcements and Upcoming events. Evidence*:* In the final developed web application this feature is implemented and Bus officials update bus schedules, Announcements and Upcoming events. Therefore, all the requirements for this application have been met.

CONCLUSION

This project has shown that the concept of a Traveller Mobile application is a viable solution to the problem of the provision of Transport services to the community. In summary: The Final Traveller System has this Functionality that allows users to view bus schedules of Gagga coach buses. The Final Traveller System has this Functionality that allows users to view confirmation messages on how and who sends the confirmation message including the relative importance of that confirmation message. In the Traveller System, this feature is implemented and users are now able to view the recent announcements and upcoming events posted. In the final Traveller system developed this feature is implemented and community members send packages using the procedures that have been provided to them in the application. In the Traveller application, this feature is implemented and the users are able to make inquiries by making telephone calls using the application directly. In the Traveller System, this feature is implemented and users are now able to search book and reserve seats by filling in the booking form.□□In the final developed web application, this feature is implemented and Bus officials update Information concerning Bus schedules, bus fares, Announcements and Upcoming events. Despite the limitations of the system produced, the researcher feels that the project has been successful in its aims to highlight the suitability of Travellers within the Transport domain, and of Traveller services within the general area of unified service provision. Within the broader scope of "real-world" applications, the adoption of Traveller as the mobile application within the Transport Domain will enable some of the benefits highlighted by this project to be brought to a wider user base. The researcher is looking forward to the day when Traveller will be commercially available and allow community members as well as Bus officials to use any service, anywhere, anytime and through any device.

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