School of Computer Sciences

CAT400 Undergraduate Major Project

Final Report

MW171821: BookMe – Bus Ticketing System with NFC and QR Code

ZULHILMI BIN MUHAMAD KASIM

124432

Supervisor: Dr.Mohd Heikal Husin

Examiner 1: Dr.Mohd Najwadi Yusoff

Examiner 2: Mr.Azlan Osman

Academic Session 2017/2018

DECLARATION

"I declare that the following is my own work and does not contain any unacknowledged work from any other sources. This report was undertaken to fulfill the requirements of the Undergraduate Major Project for the Bachelor of Science in Computer Science (Honors) program at Universiti Sains Malaysia".

Signature: ……

Name: ZULHILMI BIN MUHAMAD KASIM

Date: 18/4/2017

ABSTRAK

Pengunaan bas ekspress untuk bergerak dari satu tempat ke tempat yang lain telah menjadi satu kebiasaan bagi rakyat Malaysia terutama sekali semasa musim perayaan, ianya ditambah dengan bilangan bas express baharu yang didaftarkan pada setiap tahun. Ia bukan sesuatu yang luar biasa tentang keadaan sibuk yang perlu dilalui oleh para penumpang apabila mereka beratur bagi mendapatkan tiket mahupun ada yang hampir ditipu oleh penjual tiket yang tidak sah. Oleh itu, keperluan bagi menaik taraf sistem tiket yang sedia ada bagi bas ekpres diperlukan bagi menangani isu berkaitan sistem tiket bas ekpress dan juga keperluan yang semakin meningkat. Projek ini mengkaji pengunaan aplikasi mudah alih untuk bas ekpress di Malaysia yang menyokong sistem tanpa kertas melalui pengunaan sistem NFC atau kod QR. Sistem tiket ini membolehkan pengguna untuk menempah tiket mereka melalui aplikasi mudah alih pada bila-bila masa dan dimana sahaja. Sistem ini juga membolehkan pengguna untuk mengunci peringatan setelah mereka membuat tempahan tiket dimana peringatan tersebut akan memberi pesanan kepada penumpang 2 jam sebelum mereka memulakan perjalanan. Selain dari itu, sistem tiket ini menyokong pengunaan fungsi NFC untuk menyemak e-ticket pengguna untuk mengesahkan tiket mereka setelah menaiki bas ekpress tersebut, pengesahan menggunakan imbasan kod QR juga boleh digunakan untuk mengesahkan tiket. Dengan menggunakan sistem ini, ia dapat membantu operator bas untuk membuat pengumuman seperti terdapat bas ekspres terus ke alat mudah alih penumpang. Seterusnya, sistem ini tidak menggunakan sebarang kertas semasa transaksi atau pengesahan tiket dimana ia akan menggunakan NFC dan kod QR bagi tiket penumpang dimana ia tidak memerlukan penumpang untuk mencetak tiket mereka secara fizikal. Sistem ini menyokong kosong pengunaan kertas dimana ia dapat

membantu menyelamatkan alam sekitar. Pada penghujung setiap perjalanan bas ekspress, penumpang akan diiberi peluang untuk memberikan kadar untuk servis bas ekspress dimana ia akan digunakan sebagai maklum balas bagi syarikat bas untuk memperbaiki servis mereka pada masa hadapan. Dengan menggunakan sistem ini, ia dapa menjadikan sistem tiket bas ekspress satu platform yang lebih praktikal dan efisien bagi kedua-dua penumpang dan juga operator bas ekspres.

Katakunci: NFC, Sistem Tiket Bas, Applikasi Mudah Alih, e-tiket, kod QR

ABSTRACT

Travelling via express buses is the norm for most Malaysians especially during the festive season, with an increased number of new express buses registered each year. It is uncommon for news on how hectic the passengers would have to go through to queue for their tickets or even getting scammed by illegal ticket sellers. As such, the need to enhance the existing ticketing system for express buses is needed to cope with the higher needs as well as issues. This project examines the use of a mobile application for express buses in Malaysia that supports a paperless system via the implementation of NFC or a QR code. This ticketing system will allow users to book their tickets via the mobile application anytime and anywhere. This system also allowed user to set a reminder after they already make a ticket booking where the reminder will notify the passenger 2 hours before their journey. Besides that, this ticketing system supports the use of NFC to capture the user's e-ticket upon boarding their express bus to validate their tickets besides using QR codes. By using this system, it can helps the bus operators for making announcement directly to passenger mobile devices. Next, this system didn't use any paper in the transaction or ticket validation where it will using NFC and QR code to validate the ticket that didn't required passenger to have a physically print tickets. This system supports zero paper usage that will help to save the environment. At the end of the express bus journey, user will be asked to provide a rating for the express bus service where it can be used as a feedback for the bus company to improve their service in the future. With this ticketing system, it can make the express buses ticketing system a more practical and efficient platform for both users as well as the express bus operators.

Keywords: NFC, Bus ticketing systems, mobile application, e-ticketing, QR code

ACKNOWLEDGEMENTS

Alhamdulillah. Thanks to Allah SWT, whom with His willing giving me the opportunity to complete this Final Year Project which is title Mobile Bus Ticketing System with NFC and QR code. This final year project analysis report was prepared for School of Computer Science, Universiti Sains Malaysia (USM), basically for student in final year to complete the undergraduate program that leads to the degree of Bachelor of Computer Science. This report is based on the guidelines given by the university Firstly, I would like to express my deepest thanks to Dr. Mohd Heikal Husin, a lecturer at School of Computer Science USM and also as my supervisor who had guided many of the tasks during the two semester's session 2017/2018. I also would like to thank the lecturers of School of Computer Science USM for their cooperation during the analysis report phase by providing valuable information, suggestions and guidance that has improved this final year project report. My deepest thanks and appreciation to my parents, family, special mates of mine, and others for their cooperation, encouragement, constructive suggestion and support during the development project. Thanks as well to everyone else that has contributed by supporting my work and assisting me during this project. Last, but not least, my thanks to School of Computer Science USM, and my Personal Advisor, Mr. Azam Osman, for his great commitment and cooperation.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND SYMBOLS

NFC - Near-field communication

QR code - Quick Response Code

KL - Kuala Lumpur

GUI - Graphical user interface

SWOT - Strength, weakness, opportunities, threat

UML - Unified modelling language

CRUD - Create, Read, Update, Delete

WBS - Work Breakdown Structure

1 INTRODUCTION

1.1. Background

The existing express bus ticketing system such as Easybook.com (Online Express Bus Tickets Booking - Singapore & Malaysia, 2018) works by supporting both a web application and a mobile application. Passengers firstly select the travel date, origin and the destination of the bus that has been set by the bus operators via a web application. Besides that, passengers are allowed to choose their seats based on the bus seating diagram provided by each express bus operators and proceed for their payment. This system requires passenger to print out their tickets to be validate to the express bus ticket collector before departing. As such, the motivation for this project is to resolve the current issues with the existing system where passengers can book their bus ticket and make payment using their mobile devices and they can set a reminder after finished their booking, a notification will be send to the passengers if there is any announcement from the bus operators. Besides, there will be a rating notification where passengers can give their rating and comments for their bus trip. Along with the use of NFC and QR code functionalities would enable the ticketing platform to support an effective paperless environment.

One of the major issue with the existing ticketing system is an increased illegal activities of illegitimate bus operators during festive or holiday seasons which has led to many users being stranded at bus stations due to their tickets being rejected. Besides that, the bus tickets are commonly required to be printed out by the passengers before departure. This leads to paper wastage as the tickets are only used during the passengers boarding. In addition, passengers are unable to track their specific bus departure times

as there is no reminder for the user to remind them about their departure times. There is also the issue of time changes for the buses which the passengers would only know once they reached the express bus terminal. The common solution that has been implemented by the express bus operators is by asking the passengers to arrive at least 15 minutes earlier or making an announcement via the terminal speakers to call the user if they have not boarded their buses or any changes for the bus scheduled.

The proposed mobile application solution integrates the use of both NFC or QR code (depending on the user's device) as one of the means to validate the tickets as some of the mobile phone models don't have NFC device built in, instead the using of QR code in order to support mobile phone that doesn't have NFC. So, the bus operator can utilize a mobile device that supports both NFC and camera functionalities to scan the QR code to capture the travel information from the passenger's device. This allows the passengers to support a paperless environment during their travels. Besides that, the mobile application will allow passengers to be reminded of their departure time or if there are changes to their bus departure time. Users are also able to make secure payments via the mobile application as well. Lastly, the application would enable a passenger to rate their trip with the specific bus operators upon arriving at their destination. For instance, a passenger's trip to KL from Penang by using Plusliner is rated as 3 out of 5 stars. This rating can be accessed by the bus operator to gain passenger feedback to improve their express bus service in the future.

Table 1: Comparison between different types of ticketing system

Ticketing system	Ticket booking method	Payment method	Validation method
Airline ticketing system	1. Make online booking at the airlines website.	1.Online banking (Maybank2U, CIMBClicks)	Validate by the stewardess by checking the boarding pass.
Bus ticketing system	1. Make online booking via website or mobile application 2. Direct booking from the ticket counter	1.Online banking (Maybank2U, CIMBClicks, PayPal) 2.Counter payment	Validate by bus operator after passenger depart the express bus by checking the seat number, origin and destination.
Train ticketing system	1. Make online booking via website. 2. Direct booking from the ticket counter	1.Online banking (Maybank2U, CIMBClicks, PayPal) 2.Counter payment	Validate by the train operator by checking the ticket destination.

1.2. Problem Statements

Most Malaysians are using express bus service as their mode of transportation for traveling especially during the festive season due to the increased prices of other transportation. As more users are using the express bus services, the number of bus operators has increased as well. For example, in 1973, there were only 26 bus operators in Puduraya, but by the year 2003, there are over 67 bus operators (NARJAN SINGH, 2007).This number has consistently increased over the number of years. There are two main choices of purchasing tickets either over the counter purchase or via e-ticketing, with more passengers preferring the over the counter purchase. This is because the current e-ticketing system operated by the bus operators, does not provide enough

choices to passengers such as different destinations and the availability of the tickets are limited as well of extra charges for online tickets (NARJAN SINGH, 2007). The highest demand for express bus services often occurs during the festive and holiday seasons, for instance, more than 5,000 express buses will be on the highways during the Hari Raya period to carter to the *balik kampong* crowd (Online, 2017) as Hari Raya is one of the biggest festivals in Malaysia. This leads to an increased number of available express buses from bus operators.

The main issue with this increased demand for express bus services has led to increased activities of unauthorized bus operators who are operating without legitimate permits during that period (NARJAN SINGH, 2007). There are also some groups of individuals that selling unauthorized tickets that gives the passenger problems where the tickets are illegitimate and force the bus operator to cancel the tickets. As the result, the passenger cannot aboard the express bus. As the E-Ticketing system has been developed it has reduced or eliminated the activities of unauthorized bus operators or individuals who are operating without legitimate permits. But, the new problem that has come is the update from the express bus operators when there is an extra bus. This is important when the high demand period, for example, Hari Raya Aidilfitri, most of the tickets will be selling fast either at the bus operator counter or in the E-ticketing system. During this period most of the bus operators will have extra buses but the passenger didn't know about it as there is no official announcement about it and will give an opportunity to the irresponsible individuals or even the bus operators itself.

Furthermore, the E-ticketing system didn’t support the paperless environment. The number of paper used for printing the express bus tickets has led to a higher paper waste in Malaysia and this is bad for our environment as the tickets that been printed

will be thrown into the trash bin this problem will be solved by using NFC to validate passenger tickets instead of printing the tickets physically.

Therefore, the need to enhance the existing ticketing system is needed to cope the problems. The usage of the mobile application that is increasing among Malaysian being a factor to the idea for enhancing the existing online express bus ticketing system. The enhanced system will help to enable a passenger to set a reminder for their trip, give rating and feedback, view bus driver details and the usage of NFC and QR code will help to support a paperless environment.

1.3. Motivation

The motivation for this project is to develop a mobile application for both passengers and bus driver and also web application for bus operators. Passenger's application will help to remind passenger for their departure time that will avoid them missing their bus. Besides that, it's also allowed passenger to give their rating and comments as feedback to the bus operators as soon as they finished their trips, the bus driver details can be reviewed by the passengers of the express bus but limited to the bus that they board. The usage of NFC and QR code technology inside the system also will help to reduce the paper used for the ticketing system. For the bus driver its help to reduce the time for ticket validation and make the departure time faster compared to existing system. This system will help to reduce or eliminate illegal activities of illegitimate bus operators during festive or holiday seasons which has led to many users being stranded at bus stations due to their tickets being rejected that has taken profit from the passenger illegally. Furthermore, bus operators can make an announcement through their web application and it will notify the user of the application and help to resolve the issues of changing in bus scheduled or any important announcement.

1.4. System Objectives

BookMe search for several objectives:

- Eliminated the activities of unauthorized bus operators or individuals who are operating without legitimate permits
- Allow passenger to view express bus driver details if anything happens
- Implement zero paper usage for the ticketing system
- Allow passenger to set a reminder that will notify them for their trip
- Allow user to give rating as a feedback for the express bus service

1.5. Proposed Solutions

The purpose of this system is to helps passenger booked their ticket and make payment via mobile as the trend for mobile application is increased nowadays. This system also will support the paperless environment where passenger just needs to validate their tickets by using only their mobile devices by using QR code or NFC capabilities.

The solution proposed will be an Android-based application developed for bus driver and the passenger and web application for the bus operators. First, a web application for bus operators will be develop by using Notepad++. This application will allow the bus operators to do the CRUD (Create, Read, Update and Delete) function that related to passenger information such as their account information and booking details, bus scheduled and announcement. The database that has been used to store all the information is Firebase database and this database is connected to the bus driver and passenger application and also bus operator application. The bus operator also will be able to add the information about the express bus such as the bus registration number

and bus driver personal information. They also can update the express bus scheduled if there is any changes in the scheduled and delete any of the schedule if there is any cancellation in for a particular time and date. Bus operator also can make an announcement through the system if there is any news such as an extra busses is provided or any delayed in the bus scheduled and it will send directly to the registered passenger account. Next, an Android application will be developed for the passenger as they will need to specify their origin and where are the destination that they want to go. Then passenger need to pick a travel date that will be use by the system to display the bus schedule that are available for that particular date chosen. Passenger will be able to select the departure time from the list and they will be ask to select their seats from a diagram. After they already complete all the necessary steps for booking the tickets, passenger will be ask to make a payment where they can select the payment method either using an online banking such as Maybank2u, PayPal, or credit card. The ticket will be save into the passenger application. The passenger are allowed to view the information about the bus driver and bus details as a precaution if anything happens to them. The application also enabled passenger to track their departure by asking the passenger to set a reminder for their travel date and departure time. This reminder will notify passenger on the travel date, 2 hours before their departure time. This tickets will be validated by the bus operator either using an NFC or scanning the QR code on the tickets. This validation depends on the passenger mobile device capabilities as some of the mobile devices didn't support NFC capabilities. Passenger will be ask for the rating after they completing their journey with the express bus, and this rating will be use as a feedback for the bus company to improve their service.

1.6. Benefits and Uniqueness of the Proposed Solutions

The ticketing system implemented will benefits customer or passenger. It is not limited to only them, but it will also benefit the bus company while promoting a green environment lifestyle. Traditional ticketing system needs the customer to buy the bus tickets at the ticketing counter. However, during festive seasons such as Hari Raya Aidilfitri, Deepavali or Hari Raya Cina, the counters will filled with long queues. The purchasing process is slower and less efficient. This will also cause unpleasant environment for customer as well as the bus company. The traditional system will not only cause problems at the purchasing phase, but also during the departure time. Manual ticket checking will slower the process of validating the tickets of a trip. Delayed of the departure time sometimes can be consider as a common issue due to the manual ticket validation.

The Mobile Bus Ticketing System is implemented with the NFC and QR code as an innovation as the system is the continuation and the enhancement of the existing online express bus ticketing system. This innovation purpose in solving the issues that happens by traditional bus ticketing system. A long queue of waiting at the counter just for purchasing purpose could be avoided by make the booking through the application system. The e-ticket produced will indirectly promotes green environment lifestyles and helps in maintaining the cleanliness of the environment. Issues on slow ticket validation process could be overcome by the NFC and QR code innovation. It is either NFC or QR code technologies will be used depending on the availability those two technologies in the smartphones used. The usage of NFC or QR code will eventually help in reducing the time taken for the bus operator to validate user tickets where bus operator just need to tap on passenger mobile phone that have an NFC technology to validate their tickets.

However, there are also smartphones that are not implemented with the NFC technologies. In situation for mobile phone that have no NFC, a QR code will be used for validation process.

1.7. Organization of the Report

For the rest of the report it will continue at chapter 2 which is background and related work. This chapter will highlight the background of the project and also the existing project that has been developed. Next, in chapter 3 is about system requirement/analysis, it include project scope, system capabilities and system limitation. Besides that, this chapter consist of relevant project management information such as Work Breakdown Structure (WBS), Gantt chart, and SWOT analysis. For chapter 4, it will cover about system design and implementation that will show how the system will works. Chapter 5 focuses on the system testing as the system has been finished and need to be test for a certain criterion. The Conclusion section, it highlights the conclusion about the overall analysis that help readers to understand about the overall project. For the appendices part, it consists of additional diagrams and screenshots of the application/system.

2 BACKGROUND & RELATED WORK

2.1. The Status of Project Development

BookMe is the enhancement of the existing online express bus ticketing system. This enhancement covers the many problems that related to the express bus ticketing such as the selling of illegal bus tickets by unauthorized individual or bus operators especially on holiday seasons where most of the passenger really needs an express bus to go to their destination, bus operator can make announcement by log in to the system and add their announcement about the extra busses that will notify passenger directly to their mobile devices. This will help to solve the problem of selling if illegal bus tickets that taking opportunity over a passenger that having issues about the sold out tickets. Next, this system will give a reminder to a passenger on their mobile when the time for depart the bus is near that helps the passenger from missing their bus by asking the passenger to set a reminder a soon as the ticket is generated to them, and this reminder will notify passenger when the departure date is come. Next, passenger also allowed to view bus details that consist of bus registration number, bus company name, and bus driver details that can be used if there is a problem either with bus or the driver itself. This information can be used to as a precaution. As this is important where there is a case reported bus driver illegally punch a passenger after reporting the express bus driver falling asleep behind the wheel (Ghazali, 2017).The usage of NFC or QR code will help to reduce time for the bus operator to validate user tickets where bus operator just need to tap on passenger mobile phone that have an NFC technologies to validate their tickets and for mobile phone that doesn't have an NFC a QR code will be used to validate their tickets. This system also has a positive impact on the environment where there will be no use of paper when booking, payment and also validating the tickets as

all of the activity is conduct via the system itself. Therefore, this system will bring a positive change in the express bus services that is one of the important public transportation in Malaysia.

2.2. Similar Existing Project

2.2.1. Express Bus Ticketing Past System

For the past express bus ticketing system, user need to buy their ticket physically at the express bus ticket counter. This method have been use until now as there are some of the user didn't know how to use online platform to buy express bus ticket. Firstly, for buy a ticket, user need to be present at the express bus terminal or went to any express bus ticket agent to get their ticket. The problem that they have been facing when using this method is they need to queue up to buy the ticket and this problem has been more seriously when the festive seasons come such as Hari Raya Aidilfitri that create a long queue for user to get their ticket. Next, when they acquired their ticket, they need to wait at the bus terminal at least 15 minutes earlier before they board the express bus as some of the user have been missed their bus because they late for boarding the bus. Sometimes the express bus arrived at the bus terminal earlier than the time stated and user only notified via voice call and make them rush to the bus terminal. Lastly, when they board the express bus, a bus operator will come to the passenger and collect the ticket that will be use to verify and this will take about 15 – 20 minutes of the departure time.

2.2.2. Mobile Bus Ticketing Existing System

There are many of online booking ticket for express bus currently in service, one of the famous system is Easybook.Com (Online Express Bus Tickets Booking -

Singapore & Malaysia, 2018) that have come in 2 platform which is web-based and also mobile application. Even with this online system there will be a walk-in ticket counter system will be used for user to buy the ticket. For Easybook.Com, user need to have an account to book the tickets as form the information that have been collected from the user account will be used for their ticket when they want to book it. To book the ticket, user are allowed to choose their destinations and their departure time according to their wants. User also allowed to choose their seats based on the seats diagram provided in the system.

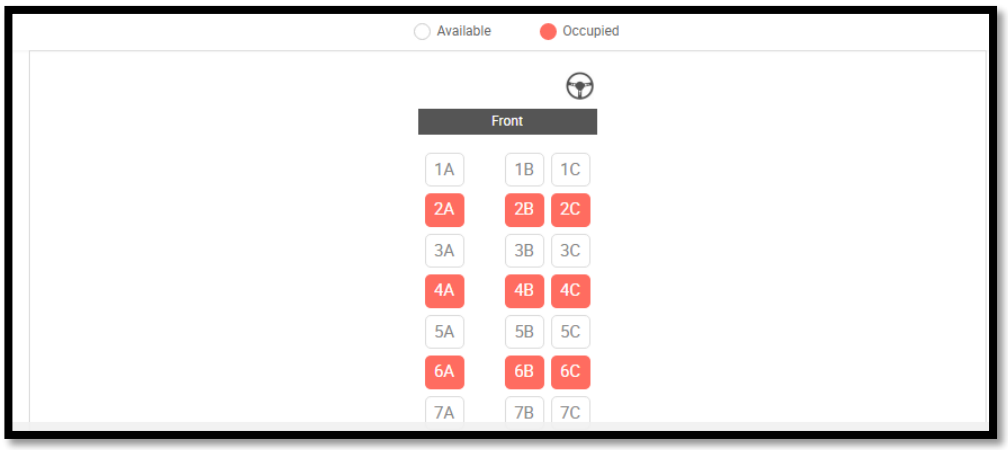

Figure 1 EasyBook.Com seat selection layout

Figure above shown the selection of the seats where the red box indicates the seats are occupied and the rest is available for the user to select it. After they have chosen their seats, users are then required to fill in their personal information such as name, address, email address, nationality and phone number. The important information that user must fill in is phone number and name. The phone number will be referred if there is changes in the express bus schedule for example the bus is arrived early than the expectation and also if the user didn't come after the bus already arrived. If user already sign up an account in Easybook.Com, they do not need to fill up the personal details as they already fill up their personal details during the sign up take place. Next, user will proceed to

make payment as the system will ask user to choose whether to pay via online banking or credit card. Finally, a ticket will be sent to the user email that will required user to print it out and will be used for validation when they are boarding the express bus.

2.2.3. Application Architecture of Existing System

Figure 2 showing the application architecture for Easybook.Com, first user will login to the application or sign up for an account. User that not login or sign up to the application are also allowed to book an express bus ticket from the application but they need to fill up personal details when they want to book the ticket and they are missed out loyalty point from Easybook.Com. Next, user will choose their origin and destination they want to go, then they will select the time that they want to travel. User also need to select seats and make payment to receive their tickets. Then the ticket need to be print and validate by the bus operator before they begin their journey.

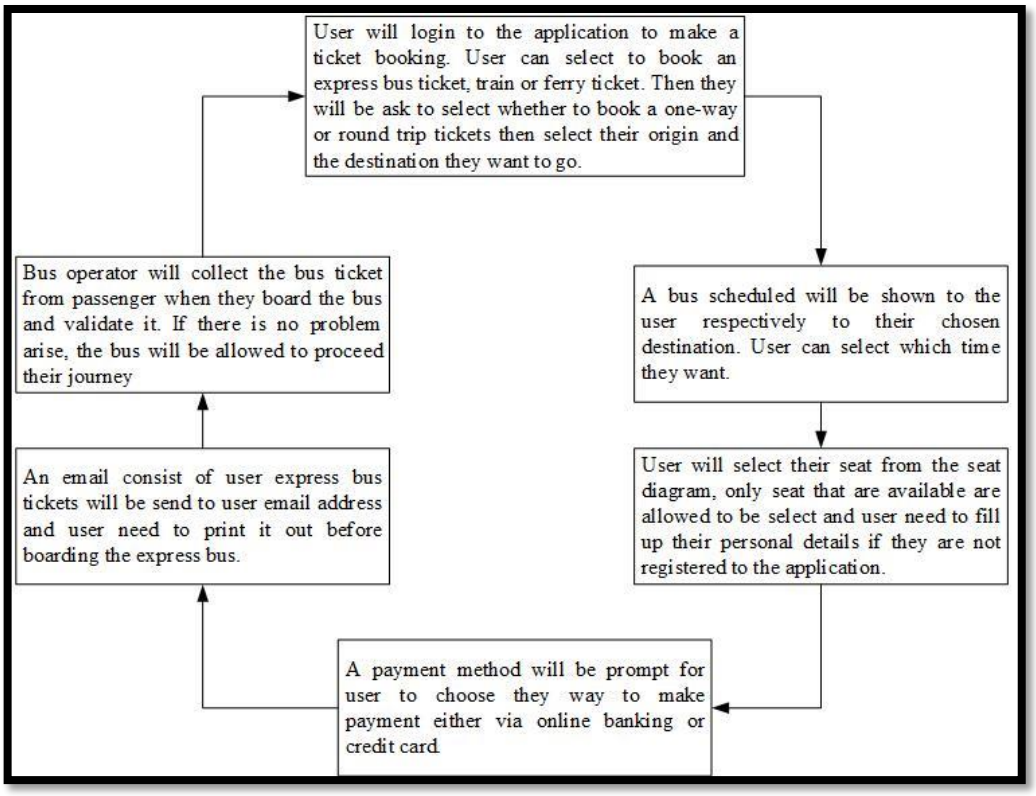

Figure 2 Application Architecture for Easybook.Com

2.3. Algorithm/Theories/Model of an Existing System

Easybook.Com (Online Express Bus Tickets Booking - Singapore & Malaysia, 2018) have several features that passenger can be used to book ticket via online. The features of the system is:

1. Selecting the origin and the destination that passenger need to travel.
2. Selecting the travel date that passenger wants to travel.
3. Allow user to select between a single trips or a round trip depends on the user needs.
4. Allow passenger to view the bus schedule that has been sort by certain date has been choose by the user and it is also has been sort by the departure time.
5. Passenger can select their seats based on the given diagram.
6. PayPal is used to make the payment for the booked ticket and a ticket will be generated after the payment is completed.

2.4. Strength and Weakness of the Existing System

The strength of the existing system is that passenger will be able to avoid troublesome queueing for buying the tickets at the ticket counter. Next, passenger will be able to book ticket by only using the system at anytime and anywhere. Furthermore, passenger also can select their seats based on the diagram but, only available seats can be chosen. Then this system allow passenger to make payment via PayPal which is a secure payment. For the weakness of the system is that, it didn't remind passenger about their departure which result some of the passenger missed their bus. Next, most of the passenger didn't receive any notification if there is some announcement made by the bus operators as they only make announcement at the bus terminal only. This

announcement is important such as if there are extra busses provided and most of the passenger didn't notified about that. In addition, this system requires passenger to print out their tickets physically and this requirement is bad for our environment as many paper will be use daily for the ticket. This system also didn't provide a platform for passenger to give their feedback that can be used to improve their service in the future. Lastly, this system seat selection allowed passenger to select seats more than the number of passenger that they choosing.

2.5. Introduction of BookMe – Bus Ticketing System with NFC and QR Code

For the prosed system, there will be 3 stakeholders that will be using the system which is passenger, bus driver, and bus operators. Android application will be developed for the use of passenger and the bus driver while bus operator will be using a web application and will do the admin part such CRUD operation. For the passenger application, there will be the basic functionalities for booking an online bus ticket as this system is enhancement from the existing system. The enhance feature of the proposed system is where passenger can set a reminder after they have completed all the step for booking the ticket. This reminder will notify user 2 hours before their departure as this feature is important to cope the existing problems. Next, passenger will receive a notification that asked the passengers for their rating and comments about their trip which is triggered from the bus driver's application. When this feature is triggered, the passengers is able to provide their feedback via their mobile devices. The last added feature for passenger is viewing bus driver details. As each express bus from the scheduled have the bus driver that has been assigned and when passenger booked the ticket, they can view the bus driver profile/details. For bus driver application, they

will have an option to make ticket validation and this validation will be tele with the number of passenger that booked the tickets. For example, if there are 35 passengers booked the tickets, bus driver can view the number of passenger that has been validate and this will help bus driver to make a faster headcount and ticket validation. The bus driver also will have a feature to inform passengers that they have arrived to their destination via the trip rating feature.

3 SYSTEM REQUIREMENTS / ANALYSIS

3.1. Project Scope, Capabilities, and Limitation

3.1.1. Project Scope

The scope of the project is focusing on enhancing the existing application in terms of the tickets validations, express bus services and user feedback. This application focuses on one bus company. In order to enhance the application, it allows bus operators to make an announcement through the application and send it directly to the passenger registered account. As some of the time the bus operator need to make an announcement but it didn't reach the passenger like in the existing system. By using this announcement functionality, it will help bus operators to send the announcement and ensure it reach to the passenger's mobile device. Next, a bus details functionality is added to the application where passenger is allowed to view the bus details such as bus registration number, bus company name and also the driver details as there is some cases where a driver punch a passenger after having been reported fall asleep behind the wheel (Ghazali, 2017). For the tickets, the information for the tickets will be the same as the existing application but the different for the enhance version is where at the top of the tickets will be a QR code print for validation purpose. The validation of the tickets will be using NFC capabilities where bus driver will have a mobile device that can validate user tickets via NFC. But, some user mobile devices may not have the NFC capability, hence the QR code will allow the bus operator to validate the passenger's tickets by scanning the QR code. For the user feedback, after they arrived at their destination, they can rate their travel by select how many stars they want to give for the express bus service and this feedback will be use by the express bus company to improve their service in the future. Passenger also can view the details of the driver and also the

express bus if there is anything happens during the trip and this information will be updated by the bus operator. Most of the functionalities such as selecting seats, and payment will be the same as existing system, where this project will enhance the existing system functionalities.

3.1.2. System Capabilities

- Security and safety consideration
    a) Login to the system will be needed to differentiate between user and the administrator of the application.
    b) Only the bus operator can add, update, and delete some of the information inside the application.
    c) The personal details of the passenger will be confidential.
    d) Passenger will make payment in a secure environment.
- Database
    a) The database will be monitored to avoid the database crash.
    b) The data inside the database will be confidential to keep the information is safe.
- Notification
    a) Reminder for the bus scheduled will be notified to the authorized user account.
    b) The notification will be control by the bus operators.
- Environmental
    a) There will be zero paper usage for this application as the ticket is not required for the user to print it out.

3.1.3. System Limitation

- Hardware Limitation
    a) Minimum hardware required will be a mobile device that support Android 4.2 Jellybean and above to avoid an application error.
- Internet Limitation
    a) Internet connection is required for the user to book the ticket and accessing the application.
    b) Internet connection is required for the user to make payments.
    c) The application for user will not be efficient if the internet is down as it's using Firebase Database that depends on the internet connection.

3.2. Project Management

3.2.1. Work Breakdown Structure (WBS)

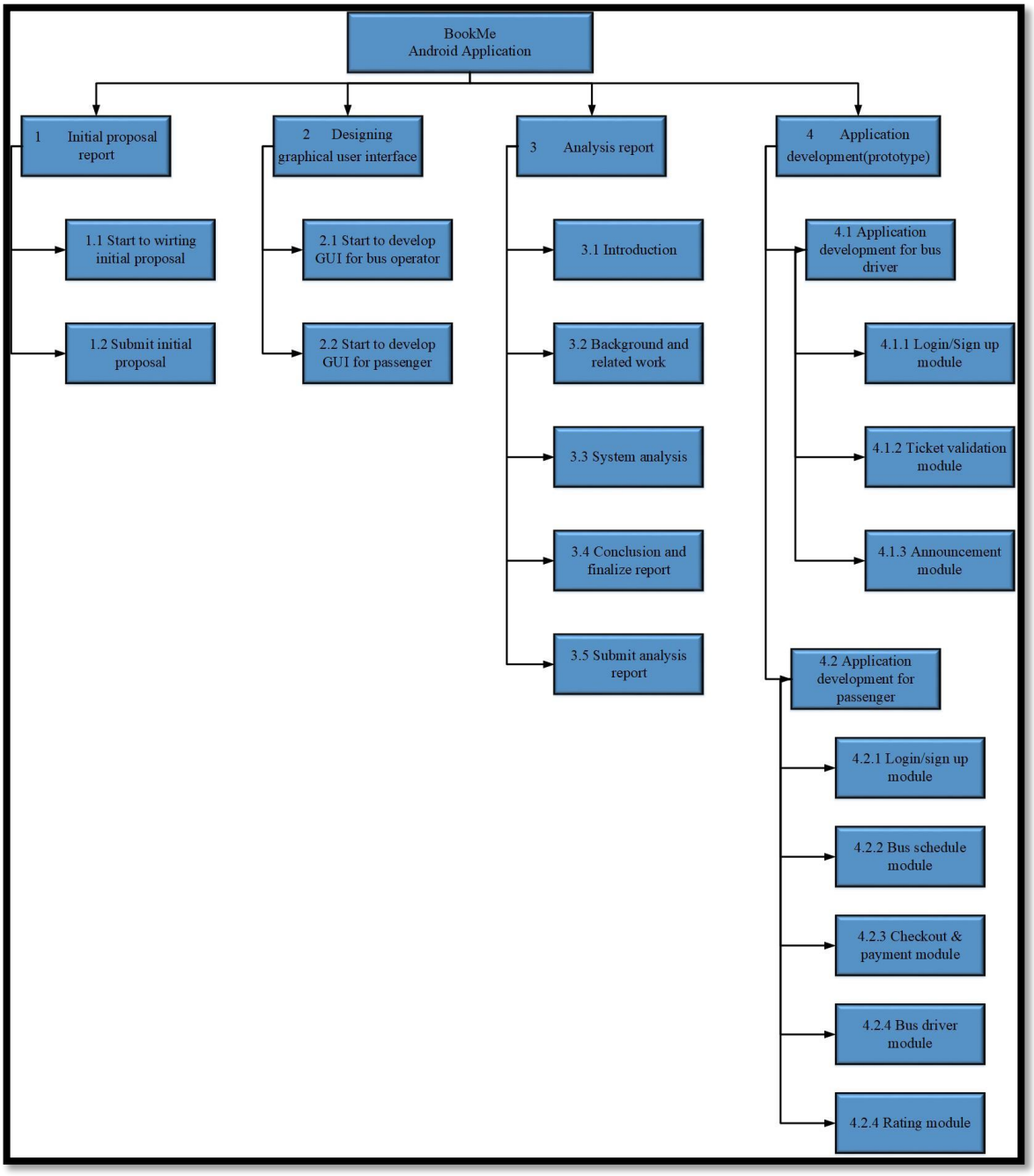

Figure 3: WBS for Iteration 1

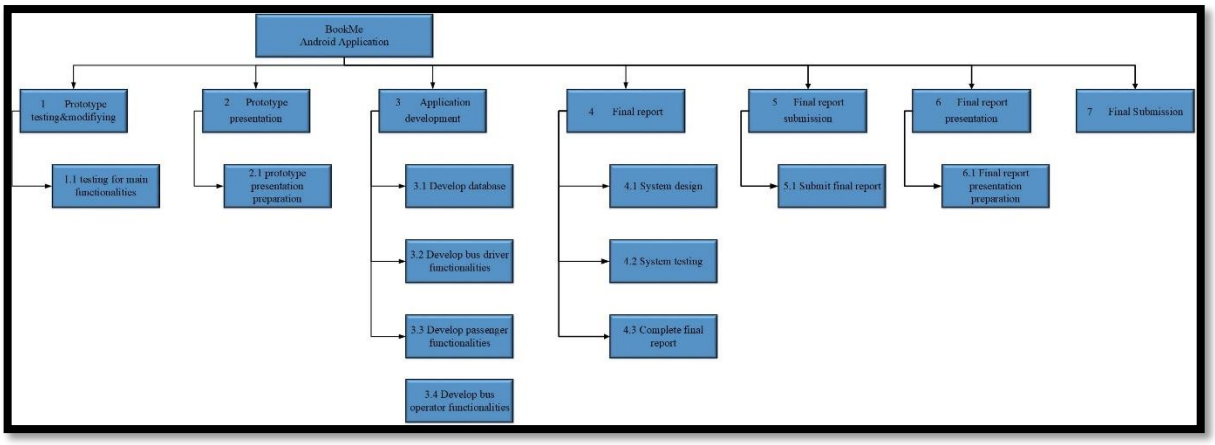

Figure 4: WBS for Iteration 2

Iteration 1

1. Initial proposal report
   1.1 start to write the initial proposal – 15 days
   1.2 submit initial proposal – 1 day
2. Developing Graphical User Interface
   2.1 start to develop GUI for admin – 6 days
   2.2 start to develop GUI for user – 8 days
3. Analysis report
   3.1 introduction – 2 days
   3.2 background and related work – 7 days
   3.3 system analysis – 19 days
   3.4 conclusion & finalize report – 7 days
   3.5 submit analysis report – 1 days
4. Application Development (prototype)
   4.1 application development for admin
      4.1.1 Login/Sign up module – 9 days
      4.1.2 Bus schedule module – 16 days
      4.1.3 Bus details module – 23 days
      4.1.4 Ticket Validation module – 7 days
      4.1.5 Announcement module – 5 days
   4.2 Application development for user

4.2.1 login/sign up module – 5 days

4.2.2 bus schedule module – 18 days

4.2.3 checkout & payment module – 14 days

4.2.4 bus details module – 11 days

Iteration 2

1. Prototype testing & modifying
   1.1 testing for functionalities – 10 days
   1.2 test drive the application – 5 days
   1.3 debug any issues – 9 days
2. Prototype presentation
   2.1 prototype presentation preparation – 5 days
3. Application development
   3.1 Develop database – 10 days
   3.2 Develop bus operator functionalities – 25 days
   3.3 Develop passenger functionalities – 15 days
4. Final Report
   4.1 System design – 20 days
   4.2 System testing – 10 days
   4.3 Complete final report – 4 days
5. Final Report Submission
   5.1 submit final report – 1 day
6. Final Report Presentation
   6.1 final report presentation preparation – 5 days
7. Final submission – 5 days

3.2.2. Work schedule – Gantt chart and milestone timeline

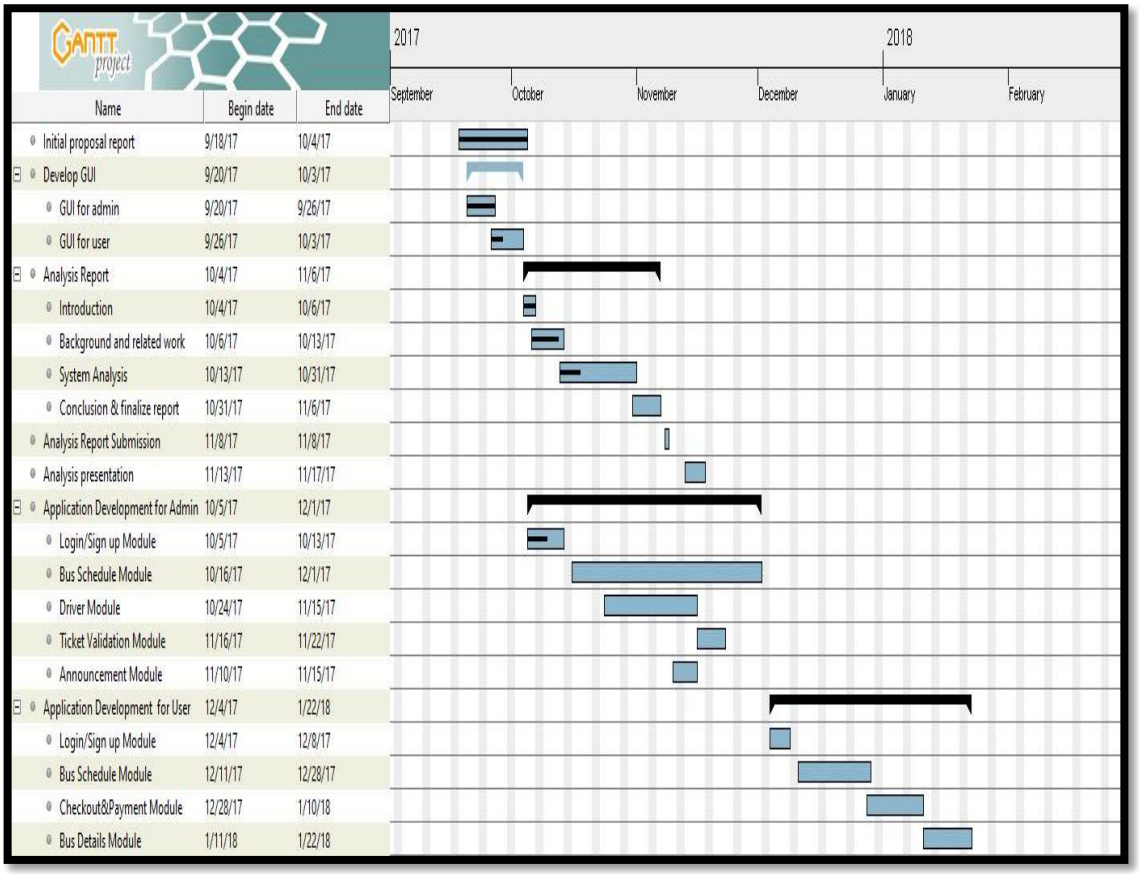

Figure 5: Gantt chart Iteration 1

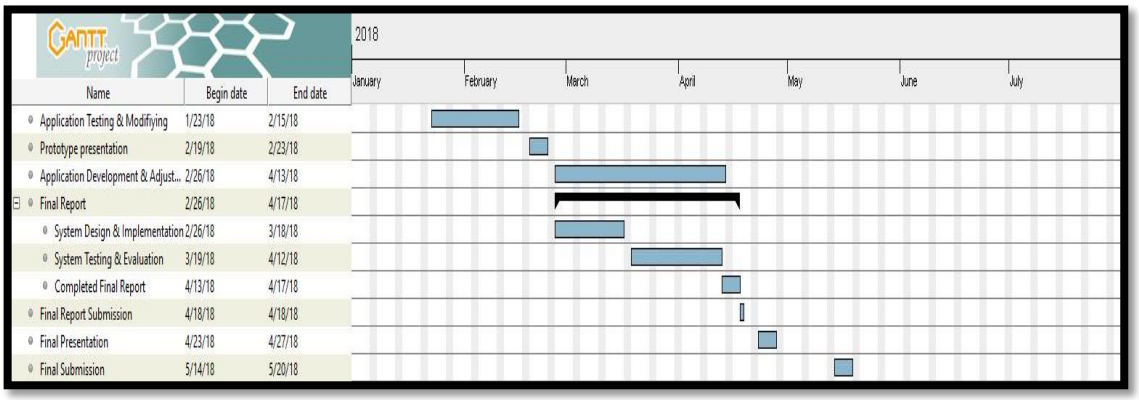

Figure 6: Gantt chart Iteration 2

3.2.3. SWOT analysis

Figure 7: SWOT Analysis for BookMe

3.3. Development Methodology

The development methodology used for this system is an agile model. This model is a combination between iterative and incremental process model. Agile model breaks products into small incremental build (Tutorialspoint.com, 2014). Each of the iteration usually will last about two to three months. The iteration including planning, requirement analysis, design, coding, unit testing and acceptance testing.

For planning and analysis phases, all of the requirement will be gathered that will helps to give an idea about what are the final product will be. Next, in the design phase a system or application will be design according the requirement that has been gathered

from the planning and analysis phases. After the design of the system is completed, an implementation phase will come where a system or application will be developed. A prototype will be completed at this phase that will help to give a look to the developer about the system they developed. The final phase is the testing phase, this is the most important phase as all the error or bugs when the run a testing will be notified and helps developer to make some adjustment to eliminate the error. This testing also will show whether the system is meet the requirements or not. Feedback will be gathered and the iteration would be repeated again. Working software is delivered after each iteration. Each build is incremental in terms of features and the final build will contain all the features required by the developer.

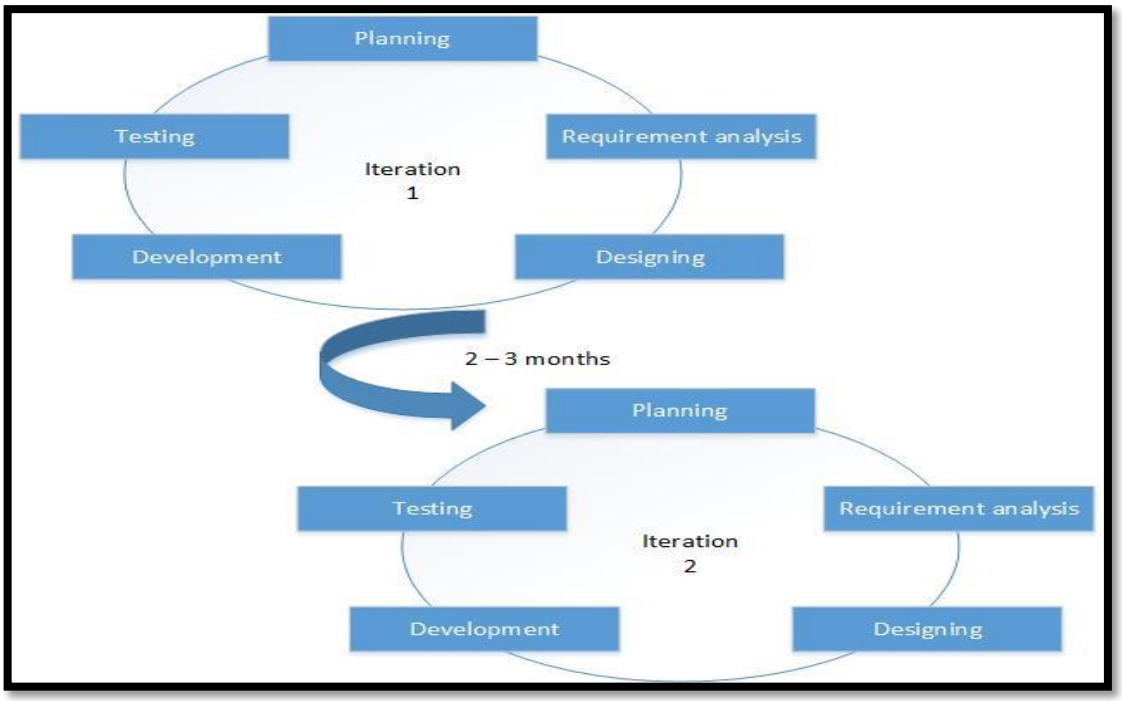

Figure 8: Illustration of an agile model

3.4. Detail Requirement of the New System

3.4.1. Data Gathering

A survey was conduct for this project by using a questionnaire. This survey is targeting user that have an experience using express bus service and the reason to conduct the survey is to gather some data that will be used to find what user want with the system are. This is important as the project need to meet the user requirement. The questionnaire was developed by using Google Forms and then was distributed through media social such as WhatsApp and Facebook groups. There are several important questions inside the questionnaire that need to be answer by the respondent. These questions will be highlighting about the NFC capabilities on user mobile devices, experience using express bus services, method to book and make payment for the ticket, the announcement form the bus operator and illegal tickets seller. 50 respondents has answer the questionnaire and the result from this survey has been interpret into a pie chart form that will help to understand more about what are the user want for this system. The questionnaire and the result of this survey is placed at the appendices.

3.5. Analysis of the New System

3.5.1. UML Modeling

3.5..1 Use Case Diagram

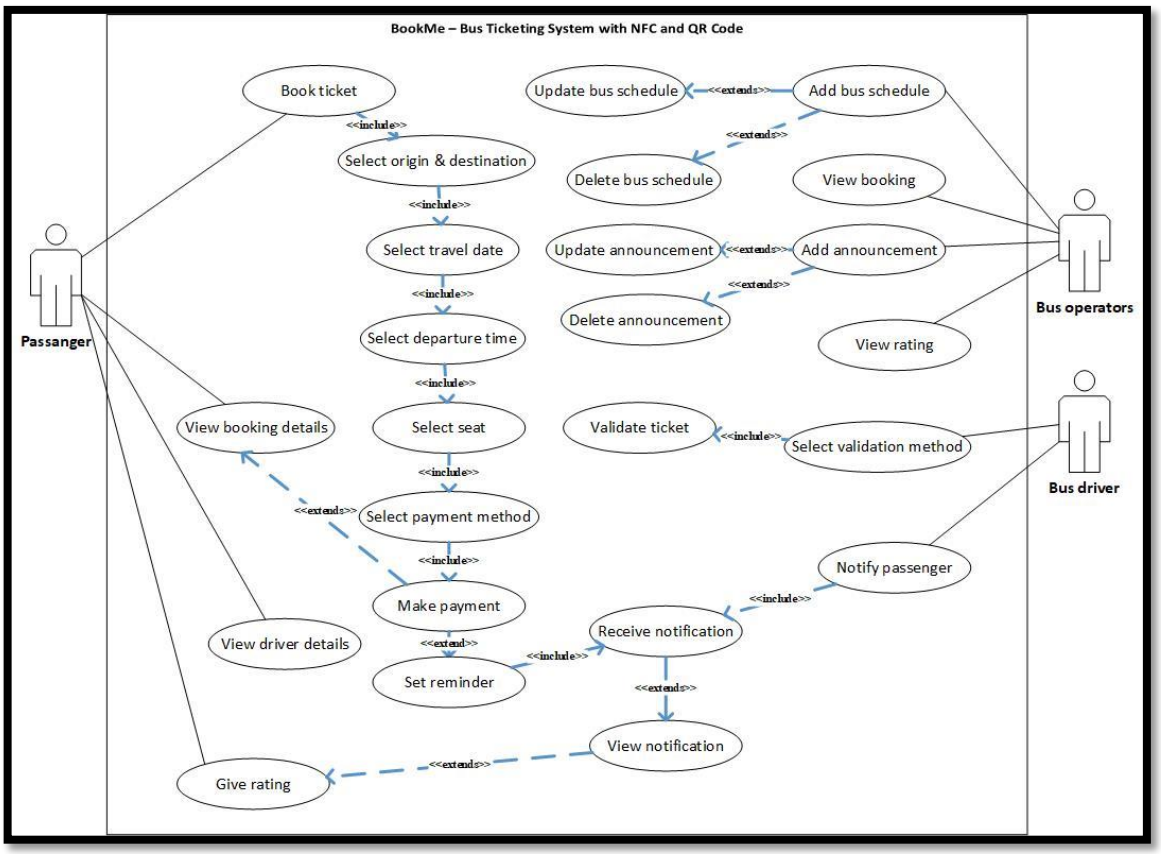

Figure 9: Use Case Diagram for BookMe

3.5..2 Use Case Descriptions

Bus Operator Use Case Description

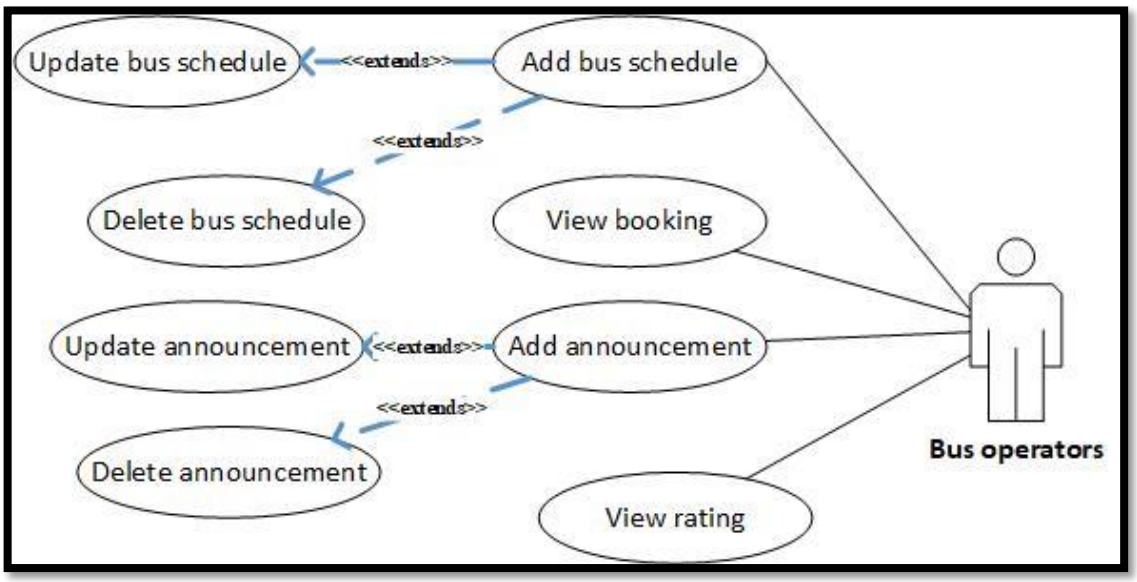

Figure 10: Bus operator use case

Table 2: Add bus scheduled

Use case name	Add bus schedule
Scenario:	Add bus schedule information.
Triggering event:	Bus operator want to add new bus schedule information
Brief description:	Bus operators can add new information to the schedule
Actors:	Bus operators
Related use cases	-
Stakeholders:	Bus operators
Preconditions:	Bus schedule need to be added by bus operator.
Post conditions:	Bus scheduled information is added
Flow of activities:	1. Bus operator input the departure date and time, price, origin and destination, bus company name and registration number, and driver details. 2. New scheduled that has been added is shown.

Table 3: Delete bus scheduled

Use case name	Delete bus schedule
Scenario:	Delete bus schedule information from the database
Triggering event:	Bus operators want to delete bus scheduled information if there is some error in the schedule

Brief description:	Bus operators can delete some of the bus scheduled information that they need to be removed.
Actors:	Bus operators
Related use cases	-
Stakeholders:	Bus operators
Preconditions:	If there is any error or problem in the scheduled and has been approved that the information need to be deleted.
Post conditions:	Information that need to be deleted is removed.
Flow of activities:	1. Bus operators select which scheduled need to be deleted. 2. The information is removed from the database and the system.

Table 4: Update bus schedule

Use case name	Update bus schedule
Scenario:	Bus schedule need to be updated if there is any changes that need to be made.
Triggering event:	Bus operators want to update bus schedule information
Brief description:	Bus operators can update information related to the schedule
Actors:	Bus operators
Related use cases	-
Stakeholders:	Bus operators
Preconditions:	The updated bus schedule information must be relevant that it need to be updated.
Post conditions:	Bus scheduled information is updated
Flow of activities:	1. Bus operators select the schedule that need to be updated. 2. Bus operators update the information that they has been select. 3. The bus scheduled is updated.

Table 5: Add announcement

Use case name	Add announcement
Scenario:	Bus operator want to announce if there is any news that need to be notify to the passenger/user such as an extra bus is provided during peak periods.
Triggering event:	New announcement need to be made by the bus operator to notify passenger/user such as extra bus has been provided.
Brief description:	During the festive seasons, most of the express bus has been fully booked and there are an extra express buses will be provided by the bus operators and this news need to be announce to the passenger/user.

Actors:	Bus operators
Related use cases	Received notification
Stakeholders:	Bus operator, passenger
Preconditions:	If there is any new important announcement need to be done bus operator will select the announcement page and add the announcement.
Post conditions:	Passenger/user will be notified with the announcement made.
Flow of activities:	1. When a new important announcement such as extra express buses are provided, bus operator will be required to announce it to the passenger/user. 2. Bus operator will add the announcement to the system and submit it. 3. Passenger/user will be notified by the announcement made by the bus operator.

Table 6: Update announcement

Use case name	Update announcement
Scenario:	There are some information about the current announcement that have been made by the bus operator.
Triggering event:	Bus operator need to update/alter some information inside the current announcement.
Brief description:	Some of the information in the current announcement that have been made need to be update such as number of extra busses provided is increase or decrease.
Actors:	Bus operators
Related use cases	-
Stakeholders:	Bus operators, passenger
Preconditions:	Bus operator need to select the announcement that need to be updated and select the update button after finished update the announcement.
Post conditions:	-
Flow of activities:	1. Bus operator need to select which announcement that need to be update. 2. Update the announcement and then select the update button. 3. The announcement has been updated and has been resend back to the user to notify them.

Table 7: Delete announcement

Use case name	Delete announcement
Scenario:	There will be an announcement that need to be deleted by the bus operators.

Triggering event:	Bus operator want to delete some of the announcements that have been made.
Brief description:	Bus operators want to delete announcement if there is some error in the announcement that have been send to the passenger.
Actors:	Bus operators
Related use cases	-
Stakeholders:	Bus operator
Preconditions:	Bus operator need to select which announcement need to be deleted and select the delete button. The announcement will be deleted.
Post conditions:	The announcement will be remove from passenger notification.
Flow of activities:	1. Bus operator want to delete announcements due to some error or they really want to delete it. 2. Bus operator will select the announcement need to be deleted and delete it. 3. When the announcement has been completely deleted, it also will be deleted from the passenger notification.

Table 8: View passenger rating

Use case name	View passenger rating
Scenario:	Rating that has been submit by the passenger will be viewed and use as feedback.
Triggering event:	Bus operator want passenger feedback to improve their service.
Brief description:	Bus operator can view the passenger rating and use the rating as feedback that can improve their service in the future.
Actors:	Bus operator
Related use cases	-
Stakeholders:	Bus operator
Preconditions:	-
Post conditions:	Bus operator view passenger rating
Flow of activities:	1. Bus operator view passenger rating that has been received and try to analyze it. 2. The data that has been analyze will be use as feedback.

Passenger Use Case Description

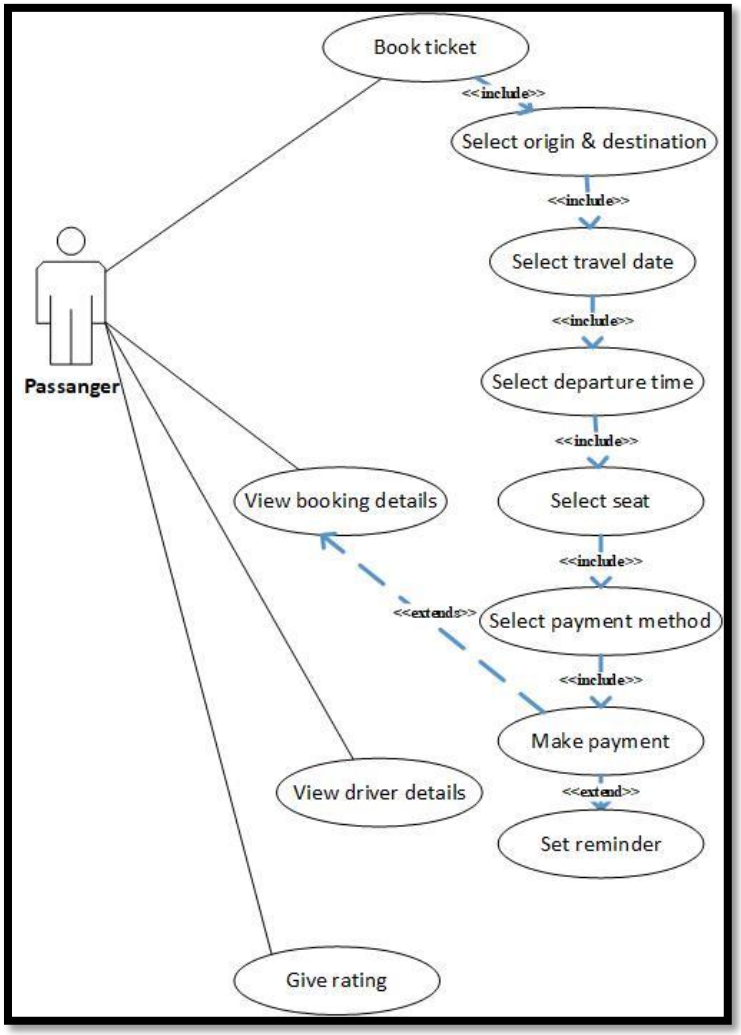

Figure 11: Passenger use case

Table 9: Book ticket

Use case name	Book ticket
Scenario:	Passenger want to book an express bus ticket through the system
Triggering event:	Passenger login to the system to make ticket booking.
Brief description:	Passenger want to make a ticket booking.
Actors:	Passenger
Related use cases	Select origin & destination
Stakeholders:	Passenger
Preconditions:	Passenger need to login to the system to make a ticket booking.
Post conditions:	Passenger need to select travel date view bus schedule.

Flow of activities:	1. Passenger login to the system. 2. Passenger select their origin and destination that they want to go. 3. Passenger need to select travel date in order to proceed to view bus schedule.

Table 10: Select origin & destination

Use case name	Select origin & destination
Scenario:	Passenger need to select their express bus terminal origin and where the destination they need to go.
Triggering event:	Passenger want to make a ticket booking.
Brief description:	Passenger need to specify their origin and where is the destination they want to go.
Actors:	Passenger
Related use cases	Select travel date
Stakeholders:	Passenger
Preconditions:	Passenger will need to select the origin and destination that available in the list.
Post conditions:	Passenger need to select travel date view bus schedule.
Flow of activities:	1. Passenger select express bus terminal origin and destination. 2. Then passenger need to select travel date.

Table 11: Select travel date

Use case name	Select travel date
Scenario:	Passenger required to select their travel date.
Triggering event:	Passenger have select their origin and destination.
Brief description:	Passenger need to select their travel date in order to view the bus schedule on that particular date.
Actors:	Passenger
Related use cases	Select departure time
Stakeholders:	Passenger
Preconditions:	Passenger need to specify their origin and destinations.
Post conditions:	Passenger can view the travel time from the schedule.
Flow of activities:	1. Passenger select their travel date. 2. A complete bus schedule with the departure time, ticket price and Bus Company can be view by the passenger. 3. Passenger need to select the departure time based on the bus scheduled.

Table 12: Select departure time

Use case name	Select departure time
Scenario:	Passenger need to select the departure time.
Triggering event:	Passenger already specify their origin and destination and also the travel date.
Brief description:	Passenger want select departure time from the bus schedule after they view the bus schedule.
Actors:	Passenger
Related use cases	Select seat
Stakeholders:	Passenger
Preconditions:	Passenger already specify their origin & destination, select travel date.
Post conditions:	Passenger need to select departure time.
Flow of activities:	1. Passenger already specify their origin & destination, select travel date. 2. Passenger will view all the departure time from the bus schedule. 3. Passenger will select the departure time and proceed to select their seat.

Table 13: Select seat

Use case name	Select seat
Scenario:	Passenger want to select their seat.
Triggering event:	Passenger already select the departure time.
Brief description:	Passenger will be allowed to select the available seat.
Actors:	Passenger
Related use cases	-
Stakeholders:	Passenger
Preconditions:	Passenger have selected the departure time from the bus schedule.
Post conditions:	Passenger allowed to select available seat.
Flow of activities:	1. Passenger have select their departure time and proceed to seat selection. 2. Passenger is only allowed to select the available seats. 3. Passenger will be directed to payment.

Table 14: Make payment

Use case name	Make payment
Scenario:	Passenger want to make payment for completing the ticket booking.
Triggering event:	Passenger already select their seat and/or fill up their

	personal details.
Brief description:	Passenger need to make payment if they want to finished their ticket booking.
Actors:	Passenger
Related use cases	Select payment method
Stakeholders:	Passenger
Preconditions:	-
Post conditions:	Passenger need to select payment method.
Flow of activities:	1. In order to finish up the ticket booking passenger are required to make payment via online. 2. Passenger will be required the payment method. 3. Make payment and received their ticket.

Table 15: Select payment method

Use case name	Select payment method
Scenario:	Passenger want to select their payment method to make payment via online.
Triggering event:	Passenger already finished up all the requirement needed to finish the ticket booking.
Brief description:	Passenger select their payment method to make the payment.
Actors:	Passenger
Related use cases	-
Stakeholders:	Passenger
Preconditions:	Passenger want to make payment.
Post conditions:	Passenger will receive the express bus ticket and receipt.
Flow of activities:	1. Passenger select the payment method such as online banking or PayPal. 2. Passenger make the payment. 3. Passenger will receive an email consist of express bus ticket and also the payment receipt.

Table 16: Set reminder

Use case name	Set reminder
Scenario:	Passenger have finish the ticket booking and want to set a reminder for their departure time.
Triggering event:	Passenger want to set reminder.
Brief description:	Passenger that already book their ticket can choose whether to set a reminder for their departure time or not.
Actors:	Passenger
Related use cases	Received notification
Stakeholders:	Passenger
Preconditions:	Passenger has set the reminder based on their travel date

	and departure time.
Post conditions:	Passenger will receive a notification.
Flow of activities:	1. Passenger will set the reminder if they need it. 2. A notification will notify passenger for their departure time and date.

Table 17: Received notification

Use case name	Receive notification
Scenario:	Passenger receive notification when an announcement has been made or the departure time and date is met.
Triggering event:	Bus operator add new announcement or departure time and date is met.
Brief description:	Passenger will be notified if there is any announcement or reminder has been set.
Actors:	Passenger
Related use cases	-
Stakeholders:	Passenger, bus operators
Preconditions:	Bus operator add/update new announcement, departure time and date is met.
Post conditions:	-
Flow of activities:	1. Passenger received a notification if any announcement has been made by the bus operators or reminder about passenger departure date and time. 2. Passenger view the notification.

Table 18: View booking details

Use case name	View booking details
Scenario:	Passenger want to view booking details.
Triggering event:	Passenger select to view booking details.
Brief description:	Passenger are able to view bus details such as bus registration number, company name.
Actors:	Passenger
Related use cases	-
Stakeholders:	Passenger
Preconditions:	-
Post conditions:	Passenger view the booking details.
Flow of activities:	3. Passenger select the view bus details page. 4. Booking details information will be previewed and passenger are allowed to view it but cannot edit the content.

Table 19: View driver details

Use case name	View driver details
Scenario:	Passenger want to view the booked bus driver details
Triggering event:	Passenger has booked bus ticket.
Brief description:	Passenger can view bus driver details once they have finished their ticket booking.
Actors:	Passenger
Related use cases	-
Stakeholders:	Passenger
Preconditions:	-
Post conditions:	Bus driver details can be viewed
Flow of activities:	1. When passenger has finished their booking, they will receive their ticket. 2. Then they can view the bus driver details.

Table 20: Give rating

Use case name	Give rating
Scenario:	The system will ask passenger to give rating at the end of the trip.
Triggering event:	System ask passenger to give rating.
Brief description:	At the end of the express bus trip, passenger will be ask to give rating for the express bus service.
Actors:	Passenger
Related use cases	-
Stakeholders:	Passenger
Preconditions:	-
Post conditions:	The rating will be viewed by the bus operator.
Flow of activities:	3. When the express bus finished their trip, the system will ask user to give their rating. 4. The rating will use star as indicator. 5. User submit the rating and will be viewed by the bus operator.

Bus Driver Use Case Description

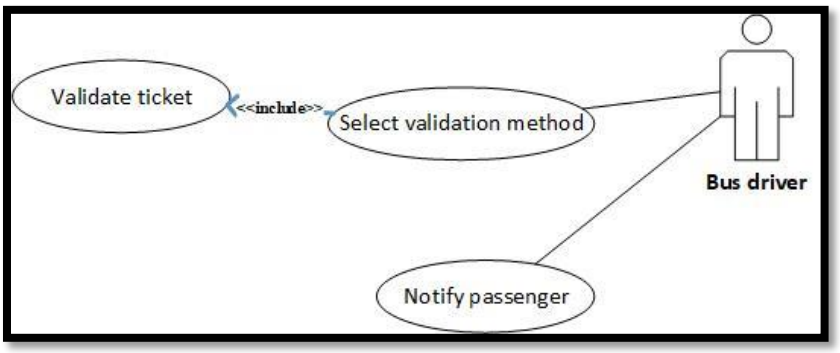

Figure 12: Bus driver use case

Table 21: Validate ticket

Use case name	Validate ticket
Scenario:	Bus driver want to validate passenger ticket before they can proceed their journey.
Triggering event:	Bus driver want to validate user ticket using the system by selecting the validate page.
Brief description:	Bus driver want to validate user ticket by using the system and they need to select the validation method which is via NFC or scanning QR code depends on user mobile devices capabilities.
Actors:	Bus driver
Related use cases	Select validate method
Stakeholders:	Bus driver, passenger
Preconditions:	Bus driver must select validate ticket page and asking whether passenger mobile devices have NFC capabilities or not.
Post conditions:	Bus driver must select the validation method either using NFC or scanning QR code.
Flow of activities:	1. Bus driver will select the validate page before they start to validate passenger ticket. 2. Bus driver will ask the user if their mobile device have NFC capabilities or not. 3. Bus driver will be required to select validation method whether via NFC or QR code.

Table 22: Select validation method

Use case name	Select validation method
Scenario:	Bus driver will be required to select validation method after them asking passenger about their mobile device NFC capabilities.
Triggering event:	Bus driver has been select the validate ticket page and they want to validate passenger ticket.
Brief description:	Bus driver need to select validation method in order to validate passenger ticket by using either NFC or QR code

	depends on passenger mobile device.
Actors:	Bus driver
Related use cases	-
Stakeholders:	Bus driver, passenger
Preconditions:	Bus driver already select the validate ticket page and knowing the validation method for the passenger ticket.
Post conditions:	Bus driver will select the validation method and start to validate passenger ticket and if the ticket is already validated, there will be a notification for both the bus operator and passenger.
Flow of activities:	1. Bus driver will select the validation method which is NFC or QR code, where they already know by asking passenger. 2. Bus driver will start to validate passenger ticket. 3. If the validation method using NFC, bus operator will touch their mobile device with passenger mobile device to validate the ticket. 4. If using QR code, bus operator will scan the QR code at the passenger ticket. 5. After the ticket has been validate, both of them will be notified.

Table 23: Notify passenger

Use case name	Notify passenger
Scenario:	When the bus driver have completed their trip and reach their destination, bus driver needs to notify passenger that they have already arrive and ask their feedback.
Triggering event:	Bus driver have reached their destination and finished their trip.
Brief description:	Bus driver will notify passenger by clicking “Arrived” button that will send push notification to passenger along with rating page.
Actors:	Bus driver
Related use cases	Notify passenger
Stakeholders:	Bus driver, passenger
Preconditions:	Only if the bus driver already reaches their destination.
Post conditions:	Passenger will be notified and will be asked for rating their trip.
Flow of activities:	4. When the bus has already reached their destination, bus driver will notify passenger through driver application. 5. After bus driver has notify the passenger through their application, a push notification will notify passenger that they already arrived and when passenger open the notification they will be ask to give rating.

3.5..3 Class Diagram

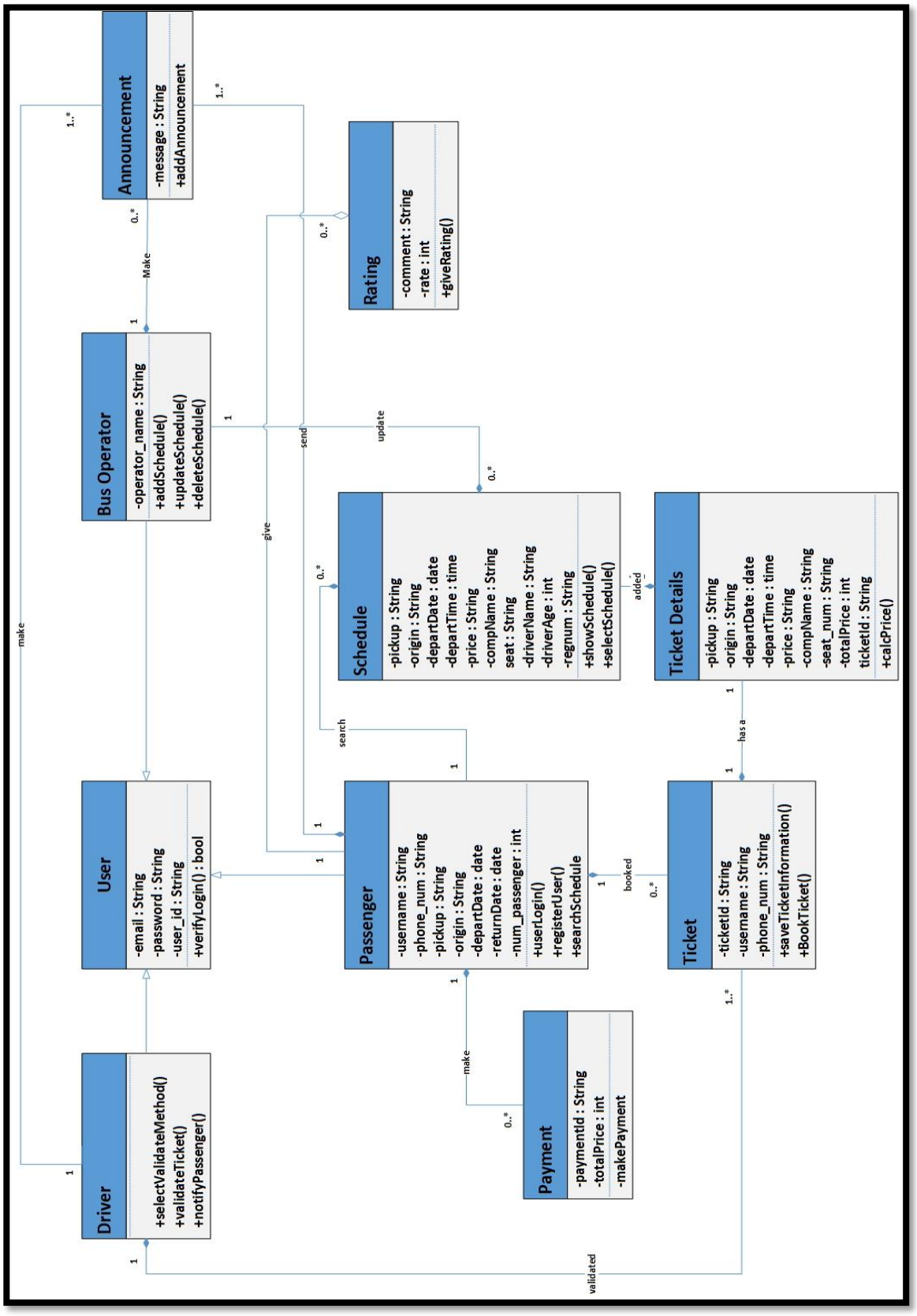

Figure 13: Class Diagram for BookMe

3.5..4 System Sequence Diagram (SSD)

Bus operator sequence diagram

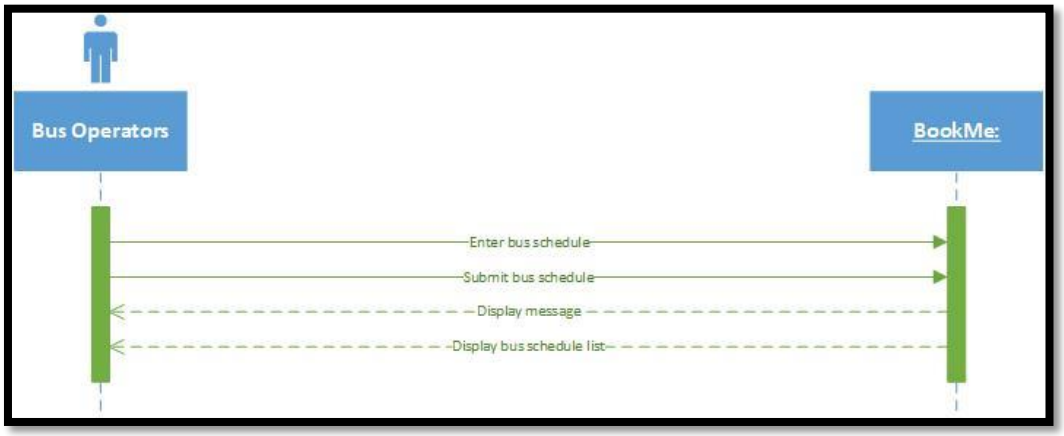

Figure 14: Add bus schedule sequence diagram

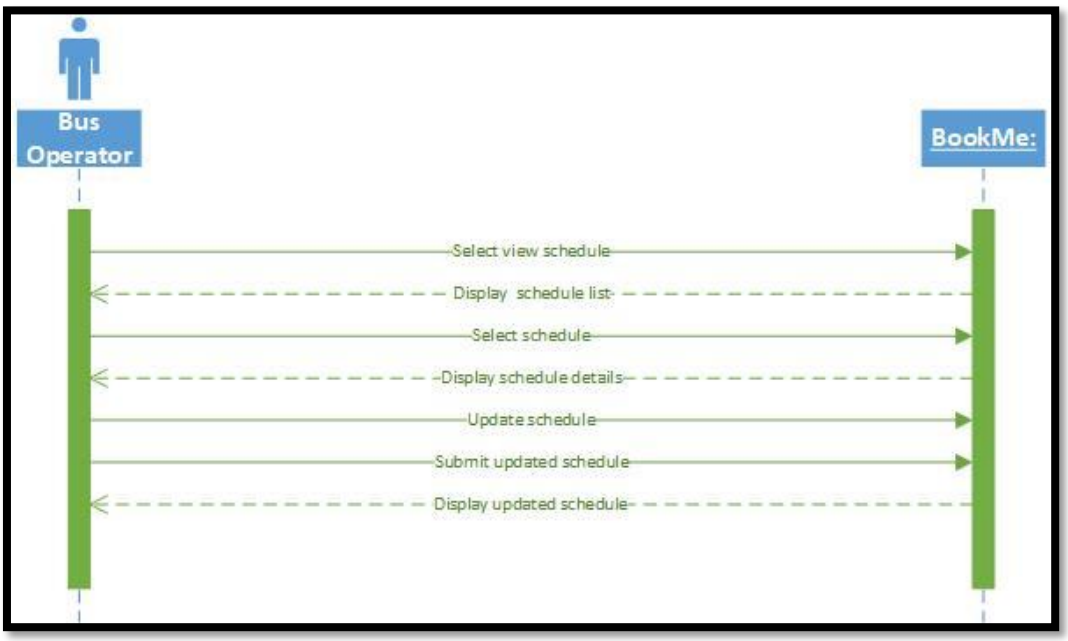

Figure 15 Update bus schedule sequence diagram

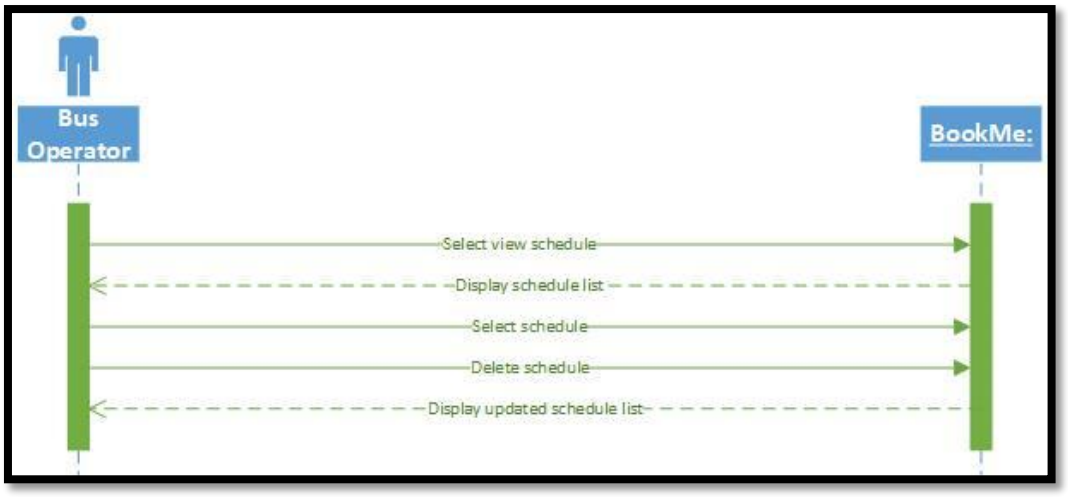

Figure 16 Delete schedule sequence diagram

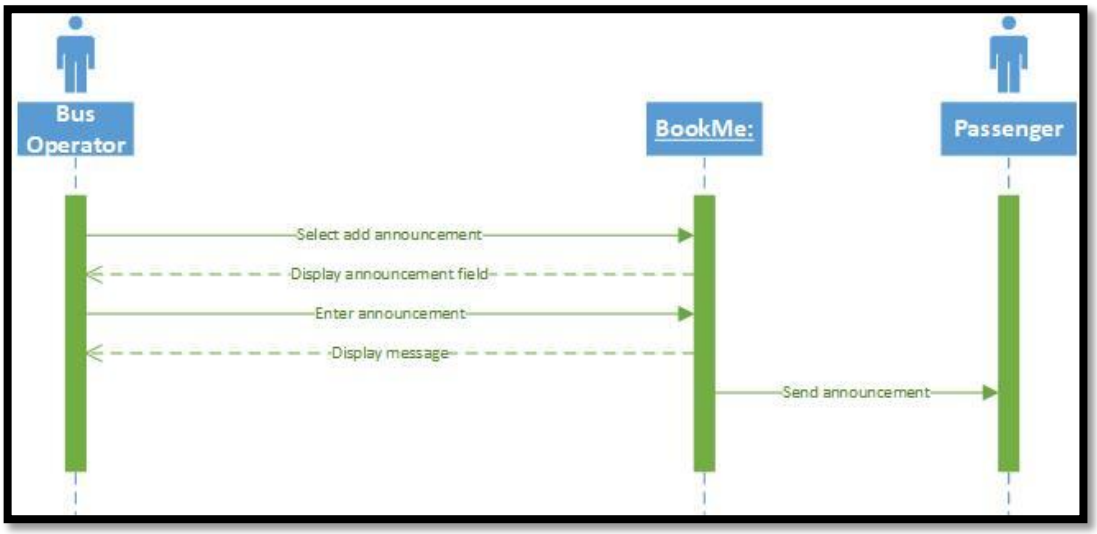

Figure 17 Add announcement sequence diagram

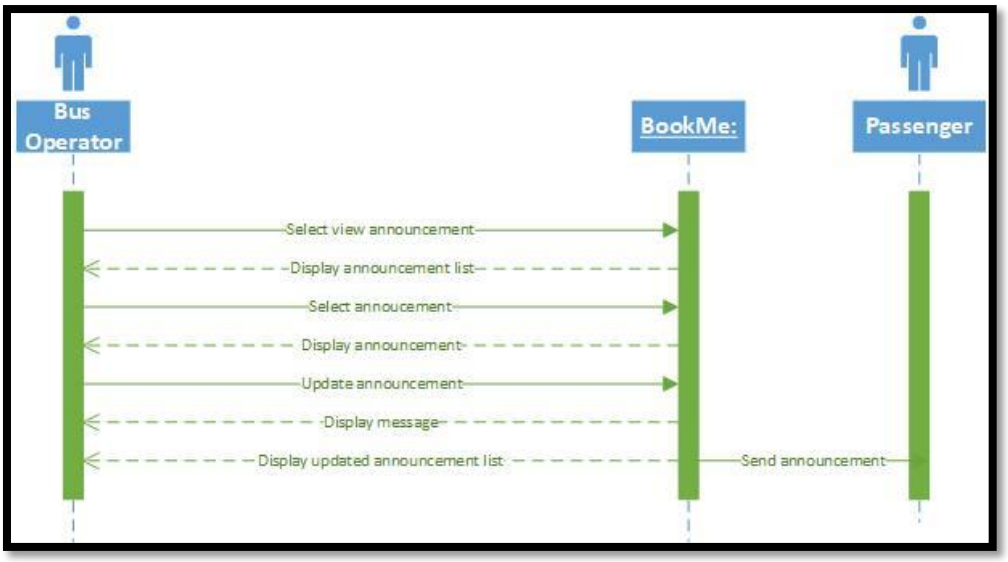

Figure 18 Update announcement sequence diagram

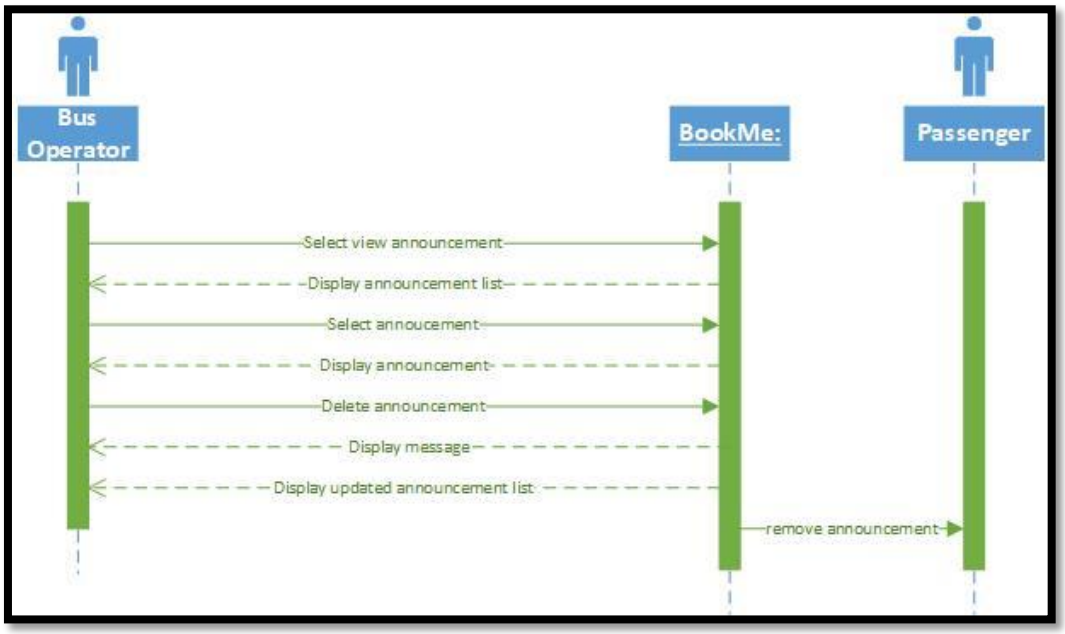

Figure 19 Delete announcement sequence diagram

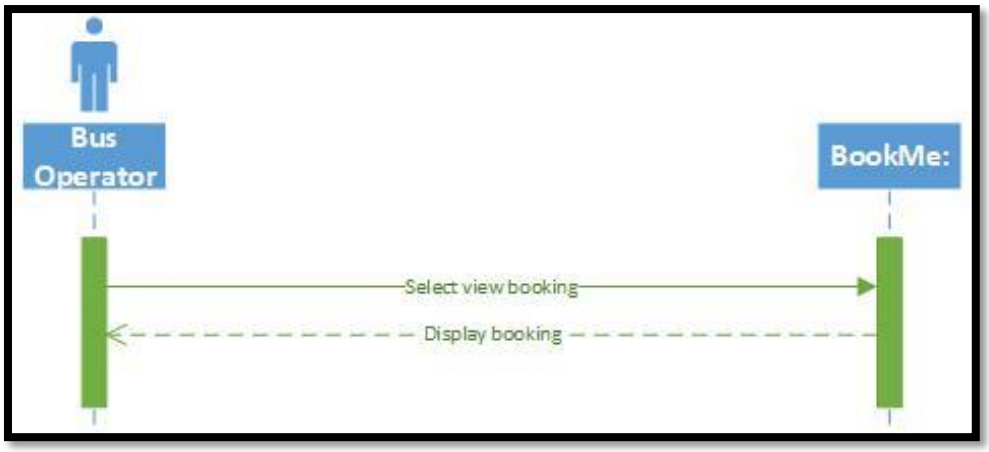

Figure 20 View booking sequence diagram

Figure 21 View rating sequence diagram

Passenger

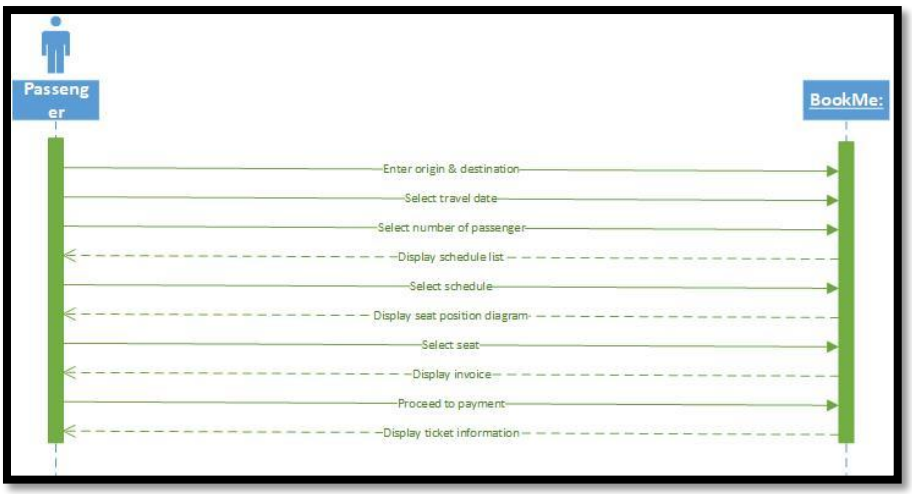

Figure 22: Book ticket sequence diagram

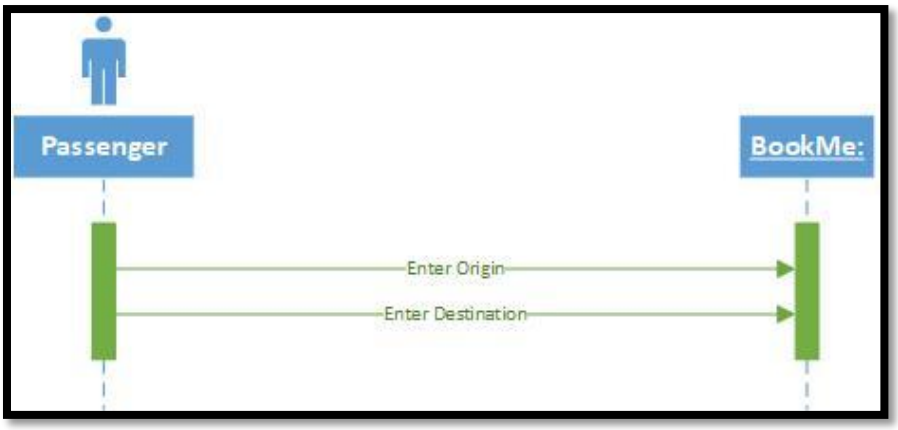

Figure 23: Enter origin and destination sequence diagram

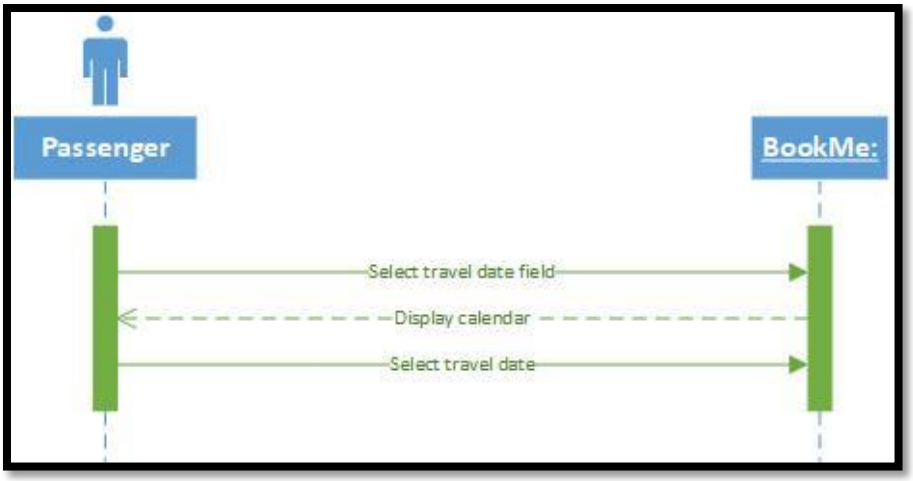

Figure 24: Select travel date sequence diagram

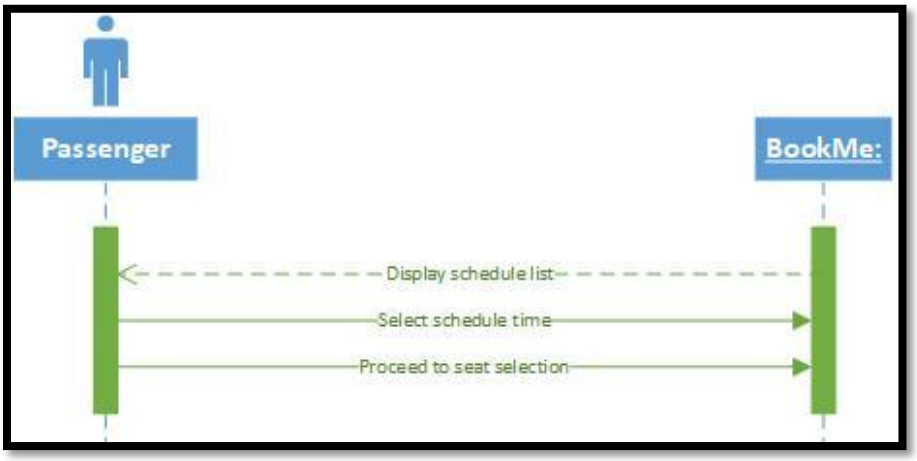

Figure 25: Select departure time sequence diagram

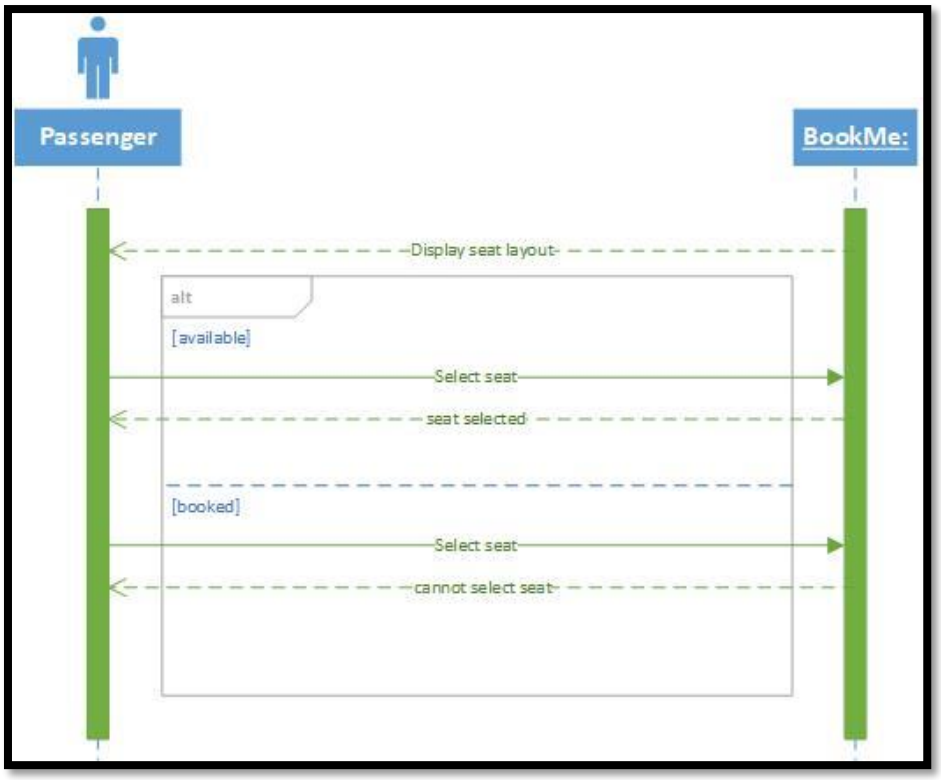

Figure 26: Select seat sequence diagram

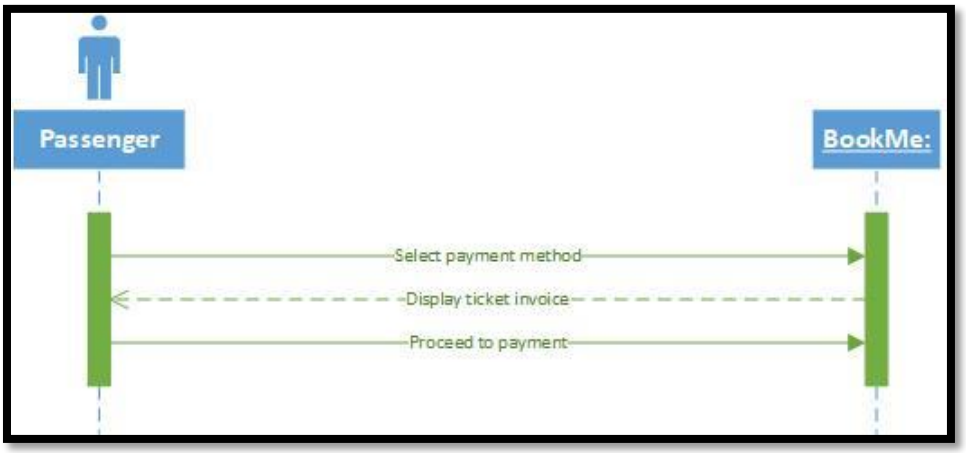

Figure 27: Select payment method sequence diagram

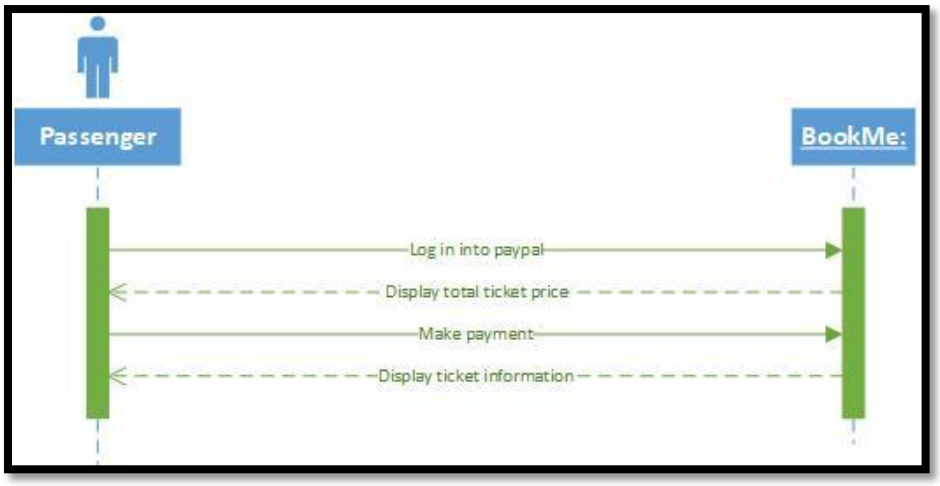

Figure 28: Make payment sequenced diagram

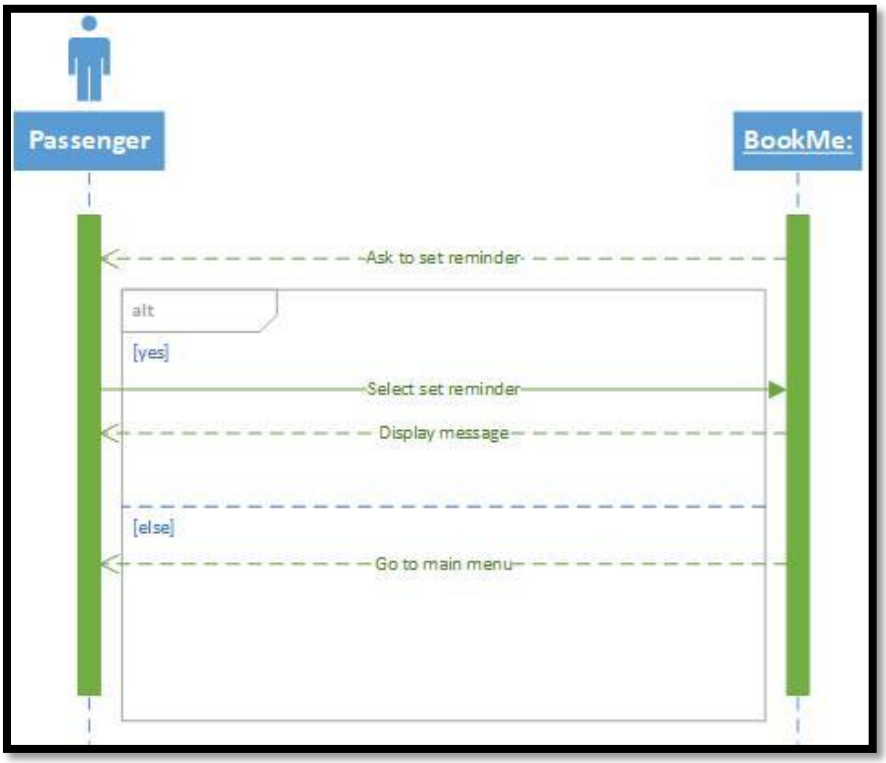

Figure 29: Set reminder sequence diagram

Figure 30: View driver details sequence diagram

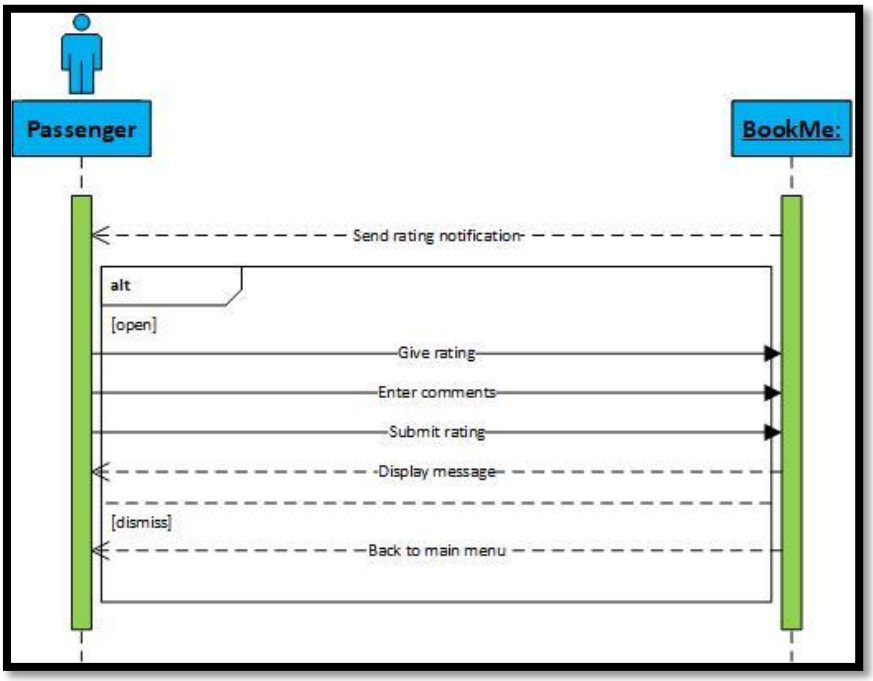

Figure 31: Give rating sequence diagram

Bus Driver

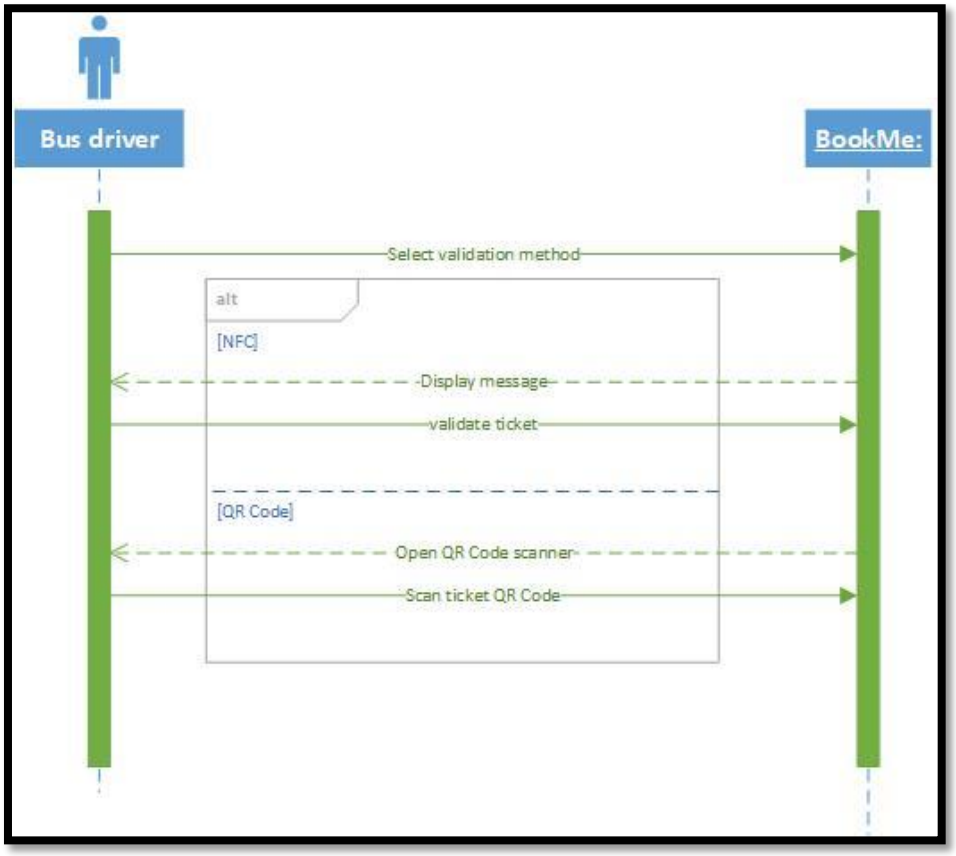

Figure 32: Select validation method sequence diagram

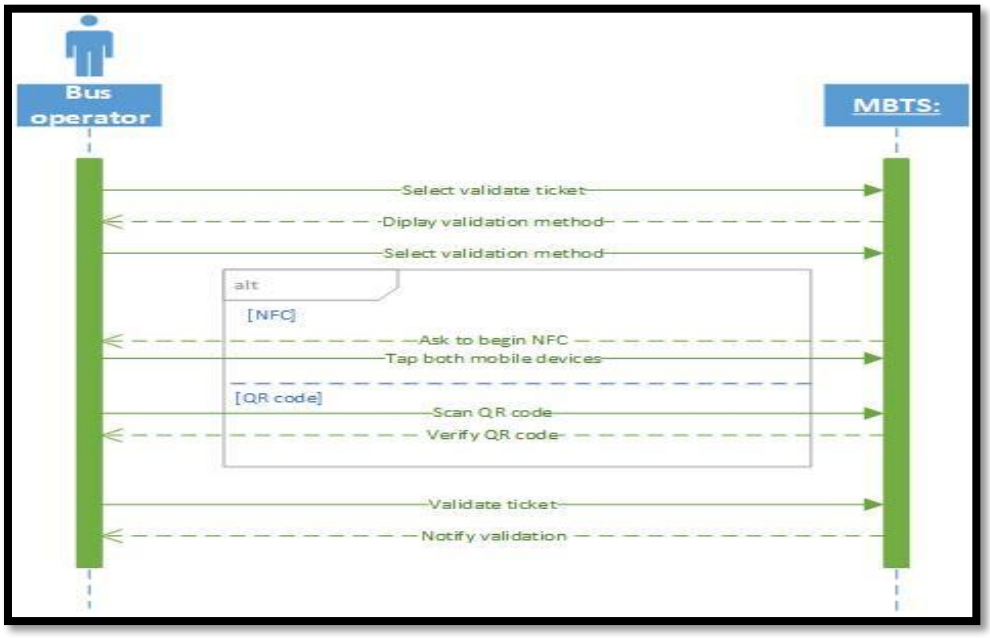

Figure 33: Validate ticket sequence diagram

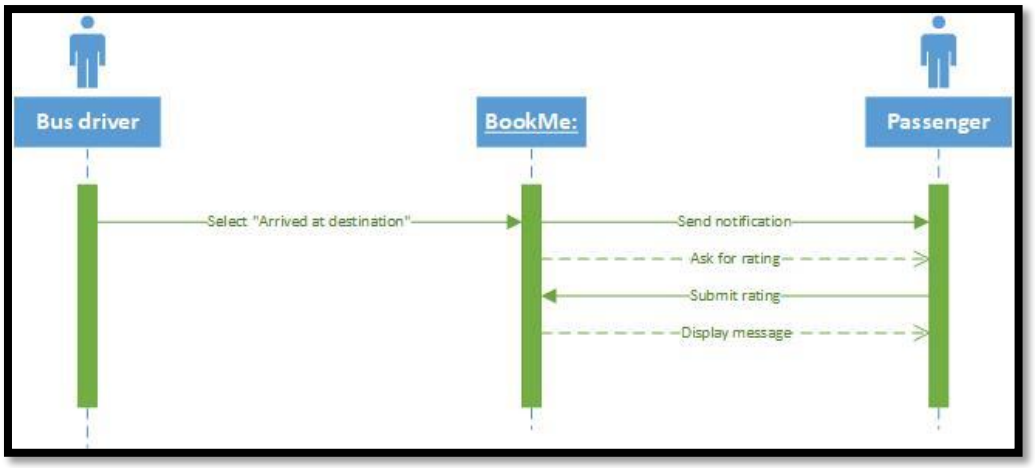

Figure 34: Notify passenger sequence diagram

3.5..5 State Chart Diagram

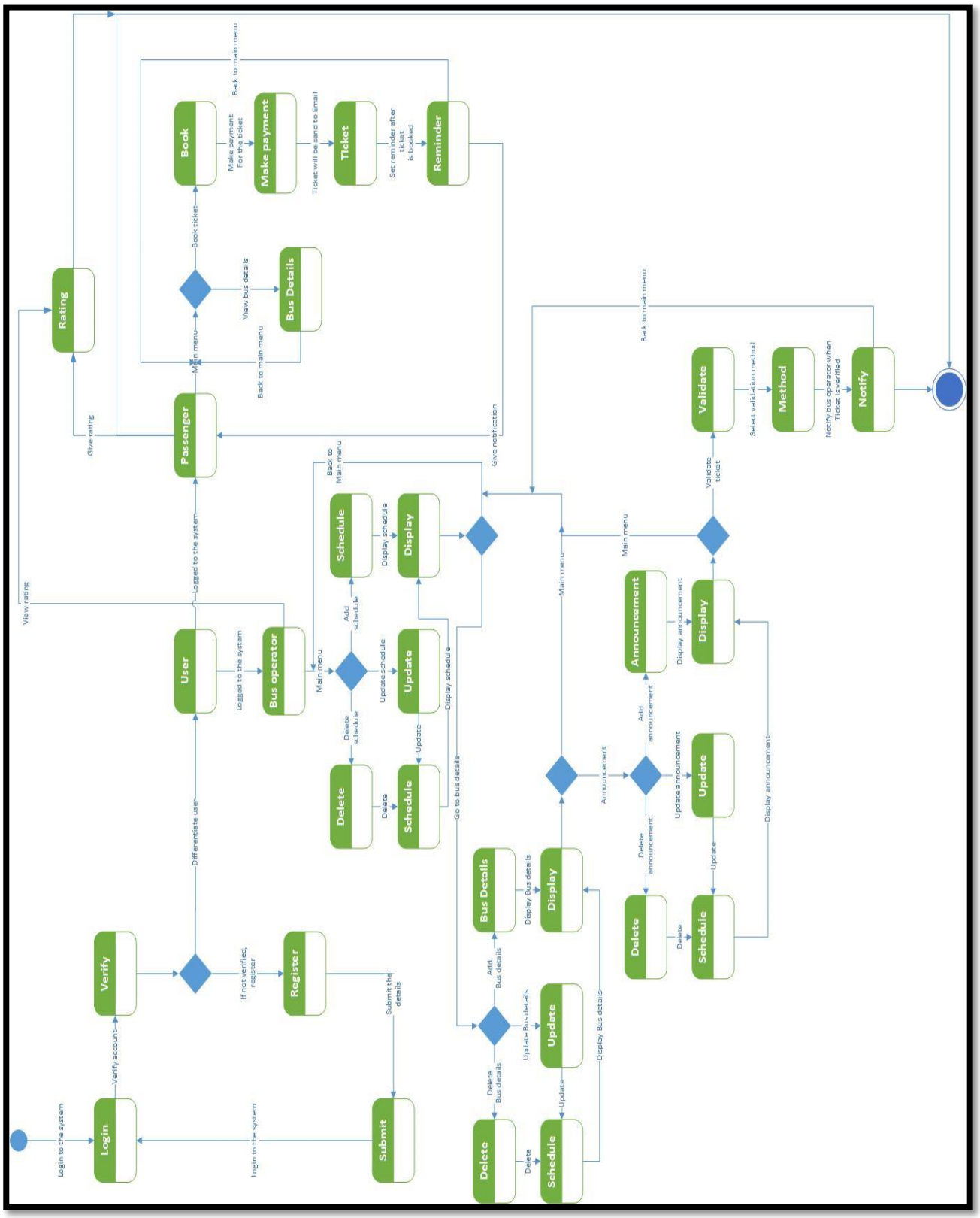

Figure 35: State Chart Diagram for BookMe

3.5.2. Flowchart

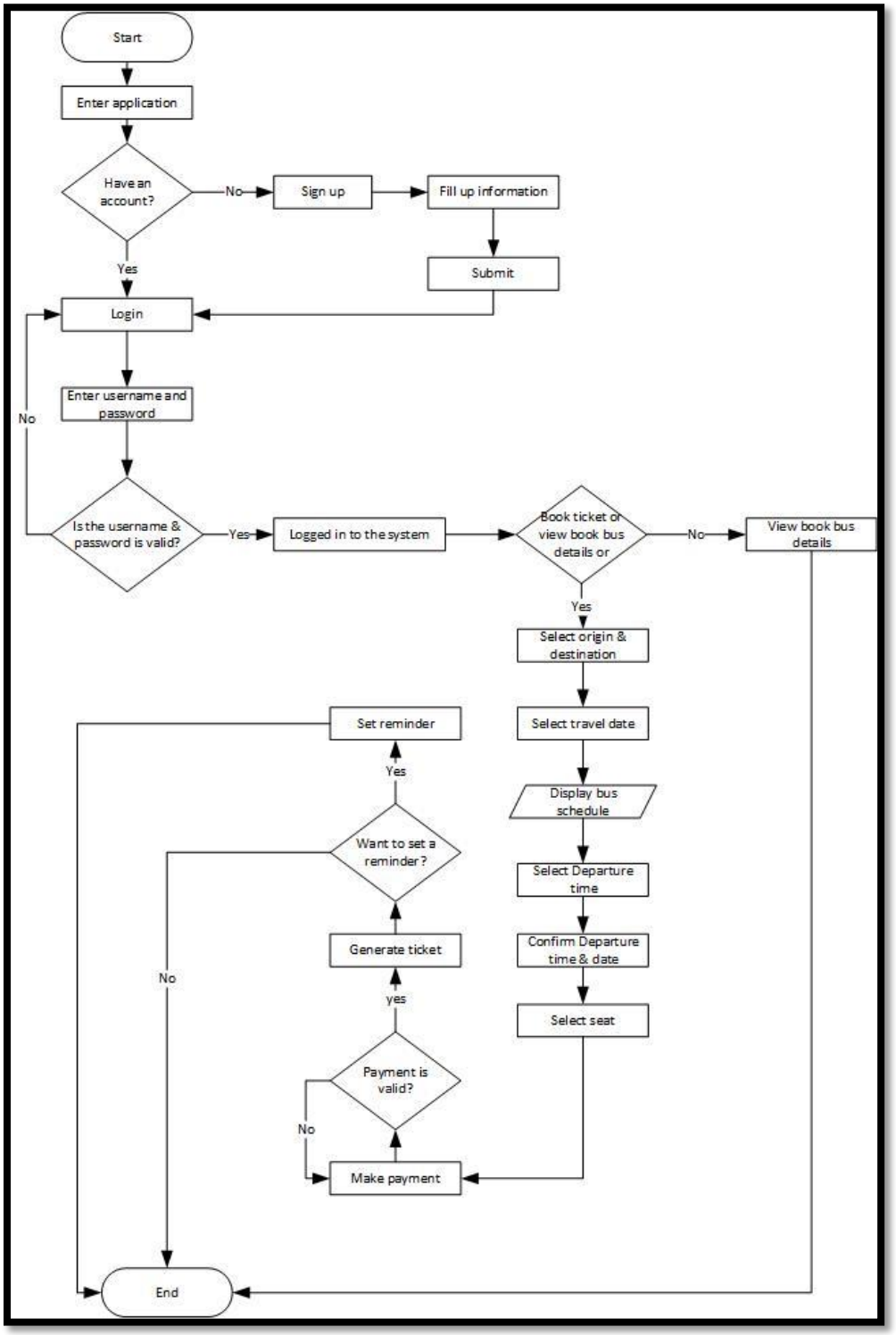

Figure 36 Passenger flowchart

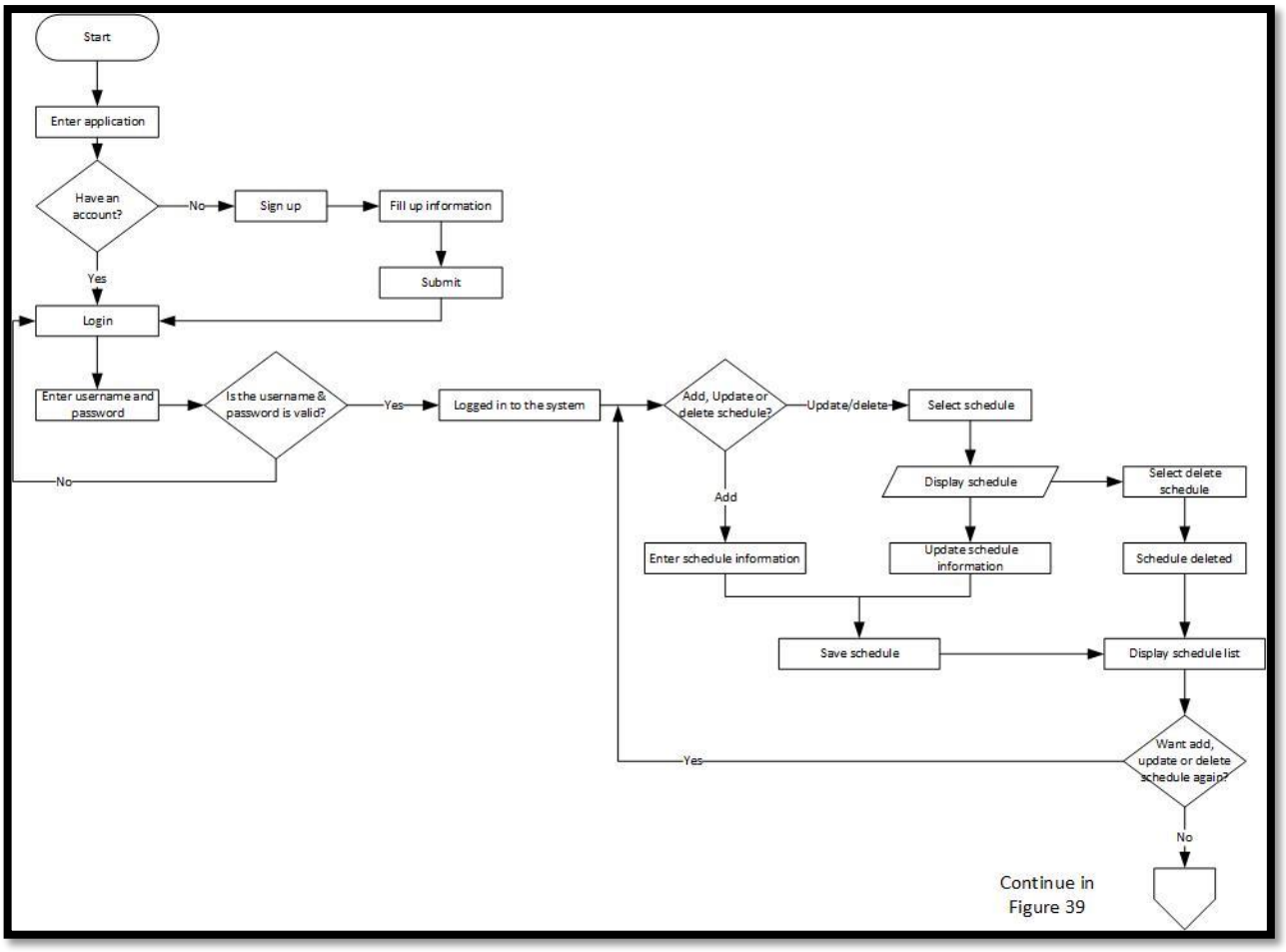

Figure 37 Bus operator flowchart part 1

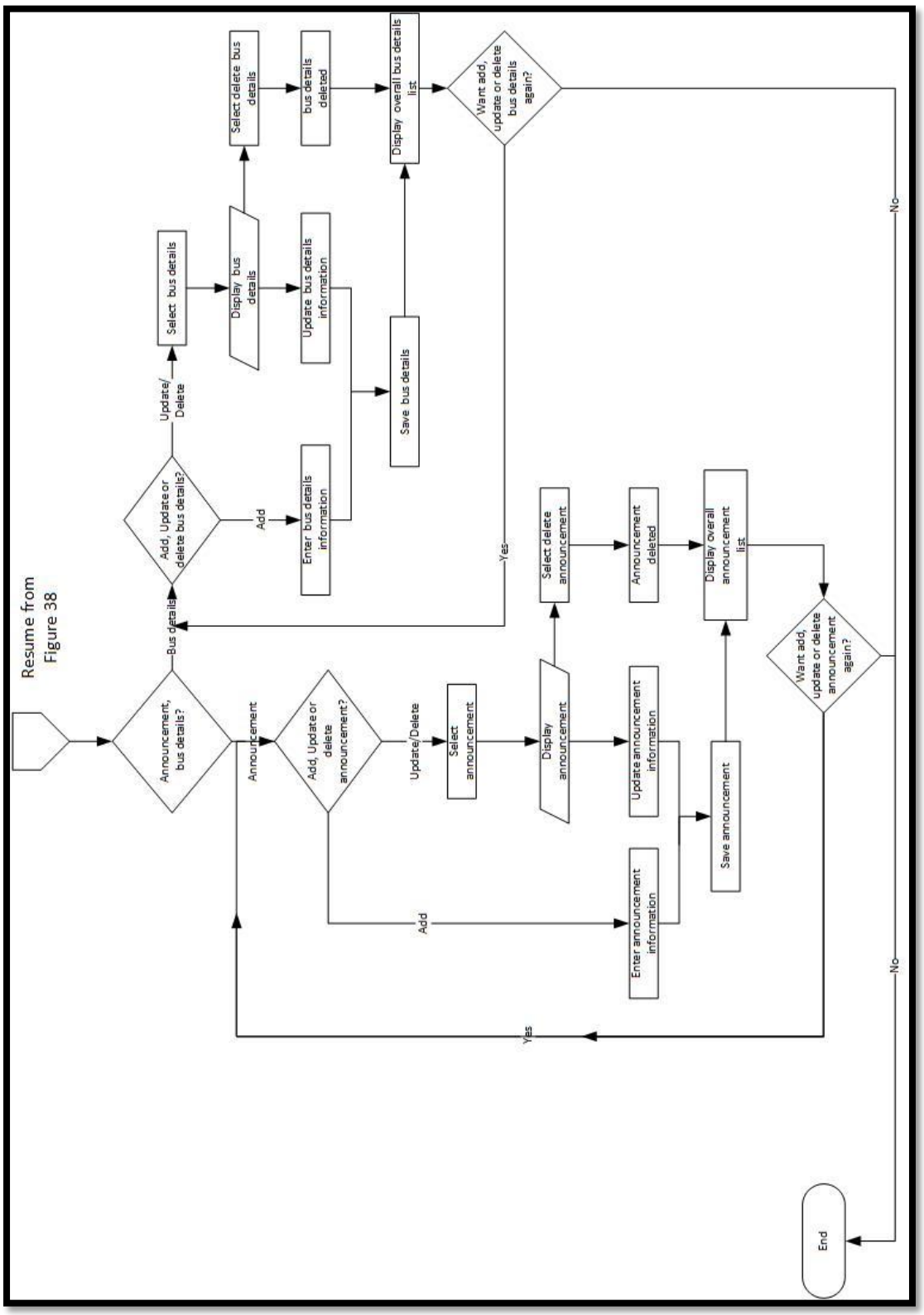

Figure 38 Bus operator flowchart part 2

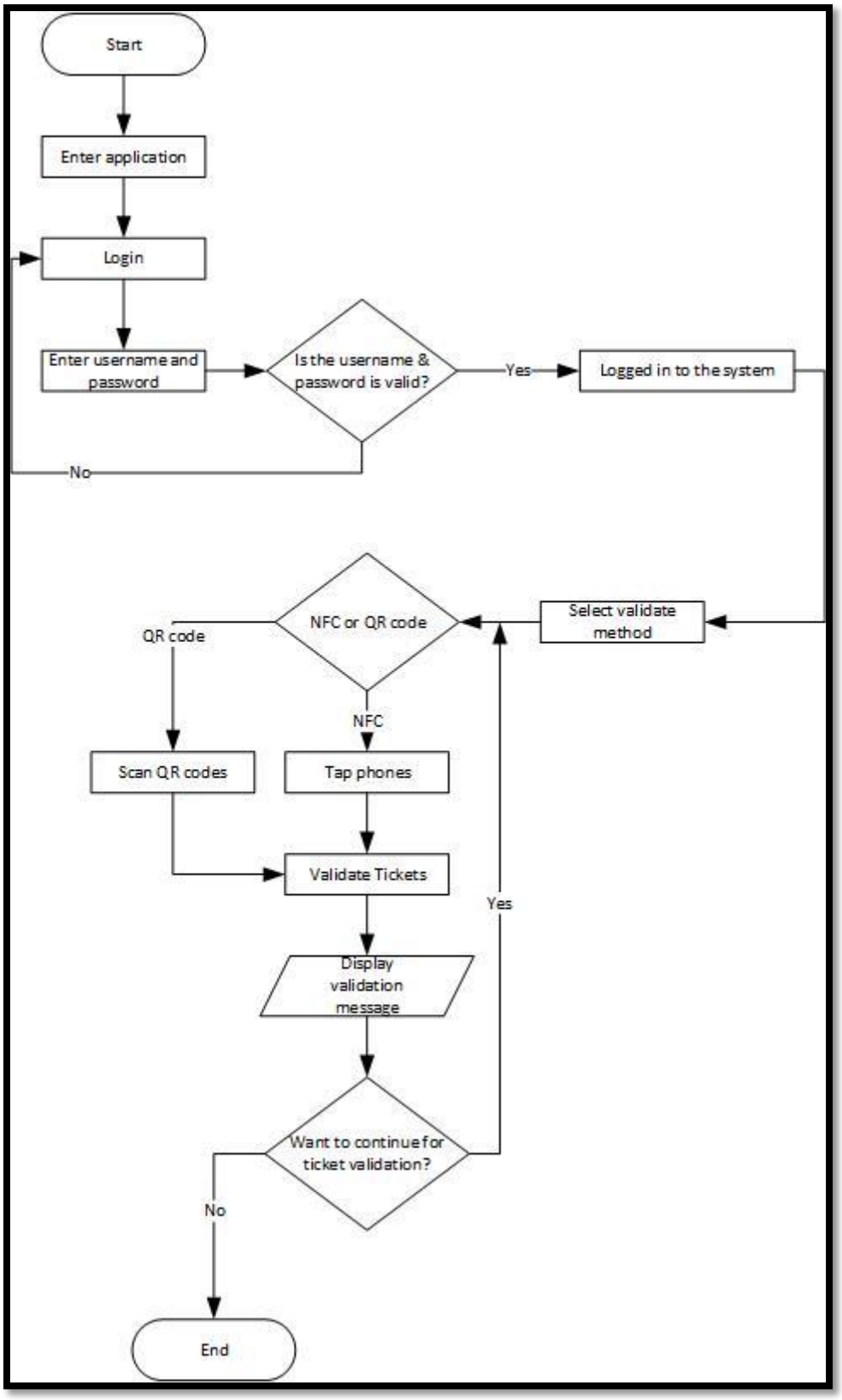

Figure 39: Bus driver flowchart

3.6. Technology Deployed

The hardware and software used for this project are:

Hardware:

- Workstation : Asus A555L
- Processor: Intel Core i5 – 5200U @ 2.7 GHz
- RAM: 4 GB
- Sony Experia ZL

Software:

- OS: Microsoft Windows 10
- Firebase Console is used to store all the information from the android and web application.
- Android Studio 3.0.1 is used to develop the android application for both passenger and bus driver application. There are some library that has been included such as Zxing library for QR Code scanner and generator.
- Notepad++ are used for developing web application for the bus operator and implement CRUD features.
- Wampp Server are used to create a localhost that can connect the web application with the Firebase Console.

Programming Language:

- Android: This programming language is the main language for this system and will be used for developing passenger and bus driver application.
- HTML: This programming language will be used for developing bus operator web application and there is also combination with CSS and JavaScript.

4 SYSTEM DESIGN & IMPLEMENTATION

4.1. Design Application Architecture

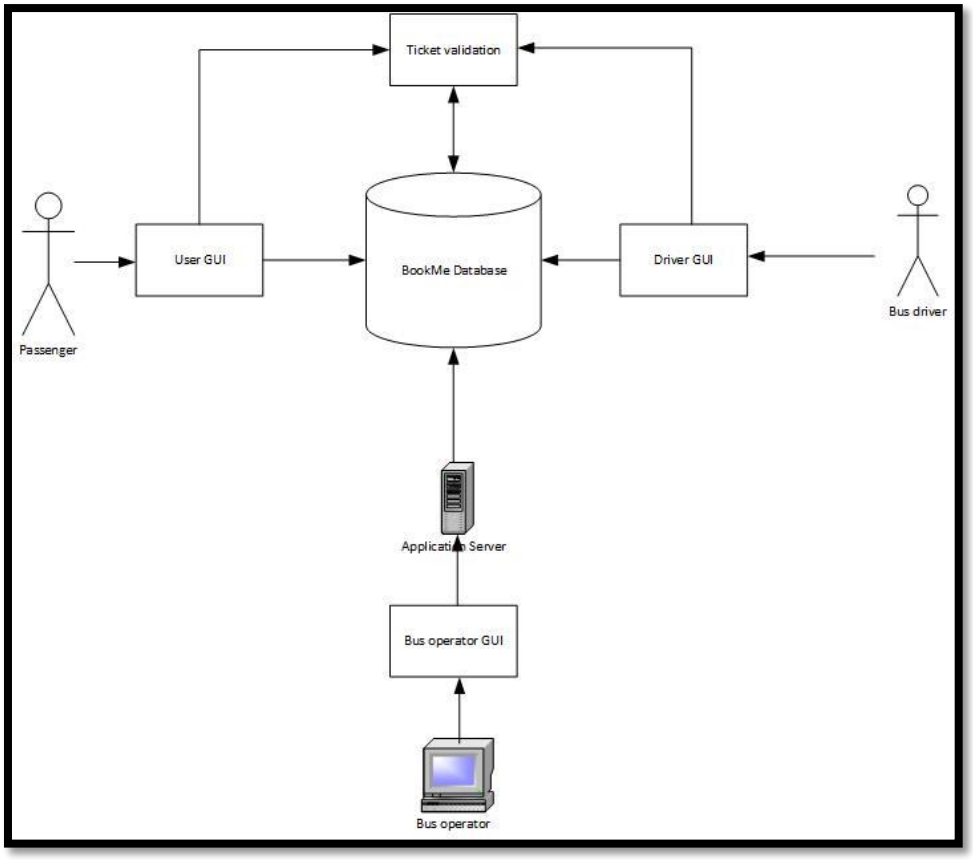

Figure 40: Application architecture for BookMe

Based on the figure above, we can see that there are 3 stakeholder that are involved for this system which is passenger, bus driver and bus operator. Each of the user have their own functionalities and all of them need to be log in into the system before they can use it. Firstly, for the passenger they can do the ticket booking, make payment, view booking, view driver details, and give rating. These functionalities is connected to a database called BookMe. The firebase use for this system is Firebase database. For the driver functionalities they can validate passenger ticket by using either NFC or scanning passenger QR Code. The validation of the passenger ticket is using ticket id that link to passenger id where it will search whether the ticket is exist inside the database and

associate with passenger id or not. If the is successfully validate, it will show a message to bus driver. Next, bus driver need to click “Arrived” button once they arrived at their destination and this will trigger passenger application where a push notification that will lead to a rating page that will allow passenger to give their rating based on the express bus trip. Both users are using the Android application that possess different functionalities based on user role. For bus operator, they will be using a web application where they are allowed to do CRUD functionalities that covers for bus schedule and notification. Bus operator also allowed to view passenger rating to get their feedback and this will be use to improve their service in the future.

4.2. Design Class Diagram

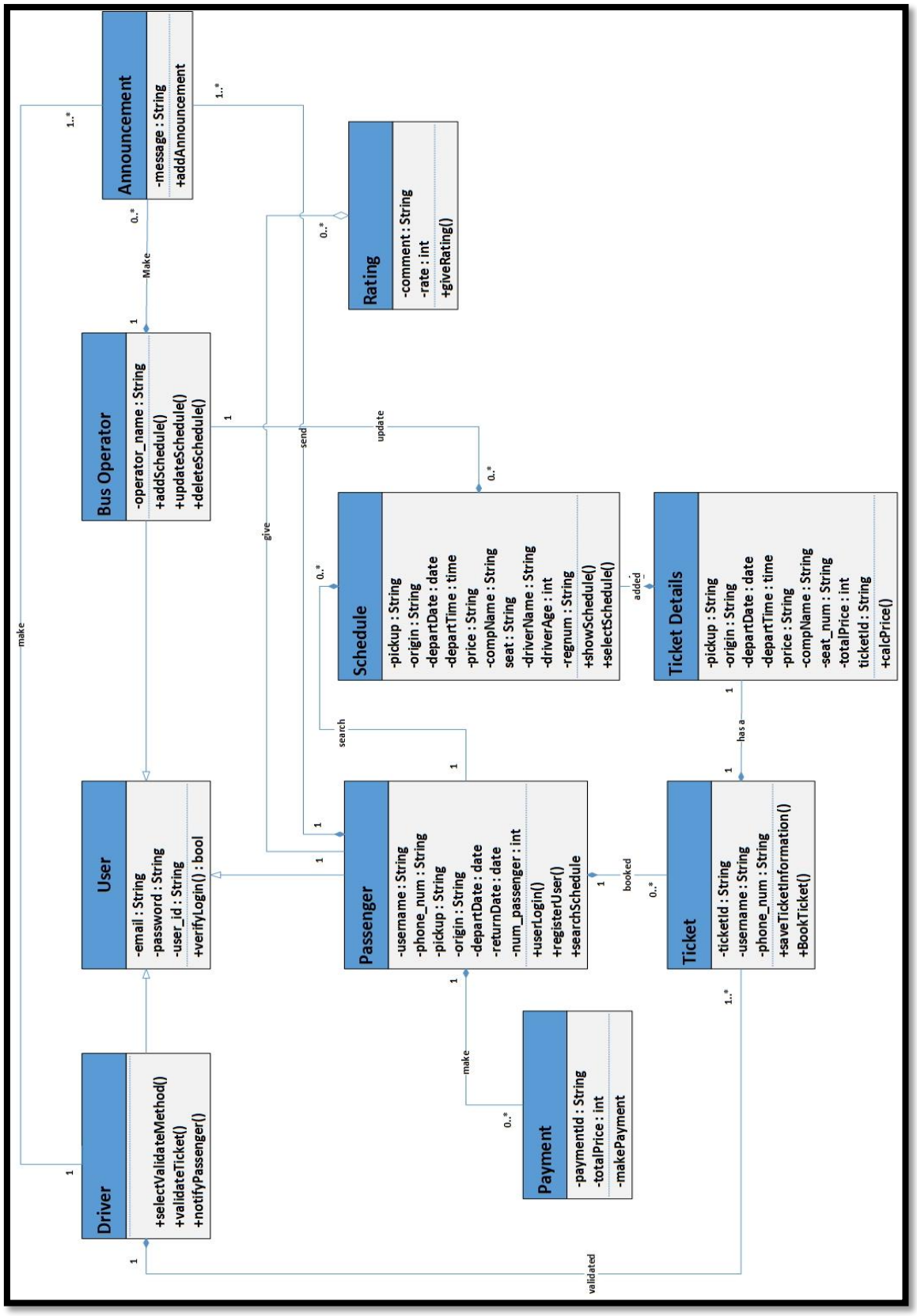

Figure 41: Design class diagram for BookMe

Figure above shows the design class diagram for the system where all the functionalities is shown in the table that linked together. There are 3 user that inherit the functionalities and the attributes from User table. For the bus operator, the functionalities that are associated with it is CRUD for schedule and also announcement where it can be changed based on bus operator will. For passenger functionalities, they are bookTicket where passenger book the express bus ticket by selecting the schedule in showSchedule and selectSchedule function. From this function there is one function they need to do which is makePayment function where all the payment will be conducted there and after that the ticket table will have a data that holds inside TicketInformation function that will be use to display the ticket to the passenger. This ticket information will be validate by the bus driver where it will match the ticket information from the passenger and the information inside the Ticket table.

4.3. Detail Sequence Diagram

4.3.1. Bus Operator Detail Sequence Diagram

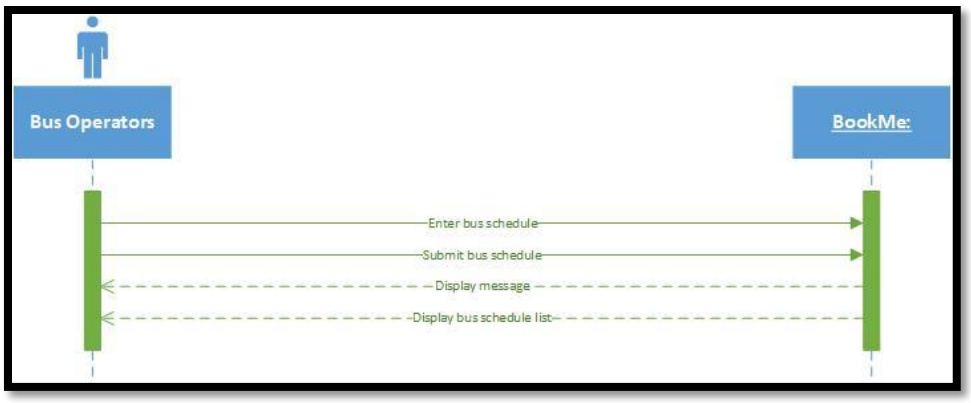

Figure 42: Details sequence diagram for add schedule

- Bus operator enter the bus schedule information such as origin and destination, departure date, departure time, ticket price, bus registration number, bus company name and driver details.

- Bus operator select submit to push the data to the database that will be updated to passenger application.
- A message “Schedule successfully added” will be prompt to bus operator that notify the schedule has been added.
- A bus schedule list will be shown to the bus operator.

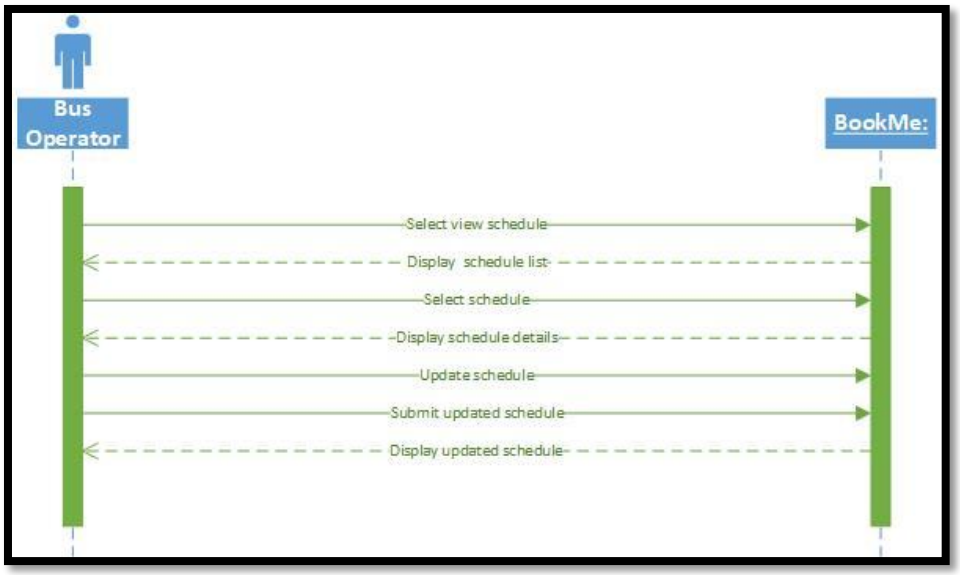

Figure 43: Detail sequence diagram for update schedule

- Bus operator select to view schedule
- Schedule list will be display to the bus operator
- Bus operator will select the schedule that need to be updated
- Schedule information can be updated
- Bus operator submit updated schedule
- Updated schedule will be added into schedule list

Figure 44: Detail sequence diagam for delete schedule

- Bus operator select to view schedule list
- Schedule list will be display
- Bus operator select the schedule that need to be deleted
- Updated schedule list will be display

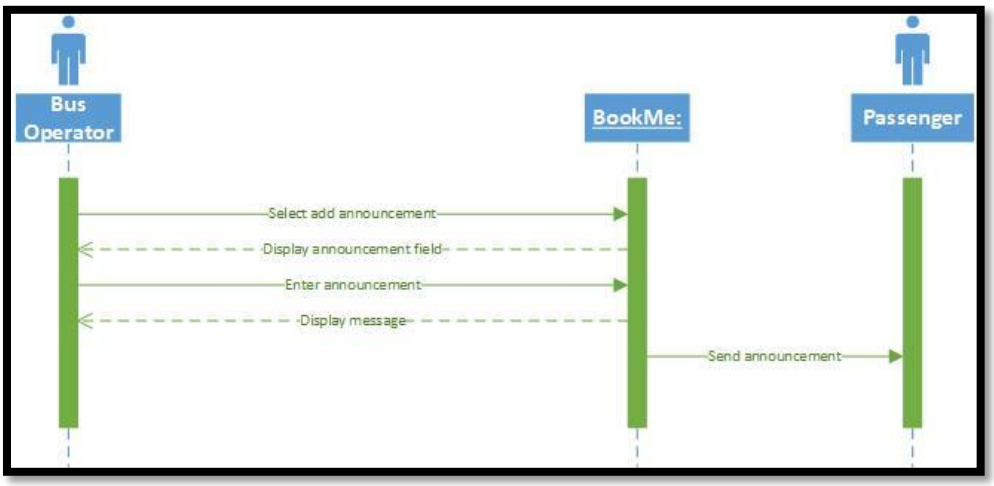

Figure 45: Detail sequence diagram for add announcement

- Bus operator select add announcement
- An announcement field will be display
- Bus operator enter announcement
- Bus operator submit announcement and will be received by the passenger
- A message will be display

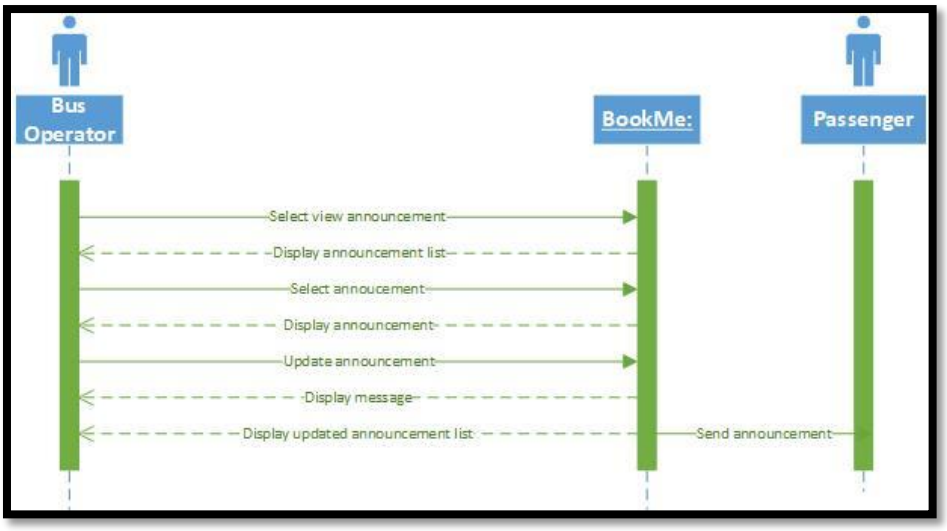

Figure 46: Detail sequence diagram for update announcement

- Bus operator select to view announcement
- Announcement list will be display
- Bus operator select which announcement that need to be updated
- Announcement will be added to announcement field and bus operator can update it
- Bus operator submit the announcement
- A message will be display if the update is successful
- Updated announcement list will be display

4.3.2. Bus Driver Detail Sequence Diagram

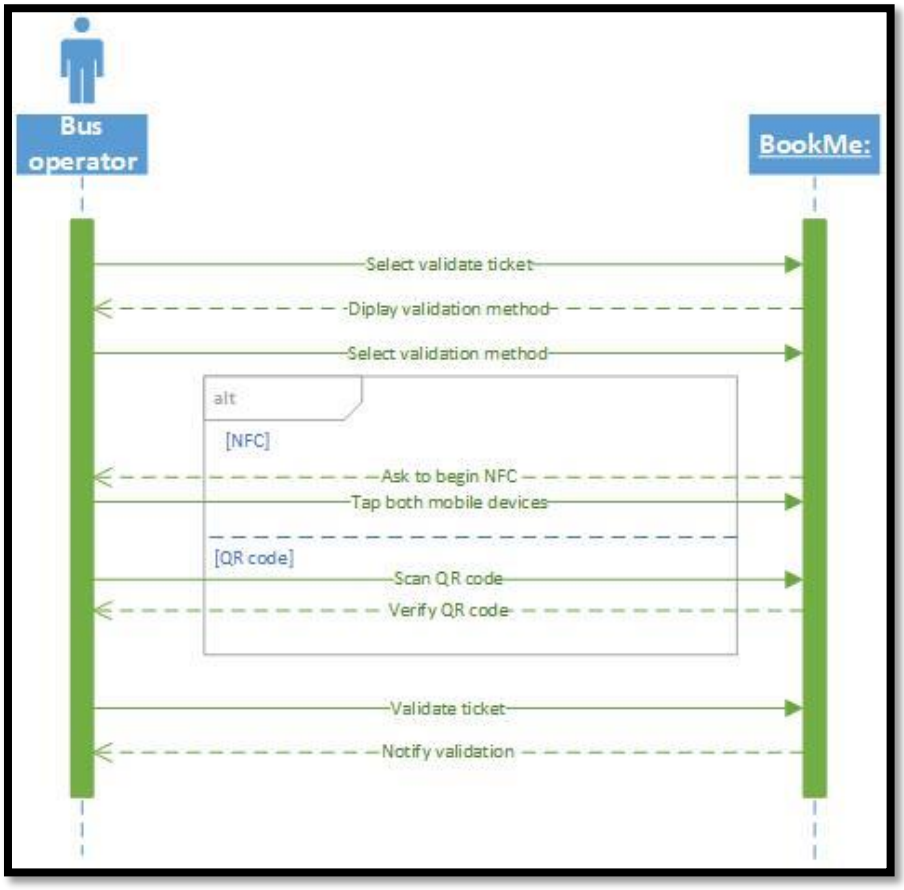

Figure 47: Detailed sequence diagram for validate ticket

- Bus driver select the method for validation
- If method selected is NFC, a message will be display that asked bus driver to tap his phone to passenger to begin validation
- If QR code, the application will open QR code scanner and bus driver need to scan passenger QR code to validate their ticket

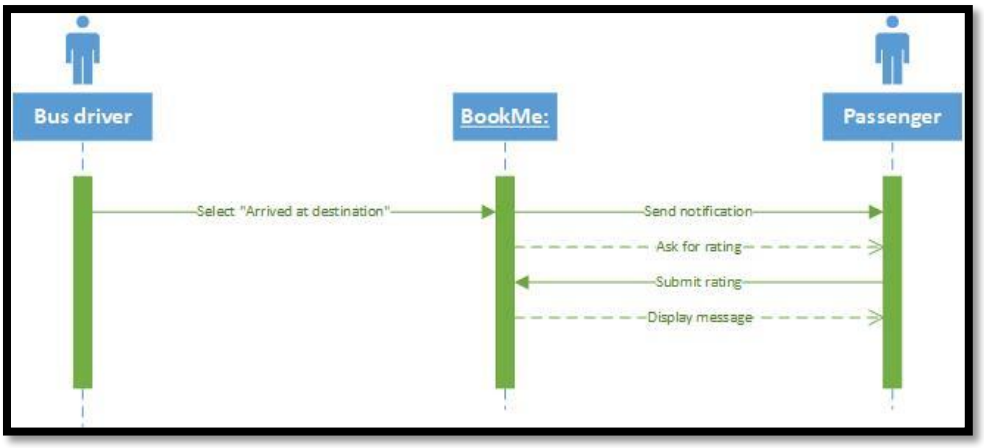

Figure 48: Detailed sequence diagram for notify passenger

- Bus driver select arrived at destination
- A notification will be send to the passenger application
- A push notification will notify passenger, these notification will ask passenger to give rating for their trip
- Passenger submit rating
- Message will be display to the passenger

4.3.3. Passenger Detail Sequence Diagram

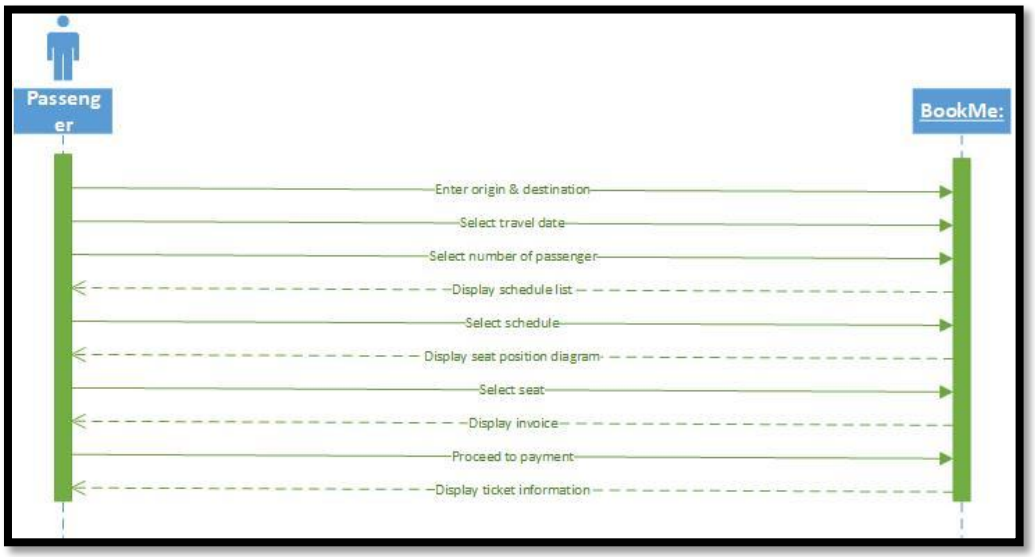

Figure 49: Detail sequence diagram for book ticket

- Passenger enter their origin and destination in the autocomplete field

- Passenger select the departure date on a calendar pop up
- Passenger select the number of passenger by using dropdown
- A schedule list will be display consist of date and departure time and passenger can select which schedule they want
- Seat diagram will be display and passenger need to select which seat they want but only available seat are allowed to be selected and its limit to number of passenger that they have selected
- An invoice will be display to passenger before they make their payment to confirm their booking
- Passenger proceed to payment (PayPal) and make payment by using their account
- Passenger ticket will be display after they complete their payment

Figure 50: Detailed sequence diagram for enter origin & destination

- Passenger enter origin and destination in the autocomplete field in the application that consist of several locations that has been added by the bus operator

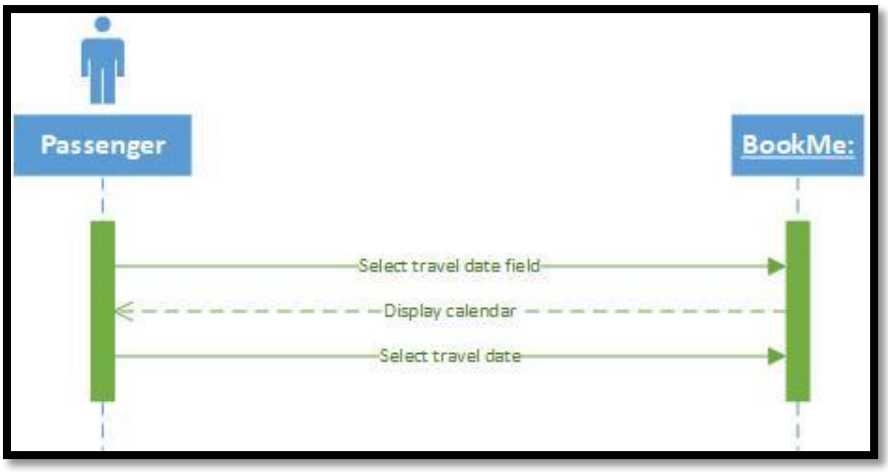

Figure 51: Detailed sequence diagram for select date

- Passenger select departure date by choosing a date from a calendar pop up and if they selected round trip option they will need to select 2 departure date

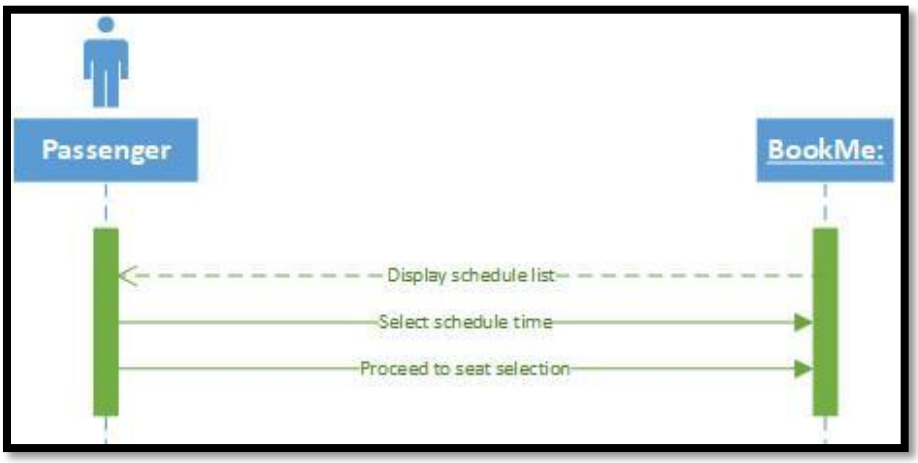

Figure 52: Detailed sequence diagram for select departure time

- A schedule list will be display to passenger where they can view all the schedule with departure time that available on the date that they has been choose
- After passenger have decided which schedule they want, they will be directed to seat selection

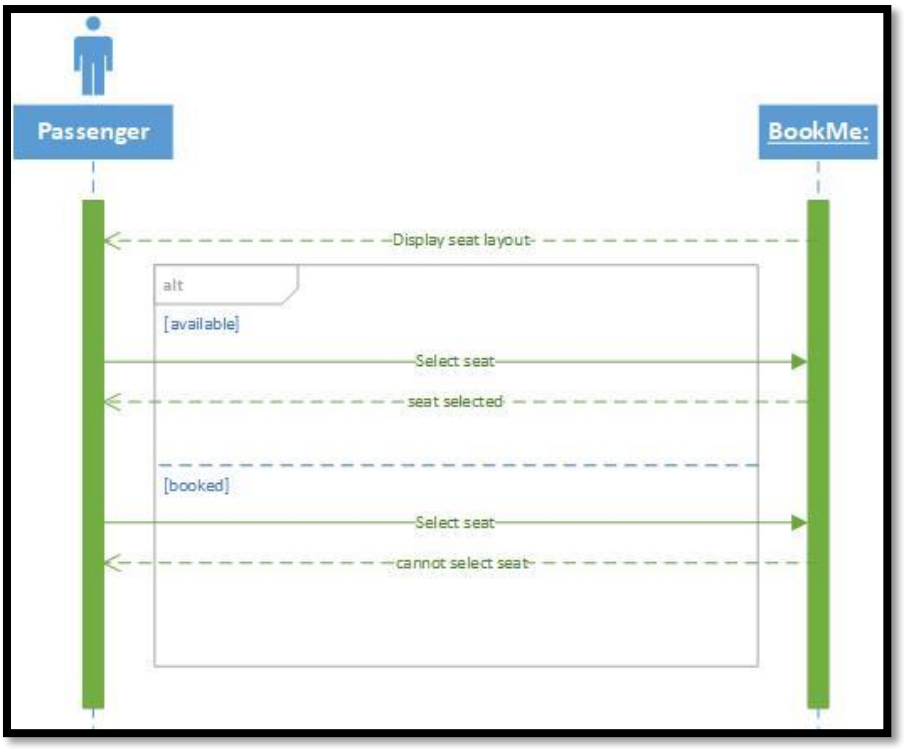

Figure 53: Detailed sequence diagram for select seat

- A seat layout diagram will be display where it will show seat that are available and seat that have been occupied. Passenger only allowed to select seat that are available
- If they have choose occupied seat they cannot click the seat
- The number of seat selected is correspond to number of passenger they have choose earlier and if seat selection is exceed the number of passenger, a pop up will display that asking passenger to proceed for payment

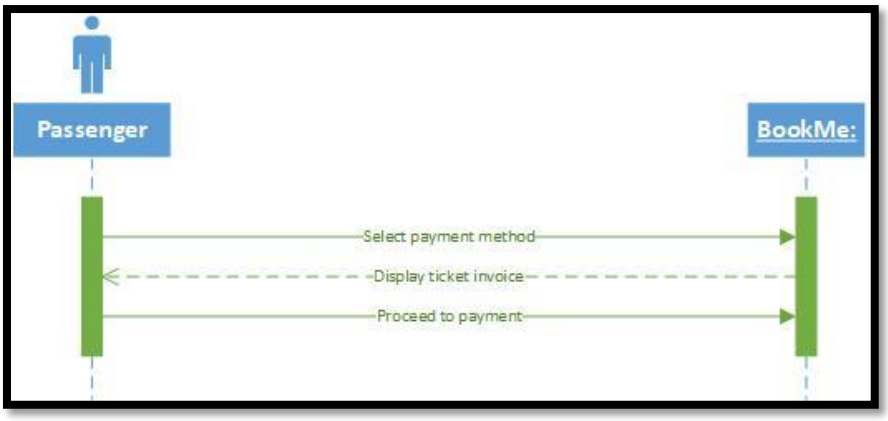

Figure 54: Detailed sequence diagram for select payment method

- Passenger will be ask to select payment method but for this case only PayPal can be use
- Ticket invoice will be display to the passenger before they proceed to make payment

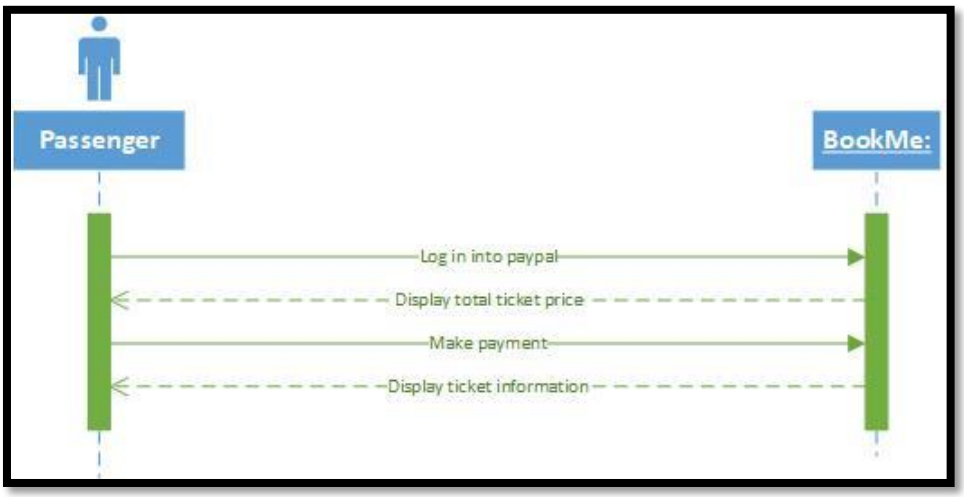

Figure 55: Detailed sequence diagram for make payment

- Passenger need to log in into their PayPal account in order to making payment
- Total ticket price will be display to the passenger to confirm their ticket and if the passenger satisfy with it, they can proceed with the payment

- Ticket information will be display to the passenger once they have finished their payment

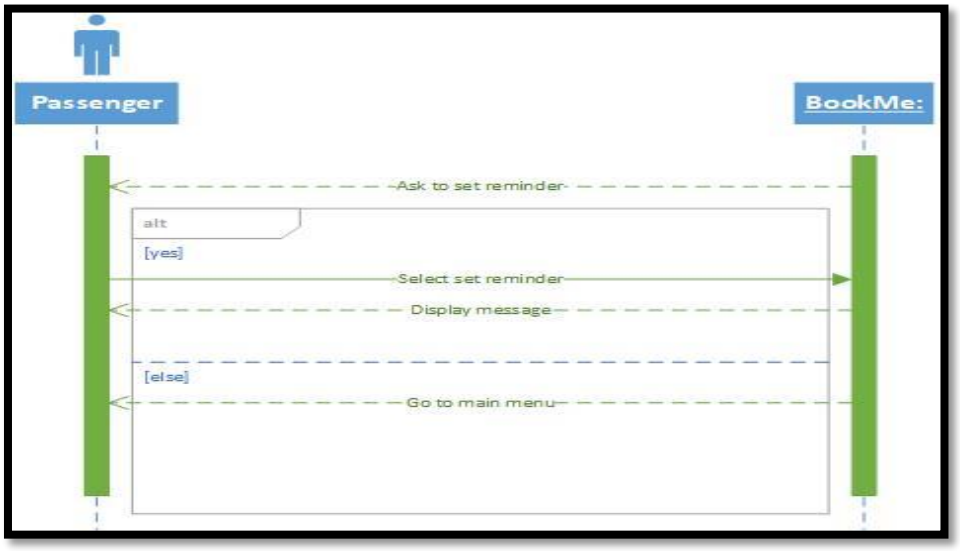

Figure 56: Detailed sequence diagram for set reminder

- An option to set reminder will be display to passenger after they have completed their payment, this reminder is correspond to passenger ticket departure time and date that will notify passenger at least 20 minutes before their departure.
- Passenger will be given option to set reminder if they need to or just proceed to main menu

Figure 57: Detailed sequence diagram for view driver details

- Another functionality is view driver details, the driver details can be viewed by the passenger if they already have their ticket as the driver details is associated with the express bus ticket.

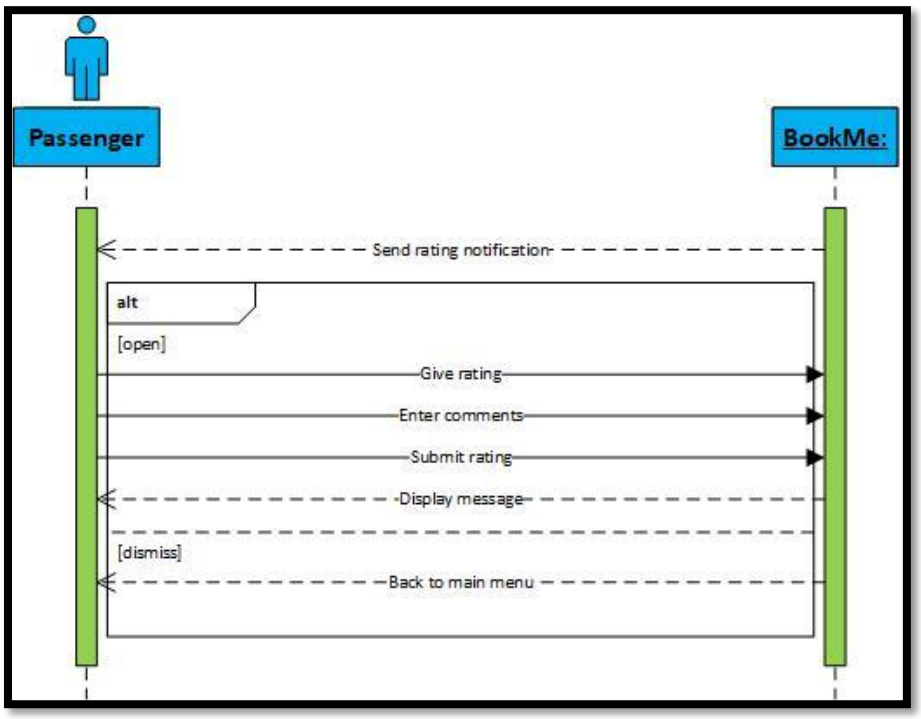

Figure 58: Detailed sequence diagram for give rating

- A rating notification will be send to the passenger after the bus driver have arrived at their destination
- This notification can be opened or dismiss by the passenger if they don't want to give rating for their trip
- If they select to give rating, a rating star and comment field will be display that allowed to passenger to give their rating and submit it
- A message will be display after they have finished their rating

4.4. Design Database

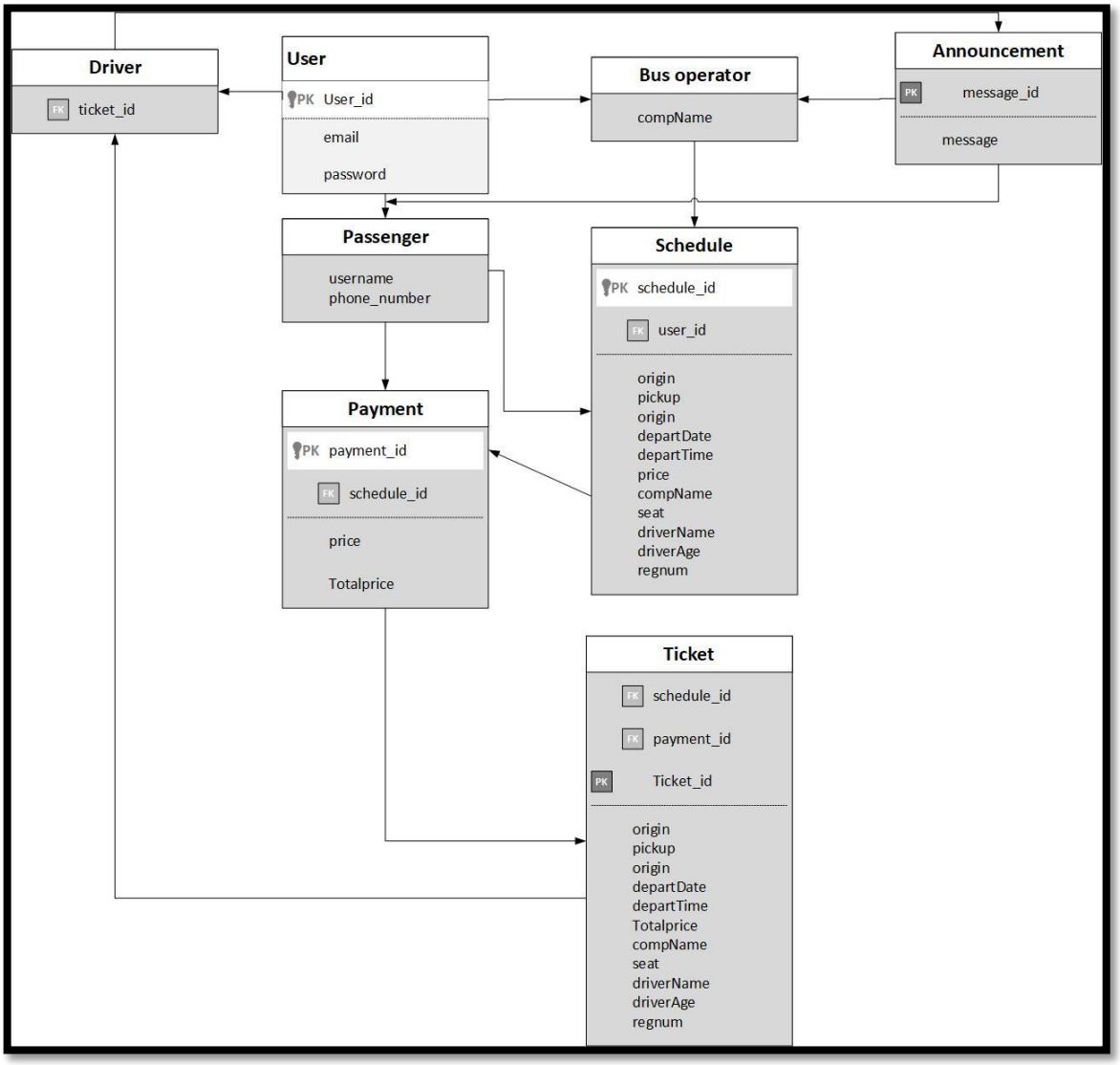

Figure 59: Design database diagram for BookMe

Figure above shown the design database for the system. Design database is use to developing database for the system, even though the database use for this system is Firebase database that using child and parent and also using JSON attributes but the design database still need to be done as a reference when developing the database for the system. There are 3 user that inherent the attributes from the main table which is User table that holds email, password and user_id attributes. Therefore all table that link to the User table will inherit all the attributes from the table. For example, table

Bus operator is linked to User table and using user_id attributes that will be use in other table that linked to Bus operator table. For Schedule table, the table has several attributes that retrieved data from the bus operator and this schedule will inherit bus operator id every time he/she add new schedule. The ticket table will acquired its attribute from the Schedule table as passenger select which schedule they want and then the price from the Schedule table will be added into payment table where it will be calculated as Totalprice in the Payment table. After making payment, the Ticket table will use all the attribute from the Schedule and Payment table to create a passenger ticket. For the Announcement table, it consist of message_id and message where it will be use by the bus operator and send it to passenger. Same goes to bus driver where they will trigger the Announcement table to send notification to passenger.

4.5. Design User Interface

4.5.1. BookMe Passenger

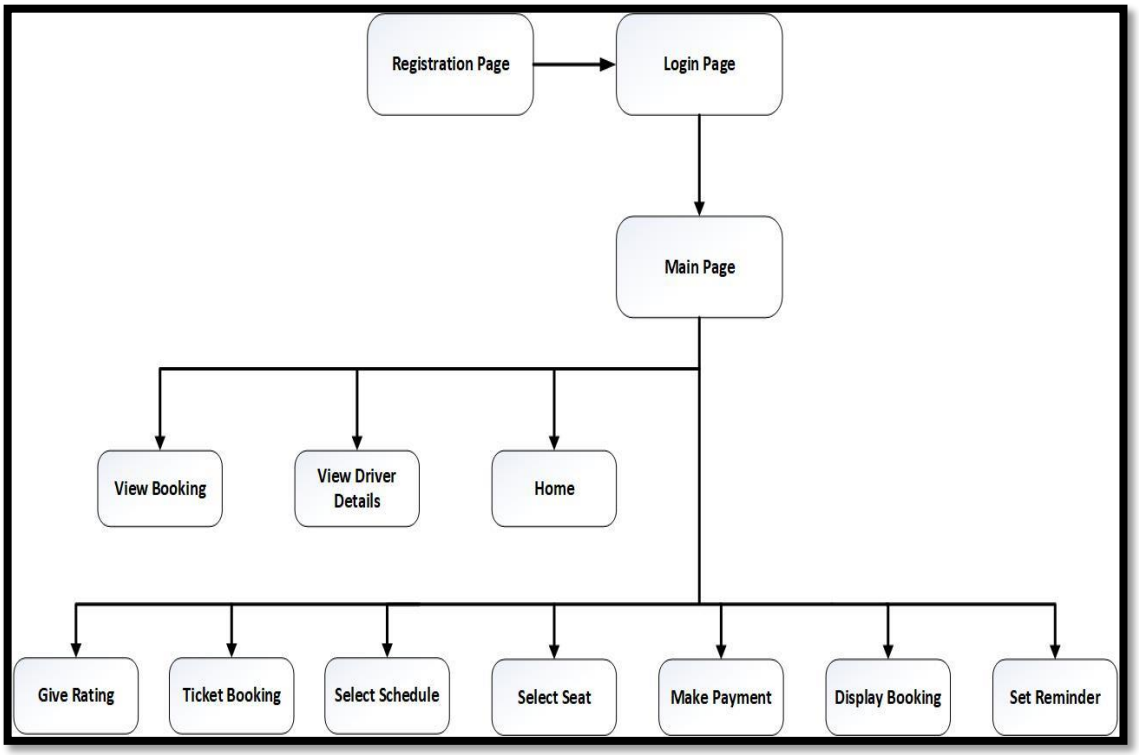

Figure 60 The flow of UI of BookMe Passenger

Figure 60 show the main feature of BookMe Passenger. The screenshot is shown in Appendix A.

4.5.2. BookMe Driver

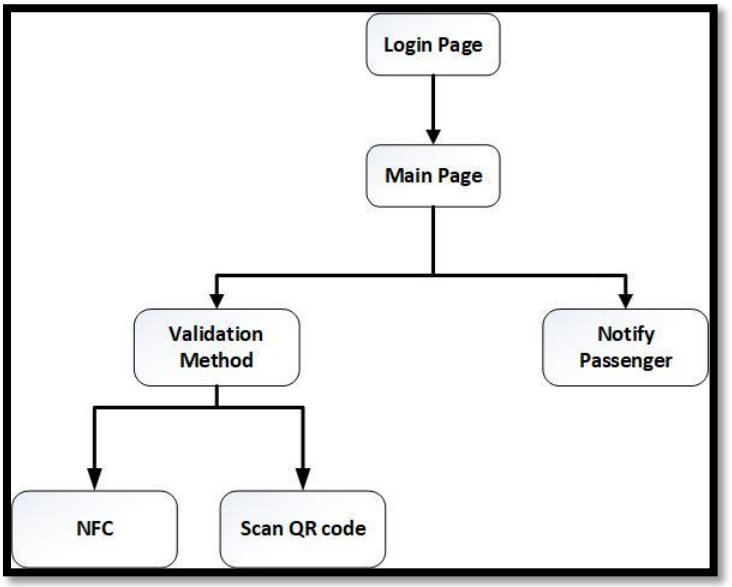

Figure 61 The flow of UI of BookMe Driver

Figure 61 show the main feature of BookMe Driver. The screenshot is shown in Appendix A.

4.5.3. BookMe Bus Operator

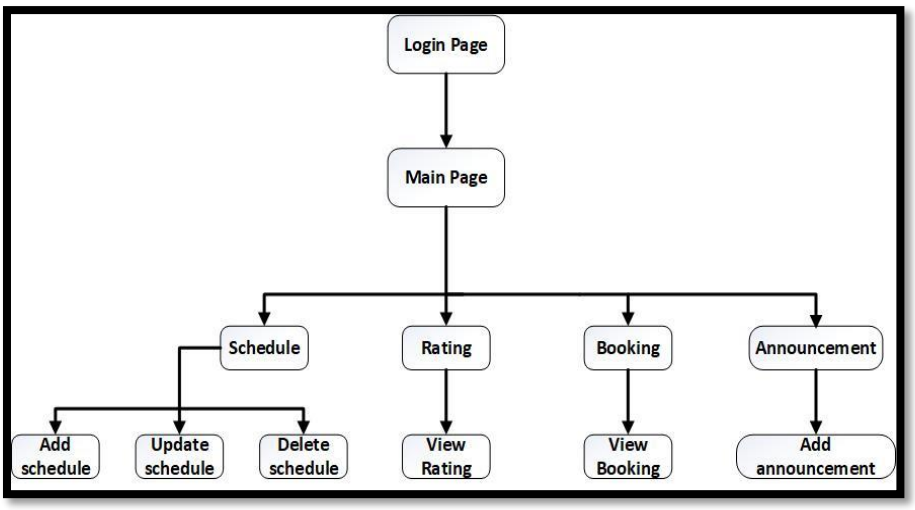

Figure 62 The flow of UI of BookMe Bus Operator

Figure 62 show the main feature of BookMe Bus Operator. The screenshot is shown in Appendix A.

4.6. Implementation Strategy

4.6.1. BookMe Passenger Implementation Strategy

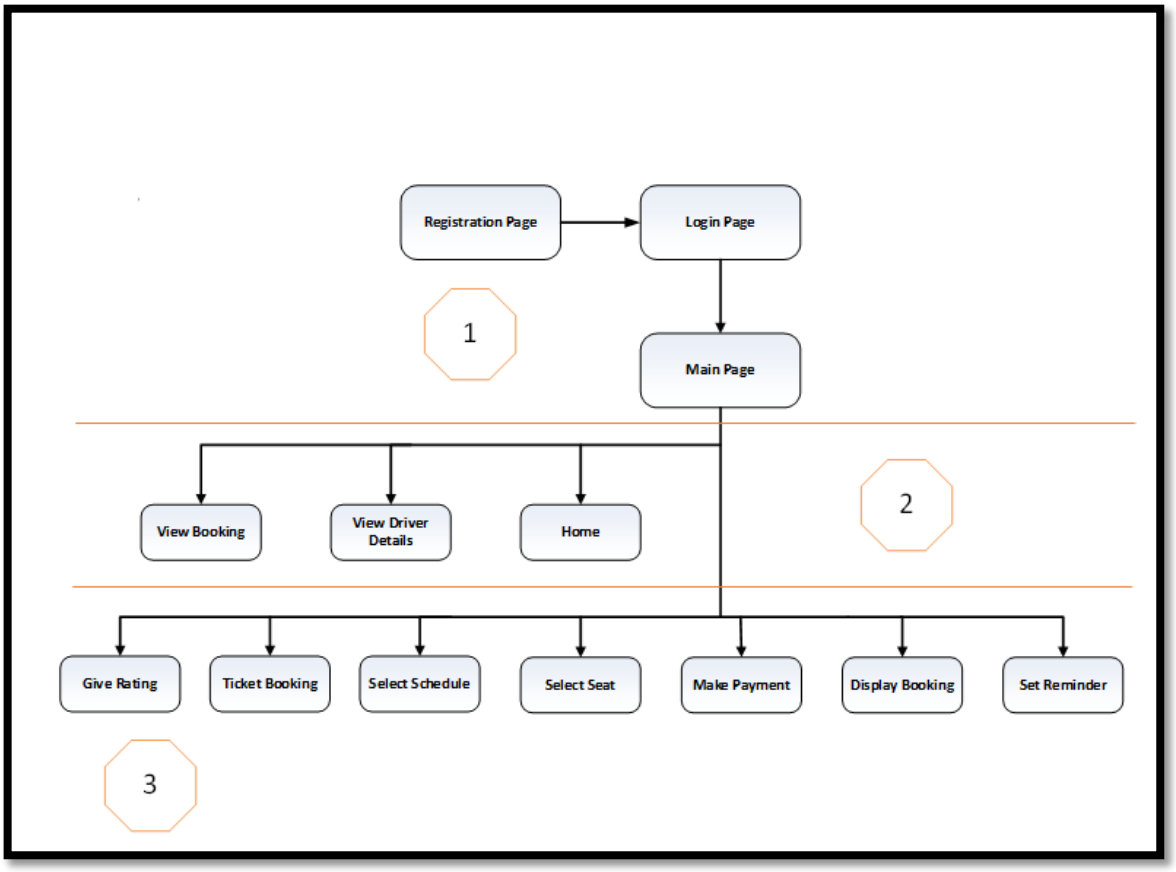

Figure 63 Flow of completing BookMe Passenger development process

In order to complete the passenger application, implementation strategy that being used is Top-Down strategy. Implementations process start by completing the function for passenger registration. If the passenger have an account they will start from the login function.

Next, the implementation process will consist of 7 main features that is stated in the Figure 63. The main features that are required passenger to completing the function is ticket booking, select schedule, select seat, make payment, and display booking. All of these main features depends on each other to be completed and passenger are required to complete the functions to enable 2 more functions which is

set reminder and give rating. What are the similarity for both of these function are it can be dismiss by the passenger as it is only an optional functionalities.

Lastly, the implementation process followed by completing the Feature Menu, where passenger can view some of the booking details and driver details if they want to do so. This feature is supported by the main feature which passing the data to the database.

4.6.2. BookMe Driver Implementation Strategy

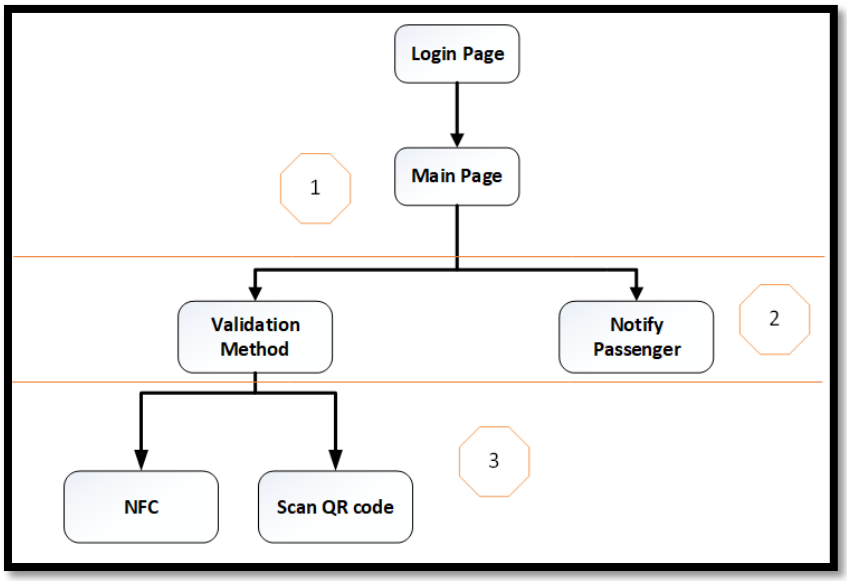

Figure 64 Flow of completing BookMe Driver development process

Based on Figure 64, implementations process starts by completing the function for driver login. For driver application there will be no registration function as they will be registered by the admin of the system.

Next, the implementation process will be continued by having two main functionalities which is validation method and notify passenger. Validation method function is just a transition to other functionalities. For the passenger notification, the

bus driver will trigger the Firebase Cloud Messaging server to send a push notification to passenger that will ask them to provide a rating for their trip.

Lastly, the implementation process followed by continuing from the function validation method where there will be 2 functions which is NFC that will required bus driver to validate passenger ticket by tapping their device together. For scan QR code, bus driver only needs to scan QR code that has been generated in passenger ticket.

4.6.3. BookMe Bus Operator Implementation Strategy

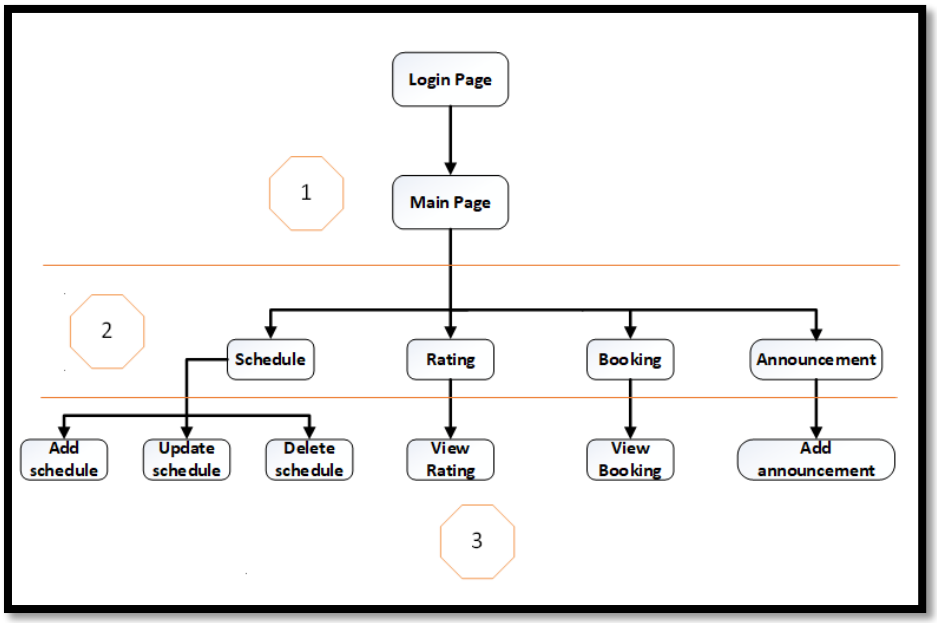

Figure 65 Flow of completing BookMe Bus Operator development process

For Bus operator application the implementation process begins with the login to the web application and they also has been registered by the admin that created the application for security purpose.

Next, the implementation process will consist of 4 main features that is stated in the Figure 65. The main features that are available for the bus operator are Schedule,

Rating, Booking, and Announcement. All of these features will have their sub features that can be access by the bus operators.

Lastly, the implementation process followed by choosing which sub features that bus operator's needs from the 4 main features. For schedule, bus operators are allowed to perform CRUD for the bus schedule where all of the data will be updated in the Firebase Database in Real-Time. They also are allowed to view passenger booking that helps them to view how many people have booked the bus ticket and view the passenger rating and feedback as a tool to improve their service. If there is any announcement, bus operator can send an announcement to passenger by entering their announcement and it will be directly send to passenger application by using push notification.

5 SYSTEM TESTING & EVALUATION

5.1. Testing Strategy

The system is being tested in four differing testing strategy that is the unit test, integration test, system test and acceptance test.

Unit Test:

Unit testing is testing directly at the most granular level. First, we needed to set up all condition for testing, then we will call the method or trigger the function so that it is being tested. The result return will then be verified.

Integration Test:

Integration test will be at a higher level of testing where individual method are combined and tested as group. The integration test is donned at each module to make sure each module is able to perform its own functions.

System Test:

The system testing is carried out to test the overall interaction of the component. It is used to check the behavior of a complete and fully integrated software product. The testing is donned to find whether the system meet the functional requirement.

Acceptance Test:

The acceptance test is carried out to test the user whether fulfilled their expectation and is focus more on the functionality

5.2. Test Case

5.2.1. BookMe Passenger Application (Android)

Passenger application for BookMe is the important part as the passenger will be the main user of the application and passenger application have the most important functionalities. To conduct the system's testing, user need to register their account through the application and after that user are allowed to login into the application main page. Passenger application with its server service and its user interface was fully tested. Below are the results of the testings that have been conducted.

5.2..1 Registration and Login

Table 24 Registration & Login Function Testing

Function	Input	Expected Result	Test Result
Passenger Registration	Email, password, username, phone number	Passenger will be directed to the application main page.	✓
Passenger Login	Email, password	Passenger will be directed to the application main page.	✓

Based on Table 24, I already demonstrate that all the functions work successfully. Passenger that are not having any account associated with the application needs to register in order to make booking, while passenger that already have a BookMe account can directly login to the application to make a booking.

5.2..2 Ticket Booking

Table 25 Ticket Booking Function Testing

Function	Input	Expected Result	Test Result
Select origin, destination, number of passenger & travel date	Origin, destination, travel date, number of passenger	When all the required field already filled by the passenger they will be redirect to the schedule page.	✓
Select schedule	-	Passenger select schedule based on the departure time and proceed to seat selection.	✓
Seat selection	Seat location	Passenger will select seat location and the seat selection only allowed on available seat and number of seat select must be same as the number of passenger.	✓
Make Payment	Email, password	Payment method will be used is PayPal and passenger need to login their PayPal account to make payment. If their payment successful they will received their Express bus ticket.	✓
Set Reminder	-	Passenger will received a notification.	✓

Based on Table 25, all the function for ticket booking is work successfully. Ticket booking is the most important part of this system. Firstly, passenger need to enter their origin, destination, travel date and number of passenger. If there is any information that entered by the passenger didn't match with the database, there will be no data

shown to the passenger. If all the information entered is match with the database, list of bus scheduled will be display and passenger will select one of it (For round trip 2 scheduled) and need to select seat for their trip. For payment, this system is currently using PayPal as it is only platform that can be used for dummy payment. If the payment already completed, passenger ticket will be displayed and they are allowed to choose whether set a reminder that will remind them for their departure or finish the booking.

5.2..3 View Booking, Driver Details and Give Rating

Table 26 View Booking, Driver Details and Give Rating Function Testing

Function	Input	Expected Result	Test Result
View Booking details	-	Passenger can view their booking	✓
View Driver details	-	Passenger can view driver details that are associated with their ticket	✓
Give Rating	Rating star and comment	Notification will ask passenger to give their rating once they reached their destination. They are allowed to dismiss the notification.	✓

Based on Table 26, all the function works perfectly. For view booking and driver details, these functions will display output if passenger already completed their booking. As for give rating functionalities it will notify passenger if they are already reached their destination and passenger can choose to give rating or just dismiss the notification.

5.2.2. BookMe Driver Application (Android)

This application will be use by the bus driver where it will consist of several functionalities which is ticket validation (NFC&QR code) and “I’m arrived” to send notification to passenger to ask their rating and to notify them that they already arrived. For driver, there will be no registration functionalities as they already been registered by the super admin of the system and they just need to login to access the application.

5.2..1 Ticket Validation

Table 27 Ticket Validation Function Testing

Function	Input	Expected Result	Test Result
Validate ticket	-	Driver click button to open validation method page.	✓
NFC Validation	Passenger ticket ID	Driver tap their device with passenger device to validate their ticket.	✓
QR code validation	Passenger ticket ID	Driver scan QR code generated from passenger ticket to validate their ticket.	✓

Based on Table 27, all the function tested work successfully. For ticket validation there will be two method that will be used by the bus driver which is NFC and QR code. Both methods will use passenger ticketID to validate their ticket by matching the ticket Id with one that exist in the database.

5.2..2 Notify Passenger

Table 28 Notify Passenger Function Testing

Function	Input	Expected Result	Test Result
Notify Passenger	Driver button click	Driver click button to send notification to passenger.	✓

Based on the Table 28, the function is worked as planned. These functionalities requires the driver to click a button that will send notification for rating from passenger and also to notify passenger when they already arrived at their destination.

5.2.3. BookMe Bus Operator Application (Web)

For admin application they will be using web application that focusing more on the CRUD functionalities where bus operator is responsible to the bus schedule, accessed passenger rating etc.

5.2.4. Bus Schedule

Table 29 Bus schedule function testing

Function	Input	Expected Result	Test Result
Add schedule	Origin, destination, date, time, company name, driver name, age, address	Bus operator add information for the bus schedule and it will be updated in the database and will be display in passenger application.	✓
Update Schedule	Origin, destination, date, time, company name, driver name, age, address	Bus operator update information for the bus schedule and it will be updated in the database and will be display in passenger application.	✓

Delete Schedule	-	Bus operator will select which schedule they need to delete from the list and delete it by using button and it will remove the schedule data from the database.	✓

Based on Table 29, all the CRUD functionalities for the bus schedule works perfectly. Bus operator add the information for the bus schedule and some of the information have their own format that can be changed as for the browser and database constraint. Same goes to update the bus schedule and for delete it will removed the information that bus operator needs to delete.

5.2..1 Announcement

Table 30 Announcement function testing

Function	Input	Expected Result	Test Result
Add announcement	Announcement title and body	Bus operator add announcement and will be send directly to passenger application.	✓

Based on Table 30, the functionalities for adding announcement works well. Bus operator just need to enter their announcement if there is announcement and will be send directly to passenger application.

5.2..2 Rating

Table 31 Rating function testing

Function	Input	Expected Result	Test Result
View Rating	-	Bus operator can view passenger rating and comment.	✓

Based on Table 31, view rating function is work successfully. For this function, bus operator is allowed to view passenger rating and comment that will be used as a tools to improve their service in the future and all of the data is updated in real-time basis.

5.3. Comparison with Other Online Bus Ticketing System

Table 32 Comparison with other online bus ticketing system

Functionalities	BookMe	EasyBook	RedBus
Login & Register	✓	✓	✓
Ticket Booking	✓	✓	✓
Seat Selection	✓	✓	✓
Schedule Selection	✓	✓	✓
Make Online Payment	✓	✓	✓
View Booking	✓	✓	✓
View Driver Details	✓	✗	✗
Set Reminder	✓	✗	✗
Give Rating	✓	✗	✗
Received Notification	✓	✓	✓
NFC validation	✓	✗	✗
QR code validation	✓	✗	✗

5.4. Summary of Important Findings

Throughout this project development, the system implementation and testing is an important phase to ensure that the product meets the minimal user requirements. Some feature that facilitates the system should be added to improve user experience. Iterative approach is used in this project which made up of three iterations. Assignment of task is an important task since it is needed to understand completely on the task that is assigned in order for the better development of the project. The objectives of this project are achieved when it is successful to satisfy all of the system objectives that has been stated for this project. Besides that, for this type of project it must focusing on the user interface part as the user for this application will come from different type of age and the level of understanding for the user about their ticket is important because the information that will be stated in the ticket will important for some of the user especially the user that has no experience using the online bus booking system.

The driver application is a new feature that has been developed as for the existing system, bus operator is the one that responsible to validate passenger ticket by manually cross-referring passenger ticket number, name, and seat location with their printed record. The user interface for bus operator need to be easy to understand and be use as bus driver needs to understand the functionalities of the system. If the system is complicated for the bus driver, it will be a burden for them in the future. By using this application for driver, the bus operator can focus on the bus schedule, announcement, and processing passenger feedback for improving their service. This application is promoting zero paper usage as a step to saving the environment.

6 CONCLUSION & FUTURE WORK

6.1. Summary of proposed solution

Throughout the development of this system, a lot of programming concept have been learned. By understanding on the passenger and bus operator problem, this system can help to solve it with the knowledge of programming. This system has been made to assist the bus operator to eliminate the activities of unauthorized bus operators or individuals who are operating without legitimate permits and also to implement zero paper usage for the express bus ticket. For the passenger it helps passenger to book ticket easier, set reminder for their trips and view driver details as there are some issues already happens between passenger and bus driver.

In the early stage of development, this system focusses more on the basic functionalities that already implemented in the existing system. Then the problem from the existing system has been refined and a requirement has been gathered to enhance the system. In the middle stage of the development, some problem has been raised where the database is not suitable enough for website development for the bus operator and this issue has been cope by designing more simplified and user-friendly GUI for the bus operator. For the passenger application, the issue has come at bus seat selection functionalities as we needed to make some limitation for passenger selecting their seats not more than the number of passenger that they have initially selected.

This system had meet the requirement and achieved the objective that has been set during the project proposal:

- Eliminated the activities of unauthorized bus operators or individuals who are operating without legitimate permits

- Allow passenger to view express bus driver details if anything happens
- Implement zero paper usage for the ticketing system
- Allow passenger to set a reminder that will notify them for their trip
- Allow user to give rating as a feedback for the express bus service

In conclusion, this system is a success project that would able to bring a lot of benefit to the passenger, bus operator and also bus driver as it helps to solve the issue that all of this time has make the express bus ticket booking become a problem to them.

6.2. Future Work

Currently in this project there are limited function which including selecting the payment method as the payment API for online banking is hard to implement without knowledge and the server for bus operator is currently using the localhost server and not be able to be deployed on others workstation. More function can be added by gathering more information for the express bus ticket booking. The validation method by using NFC and QR code can be implemented in every type of ticket booking in the future where it can helps to minimize the time taken to validate user ticket and also make the ticket validation more secure. In hoping in the future, all the online booking system will be enhanced their system to be the same as BookMe that using NFC and QR code validation besides the zero usage of paper for the ticket.

REFERENCES

Ghazali, R. (2017, August 28). *Bus driver allegedly punches man who caught him napping behind wheel*. Retrieved from Nation | The Star Online: https://www.thestar.com.my/news/nation/2017/08/28/bus-driver-punches-man-who-caught-him-napping/

NARJAN SINGH, M. A. (2007). Melisa Kaur.pdf | E Commerce | Usability. *A STUDY AND DEVELOPMENT OF AN ONLINE BUS TICKETING SYSTEM*, 22.

Online Express Bus Tickets Booking - Singapore & Malaysia. (2018, March 14). Retrieved from Easybook®|Book Ticket Online: Bus,Train,Ferry,Car -Largest in SEAsia: http://www.easybook.com/en-my

Online, T. S. (2017, June 18). *5,000 express buses on highways to ease exodus*. Retrieved from Nation | The Star Online: https://www.thestar.com.my/news/nation/2017/06/19/5000-express-buses-on-highways-to-ease-exodus/

Tutorialspoint.com. (2014). *SDLC Agile Model*. Retrieved from Tutoralspoint.com: https://www.tutorialspoint.com/sdlc/sdlc_agile_model.html

APPENDICES

Appendix A

Screenshot of BookMe (Passenger) application

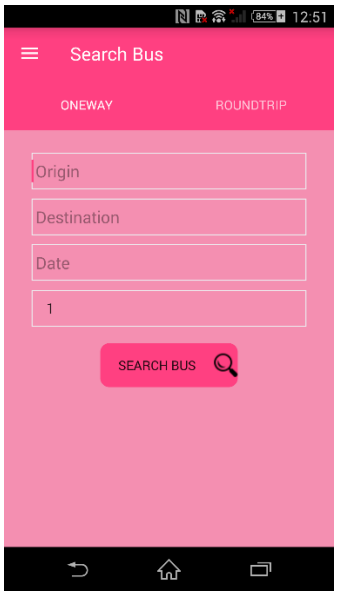

Figure A. 1 Interface for home page

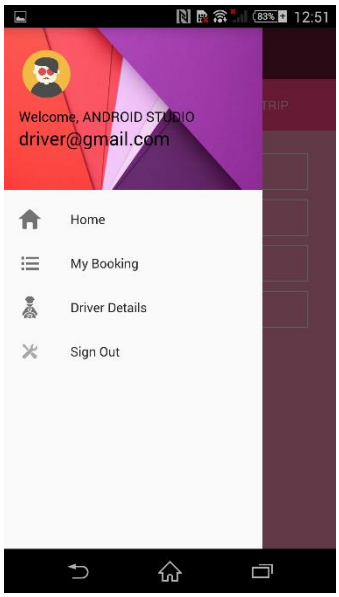

Figure A. 2 Interface for Side navigation menu

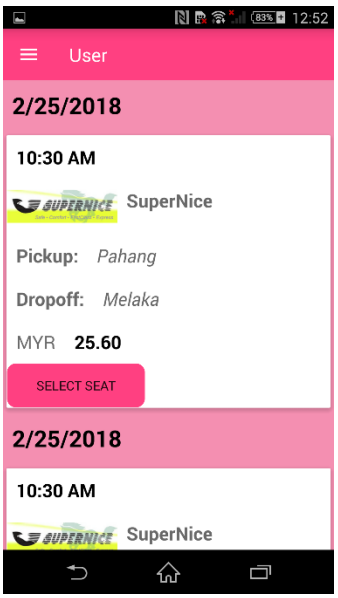

Figure A. 3 Interface for bus schedule

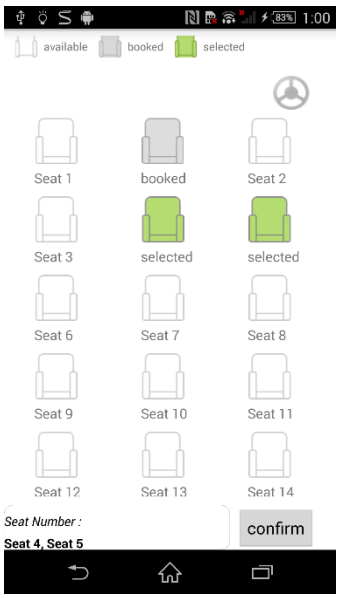

Figure A. 4 Interface for seat selection

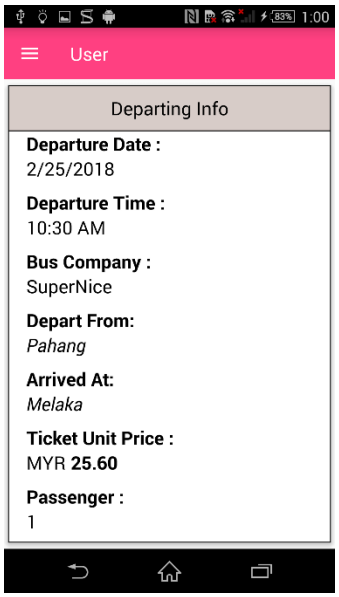

Figure A. 5 Interface for booking invoice

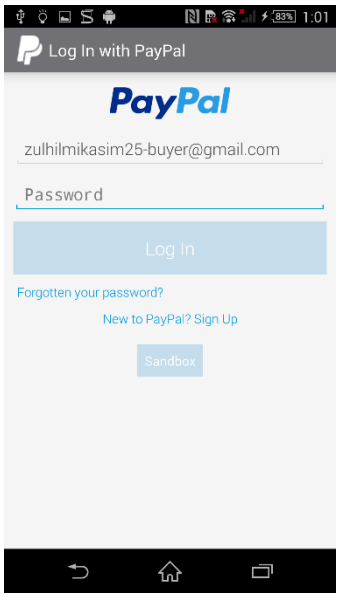

Figure A. 6 Interface for PayPal payment

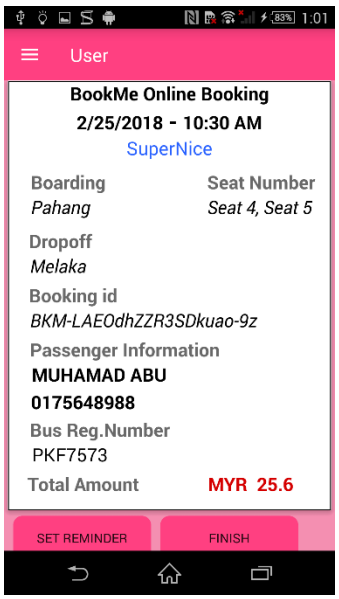

Figure A. 7 Interface for passenger ticket

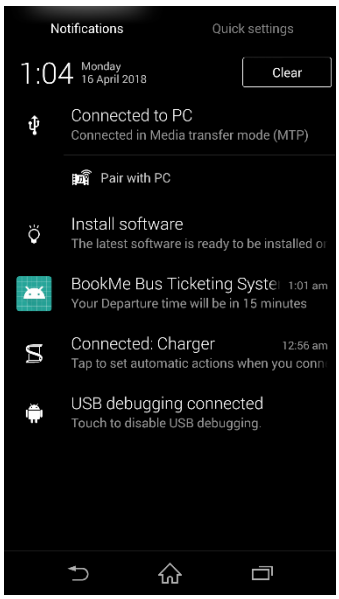

Figure A. 8 Reminder alert

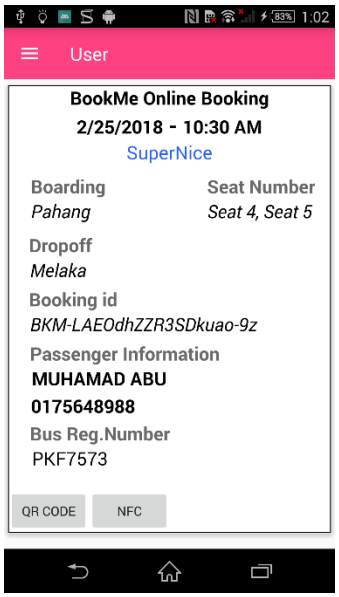

Figure A. 9 Interface for view booking

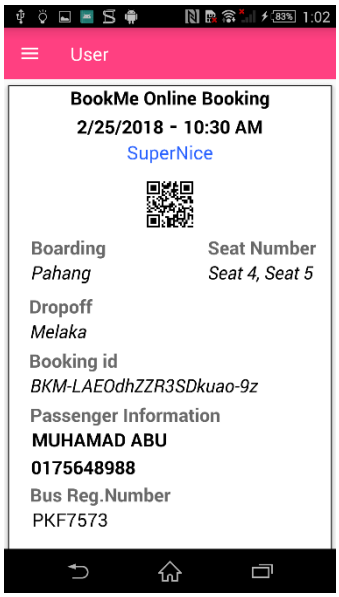

Figure A. 10 Interface for generate QR code

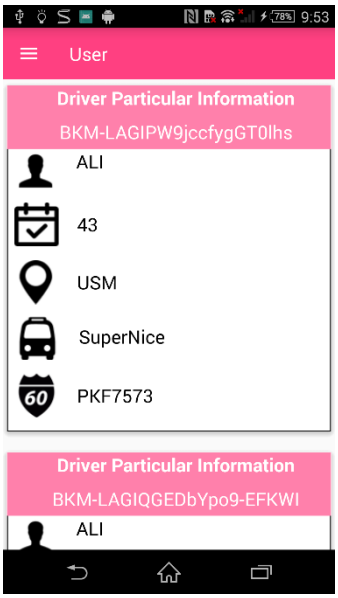

Figure A. 11 Interface for view driver details

Screenshot of BookMe (Driver) application

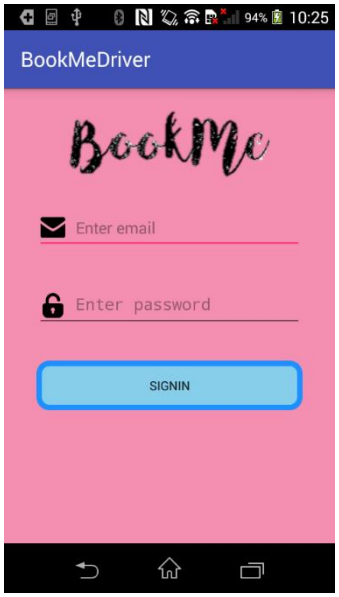

Figure A. 12 Interface for Driver Login

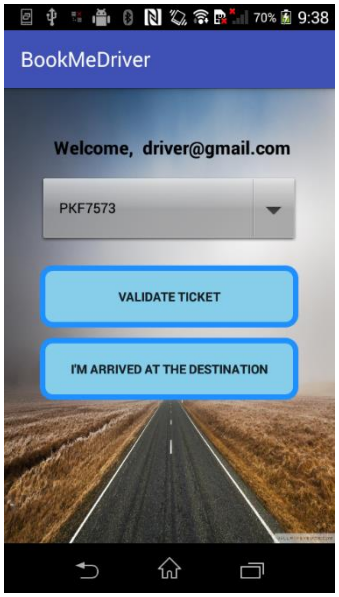

Figure A. 13 Interface for Home Page

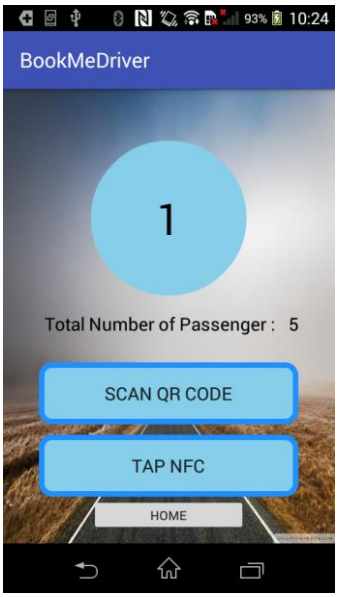

Figure A. 14 Interface for ticket validation

Screenshot of BookMe (Bus Operator) application

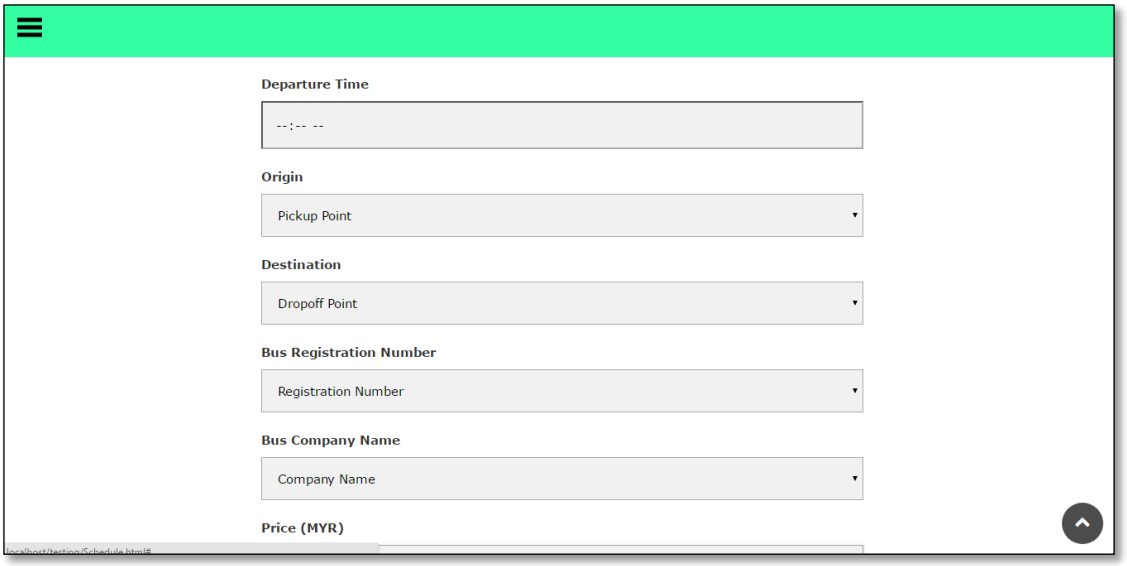

Figure A. 15 Interface for add new schedule

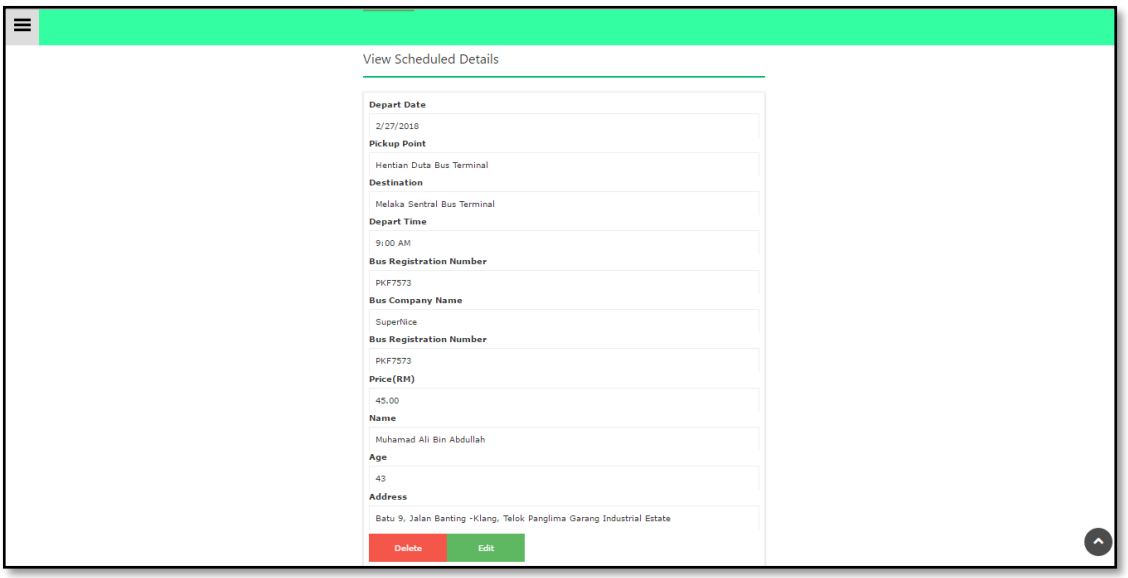

Figure A. 16 Interface for view, update, and delete schedule

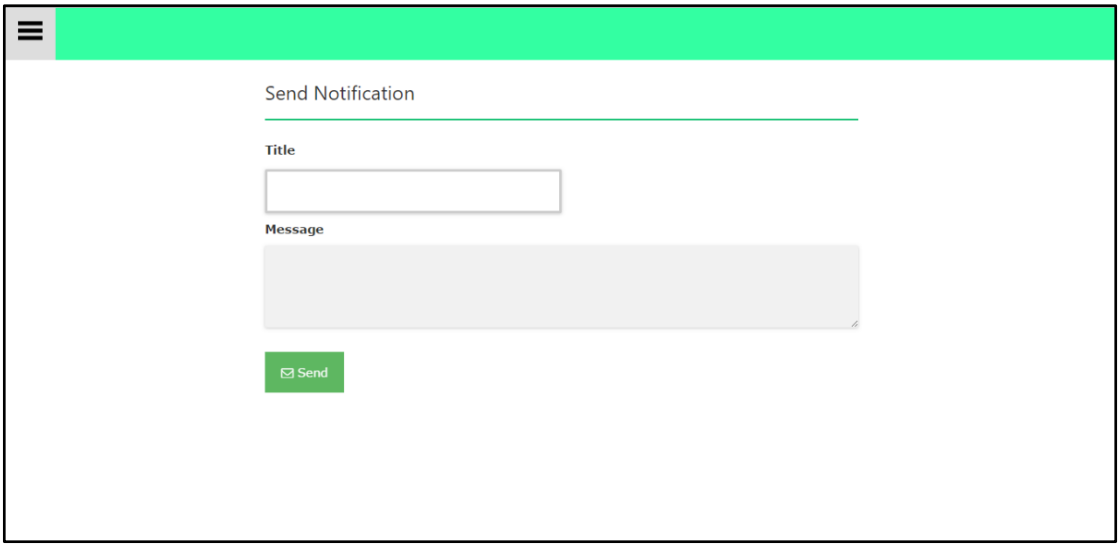

Figure A. 17 Interface for send new announcement

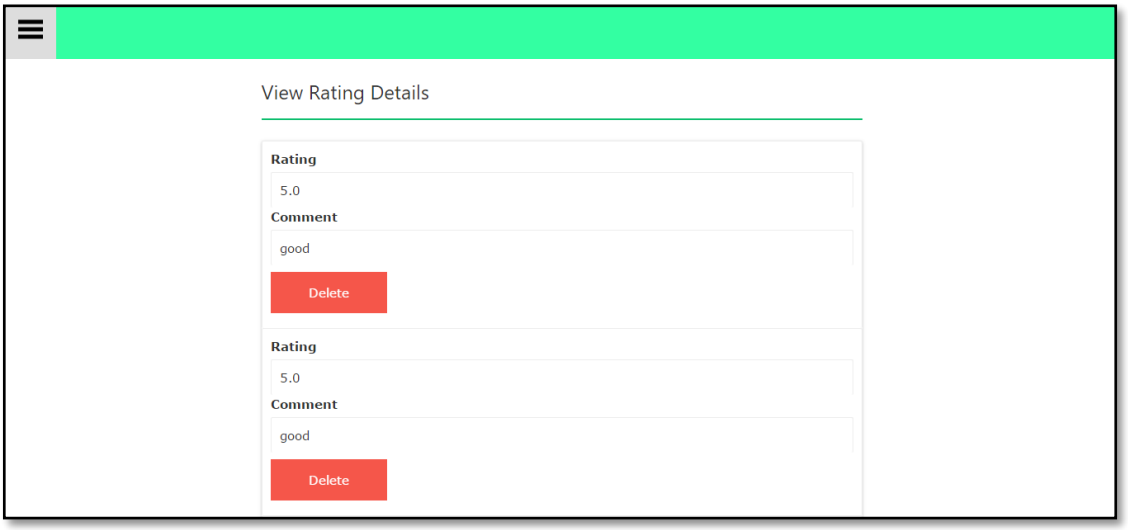

Figure A. 18 Interface for View passenger rating