QRPAY PARKING SYSTEM

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Bachelor of Computer Science (Software Engineering) with Honours

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Thesis submitted in fulfillment of the requirements
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ABSTRAK

Kaedah pembayaran tempat letak kereta awam sentiasa menjadi isu hangat selama bertahun-tahun. Banyak masalah berlaku termasuk kerosakan mesin, kekurangan ejen kupon telah menyusahkan ramai orang yang menggunakan ruang letak kereta. Ramai pakar telah mencipta beberapa aplikasi untuk mengatasi isu yang sama di kawasan yang berbeza. Walau bagaimanapun, masih terdapat beberapa kekurangan yang berlaku dalam aplikasi sedia ada. Sistem QrPay dicadangkan untuk menangani masalah pembayaran letak kereta yang berlaku di Kuantan, Pahang dengan cara yang lebih baik. Idea utama Sistem QrPay ialah pengguna boleh menetapkan tempat letak kereta dengan peranti mudah alih mereka dengan mengimbas kod QR yang dilampirkan di tempat letak kereta. Pengguna boleh membuat pembayaran letak kereta mereka melalui aplikasi mudah alih di mana sistem secara automatik akan mengira jumlah untuk mereka berdasarkan masa yang mereka habiskan pada sesi letak kereta. Sistem ini akan dihasilkan dengan menggunakan pendekatan Mobile-D yang merupakan salah satu metodologi Agile umum. Pembangunan sistem akan melalui lima fasa berbeza yang akan dibincangkan dalam laporan ini. Projek ini disasarkan kepada pihak berkuasa tempatan dan orang awam di Kuantan, Pahang untuk mendapatkan pengalaman yang lebih baik semasa menggunakan ruang letak kereta awam. Projek ini dibangunkan dengan menggunakan Visual Studio termasuk Xamarin.Forms dan Windows Form. Perekaan Interface telah dicipta bagi menyenangkan pengguna semasa menggunakan aplikasi dan dibuat berdasarkan Software Requirements Specification (SRS). Semua fungsi yang diperlukan telah divisualisasikan dalam Use Case dan Seqquence Diagram. Bagi tujuan pembangunan system, semua class dan data structure telah dibangunkan berdasarkan Software Design Document (SDD). 30 pengguna telah diminta untuk menjalankan User Acceptance Test (UAT) bagi aplikasi yang dicipta dan maklum balas telah diringkaskan dalam dokumen UAT..Dengan mewujudkan sistem ini, pengguna awam boleh membuat pembayaran untuk sesi letak kereta mereka dengan cara yang lebih mudah, dengan mengmbas kod QR yang dilampirkan.

ABSTRACT

The current public parking payment method has always been a great issue for years. Many problems including faulty machine, lack of coupon agent have troublesome the people who are using the parking space. Many experts have created some applications to overcome the same issues in different area. However, there are still some inadequate occurred in the current existing applications. QrPay Parking System is proposed to handle the parking payment issues occurred in Kuantan, Pahang with a better way. The main idea of QrPay Parking System is the user can locate the parking lot with their mobile device by scanning the QR code attached at the parking lots. The user can make their parking payment through the mobile application where the system will automatically calculate the amount for them based on the durations they spent on the parking session. This system will be developed by using the Mobile-D approach which is one of the general Agile methodologies. The development of the system will go through five different phase which we will discuss in this report. This project is targeted to the local authority and the public figures in Kuantan, Pahang to have a better experience on using the public parking spaces. This project is implemented by using Visual Studio including Xamarin.Forms and Windows Form. The interface design is easy for user to navigate and is created based on the Software Requirements Specification (SRS). All the functions available are visualized in Use Case and Sequence Diagram. For development purpose, all the classes and data structure are implemented based on Software Design Document (SDD). 30 users have been asked to perform user acceptance test (UAT) on the applications created and the feedback have been summarized in the UAT document. By creating this system, the public user can perform payment for their parking session in a more convenient way, which by scanning the attached QR Code.

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QR	Quick Response

CHAPTER 1

INTRODUCTION

1.1 Introduction

Nowadays, many tasks that was manually operated are being computerised. Previously, a complete task that consist of many procedures is consuming time and other resources. The major focus of the changes from manual ways to computerised ways is to provide convenience to the user on completing the tasks and give more satisfaction to them. Most of us, almost everyone is holding at least a smartphone with us. Despite on that, the smartphone still being use mostly on communication purpose only instead of many other functions that it can perform. In order to upgrade the quality of our daily life, the usage of smartphone should be optimized to its' full capability.

Currently in Malaysia, the payment on the public parking often become an issue. People were experiencing situations where they cannot find a working parking machine or lack of parking coupon when they parked their vehicle on the public parking space. These issues could make them failed to make payment for their parking. Thus, they had to take risks to be penalized by the local authorities. It is too sad to find out that the responsibility on what happened should not only taken by the public but other parties as well.

Thus, this project is being proposed in order to solve the several issues that mentioned. The QR code technology is added to the system in order to enhance users' experience while using it.

The QR code is basically a natural extension of the conventional barcode(Mark O'Neill, 2015). In many other developed countries, QR code technology has been widely used in different fields including advertising and payment services. QR code can store a huge amount of information in one design of code. As many of us have at least one mobile device with us, the QR code can be access in a simple way.

1.2 Problem Statement

Below are the following problems that occurred.

1.2.1 Faulty Machine

Some areas in our region still using a method where people insert money to the machine to get a parking ticket based on the amount inserted. However, there are a lot of machine that have worked for years and did not have regular maintenance on it(Natashya, 2017). This cause the machine became faulty. Some machine will even calculate a wrong charges from the payment people paid on it(Fa Abdul, 2016). Note that the distance between these machines are not near with each other and people cannot ensure that the next machine that they can find is working properly(Ismail, 2017). Without a doubt, this will waste their time and energy. Certainly, they probably would not be able to make their payment successfully.

1.2.2 Lack of Coupon Agent

Some areas are starting to use another mechanism which is prepay parking coupon. People only need to tear off the relevant tabs to indicate the date and start time of the parking. However, people always experience situation where there is no any coupon left and unable to find any coupon agent near their parking space immediately(Metro News, 2017). Thus, they will be unable to display the coupon on their vehicle’s dashboard.

1.2.3 Environmentally Destructive

Both car park ticket from machine and the parking coupon are using paper as the media to display the payment evidence. Perhaps only 6 out of 71 tabs of the coupon is being used for each of it. Moreover, each coupon is only valid for 1 hour and the coupon is no longer can be use other than being thrown or recycle purpose.

1.2.4 Lack of Flexibility

Both car park ticket from machine and the parking coupon are using a time-limit standard where people had to rush back to their car to extend their parking period(Malaysian Digest, 2016). This is exhausting and tiring when people might be having busy business on that time.

1.3 Objectives

The aim of this project is to handle the problem stated in order to enhance the experience of the user while using the system with the following objectives:

i. To study the process of the existing car park payment system and propose suitable functions during the development of the project.

ii. To create a prototype of parking payment system based on QR code scanner.

iii. To test the system on functionality and users' acceptance level.

1.4 Scope

The project's scopes are listed as follows:

i. The system consists of mobile applications and windows application.

ii. The system is targeted to the public figures in Kuantan who using public parking spaces and the local authorities.

iii. The system is computerised to allow user to make parking payment through mobile platform and QR code scanner.

1.5 Significance

The importance of this project are listed as below:

i. This system helps the user to make parking payment in a more convenient way.

ii. This system creates a paperless mechanism during the parking payment process.

1.6 Report Organization

This thesis consists of five chapters including introduction, literature review, methodology, result and discussion, and finally the conclusion.

Chapter 1 is about introduction of the project which the idea of the project is discussed. This chapter also explains about the problem occurred before this system is being developed. Objectives of this project and its scopes are being stated in this chapter.

Chapter 2 is discussed about the project literature review. Some research has been made in this chapter to make comparison with others existing system that are close to this project.

Chapter 3 is discussed about the methodology that are being used and how it will be implemented to develop the system. This chapter also explains the flow of the system.

Chapter 4 is discussed about the implementation of the applications including the development environment and tools involved. The result of the system is also discussed in this chapter.

Chapter 5 is summarised the entire project including the constraints, the advantage of the system and future improvement can be done.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

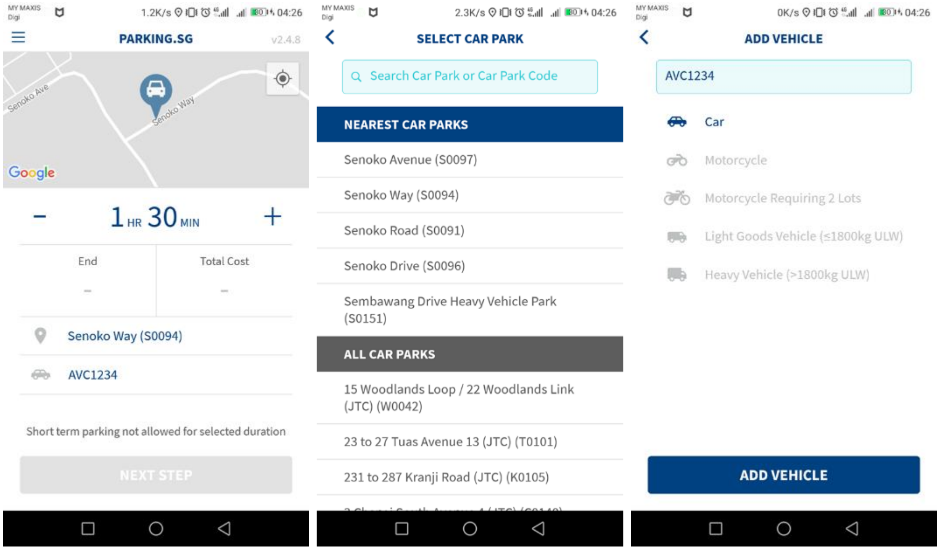
In this chapter, further details about three existing application or system which related to car parking payment system will be discussed. These discussions including the specifications that implemented in the applications along with the pros and cons of these applications. Besides, the technical details and the features of these application will be compared with each other. This is to act as a reference for further development of this project by enhance the advantages and eliminates the disadvantages.

2.2 Review of Existing Application

This part explains the study and analysis that have been made on three existing parking payment mobile application. All the features, methods and processes used to operate the applications are all summarize in the review.

2.2.1 Parking.sg

The Urban Redevelopment Authority (URA) and Housing & Development Board (HDB), in partnership with the Government Technology Agency of Singapore (GovTech), have announced they will jointly develop a parking coupon mobile application called parking.sg in May 2017(Heong Tung, 2017). The government of Singapore has been installing electronic entry gantries at public car parks to reduce the use of parking coupons. However, the electronic entry gantries can only be installed at the big car parks. Thus, the Parking.sg is created to help people while using the car parks at the individual lots that line at the small streets. Figure 2.1 shows some interfaces of Parking.sg.


PARKING.SG
v2.4.8
Senoko Ave
Senoko Way
Google
1 HR 30 MIN
End
Total Cost
Senoko Way (S0094)
AVC1234
NEXT STEP
SELECT CAR PARK
Search Car Park or Car Park Code
NEAREST CAR PARKS
Senoko Avenue (S0097)
Senoko Way (S0094)
Senoko Road (S0091)
Senoko Drive (S0096)
Sembawang Drive Heavy Vehicle Park (S0151)
ALL CAR PARKS
15 Woodlands Loop / 22 Woodlands Link (JTC) (W0042)
23 to 27 Tuas Avenue 13 (JTC) (T0101)
231 to 287 Kranji Road (JTC) (K0105)
ADD VEHICLE
AVC1234
Car
Motorcycle
Motorcycle Requiring 2 Lots
Light Goods Vehicle (≤1800kg ULW)
Heavy Vehicle (>1800kg ULW)
ADD VEHICLE

Short term parking not allowed for selected duration

Figure 2.1 Interfaces of Parking.sg

Source : (Melissa, 2017)

The main advantage of the application is it can detect the current location of the user and hence a list of car park is sorted out based on the location detected. Furthermore, Parking.sg allowed to refund when user ended his or her parking session before the duration entered is expired(Venkataraman, 2017). This could save money of the user from unnecessary charges on the parking session. However, the application is not very user friendly where every time user starts a new session, the user is required to enter the vehicle number and type the details manually again.

2.2.2 SmartParking Melaka

SmartParking is a mobile application which start launched in Malacca, Malaysia on Jan 2018. The convenient method was introduced on Jan 1 by Hang Tuah Jaya Muni-ci-pal Council (MPHTJ) and Melaka Historic City Council (MBMB)(Metro News, 2018). The application was created as another alternative way to pay for parking instead of using parking coupon which the people might get mistakes when scratching the certain tabs of the coupon. However, this application will not fully overwrite the current parking payment system in Malacca which using the parking coupons way. Figure 2.2 shows some interfaces of the application SmartParking Melaka.

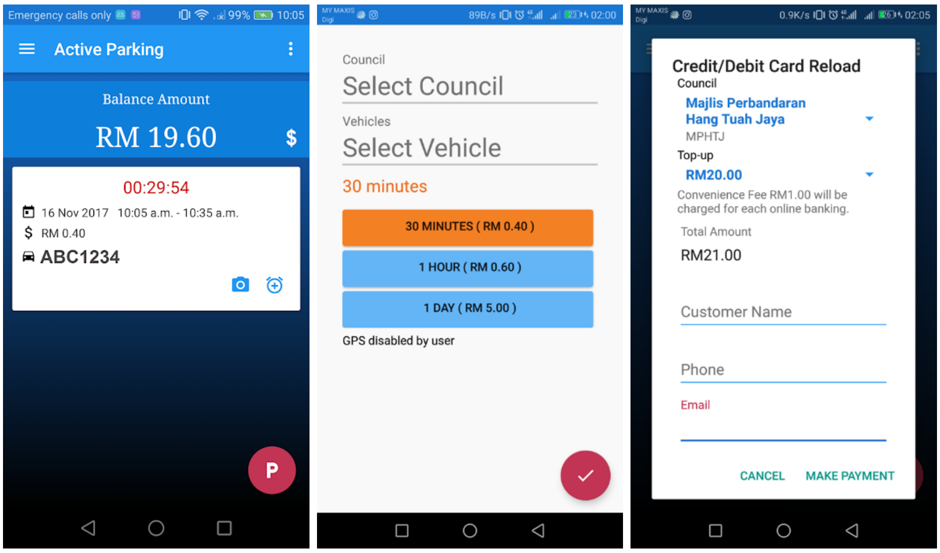
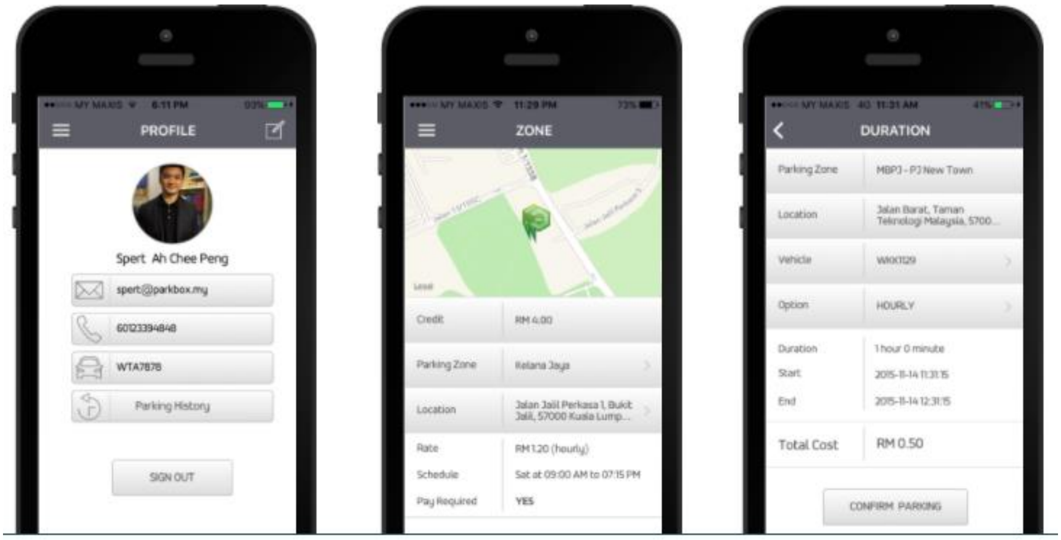


Figure 2.2 Interfaces of SmartParking Melaka

The main advantage of using this application is the people can directly pay the amount of parking fees from the wallet of the application which have been reloaded. However, there is a disadvantage of using this application where the money that being reloaded to the application is separated for different council. The people will also need to select the appropriate council during the parking session which this process might can confuse the people and turns out selected a wrong council which authorize the current parking location.

2.2.3 Parkbox

ParkBox is a mobile application introduced in Taiping, Malaysia on Dec 2015. Taiping Municipal Council is the first local authority in the country to embark on this cashless and paperless public parking payment system, provided by ParkBox Digital Sdn Bhd(Metro News, 2015). This application also allowed the council officers verify payments made by motorists in a more convenient way. Figure 2.3 shows some interface of the application ParkBox



Spert Ah Chee Peng
spert@parkbox.my
60123394848
WTA7878
Parking History

Credit RM 4.00
Parking Zone Kelana Jaya
Location Jalan Jalil Perkasa 1, Bukit Jalil, 57000 Kuala Lump...
Rate RM 1.20 (hourly)
Schedule Sat at 09:00 AM to 07:15 PM
Pay Required YES

Parking Zone MBPJ - PJ New Town
Location Jalan Barat, Taman Teknologi Malaysia, 5700...
Vehicle WKK1129
Option HOURLY
Duration 1 hour 0 minute
Start 2015-11-14 11:31:15
End 2015-11-14 12:31:15
Total Cost RM 0.50

Figure 2.3 Interfaces of Parkbox
Source : (Adrian, 2017)

The main advantage of using this application is the user have no need to key in the required details for every session started. Since all details is registered before starting a session, user only have to make selection on the car park, vehicle registered and the charge basis. However, the fund that have been pay is not refundable thus any earlier finish session will cause the user experience unnecessary charges(Spert, 2016).

2.3 Comparisons on Existing Application

This part explains the study and analysis that have been made on three existing parking payment mobile application and the proposed system. All the features, methods and processes used to operate the applications are all summarize in the review. Table 2.3.1 shows the comparisons between Parking.sg, SmartParking, Parkbox, QrPay.

Table 2.3.1 Comparisons between Parking.sg, SmartParking Melaka, Parkbox and QrPay

	Parking.sg	**SmartParking**	**Parkbox**	**QrPay (Proposed system)**
Hardware	• Smartphone			
Platform	• Android/ Apple			• Android
Requirements and Permissions	• Internet Connection • GPS			• Internet Connection • Camera
Features	• Require log in • Location detection • User enter vehicles number for each session • Register credit or debit card	• Log in not required • Location detection • Register vehicles • Manually select council • Deduction from in app credit only • Top up credit for different council	• Require log in • Location detection • Register vehicles • Top up credit • Deduction from in app credit only • Unused credit is refundable	• Require log in • QR scanner • Register vehicles • Top up credit • Deduction from in app credit only • Unused credit is refundable

	• Charge directly from credit or debit card bank account • Refund availability from session ended earlier • Parking History • 10 minutes session expiry alert • Extend session through app • 30 minutes basis parking session	• 15 minutes session expiry alert • Parking History • 30 minutes, 1 hour and 1 day options for parking session	• 10 minutes session expiry alert • Extend session through app • Hourly, daily or monthly parking session • No typing input per session	• Extend session through app • 1 hour basis parking session

From the table, the three-existed application are required permission of GPS to detect the location of the parking lot. However, the proposed system QrPay, will not require GPS as each parking lot will be allocate with an identical QR code which let the user to direct scan it from their phone.

In terms of vehicle, user of Parking.sg need to enter the number plate of their vehicle for each session of parking they are using while the other two only require user to select the vehicle they have registered. From this view, the QrPay will use the mechanism of vehicle registration to save time.

Next is about the payment way, Parking.sg use the way where all the transaction will be executed directly through the credit or debit card of the user which have been registered. However, the other two applications use the in-app wallet basis where user can reload on the application and may feel more secure in this way. Hence, QrPay will use the in-app wallet as the payment method and the unused balance should be refundable when the user is thinking about stop using the application.

Here comes the most important part which is the parking session. All three-existed application using different time-basis for their parking session, from the minimum of 30 minutes until even monthly basis. As a new application proposed, QrPay will start by using 1 hour basis while further different basis shall be available in the future. All the applications will notify the user on the expiring session 10 to 15 minutes before it. However, QrPay will not apply the notify mechanism for current moment. While to increase the flexibility of the user, all the applications including QrPay will allow user to extend the parking session through the application before the session ended.

In conclusion, the QrPay will take the advantages of each existed application as for reference. The advantages will be magnified and all the disadvantages will be eliminated as much as possible.

CHAPTER 3

METHODOLOGY

3.1 Introduction

In this chapter, we will discuss the methodology that will be applied during the entire development process of this project. Putting a great deal of effort to build a mobile application can make the development process to meet its goals efficiently. The methodology needed to be well defined in the aspects of process to be followed and the products to be created. Doing this will help to ensure that the development process can be follow up in a predictable way.

Thus, methodology can be defined as a collection of interrelated elements that are being involved or applied in the development process (Gonzalez-Perez, 2005). These elements included the approach being apply, the hardware and software being used and the process planning throughout the development phase. Different system should have different methodology depends on its needs and limitations. For QrPay, Mobile-D approach will be applied with certain criteria to be consider(Spataru, 2010). Further explanation will be done on this chapter later.

3.2 Methodology

3.2.1 Development Approach

For the development of the QrPay, the software development approach used is the Mobile-D approach. Mobile-D is one of the general agile development approaches which based on Extreme Programming, Crystal methodologies and Rational Unified Process(Abrahamsson[1] et al., 2003). This approach is chosen as it suitable for a development team consist of less than 10 people(Abrahamsson, Ihme, Kolehmainen, Kyllönen, & Salo, 2003). A system that implement with the Mobile-D approach is comprising with 5 phases which is explore, initialize, productionize, stabilize and system test & fix.

3.2.1.1 Explore

The aim of the explore phase is to establish the initial project as well as to prepare foundation for future development. First, we have identified the current issues and problem which are facing by the public figure while intend to make payment for their parking session. Several reasons that cause the issues have been confirmed as we discussed in Problem Statement. Then, we have identified the potential client to propose a system in terms to overcome the issues. The local authorities Kuantan Municipal Council who control the public parking in Kuantan have been confirmed as the potential client. Next, we did some research about some current existing systems that used to overcome the public parking issues and propose a new system scope based on the pros and cons of the existing systems.

3.2.1.2 Initialize

The next phase is the initialize phase which can only start after the explore phase is completed. In this phase, we met with the clients to explore the requirements and architecture of the system. All the requirements have been recorded and documented in the Software Requirements Specification (Appendix A). We also defined the hardware and software needed to develop the proposed system.

3.2.1.3 Productionize

Productionize phase is where the implementation of the project take place. The implementation process should be completed within this phase. The principal functionality of the mobile application should be implemented in some different stages.

In planning day, we analyse the requirements to identify the functions should be included in the system. We also designed the use case that will match with the functions identified. Furthermore, we designed the user interface layout to be created in the next phase. The designs are included in the Software Requirements Specification (Appendix A). Next, we designed the data model and the architecture of the system which included in the Software Design Document (Appendix B). In the final phase of planning day, we create a test plan to be follow up after the implementation is done.

While in the working day, the main task is to implement the user interface components, the functionalities and the iteration between them.

Lastly in the release day, all the user interfaces and functionalities that have been implemented will be package as a worked prototype.

3.2.1.4 Stabilize

In this phase, the implementation of the system is finalized. We finalized the software architecture, design and user interface components. All these components is documented formally. We also ensured that the required functionality is working and met with client's requirement.

3.2.1.5 System Test & Fix

This phase is the last phase where we test the system according to the test plan created previously. The aim is to remove the defects and deliver the application without errors if possible.

3.2.1.6 Challenges of Using Mobile-D Approach

Mobile-D is designed to be apply in smaller team which up to 10 members only. The team members must have confidence with each other and must always giving commitment to accomplish team goal(Supan*, Teković*, Škalec*, & Stapić, 2013). As Mobile-D required a frequent communication between the developer and the client, the client who are not communicative will give some hard work to the team during the implementation.

3.2.2 Product Perspective

Figure 3.1 show the context diagram of QrPay Parking System.

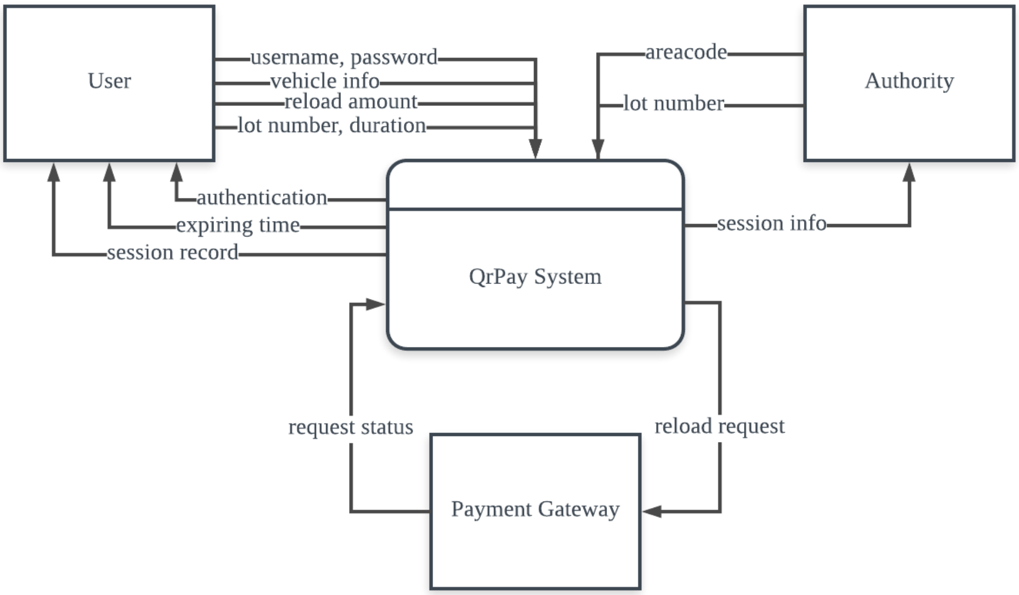


Figure 3.1 Context Diagram of QrPay Parking System

There are 3 entities directly interact with the QrPay Parking System which are user, authority and payment gateway. The user will provide username and password during login process and receive authentication from the system. Besides, user will also provide vehicle info and reload amount to manage vehicle and wallet. The user also provides lot number and duration during parking session and received the expiring time from the system. The session record will also receive by the user from the system.

Next, the authority also required to provide area code or lot number to check the session status of the parking lots. The admin can manage the parking lots data by providing the area info and parking lot amount. The payment gateway is mainly interacting with the system on the manage wallet tasks.

Figure 3.2 Shows the data flow diagram of QrPay Parking System.

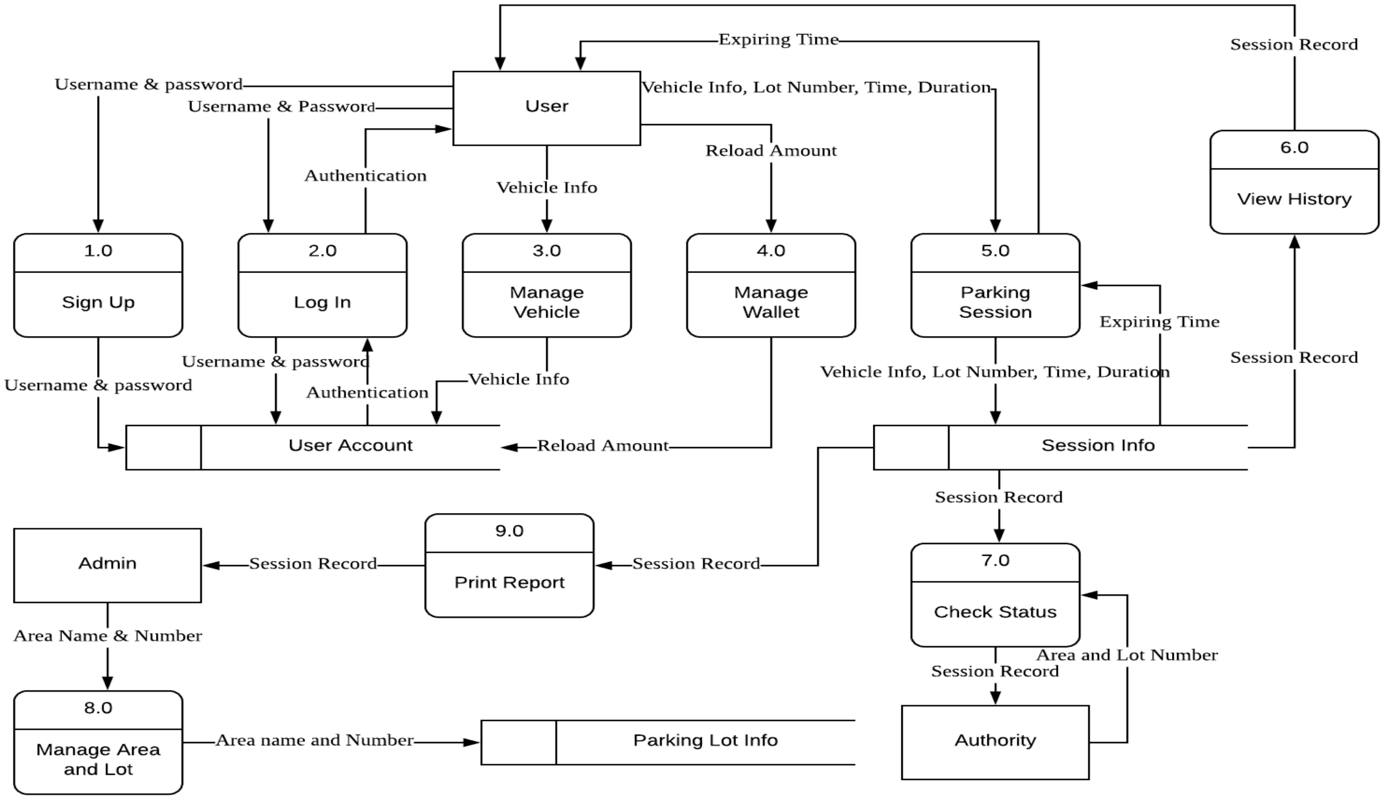


Figure 3.2 Data Flow Diagram Level 1 of QrPay Parking System

The data flow diagram level 1 of QrPay Parking System shows that the main process involved by the entity with the system in a clearer way. The main processes are show in the diagram.

3.2.3 Use Case Diagram

Figure 3.3 shows the use case diagram of QrPay Parking System.

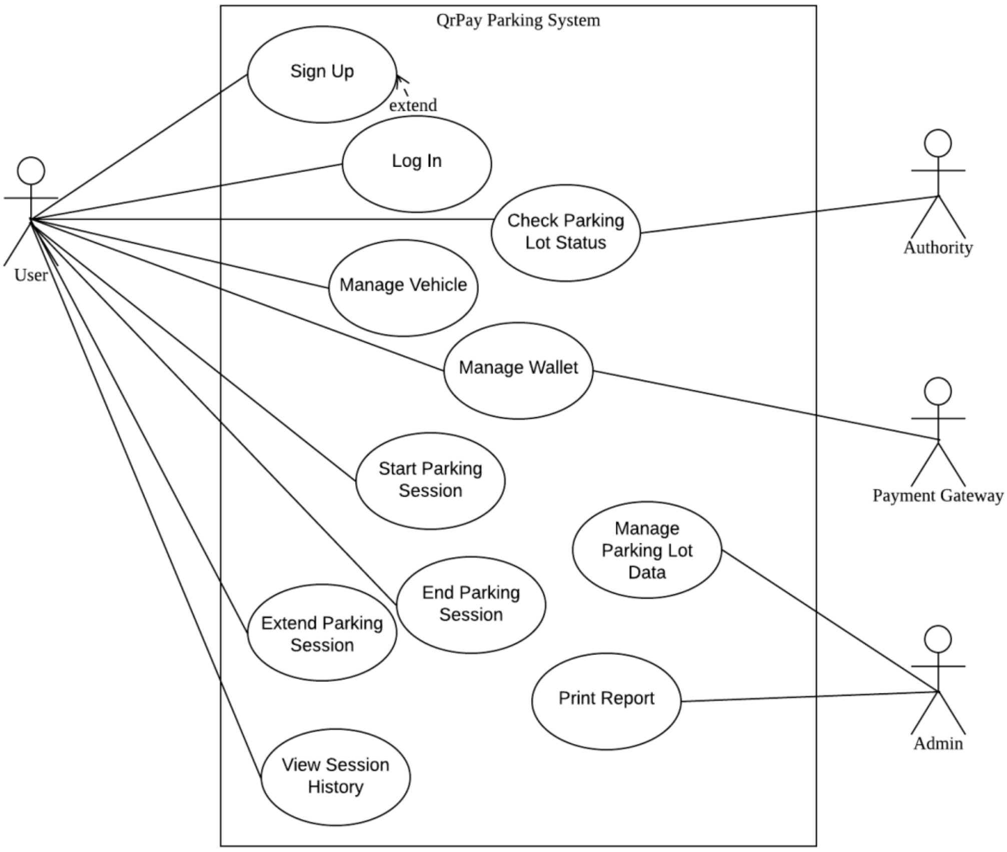


Figure 3.3 Use Case Diagram of QrPay Parking System

The figure shows the how the actors of the system operate the system. The details of each use case will be described in Software Requirements Specification (Appendix A).

3.2.4 General Architecture

Figure 3.4 shows the general architecture of QrPay Parking System.

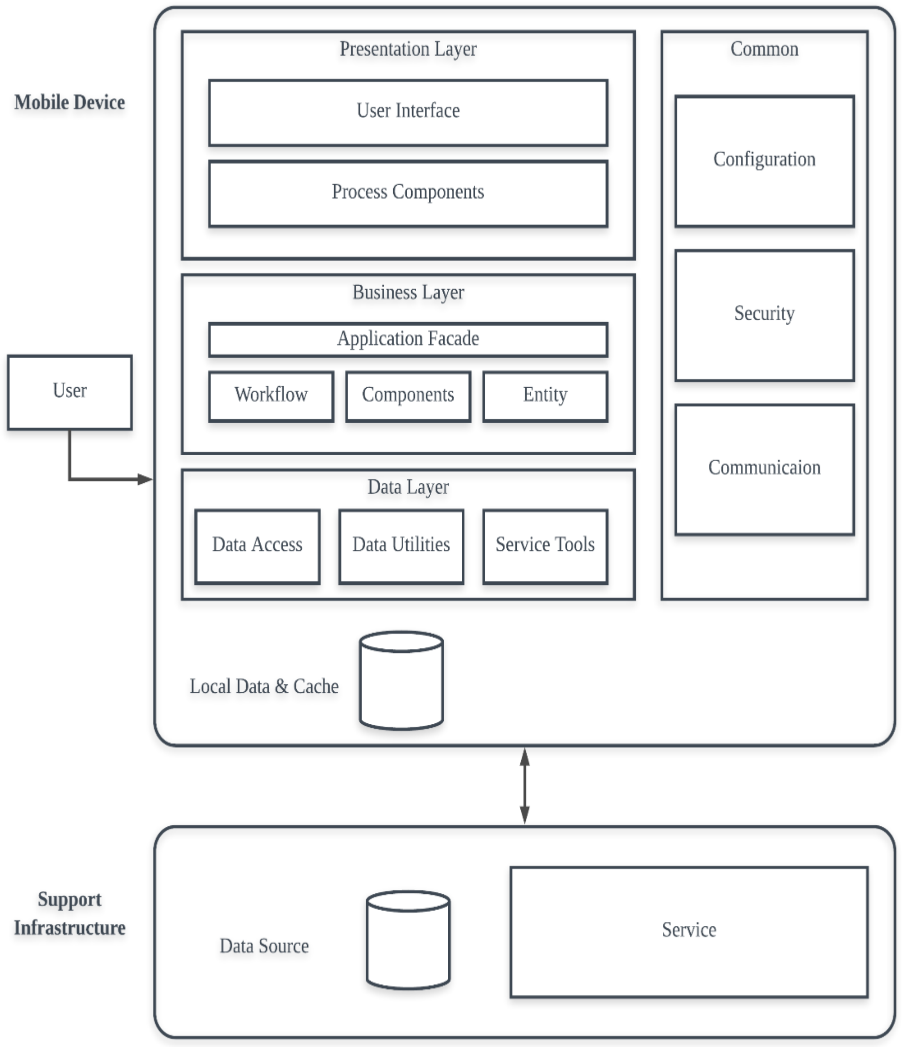


Figure 3.4 General Architecture of QrPay Parking System

Source: (Pisuwala Ubaid, 2017)

QrPay Parking System as a mobile application, will be separated into several layers. These layers consist of presentation, business and data layer(Latif Yasir, 2015). These layers will be located at the mobile itself where the main processing more on the local site(Pisuwala, 2017). While there are still some data source are located at the server side, the Internet connection are still required in the application.

3.2.5 Package Module

Figure 3.5 shows the package module of QrPay Parking System.

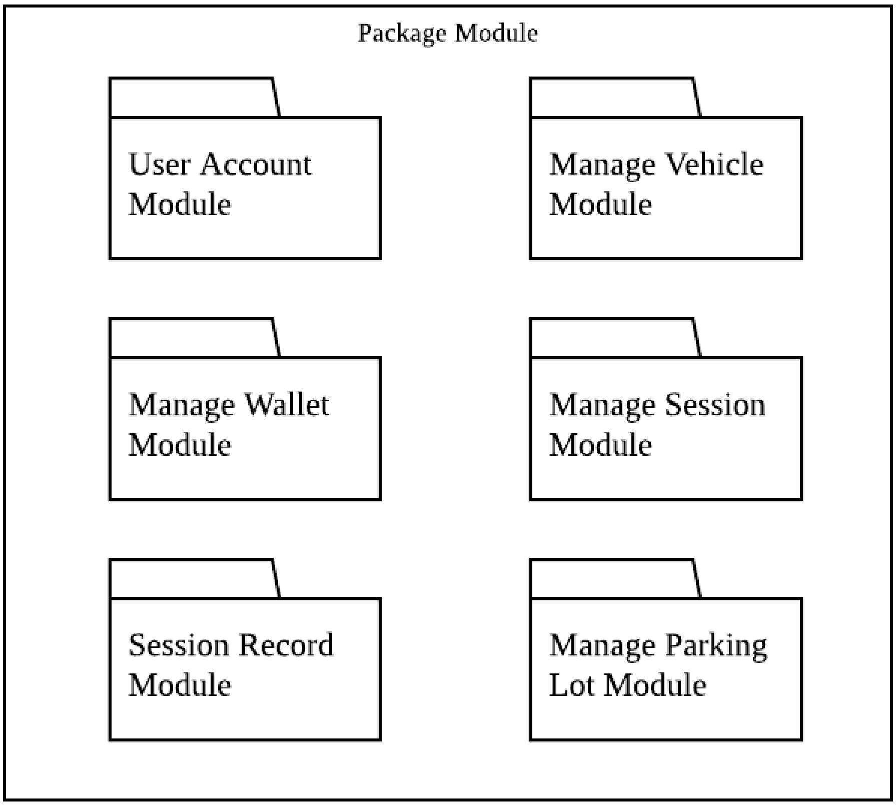


Figure 3.5 Package Module of QrPay Parking System

3.2.5.1 User Account Module

This package is used to manage all the substances pertaining to the user account and their information such as sign up account and log in with the account created.

3.2.5.2 Manage Vehicle Module

This package is used to manage all the substances pertaining to the vehicle information such as adding or removing a vehicle data from the account.

3.2.5.3 Manage Wallet Module

This package is used to manage all the substances pertaining to the in-app wallet such as reload amount into the user’s account.

3.2.5.4 Manage Session Module

This package consists of all presentation logic pertaining parking session such as start, end and extend the parking session. The notify from the system also included in this package.

3.2.5.5 Session Record Module

This package consists of all presentation logic for the park session record as user, authority and the admin will require different view on the records.

3.2.5.6 Manage Parking Lot Module

This package is used to manage all the substances pertaining to area and parking lot such as create QR code and insert data into database.

3.3 Hardware and Software

QrPay is a mobile application which have certain requirements to ensure its functionality. In this section we will discuss the hardware and software require during the development.

3.3.1 Hardware Requirements

Table 3.3.1 shows the hardware requirements with its’ function or purpose.

Table 3.3.1 Hardware Requirements of QrPay Parking System

Hardware	Function/ Purpose
Laptop	• To develop the system • To prepare the documentation of the system • To act as a simulator of the application • To monitor the system usage • To save the data of the application • To run the Windows application.
Android Mobile Phone	• To run the application in Android platform
USB Storage	• To back up the data of the application

3.3.2 Software Requirements

Table 3.3.2 shows the software requirements with its’ function or purpose.

Table 3.3.2 Software Requirements of QrPay Parking System

Software	Function/ Purpose
Xamarin	• To build the application in multiple mobile platforms
Azure SQL	• To store the database
Lucidchart	• To model and design the diagram of the system
Microsoft Office 365	• To document the proposal and the report • To prepare the slide shows for presentation
Mendeley	• To manage the references used in the report
Turnitin	• To provide feedback and check for plagiarism on the report
Smartsheet	• To create Gantt Chart

3.4 Gantt Chart

The planning of the tasks throughout this project have been made by using Gantt Chart. The project is divided into few sections. The Gantt Chart have been attached in Appendix C.

3.5 Implementation

In this section, we will discuss how the QrPay Parking application will be implemented with the methodology mention. The system is developed using Agile methodology which more specifically, the Mobile-D approach. The Xamarin will be used to write the programming code for the system and design the interface of the application. The application will be test on both Xamarin's simulator and an Android phone. The data of the application will be save through the Azure SQL in the Azure server and monitor the usage through the Visual Studio.

3.6 Testing

This section will briefly explain the testing techniques will be used to test the system. Functionality testing will be used to test the functionality of very components that have been developed. A list of test cases will be created based on the different functions of the components. The expected test result including the behaviour of the system responding to the user operation, the output value based on the input from the user. Next, we will also conduct the user acceptance testing. The main idea of user acceptance test is to test the overall flow of the system by some selected targets user. This testing techniques will carry out the satisfaction level of the target users

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

In this chapter, we will discuss in detail the process throughout the implementation of the QrPay Parking System which consist of 2 mobile application and 1 windows application. This included the programming codes that used to execute the functions and behaviour of the system. According to Mobile-D approach, implementation of interface components, the functionalities and the iteration between them is done in working day of productionize phase. Then, the implementation is finalized and packaged together in stabilize phase and lastly the system will be test according to the test plan.

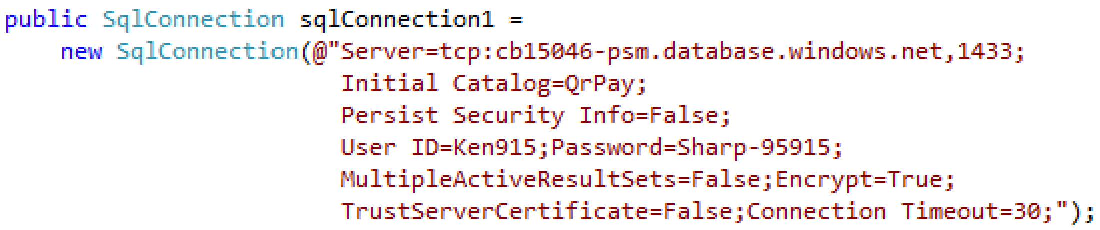
4.2 Implementation

4.2.1 Development Environment

The 2 mobile applications, QrPay Parking (for public user) and QrAuthorize Parking (for authorities) is developed by using Xamarin.Forms, with the version 3.4.0. Xamarin.Forms exposes a complete cross-platform UI toolkit for .NET developers. Build fully native Android, iOS, and Universal Windows Platform apps using C# in Visual Studio. While the windows application QrPay Parking Admin (for admin user) is developed with Windows Form.

4.2.2 Database Server

The data of the applications is stored in the Microsoft Azure SQL Database, which is a cloud database provided by Microsoft Azure. Figure 4.1 shows the connection of the SQL Database.



```
public SqlConnection sqlConnection1 =
    new SqlConnection(@"Server=tcp:cb15046-psm.database.windows.net,1433;
                        Initial Catalog=QrPay;
                        Persist Security Info=False;
                        User ID=Ken915;Password=Sharp-95915;
                        MultipleActiveResultSets=False;Encrypt=True;
                        TrustServerCertificate=False;Connection Timeout=30;");
```

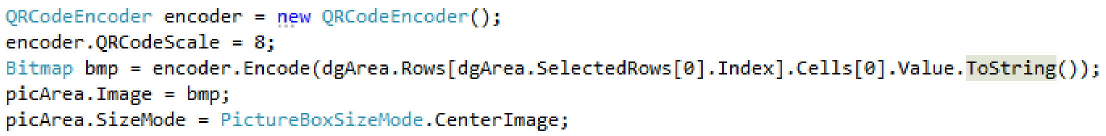
Figure 4.1 Code for SQL Connection

4.2.3 Applications

This section will show the programming codes of the main function for each of the applications.

4.2.3.1 QrAdmin Parking

The QrAdmin Parking is a windows form application which used by the admin to manage the data of the parking lot. The admin can add the area data, specifically the area name into the system. The main function on this will be the generate of QR Code based on the area name inserted. The QRCodeEncoder comes from the MessagingToolkit.QRCode is a .NET component that can be used to encode and decode QRCode. Figure 4.2 shows the code to encode a QR Code based on the string given.



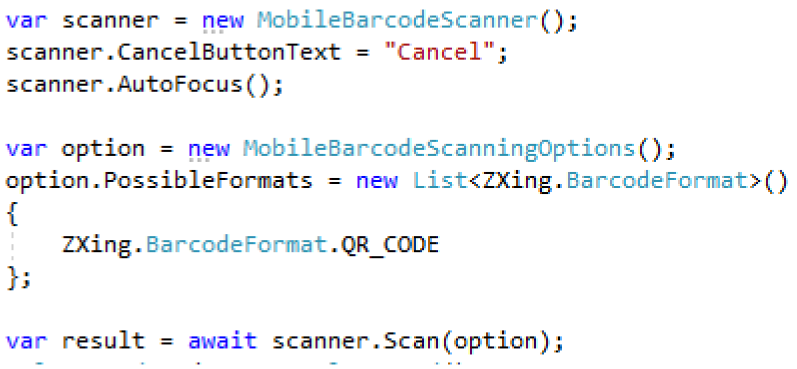
```
QRCodeEncoder encoder = new QRCodeEncoder();
encoder.QRCodeScale = 8;
Bitmap bmp = encoder.Encode(dgArea.Rows[dgArea.SelectedRows[0].Index].Cells[0].Value.ToString());
picArea.Image = bmp;
picArea.SizeMode = PictureBoxSizeMode.CenterImage;
```

Figure 4.2 Code for encode QR Code

Besides, the print report is another main function of the application. iTextSharp library is used to create pdf file on the elements needed in the report.

4.2.3.2 QrPay Parking

The QrPay Parking application is a mobile application which use by the public user, scan the QR Code identically attached at each of the parking lot will be the main focus. ZXing.Net.Mobile library is imported to make scanning QR Code effortless and painless as it is based on the open source library, ZXing (Zebra Crossing). Figure 4.3 shows the code to activate QR Code scanner and decode it. After the QR Code is being decode, the result which is a string consists of the Parking Lot number will be used to start a parking session.



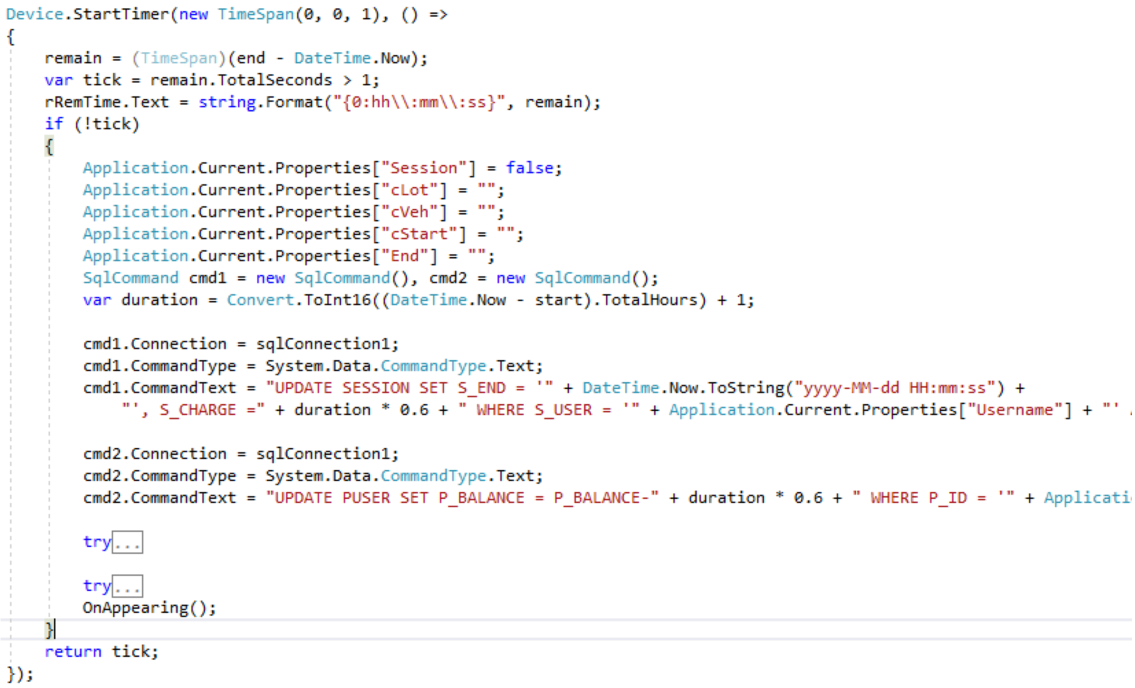
```
var scanner = new MobileBarcodeScanner();
scanner.CancelButtonText = "Cancel";
scanner.AutoFocus();

var option = new MobileBarcodeScanningOptions();
option.PossibleFormats = new List<ZXing.BarcodeFormat>()
{
    ZXing.BarcodeFormat.QR_CODE
};

var result = await scanner.Scan(option);
```

Figure 4.3 Codes for start a QR Code Scanner

Beside from QR Code Scanner, the main function of the application will be the timer to countdown the time for their parking session. Device.StartTimer() method is used to start a recurring timer on the UI thread using the device clock capabilities. Figure 4.4 shows the code to start the countdown timer and terminated when the time is finished.



```
Device.StartTimer(new TimeSpan(0, 0, 1), () =>
{
    remain = (TimeSpan)(end - DateTime.Now);
    var tick = remain.TotalSeconds > 1;
    rRemTime.Text = string.Format("{0:hh\\:mm\\:ss}", remain);
    if (!tick)
    {
        Application.Current.Properties["Session"] = false;
        Application.Current.Properties["cLot"] = "";
        Application.Current.Properties["cVeh"] = "";
        Application.Current.Properties["cStart"] = "";
        Application.Current.Properties["End"] = "";
        SqlCommand cmd1 = new SqlCommand(), cmd2 = new SqlCommand();
        var duration = Convert.ToInt16((DateTime.Now - start).TotalHours) + 1;

        cmd1.Connection = sqlConnection1;
        cmd1.CommandType = System.Data.CommandType.Text;
        cmd1.CommandText = "UPDATE SESSION SET S_END = '" + DateTime.Now.ToString("yyyy-MM-dd HH:mm:ss") +
            "', S_CHARGE =" + duration * 0.6 + " WHERE S_USER = '" + Application.Current.Properties["Username"] + "'

        cmd2.Connection = sqlConnection1;
        cmd2.CommandType = System.Data.CommandType.Text;
        cmd2.CommandText = "UPDATE PUSER SET P_BALANCE = P_BALANCE-" + duration * 0.6 + " WHERE P_ID = '" + Applicati

        try...

        try...
        OnAppearing();
    }
    return tick;
});
```

Figure 4.4 Code for starting countdown timer

4.2.3.3 QrAuthorize Parking

The QrAuthorize Parking application is a mobile application which use by the authority user, is used to check the status of the parking lot either single or the whole area. The authority can scan the QR Code attached at the parking lot or the centre of the area to check the status. Same as the QrPay Parking application, the ZXing.Net.Mobile library is imported. After the QR Code is being decode, the result which is a string consists of the Parking Lot number or the Area number will be used to check the parking session status.

4.3 Testing

This section describes about the behaviour of the project and all components that have been implemented is being test. The developer of the applications used the White Box Testing to make testing on the internal structure and the design of the applications. Unit Testing and Integration Testing is done to ensure every component may work as expected behaviour to ensure the functionality can worked as expected.

Several random users are being chose to perform Black Box Testing on the applications to make sure the applications can be worked smoothly and acceptable. The testing required to cover all use case and any fail of performance shall be fixed as soon as possible. The test results are shown in the User Acceptance Test (APPENDIX D).

4.4 User Manual

The User Manual (APPENDIX E) is created to guide the user to install and use the application with detailed operations.

CHAPTER 5

CONCLUSION

5.1 Introduction

This chapter describe the summary of QrPay Parking System on how it can be used to resolved issues of current payment system for the parking session. The methodology used will also be summarized in this chapter. Besides, this chapter also proposed future suggestion to improve the system to a better way.

5.2 Research Constraint

There are some constraints met throughout this project cycle. One of it will be the limited resources to create a multiplatform application. Development of iOS application required many resources such as developer account which need to be pay and some extra library to be purchase in order to adapt into the development.

Besides, the unstable development tools and mismatch between old library and new platform release would suffer the development process. Xamarin.Forms which is inside the Visual Studio is used to develop native mobile application. Since the updates on the operating system of mobile device is getting faster nowadays, the development require a lot of time to follow the updates.

5.3 Disadvantages and Future Works

There are some works could be adapting to this project in the future. First and foremost would be making the availability of iOS version of the application. Currently this application only available in Android version causing many user with Apple device unable to use it.

Next, the security level of the application could be increase as it involved money transaction within the application. Two-way encryption of the password on the account is a suitable way to secure the user involved in loss of money.

Besides, the notification service should be available in the future to notify user about their expiring parking session. Even with extend parking session functionality, the function would be unavailable if the user does not notice their parking session is over.

5.4 Conclusion

QrPay Parking System is developed to provide a method for public user make payment on their parking session in a more convenient way. Mobile device has become the icon of the modern world. Using mobile application to perform payment on parking session would not be difficult for most of the people as they probably have at least mobile device with them.

QrPay Parking System have been developed based on the study of existing mobile parking payment system. Most of the advantages of these applications have been adapt into QrPay Parking System. This project has undergo several testing phase and based on the result, QrPay Parking System is able to behave as expected.

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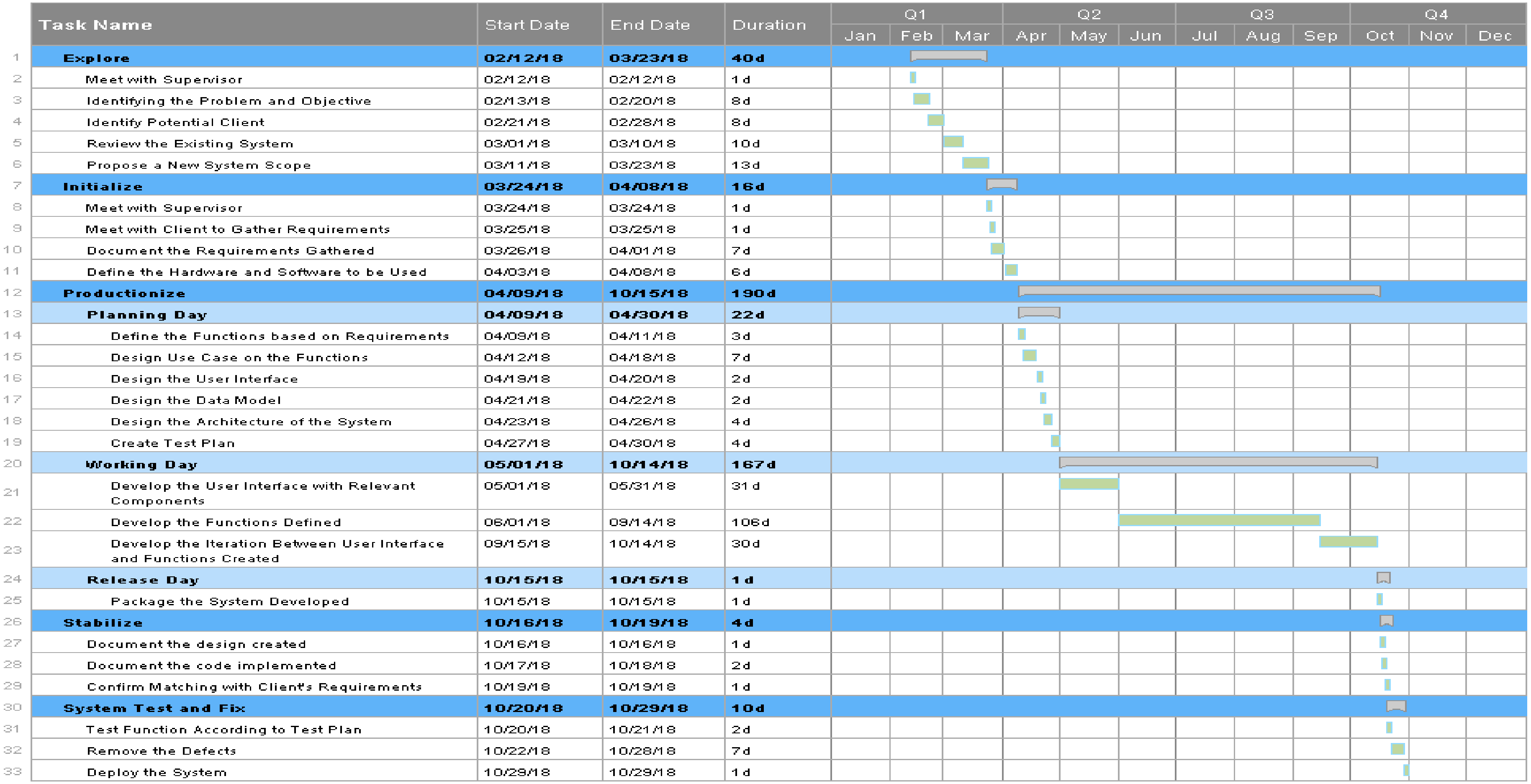
APPENDIX A
SOFTWARE REQUIREMENT SPECIFICATION (SRS).

APPENDIX B
SOFTWARE DESIGN DOCUMENT (SDD)

APPENDIX C
GANTT CHART



	Task Name	Start Date	End Date	Duration
1	**Explore**	**02/12/18**	**03/23/18**	**40d**
2	Meet with Supervisor	02/12/18	02/12/18	1d
3	Identifying the Problem and Objective	02/13/18	02/20/18	8d
4	Identify Potential Client	02/21/18	02/28/18	8d
5	Review the Existing System	03/01/18	03/10/18	10d
6	Propose a New System Scope	03/11/18	03/23/18	13d
7	**Initialize**	**03/24/18**	**04/08/18**	**16d**
8	Meet with Supervisor	03/24/18	03/24/18	1d
9	Meet with Client to Gather Requirements	03/25/18	03/25/18	1d
10	Document the Requirements Gathered	03/26/18	04/01/18	7d
11	Define the Hardware and Software to be Used	04/03/18	04/08/18	6d
12	**Productionize**	**04/09/18**	**10/15/18**	**190d**
13	**Planning Day**	**04/09/18**	**04/30/18**	**22d**
14	Define the Functions based on Requirements	04/09/18	04/11/18	3d
15	Design Use Case on the Functions	04/12/18	04/18/18	7d
16	Design the User Interface	04/19/18	04/20/18	2d
17	Design the Data Model	04/21/18	04/22/18	2d
18	Design the Architecture of the System	04/23/18	04/26/18	4d
19	Create Test Plan	04/27/18	04/30/18	4d
20	**Working Day**	**05/01/18**	**10/14/18**	**167d**
21	Develop the User Interface with Relevant Components	05/01/18	05/31/18	31d
22	Develop the Functions Defined	06/01/18	09/14/18	106d
23	Develop the Iteration Between User Interface and Functions Created	09/15/18	10/14/18	30d
24	**Release Day**	**10/15/18**	**10/15/18**	**1d**
25	Package the System Developed	10/15/18	10/15/18	1d
26	**Stabilize**	**10/16/18**	**10/19/18**	**4d**
27	Document the design created	10/16/18	10/16/18	1d
28	Document the code implemented	10/17/18	10/18/18	2d
29	Confirm Matching with Client's Requirements	10/19/18	10/19/18	1d
30	**System Test and Fix**	**10/20/18**	**10/29/18**	**10d**
31	Test Function According to Test Plan	10/20/18	10/21/18	2d
32	Remove the Defects	10/22/18	10/28/18	7d
33	Deploy the System	10/29/18	10/29/18	1d

APPENDIX D
USER ACCEPTANCE TEST (UAT)

APPENDIX E
USER MANUAL

Software Requirement Specification (SRS)

For

QrPay Parking System

(Version 1.0)

Prepared by **TEE KEN LEE**

Faculty of Computer Systems & Software Engineering (FSKKP)

Universiti Malaysia Pahang

TABLE OF CONTENT

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LIST OF FIGURES

1.0 INTRODUCTION

1.1 Purpose

The Software Requirements Specification (SRS) is documented purposely to specify the requirements for QrPay parking payment system. This document gives an in-depth insight of the complete QrPay system by defining the function that the system will offer and the behavior of the system to meet each requirement propose by the stakeholders. This document is intended for both the stakeholders and the developers of the system.

1.2 System Overview

This system called QrPay as users can start a parking session at public parking and make payment on it using this mobile application by scanning the QR code attached at each parking lot. To using the features of QrPay, user must register and log into the application to start the parking session. Besides, user can register multiple vehicle in one account as some user might own more than one vehicle. Furthermore, user can manage the in-app wallet by top up credit via Internet banking. Other than that, the authority can use the application to check the status of the parking session to perform their duty which is make penalty on parking violation. User can also manage their parking session whether to end or extend the parking session time.

1.3 Document Overview

1.3.1 Introduction

This section describes the purpose, the system overview and document overview. The explanation consisted of the background of the system, the function that the system will be offer.

1.3.2 Product Description

This section describes the product perspective, product functions, user characteristics, constraints and the assumptions. In product perspective, the overview of the system and the actors that involved in this system will be displayed by using a context diagram. The function that QrPay provide and the actor who involved in each function will be explained in this chapter. In addition, this chapter also explain the general characteristics of the intended user including their experience and expertise. The constraint and certain assumptions on the system flow will also be mentioned in this chapter.

1.3.3 Interface Requirements

This section shows the user interface of the system that will be develop. The user interfaces are divided into three sections which the one that will be use by the public user, the authority and the admin. All the interfaces are based on the form of mobile application and Windows application

1.3.4 Software Product Features

This section describes the application features in form of use case. Each use case will explain in detail. The use cases show the process flow of each function in a understandable language.

1.3.5 Sequence Diagrams

This section shows all the sequence diagrams which related to the use cases created. The diagrams are including the basic flow and their exception flow.

2.0 PRODUCT DESCRIPTION

2.1 User Characteristics

Table 2.1 shows the users involved in QrPay System with their experiences and expertises.

Table 2.1 User Characteristics of QrPay System

User	**Experience & Expertise**
Public User	• The system interfaces are simple yet user friendly. Thus, user can easily catch up on how to use the system. • Experience in using mobile smart phone. • Experience in surfing internet.
Authority	• The system interfaces are simple yet user friendly. Thus, user can easily catch up on how to use the system. • Experience in using mobile smart phone. • Experience in surfing internet.
Admin	• The system interfaces are simple yet user friendly. Thus, user can easily catch up on how to use the system. • Experience in using computer. • Experience in surfing internet.

2.2 Constraints

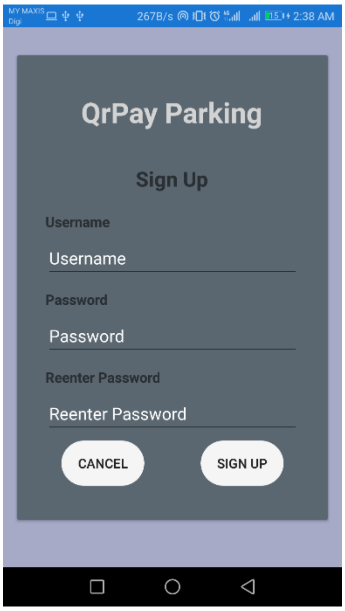
Table 2.2 shows the constraints in the QrPay System.

Table 2.2 Constraints in QrPay System

Aspect	Description
Hardware Limitation	• Smart phone is needed to use this application • The smartphone must have camera features • The smartphone must able to connect to Internet
Higher-order Language Requirements	• Developer must have programming language knowledge on C#, SQL, etc.
Reliability Requirements	• The probability of system failures shall not exceed 2% per month.
Safety and Security	• User must sign in with username and password

3.0 Interface Requirements

3.1 QrPay Parking


QrPay Parking

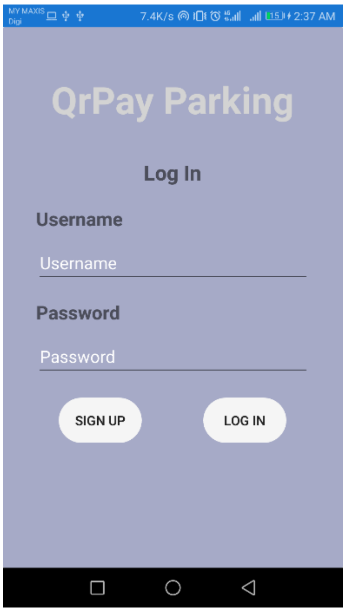
Sign Up

Username: Username

Password: Password

Reenter Password: Reenter Password

Figure 3.1 Sign Up

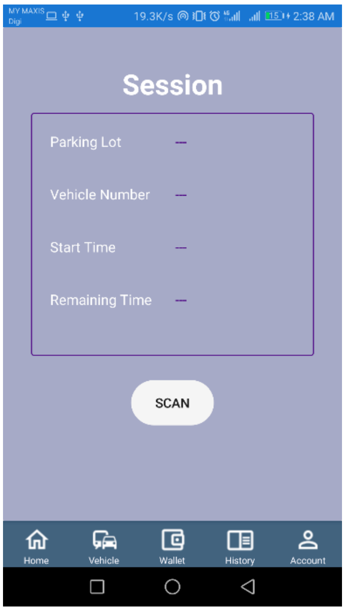

QrPay Parking

Log In

Username: Username

Password: Password

Figure 3.2 Log In


Session

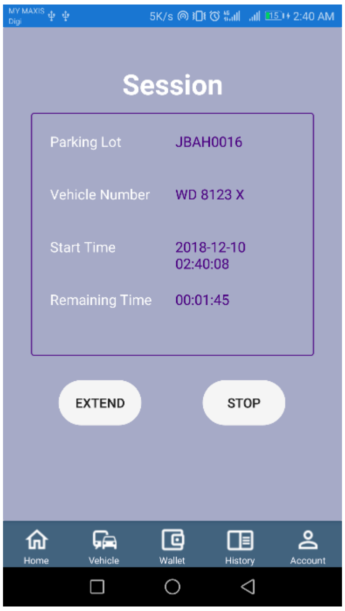
Parking Lot —

Vehicle Number —

Start Time —

Remaining Time —

Figure 3.3 Home Page


Session

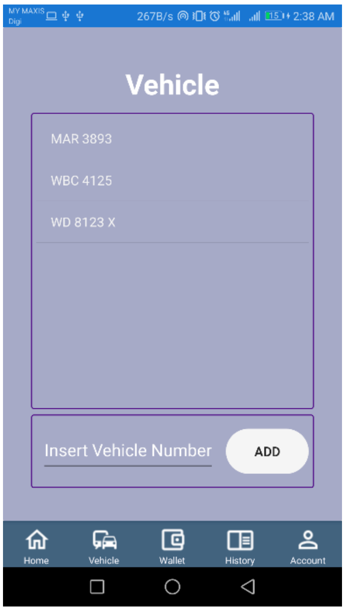
Parking Lot JBAH0016

Vehicle Number WD 8123 X

Start Time 2018-12-10 02:40:08

Remaining Time 00:01:45

Figure 3.4 Session


Vehicle

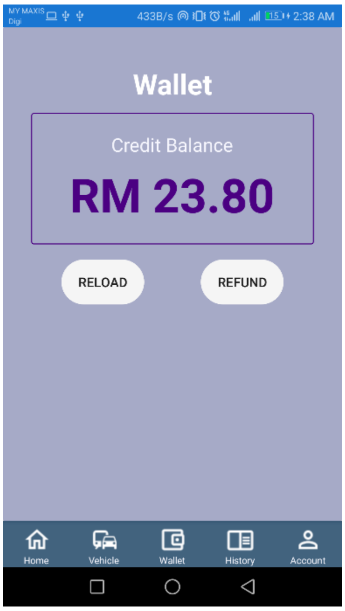
MAR 3893

WBC 4125

WD 8123 X

Insert Vehicle Number

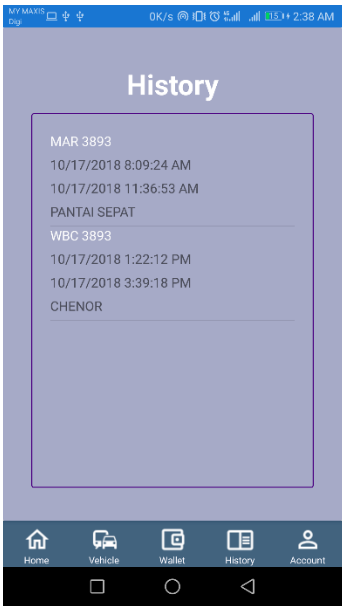
Figure 3.5 Manage Vehicle


Wallet

Credit Balance

RM 23.80

Figure 3.6 Manage Wallet


History

MAR 3893

10/17/2018 8:09:24 AM

10/17/2018 11:36:53 AM

PANTAI SEPAT

WBC 3893

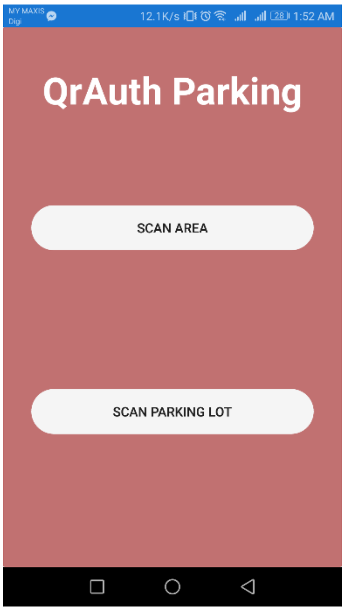
10/17/2018 1:22:12 PM

10/17/2018 3:39:18 PM

CHENOR

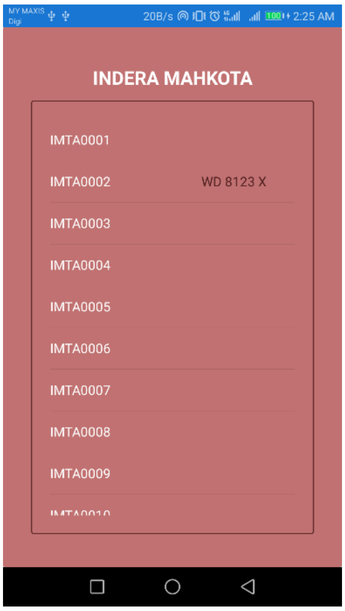
Figure 3.7 View History

3.2 QrAuth Parking



QrAuth Parking

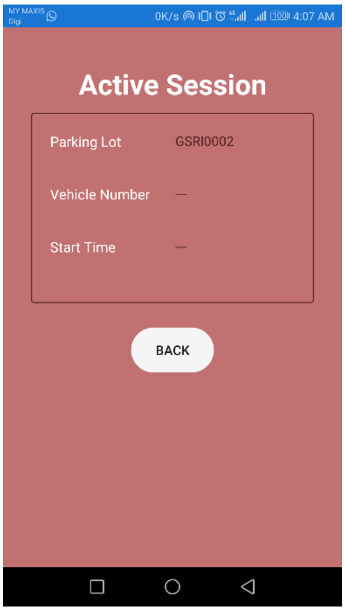
Figure 3.8 Main Page



INDERA MAHKOTA

IMTA0001	
IMTA0002	WD 8123 X
IMTA0003	
IMTA0004	
IMTA0005	
IMTA0006	
IMTA0007	
IMTA0008	
IMTA0009	
IMTA0010	

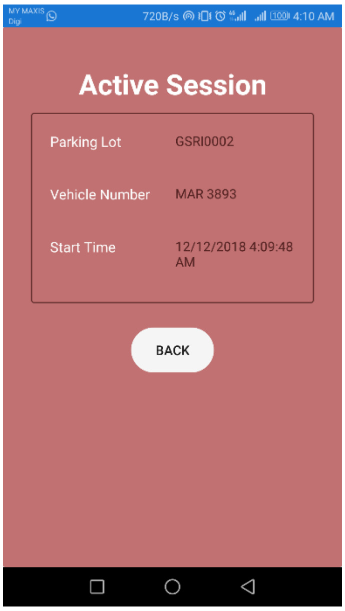
Figure 3.9 Lot List



Active Session

Parking Lot	GSRI0002
Vehicle Number	---
Start Time	---

Figure 3.10 Inactive Session



Active Session

Parking Lot	GSRI0002
Vehicle Number	MAR 3893
Start Time	12/12/2018 4:09:48 AM

Figure 3.11 Active Session

3.3 QrPay Admin

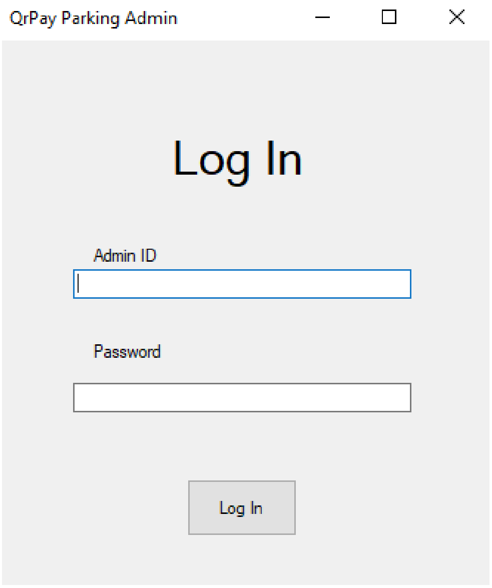
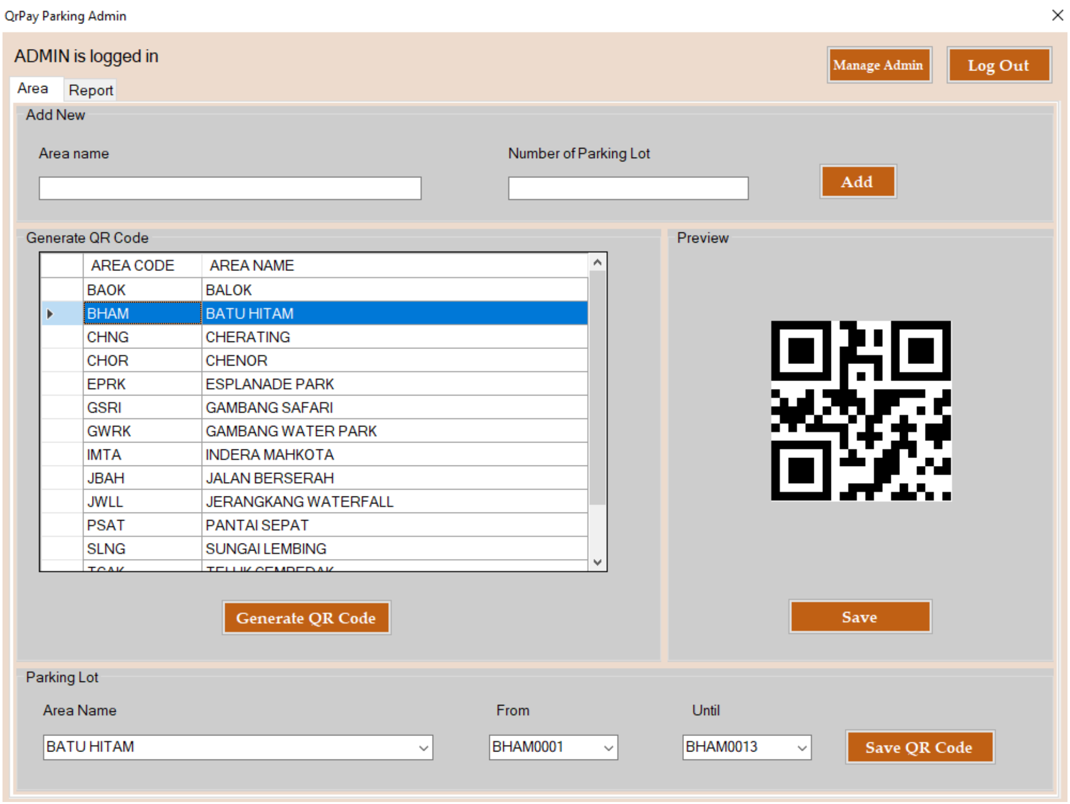


Figure 3.12 Admin Log In



ADMIN is logged in

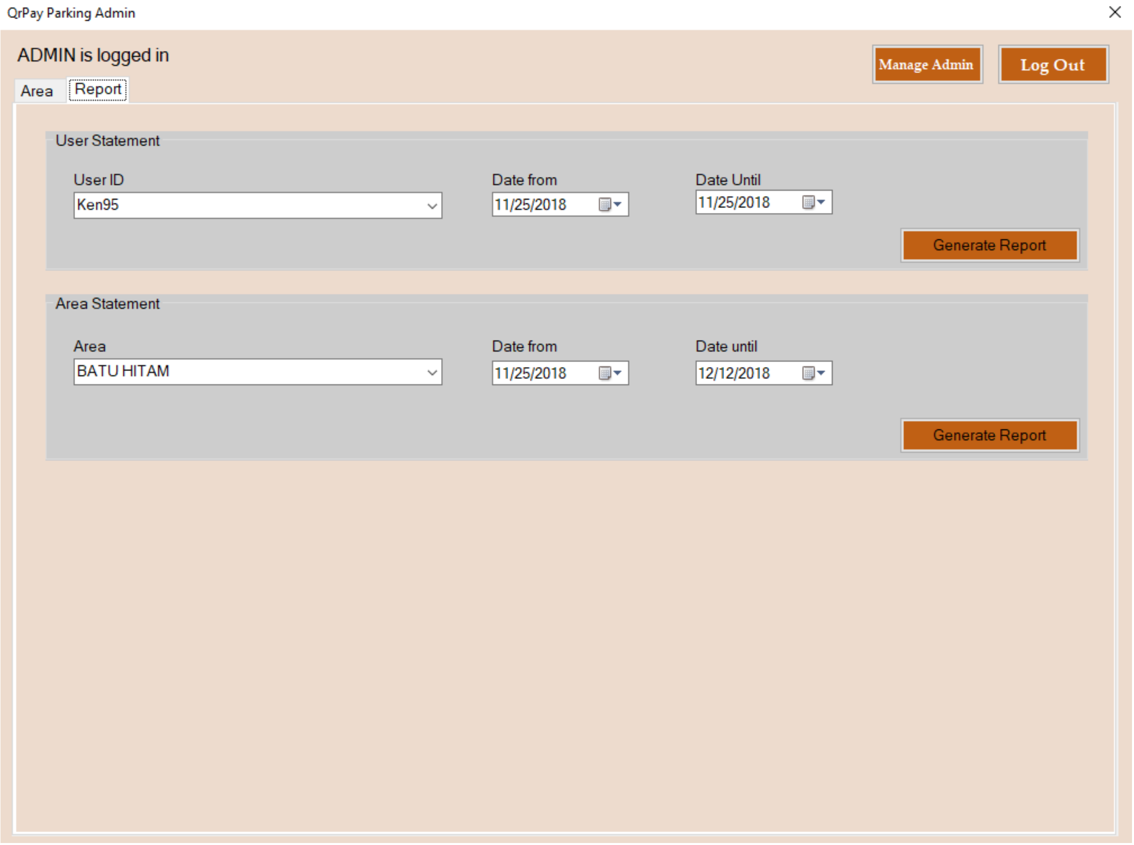
AREA CODE	AREA NAME
BAOK	BALOK
BHAM	BATU HITAM
CHNG	CHERATING
CHOR	CHENOR
EPRK	ESPLANADE PARK
GSRI	GAMBANG SAFARI
GWRK	GAMBANG WATER PARK
IMTA	INDERA MAHKOTA
JBAH	JALAN BERSERAH
JWLL	JERANGKANG WATERFALL
PSAT	PANTAI SEPAT
SLNG	SUNGAI LEMBING
TCAK	TELUK CEMPEDAK

Area Name: BATU HITAM

From: BHAM0001

Until: BHAM0013

Figure 3.13 Manage Parking Lot



QrPay Parking Admin

ADMIN is logged in

User Statement

User ID: Ken95

Date from: 11/25/2018

Date Until: 11/25/2018

Area Statement

Area: BATU HITAM

Date from: 11/25/2018

Date until: 12/12/2018

Figure 3.14 Print Report

4.0 SOFTWARE PRODUCTS FEATURES

4.1 Sign Up

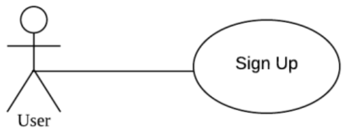


Figure 4.1 Sign Up Use Case

Table 4.1 Sign Up Use Case

Use Case ID	QP-REQ01
Brief Description	A user of the application creates an account
Actor	1. User
Pre-Condition	1. The application is installed in the smart phone and is opened. 2. The user is not logged into the system
Basic Flow	1. The system prompts the user to enter username and password or sign up 2. The user click “Sign Up” button 3. The system prompts the user to register username, password. 4. The user enters required information. 5. System verifies information
Alternative Flow	1. Invalid Information Entered 1.1 User click submit after enters required information 1.2 System display message to correct invalid information 1.3 User re-enters required information
Exception Flow	1. Cancel Registration 1.1 The user click the “Cancel” button 1.2 The system returns the user to the login page without the user being logged in and any information entered has been erased.
Post-Condition	1. New account is created 2. User able to log in using username and password
Sequence Diagram	1. Figure 5.1 Sign Up 2. Figure 5.2 Sign Up – Cancel

4.2 Log In

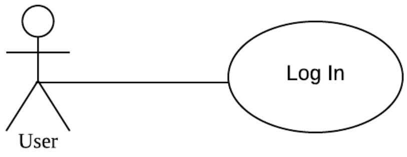


Figure 4.2 Log In Use Case

Table 4.2 Log In Use Case

Use Case ID	QP-REQ02
Brief Description	A user of the application or an authority logs into the system
Actor	1. User
Pre-Condition	1. The application is installed in the smart phone and is opened. 2. The user is not logged into the system
Basic Flow	1. The system prompts the user or the authority to enter username and password or Sign Up 2. The user or the authority enters username, password and click “Login” button. 3. The system validates the entered username and password to ensure the username and password is valid in the system.
Alternative Flow	1. User Fails Authentication 1.1 The system validate that the entered username and password is invalid in the system 1.2 The system show message on invalid field and prompt user to re-enter the valid information 1.3 The flow continues from step 2 in Basic Flow.
Exception Flow	None
Post-Condition	1. The user or the authority is logged in 2. The application is directed to the home page
Sequence Diagram	1. Figure 5.3 Login

4.3 Manage Vehicle

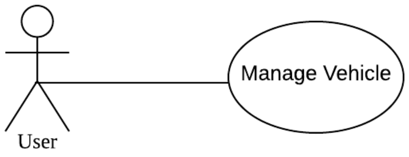


Figure 4.3 Manage Vehicle Use Case

Table 4.3 Manage Vehicle Use Case

Use Case ID	QP-REQ03
Brief Description	User registers vehicles in the application
Actor	1. User
Pre-Condition	1. The user is logged into the system
Basic Flow	1. The user selects the Vehicle Tab 2. The user enter the vehicle number and click "Add" button 3. The system saved the information into database
Alternative Flow	None
Exception Flow	None
Post-Condition	1. The vehicle list is refresh
Sequence Diagram	1. Figure 5.4 Manage Vehicle

4.4 Manage Wallet

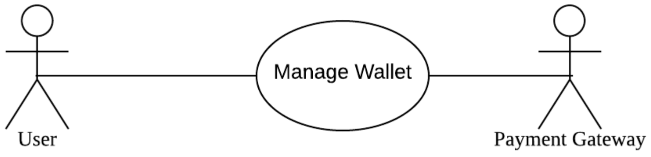


Figure 4.4 Manage Wallet Use Case

Table 4.4 Manage Wallet Use Case

Use Case ID	QP-REQ04
Brief Description	A user manages the balance in the in-app wallet
Actor	1. User 2. Payment Gateway
Pre-Condition	1. The user is logged into the system
Basic Flow	1. The user selects the Wallet tab 2. The user clicks the Reload button 3. The system prompts the user to enter desired amount and payment gateway. 4. The user enters the desired amount and payment gateway 5. The system initiates an authorization request to selected payment gateway 6. The payment gateway authorizes the request is successful and transfer the fund into user’s account
Alternative Flow	None
Exception Flow	1. Request Unsuccessful 1.1 The payment gateway authorizes the request is unsuccessful 1.2 The system shows failure message to the user 2. Cancel Reload 2.1 The user selects the cancel option 2.2 The system closes the dialogue and any information entered has been erased

Post-Condition	1. The balance in the in-app wallet increased
Sequence Diagram	1. Figure 5.5 Manage Wallet 2. Figure 5.6 Manage Wallet – Unsuccessful Request 3. Figure 5.7 Manage Wallet - Cancel

4.5 Start Parking Session

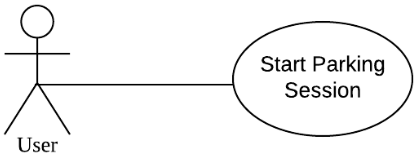


Figure 4.5 Start Parking Session Use Case

Table 4.5 Start Parking Session Use Case

Use Case ID	QP-REQ05
Brief Description	A user starts a parking session
Actor	1. User
Pre-Condition	1. The user is logged into the system
Basic Flow	1. The user clicks "Scan" button at the Home Page 2. The system prompts the user to scan the QR code attached at the parking lot. 3. The user scans the QR code 4. The system prompts the user to select vehicle and duration in 1 hour basis 5. The user selected the required information 6. The system validates the balance is sufficient in user's account
Alternative Flow	None
Exception Flow	1. Cancel Create Session 1.1 The user selects the "Cancel" button 1.2 The system redirects to the home page 2. Insufficient Credit 2.1 The system validated the balance is insufficient in user's account to start a new session 2.2 The system display warning message and advice user to reload 2.3 The system redirects to the home page

Post-Condition	1. A new parking session is started at user’s account
Sequence Diagram	1. Figure 5.8 Start Session 2. Figure 5.9 Start Session – Cancel 3. Figure 5.10 Start Session – Insufficient Balance

4.6 End Parking Session

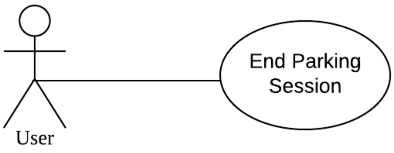


Figure 4.6 End Parking Session Use Case

Table 4.6 End Parking Session Use Case

Use Case ID	QP-REQ06
Brief Description	A user or the system end the parking session created
Actor	1. User 2. System
Pre-Condition	1. A parking session is started
Basic Flow	1. The user clicks on the “Stop” button 2. The system prompts the user to confirm on end session 3. The user confirms on it
Alternative Flow	1. Session Expired 1.1 The system detected that the session has reach its expiration time 1.2 The system ends the session automatically
Exception Flow	None
Post-Condition	1. The parking session ended and redirect to the home page 2. The system deducts the appropriate amount from user’s in-app wallet
Sequence Diagram	1. Figure 5.11 End Session

4.7 Extend Parking Session

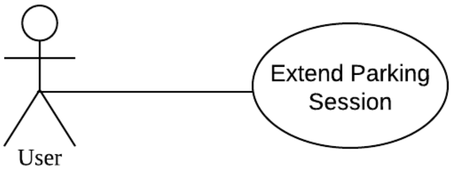


Figure 4.7 Extend Parking Session Use Case

Table 4.7 Extend Parking Session Use Case

Use Case ID	QP-REQ07
Brief Description	A user extends the parking session directly from the system
Actor	1. User
Pre-Condition	1. A parking session is started
Basic Flow	1. The user clicks on the “Extend” button 2. The system prompts the user to select duration in 1 hour basis 3. The user entered the duration desired 4. The system validates the balance is sufficient in user’s account
Alternative Flow	None
Exception Flow	1. Cancel Extend Session 1.1 The user selects the cancel option 1.2 The system closes the dialogue 2. Insufficient Credit 2.1 The system validated the balance is insufficient in user’s account to extend the session 2.2 The system display warning message and advice user to reload
Post-Condition	1. The remaining time of the parking session is extended
Sequence Diagram	1. Figure 5.12 Extend Session 2. Figure 5.13 Extend Session – Cancel 3. Figure 5.14 Extend Session – Insufficient Balance

4.8 View Session History

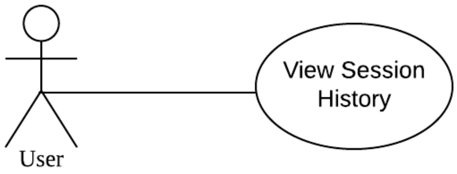


Figure 4.8 View Session History Use Case

Table 4.8 View Session History Use Case

Use Case ID	QP-REQ08
Brief Description	A user views the history of parking session being made
Actor	1. User
Pre-Condition	1. The user is logged into the system
Basic Flow	1. The user clicks on the History tab
Alternative Flow	None
Exception Flow	None
Post-Condition	1. The system displays up to 20 previous parking sessions including the vehicle number, start time and end time
Sequence Diagram	1. Figure 5.15 View Session History

4.9 Check Parking Lot Status

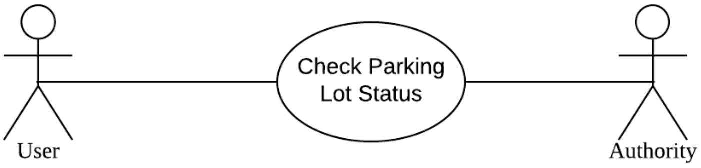


Figure 4.9 Check Parking Lot Status Use Case

Table 4.9 Check Parking Lot Status Use Case

Use Case ID	QP-REQ09
Brief Description	An authority checks whether a parking session is started in certain parking lot.
Actor	1. Authority 2. User
Pre-Condition	1. The application is installed
Basic Flow	1. The authority clicks Scan button at the Home Page 2. The system prompts the authority to scan the QR code attached at the parking area. 3. The authority scans the QR code 4. The system shows the list of parking lots in the area with current status.
Alternative Flow	None
Exception Flow	None
Post-Condition	1. The system displays the status of the parking lot that the authority scans on.
Sequence Diagram	1. Figure 5.16 Check Session

4.10 Manage Parking Lot Data

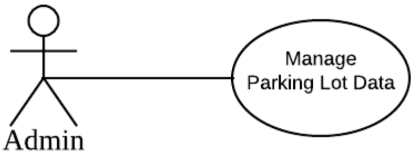


Figure 4.10 Manage Parking Lot Data Use Case

Table 4.10 Manage Parking Lot Data Use Case

Use Case ID	QP-REQ10
Brief Description	The admin add the area and parking lot data into database
Actor	1. Admin
Pre-Condition	1. The application is opened
Basic Flow	1. The admin clicks on the Area tab 2. Admin enter area name and number of parking lot 3. Admin click "Add" button 4. Admin select the area name from the list and click "Generate QR Code" button 5. Admin click "Save" button 6. Admin select area name and parking lot number 7. Admin click "Save QR Code" button
Alternative Flow	None
Exception Flow	None
Post-Condition	1. The area and parking lots data are saved into database 2. The Qr Code of the area and the parking lots are saved in the computer
Sequence Diagram	1. Figure 5.17 Manage Parking Lot Data

4.11 Print Report

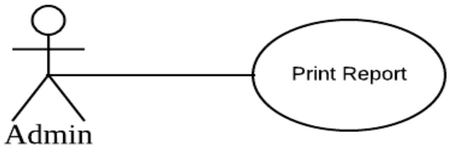


Figure 4.11 Print Report Use Case

Table 4.11 Print Report Use Case

Use Case ID	QP-REQ11
Brief Description	The admin view and print the report
Actor	1. Admin
Pre-Condition	1. The application is opened
Basic Flow	1. The admin clicks on the Report tab 2. The admin select the user ID or area name and the desired timeline 3. The admin click the "Generate Report" button
Alternative Flow	None
Exception Flow	None
Post-Condition	1. The system save the report in pdf format
Sequence Diagram	1. Figure 5.18 Print Reports

5.0 SEQUENCE DIAGRAMS

This section will show the sequence diagram of the QrPay System.

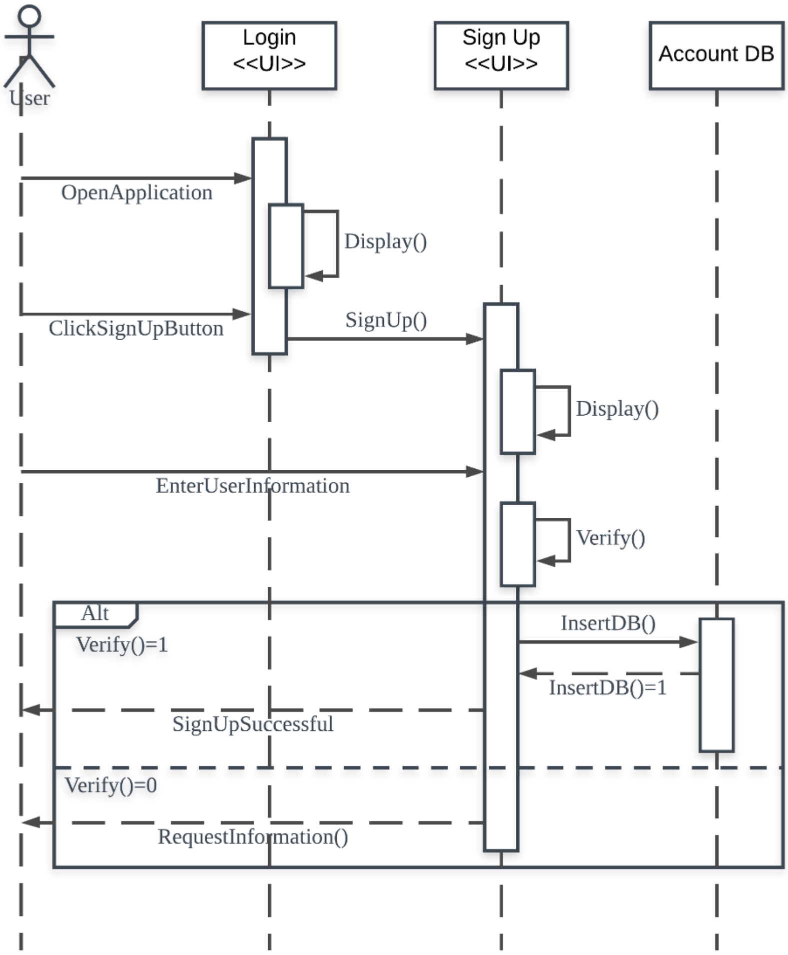


Figure 5.1 Sign Up

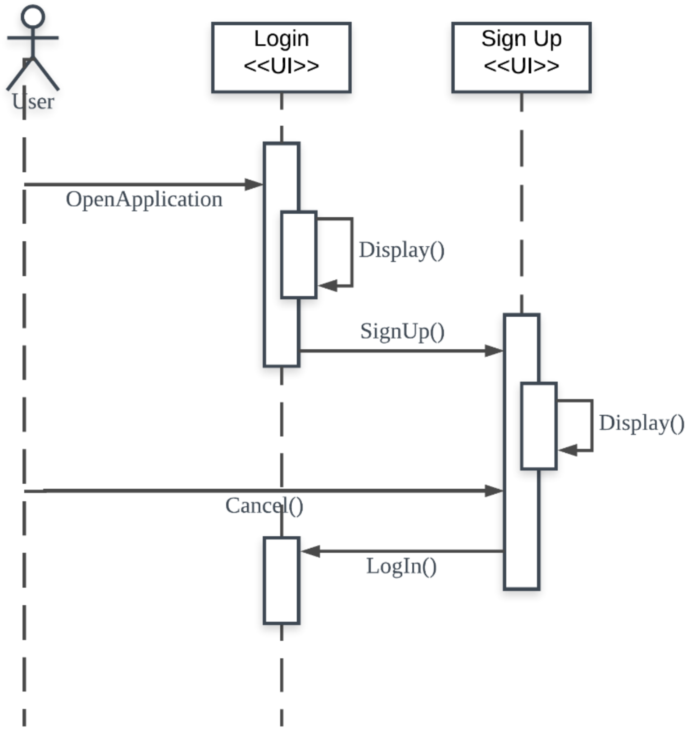


Figure 5.2 Sign Up – Cancel

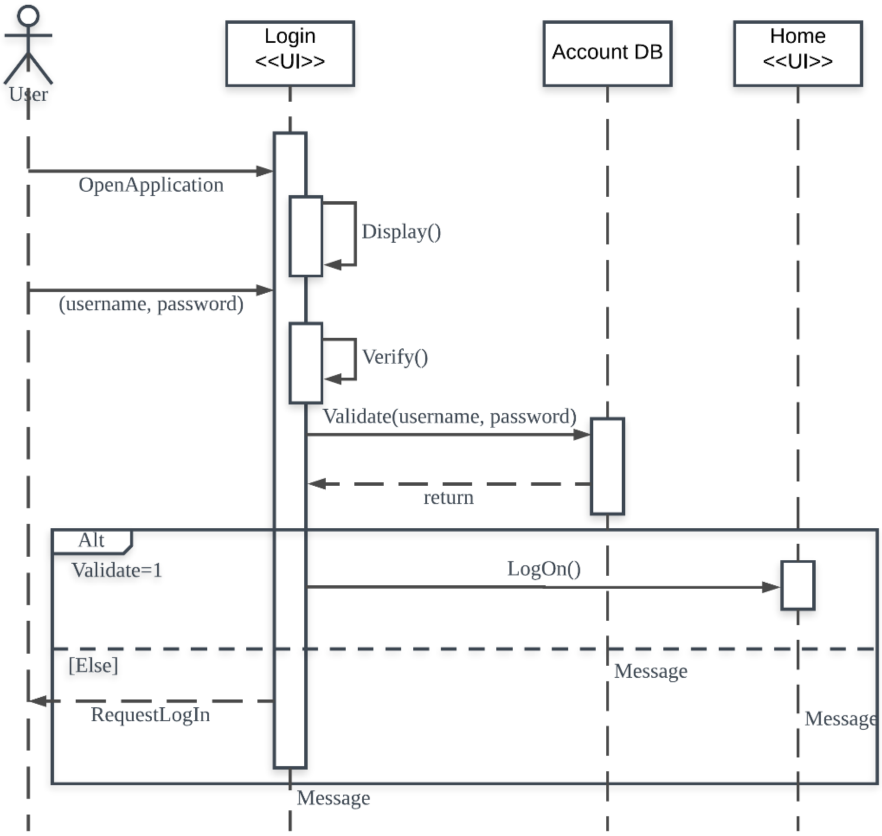


Figure 5.3 Login

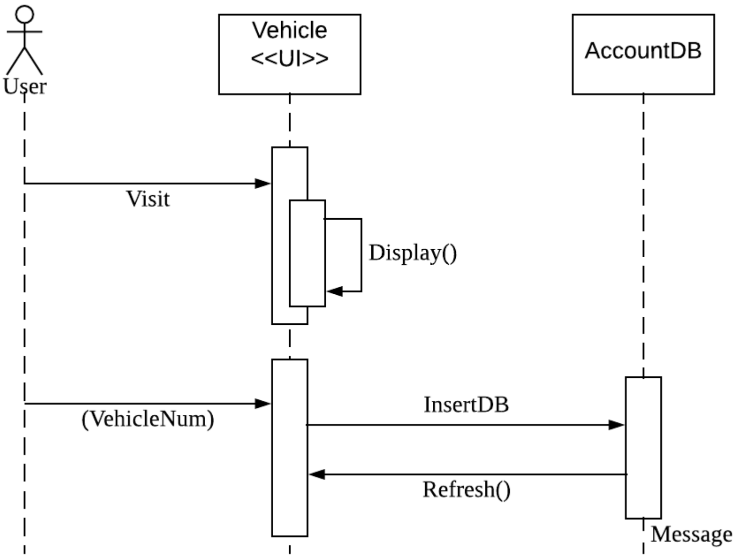


Figure 5.4 Manage Vehicle

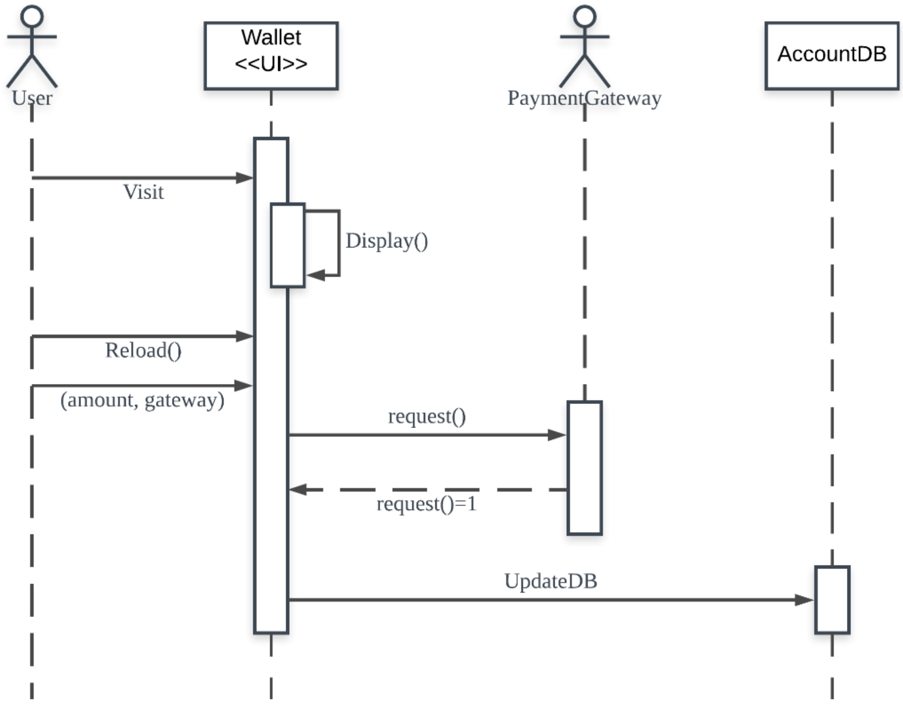


Figure 5.5 Manage Wallet

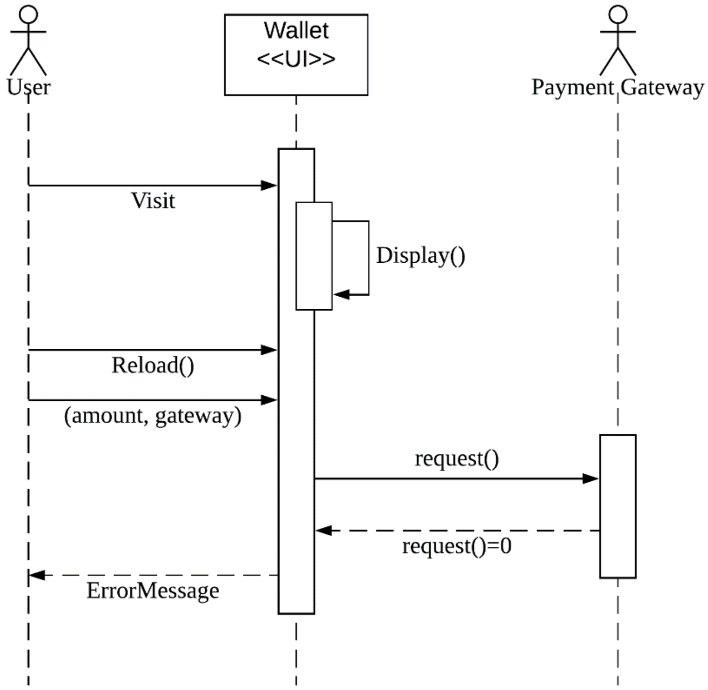


Figure 5.6 Manage Wallet – Unsuccessful Request

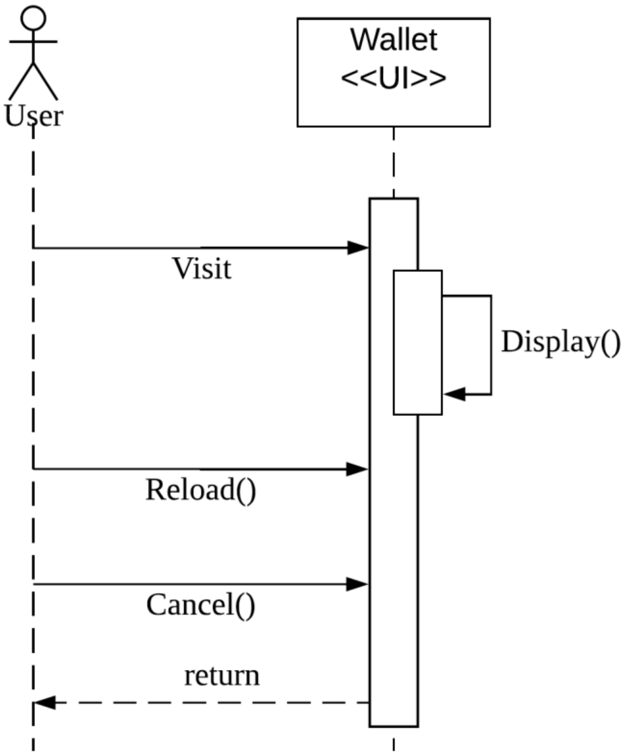


Figure 5.7 Manage Wallet - Cancel

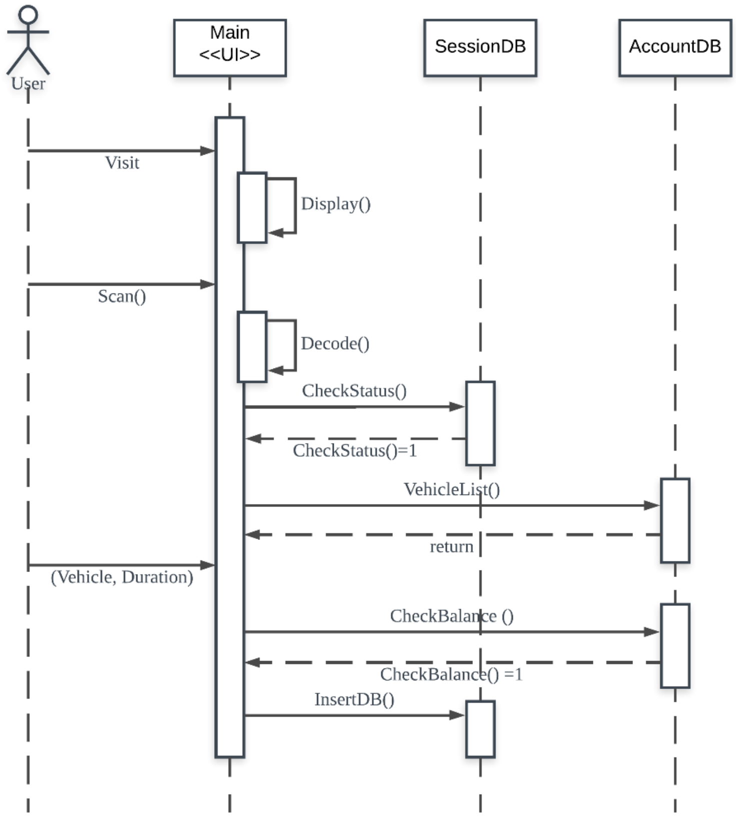


Figure 5.8 Start Session

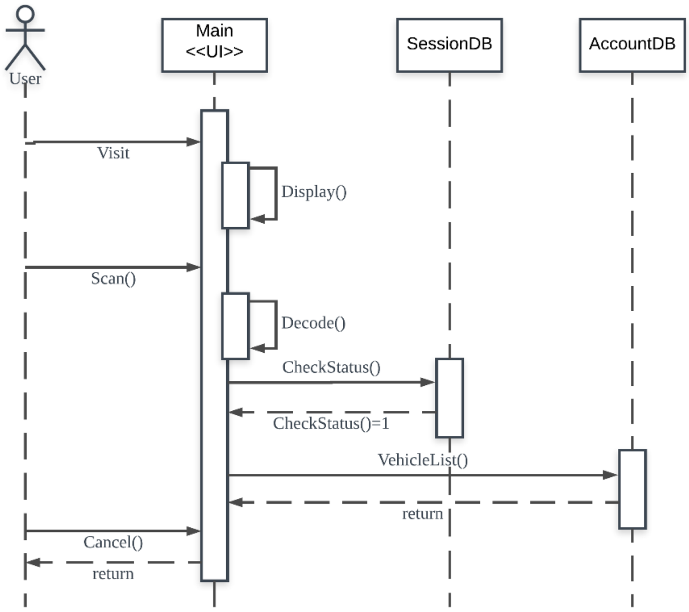


Figure 5.9 Start Session – Cancel

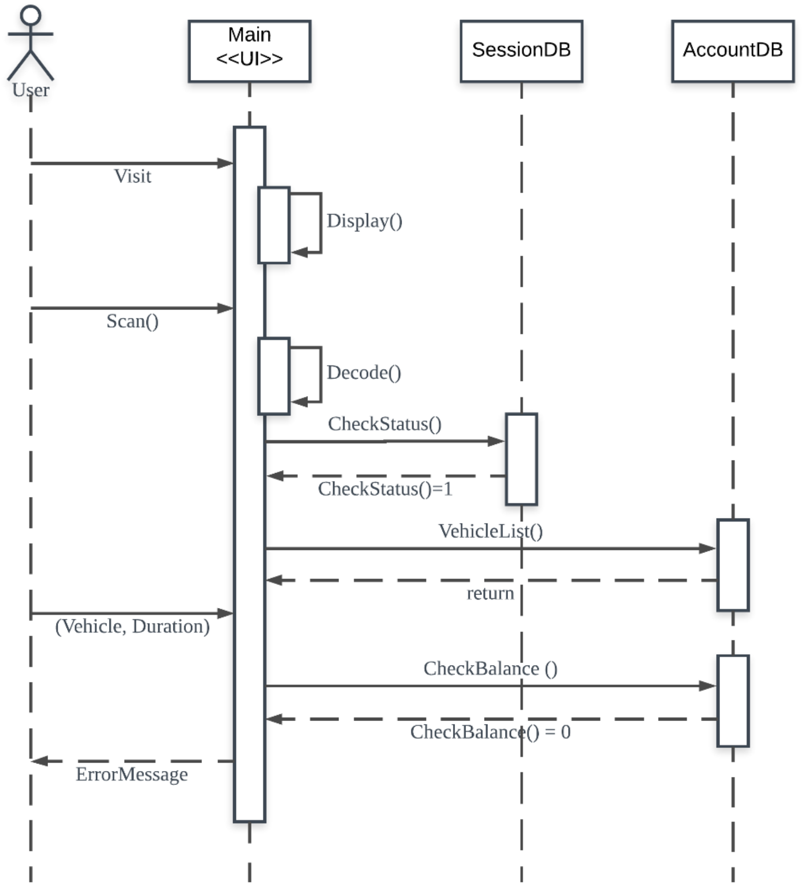


Figure 5.10 Start Session – Insufficient Balance

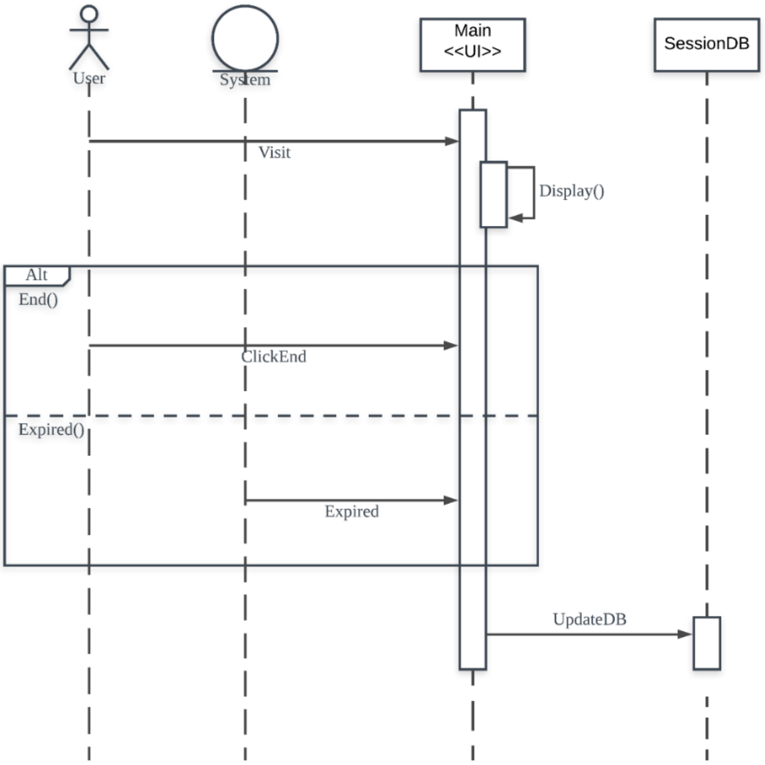


Figure 5.11 End Session

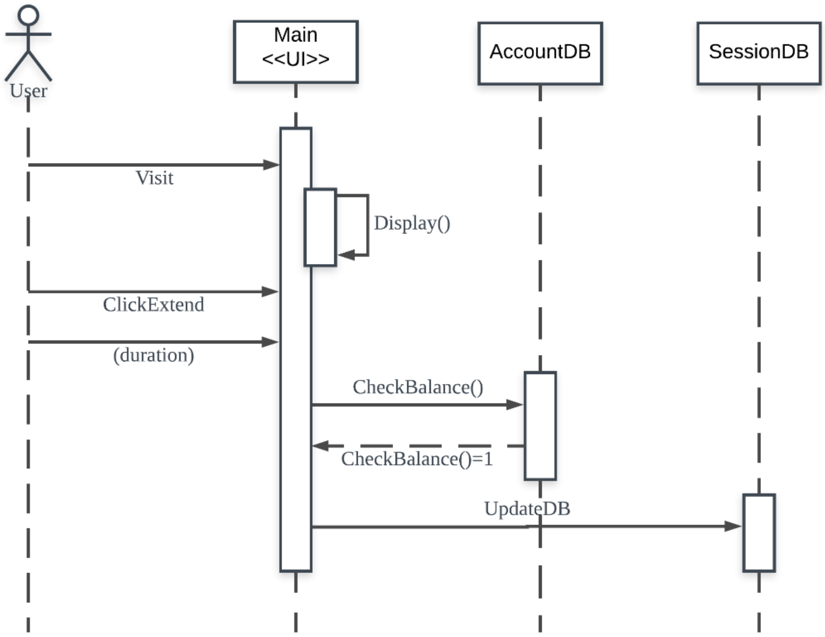


Figure 5.12 Extend Session

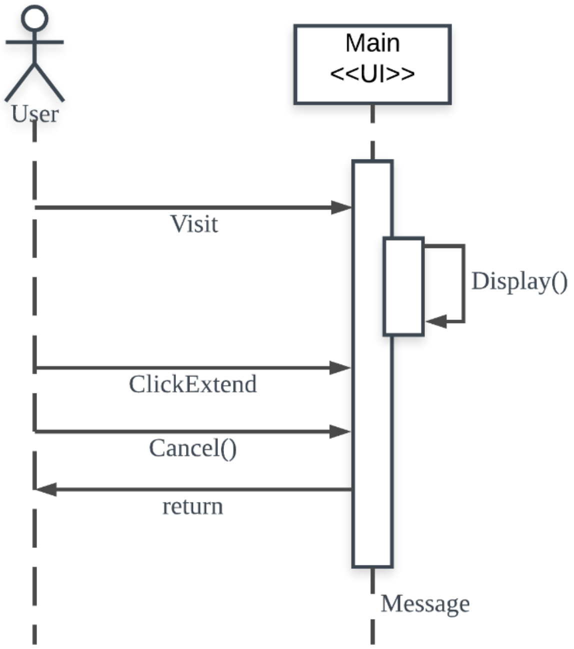


Figure 5.13 Extend Session – Cancel

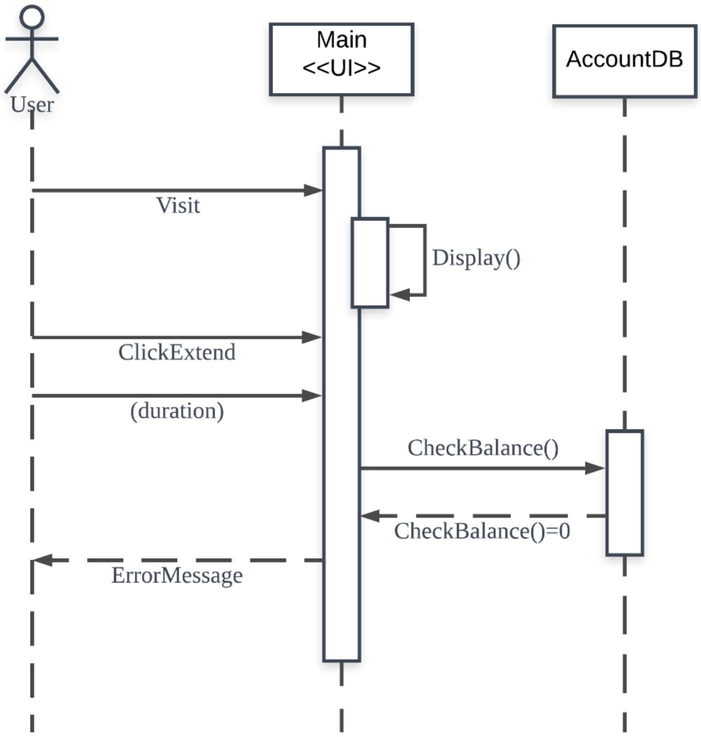


Figure 5.14 Extend Session – Insufficient Balance

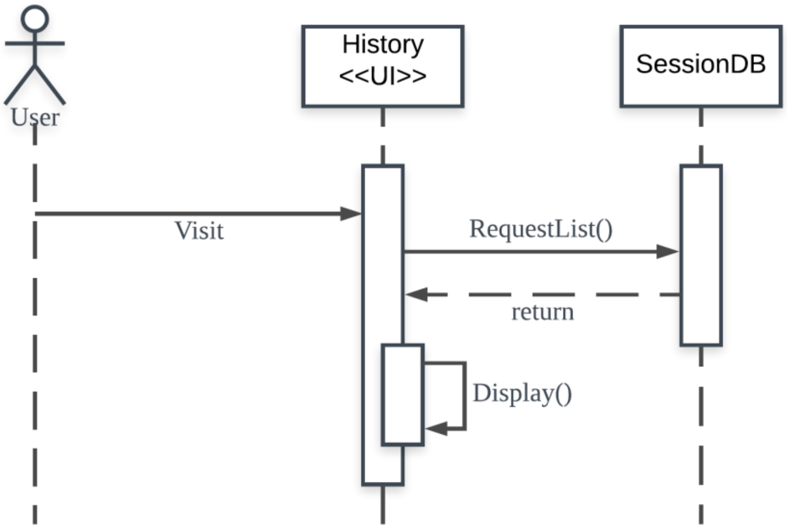


Figure 5.15 View Session History

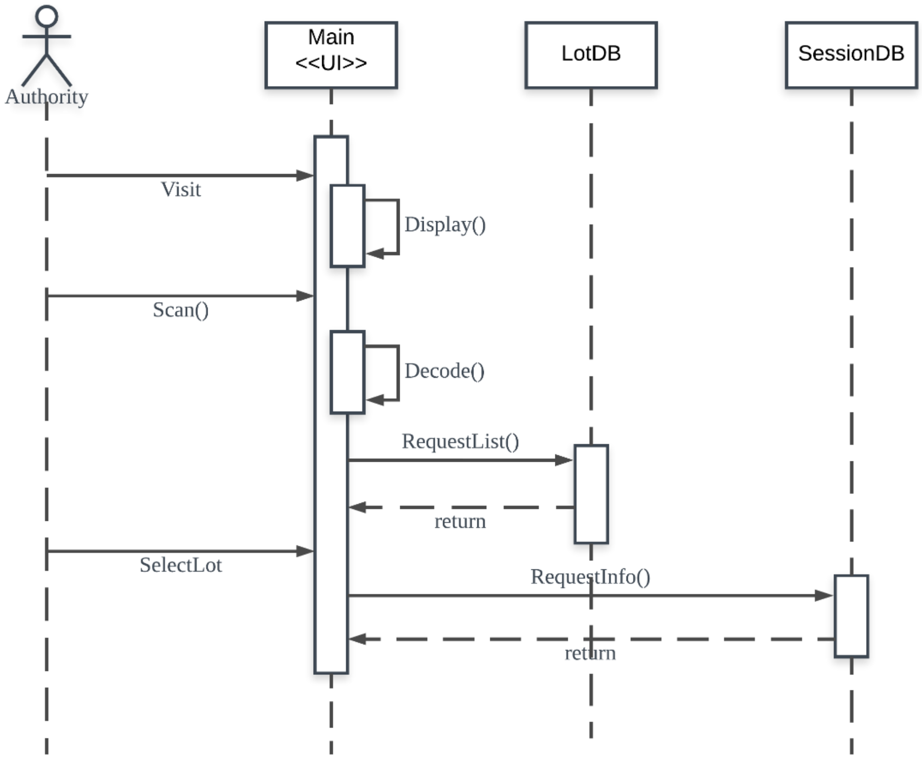


Figure 5.16 Check Session

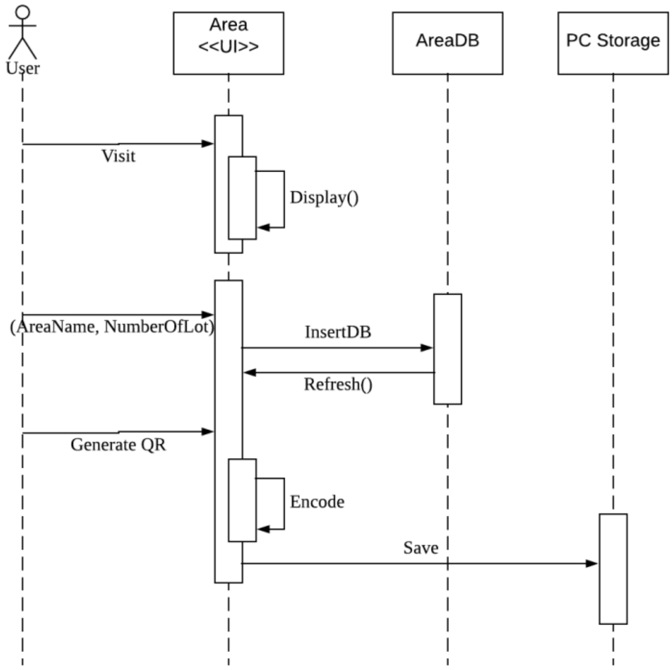


Figure 5.17 Manage Parking Lot Data

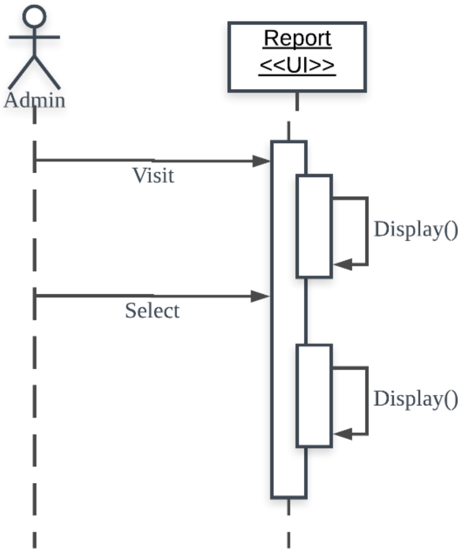


Figure 5.18 Print Report

6.0 SYSTEM REQUIREMENTS APPROVAL

	Name	Date
Verified by: Developer	TEE KEN LEE	9 JAN 2019
Approved by: Client	LAI JIA BAO	9/1/19

Software Design Document

(SDD)

For

QrPay Parking System

(Version 1.0)

Prepared by **TEE KEN LEE**

Faculty of Computer Systems & Software Engineering (FSKKP)

Universiti Malaysia Pahang

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

1.1 Purpose

The Software Design Document (SDD) is documented purposely to describe the components of QrPay Parking System. This document also describes the implementation details of QrPay Parking System as specific in the Software Requirement Specifications (SRS). This document could be used as a reference during the development phase. This document is intended for the current developer team and future developer and maintenance team of the system.

1.2 Document Overview

1.2.1 Introduction

This section describes the purpose of writing this document and the overview throughout this document.

1.2.2 System Architecture

This section shows the static architecture of the QrPay Parking System.

1.2.3 Database Design Design

This section describes the design of the database implemented in the QrPay Parking System. The relationship between the data will be explained by using the Entity Relationship Diagram (ERD). The specific type and the constraint of the data will also be explained in this section.

2.0 SYSTEM ARCHITECTURE

2.1 Static Organization

Figure 2.1 shows the static organization of QrPay System.

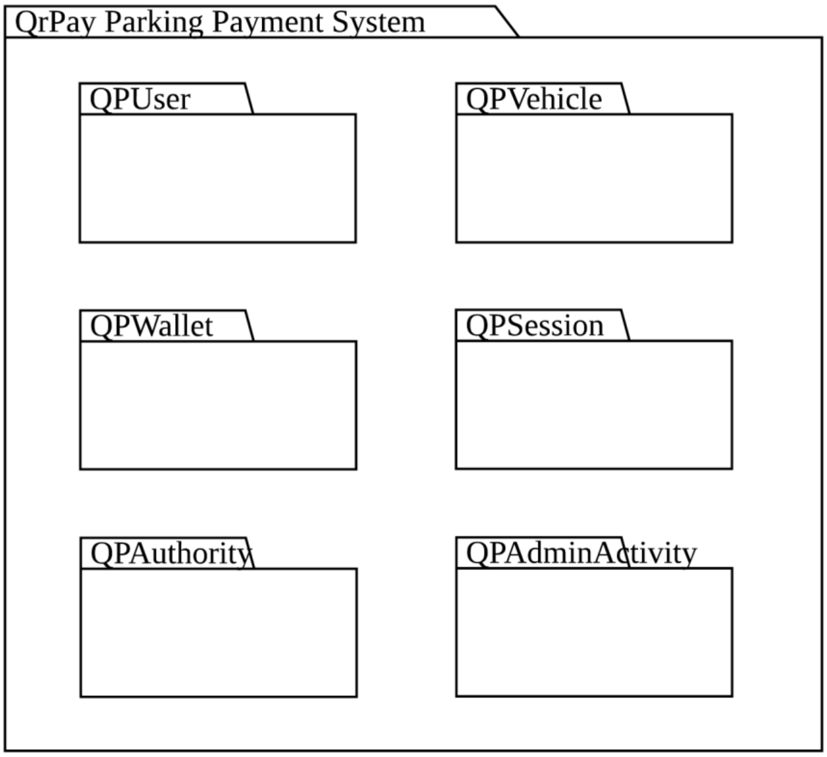


Figure 2.1 Static Organization of QrPay System

3.0 DATABASE DESIGN

3.1 Data Modelling

The model of the data is described using Entity Relation Diagram (ERD) as shown in Figure 3.1.

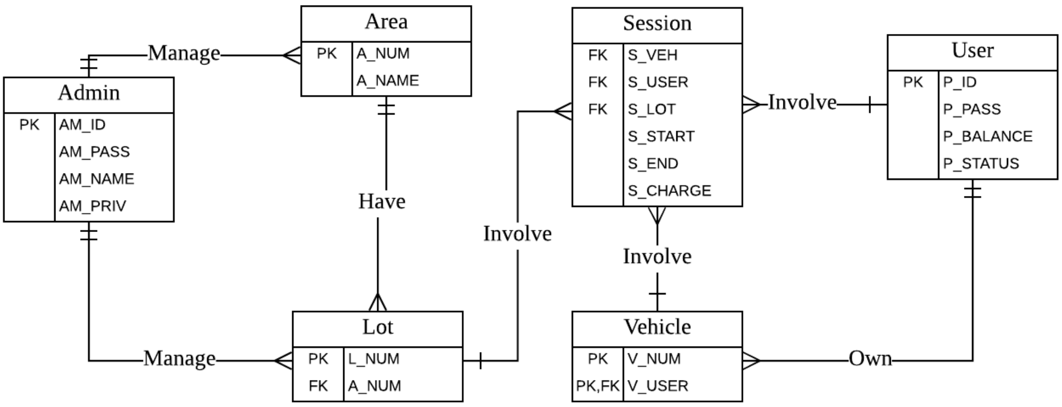


Figure 3.1 ERD of QrPay System

3.2 Data Dictionary

The data dictionary below will explain the components in every entity in the database.

3.2.1 User

Table 3.2.1 Data Dictionary for User

VALUE	KEY	DATA TYPE	LENGTH
P_ID	PK	VARCHAR	15
P_PASS		VARCHAR	15
P_BALANCE		DECIMAL	5,2
P_STATUS		BIT	-

3.2.2 Vehicle

Table 3.2.2 Data Dictionary for Vehicle

VALUE	KEY	DATA TYPE	LENGTH
V_NUM	PK	VARCHAR	10
V_USER	PK,FK	VARCHAR	15

3.2.3 Parking Lot

Table 3.2.3 Data Dictionary for Parking Lot

VALUE	KEY	DATA TYPE	LENGTH
L_NUM	PK	VARCHAR	10
A_NUM	FK	VARCAHR	10

3.2.4 Session

Table 3.2.4 Data Dictionary for Session

VALUE	KEY	DATA TYPE	LENGTH
S_VEH	FK	VARCHAR	10
S_USER	FK	VARCHAR	15
S_LOT	FK	VARCHAR	10
S_START		DATETIME	-
S_END		DATETIME	-
S_CHARGE		DECIMAL	5,2

3.2.5 Area

Table 3.2.5 Data Dictionary for Area

VALUE	KEY	DATA TYPE	LENGTH
A_NUM	PK	VARCHAR	10
A_NAME		VARCHAR	50

3.2.6 Admin

Table 3.2.6 Data Dictionary for Admin

VALUE	KEY	DATA TYPE	LENGTH
AM_ID	PK	VARCHAR	15
AM_PASS		VARCHAR	15
AM_NAME		VARCHAR	30
AM_PRIV		BIT	-

4.0 PRELIMINARY DESIGN

This section shows the internal organizational structure of each application of QrPay Parking System. The relationship among subsystems will be described.

4.1 QrPay Parking

4.1.1 Login Class

Class Type : Entity Class

Responsibility : Allow user to log into the application

Attribute	:lUsername	: String
	lPassword	: String
Method	:btnLog_Clicked	: to Log into system with username and password
	:btnSign_Clicked	: to prompt the sign up window

4.1.2 Sign Up Class

Class Type : Entity Class

Responsibility : Allow user to register a new account

Attribute	:sUsername	: String
	sPassword1	: String
	sPassword2	: String
Method	:btnSign_Clicked	: to create new account in database
	:btnCancel_Clicked	: to pop out the sign up window

4.1.3 HomePage Class

Class Type : Entity Class

Responsibility : Allow user to start,stop and extend a parking session

Attribute	:rLotNum	: String
	rVehnum	: String
	rStartTime	: DateTime
	end	: DateTime
	remain	:TimeSpan
Method	:btnScan_Clicked	: to start a Qr Code scanner
	StartSession	:to start a parking session
	:btnStop_Clicked	: to end a parking session
	btnExtend_Clicked	: to prompt a extend parking session window
	OnAppearing	: to refresh the view and countdown the remaining time of parking session

4.1.4 ExtendPopup Class

Class Type : Entity Class

Responsibility : Allow user to extend the parking session

Attribute	:sDuration	: TimeSpan
Method	:btnConfirm_Clicked	: to confirm the extend parking session
	:btnCancel_Clicked	: to pop out the extend session window

4.1.5 VehiclePage Class

Class Type	: Entity Class	
Responsibility	: Allow user to register a new vehicle	
Attribute	:nVehnum	: String
Method	:btnAdd_Clicked	: to add a new vehicle number into account
	: Refresh	: to refresh the vehicle list

4.1.6 VehicleList Class

Class Type	: Controller Class	
Responsibility	: To get a list of vehicles registered in the account	
Attribute	: vehicles	: List<Vehicle>
Method	: GetVehicles	: to get the vehicle list from the database

4.1.7 Vehicle Class

Class Type	: Object Class	
Responsibility	: to initial the attribute of vehicle	
Attribute	: Vehnum	:string

4.1.8 WalletPage Class

Class Type	: Entity Class	
Responsibility	: Allow user to manage balance of the account	
Attribute	: wBalance	: Double
Method	: btnReload_Clicked	: to prompt the reload window
	: btnRefund_Clicked	: to refund all the remaining balance of the account

4.1.9 ReloadPopup Class

Class Type : Entity Class

Responsibility : Allow user to reload amount into account

Attribute :rAmount : Double

balance : Double

reload : Boolean

Method :btnConfirm_Clicked : to confirm on the reload amount into the account

:btnCancel_Clicked : to pop out the reload window

4.1.10 HistoryPage Class

Class Type : Entity Class

Responsibility : Allow user to view parking session history

Attribute :sessionlist : SessionList

4.1.11 SessionList Class

Class Type : Controller Class

Responsibility : To get the session data from the database

Attribute : sessions :List<Session>

4.1.12 Session Class

Class Type : Object Class

Responsibility : to initial the attributes of session

Attribute	:vehnum	: String
	start	: String
	end	: String
	charge	:String
	area	:String

4.2 QrAuth Parking

4.2.1 Main Page Class

Class Type : Entity Class

Responsibility : The main page of the application as starting point

Method :btnArea_Clicked : to scan the parking area QR Code

:btnParking_Clicked : to scan the parking lot QR Code.

4.2.2 AreaPage Class

Class Type : Entity Class

Responsibility : Display the parking lot status for the selected area

Attribute :lotlist : LotList

AName : String

4.2.3 LotList Class

Class Type : Controller Class

Responsibility: Get the list of parking lots with status of each parking lot.

Attribute :lots :List<Lot>

Method :GetLot :get the list of parking status from database

4.2.4 Lot Class

Class Type : Object Class

Responsibility : To initialize the attributes of parking lot

Attribute :lotnum : String

vehnum : String

4.2.5 LotPage Class

Class Type : Entity Class

Responsibility : Display the selected parking lot status

Attribute :rLotNum : String

rVehnum : String

rStartTime : Datetime

Method :btnBack_Clicked : to navigate back to the application main page

4.3 QrPay Admin

4.3.1 frmLogin Class

Class Type : Entity Class

Responsibility : Allow admin to log into the application

Attribute :txtID : String

txtPass : String

Method :btnLogIn_Click : to log into the system with ID and password

4.3.2 frmMain Class

Class Type : Entity Class

Responsibility : Allow admin to perform admin tasks

Attribute :txtArea : String

txtNumber : Number

bmp : Bitmap

dpRUFrom : Date

dpRUUntil : Date

Method :frmMain_Load : to refresh the content with binding dataset

:btnLogOut_Click : to log out from the system

btnAdd_Click : to add the area and parking lot data into database

:btnGenerate_Click : to generate and preview the QR Code of the selected area

:btnSave_Click : to save the generated QR Code into PC.

:GetEncoder : to convert the QR Code image into jpeg format

:btnPSave : to save the QR Code of parking lots into PC

:btnRUSave_Click : to validate the info for generate user statement

:PrintUserPdf : to generate the user statement in pdf format

:btnRSSave_Click : to validate the info for generate area statement

:PrintUserPdf : to generate the area statement in pdf format

:btnAdmin_Click : to start the manage admin windows

4.3.3 frmAdmin Class

Class Type : Entity Class

Responsibility : Allow admin to manage admin accounts

Attribute :txtFName : String

txtLName : String

txt

Method	:btnAdd_Click	: to add new admin account with entered name
	btnClose_Click	: to close the manage admin window
	btnGrant_Click	: to grant higher privilege to the admin
	btnRevoke_Click	: to revoke the higher privilege from the admin

5.0 SYSTEM DESIGN APPROVAL

	Name	Date
Verified by: Developer	TEE KEN LEE	9 JAN 2019
Approved by: Client	LAM JIA BAO	9 JAN 2019

User Acceptance Test

(UAT)

For

QrPay Parking System

(Version 1.0)

Prepared by **TEE KEN LEE**

Faculty of Computer Systems & Software Engineering (FSKKP)

Universiti Malaysia Pahang

TABLE OF CONTENT

1.0 INTRODUCTION

1.1 Purpose

The User Acceptance Testing (UAT) is documented purposely to make sure all the applications of QrPay Parking System behave like they intended to do. All of the scenarios have been shown in the form of use cases and these flows are being tested. This document is intended for the current developer team and future developer and maintenance team of the system.

1.2 Document Overview

1.2.1 Introduction

This section describes the purpose of writing this document and the overview throughout this document.

1.2.2 Testing Report

This section shows the test cases of each application with several use cases.

2.0 TESTING REPORT

Use Case ID	Use Case	Action	Expected Result	P/F	Comment
QP-REQ01	Sign Up	Click “Sign Up” button with incomplete input.	System display alert.	P	
		Click “Sign Up” button with mismatch between 2 password field.	System display alert	P	
		Click “Sign Up” button with complete and correct input.	System display message that account is created and navigate back to Log In page.	P	
		Click “Cancel” button.	System navigate back to the Log In page.	P	
QP-REQ02	Log In	Click “Log In” button with incomplete input.	System display alert.	P	
		Click “Log In” button with non-registered ID.	System display alert.	P	

		Click “Log In” button with wrong password.	System display alert.	P	
		Click “Log In” button with complete and correct input.	System navigate to Home page.	P	
QP-REQ03	Manage Vehicle	Click “Vehicle” tab.	System navigate to Vehicle page.	P	
		Click “Add” button with incomplete input.	System display alert.	P	
		Click “Add” button with input	System display message that data is recorded.	P	
		Pull the vehicle list	The vehicle is refresh.	P	
QP-REQ04	Mange Wallet	Click “Wallet” tab.	System navigate to Wallet page.	P	
		Click “Reload” button	System popup Reload page.	P	
		Click “Reload” with incomplete input	System display alert.	P	

		Click “Reload” with valid input	System display confirmation message.	P	
		Click “Yes” for confirmation	System display message that reload successfully.	P	
QP-REQ05	Start Parking Session	Click “Home” tab	System navigate to Home page.	P	
		Click “Scan” button	System prompt QR code scanner page.	P	
		Scan invalid QR code	System display alert and close the scanner page.	P	
		Scan valid QR code	System pop up session detail page.	P	
		Click “Start” button with incomplete input	System display alert.	P	
		Click “Start” button with complete but insufficient balance	System display alert and navigate back to Home page.	P	

		Click “Start” button with complete input and sufficient balance	System navigate back to Home Page and start counting timer with details.	P	Works but need to manually refresh the page
QP-REQ06	End Parking Session	Click “End” button	System display confirmation message.	P	
		Click “Yes” for confirmation	System stop the counting timer and make charges on the account.	P	
QP-REQ07	Extend Parking Session	Click “Extend” button	System prompt user to select duration to extend.	P	
		Click “Confirm” button but insufficient balance	System display alert and navigate back to Home page.	P	
		Click “Confirm” button with sufficient balance	System navigate back to Home Page and continue counting timer with extended duration.	P	Works but need to manually refresh the page
QP-REQ08	View Session History	Click “History” tab	System navigate to History page.	P	

QP-REQ09	Check Parking Lot Status	Click “Scan Area” button	System start scanner	P	
		Scan invalid QR Code	System prompt error message	P	
		Scan valid QR Code	System navigate to interface of parking lots with status	P	Can add more information on the status
		Click “Scan Lot: button	System start scanner	P	
		Scan invalid QR Code	System prompt error message	P	
		Scan valid QR Code	System navigate to interface of parking lot with status	P	
QP-REQ10	Manage Parking Lot Data	Click “Add” button without input	System display alert	P	
		Click “Add” button with inputs	System display message and the area list is refreshed	P	
		Click “Generate and Preview” button	Interface display the QR Code Generated	P	

		Click “Save” button	System saved the generated QR Code	P	Allow selection of saving path to save if possible
		Click “Save QR” button	System saved the generated QR Code as collection		Allow selection of saving path to save if possible
QP-REQ11	Print Report	Click “Generate User Statement” button	System saved the statement in pdf format		Allow selection of saving path to save and auto view if possible
		Click “Generate Area Statement” button	System saved the statement in pdf format		Allow selection of saving path to save and auto view if possible

3.0 TESTER VERIFICATION

Test Form ID	Tester Name	Signature	Date
UAT-001	LEE JUN XIAN		09/01/2019
UAT-002	YHOI WEN BIN		09/01/2019
UAT-003	DESMOND HON KAI HENG		09/01/2019
UAT-004	YIP KAR FUNG		09/01/2019
UAT-005	CHENG WEI QUAN		09/01/2019
UAT-006	TAN CHEH PHEY		09/01/2019
UAT-007	NG RUEY SHYEN		09/01/2019
UAT-008	Beh Yu Ling		09/01/2019
UAT-009	Saw Hui QI		09/01/2019
UAT-010	Lee Wan Yee		09/01/2019
UAT-011	Boo Ying Qi		09/01/2019
UAT-012	Low Xin Yee		09/01/19
UAT-013	Ng Sau Yik		09/01/2019
UAT-014	Kee Poh Chien		09/01/2019
UAT-015	NUR SYAZWANI		10/1/2019
UAT-016	NUR AZILLAH		10/1/2019
UAT-017	Cheng Shen Sing		10/1/2019.
UAT-018	WILSON LIM WEI SHENG		10/1/2019
UAT-019	LIM XUE QING		10/1/2019
UAT-020	CASSANDRA YEN PEI YING		10/1/2019
UAT-021	CHONG YEE CHIN		10/1/2019
UAT-022	TAN MEI TING		10/1/2019
UAT-023	LEE MENG YAN		10/1/2019
UAT-024	TAN HUI ZHAN		10/1/2019
UAT-025	SABRINA CHUA WEN HUI		10/1/2019
UAT-026	CHAN PEI YIN		10/01/2019
UAT-027	ROY CHEONG SHEN THONG		10/1/2019
UAT-028	TANG MUNLIN		10/1/2019
UAT-029	NG YING CAN		10/1/2019
UAT-030	WONG WEI QIAM		10/1/2019

Conducted By

TEE KEN LEE
Developer

User Manual

For

QrPay Parking System

(Version 1.0)

Prepared by **TEE KEN LEE**

Faculty of Computer Systems & Software Engineering (FSKKP)

Universiti Malaysia Pahang

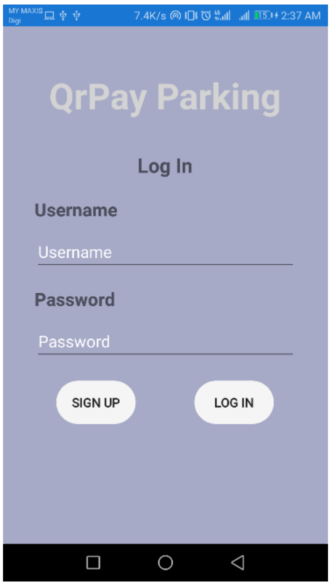
TABLE OF CONTENT

1.0 GETTING STARTED

To use the QrPay Parking System, you have to install the application on your device.

- Public User - QrPayParking.apk
- Authority User - QrAuthParking.apk
- Admin – QrPayAdmin.appxbundle

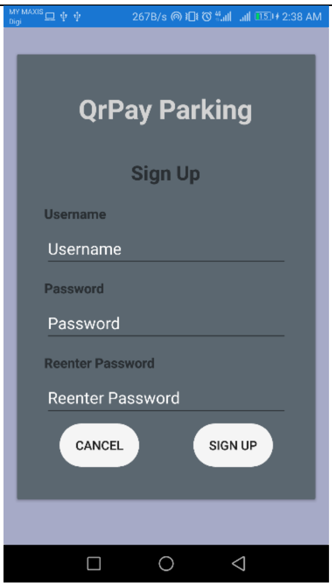
2.0 QrPay Parking



Log In

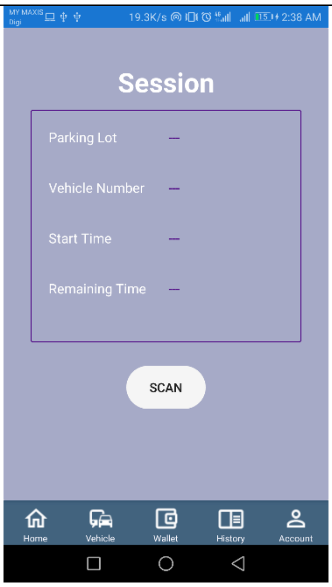
You need to register an account to use the application.

1. To register an account, click "SIGN UP" button
2. Sign in to the application by entering username and password in the allocated field
3. Click the "LOG IN" button to complete the process



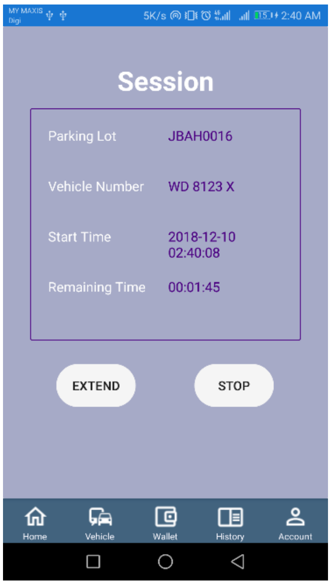
Sign Up

1. A window will pop up when you click the "SIGN UP" button from the Log In page
2. Enter username, password and reenter password in the allocated field
3. Make sure the password fields is match with each other
4. Click the "SIGN UP" button to complete the process
5. Click the "CANCEL" button to cancel create account.



Home Page

1. After log in, the application will navigate to home with no session started
2. Click "SCAN" button to start a parking session



Session

Parking Lot JBAH0016

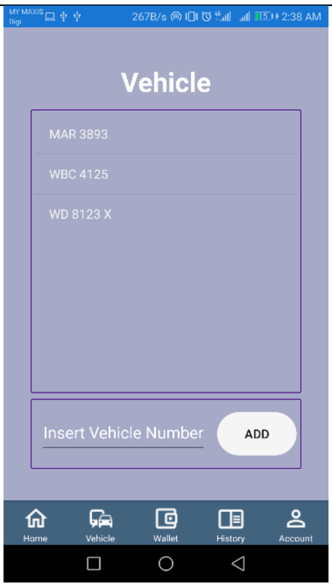
Vehicle Number WD 8123 X

Start Time 2018-12-10 02:40:08

Remaining Time 00:01:45

Parking Session

1. After scan the QR code and selected relevant info, the parking session will be started
2. Click “EXTEND” button if you wish to extend your parking session duration
3. Click “STOP” button if you wish to finish your parking session earlier then original desired time
4. The credit balance will be deducted based on the parking session duration



Vehicle

MAR 3893

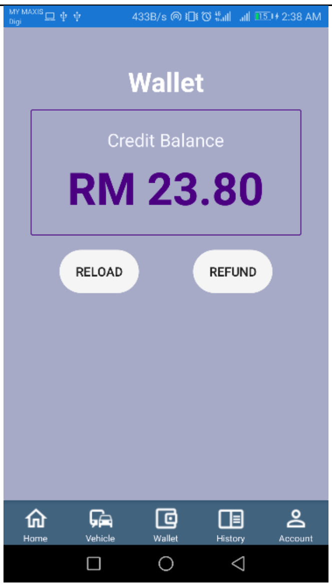
WBC 4125

WD 8123 X

Insert Vehicle Number

Manage Vehicle

5. You can add vehicle number to your account by clicking the “Vehicle” tab
6. Enter your vehicle number in the allocated field
7. Click the “ADD” button to complete the process
8. The list on the top frame will be refresh



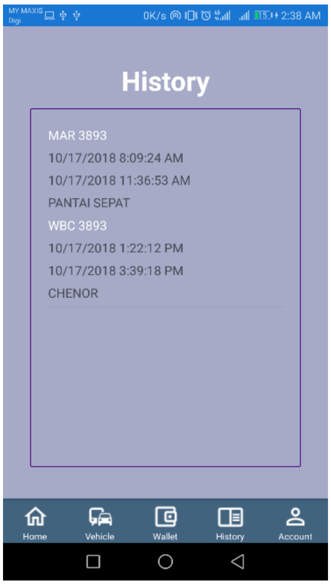
Wallet

Credit Balance

RM 23.80

Manage Wallet

1. You need to have credits in your account to start your parking session
2. Click the “Wallet” tab to navigate to Wallet page
3. Click “RELOAD” button if you want to add credits into your account
4. Click “REFUND” button if you want to retrieve all credits from your account

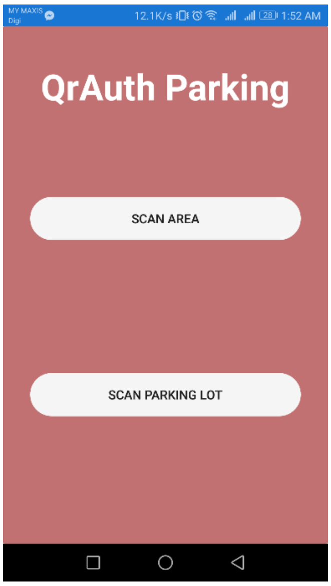

History

MAR 3893
10/17/2018 8:09:24 AM
10/17/2018 11:36:53 AM
PANTAI SEPAT
WBC 3893
10/17/2018 1:22:12 PM
10/17/2018 3:39:18 PM
CHENOR

Manage Wallet

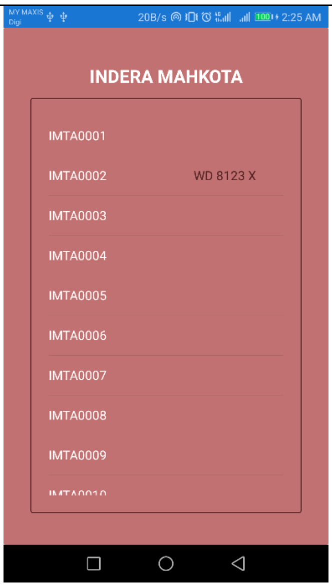
1. You can view your previous parking session history by clicking the “History” page

3.0 QrAuth Parking



Main Page

1. You can check the parking lot status in batch or in single
2. To check the parking lot status in batch of the area, click “SCAN AREA” button
3. To check the parking lot in single, click “SCAN PARKING LOT” button



INDERA MAHKOTA

IMTA0001

IMTA0002 WD 8123 X

IMTA0003

IMTA0004

IMTA0005

IMTA0006

IMTA0007

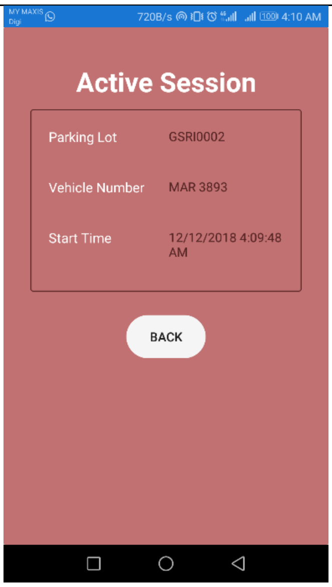
IMTA0008

IMTA0009

IMTA0010

Area Info

1. By clicking the “SCAN AREA” button and scanned QR Code, the parking lot status of the area will display in list



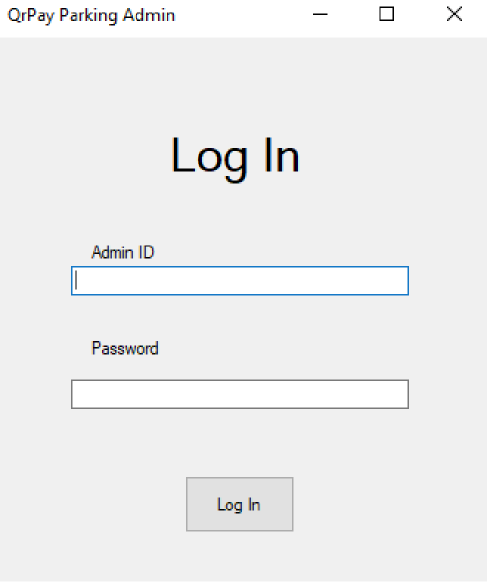
Active Session

Parking Lot	GSRI0002
Vehicle Number	MAR 3893
Start Time	12/12/2018 4:09:48 AM

Parking Lot info

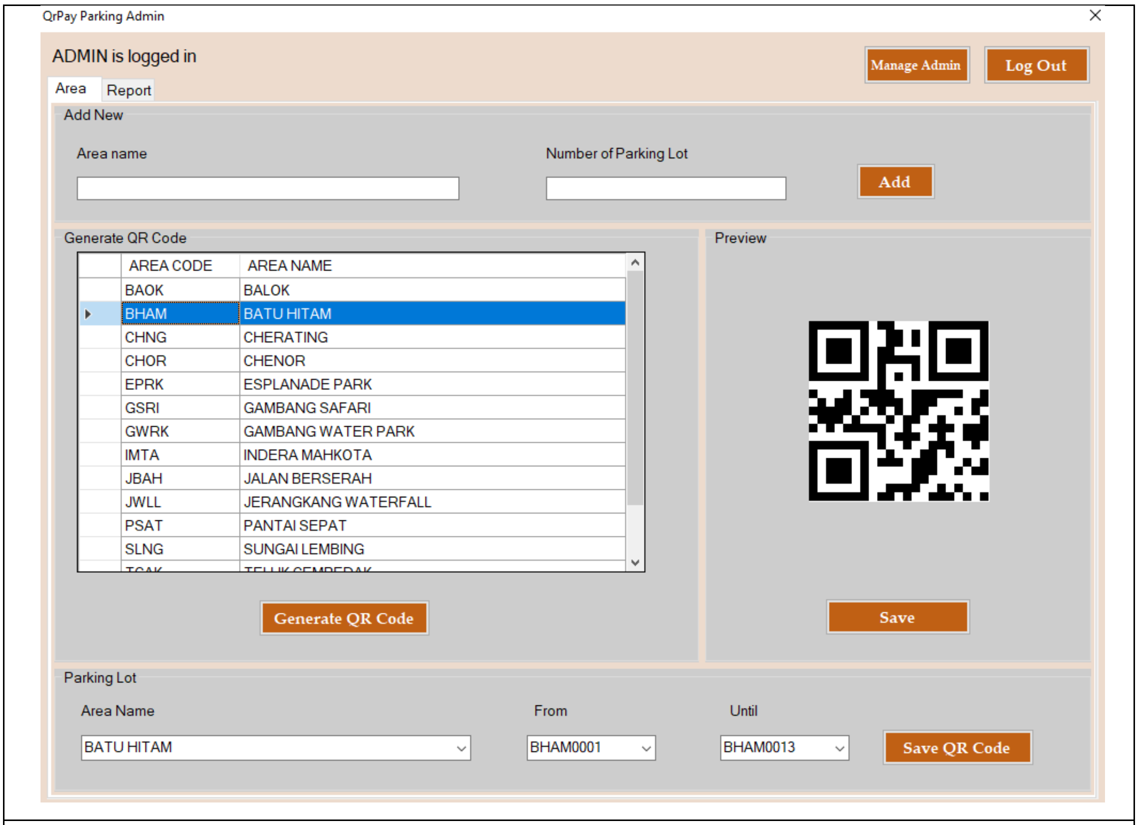
1. By clicking the “SCAN PARKING LOT” button and scanned QR Code, the parking lot status will display in details

4.0 QrPay Admin



Admin Login

1. You need to login with Admin ID (default: admin) and password (default: 1234) to use the application
2. Enter the Admin ID and password in the allocated fields
3. Click “Log In” to complete the process.



AREA CODE	AREA NAME
BAOK	BALOK
BHAM	BATU HITAM
CHNG	CHERATING
CHOR	CHENOR
EPRK	ESPLANADE PARK
GSRI	GAMBANG SAFARI
GWRK	GAMBANG WATER PARK
IMTA	INDERA MAHKOTA
JBAH	JALAN BERSERAH
JWLL	JERANGKANG WATERFALL
PSAT	PANTAI SEPAT
SLNG	SUNGAI LEMBING

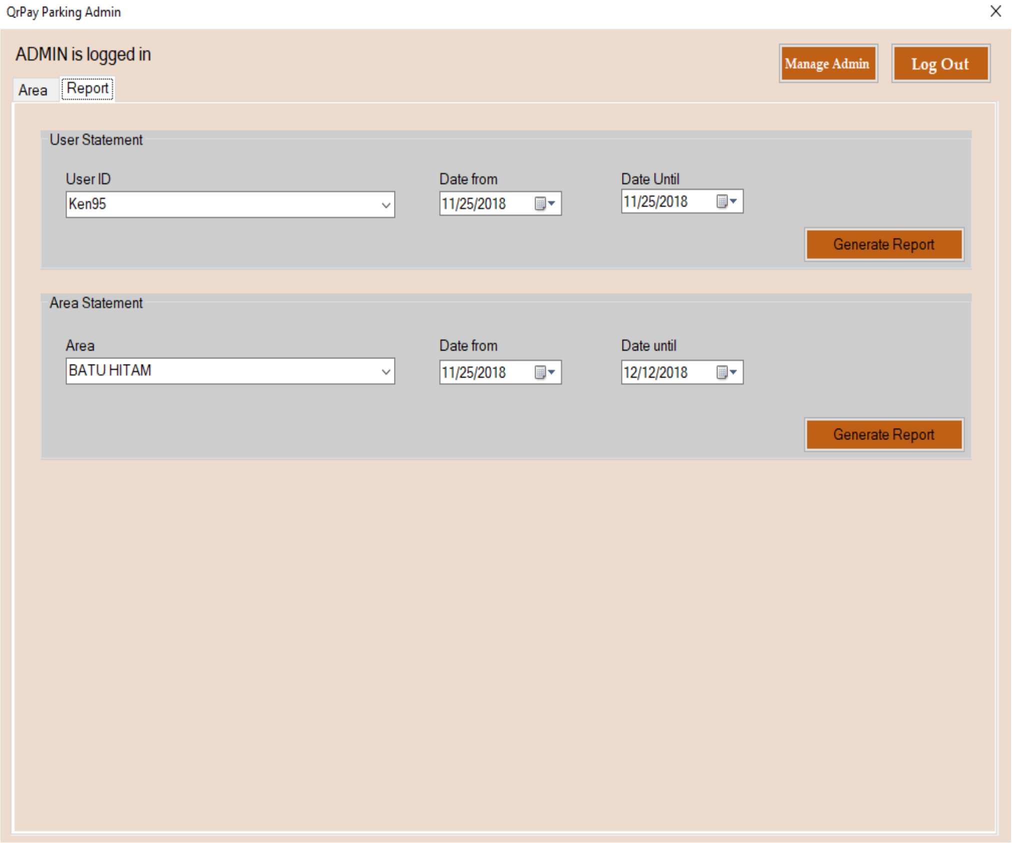
Area Name: BATU HITAM

From: BHAM0001

Until: BHAM0013

Mange Parking Lot

1. Click “Area” tab to manage parking lot
2. Enter the area name and number of parking lot to create new data in database
3. Select the area and click “Generate QR Code” button to preview the area QR code
4. Click “Save” button to save the area QR Code into PC
5. Select Area Name, Parking Lots number and click “Save QR Code” button to save the QR Code of parking lots in batch.



QrPay Parking Admin

ADMIN is logged in

User Statement

User ID: Ken95

Date from: 11/25/2018

Date Until: 11/25/2018

Area Statement

Area: BATU HITAM

Date from: 11/25/2018

Date until: 12/12/2018

Print Report

1. Click “Report” tab to generate report statement
2. Select user ID, dates and click “Generate Report” button to generate user statement
3. Select Area, dates and click “Generate Report” button to generate area statement