

# PARKING LOT MANAGEMENT SYSTEM

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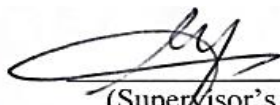
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# PARKING LOT MANAGEMENT SYSTEM

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## **ABSTRAK**

Pada masa kini, tempat meletak kenderaan di pusat membeli belah merupakan salah satu masalah yang dihadapi oleh orang ramai. Kebanyakan kereta yang ingin meletak kenderaan di dalam kawasan pusat membeli belah memerlukan pemandu untuk mengambil kupon tiket di mesin yang disediakan dipagar masuk pusat membeli belah. Hal ini menyebabkan kesesakan di pagar masuk pusat membeli belah terutamanya pada masa puncak seperti hujung minggu dan cuti umum kerana ramai orang datang ke pusat membeli belah tersebut. Oleh itu, objektif pelaksanaan sistem baru ini adalah untuk menambahbaik sistem yang sedia ada dengan sistem yang menggunakan pemandu untuk mengimbas kad pintar yang disediakan dan memudahkan pemandu untuk mencari tempat letak kenderaan dengan menggunakan Pengenalan Frekuensi Radio (RFID). Sistem ini juga melibatkan Arduino Mega dan alat pengesan meletak kenderaan yang mengesan tempat letak kenderaan jika tempat letak kenderaan itu kosong atau penuh. Arduino akan berinteraksi dengan Bluetooth untuk memudahkan pengguna menggunakan sistem ini supaya mudah mencari tempat letak kenderaan dengan telefon pintar mereka. Pentadbir juga boleh mengurus pengguna berdaftar di tempat letak kenderaan.

## **ABSTRACT**

Nowadays, parking at shopping malls is one of the problems faced by the public. Most cars that want to park within the shopping complex need the drivers to take parking ticket on the machine provided at the entrance gate in shopping complex. This causes congestion at the entrance gate of shopping complexes especially at peak times such as weekends and public holidays as many people come to the centre of the shopping complex. Therefore, the objective of implementing the new system is to improve the existing system with the drivers need to scan the provided smart card and facilitate the driver to locate the parking space using the Radio Frequency Identification (RFID). The system also involves Arduino Mega and a parking sensor that will detect the parking if it has vacant space or not. Arduino will interact with Bluetooth module to make it easier for users to use the system which is easily for them to locate the parking by using their smart phones. The administrator also can manage registered user information in the parking lot.



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## **LIST OF ABBREVIATIONS**

RFID	Radio Frequency Identification
QR	Quick Response
RAD	Rapid Application Development
SDLC	System Development Life Cycle
GUI	Graphical User Interface
IDE	Integrate Development Environment

## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Introduction**

Nowadays, there are a lot of big building that occupied with big car park was built to meet the growing market needs for parking. The industrial growth of the world is reflected by the increase in the number of automobiles on the streets throughout the world, which has caused a lot of parking related problems. This Parking Lot Management System is developed based on the existing parking system which requires parking ticket. In large scale indoor car park, the existing system is lead to a long queue just to get the parking ticket. By using the Radio Frequency Identification (RFID), it will reduce the traffic flow at the entrance. Plus, the RFID can replace the existing system that used the parking ticket.

In addition, people not only have the trouble at the entrance but they also have the trouble to find the available parking space (Anand, Gopinath, Shriny and Illakiya, 2016) at the parking lot. This is a common problem especially in a building that have many people such as hospital, airport or other big building especially multi-storey car park that are becomes more tedious (Anand et al., 2016). Then, with a connection by using Arduino Bluetooth module through a mobile phone to the system, drivers can find the vacant parking easily because it will assist them which parking slot is available. Moreover, people also have the trouble to locate their car that they park early. This is a common problem for people in a big parking lot that have multi-storey car park which requires them to memorise the special code like LL11 and which level they are at. So, with an application in a mobile phone, drivers can scan the Quick Response (QR) code. It is easily for them to have the records of their car at the parking lot. Having a mobile



phone among people is not only necessity but it is a lifestyle that is very useful for people.

This Parking Lot Management System is implemented that help to reduce traffic flow at the entrance gate and easy for drivers to find the available parking space in a wide range of parking area because it is very time consuming for drivers to find the vacant space (Masali & Manjusha, 2016). It is also easy for people to find the vacant parking rather than drive vainly between the crowded cars at the car park. So, this system is one of the ways to resolve the problems that can reduce traffic flow at the entrance gate, easy to find the available parking slot at the parking lot and to locate car in a crowded parking lot. According to Baglane, Kulkarni, Raut, & Khatavkar (2014), the use of parking management system would reduce the human efforts and time with additional comfort.

## **1.2 Problem Statement**

Most of the problems in a shopping complex that have crowded parking lot that people faced is to be in a long queue to get the parking ticket especially during peak hours. Mostly of the parking lots at the entrance and exit gate, still require human effort to get the parking ticket at the entrance gate. The parking ticket is needed for the payment of how long they park in the parking lot. It is time consuming for the drivers to get the parking ticket at the entrance that they need to push the button at the entrance to get the parking ticket. Thus, it will cause road congestion at the entrance because mostly shopping complex at the urban area is the main place that they will come.

Furthermore, when the drivers take a few time at the entrance just to take the ticket, they will also take a long time drive around the parking lot to find an available parking space (Gowda, R, & R, 2017). According to Yusnita, Fariza, & Norazwinawati (2012) this problem is occurs due to increasing the number of cars compared to the availability of parking spaces especially in urban areas. They will drive around the parking lot to find the vacant space which they need to drive through the multi-storey car park. Thus, Nandyal, Sultana, & Anjum (2017) stated that to discover vacant parking spaces can take over 10 minutes for around 66% of guests during amid ends of the week or open occasions.

In addition, to locate the car at the parking lot also a problem to the people because sometimes they need to memorize the exact location of their car that they park early (Fatimah, Razak, Liew, Lee, & Lim, 2015). This issues is commonly happened for someone that are absent-minded or forgetful especially in a parking lot that they are not common with. They took some time to locate where they parked their car and they walk vainly between hundreds of vehicles trying to track their car.

So, this project is invented to resolve some of the inconvenienced issues. The main role for the project is to reduce traffic congestion at the entrance gate, assist drivers to park car at the parking lot by using RFID and to locate car at the parking lot in a crowded shopping complex. Thus, the users that use the system will not have to face a lot of problems at the parking lot. Table 1.1 shows the summary of the problems that people face at the parking lot.

**Table 1.1** Summary of Problems at Parking Lot

<b>Problem</b>	<b>Description</b>	<b>Effect</b>
Time consuming	Drivers waste their time at the entrance gate while to get the parking ticket because of the traffic during the peak hour.	They have to be in a long queue because the existing system is still using the human effort that people need to push the button to get the parking ticket. So it causes traffic at the entrance gate.
Difficult to find vacant space at the parking lot.	Most of the problems at the parking lot is to find a vacant parking slot to park the car especially during the peak hours or weekend that many people tend to go the shopping mall.	This will make the drivers wasting their time to drive around the parking lot to find the available parking slot without assist.
Not memorize the parking lot of the car park	With a lot of parking space at the parking lot, people occasionally did not remember where they park the car early	They hard to track their car and need to walk thoroughly to the multi-storey car park to find their car. Because of that,

	<p>after they want to exit the shopping complex. Sometimes, they just walk through the parking lot just to find their car. They also take picture of the parking lot to save the record. But, they also may take the wrong record of the parking lot.</p>	<p>they are required a lot of time to locate the car.</p>
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### 1.3 Objective

The objectives of this project are:

- i. To investigate the existing parking lot management system
- ii. To develop a system based on RFID and QR code for the ECM Mall, Kuantan.
- iii. To develop a parking lot management system based on RFID, Arduino and Bluetooth module to connect the system with the user's smart phone.

### 1.4 Scope of Project

The scopes of this system are:

- i. The system is using Arduino Mega Board, RFID to read the RFID tag, sensor module to detect the parking lot, and Arduino HC-05 Bluetooth module to connect the smart phone with the system.
- ii. The QR code is for parking area that save the name of parking lot.
- iii. This prototype of this project will only use the car which have registered the RFID tag.
- iv. The system is focus in indoor parking lot and only four parking slot at the basement parking will be simulates.

## **1.5 Significance**

- i. Can reduce the time at the entrance gate to get the ticket manually and can assist drivers which parking slot is available to park the car.
- ii. Assist drivers to know the number of parking slot availability and which parking slot is available.
- iii. Facilitate user in locating their car where they park early at the parking lot.

## **1.6 Thesis Organization**

This thesis consists of three chapters. Chapter one discuss on the system overview which describes what the system is all about including introduction, problem statement, objective, scope of the project significance and thesis organization.

Chapter 2 discuss about all literature reviews of the system and applications based on the existing work. In this chapter, it is about the comparison of the existing system based on their features, advantages and disadvantages. The related system also has been identified and discussed in this chapter.

Chapter 3 explains in detail the algorithm, methodology and the process of parking lot management system using RFID and Arduino. This chapter includes the design of the system, the justification of the method used and the requirement of the hardware and software to develop the system.

Chapter 4 is explain about implementation and testing of the system. This chapter also includes the discussion of the result. All the methods implemented is discussed based on the software and hardware requirements that used in the system.

Chapter 5 which is the final chapter for this project is discussed about the conclusion of the overall of the chapters. The development constraints and future work also explain in this chapter.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This chapter will focus about the study of the project in general. This chapter will include the details methods which are suitable to adapt to this project and the comparison of the existing systems. The main purpose of Parking Lot Management System is to help drivers reduce their time at the entrance gate to get the parking ticket especially at the peak hour and locating the car where he has parked earlier in the indoor parking lot. In this project, the main components that involve to build the device are Arduino, RFID reader and RFID tag, QR Code and a mobile phone with a connection to the system that display the availability of the parking space at the parking lot.

The system is connecting using Bluetooth module on the Arduino through the mobile phone where the system assists drivers to park their car at the available parking space. All the explanations will be discussed later.

#### **2.2 Radio Frequency Identification (RFID)**

RFID stands for Radio-Frequency Identification. RFID is a technology that uses radio waves to identify items or people. In general, RFID system consist of RFID reader and RFID tags. The RFID tag needs to be scanned by RFID reader to retrieve the identifying information. RFID have same purposes with barcode but RFID tag can be read outside the line-of-sight, whereas barcode must be aligned with an optical scanner (AB&R (American Barcode and RFID), 2011).

RFID technology is useful and requires no personnel because it is an automated vehicle identification system that the network includes a wide range of automation technologies (Pala & Inanc, 2009). In this system which is Parking Lot Management System is using RFID reader that detects the smart card parking. The card parking has the built-in RFID tags in it. The first-time user of the system is required to manually register their registration and then user can get their smart card. RFID is collecting data and identification automatically that it ensures the accurate and timely data and exit entry. The RFID tag transmits data to the RFID reader that converts the radio waves to a more usable form of data. Therefore, with the use of RFID system, drivers did not have to be in a long queue just to get a parking ticket at the entry gate.

There are a few advantages of RFID that give benefits to people. The RFID can read the RFID tags in challenging circumstances at remarkable speed (Dogra, 2011) and from a greater distance even in harsh environment. As compared to QR code, it required the label to be clean to ensure that the reader reads the label. Moreover, the QR code requires a direct line of sight for scanner to read the QR code. Unlike RFID, the RFID tag does not require a direct line of sight. Therefore, RFID is chosen in this project since it has a lot of advantages.

### **2.3 Arduino**

Arduino is an open-source platform based on easy-to-use hardware and software (Orsini, 2014) for building electronic projects. This microcontroller board was designed to be small and cheap so that everyone affords to buy it. It contains a few features such as 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. To get started with this Arduino, the microcontroller is connected to a computer with a USB cable or power it with a AC-to-DC adapter.

The small size of this device and its affordable price makes Arduino as one of the most chosen devices among other electronics devices that require more than a basic microcontroller. Arduino program can run on Windows, Linux, and Macintosh operating system. The programming is easy to learn and apply for the beginners and amateurs.

Arduino can be utilized to create such devices that can interact with the environment using sensors and actuators (Shah & Chaudhari, 2017). The serial communication is channels over USB by an ATmega16U2 on the board and appears as a virtual com port to software on the computer. The Arduino software which is the Arduino program includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. Arduino additionally rearranges the methodology of working with microcontrollers.

Moreover, Arduino have several advantages between other microcontrollers. Arduino is a very simple to interface sensors and other electronic component than Raspberry Pie that requires installation of libraries and software. The Arduino program is available as open source but Raspberry pi is a closed source program. Therefore, Arduino is the choice for this system because Arduino is involved with reading sensor data.

## **2.4 Quick Response (QR) Code**

Quick Response (QR) code is a 2D barcode that contains information about the item that used for easy access the information through a mobile phone. They can be depicted on screen or printed on paper. QR code is a way that user can get immediate access to the information in it. QR code consist of 40 versions, four levels of error correction, and can encoding 7089 numeric data with the maximum symbol size (Satpalkar, Stephen, Salian, & Shaikh, 2016).

Moreover, QR code has many advanced features. It have high-speed reading Adapted with CCD reading that can recognize many QR code symbol per second. QR code has good fault tolerance. Even if some part of the code is damaged, information can still be decoded from the code. By using QR code, it save the cost because it can generate by using online and user just need to install the application of QR code scanner.

In this system, QR code is using to locate the car at parking lot because some people did not memorize where they park their car especially at the multi-storey building that have many parking lots. The QR code will contain information of the parking lot such as what level they parking. User will scan the QR code on the nearest pillar of the parking lot using their mobile phone (Fatimah et al., 2015). After they scan

the QR code, the information of the parking lot will be save in the application in the mobile phone.

## **2.5 Arduino HC-05 Bluetooth Module**

This system is using Arduino HC-05 Bluetooth Module to connect with the mobile phone via Bluetooth connection. The Bluetooth module can act as master or slave. The master Bluetooth can search other Bluetooth devices and initiate connection while, the slave Bluetooth cannot search for other Bluetooth devices and can wait for master to initiate connection and accept the connection.

In this system, the Bluetooth module is connect to Arduino and the Bluetooth will send the data from Arduino to the mobile phone. User can use the mobile phone and connect the bluetooth of the Arduino module to know the availability of the parking slot. So, user can easily detect the available parking using the mobile phone.

## **2.6 Review of Existing System**

Based on the research that has been made, there are three existing systems. The functions and the features of the existing system are studied so that it can be used to enhance the next generation of parking lot management system. The existing system are RFID-Based Automatic Vehicle Parking System Using Microcontroller, QR Based Car Parking, and Smart Parking System Using the Raspberry Pi and Android.

### **2.6.1 RFID-Based Automatic Vehicle Parking System Using Microcontroller**

Dorjee, Rasaily, & Cintury (2016) proposed a system that is a solution for drivers that have problems at the entrance gate which drivers always have to wait in a long queue. The RFID card is been use to replace the ticketing parking system at the entrance gate. For this system, every driver owns his vehicle parking card that contains the amount of the parking fees. This way is very easy for drivers to pay their parking fees without pay at the AutoPay machine that require to prepare the exact amount. The smart parking card will be read by the reader and the reader passes the data to the microcontroller. In the time, the entrance time is been record and when the drivers want



to exit from the parking lot, they need to show the parking card and the reader records the out time.

This system require the first time drivers to get started with RFID-based automatic vehicle parking system that need register the vehicle with the parking owner to get the RFID tag (Dorjee et al., 2016). The RFID reader will read the RFID tag at the entrance gate and the barrier gate will open for the drivers to park at the parking lot. The parking fees will be deducted in the smart card RFID tag when the RFID reader read the tag at the exit gate.

This RFID-Based Automatic Vehicle Parking System facilitates faster user authentication that can reduce waiting time at the entrance gate. This system also provides a buzzer at the gate when drivers show an invalid RFID card on the RFID reader. The main advantage of this system is, it facilitates faster user authentication by using the RFID and provide security for users. Meanwhile, the disadvantage of this system is the system has no application for users to remotely check the status of the parking spaces.

### **2.6.2 QR Based Car Parking**

This system proposed by Singh, Singh, Singh, & Prajapati (2018) that is an allocation of parking lot using the Quick Response (QR) code that is generate after users register at the website. Users can find vacant space of parking lot and reserve the parking lot before they enter the building to park their car.

This system is using mobile application that easy for user to use the system. They can register, login, and make a reservation slot with a QR code. Users register on the application by providing the information of car number, name, phone number, car model, email and password. After users have been registered, they can login into the application and book the parking slot. The data that have registered is save to the database and will send to the users' email.

In this project, users need to show the email to the security checker for verification to park at the reservation parking slot. While leaving the parking lot, user has to show his QR code to the security checker and scan it. The amount of parking fees will be shown to the user after the scanning of the QR code. The purpose of the QR

code in this system is to know whether parking slot is available and easy for user to find their ways to the parking lot. Figure 2.1 shows the applications of the system for the users.

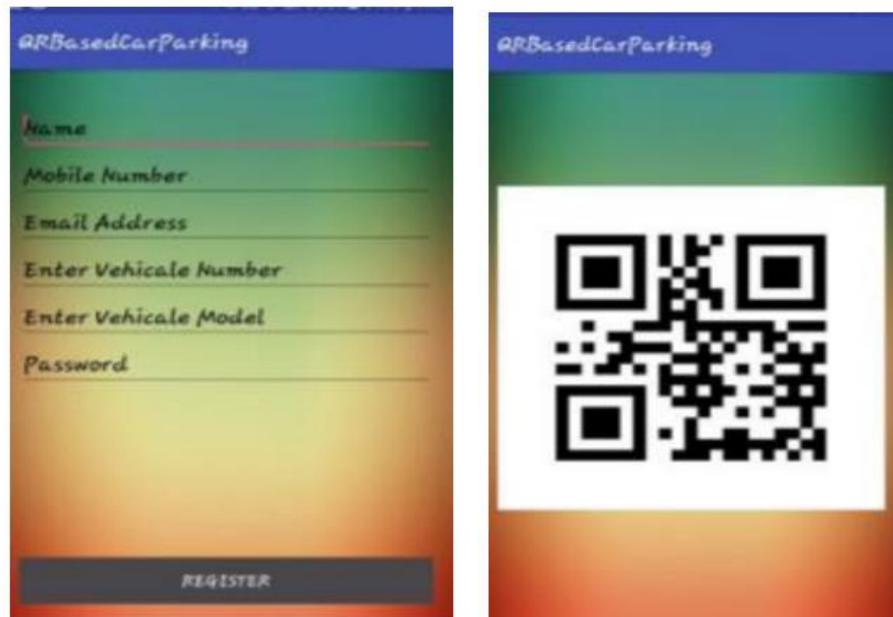


Figure 2.1: Application of the System

Source : (Singh et al., 2018)

The advantage of this system is easy for users to find the parking lot because they have reserved the parking slot by the QR Code. They did not have to spend more time to find a parking slot at the parking area. Meanwhile, the advantages of this system are users still needs stop at the entrance gate to get their parking ticket. Then, they also need to show their confirmation Email to the security checker manually before parking at the parking slot and show the QR code to the security checker to pay the amount of the parking fees. That is also requires more time to performing the actions at the parking lot.

### 2.6.3 Smart Parking System Using the Raspberry Pi and Android

This system proposes an automated car parking system by an android application that can reduce human's intervention to the minimal (Gavali, Kunnure, Jadhav, Tate, & Patil, 2017). The system provides user to know the number of cars can be parked at the parking lot at any time given based on the parking space availability.

In this system, it used Raspberry Pi that attached with various of IR sensors. The IR sensors determined the parking status at the parking lot. Android application is used to see the status of the parking in the parking lot and Raspberry Pi used Raspbian operating system. The setup of parking lot using the Raspberry Pi and IR sensor can be access via mobile application over Wi-Fi network. Figure 2.2 shows the architecture of the system.

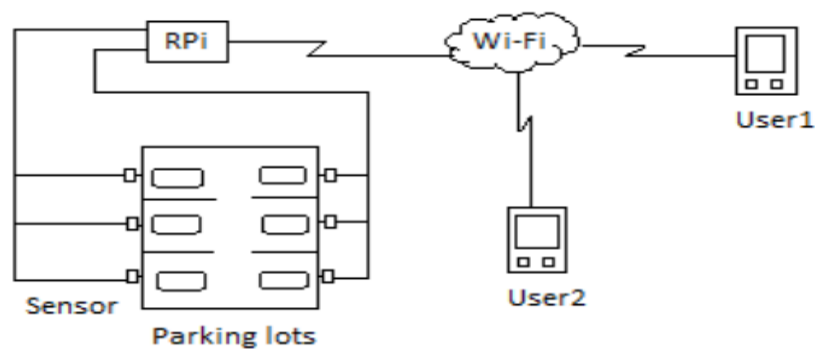


Figure 2.2 Architecture of the System Using Raspberry Pi and Android

Source: Gavali et al. (2017)

Thus this system proves to be useful for the purpose of the car parking automation and helps reduce the car drivers time because the parking vacant space is handled by the Parking Control Unit. But users need to have smart phone and the application on it before they can see the parking status.

## 2.7 Comparison of Existing Systems with Parking Lot Management System

Based on the research of the existing systems that have been made, Table 2.1 shows the comparison of the existing system with parking lot management system in terms of their features, advantages and disadvantages.

**Table 2.1** Comparison of the Existing System

System	RFID-Based Automatic Vehicle Parking System Using Microcontroller (2016)	QR Based Car Parking (2018)	Smart Parking System Using the Raspberry Pi and Android (2017)	Parking Lot Management System
Technology Used	Microcontroller & RFID	QR Code	Raspberry Pi, Sensor module	Arduino Mega, Bluetooth module, RFID module
Application Used	Web Based	Web Based, Android	Android	Web Based, Android
Web Application manage by Administrator	No	Yes	No	Yes
Database	Yes	Yes	Yes	Yes
Advantages	Low time required for performing operation  Faster user authentication	Easy to find parking lot  Reduces the fuel consumption and traffic congestion	Provides the accurate information.  More efficiency	Reduce traffic congestion and fuel consumption at the entrance  Easy to find parking

				Using ticketless system
Disadvantages	No application for users to check the status of vacant parking spaces.	Require more time for performing actions.	Users require to have smart phone to see the parking status.	Users require to have smart phone to see the parking status.

From the comparison between the similar existing systems, each system has its own features, advantages and disadvantages. However, parking lot management system have same features with Smart Parking System using the Raspberry Pie and Android because it has effective execution to find vacant space by using smart phone. So, this is suitable for Parking Lot Management System and the enhancement can develop from it. The Parking Lot Management System is using Arduino Mega and Bluetooth module to connect to the users. Then, RFID is also an enhancement in the system to make the system more efficient. Although the usage of RFID is likely not wide in the technology, but it is worth it because it is easily for user to reduce their time at the parking lot and can resolve the issues of the parking ticket.

## **CHAPTER 3**

### **METHODOLOGY**

#### **3.1 Introduction**

This chapter is to describe the methodology used to make sure that the developments of the project get the expected result. The methodology also covered the process and the flow on making the project that will discuss the materials to be used either software or hardware and also the method used in the system. Parking Lot Management System will be developed based on the methodology that will be used. The phases of the methodology, hardware and software requirements that used for the systems development will be discussed in this chapter.

#### **3.2 System Development Methodology**

System development methodology is a framework that has different phases containing the activities with the better management to plan, structure and control the process of developing the system. The suitable methodology will lead the development of the system become more efficient and effective.

The methodology that used in developing the system is Rapid Application Development (RAD). RAD is a software development methodology that uses to build application that is a much faster development by rapidly producing prototypes for the end user and offering opportunity that can improve to get higher-quality results. The RAD methodology is chosen because it is reduce the development time, lower the costs, and high quality. The RAD in Systems Development Life Cycle (SDLC) consists of four phases which are requirements planning, user design, construction and cutover. The phases of the SDLC are used to complete the development of the system. Figure

3.1 shows the phases of SDLC. All the informations regarding the phases in the model will be discussed.

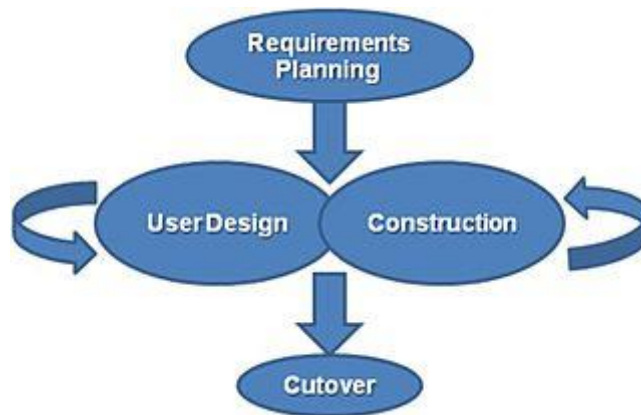


Figure 3.1: Phases of SDLC Used by RAD

### 3.2.1 Requirement Planning

At this phase, it required a planning document that needs to identify the problem of the existing systems, analysis the problems, and the scope of the system. It also focused on how to initiate the process to ensure that the system is in a good flow to develop. In this phase, it is important to plan the project wisely that can guide me to develop the project. The planning phase can help me to manage the time, cost, the risk and issues during the development of the project.

The most important in this phase is to have a detailed study of this system. The problem and the scope of the project need to be analysed and gathers the requirements of the study of this system to have an understanding in developing the system. Furthermore, the user also needs to be analyzed to make sure that the Parking Lot Management System is user friendly and suitable to be implemented to other users so that it can meet the users expectations.

This Parking Lot Management System can overcome the problems at the parking lot that can reduce road congestion at the entrance and for search a vacant space. For a better planning to develop the system, a Gantt Chart is created to know the flow to develop the project.

### **3.2.2 User Design**

The next phase is design where all the information is collected to achieve the project's goal. In this phase, the system will be designed to make the system meet the requirements of the users. It consist the flowchart of the system, context diagram, use case diagram and other diagrams that will be designed. By designed the diagram, user can know the more about the flows of the system.

#### **3.2.2.1 Flowchart of the System**

Flowchart of the Parking Lot Management System illustrates how the Parking Lot Management System works. The flowchart will start by the Arduino microcontroller is connected with the RFID reader, Bluetooth, and other hardware that will used. When users approaching at the entrance user can scan their registered card to the RFID scanner. The RFID reader will read the RFID tag of the valid user so the gate will open.

By using smart phone, users can connect with the Bluetooth on the board of the Arduino which can connect the smart phone with the system to assist them to park the car. The LED at each parking slot determines the status of the parking slot. Administrator also can see the web based for the parking lot. Figure 3.2 below shows the flowchart of the system.



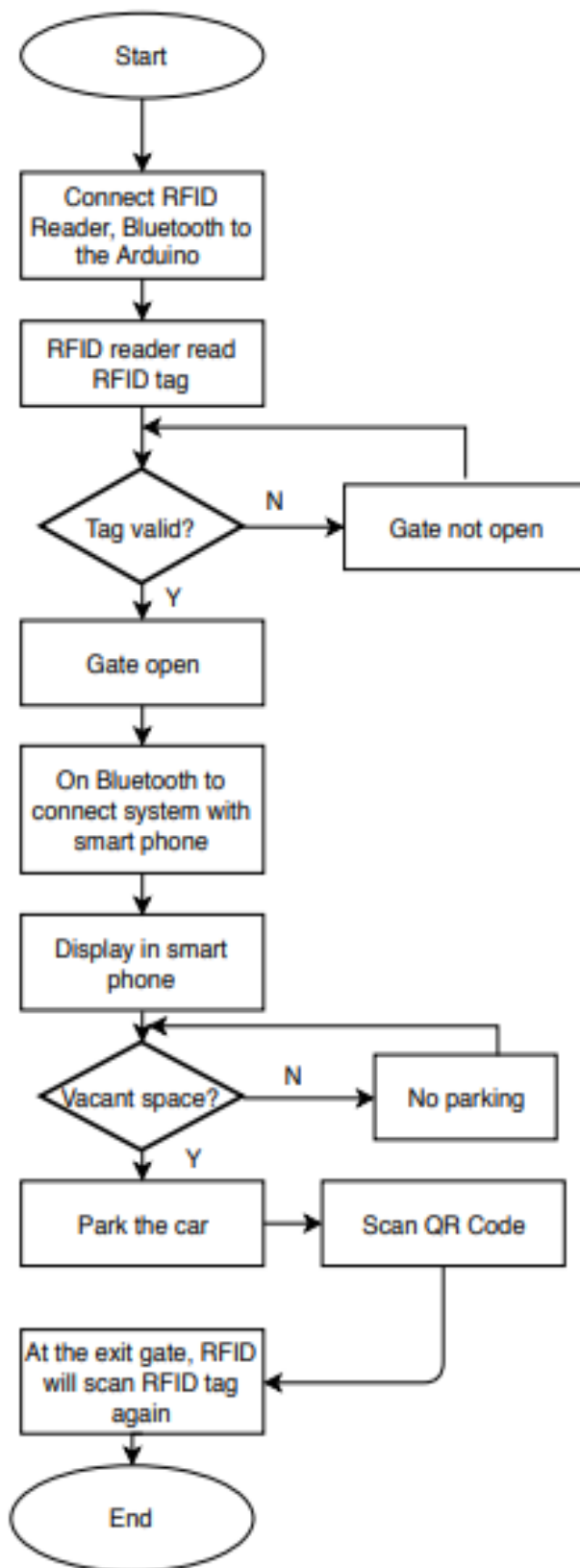


Figure 3.2: Flowchart of the Parking Lot Management System

### 3.2.2.2 Context Diagram of the System

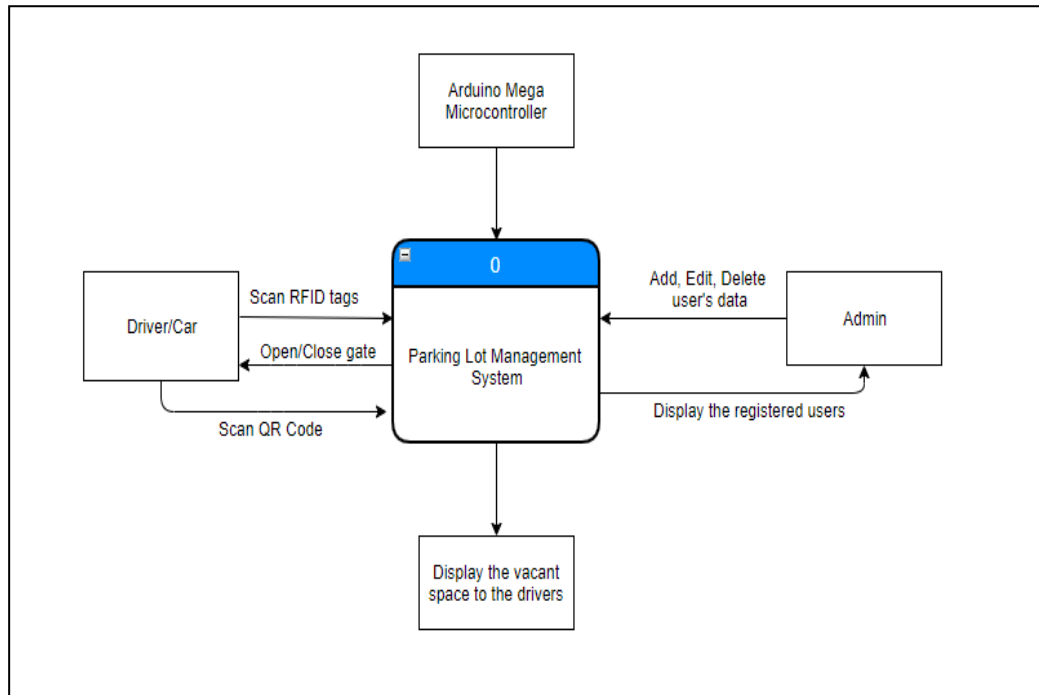


Figure 3.3: Context Diagram of Parking Lot Management System

Figure 3.3 shows the context diagram of the system. The figure illustrates the relationship between the system and the external entities like systems, organizational groups and others that have the input and output. The driver will scan the RFID tag that the reader build on the Arduino microcontroller to open the gate. If the driver can connect to the system with smart phone, it will display the available parking slot at the parking lot. Drivers also can scan QR Code that provided at each of the parking lot which they can save their location of the car. This system is ease for admin to check the parking status, the payment information and manage the registered driver's information.

### 3.2.2.3 Use Case Diagram of the System

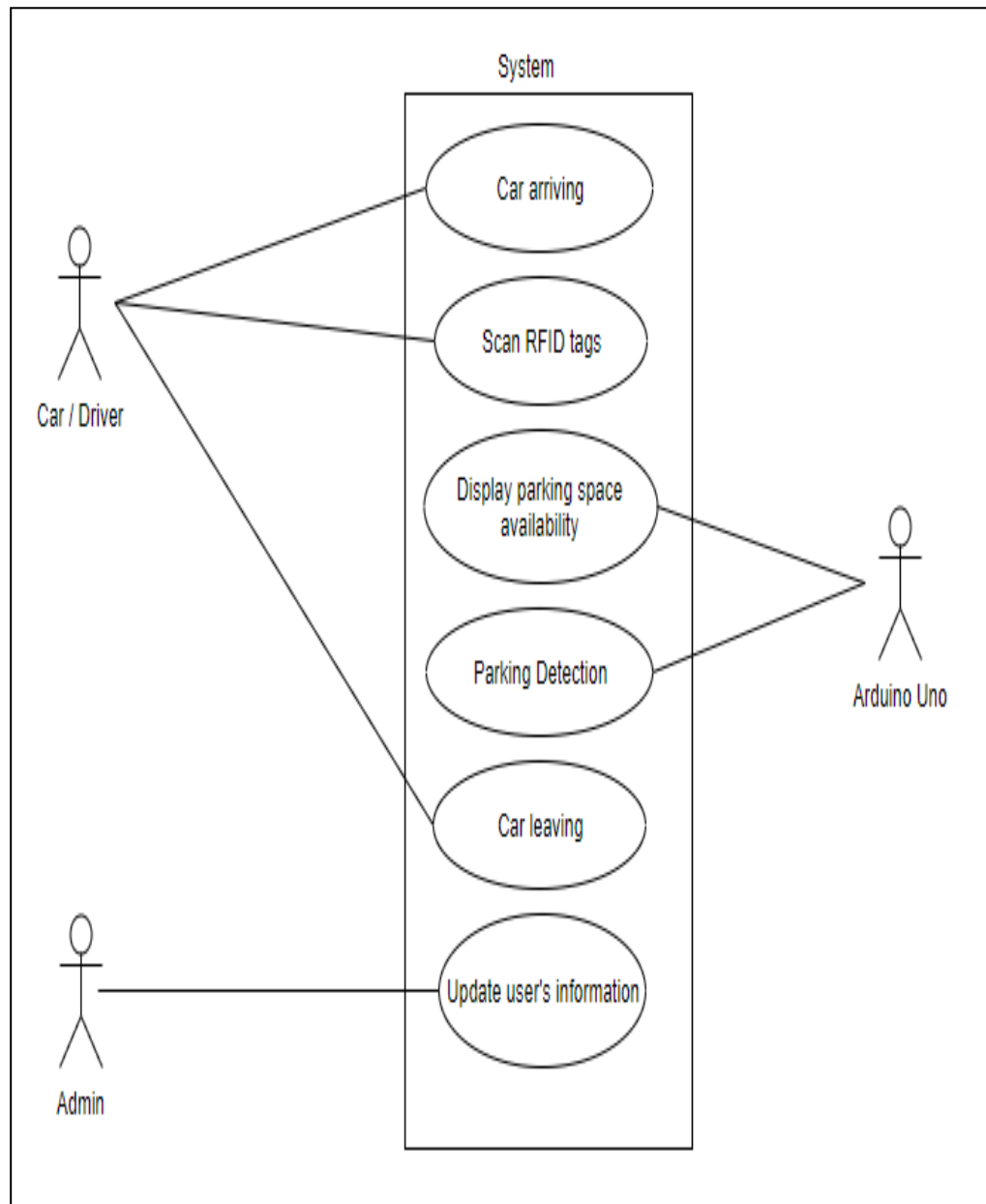


Figure 3.4: Use Case Diagram of Parking Lot Management System

Figure 3.4 shows about the interaction between the actor and the elements of the systems. When a driver approach at the entrance gate, the driver will scan the registered RFID tag and the Arduino display the number of parking space availability at the parking lot to the user through the smart phone that detect by the parking sensor. Then, the administrator can update user's information.

### 3.2.2.4 System Architecture of the System

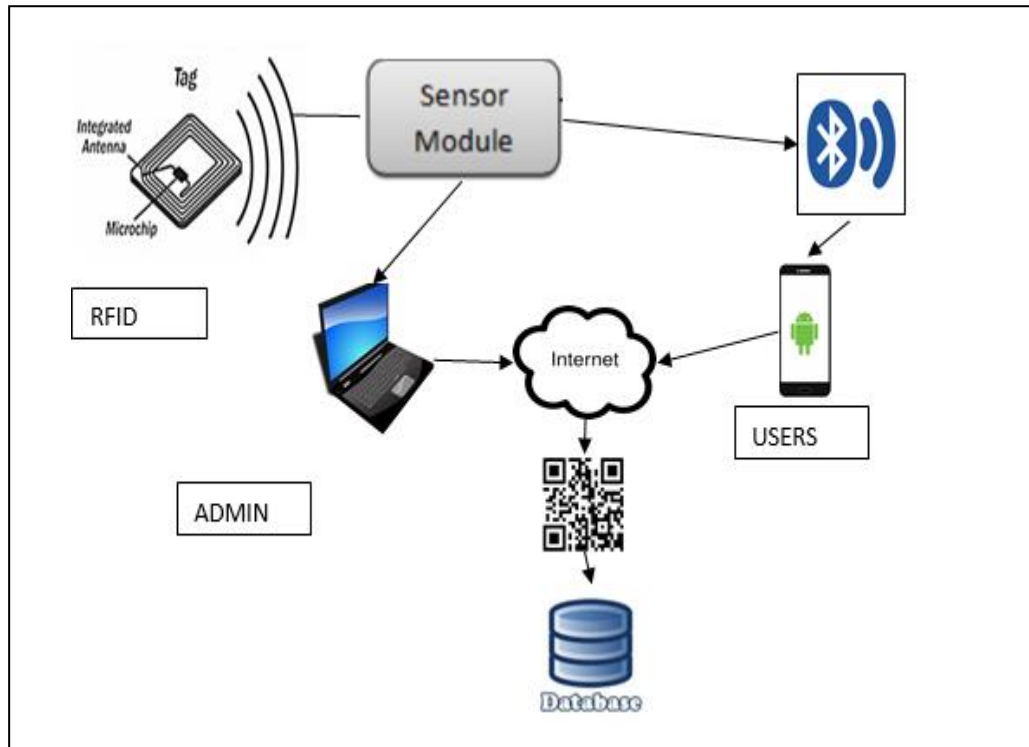


Figure 3.5: System Architecture of Parking Lot Management System

Based on the figure above, it shows that RFID reader will detect the RFID tag which the data generated from the sensor will be sent to the Arduino Uno microcontroller. Entrance and exit gate will open when the valid RFID tag is read by the RFID reader. Bluetooth module on the Arduino will connect to the smart phone. So that users can display the parking spaces availability at the parking lot. The QR Code is provided at each parking area in the parking lot for user to save their car location so that it is easy for them to find the car. The administrator can manage the registered user via the web application and the information will be saved in the database.

### 3.2.2.5 User Interface For Web Application and Smart Phone

Graphical User Interface (GUI) are very important features that should be analyze for the system. GUI in an interface is the interaction between human and computer or smart phone using the input device like the keyboard. For this system, Notepad++ is using to design the interface with the HTML and PHP program. The design of the system will be discussed.

Figure 3.6 shows the GUI of an interface for the administrator. It is to display the TAGs information which is the information of the registered RFID tag. The admin also can do some actions for the information that save in the database.

[Click Here To Add](#)

Data Table

10 records per page

Search:



Image	Name	RFIDSerialNumber	PhoneNumber	Email	Action
	Siti Aminah	EA FC 14 2E	123456789	aminah22@gmail.com	<a href="#">Edit</a> <a href="#">Delete</a>
	Ahmad Hisyam	56 94 EC 1F	163456106	hisyams@gmail.com	<a href="#">Edit</a> <a href="#">Delete</a>

Figure 3.6: Web Application for Administrator 1

Figure 3.7 below shows the database table for the TAGs. All the data will be recorded in the database. The database that I used is for the web application is XAMPP.


#	Name	Type	Collation	Attributes	Null	Default
<input type="checkbox"/> 1	<b>u_id</b> 	int(30)			No	None
<input type="checkbox"/> 2	<b>u_name</b>	varchar(30)	latin1_swedish_ci		No	None
<input type="checkbox"/> 3	<b>u_rfid</b>	varchar(30)	latin1_swedish_ci		No	None
<input type="checkbox"/> 4	<b>u_phone</b>	int(30)			No	None
<input type="checkbox"/> 5	<b>u_email</b>	varchar(50)	latin1_swedish_ci		No	None
<input type="checkbox"/> 6	<b>u_profile</b>	longblob			Yes	NULL

Figure 3.7: TAGs Database

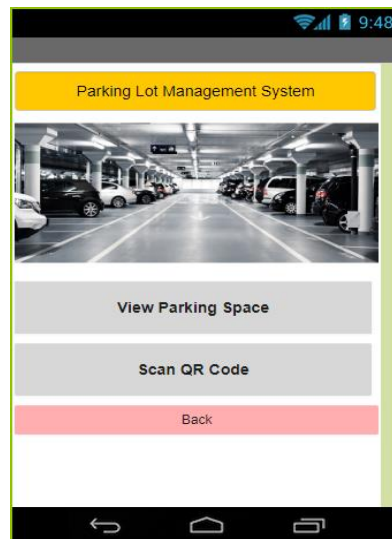


Figure 3.8: Users Application

Figure 3.8 shows that the interface for users where they need to choose the action. There are two options that the user can choose which are to view parking space and to scan QR code. The user can scan the QR code that been provided at each level of parking lot to save the location of their car in case they did not remember where they park the car. Then, the location will be save in the application for to check the location of the car.

Figure 3.9 shows the GUI for the users that can connect with the system using the Bluetooth to the system. The smart phone will be one of the platforms for user to know which parking are still available because it is very difficult to search for busy parking at the parking lot.

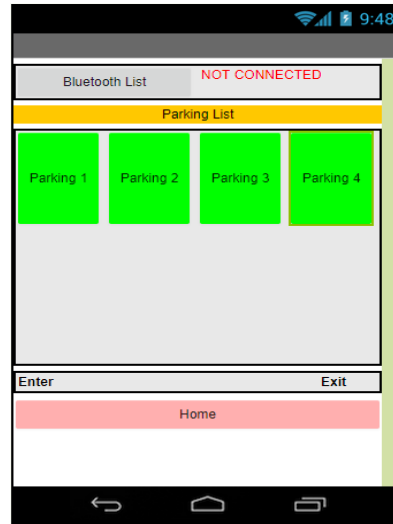


Figure 3.9: Assist Parking Space for Users Using Bluetooth

Figure 3.10 shows the GUI that user can scan the QR code to save the location of the car at the parking lot in case the user forgot the location, then they can refer to the mobile application to check the location.

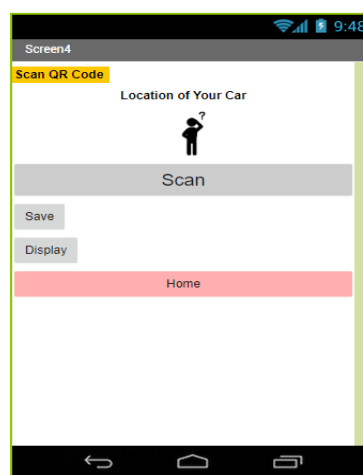


Figure 3.10: GUI for Scan QR Code

### **3.2.3 Construction**

The construction phase is to develop the prototype as a real working system including the code of the system. After the design phase has completed, then this phase needs to begin in order to make the system is effective. The Parking Lot Management System needs the hardware development such as the structure of the Arduino with other components and software development such as the user interface. This system also needs to be check regularly to ensure that it will run smoothly without any error and to meet the user's requirements.

### **3.2.4 Cutover**

This is the final phase in RAD of SDLC implementation which is the cutover phase. In this phase, it will include the activities that need to be executed such as data conversion, user training, system changeover and full-scale testing in the system. It will test the components that used to ensure that the product meets the user's requirements. All the errors and any defects that are found during developing of the system need to be fixed so that at the end of this phase, the system will be free from errors. After carrying out the testing, the system can be delivered to the user and placed in better operation.



### 3.3 Hardware and Software Requirements

Table 3.1 below show the list of hardware needed and its description that will be used during the process of development the system.

**Table 3.1** : Hardware Requirement and its Description

Hardware	Description
Arduino Mega	Act as the brain for controlling the parking system that connects with RFID reader.
RFID reader	Detect the smart card to open the barrier gate.
RFID tag	Act as a smart card to be scan by the RFID reader
Laptop	Develop the system
Smart Phone	To see the vacant space and scan the QR code
Light Emitting Diod (LED)	To show the parking space availability that display 'GREEN' or 'RED' light.
Infrared Obstacle Sensor	Detect the distance and presence of the car at the entrance and exit gate and the parking lot.
Servo Motor	Control the movement of entrance and exit gate.
Breadboard	To attach most of the components into it
Jumper Wires	Connect all the components to the Arduino

Based on the hardware requirements, it has their own role to develop the Parking Lot Management System.

i. Arduino Mega 2560



Figure 3.11: Arduino Board Mega 2560

Figure 3.11 shows an Arduino Mega which is an open-source microcontroller board based on the ATmega1280 microcontroller(Shah & Chaudhari, 2017). It is the heart of the project. It receives and sends information to the respective circuit that connect with it. The board is equipped with digital and analog input/output pins that can be interfaced for other circuits various expansion boards. The Arduino Mega is connected to the PC with a USB cable to get started.

ii. RFID Reader and Tag



Figure 3.12: RFID Reader and Tags

RFID is a technology that enables wireless data transmission wirelessly through radio waves (Pala & Inanc, 2007). By using the RFID system for the parking lot management system as in Figure 3.12, is an enhancement for the existing system that drivers not need to take the coupon ticket anymore so the traffic jam problem will be avoided. Drivers will not have to make any payment of the parking thus it will make the faster traffic flow (Parkhi, Thakur, & Chauhan, 2014). The RFID card reader will read the RFID tag in range so that the barrier of the gate will be open.

iii. LED



Figure 3.13: LED

Figure 3.13 shows LED that used in this Parking Lot Management System is used to show the availability of the parking slot to the users. It will be placed at each parking slot. The green colour of LED will display at the parking lot for each parking slot to show it is available while the red colour of LED will show that the parking slot is not available.

iv. Arduino HC-05 Bluetooth Module



Figure 3.14: HC-05 Bluetooth Module

Figure 3.14 shows the hardware which is to connect the system with the smart phone that will use by the drivers to see which parking slot is available to park the car. The smart phone will be program to connect with the arduino HC-05 Bluetooth. So that, the drivers able to see through their smart phone to know the location of available parking slot. This Bluetooth module then will send the data from Arduino to the mobile application.

v. Infrared Obstacle Sensor



Figure 3.15: IR Sensor

Figure 3.15 shows the components of IR Sensor that detect obstacle. This IR Sensor is used at the entrance and exit gate to detect the presence of car. When the sensor detect the car and the user scan the RFID tag, then the gate will open for the car. It also have at the parking lot which detect the presence of car.

vi. Ultrasonic Sensor HC-SR04



Figure 3.16: Ultrasonic Sensor HC-SR04

Figure 3.16 shows the sensor that detect the distance of an object. This sensor is used in this project to detect the distance of the car at the parking slot. If the sensor detects the presence of car in a specific distance, the sensor will send the signal to the Arduino board.

vii. Breadboard

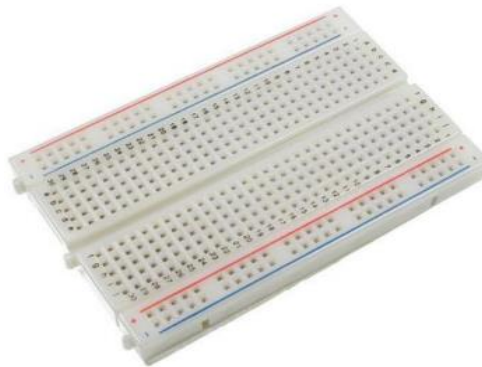


Figure 3.17: Breadboard

Figure 3.17 shows the breadboard which is used to attach most of the hardware and act as extra pin for the arduino board. It is because the pin on Arduino cannot be shared together.

Table 3.2 below shows the list of software and description that will be used during the process of implementation and documentation.

**Table 3.2 :** Software Requirement and its Description

Software	Description
Windows 10	Develop the system, documentation and install other software.
Microsoft Office Word 2013 Microsoft Power Point	Prepare the documentation. Prepare the slide presentation
Gantt Project	Used to create Gantt Chart
Arduino Integrate Development Environment (IDE)	Run and write code for Arduino using C Programming Language.
Draw.io	To design and create flowchart and diagrams for the documentation.
MIT App Inventor 2	Develop code for the application in the smart phone
QR Code	Develop the QR code.
Notepad++	Design the interface of the web application
XAMPP	Store the registered driver's information of the tag into database.

### 3.4 Gantt Chart

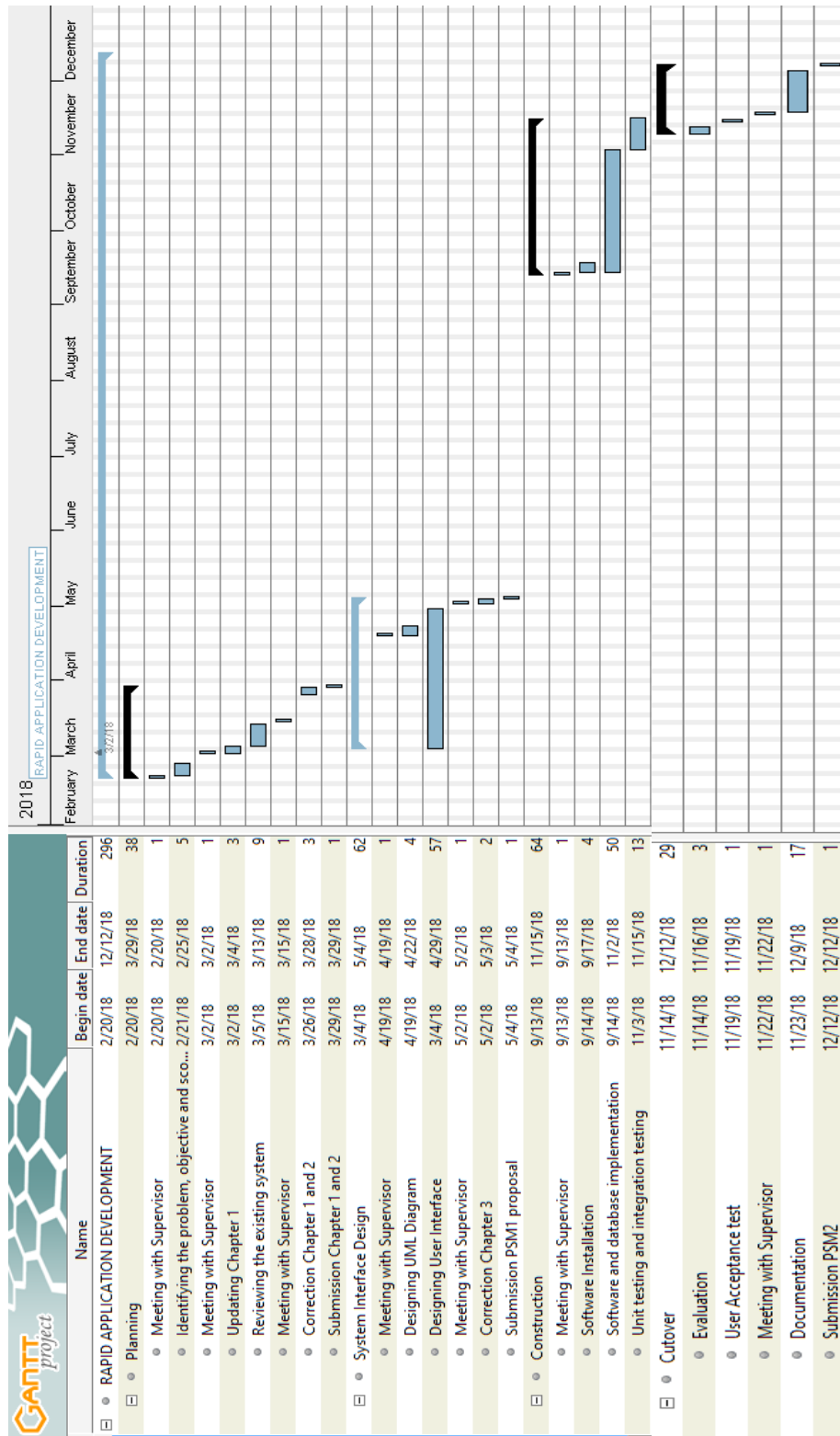


Figure 3.18: Gantt Chart

Based on Figure 3.18, it shows that the Gantt Chart during the PSM1. Planning and System Interface Design phase of the Rapid Application Development (RAD) methodology is done throughout PSM1 session while construction and cutover phase will be done throughout PSM2. The progress for PSM1 is started from 20<sup>th</sup> February 2018 and ended on 4<sup>th</sup> May 2018. While, the progress for PSM2 is started from 13<sup>th</sup> September 2018 and ended on 12<sup>th</sup> December 2018. The Gantt Chart is also shown in Appendix A.

### **3.5 Summary**

To summarize, methodology is important to perform the good development of the system. Among all of the methodologies, Rapid Application Development (RAD) methodology was chosen due to its performance and flexibilities. It is because this methodology is very suitable for the system that can be updated from time to time. The hardware and software used are to ensure that the system will be develop with the best requirement and complete the project task to meet the system design.



## **CHAPTER 4**

### **IMPLEMENTATION AND DISCUSSION**

#### **4.1 Introduction**

This chapter is to discuss in detail about the process of the Parking Lot Management System. All the implementation and configuration will be state here. Implementation and testing phases are the most important to complete this project that can detect the weaknesses or error during the phases. Through the phases, it will used to achieve the goal and the objective that will increase the level of successfulness.

This chapter also will focus on the system design and implementation in a brief description for each process of the interface. The coding of the system will be examined to ensure the function of the system. It is important to understand the project planning and the structure of the plan to get a good result.

In this stage, some alteration can be considered to ensure this project meets the client requirements. At the end of this chapter, the result of the discussion will be justified.

#### **4.2 Implementation**

In this subchapter, the implementation of all the devices that have been implemented to the Arduino and mobile application is being evaluated for the system to meet the client's requirements. This implementation is to create a valuable application and make the system is functionable for user and to achieve the objective of this system.

### 4.2.1 Hardware Implementation

This subchapter discusses about the structure of the project and all components that have been implemented is being connected. The figures below show how the devices are connected with another devices. For this project, the Arduino Mega is the main device to connect with other devices. The devices that connected to the Arduino are RFID reader, servo motor, ultrasonic sensor, LED, and Bluetooth. All the devices have to make sure all each pin was correctly connected to ensure the devices will be able to work properly and can use for this project. Figure 4.1 shows the example of implementation for the RFID with the Arduino. The Arduino is functioning when the LED for both RFID and Arduino board is on. Then, the other sensors also connected with the Arduino like Figure 4.2 which shows some of the connection between the devices and Arduino Mega with the breadboard.

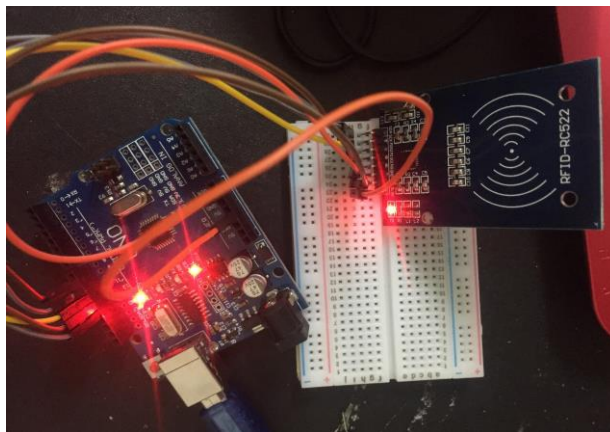


Figure 4.1: Connection between RFID reader and Arduino

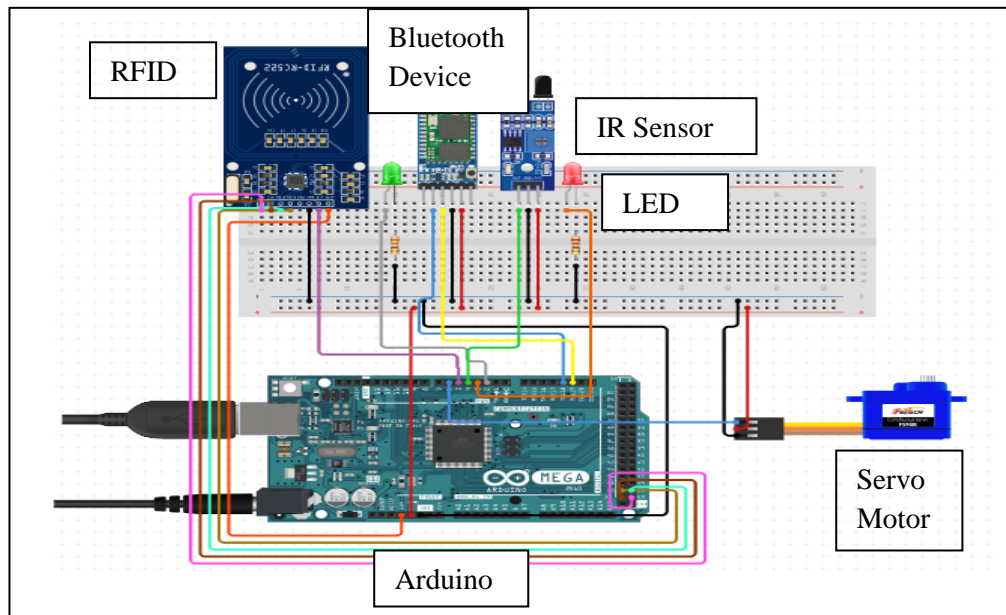


Figure 4.2: Connection between Devices with Arduino

#### 4.2.2 Tools and Technologies

Parking Lot Management System is being developed for a parking lot in a building using Arduino Mega as a prototype for the parking. Programming language that have been used for the Arduino Mega is C language and interact with online software platform to create the mobile supplication which is MIT App Inventor 2.

In this stage, all the requirements must be implements to fulfil the client requirements. There are several interfaces and components that have been implemented in this project for the mobile application.:

- i. Start Page Interface
- ii. Home Page Interface
  - a. View Parking Space
  - b. Scan QR Code
- iii. View Parking Space Interface
  - a. Bluetooth list
  - b. Home
- iv. Scan QR Code Page Interface
  - a. Scan, Save and Display
  - b. Home

a) Start Page Interface

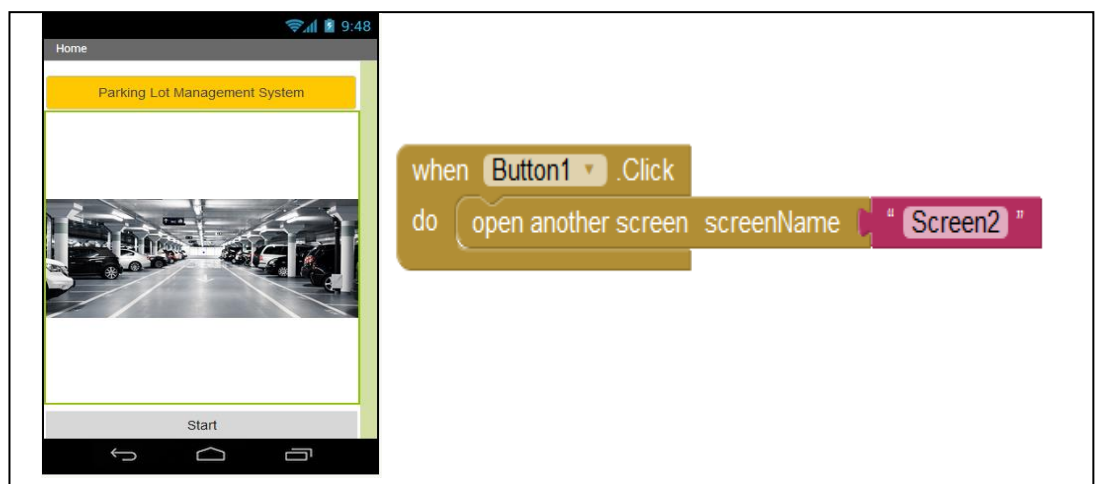


Figure 4.3: Start Page Interface and Block Code

Figure 4.3 shows the interface of the start page and the block code of the mobile application for the users. In this page, user can click the Start button on bottom that have been labelled to use the application to go to the next page.

b) Home Page Interface

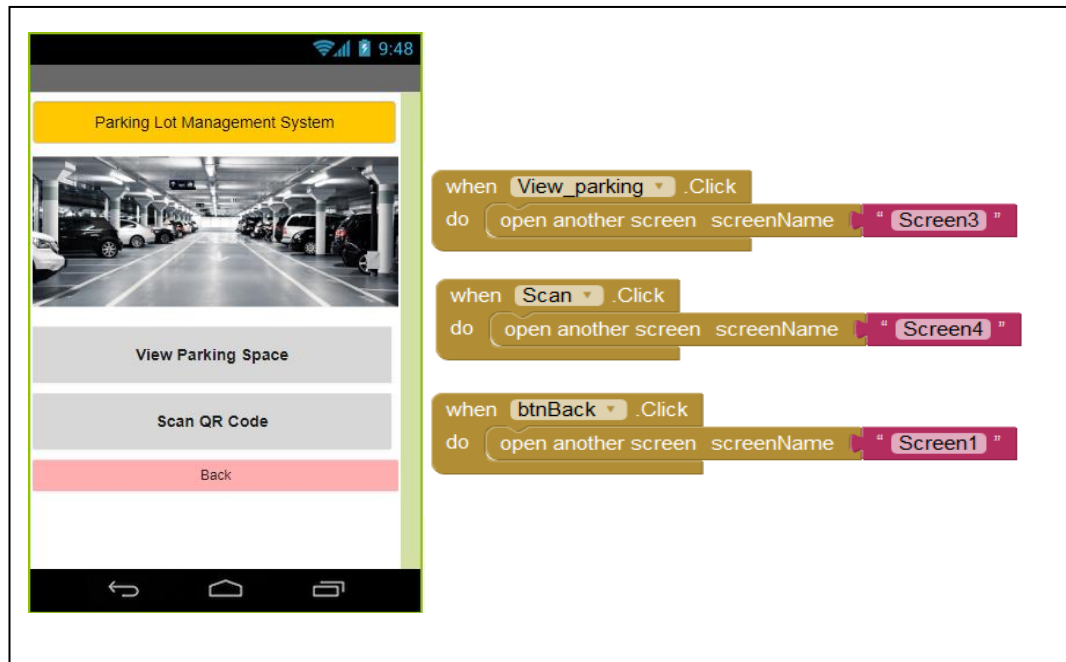


Figure 4.4: Home Page Interface and the Block Code

Figure 4.4 shows the main page of the mobile application for the user. The main function of the application is shown to the user that they can choose, which is view parking space and scan QR code. So, user just need to click the button in order to start the function of the view parking space and the scan QR code.

c) View Parking Space Page Interface



Figure 4.5: View Parking Space Page Interface

Figure 4.5 shows the View Parking Page for the user to view the availability of the parking slot at the basement of the shopping mall. In order for user to do that, user need to connect the mobile application with the Bluetooth module on the Arduino that will send data to the mobile application via the sensor. In this case for this project, only four parking are used to represent as the real parking in basement parking.

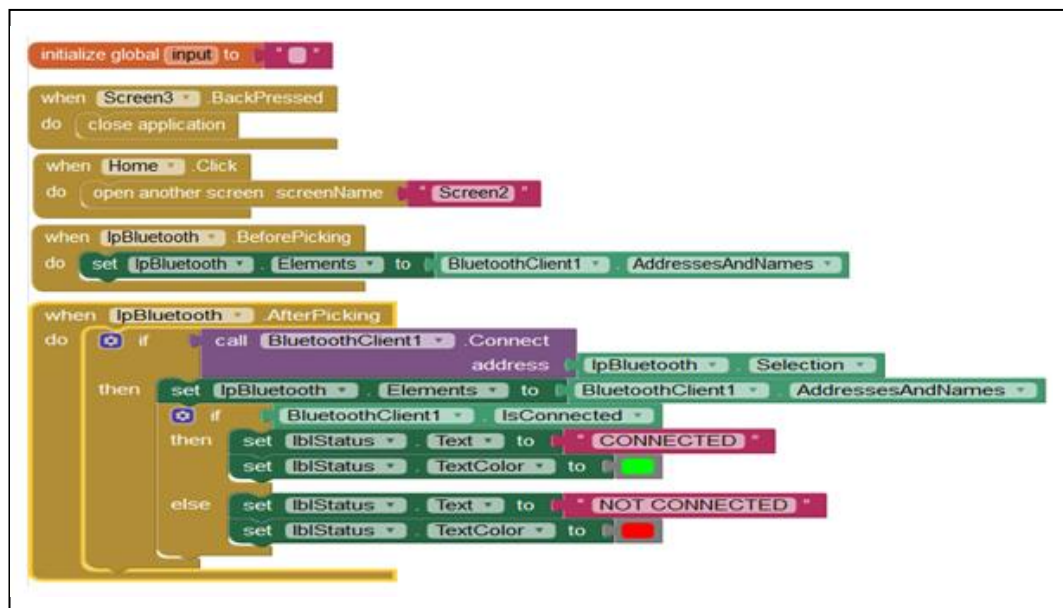


Figure 4.6: View Parking Space Block Code 1

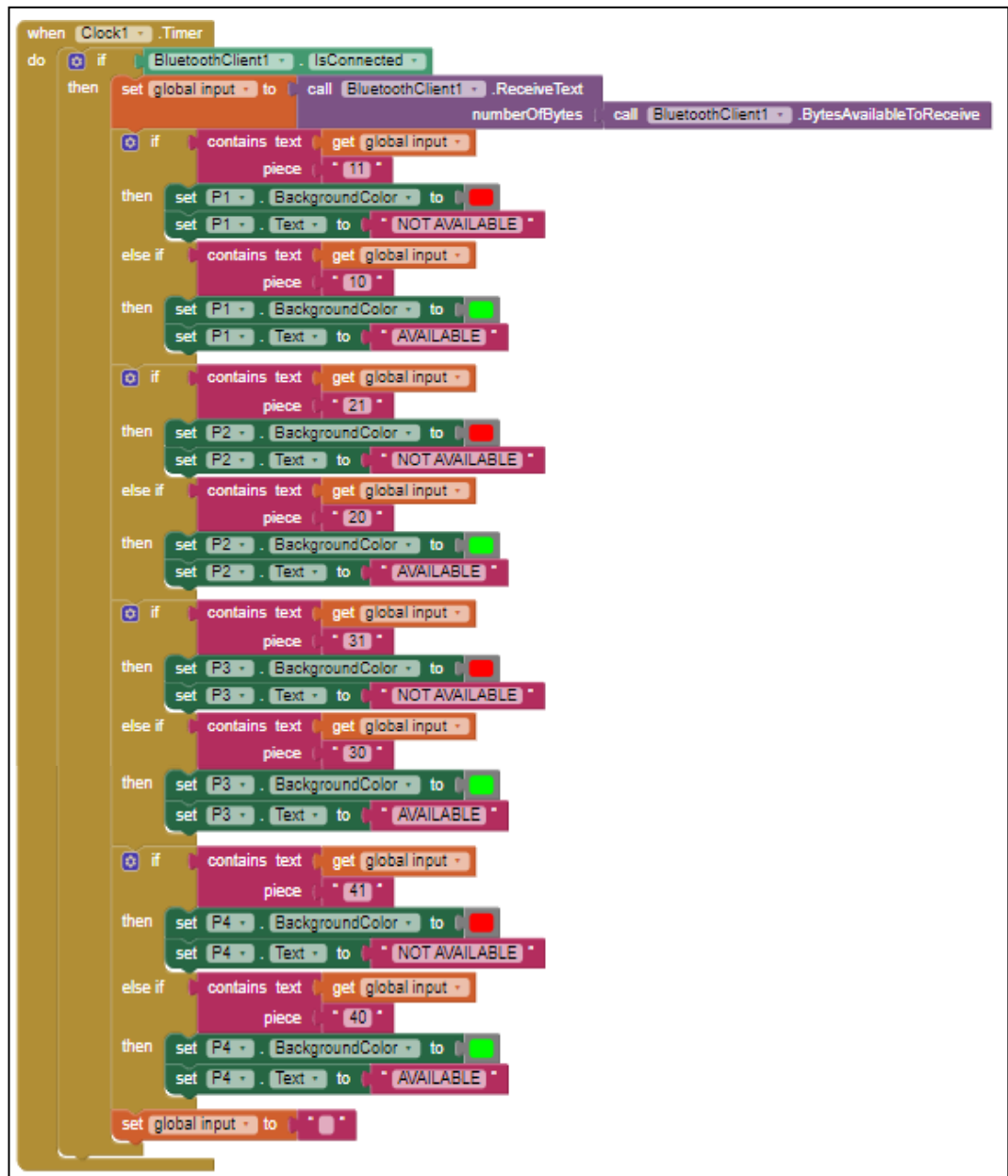


Figure 4.7: View Parking Space Block Code 2

Figure 4.6 and Figure 4.7 shows the block code for the view parking space. For the Figure 4.6, it describes the connection between mobile application and the Arduino device like Bluetooth device. The list of Bluetooth device that is available will be open when user click the Bluetooth List button. While, for the Figure 4.7, it describes the availability of the parking slot at the basement when the application is connected to Bluetooth device. For the application, it only uses two colours to represent the availability of the parking slot which is green and red. The application will be function when there is a car at either parking slot 1 until parking 4 and the box in the mobile

application will turn red which represent the parking slot is not available. While, when there is no car at the parking slot 1 until 4, the box will turn green which is the parking slot is available.

#### d) Scan QR Code Page

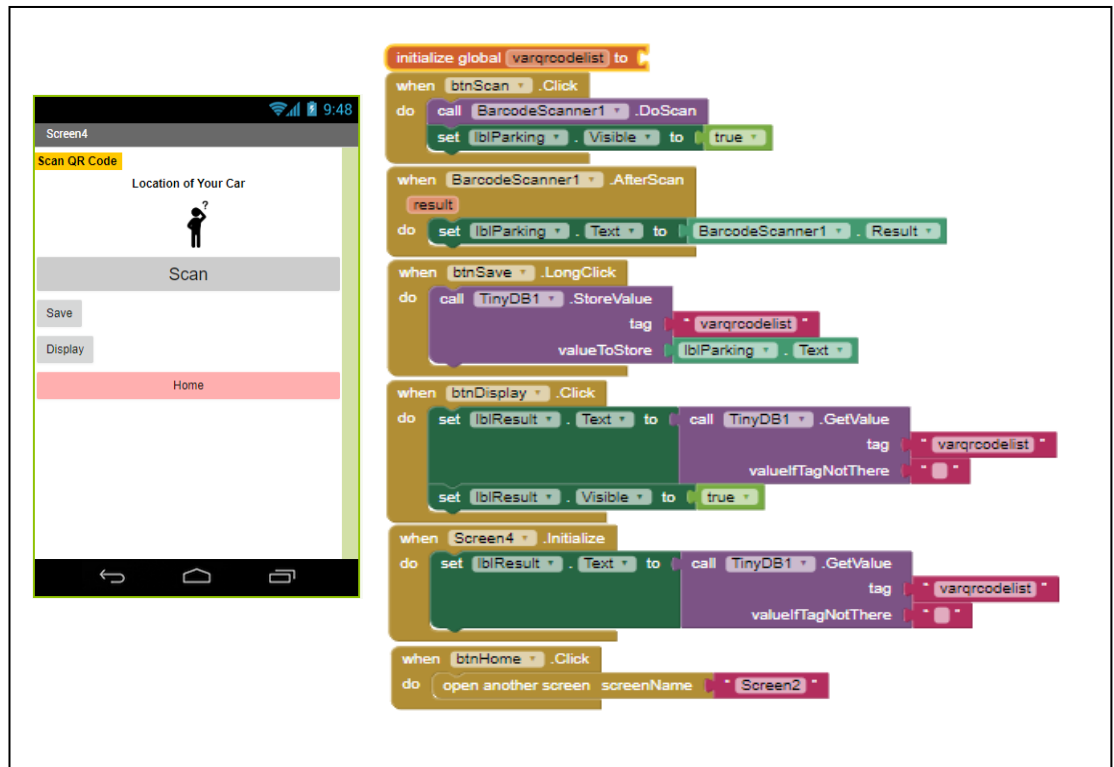


Figure 4.8: Scan QR Code Interface and Block Code

Figure 4.8 shows the interface and the block code for user to scan the QR code. The function of the QR code is to know the location of the parking where the user had parked the car. When the user click the Scan button, the mobile application will display the scanner to scan the QR code like Figure 4.9 below that have been provided at the parking. Then it will display the information of the parking. User also can save the information in the application and can display the information later. The full code for the mobile application is in Appendix B.





Figure 4.9: QR Code for Location of the Parking

### 4.3 Testing

In this part, the result of test is being acquired when the mobile application is usable to view the parking and scan QR code in the application. In order to do that, user need to install the application and connect the application with the Bluetooth device that will display the availability of the five parking slots on the basement parking slot.

#### 4.3.1 RFID scanning

For the result of the RFID scanning, it will display that the RFID card is authorized or not authorized for the user. Figure 4.10 shows that the result of authorized access for the RFID card. If the RFID card is not register, then it will deny the access.

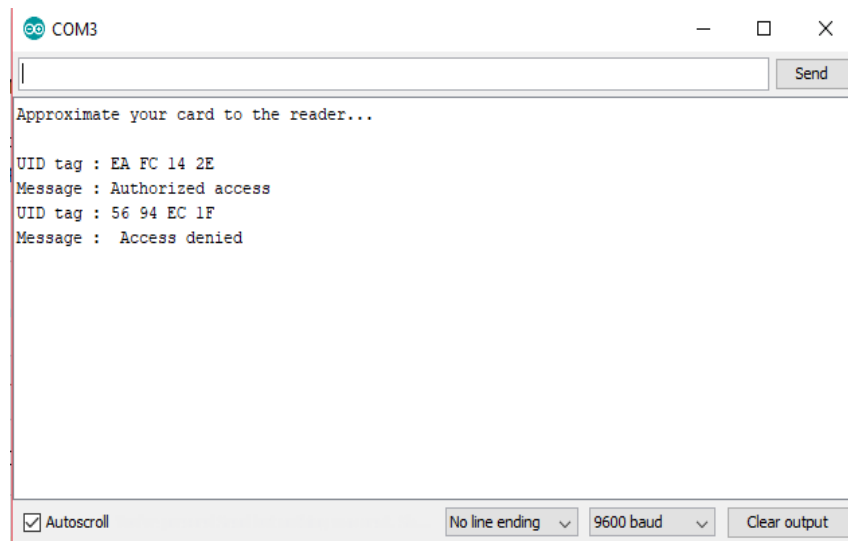


Figure 4.10: Result of RFID Scanning

```

void rfid()
{
    // Look for new cards
    if ( ! mfrc522.PICC_IsNewCardPresent() )
    {
        return;
    }
    // Select one of the cards
    if ( ! mfrc522.PICC_ReadCardSerial() )
    {
        return;
    }
    //Show UID on serial monitor
    Serial.print("UID tag :");
    String content= "";
    byte letter;
    for (byte i = 0; i < mfrc522.uid.size; i++)
    {
        Serial.print(mfrc522.uid.uidByte[i] < 0x10 ? " 0" : " ");
        Serial.print(mfrc522.uid.uidByte[i], DEC);
        content.concat(String(mfrc522.uid.uidByte[i] < 0x10 ? " 0" : " "));
        content.concat(String(mfrc522.uid.uidByte[i], HEX));
    }
    Serial.println();
    Serial.print("Message : ");
    content.toUpperCase();
    if (digitalRead(ir) == LOW){
        if ((content.substring(1) == "EA FC 14 2E") || (content.substring(1) == "56 94 EC 1F"))
        {
            Serial.println("Authorized access");
            myservol.write( 90 );
            delay(3000);
            myservol.write( 0 );

            //runsensor();
        }
        else {
            Serial.println(" Access denied");
            delay(3000);
        }
    }

    if (digitalRead(ir2) == LOW){
        if ((content.substring(1) == "EA FC 14 2E") || (content.substring(1) == "56 94 EC 1F"))
        {
            Serial.println("Thank You");
            myservo2.write( 90 );
            delay(3000);
            myservo2.write( 0 );
        }
    }
}

```

Figure 4.11: Source Code for the RFID and Sensor

Figure 4.11 shows the source code of the RFID and the sensor that have been implemented. The registered card of RFID is set into the source code and the output is like Figure 4.9. The code is explaining about the setup of UID of the RFID card which is insert as an access user. The IR sensor is set to detect the presence of car at the entrance and exit. In the code, when the IR sensor is LOW, it means that the sensor is detect obstacle.

### 4.3.2 View Parking Space

When user connect the mobile application with the Bluetooth of the Arduino, it will display the parking slot for the user if the parking slot is available or not. The user need to connect with the HC-05 Bluetooth in the mobile application. After the user connect it, the mobile apps will display CONNECTED at the top of the screen which is it is ready to use. If the parking is available, the mobile application shows the green colour while the red colour show that the parking is not available as Figure 4.12.

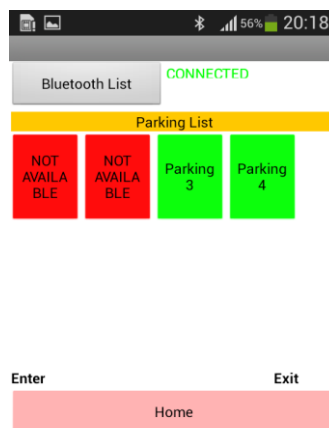


Figure 4.12: Result of View the Parking Space

### 4.3.3 Scan QR Code

When user scan the QR code using the mobile application, they can save and display the information of the parking. Figure 4.13 and Figure 4.14 shows the result when the user scan the QR code and shows the data when user save the location. If the user close the application, they still can display the location that is saved before.

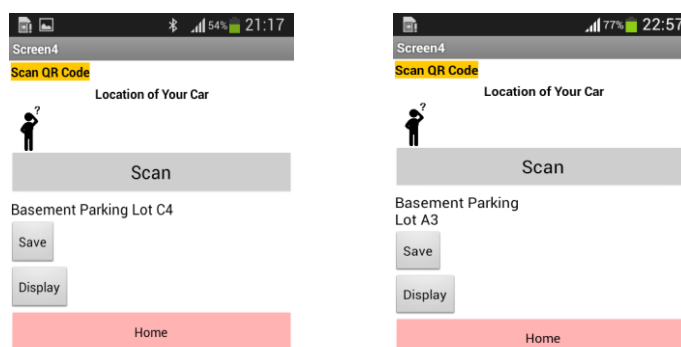


Figure 4.13: Result of Scan QR Code

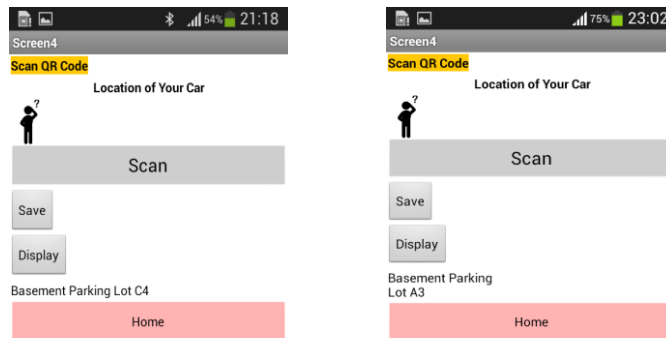


Figure 4.14 Display the Parking Lot Information

#### 4.3.4 Web Page for Administrator

Click Here To Add

Data Table					
10 records per page					
Search:					
Image	Name	RFIDSerialNumber	PhoneNumber	Email	Action
	Siti Aminah	EA FC 14 2E	123456789	aminah22@gmail.com	<a href="#">Edit</a> <a href="#">Delete</a>
	Ahmad Hisyam	56 94 EC 1F	163456106	hisyams@gmail.com	<a href="#">Edit</a> <a href="#">Delete</a>

Figure 4.15:Web for Administrator

Figure 4.15 shows the web page for the administrator. It is to add the registered RFID user as an authorized access for the parking lot. The information will be saved in the XAMPP database like Figure 4.16 for the administrator record.



+ Options							
		u_id	u_name	u_rfid	u_phone	u_email	u_profile
<input type="checkbox"/>	 Edit  Copy  Delete	4	Siti Aminah	EA FC 14 2E	123456789	aminah22@gmail.com	[BLOB - 9 B]
<input type="checkbox"/>	 Edit  Copy  Delete	5	Ahmad Hisyam	56 94 EC 1F	163456106	hisyams@gmail.com	[BLOB - 9 B]

Figure 4.16 Database of Registered User

#### **4.4 Summary**

From this chapter, the implementation and result discussion were discussed. First, the hardware of Arduino and other sensors are implemented. The mobile application also has been implemented to achieve the objective. All the sensors are connected to the Arduino which can send data through it. The results of the mobile application were stated at this chapter which help user to park the car at the parking lot and user also can scan QR code to save location of the parking lot of the car.

## **CHAPTER 5**

### **CONCLUSION**

#### **5.1 Introduction**

This chapter contains the achievement of the objective for this project and the future suggestion and enhancement to improve the system. The conclusion of the project, methodology used to develop this application also will be described.

This project is about Parking Lot Management System, which the parking indoor is one of the most common matter in this world. The objective of this system that has been developed has achieved which is to develop a system that can assist user to parking car at the parking slot based on the mobile application, locate car at the parking lot and and can reduce the traffic congestion at the entrance. Besides, this system is developed as user friendly.

As for the methodology, this project used Rapid Application Development (RAD). This methodology was chosen because most of the criteria meet with this project requirement compared to other methodologies. The RAD in Systems Development Life Cycle (SDLC) consists of four phases which are requirements planning, user design, construction and cutover. The phases of the SDLC was used to complete the development of the system.

## **5.2 Constraint**

This section will discuss about the project constraint that occur during the development of this project. One of it is lack of knowledge about Arduino and limited time to study. So, it needs more time to understand and develop the project for a beginner. Then, the other challenge is when to connect two RFID module on the same board of Arduino. The Arduino Mega cannot detect one of the RFID module and only one is functioning.

In addition, the problem is when the Arduino want to connect with the mobile application via Bluetooth that the sensor of the Arduino cannot work well when send data to the mobile application for user to view the available parking slot. Next, this application is only for mobile phone with android operating system only, it cannot be used for IOS and web based. Then, this system also more focus on user and not on the administrator.

## **5.3 Future Enhancement**

There are several enhancements that can be improved of the Parking Lot Management System. Firstly, add the route map function of the mobile application for the user to locate the car at the parking lot if they forget the location of the car they park. Besides, the current administrator function also can be improved to make the enhancement for the system. The administrator can manage the parking slot and the time of registered users enter and exit the parking lot. Other than that, add the online payment wallet for ease of use that allows user to make payment via online transaction. It is easy that can use in the mobile application.

## **5.4 Conclusion**

As a conclusion, this project has achieved the respective three objectives. All the implementations of the project have been developed. In this chapter, the constraints faced during developed this project is being discussed. Moreover, some enhancement that can be improved in the future for the project has been discovered to make the system more useful and better for the user.

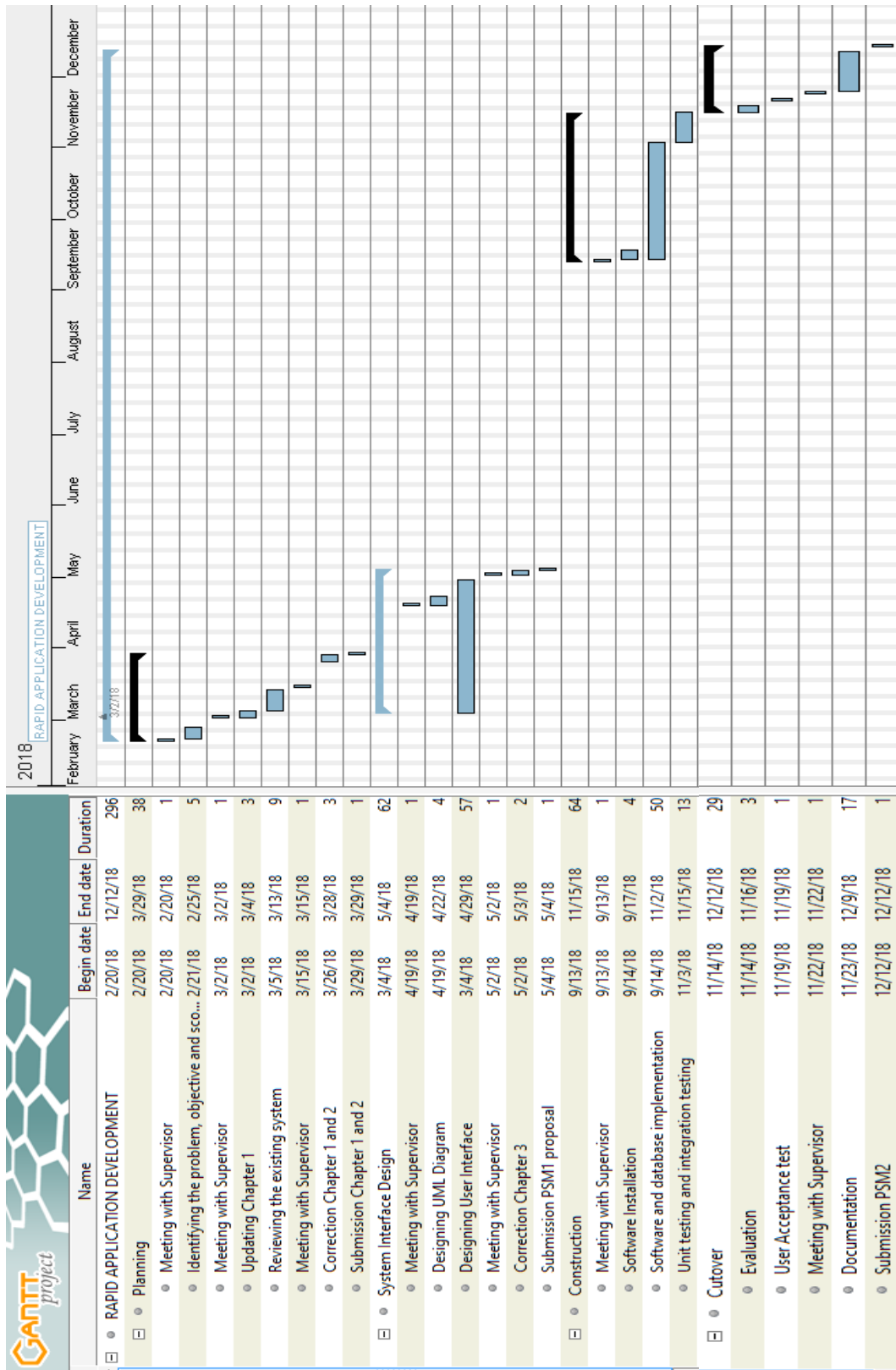


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<https://doi.org/10.1109/RFIDEURASIA.2007.4368108>

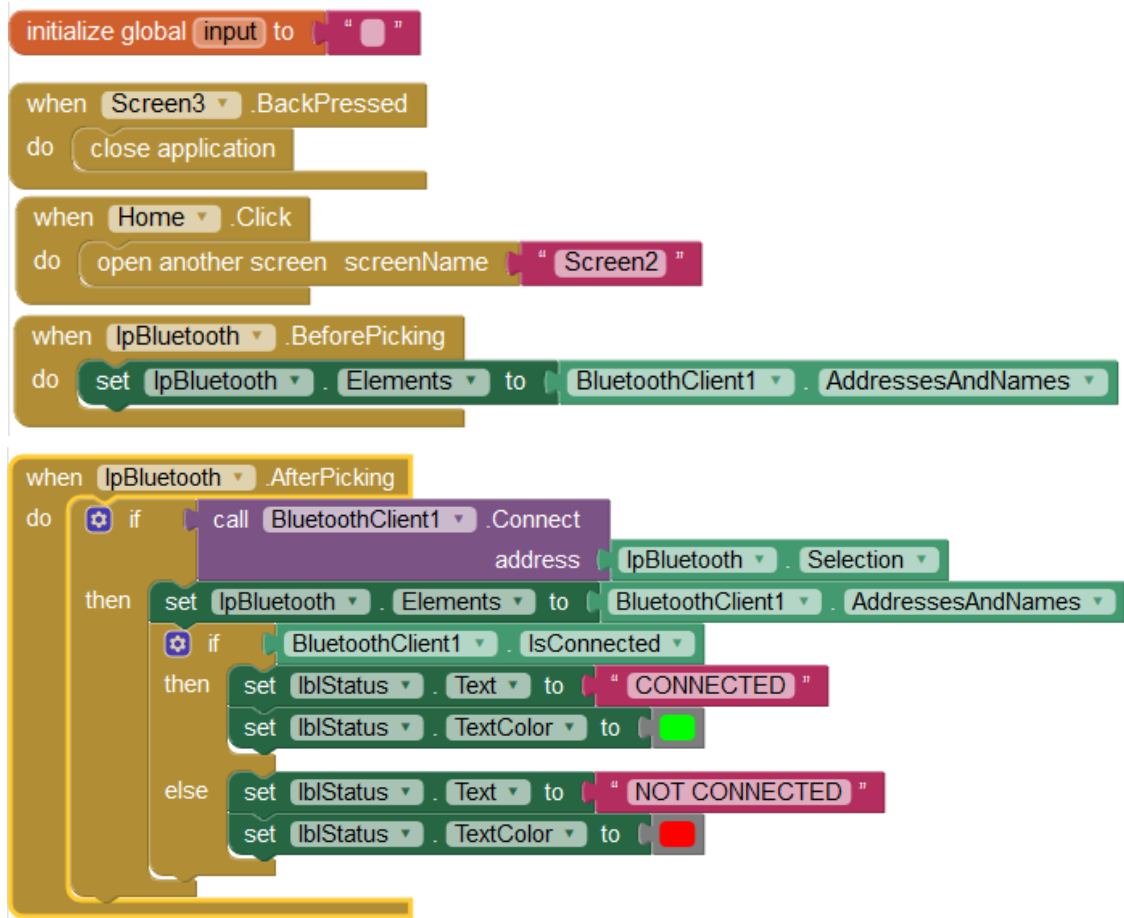
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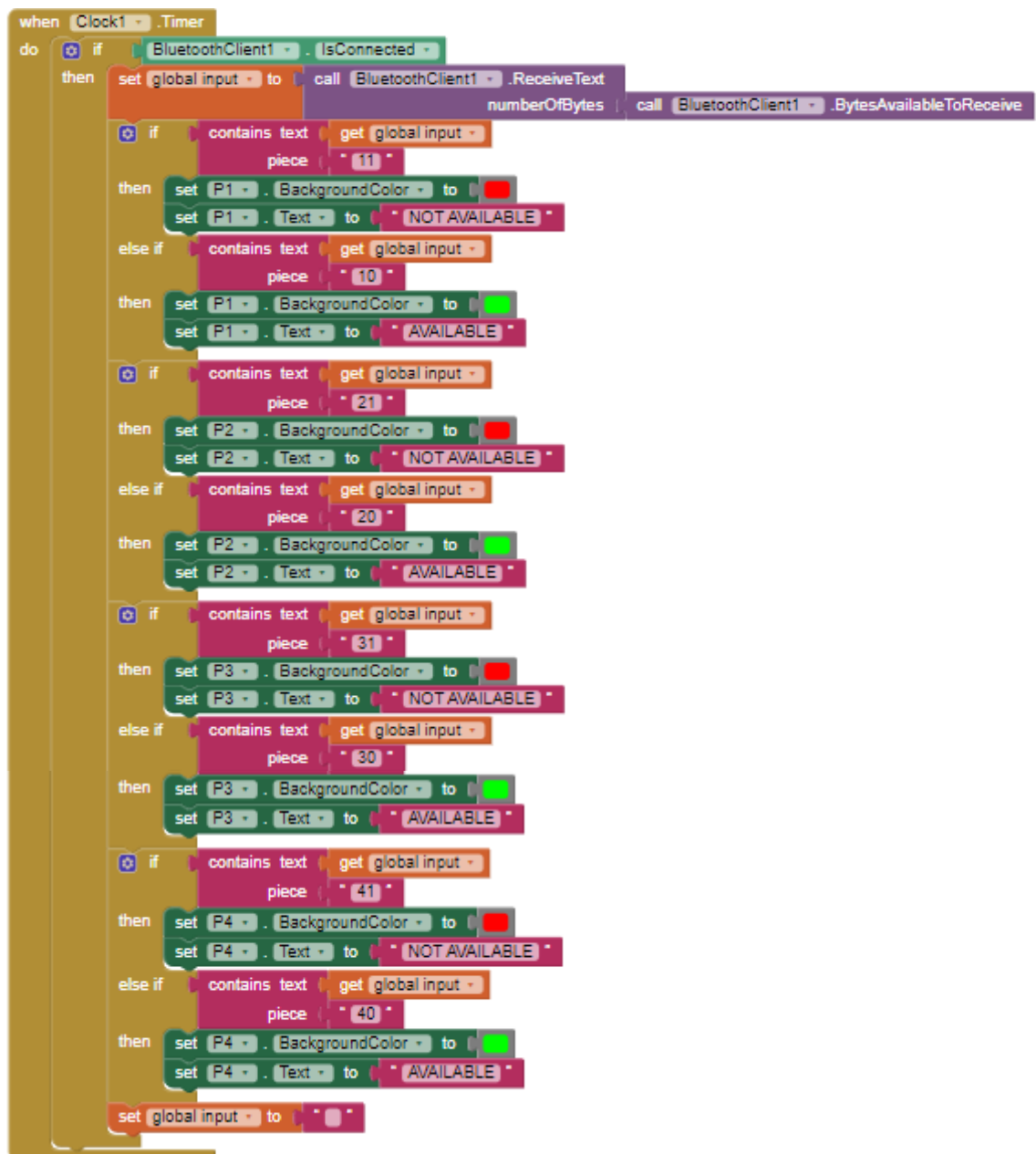
## APPENDIX A



## APPENDIX B

### Mobile Application Code for Bluetooth:





## Mobile Application Code for Scanning

```
initialize global varqrodelist to
when btnScan .Click
do call BarcodeScanner1 .DoScan
  set lblParking .Visible to true

when BarcodeScanner1 .AfterScan
  result
do set lblParking .Text to BarcodeScanner1 .Result

when btnSave .LongClick
do call TinyDB1 .StoreValue
  tag varqrodelist
  valueToStore lblParking .Text

when btnDisplay .Click
do set lblResult .Text to call TinyDB1 .GetValue
  tag varqrodelist
  valueIfTagNotThere ""
  set lblResult .Visible to true

when Screen4 .Initialize
do set lblResult .Text to call TinyDB1 .GetValue
  tag varqrodelist
  valueIfTagNotThere ""

when btnHome .Click
do open another screen screenName Screen2
```

The code is written in a block-based programming language and consists of the following logic:

- Global Variable:** A global variable named `varqrodelist` is initialized.
- btnScan Click:** When the `btnScan` button is clicked, the `BarcodeScanner1` object's `DoScan` method is called, and the `lblParking` label's `Visible` property is set to `true`.
- BarcodeScanner1 AfterScan:** When the `BarcodeScanner1` object's `AfterScan` event occurs, the `lblParking` label's `Text` property is set to the `Result` of the scanner.
- btnSave LongClick:** When the `btnSave` button is long-clicked, the `TinyDB1` object's `StoreValue` method is called with the tag `varqrodelist` and the `lblParking` label's `Text` as the value to store.
- btnDisplay Click:** When the `btnDisplay` button is clicked, the `lblResult` label's `Text` is set to the value returned by `TinyDB1`'s `GetValue` method (using tag `varqrodelist`), and its `Visible` property is set to `true`. A default value of an empty string is specified if the tag is not found.
- Screen4 Initialize:** When `Screen4` is initialized, the `lblResult` label's `Text` is set to the value returned by `TinyDB1`'s `GetValue` method (using tag `varqrodelist`), and its `Visible` property is set to `true`. A default value of an empty string is specified if the tag is not found.
- btnHome Click:** When the `btnHome` button is clicked, the application opens another screen named `Screen2`.