REAL TIME BUS TRACKING APPLICATION

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This report is submitted in partial Fulfilment of the Requirements for Diploma in Electronic Engineering (Communications)

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ENDORSMENT

"I hereby acknowledge that I have read this report and I find that its contents meet the requirements in terms of scope and quality for the award of the Diploma in Electronic Engineering (Communication)"

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DECLARATION

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ABSTRACT

Public buses has been used by passengers for ages. It is one of the easiest and most convenient public transport. Even though the buses nowadays are equipped with the latest technologies, passengers still have to wait long hours for the bus. Moreover, passengers are impatient while they are waiting in bus stop because they are not able to know exactly how long to wait and where the next coming bus is. The main purpose of this project is to develop a real time bus tracking system to enhance current bus service system and reduce the workload of bus management team. Global Positioning System (GPS) is the main technology implemented behind the system. A GPS receiver is used to track on real time bus coordination by continuously receiving the position data which are latitude and longitude values from GPS satellite, then send the position data back to main server and server process the raw position data into real time information for users. This system is implemented on an Android App so that passengers are able to view the information through smartphone devices. Methodology applied in this project is prototype development model. The system developed in this project is not modules independently, all modules have to integrate become a working system. Therefore, prototype is developed and use for system evaluations, testing and enhancements. The users can get flexibility of planning travel using the app, to decide on which bus to take or when to catch the bus. The waiting time of the user can be reduced. Simple mode of communication is the key feature of the Bus Tracking system. After all modules integration, the system is able to provide a more accurate bus arrival time and to reduce workload performed by bus management team.

ABSTRAK

Bas-bas awam telah digunakan oleh penumpang untuk beberapa tahun. Ia adalah salah satu pengangkutan awam yang paling mudah dan paling murah. Walaupun bas pada masa kini dilengkapi dengan teknologi terkini, penumpang masih perlu menunggu masa yang lama untuk bas. Selain itu, penumpang tidak sabar semasa mereka sedang menunggu di perhentian bas kerana mereka tidak dapat mengetahui dengan tepat berapa lama menunggu dan di mana bas datang seterusnya berada. Tujuan utama projek ini adalah untuk membangunkan satu sistem pengesanan bas masa nyata untuk meningkatkan sistem perkhidmatan bas semasa dan mengurangkan beban kerja pasukan pengurusan bas. Sistem Kedudukan Global (GPS) adalah teknologi yang utama dilaksanakan di belakang sistem. Seorang penerima GPS digunakan untuk mengesan pada penyelarasan bas masa sebenar dengan terus menerima data kedudukan yang nilai latitud dan longitud dari satelit GPS, kemudian menghantar data kedudukan kembali ke pelayan utama dan proses pelayan data kedudukan mentah ke dalam maklumat masa sebenar untuk pengguna . Sistem ini dilaksanakan pada Aplikasi Android supaya penumpang dapat melihat maklumat melalui peranti telefon pintar. Metodologi yang digunakan dalam projek ini adalah model pembangunan prototaip. Sistem yang dibangunkan dalam projek ini tidak modul bebas, semua modul perlu mengintegrasikan menjadi satu sistem yang bekerja. Oleh itu, prototaip dibangunkan dan digunakan untuk sistem penilaian, ujian dan tambahan. Para pengguna boleh mendapatkan fleksibiliti perjalanan perancangan menggunakan aplikasi, untuk membuat keputusan di mana bas untuk mengambil atau bila untuk menangkap bas. Masa menunggu pengguna dapat dikurangkan. Cara mudah untuk komunikasi adalah ciri utama sistem masa sebenar penjejakan bas. Lagipun integrasi modul, sistem ini dapat memberikan masa ketibaan bas yang lebih tepat dan mengurangkan beban kerja yang dilakukan oleh pihak pengurusan bas.

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CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

Among all public transportation services, bus service is the major transportation used by public. Especially in a busy town or city, bus is the most easy, convenient and cheaper transportation. Various reasons that people take bus instead of driving own vehicle such as traffic jam, heavy parking fee and lack of parking slot in destination.

However, bus transportation service has very poor transportation information system nowadays. Bus user do not know the exactly arrival time for a bus, but only know the scheduled arrival time. Compare to train or flight transportation system, bus transportation service does not have a proper system to track all buses position and the actual arrival time in every bus stops. These problems occur because current bus service system did not apply real time tracking technology to track on each buses on the road and also lack of a platform to update latest bus traffic information to bus users. In order to solve these problems and enhance current bus service system, real time bus tracking system has to develop and implement. With real time bus tracking system, bus position data is connected real time and transmitted to a central server for processing and extracting transit information.

The main technology used to develop this system is Global Positioning System (GPS). GPS technology able to receives the position of an object from space-based satellite navigation system through a GPS receiver. Some programming languages such as will be used to develop the proposed system.

The developed bus tracking system will able to provide bus users a real time platform to check on updated bus traffic information, for examples bus arrival or departure time. Besides, this system also able to reduce workload for bus management team and provide an immediate platform to update latest and accurate bus traffic information to bus users.

1.2 PROBLEM STATEMENT

One of the problems occurring in current bus service is student did not know exactly what time a bus will arrive, but only know the scheduled arrival time. Student needs to wait for a bus without knowing what time the bus will arrive actually. Sometime, student might feel anxious and impatient when they waiting for a bus if they do not know what time the bus will arrive especially when student rushing of time for certain reason.

Additionally, this situation wasted a lot of time when waiting in bus stop because the time wasted can actually spend on other matter. Besides, current bus management unable to schedule an accurate bus timetable for passengers. This is because current bus system is implementing manual tracking on bus arrival time and travel duration between two bus stops. The estimated arrival time is calculated based on the average travel duration between two bus stops. It was not accurate because of various uncertainties will happened on each bus stop. Lack of real time platform is the serious communication problem between bus user and bus management team.

Without a real time platform, bus management side unable to update latest bus traffic information for passengers. Passengers also cannot check on the updated bus schedule if there is a bus delay happens. For example, passengers can choose to walk to the building he or she want to go instead of waiting for a delay bus if there is a real time platform for student to know about the bus is delay.

1.3 OBJECTIVES

There are several objectives have to be achieved in developing Real Time Bus Tracking System:-

- To design GPS tracking device to put into bus transportation system.
- To develop smartphone application to check on the arriving time and destination of the tracked bus.
- To embedded Global Positioning System (GPS) with a Wi-Fi Module (ESP8266) and program an Arduino Nano Board.
- To design a fully functional real time bus tracker system using the GPS device and the application is user friendly to passengers.

1.4 PROJECT SCOPE

The scope of this project includes 3 different types of technologies which is, Global Positioning System (GPS) and Wi-Fi Module (ESP8266) and Arduino Nano Board. This project is focused to design and build the prototype of Real Time Bus Tracking Application that would be a starting point to build the realistic Real Time Bus Tracking Application. Therefore, this prototype will cover the scope as followed:-

- Using Arduino Nano to develop network for Real Time Tracking Bus System.
- Using Wi-Fi Module (ESP 8266) to transmit and receive signal.
- Using Blynk Sever to store database of the bus.
- Using GPS to detect the location of the bus.
- Using APPS to display the position and arrival time of the bus.

This project is actually developed for passengers of the free bus around Selangor. But for this prototype project design, the user is Politeknik Shah Alam students and frequent bus users around Shah Alam for testing.

CHAPTER 2

LITERATURE REVIEW

Bus transportation service is every way, but without a good bus management system, bus service may not fully utilize. In our country, majority bus service providers are not performing real time bus tracking. They only provide scheduled timetable which is not accurate in real time.

However, there is a University in Malaysia successfully implemented real time bus tracking system. In oversea countries, there are many university implemented real time tracking system for shuttle bus service. Thus, studies are performed on the bus tracking system implemented by Asia Pacific University (APU) in Malaysia, Northern Illinois University (NIU) located in USA and Rice University in Texas, USA.

Study also performed on Singapore Bus Service (SBS) Transit. It provided an application called Intelligence Route Information System (iris NextBus) for Singapore bus users to find out estimated bus arrival time. Iris NextBus also available in mobile application and study is emphasized on it mobile application. Besides, studies are also performed on technologies involved and methodology applies in the proposed system

2.1 ANALYSIS ON EXISTING SYSTEMS

There are existing bus tracking systems implemented by Asia Pacific University (APU), Northern Illinois University (NIU), Rice University and Singapore Bus Service (SBS). Studies in detailed are performed and stated as following.

2.1.1 ANALYSIS ON ASIA PACIFIC UNIVERSITY (APU) BUS TRACKING SYSTEM

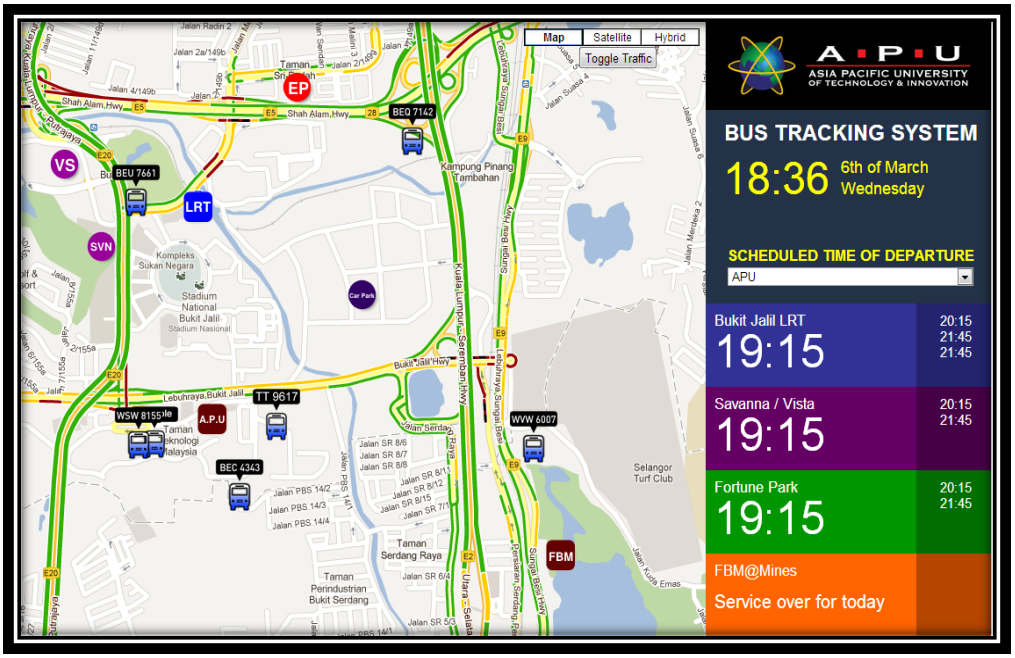

Figure 2.1 : APU Bus Tracking Webpage

It is built in a web page with Google Map embedded. The web page allows APU students to check on bus traffic status anytime in anywhere as long as use a device with browser and Internet accessibility. There are bus icons allocated inside the map and those icons indicated that a particular bus real time position. The bus plate number is linked with every bus icon in the map. It is to ensure that student take the right bus with bus plate number verification.

When the bus is reach a bus stop because different bus will move to different route. Next, there is a bus timetable in right hand side of the web page. Show student about the bus arrival time in each bus stop. The most important feature is the web page will automatically refresh every 5 second. However, this system still got limitations. The timetable provided in this system is still the scheduled time of departure for each bus stop. This system still unable to provide the exactly arrival time for each buses based on the exactly position of bus. But at least students can confirm that a bus is approaching to a bus stop based on the movement of a bus icon in the map. Second, this web page only shows the most important destination bus stop of a bus route but do not show the whole bus route to student. Student might not know others bus stop is on which bus route.

Moreover, beside those main destination bus stop. Many others small bus stop does not show in the map. If the student does not know how to refer on map, the student will not know where is the bus stop allocated in map and which bus should take. If there is bus stop icon in the map, this problem will solved. The APU bus tracking system will be the design fundamental for proposed system. Since APU bus tracking system operating in same environment (University bus service), the design of system will be suitable to build for proposed system in this project.

2.1.2 ANALYSIS ON NORTHERN ILLINOIS UNIVERSITY (NIU) BUS TRACKING SYSTEM

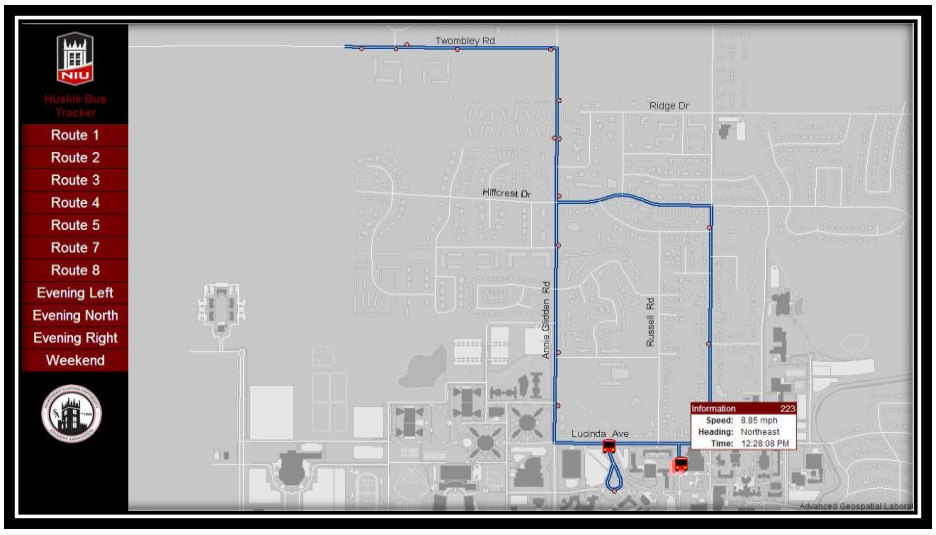

Figure 2.2: NIU Bus Tracking Routes

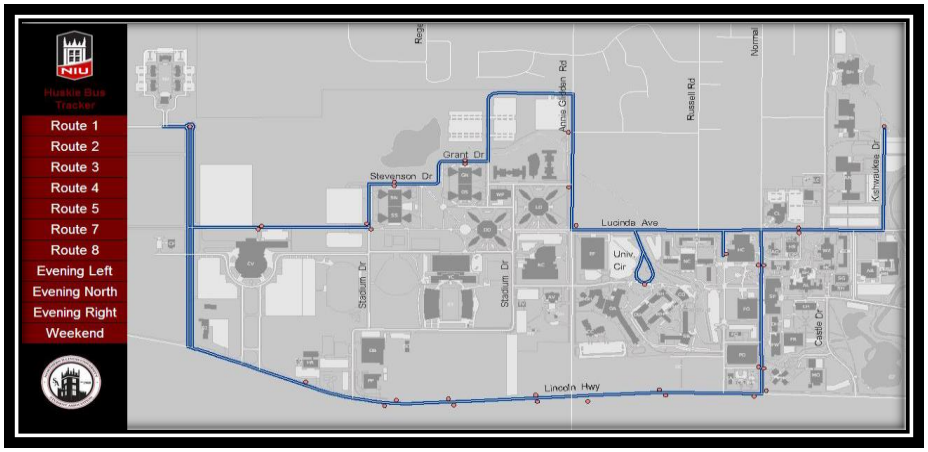

Figure 2.3: NIU Bus Tracking Routes

The bus tracking system show in Figure 2.2 and Figure 2.3 is developed by Northern Illinois University. The uniqueness of NIU bus tracking system is the map is not using Google Map, but use jpg format map converted from Google Map. The purpose of using jpg map is to use different map to show different bus route. In Figure 2.2 is showing the "Route 4" bus route and the map in Figure 2.3 are showing "Route 1" bus route. In Figure 2.3, there are two type of bus icon.

One of the bus icons with shadow is indicate that the bus is moving and the bus icon without shadow is not moving. The bus information will show on a pop-up box when user place mouse cursor on a bus icon. Moreover, there are orange colour dot beside the bus route and those dot is represent bus stops in the map. One of the strengths for NIU bus tracking system is the web page does not refresh when updating bus position. It is using a real time programming skill to update the bus icon position in the map without reload the whole map image. Second advantage is this bus tracking system divided different bus route into different map image. This can clearly show the bus route to users which the bus will go to. Moreover, there are bus stop icons allocated among the bus route. User can easily know where the bus stops are located and able to know which bus stop is belonging to which bus route.

Lastly, the bus icons differentiate with shadow. The bus icon with shadow mean it is moving and another one without shadow is not moving. User may know about the bus is moving or not. If the bus is not moving, user might try rush to the bus stop to take the bus. However, one of the drawbacks of this system is it does not show the bus arrival time or bus timetable on the web page. It is a big problem if a bus user does not know how to estimate the bus arrival time based on the movement of a bus icon in the map. Furthermore, it does not show whether the bus is on service or not. If the bus is out of service, the icon in the map will just not moving. But users do not know it is out of service and user might wait for the bus. It shells put information to show user about bus traffic status.

Different bus will have different route, if all buses is moving in a single map. Users might felt confusing to look for the bus the user wants to take. Thus, the advantage of NIU bus tracking system will be needed for proposed system. Differentiate different bus route with different map will show better information to users. Users can filter the bus route the user want to go and look of the correct bus which need to take.

2.1.3 ANALYSIS ON RICE UNIVERSITY SHUTTLE BUS TRACKNING SYSTEM

Figure 2.4: Rice University Bus Tracking apps

The shuttle bus tracking system show in is developed by Rice University located in Texas, USA. The system is built in web page embedded with Google Map and simple interface to show bus services information. The map is showing the campus area of Rice University and the position of buses. The strength of Rice University tracking system is the bus position update speed. Every bus icon is the map will update location with interval 2 seconds. It is very fast update speed compare with other bus tracking system available. With high update speed, the bus icons seem like moving in the map from user point of view. Moreover, the map allow user to zoom in and zoom out without affect bus icons update speed. When user zooms in to look at particular area, the bus icon update speed is still the same. There are few different bus icons with different colour in the map. Each colour indicates different bus service and different route in the campus. In the right hand side of the web page, there are few tab boxes to show user about different shuttle bus service information. The information included bus route and bus scheduled arrival time.

The weaknesses of Rice University Shuttle tracking system is it do not show bus routes in the map. User will not know where the buses moving to if user do not know about the bus route. Those bus stops also not available in the map, this will be difficult for some users that do not know where the bus stop allocated in the map. Another drawback of this system is it does not show the real time bus arrival time to user. User has to estimate the bus arrival time by the movement of a bus icon in the map. In the proposed system, bus position and arrival time update speed is very important to determine accurately of the system. Faster update speed will increase the level of real time information system. Thus, the update speed of Rice university shuttle tracking system will be as an example for proposed system.

However, update speed more depends on Internet access speed. Therefore, the initial update speed for proposed system will be set to 3 seconds interval instead of the faster update speed with 2 seconds interval.

2.1.4 ANALYSIS ON SINGAPORE BUS SERVICE (SBS - iris NextBus) SYSTEM

Figure 2.5: Singapore Bus Service Webpage

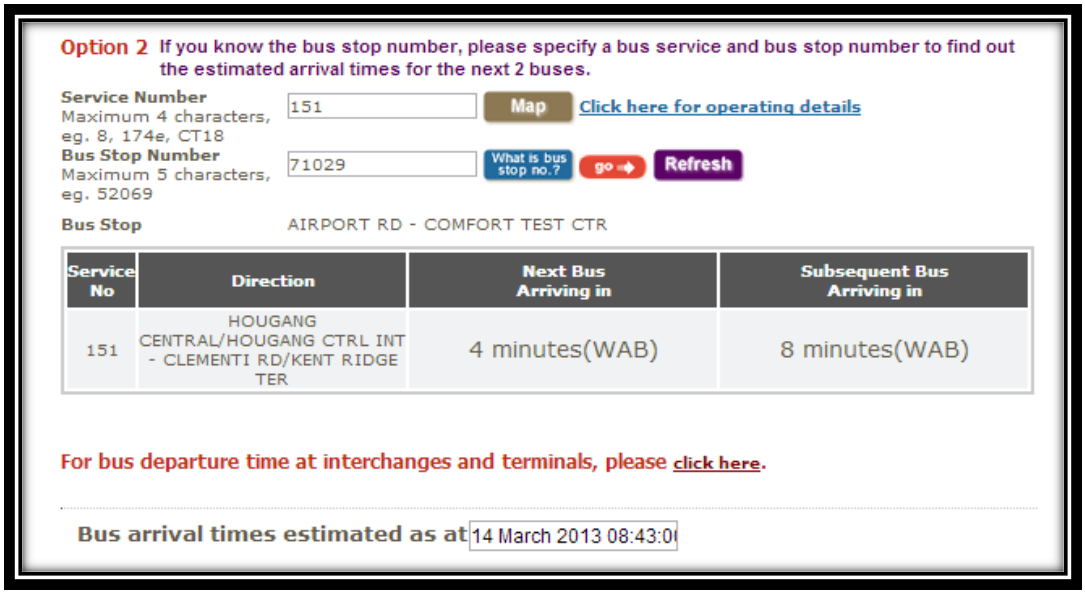

Figure 2.6: Singapore Bus Service Webpage

Singapore Bus Service (SBS) iris NextBus application is a public bus tracking system developed by Singapore bus service operator. Iris is the acronym for Intelligence Route Information System (SBS Transit).This system provided bus traffic information to Singaporeans and travellers. Provided a real time platform to check on bus traffic status and enhance travel experience to users. SBS iris NextBus application is available in two different platforms, which are web page and mobile application. For web page version, there are two options to let user find out the estimated arrival time. First option is let user choose from a list when user do not know about the service number and the bus stop number which show in Figure 2.5. First step, choose service number to query database. Next, choose the direction if there are different direction for the bus service chosen in first step and last step is select the bus stop number which user wish to find out. Finally the web page will refresh and the estimated arrival time is shown. It also showed the subsequent bus arrival time for users.

In Figure 2.6 show the second option to find out the bus arrival time. This option allows users to enter service number and bus stop number directly if the user knows about the bus service and bus top number. Press on "GO" button, the web page will refresh and show the details for the bus service enter by user. Both option results will also show the time for next bus arrival at the bottom side.

The advantage of SBS iris NextBus application is it allows user to manually search for a particular bus route or bus stop arrival time. Users can search for the bus which the user wants only, so it won't confuse users with whole list of bus arrival time that user do not needs to know. This advantage can help user to reduce data loading when requesting for bus traffic data, because it only show the information which the user want to know. Moreover, the system clearly shows every bus stop with bus stop number and location to users so that user able to know which bus stop it is.

Provided mobile application version. User can use mobile device to check on bus arrival time in every way instead of using computer. There are limitation on this system, it is the user has to know the exactly location name, bus stop number and bus route in order to use this system. Because this system is not view in map, so that user has too familiar with the bus route or bus stop number to request for correct bus traffic information from this application. The mobile application version of SBS iris NextBus system will be needed to the proposed system. Nowadays, every people at least will hold one smart phone on hand. Thus, it is better to have mobile application version for an efficient system.

2.2 STUDIES ON TECHNOLOGY INVOLVED

In order to build a system, studies on major technologies are needed. There are Global Positioning System (GPS) and Android mobile application platform. Studies in detailed are stated as following.

2.2.1 GLOBAL POSITIONING SYSTEM (GPS)

GPS is a satellite based navigator system developed by the Department of Defence of USA. Initially is designed to assist coordination of location for military plane and ship worldwide. Today, GPS feature was extended into commercial and scientific field. Commercially, GPS was used for navigation and as a position tool for vehicle, plane and ship (Maggi Glasscoe, 1998). In order to receive GPS data from satellite, a device called GPS receiver is needed. Nowadays, almost every Smartphone in market is embedded with GPS receiver. The GPS Satellites System GPS uses 27 satellites (24 active, 3 are meant for backup) to allocate position request by GPS receiver. The 24 satellites are orbiting the earth about 20,000 km above the Earth. They are constantly moving, making two complete orbits in less than 24 hours. These satellites are traveling at speed of about 7,000 miles per hour. GPS satellites are powered by solar energy. The GPS system also called NAVSTAR, the official name of GPS by U.S. Department of Defence. (GARMIN)The accuracy of position tracking by satellites will affected by certain atmospheric factor, typically a normal GPS receiver receive position accurate are within 15 meters. Nowadays, newer GPS receiver is developed and enhanced to receive position data with accurate level within 3 meters on average.

2.2.1.1 Assisted GPS (A-GPS)

Assisted GPS is a technology to enhance the performance of standard GPS. Typically A-GPS is implemented in devices connected to the cellular network, which is the mobile device or smart phone nowadays. Originally, GPS receiver build-in in smart phone will receive the position data from satellites when the smart phone request for position information. If there is a case inside a city with many building around, the signal transmit from satellites will be reflected by the building before reach the smart phone. Thus, Assisted GPS is developed to overcome this problem. To allow smart phone users to obtain faster position information in their phone, A-GPS acquires information about the location from satellites and stores within the cellular network so that the information does not need to download from satellites when users request it. Beside of directly receive position from satellites, A-GPS uses proximity distance between cellular towers and the requesting smart phone to calculate the position for the smart phone requesting of position information. (Fred Zahradnik

2.2.1.2 GPS Position Measurement.

Latitude and longitude are primary denoted in degrees. However, the increment is expressed as minutes and seconds when less than one degree. It also can convert to decimal for calculation. Latitude lines is measure north and south between the pole, while longitude lines is measure the west and east position .For example, the latitude and longitude position of Kampar McDonald would be 4 º 19' 34.5972" N, 101 º 8 ' 40.7544" W. It can be read as latitude 4 degree 19 minutes 34.5972 seconds, longitude 101 degree 8 minutes 40.7544 seconds. It can also convert to decimal, latitude 4.326277407216858 and longitude 101.14465355873108 (data taken from: http://locates.com.au/gps.html)

In bus tracking system, bus positioning module will install in a smart phone with GPS feature. This module will active GPS receiver in the smart phone and continuously receive the position data from satellite system by the GPS receiver and send to central server with interval 2 seconds.

2.2.2 MOBILE APPLICATION PLATFORM - ANDROID OPERATING SYSTEM

Android is a Linux based operating system developed by Google. Typically, Android was designed primarily for touch screen mobile devices such as smart phone and tablet. Nowadays, Android was developed until version 4.2. It also called Jelly Bean. According to a smart phone usage statistics done by an author named Anson Alexander, Android has to highest market share in year 2012 (Anson Alexander, 2012). There are some reason why Android is better then iOS is stated into a list in as follow (Simon Hill, 2013).

1. Multiple devices - Android operating system is applicable for variety of smart phone such as Samsung, HTC and Sony.
2. Multiple price points - Because of multiple devices are supporting Android operating system, variety of model is available in market from low price to higher price. So that, user can buys an Android phone according budget.
3. Customization - Android is always allowed user to have customization on Android platform smart phone while iOS phone want to keep control from customization by user.
4. Integrated with Google services - Android phone is integrated with some Google services such as Google Map, Google mail, Google Drive and so on.

There is another statistics shown that how smart phone user used their smart phone in daily life (Anson Alexander, 2013). The statistics showed that 72% of smart phone users are using their smart phone for map and it is the second higher. This number showing that most smart phone users are using their smart phone to allocated their position or showing the direction to a destination. People tend to use smart phone instead of pure GPS devices for position allocation, this is because today smart phone is embedded with GPS feature (James Kendrick, 2011).

In term of development for GPS application in Android operating system platform, Google was provided very convenient tools for developers to develop application with GPS feature (Android Developers, n.d.). Developer can easily customize the GPS feature according to their needs. Besides, Google is also provided Google Map for developers. Once Google Map is plugged into application, user can easily retrieve map in anywhere over the world. In bus tracking system, Android has been chosen for mobile application version of the system. This is because of the advantages provided by Android stated above.

Firstly, Android is applicable for multiple devices and also with wide range of prices for different model and specification of phone. With this point, it can say that every person is able to own an Android phone. Additionally, most Android smart phone model available in market is embedded with GPS feature. Furthermore, GPS feature can easily created by developer because of useful tools provided by Google. Therefore, Android platform is chosen for the mobile application version of the proposed system.

CHAPTER 3

METHODOLOGY

The methodology chosen must be suitable for the development of the system as the methodology will step-by-step guide developer and developer must follow in order to develop and deliver the system successfully. In this chapter, chosen methodology will be discussed in the development of the Real Time Bus Tracking Application System.

3.1 CHOSEN METHODOLOGY

After studies on suitable methodologies, prototype development methodology is chosen. The reason in choosing this methodology is because of the advantages provided by this methodology will assist the development of proposed system to success path. The main reason to choose prototyping is because the proposed system will involve more user interaction in order to acquire more user feedbacks and able to produce a successful system under user expectations. In development processes of Real Time Bus Tracking System, there are many uncertainly existed. In the bus tracking process, there would be many errors or unexpected results occur and this will affect the accuracy of estimated bus arrival time for users. In Users perspective, the accuracy of estimated arrival time will determine the success of the system. Therefore, prototyping approach is suitable to test on acceptation of final system from users.

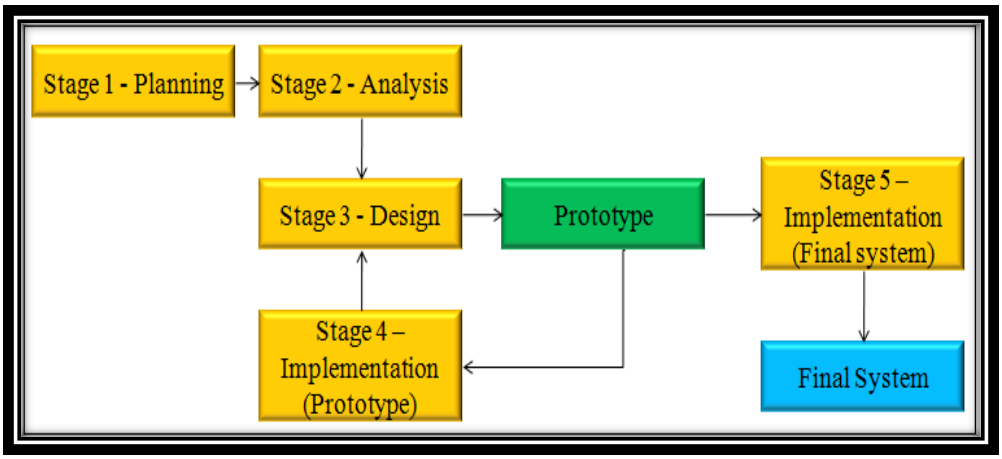

Figure 3.1 : Method Block Diagram

3.2 APPLICATION OF CHOSEN METHODOLOGY

There are 4 stages in prototyping development methodology which are planning, analysis, design and final system implementation. Every stages are discussed in detailed in this section.

3.2.1 STAGE 1 - PLANNING

Planning has been done in first stage. After discussion with project supervisor, the name for proposed project "Real Time Bus Tracking System" is produced. After confirmation of project title, studies on existing bus tracking system are performed. Unfortunately, there is only one University in Malaysia provided bus tracking system on shuttle bus service. So, studies on existing system are performed on few foreign countries and Universities. The fundamental of proposed system was clearly verified after studies performed on existing system. Based on studies performed on existing system, some common problems were found and problem statements were generated.

The estimated bus arrival time is very important to determine the performance of bus service.

Bus user have to know what is the exactly time the bus will arrive on bus stop. Provided real time bus tracking in map view instead of just showing timetable to user. Based on the studies, we can say that graphically view on bus tracking systems is one of the main expectations from user. By showing bus position is a map, user can know where exactly the bus now and how far or how long the bus will arrive. Scope of the project was done in planning stage too. However, there is a problem within the project scope. Because of the proposed project is focused on a certain bus. So, the map was maybe circulated to a smaller area.

Since we can use Google maps, so not much of problem will occur. Based on problem statements, objective of proposed system had been clarified. It is to design an application to help the users track and see their bus available. Finally, the final project scope was identified to meet the project objectives and overcome the problems on problem statements.

3.2.2 STAGE 2 - ANALYSIS

In this stage, analyses on existing systems have been made. Few bus tracking systems available had been studied and the main system requirements had been founded. User want to know where is the position of the bus before arrive and showing bus position in a map is more meaningful instead of just showing estimated arrival time. Besides, observation on current bus system has been made. Users only know about the scheduled arrival time but somehow the bus is not arrived on time. Users would feel impatient while waiting at bus stop. Thus, functional and non-functional requirements are gathered from observation and interview. Next, literature reviews in term of technologies, suitable programming language, platforms and methodologies are made.

This is done to ensure that the proposed system delivered matches the user's requirements and expectations.

A study on technology needed is to know how the technology work and make use of it in proposed system. Study on suitable programming language and different platforms are important to ensure that the programming language is sufficient to build the proposed system and how to integrate different modules with different platforms into a meaningful system to provide useful information to user. Finally, study on suitable methodology is to understand more about the chosen methodology in aiding the proposed system development processes.

3.2.3 STAGE 3 - DESIGN

The development of proposed system is begun and functional system has to be developed in this stage. In prototyping methodology, this design stage will be the prototyping loop point and the first prototype is developed in the first loop. After the first prototype has been evaluated by user and came out with new requirements, development process will loop back to this stage. Redesign and rebuild the second prototype. In the first prototype design process, prototype is developed based on the main requirements acquired at stage 2. Prototyping is only focus on functionality of system instead of focus on user interface. Thus, prototype is build with simple interface and more effort will put on functions and features modules of the system. The next step would be the design of database; the Entity Relationship Diagram (ERD) must be design so that the entities can be extracted. Primary key and foreign key of each table should be assigned in order to draft out the relationship for every table in database. So that we can know that which data is needed to be process and which data should be shown to the user. Besides, normalization must be performed in order to create a smooth and efficiency database.

A test plan for first prototype must be designed so that testing can be done once the first prototype is developed. In prototyping model, test plan is create based on

different prototype. This is because new version prototype will have new requirements and the first test plan will be specifically tested on first prototype requirements.

3.2.4 STAGE 4 - IMPLEMENTATION

This stage is executed when the prototype is accepted by users. When the latest version of prototype is satisfied user requirements, development process will jump out from prototyping loop. The final system will then developed based on the accepted prototype. The accepted prototype will became the fundamental of final system and the user interface of final system will be enhanced. Functionalities in the accepted prototype will fully apply into final system. After final system is developed, final testing will be performed. Go through the final testing, the final system is ready to deploy and implement into real operating environment. Finally, the whole processes of development must be documented so that the system can be easily maintained in future

3.3 HARDWARE AND SOFTWARE

3.3.1 HARDWARE

The hardware used in this project is Arduino Nano V3.0 , Wi-Fi Module (ESP8266) and a GPS Module **(GY-NEO6Mv2).**

3.3.1.1 Arduino Nano V3.0

It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one.The Arduino Nano can be powered via the Mini-B USB connection, 6-20V unregulated external power supply (pin 30), or 5V regulated external power supply (pin 27). The power source is automatically selected to the highest voltage source.

Figure 3.2 : Arduino Nano V3.0

3.3.1.2 GPS Module (GY-NEO6Mv2)

The NEO-6 module series is a family of stand-alone GPS receivers featuring the high performance u-blox 6 positioning engine. These flexible and cost effective receivers offer numerous connectivity options. Innovative design and technology suppresses jamming sources and mitigates multipath effects, giving NEO-6 GPS receivers excellent navigation performance even in the most challenging environments

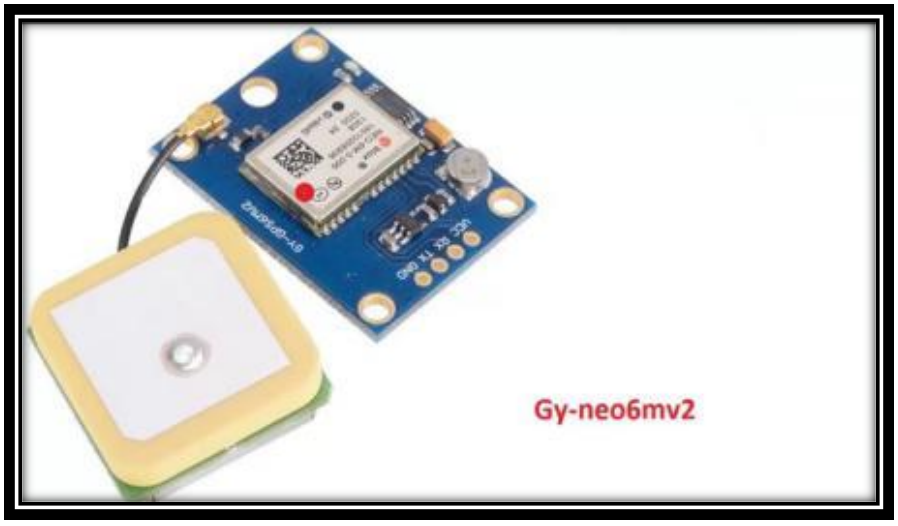

Figure 3.3: GPS Module

3.3.1.3 WIFI Module (ESP8266)

The ESP8266 Wi-Fi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime.

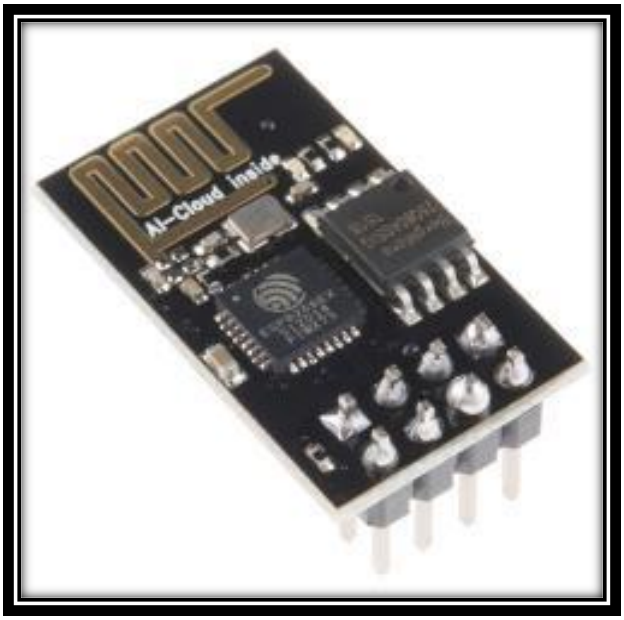

Figure 3.4: Wi-Fi Module

3.3.2 SOFTWARE

Two type of software's used in our Real Time Bus Tracking System are -

- Blynk Server
- MIT App Inverter 2

3.3.2.1 BLYNK Server

Blynk is a Platform with iOS and Android apps to control Arduino, Raspberry Pi and the likes over the Internet.It's a digital dashboard where you can build a graphic interface for your project by simply dragging and dropping widgets.

Blynk is not tied to some specific board or shield. Instead, it's supporting hardware of your choice. Whether your Arduino or Raspberry Pi is linked to the Internet over Wi-Fi, Ethernet or this new ESP8266 chip, Blynk will get you online and ready for the app.

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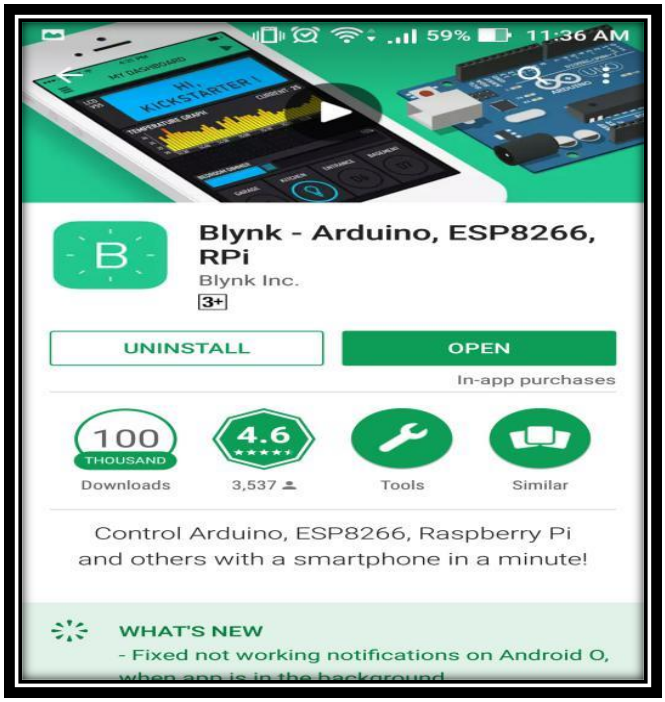

Figure 3.5: Blynk Server app

After the blynk application is downloaded .The new account will be created. After that, the server will be activated and linked with the GPS tracker device. After a few setup in the BLYNK application .The value of the latitude and longitude will be display on the application, as the GPS tracker device moves around the value of the latitude and longitude will be changed according to the location.

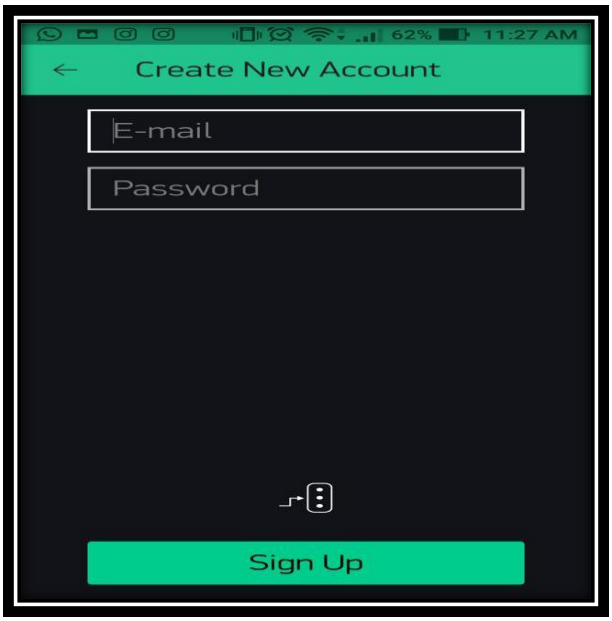

Figure 3.6: Blynk Server Layout 1

Figure 3.6 shows the application was selected and it will show 'create a new account'. After the account created, we can access the BLYNK server.

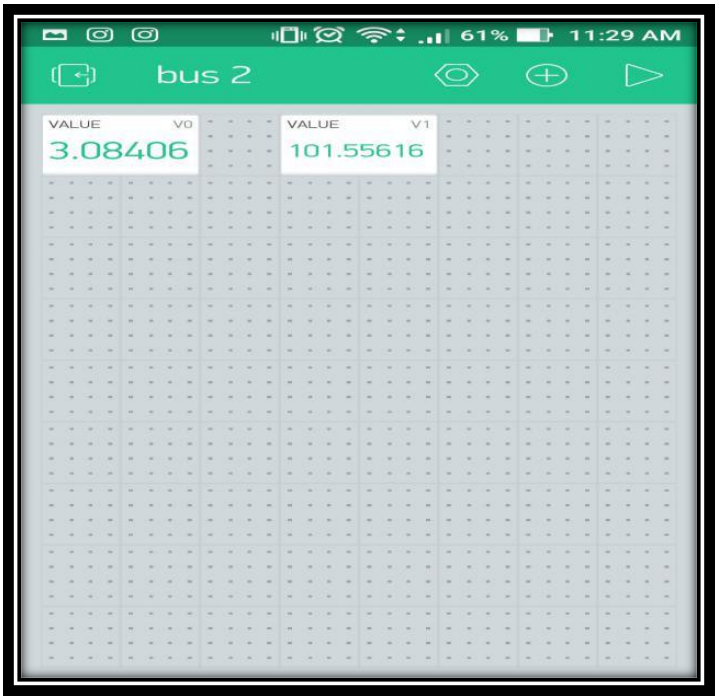

Figure 3.7: Blynk Server Layout 2

The Figure 3.7 show the Latitude and Longitude value entered. The value v0 will show the latitude value and the value V1 will shows the value of longitude.

3.3.2.2 MIT APP INVENTOR 2

Figure 3.8: MIT Inverter App

Figure 3.8 shows the software that we use to develop a basic application for the real time bus tracking system

Figure 3.9: Database of MIT Inverter App

Figure 3.9 shows the application database. The application database will be in block. This Block diagram don't have a long coding. Drag and Drop the block to create program.

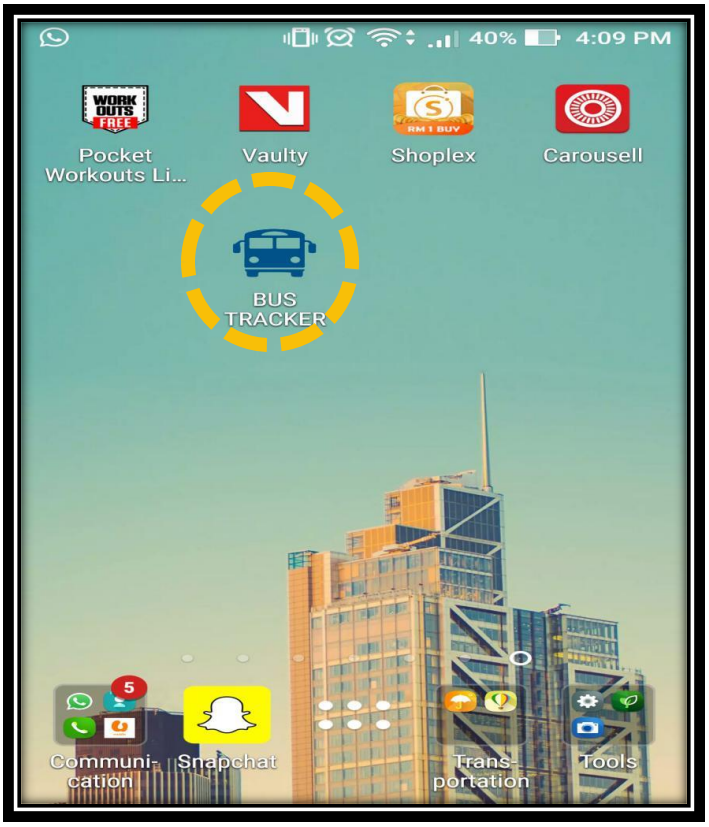

Figure 3.10: Bus Tracker Icon

The figure 3.10 above shows the icon of the real time bus application System. The application still in an apk.file format. The application in process to publish in The GOOGLE PLAY STORE.

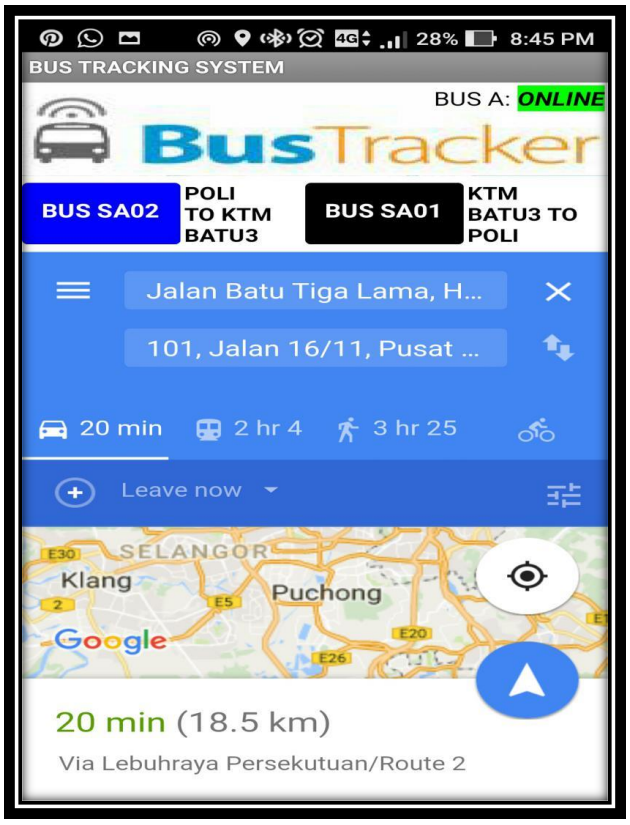

Figure 3.11: Bus Tracking App Layout

In figure 3.11 shows the basic application which was developed using the Mit app inventor 2.The application has a basic layout which shows the bus number and the map was linked with the GOOGLE MAPS. The application will show the distance and the time arrival. This feature works due to the application was linked with the Google Maps. As the bus coming to the application user location, the time arrival and the distance will be reduced.

3.4 CIRCUIT

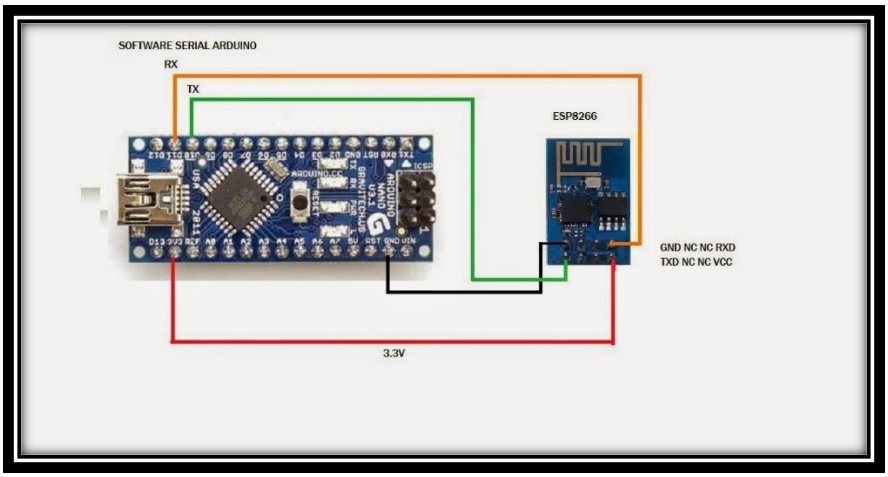

Figure 3.12: Circuit of Arduino and Wifi Module

3.4.1 CIRCUIT EXPLAINATION

Here Tx pin of GPS module is directly connected to digital pin number 10 of Arduino. By using Software Serial Library here, we have allowed serial communication on pin 10 and 11, and made them Rx and Tx respectively and left the Rx pin of GPS Module open. By default Pin 0 and 1 of Arduino are used for serial communication but by using Software Serial library, we can allow serial communication on other digital pins of the Arduino. 12 Volt adaptor is used to power the GPS Module. Wi-Fi module ESP8266**'s** Vcc and GND pins are directly connected to 3.3V and GND of Arduino and CH_PD is also connected with 3.3V. Tx and Rx pins of ESP8266 are directly connected to pin 2 and 3 of Arduino. Software Serial Library is also used here to allow serial communication on pin 2 and 3 of Arduino.

3.4.2 BLOCK DIAGRAM

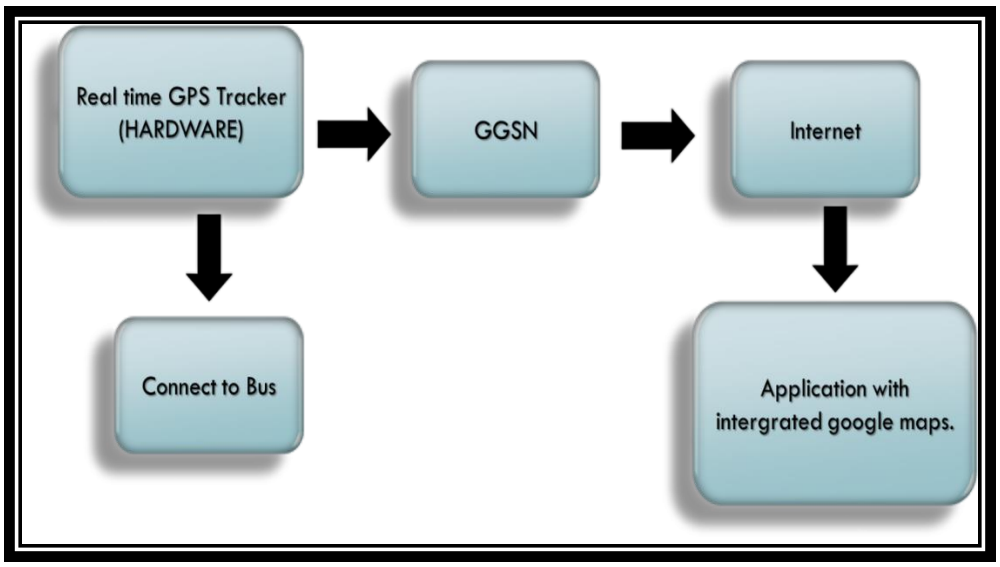

Figure 3.13: Block Diagram of System

This is the proposed block diagram where we can see the Real time GPS Tracker is placed on the bus. This GPS will be connected to the bus and it's WIFI. Then through the Gateway GPRS System Network will fetch the position of the bus. The GGSN is server. This is shown on our application integrated with Google Maps which is connected to a WIFI or Internet connection.

3.4.3 FLOWCHART

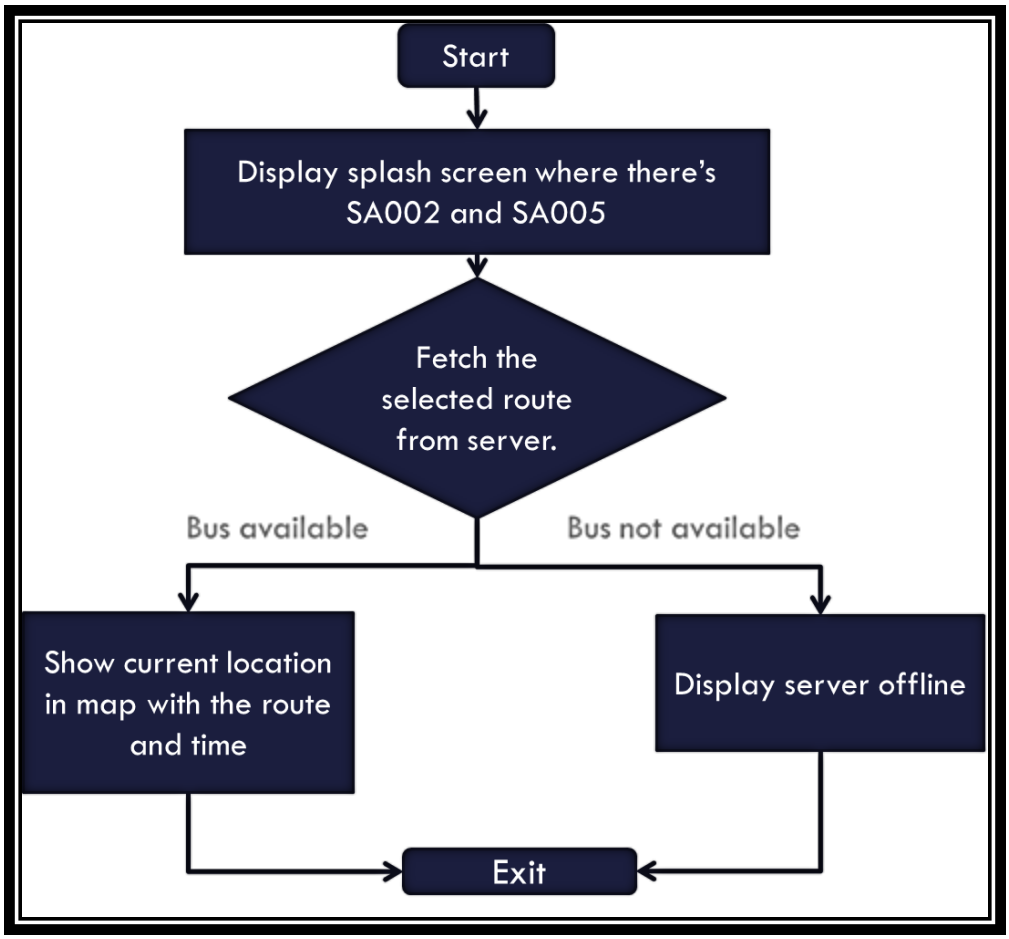

Figure 3.14: Flowchart of the bus apps

As you can see, this is how the application will function. At first when the app is started, the splash screen appears and the homepage is loaded. Then it will fetch the selected bus route from the server. If the bus is available then the app will show the current location on the map together with the estimated time of arrival. If the bus is not available, then it will display not valid bus. After using the app, when user closes the app, it is exited. And the process starts again when the app is opened again.

CHAPTER 4

RESULTS

4.1 Results of simulation

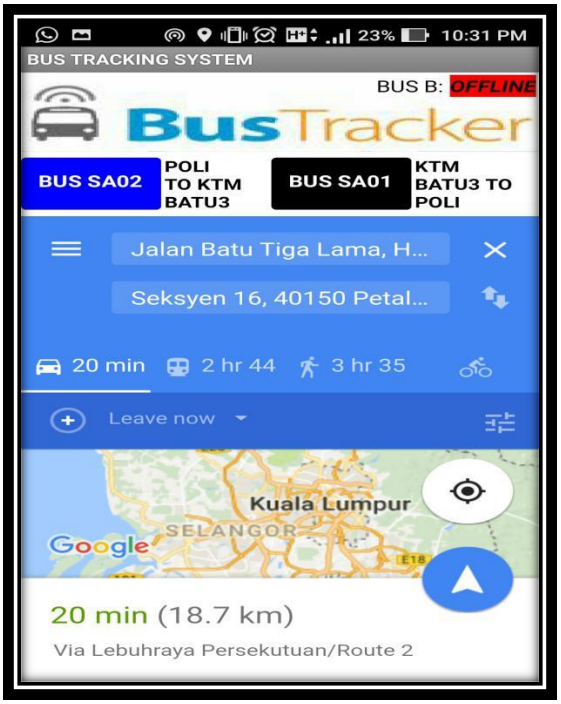

Figure 4.1: App Layout

What we expect for our results is the design of the application which has a friendly user interface. And as stated in our project proposal which is to link that application to Google Maps in order to show the accurate timing of the awaited bus. User can now be able to download it from the Google Play Store to get the fully functional app. The applicaton will also be able to show the routes and where the bus will be heading or how long would it take to arrive.

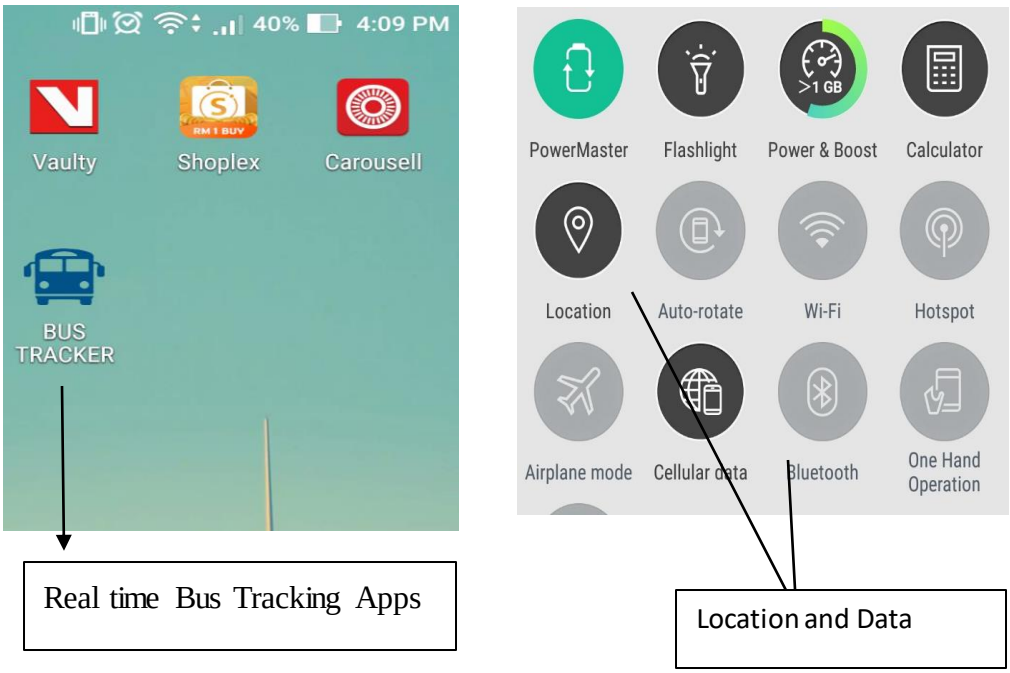

Figure 4.2 Apps Simulation

The figure 4.2 above shows the simulation of the bus tracking application system works on a smartphone. The application was installed in smartphone from the Google Play Store. After the application was installed we can see the application icon on the home screen. Before the application is opened, the data and the GPS location on the smartphone should open.

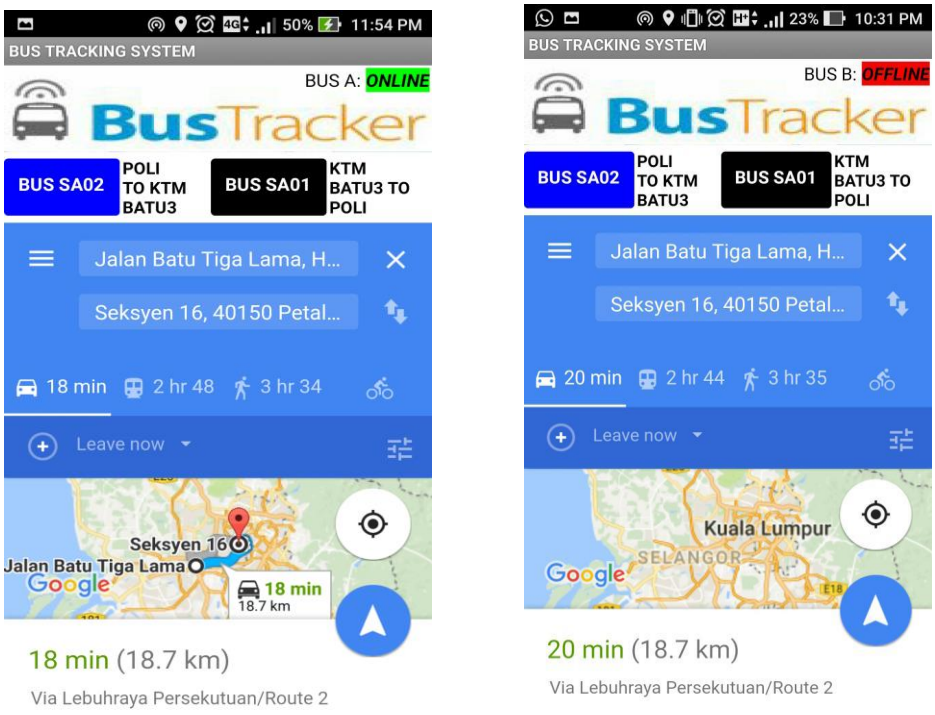

Figure 4.3: Apps Simulation

Figure above shows the real time bus tracking application system. After the application was opened, the Google map will pop out. The two bus name will displays above the Google maps. When the GPS device was connected to the Wi-fi in the bus .When the bus route is online, the application will show a status online or offline. If the bus route is online it will show online .If the bus route offline it will show offline above the application.

CHAPTER 5

ANALYSIS AND DISCUSSION

5.1 ANALYSIS AND DISCUSSION

Based on testing the real time bus tracker system it will be show the signal transmit and receive from the GPS satellite .This testing was done by 2 parts which is indoor and outdoor.The bus tracker device will get a high GPS signal when it placed in out door while low signal indoor.

5.1.1 Analysis problem

- No supply power in the real time bus tracker device.
- Low signal strength of GPS module in the real time tracker.
- HTTP connection is slow
- Bad weather condition make the GPS tracker loss connection.

5.2 LAYOUT DESIGN

5.2.1 SYSTEM DESIGN

System design is one of the most important things that developer has to do before develop a system. A good system design may give a good startup and able to cope with system requirements. In this chapter, system design would be introduced. System and Application design of the system will be explained. Based on the figure below, this real time bus tracker device is integrated with new trend technology such as wifi module ESP8266, Arduino Nano and Global Positioning System (GPS) module .

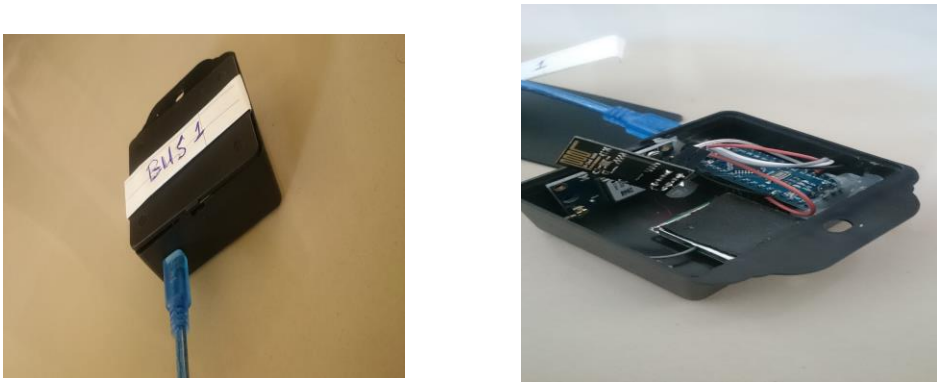

Figure 5.1: GPS Device

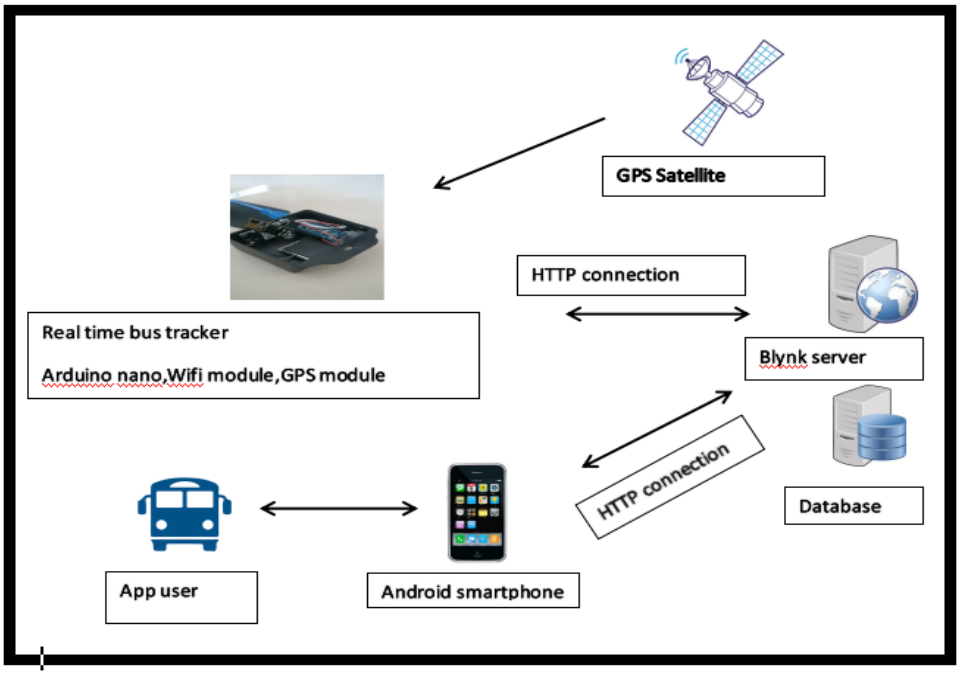

Figure 5.2 :System Design

The GPS device has Arduino Nano, GPS Module and WIFI Module (ESP8266).It receive signals of latitude and longitude from sattelite and the gps antenna from GPS Module will send the location through Arduino board. Then the information will be sent to the server through the WiFi Module and the information is displayed on our bus app.

5.2.2APPLICATION DESIGN

The interface design of the application mustbe simple as possible so that the bus user able to get information easily.The interface design of the application must be consistency so that the bus user able to remember where are the position of important information is and no need to relearn the application

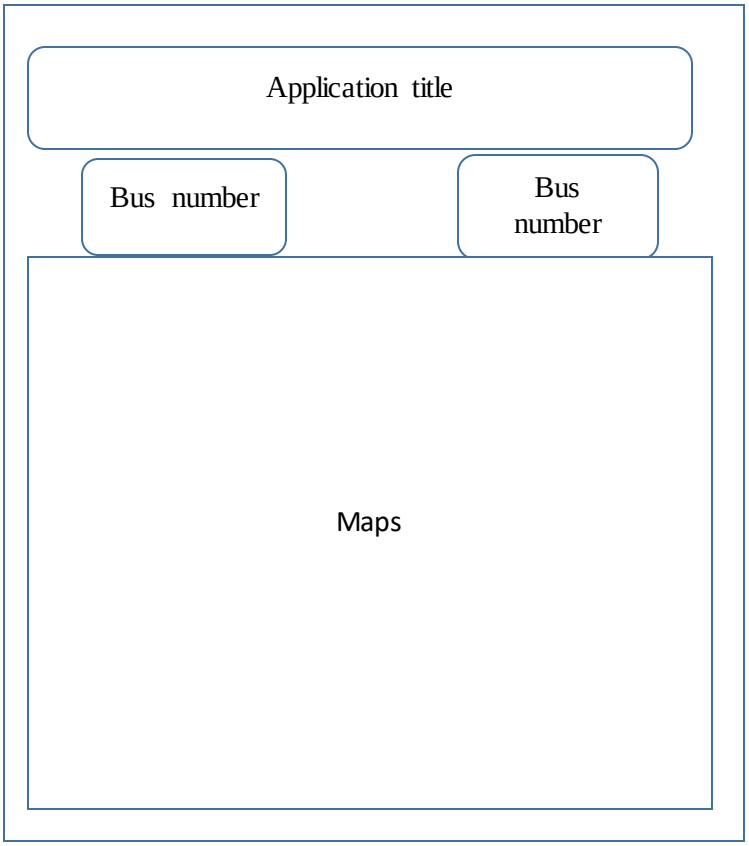

Figure 5.3 Apps Layout

5.3 TESTING AND TROUBLESHOOTING

The real time bus tracking system is impletmented using the software platforms and tools introduced in previous section.The application successfully installed on Android smartphones.The Blynk server is setup o Internet to simulate the transit control center where the database is hosted. PRE- testing once the application was on the Blynk server start to receive data from the GPS device and send it the the application.The bus user applicationMust enable the Gps receiver on the phone to retrieve the current location and the distance ,time arrival of the bus.

There were some problem that we facing for the application system.The Map size was to small and the location of the bus was not accurate. We troubleshoot the application system and find out there are some errors in the coding of the application.

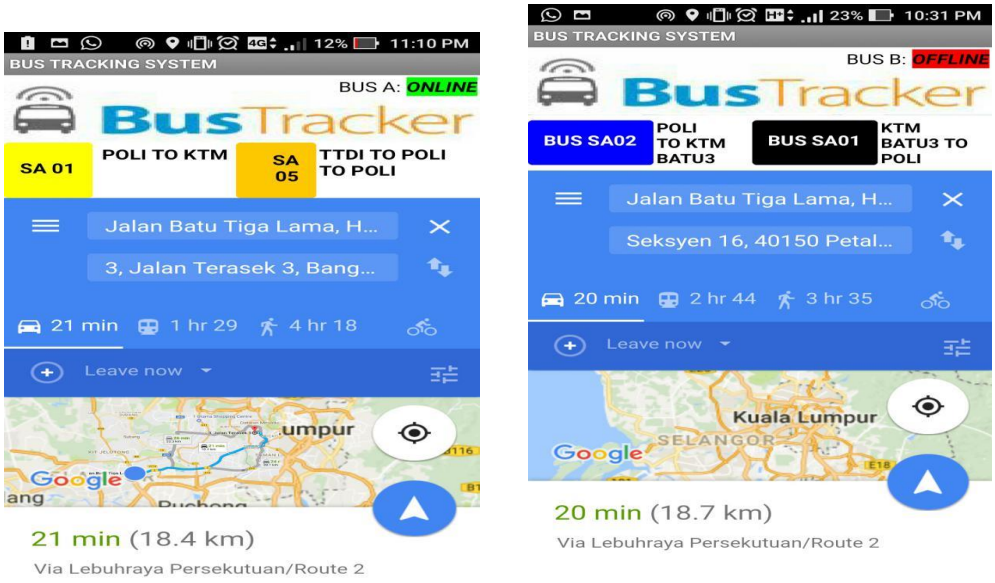

Figure 5.4 : Real time bus tracking app.

5.4 DATA QUESTIONNAIRE

Section A

QUESTION 1

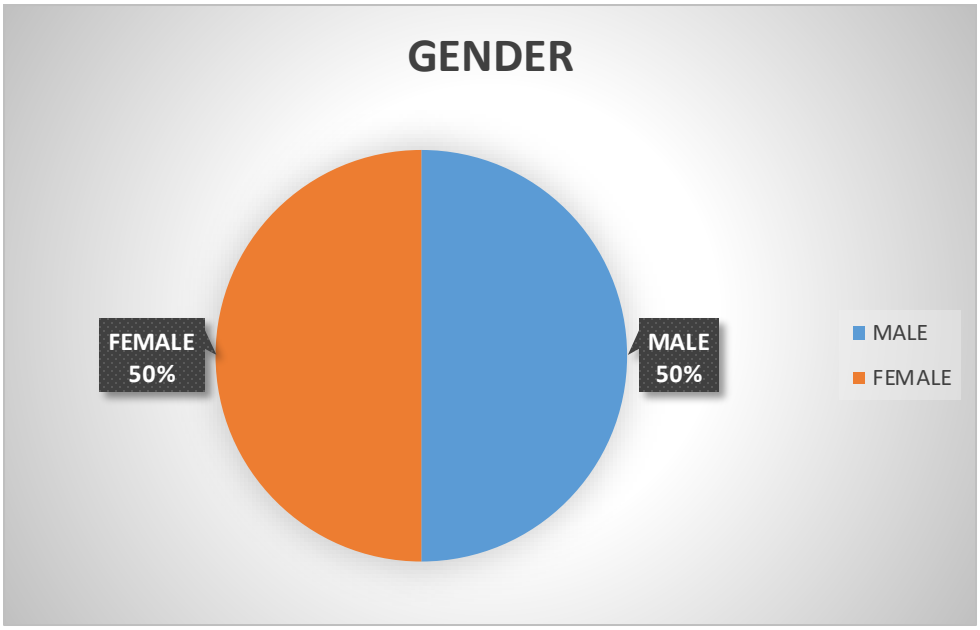

Figure 5.5. : Pie chart of Gender

The diagram above shows 50 respondents from Politeknik Shah Alam who have given their response. According to the pie chart above, the gender of respondents consist of male and female, which is 50% of male (25 peoples) and 50% of female (25 peoples).

QUESTION 2

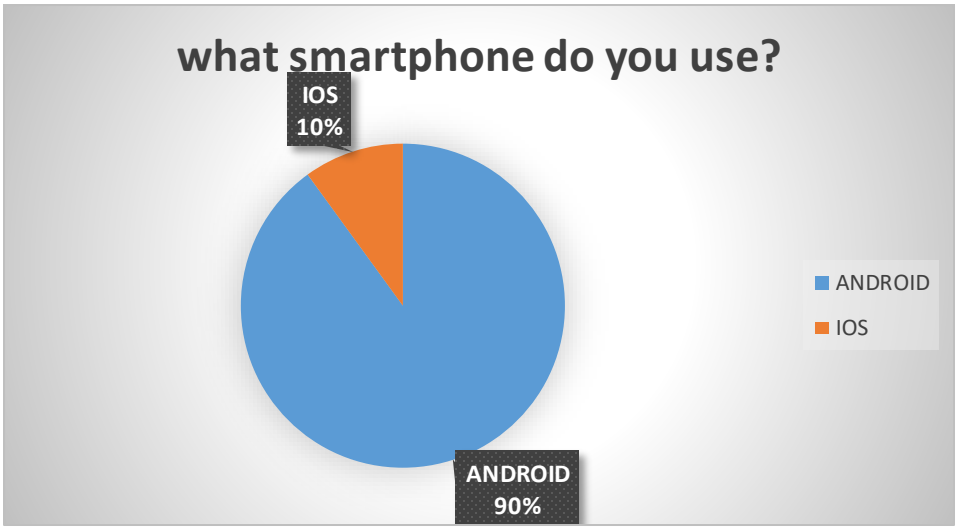

Figure 5.6: Pie chart of Gender

The diagram above shows 50 respondents from Politeknik Shah Alam who have given their response According to the pie chart above, the smartphone of respondents consist of ios and android. The number of male respondent are 90% (45 person) and female are 10%(5 person). From this pie chart we can conclude that most of the respondents using android phones which they able to use this app.

QUESTION 3

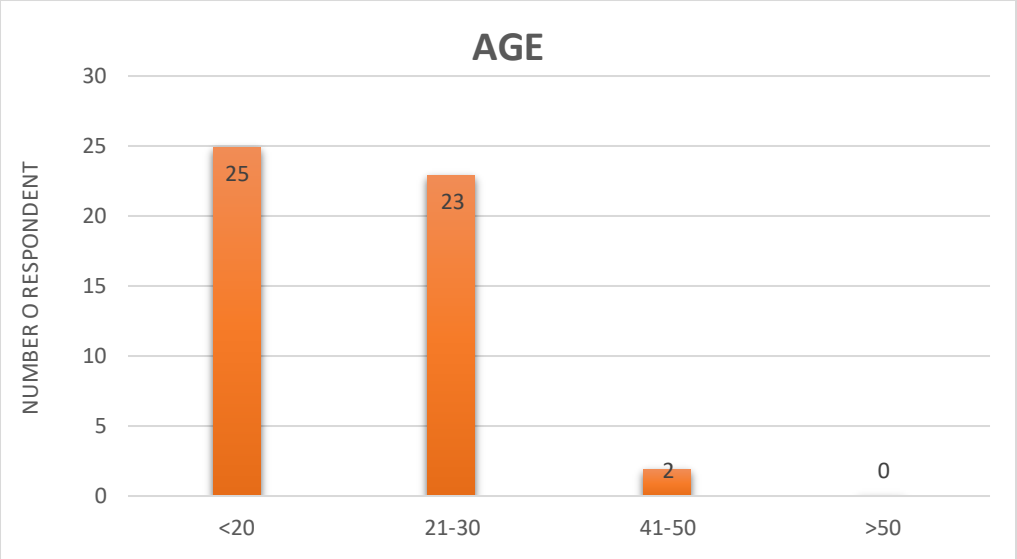

Figure 5.7 : Bar graph of age group

The diagram above shows 50 respondents from Politeknik Shah Alam who have given their response The diagram above shows the age group of respondents consists of 4 groups. That are <20, 21-30, 41-50 and >55 above. Group <20 ages are 25 respondents which is 50% of the respondents, 23respondents comes from group 21-30 which is 46% while for group 41-50 consists of 2 respondents only.

QUESTION 4

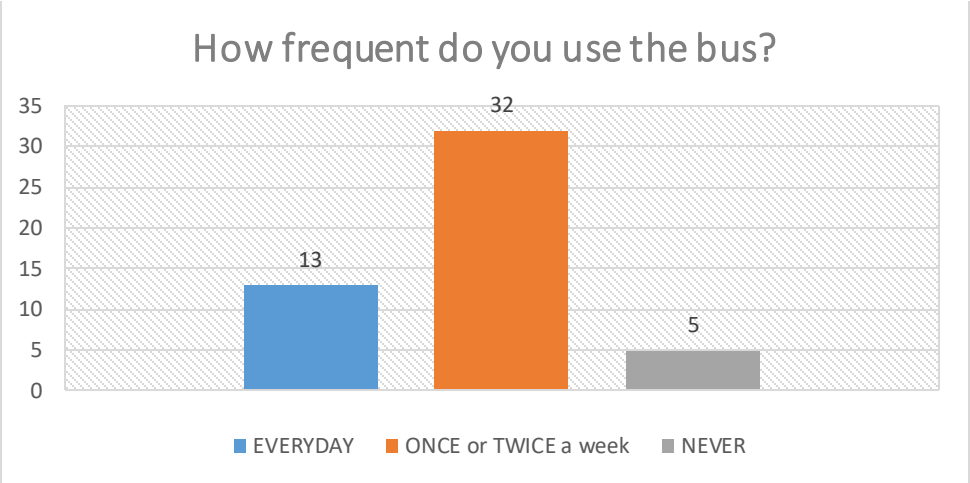

Figure 5.8 : Bar graph of frequent bus users

The diagram above shows 50 respondents from Politeknik Shah Alam who have given their response The diagram above shows "how frequent do you use the bus", group of respondents consists of 3groups. That are everyday, once or twice a week and never. For group everday are 13 respondents which is 26% of the respondents, 32 respondents comes from group once or twice a week which is 64% while for group never consists of 5 respondents only. From this we can conclude that most of the respondents using bus once or twice a week.

Section B

QUESTION 1

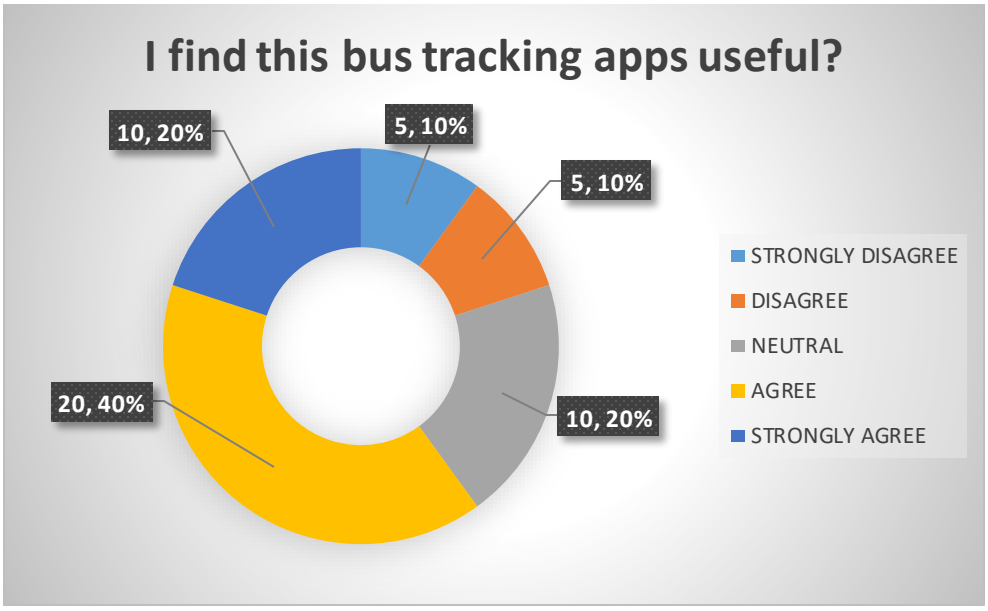

Figure 5.9 : Pie chart of apps usefulness

The diagram above shows 50 respondents from Politeknik Shah Alam who have given their response by strongly disagree, disagree, neutral, agree and strongly agree to the survey about the statement that states "I find this Bus Tracking Apps useful." Among 50 respondent, 5 of them is strongly disagreed to this statement and 5 of them disagreed to this statement. 10 of them respondents neutral about the statement that state. The number of respondents who agreed with the statement are 20 of them and the pie chart above clearly shows that only 10 respondent among 50 respondent strongly agreed with this statement. From this pie chart we can conclude that most of the agree that this app is useful.

QUESTION 2

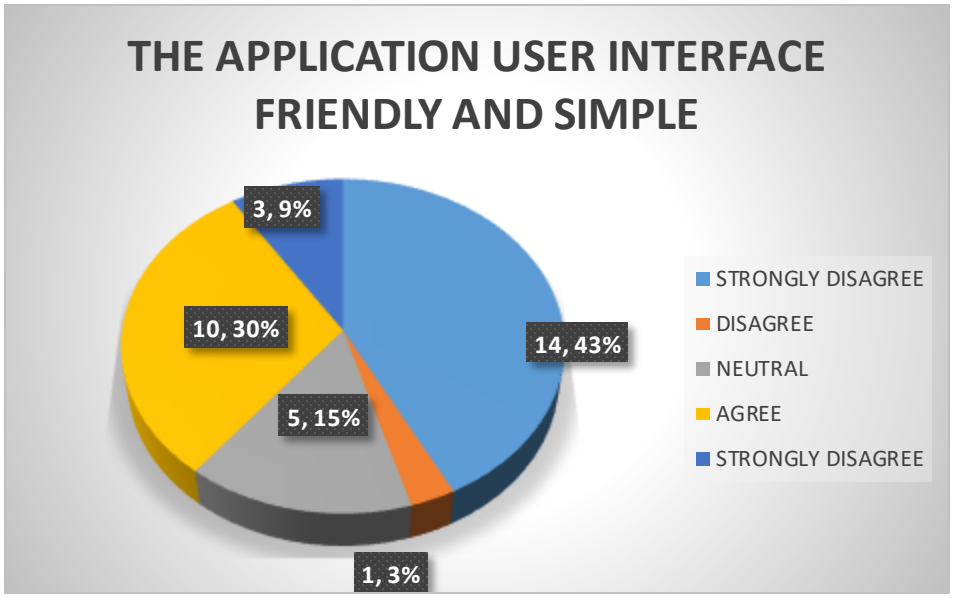

Figure 5.10 : Pie chart of interface of apps

The diagram above shows 50 respondents from POLITEKNIK SHAH ALAM who have given their response by strongly disagree, disagree, neutral, agree and strongly agree to the survey about the statement that states "The application user interface friendly and simple." 14 of them is strongly disagreed the statement and 1 of them disagreed that "The application user interface friendly and simple". Among 50 respondent, 5 of them response neutral about this statement. The number of respondent who agreed with the statement are 10 of them and the pie chart above clearly shows that only 20 respondent among 50 respondent strongly agreed that "The application user interface friendly and simple".

QUESTION 3

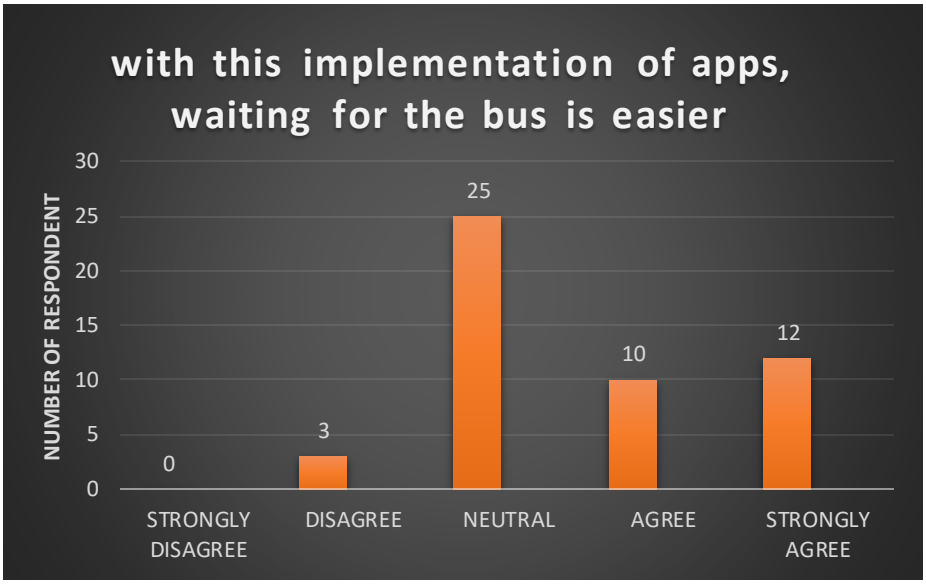

Figure 5.11 : Bar graph of apps implementation

The diagram above shows 50 respondents from POLITEKNIK SHAH ALAM who have given their response by strongly disagree, disagree, neutral, agree and strongly agree to the survey about the statement that states "with this implementation of apps, waiting for the bus is easier". Among 50 respondent, no one is strongly disagreed the statement and 3 of them disagreed that "with this implementation of apps, waiting for the bus is easier". 25 of them response neutral about the statement that states. The number of respondent who agreed with the statement are 10 of them and the bar graph above clearly shows that 12 respondent among 50 respondent strongly agreed to this statement. From this bar chart we can conclude that most of the respondents response neutral because this application user interface friendly and simple.

QUESTION 4

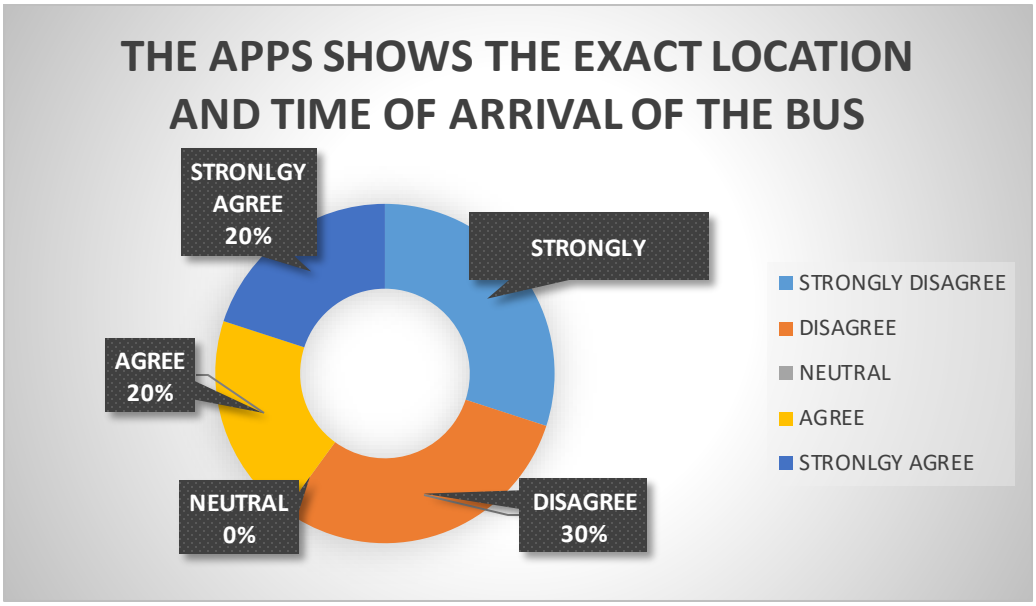

Figure 5.12: Pie chart of accuracy of apps

The diagram above shows 50 respondents from POLITEKNIK SHAH ALAM who have given their response by strongly disagree, disagree, neutral, agree and strongly agree to the survey about the statement that states "the apps shows the exact location and time of arrival of the bus." The percentage of the respondents who strongly disagreed to the statement is 30% and 30% of them disagreed to this statement. The percentage of respondent who agreed with the statement are 20% of them and the pie graph above clearly shows that 20% respondents among 50 respondent strongly agreed to this statement. From this we can conclude that most of them disagree with this statement because this app not showing accurate location of the bus.

QUESTION 5

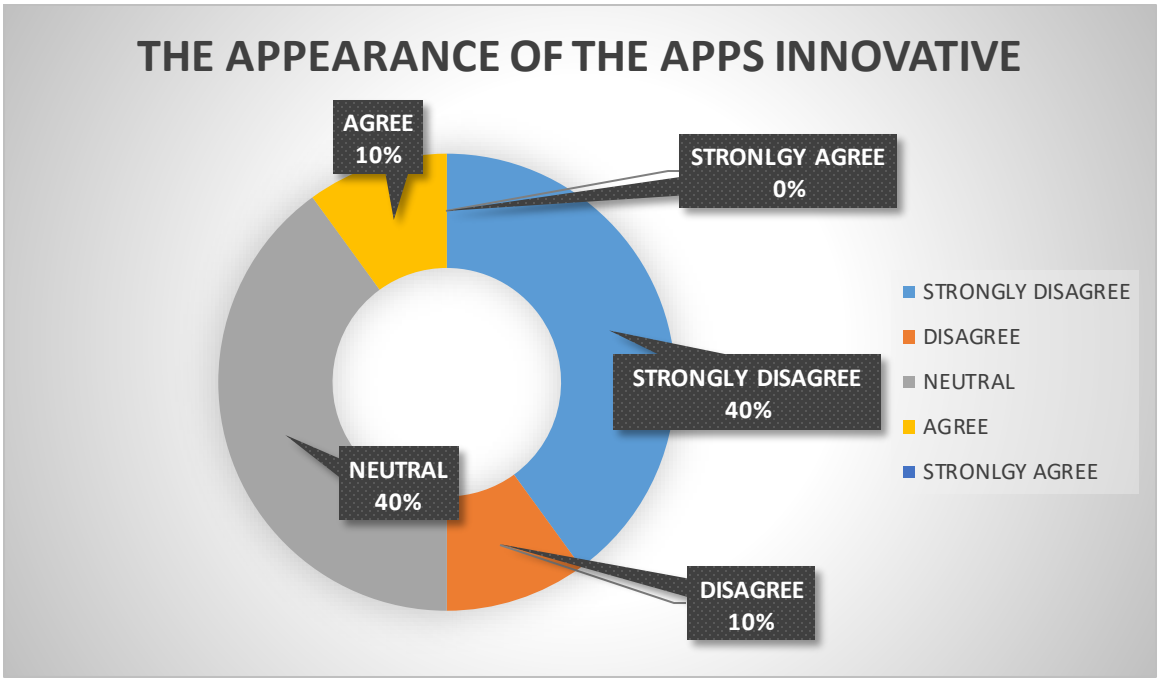

Figure 5.13 : Pie chart of apps innovation

The diagram above shows 50 respondents from POLITEKNIK SHAH ALAM who have given their response by strongly disagree, disagree, neutral, agree and strongly agree to the survey about the statement that states "the appearance of the apps innovative." The percentage of the respondents who strongly disagreed to the statement is 40% and 10% of them disagreed to this statement. The percentage of the respondents who choose neutral are 40%. The percentage of respondent who agreed with the statement are 10% of them and the pie graph above clearly shows that 0% respondent among 50 respondent strongly agreed. From this chart we can conclude that most of the respondent didn't find the appearance of this app is less innovative.

QUESTION 6

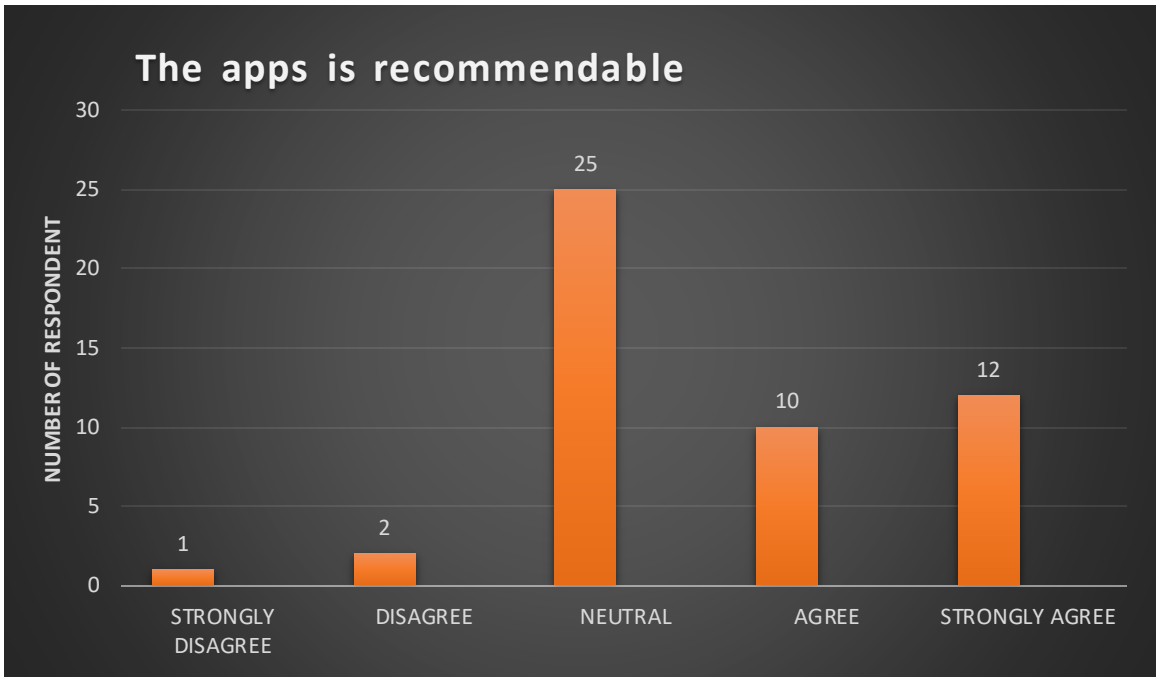

Figure 5.14 : Bar graph of Apps rate

The diagram above shows 50 respondents from POLITEKNIK SHAH ALAM who have given their response by strongly disagree, disagree, neutral, agree and strongly agree to the survey about the statement that states "this app is recommendable." The percentage of the respondents who strongly disagreed to the statement is 2% and 4% of them disagreed to this statement. The percentage of the respondents who choose neutral are 50%. The percentage of respondent who agreed with the statement are 20% of them and the pie graph above clearly shows that 24% respondent among 50 respondent strongly agreed. From this chart we can conclude that most of the respondents response neutral , this is because this app is useful for future and bus users.

5.5 ESTIMATION COST

Table below shown as total cost from bill of material has been listed and calculated. The item that we used in real time tracking application device also listed on this table. Our budget is around RM 700 but the total cost that used by us for fulfilled real time application is RM 227.80 for one device. Since we did two device so it cost RM 455.60, for the extra balanced of money was used for transportation and preparation Electrical Electronic Engineering Innovation Competition (EEEIC) 2017.

Hardware	Price of per unit
WIFI MODULE (ESP8266)	**RM 30.50**
GPS MODULE	**RM 109.90**
ARDUINO NANO	**RM 35.40**
CASING	**RM 50**
CONNECTING WIRE (3METERS)	**RM 3**
	TOTAL : RM 227.80

Table 5.1: Estimated cost

CHAPTER 6

CONCLUSION

While waiting for a bus, people may felt impatient and anxious if he or she does not know when the bus will arrive. For the bus management side, it is very difficult to provide an accurate schedule for bus user due to some uncertainties may happen on the road such as traffic jam or bus break down. When a bus is delayed, bus management side should inform bus user immediately. However, they do not have a platform to inform bus user in real time about the latest bus traffic status. In order to enhance bus system and increase the performance of bus service provider, the bus tracking system is needed. Bus tracking system provided a real time platform for bus user to check on bus traffic status in anytime and anywhere. It also provided a platform for bus service provider to monitor bus status and update latest information to user.

6.1 FUTURE ENHANCEMENT

The estimated bus arrival time is based on the average of arrival time in every bus stop in current version of system and it is not the most accurate estimated time. Because the current system does not consider about unexpected situation happened on the road such as traffic status and bus users boarding status. In future, the system will enhance to provide more accurate estimated arrival time to user. There are many other enhancements for the proposed system, one of the important enhancement would be create an artificial intelligence program to automatically study and analysis bus route data to provide most optimum estimate arrival time. By applying artificial intelligence program, the system will become more valuable because of the accuracy of estimation on arrival time.

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APPENDICES

APPENDIX A

Figure 8.1: EEEIC Competition Participants

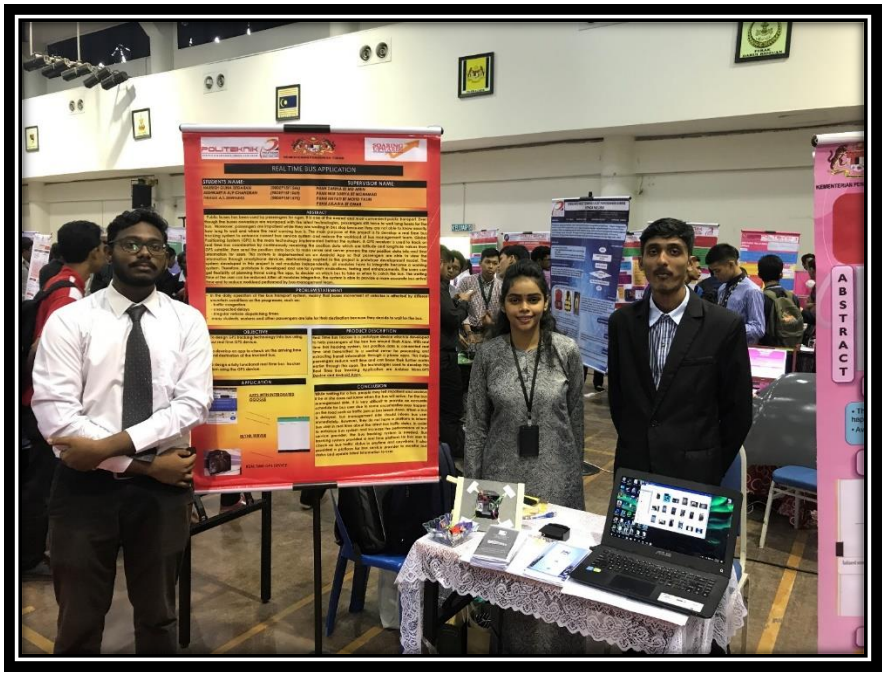

Figure 8.2: EEEIC Group Members

APPENDIX B

No	Activity	Status	WEEKS														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Hardware of project was done.	R															
		L															
2	Programming of project was done.	R															
		L															
3	WIFI MODULE was changed to new one.	R															
		L															
4.	Sever for project had minor problem. And was changed to a new one.	R															
		L															
5	Android Application is redesigned.	R															
		L															
6	Programming for ARDUINO Nano was shortened.	R															
		L															
7	Connected to the application and device via the server.	R															
		L															
8	Test application and device part by part.	R															
		L															
9	Testing of the whole system at different places.	R															
		L															
10	Get permission from Smart Selangor Bus to put device in.	R															
		L															
11	Connect the device through the bus WIFI. Status of device will be online.	R															
		L															
12	Test the system by monitoring the Android Apps.	R															
		L															
13	Final Presentation	R															
		L															
14	Complete data and analysis is produced.	R															
		L															
15		R															

TABLE 8.1: Gantt Chart