
**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

# DESIGN MONITORING POSITION SYSTEM OF UTeM BUS

This report submitted in accordance with requirement of Universiti Teknikal Malaysia Melaka (UTeM) for Bachelor's Degree Electronic Engineering Technology (Electronic Telecommunication) Hons.

by

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# ABSTRAK

Tujuan utama projek ini adalah untuk mereka sistem pemantauan bas UTeM. Tedapat perkakasan dan perisian yang digunakan untuk menjalankan projek ini. Perkakasan yang digunakan adalah Sistem Kedudukan Global (GPS), Sistem Global untuk Telefon (GSM Modul), mikro kawalan (Arduino) dan komputer peribadi. Sementara itu, perisian yang digunakan seperti Code Block, Adobe Flash dan Arduino (versi 1.6.5). GSM modul yang digunakan ialah GSM 900 kerana ia adalah GSM modul yang agak mudah untuk dikendalikan. Kemudian, frekuensi yang digunakan pada GPS sekitar 1227.60 - 1575.42 MHz. Projek ini menggunakan kehilangan kuasa dan ketepatan GPS sebagai elemen utama dalam analisis. Untuk pandangan masa hadapan, projek ini akan memberi manfaat kepada pihak pentadbiran UTeM dalam memantau kedudukan bas UTeM.

# ABSTRACT

The main goal of this project is to design monitoring position system of UTeM bus. There is hardware and software used to make this project. The hardware used is Global Positioning System (GPS), Global System for Mobile (GSM Module), and microcontroller (Arduino). While the software used is Code Block, Adobe Flash and Arduino (version 1.5.6). The GSM module used is GSM 900 since it is quite easy to understand and handle. Then the GPS use frequency range around 1227.60 - 1575.42 MHz. This project use path loss measurement and GPS accuracy as the main element in the analysis. For the future view, this project will give benefits to the UTeM university management in monitoring position of UTeM bus.

# DEDICATION

*Special dedication to:*

*My mother, father, siblings, housemate, friends and her who always support and encourage me through my education journey.*

*My supervisor Mr. Chairulsyah Wasli*

*To other lecture Dr. Abdul Kadir and Mr. Win Adiyansyah Indra*

*Thank you for everything.*

# ACKNOWLEDGMENT

In the name of Allah, the Most Beneficent and Most Merciful.

First of all, all praised to Allah with the Most Kindness for giving me a chance to finish and completed this project.

Besides, for my supervisor, I would like to thanks to you for supervised, guide, support and ideas that you give to me in order to ensure this project can be accomplished. I also asking apologized to my supervisor in case I am doing wrong. Thank you again for spent time for me to help encounter several problems happen during this project carried out.

Other than that, I would like to say thank you to other lecturer that give their help to me especially to Dr. Kadir and Mr. Win Adiyansyah Indra. Both of them very help in finishing this project.

Not forget, to my parent, friends and her who give me inspiration in completing this final year project. With your love and support made me stay still and finish this project.

# TABLE OF CONTENT

# LIST OF TABLE

# LIST OF FIGURE

# LIST OF ABBREVIATION, SYMBOL AND NOMENCLATURE

| | |
|---|---|
| UTeM | Universiti Teknikal Malaysia Melaka |
| GPS | Global Positioning System |
| GSM | Global System for Mobile |
| PC | Personal computer |
| DGPS | Differential GPS |
| km/s | Kilometer / second |
| DOD | Department of Defense |
| Hz | Hertz |
| C++ | Coding software |
| US | United State |
| SMS | Short message service |
| Attn | Attenuation |
| LEOSATS | Low Earth Orbit satellite |
| MEOSATS | Medium Earth Orbit satellite |
| GEOSATS | Geosynchronous Satellite |
| Km | Kilo Meter |
| ms | mili second |
| BTS | Base Transceiver Station |

# LIST OF APPENDICES

# CHAPTER 1

# INTRODUCTION

## 1.1 Background

Roughly, this project developed in order to overcome problem regarding unknown specific current position of UTeM bus location. Unknown current position of UTeM bus location give quite huge problem especially to UTeM management in order to ensure their bus following the schedule provided. Basically, what is going to do is to develop a kind of system that contain communication path between UTeM bus and university management to monitor current location of the bus. The thing that should be done to make this project is searching a lot of information regarding monitoring system such as Global Positioning System, (GPS), and Global System for Mobile Communication, GSM module and Arduino since this project used Arduino as microcontroller. The information collected will be used for the next activity which is calculating, measuring and simulating.

There were two phase in running this project. First phase is about calculating, simulating and measuring the communication link between transmitter installed inside the bus and PC used to display the current location of the bus. Most of the design will be used software like C++, Arduino and Adobe Flash. The second phase is about to develop the communication link between

transmitters installed inside the bus and PC used to display the current location of the bus by using GSM 900 module.

## 1.2 Problem Statement

The main problem face before this project developed is the bus did not follow the schedule made by university management due to several reason like traffic congestion and else. Therefore, this project will help the university management to ensure their bus following the schedule provided. Besides, in this project, a monitoring (global positioning system) GPS with good overall performance will be used.

## 1.3 Objectives

1. To the gain knowledge about the role of GPS in monitoring moving object like, UTeM bus.
2. To make an animation about the UTeM bus monitoring system for better understanding about this project.
3. To develop a coding that used for Arduino in order to monitor the position of moving object like UTeM bus.

## 1.5 Project Scope

The first scope that going to explore is about the literature review. In this literature review, there were several books and journals used in order to gain information and fact regarding monitoring position system, GPS and GSM communication. The list of the book and journal that already viewed listed in references section.

While, in animation section, the will be an animation develop to represent the project developed. This main purpose of this animation is to give a graphical approach to the panel or viewer. So that, with the graphical approach the panel or viewer can gain more understanding about how this project or system operated. For the design section, most of the activities are about design. The design is including on the system and hardware. The design task usually required a lot of time due to idea, error and repairmen. There were several design developed. However, only a well project design will be selected and proceed with the next process.

The design project needs to pass through some inspection like calculation, simulation and measurement. The project design need to be tested with some calculation related to monitoring position. The calculation used like the calculation of return loss by using formula found from the book. Besides, simulations also need to be done to find out whether the project designs operate according to desire operation. Other than that, measurements also need to carry out in order to check whether the value required in this project is obtained or not. The example of the measurement is on output frequency and input impedance. All of three tests which are calculation, simulation and measurement will be repeated again if the test is not fine.

Once all the result and information gain from previous operation. The result and information will need to analyze. The main purpose of analyze is to observe the result obtain and use the observation to make the discussion about the project. The analysis done also to compare between the results obtain with the theoretical result. Other than that, analysis also carried out to find the solution on certain problem happen.

The software use to design this monitoring position is Adobe Flash, Arduino, and Code Block. As Information, this software will help in term of detecting the current position of the bus. Besides, this software also help to

generate the hardware used. Last but not least is about thesis writing. Thesis writing is the part where the documentation of the project develops is written. With thesis writing, all of the information regarding project developed such as result, analysis and animation can be view and read to get further understanding about the project. This project scope limited to a UTeM bus only where the coverage area is the daily route used by UTeM bus.

## 1.6 Thesis Outline

Basically, this full report contains about five chapters. Chapter one is all about the introduction of this project like little bit project background, objectives and problem statement. The next chapter is chapter two which is Literature Review where all the information regarding the project shown in this section. The information is quite detail since to develop a good project design. Then, in chapter three, Methodology, the chapter that tell the step by step procedure starting from nothing until the project finish all together with the full report and presentation. While in chapter four, the main business in this chapter is about the result obtain, analysis and calculation. There also result comparison between calculated and the measured value. Last but not least is chapter five where the conclusion and all suggestion about further study will be display.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Global Positioning System

Global Positioning System or GPS is kind of system that has been used to support a wide variety of application, such as high efficiency positioning and navigation (Aly M. El-Nagar 2011). The basic values that needed in positioning and navigation is the latitude and longitude values. Each GPS has its own accuracy depending on the value of data transferred per second.

The global positioning system (GPS) also can be describe as space-based global navigation satellite system that provides reliable location and time in all weathers, at all times and anywhere on or near the earth when and where there is an unobstructed line of sight to four or more GPS satellite (C. Ordonez Galan et al. 2010). It is maintained by the US government and is freely accessible by anyone with a GPS receiver. GPS was created and realized by the US Department of Defense (DOD) and was originally run with 24 satellite. It was established in 1973 to overcome the limitations of previous navigation systems. The satellites orbit at the high 20,350 km above the earth surface. Each one circles the earth twice a day in one of six orbits to provide continuous worldwide coverage. Figure 2.1 shows how the satellite in earth orbit.

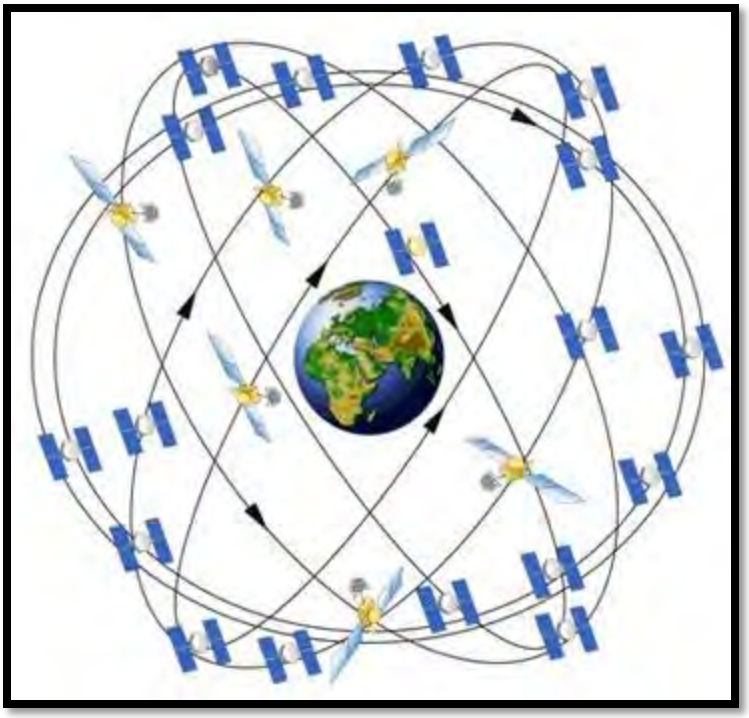

Figure 2.1: 24 satellites orbit around the earth (www.quora.com, 2014)

### 2.1.1 GPS Error

Global Positioning System (GPS) measurement can be corrupted by several error sources (Aly M. El-naggar, 2011). These errors categorized as biases and random error. Common-mode error between the reference and the rover GPS station caused from Ionospheric and tropospheric refraction and delays, satellite and receiver clock biases, and orbital errors. The Ionospheric delay in the propagation of Global Positioning System (GPS) signal is one of the main sources of error in GPS precise positioning and navigation.

A dual-frequency GPS receiver can eliminate (to the first order) the ionospheric delay through a linear combination of L1 and L2 observations. The most significant effect of ionospheric delay appeared in case of using single frequency data. Differential GPS (DGPS) provides users with corrections to

remove the correlated bias terms between receivers. The ionospheric effect became the biggest source of error in GPS positioning and navigation.

### 2.1.2 How GPS Works

First, the GPS satellite broadcast radio signal providing their location, status and precise time from onboard clock. Then the GPS radio signals travel through space at the speed of light which is more than 299,792 km/s. A GPS device receives the radio signals, accepts nothing except their exact time arrival, and uses these to calculate its distance from each satellite in view. Once a GPS device knows its distance from at least four satellites, it can use geometry to determine its location on earth in three dimensions. A GPS device applies this formula to the satellite's signal in order to calculate its distance from a satellite.

$$Time = distance / rate \tag{2.1}$$

*Rate = speed of light, [m/s]*
*Time =time signal travel through space, [s]*
*Distance = distance GPS from satellite, [km]*

The signal's travel time is the difference between the time broadcast by the satellite and the time the signal is received. As matter of fact, satellite also has their aging time. When the time arrives the US Air Force will launch a new satellite to replace the old satellite all together with upgraded accuracy and reliability. For further understanding, please refer to figure 2.2 below.

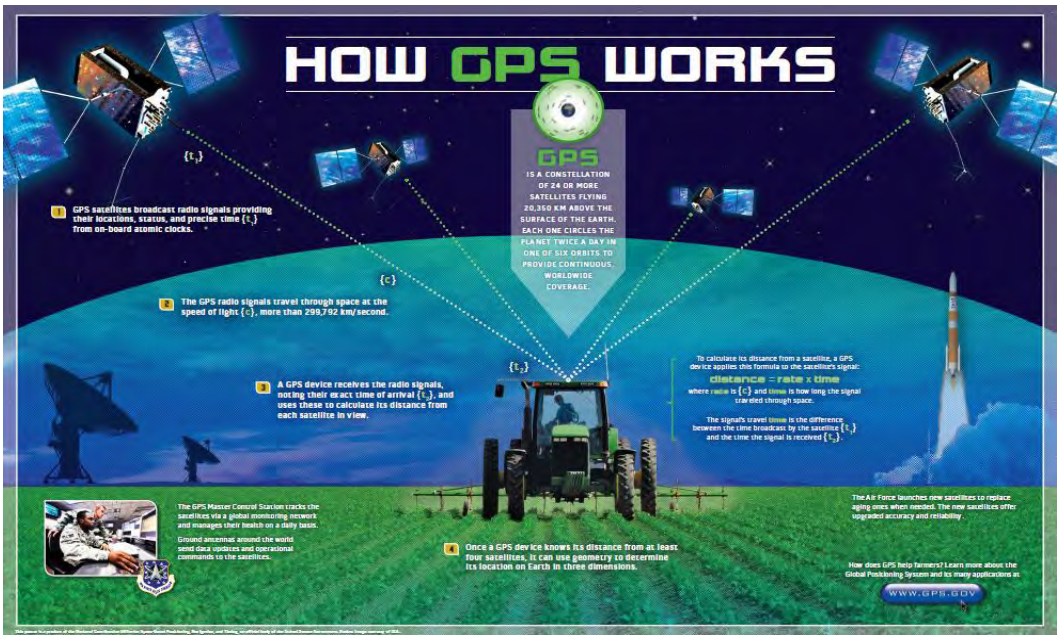


Figure 2.2: GPS network topology (www.gps.gov, 2013)

### 2.1.3 Accuracy in GPS

The positioning accuracy has been achieved with the Global Positioning System (GPS) in continuously operating GPS network has been considerably improved during the last few years. The rapid development of the positioning accuracy with GPS, mainly under the umbrella of the international GNSS Services for Geodynamics consortium, provide more précised determination of satellite orbital parameters, through the enlargement of the GPS satellite constellation, and the improvement of the global Continuous GPS (CGPS) tracking system coverage (U. Dogan et al 2014).

In operating GPS network there is many advantages gained. One of the advantages is elimination of non-modeled systematic effects on daily estimates of site positions for both and long-term effects as well as the ability to study can be increased. The other advantages is error involving with variations in the measurement of the local vector due to the phase reference variations of the

different antennas can be eliminated fixed, stable pillars antenna. Below is the formula and calculation in order to measure the accuracy of the GPS.

*Circumference of the earth = 40,075 km* (2.2)

*Degree of the earth circumference = 180°*

180° = 40,075 km

1° = 222.64 km

*∴ According to GPS reading, the reading up to 0.000001 which is* $10^{-6}$.

*Then,*

Accuracy = 222.64 km / $10^{6}$

= 0.2 meter

Just to be informed that the accuracy of the GPS in seasonal change also can be investigated, analyzed and measured. Each season will give different accuracy of GPS due to several factors like temperature, humidity and cloud thickness. The accuracy of the GPS measured based on the seasonal variations, the observing session duration and baseline length. The reading of latitude and longitude of the location can be vied like in figure 2.3 below.


Figure 2.3: latitude and longitude shown in GPS (www.rcgroups.com, 2014)

## 2.2 Global System for Mobile Module (GSM Module)

Human machine communication represented the Global System for Mobile (GSM) that acts as an intermediate between owner and system (N. Kiruthigaet al. 2015). GSM is the worldwide accepted standard for digital cellular communication. GSM modems are most frequently used to provide mobile internet connectivity and many are used for sending and receiving Short Message Services (SMS).

A wireless link is provided between the owner's cell phone and MCU (Microcontroller Unit) by GSM (Global System for mobile) module. It is similar to dial-up modem. The main dissimilarity between them is that in dial-up modem transmission and reception of data is through fixed telephone line whereas wireless modem uses radio waves. PIC uses AT (Attention) command to control modem. The figure of GSM module combined with Arduino can be viewed in figure 2.4 while single figure of GSM module can be viewed in figure 2.5. GSM modem maintain set of standard AT commands. The functions of AT commands are given below:

a) Reading writing and deleting SMS messages
b) Sending SMS message
c) Monitoring the signal strength
d) Monitoring the charging status and the charge level of the battery
e) Reading, writing and searching phone book entries

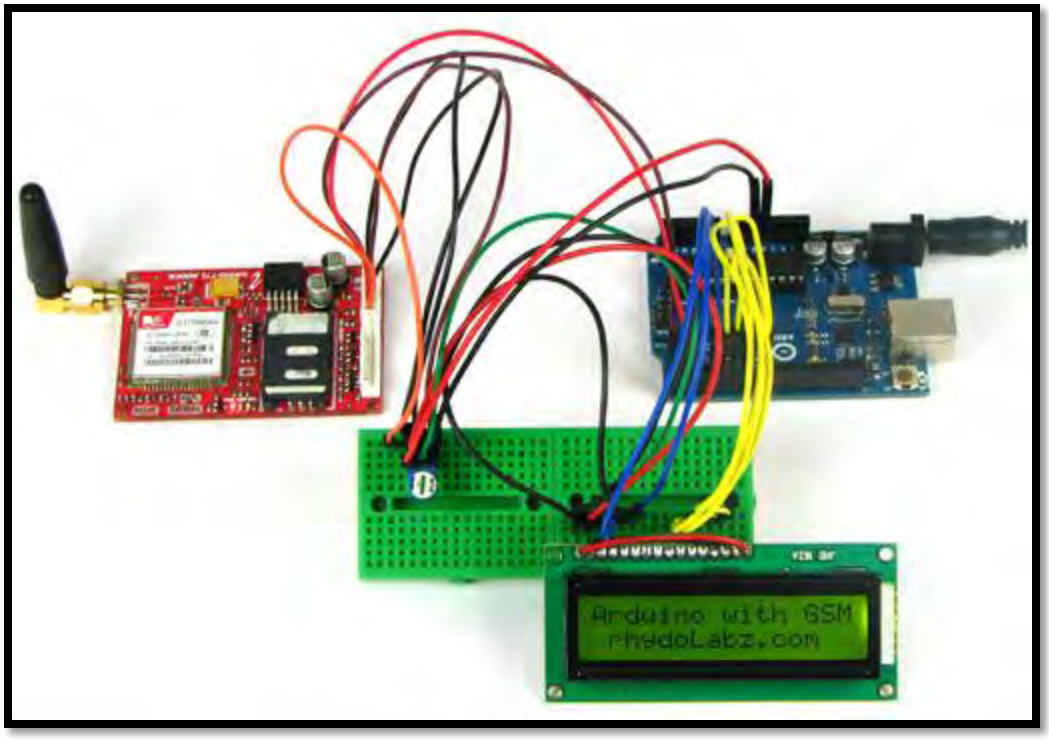


Figure 2.4: GSM module combine with Arduino (www.rhydolabz.com, 2013)

Figure 2.5: GSM module (www.elecfreeks.com, 2014)