GPS Based Vehicle Tracking System

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GPS Based Vehicle Tracking System

Mohd Hakimi Bin Zohari, Mohd Fiqri Bin Mohd Nazri

Abstract: The research is about creating a system for tracking vehicle. Objective of the research is to design and develop a GPS based Vehicle Tracking System in order to display location of vehicle on Google Maps. This system used Arduino MEGA as a microcontroller and it will be used as the main processing unit. Next, Ublox NEO-6m GPS module is used to routing the coordinate while SIM 900A GSM module is used to connecting with the user. The product was successfully run at outdoor and having some problem at indoor due to GPS module cannot extract the accurate coordinate when there is a roof or obstructer that block the direct signal connection between the GPS and satellite. For the next improvement, the researcher can use the high quality of GPS module to connect with satellite. An example, GPS NEO-6P module where it can collect data more accurate and stay connect to the satellite.

Index Terms: GSM (Global Services for Mobile Communication), GPS (Global Positioning System), Vehicle Tracking System.

1 INTRODUCTION

Nowadays, crime rates in Malaysia are increasing rapidly, such as stolen vehicles cases. Various devices have been invented to reduce the crime rate. This is because criminals are also become crafty and they using various ways to commit crimes. Now the demand for the vehicle's detection devices increases from time to time, it is increasing in line with the growing number of vehicles in Malaysia. Lot of tracking devices have been installed in vehicles, either by the car manufacturer or by third party developer. Today's electronic technology is growing fast, making users more tend to using tools that can be controlled directly through their phones or computer. Development of GPS based vehicle tracking system is an electronic device project that allows owners of vehicles to know the exact location of the vehicles [1]. This project can be positioned the location of vehicle and show it on Google Maps. In general, this system will send the coordinates and Google Maps link to mobile phone user using message. For the record, the theft case of vehicles in the first half of 2015 are as follows, 4,539 private vehicles, 7,122 motorcycles and 751 commercial vehicles were reported missing by the Vehicle Theft Reduction Council of Malaysia (VTREC). This due to the components in the car get high demand dark market. Usually the percentage of getting back the lost vehicle is very low. In order to solve this problem many GPS detectors have been build to reduce the rate of theft case. Namely, the GPS locator is usually showing current location and do not update the vehicle location after that. Besides that, GPS detectors only show the coordinates of longitude and latitude, so the user will waste their time to search place based on longitude and latitude that show exactly their vehicle location [2].

2 METHODOLOGY

2.1 Overview of Purpose System

Based on block diagram from Figure 1, Arduino MEGA is used to control the whole process between GPS module and GSM module. GPS module is used to get the coordinates of the vehicle while GSM module is used for sending coordinates to user by message. In order to track the vehicle location, first it needs to find the coordinates of vehicle. GPS module will connect with satellite continuously to get the coordinates. Then GPS will send the coordinates to Arduino UNO. Arduino MEGA will extract the required data that received by GPS. When GSM module receive command from user by massage, GSM module will cooperate with Arduino MEGA to reply the message and send it to user by using GSM module. The message contains the coordinates of vehicle location.

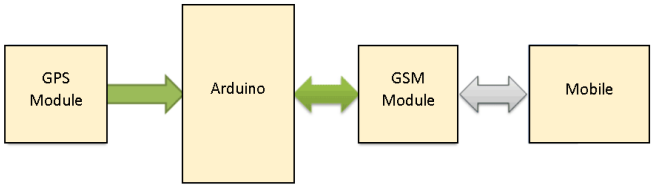

***Fig. 1**. Block Diagram of GPS Based Vehicle Tracking System.*

Figure 2 shows the flowchart of GPS Based Vehicle Tracking System. First, GPS will be connecting continuously with satellite to routing the coordinate. Once the LED at GPS module was blinking, it means the location was locked. Then, check the LED at GSM Module. It will blinking after get the mobile communication line. After all LED was blinking, user can sent "START" to GSM module via massage. GSM will reply the message. The message will contain location of vehicle detail and URL link to Google Maps. The location will be updated every one minute. In order to terminate the system, user just need to sent "STOP" to GSM. Then, the system will stop sending message to user's phone.

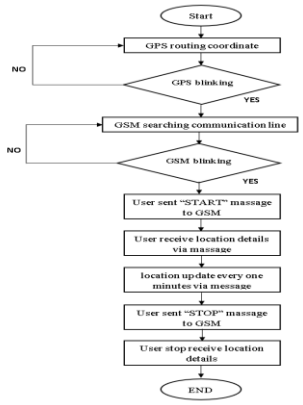

***Fig. 2**. Flowchart of GPS Based Vehicle Tracking System.*

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2.2 Software Development

Figure 3 shows the software that used to develop the program, namely IDE software. The software is an open-source Arduino Software, the code will be written on this software and it will be upload to Arduino board.

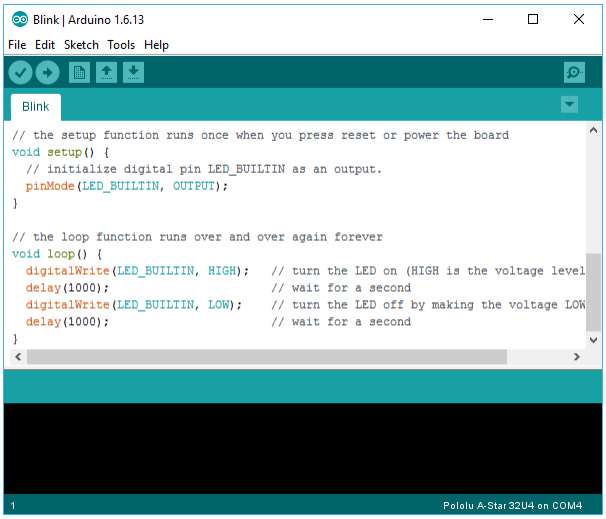

Fig. 3. IDE Software.

Arduino Mega 2560 is a microcontroller board based on the ATmega2560. As shown in Figure 4, it has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller and simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started [3].

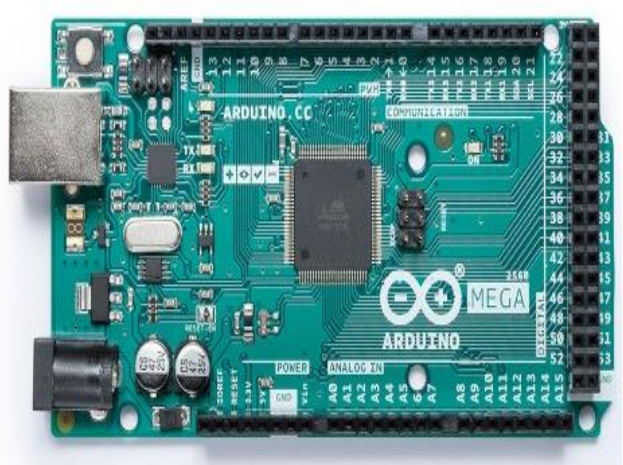

***Fig. 4**. Arduino Mega 2560.*

Figure 5 shows SIM900A Module which is built with Dual Band GSM/GPRS based SIM900A module from SIMCOM. It works on frequencies 900/ 1800 MHz. SIM900A can search these two bands automatically. AT Commands can also set the frequency bands. The baud rate is configurable from 1200-115200 through AT command. The GSM/GPRS module has internal TCP/IP stack to enable connection with internet via GPRS. SIM900A is an ultra-compact and reliable wireless module [5].

***Fig. 5**. SIM900A GSM Module.*

NEO-6 module is a series of family stand-alone GPS receivers featuring the high-performance UBLOX 6 positioning engines. These flexible and cost-effective receivers offer numerous connectivity options in a miniature 16 x 12.2 x 2.4 mm package. Their compact architecture and power and memory options make NEO-6 modules ideal for battery operated mobile devices with very strict cost and space constraints [4]. As can see on Figure 6, this module has an external antenna and built-in EEPROM.

***Fig. 6**. NEO-6 GPS Module.*

Figure 7 shows LM2596 series of regulators are monolithic integrated circuits that provide all the active functions for a step-down (buck) switching regulator, capable of driving a 3-A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3 V, 5 V, 12 V, and an adjustable output version.

Fig. 7. *LM2596 DC-DC Buck Converter Step-Down Power Module.*

The Figure 8 shows the schematic diagram for GPS based Vehicle Tracking System. The PWM pin number 10 and 11 of Arduino will connect to RX and TX of GPS module.

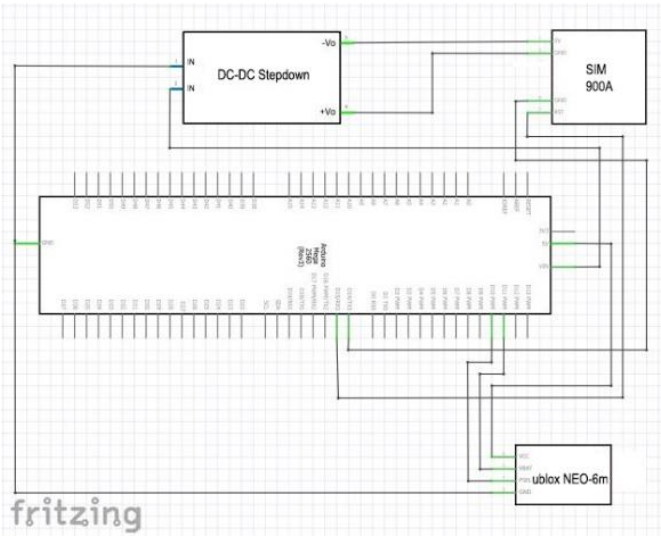

Fig. 8*. Circuit of GPS Based Vehicle Tracking System.*

While GPS module Vcc and GND will connect to 5V and GND pins of Arduino. GSM module Vcc and GND pins are connected to Step-Down Power Module before connect to Vin and GND of Arduino to avoid overflow. Tx and Rx pins of GSM are directly connected TX514 and RX315 of Arduino. Software Serial Library is also used for all RX and TX to allow serial communication.

3 RESULTS

3.1 Prototype

A GPS Based Vehicle Tracking System prototype has been developed for the project. Figure 9 shows the general view of the project prototype, while Figure 10 shows the picture of component in the system.

Fig. 9*. General View of GPS Based Vehicle Tracking System.*

Asdasd

The component in a blue box is DC-DC Stepdown, the yellow box is GSM Module while the green box is GPS Module and the red box is an Arduino Mega.

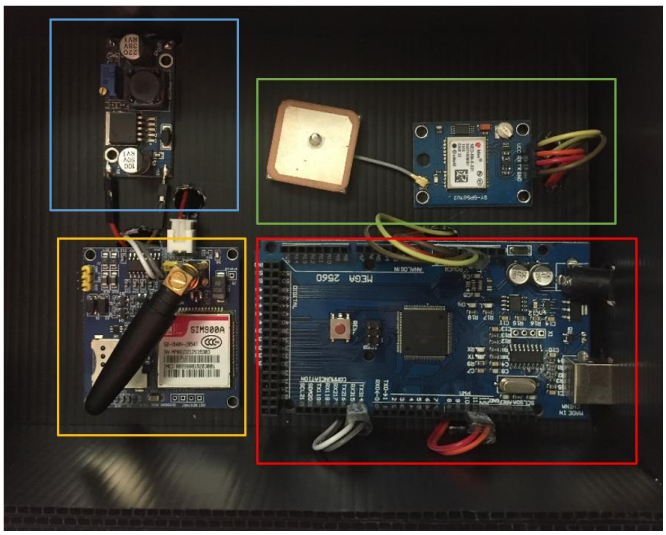

Fig. 10*. Component of GPS Based Vehicle Tracking System.*

Figure 11 shows the view of the project while been test. Firstly, the program will be upload to Arduino MEGA. Then wait for the GPS for routing the coordinate and GSM for connecting a phone line. After get the coordinate, GPS will blink every 3-4 second. Same with GSM, after get the line, it will blink 3-4 second. In the figure, the LED for GPS and GSM indicators were blinking, which mean the coordinate was already locked. Then it ready to send an information if it received a command from user.

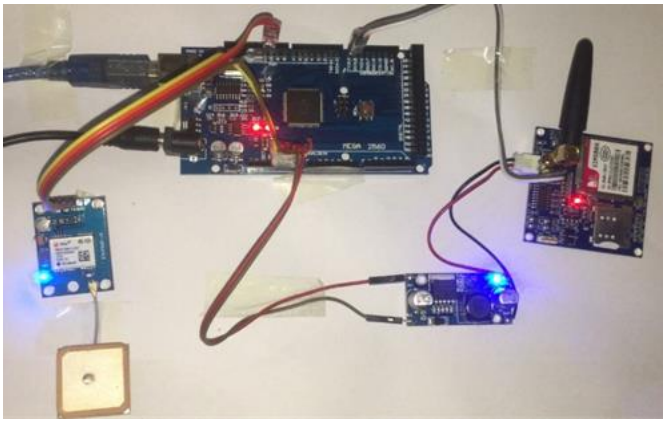

***Fig. 11**. Project Being Test.*

The vehicle tracking system was test at outdoor and indoor. The result was depending at the surrounding location. Figure 11 shows the general view of the project. First the program will be upload to Arduino. Then wait for the GPS for routing the coordinate and GSM for getting a phone line. After get the coordinate, GPS will blink every 3-4 second. Same with GSM, after get the line, it will blink 3-4 second. In the Figure 11 the LED at GPS and GSM were blinking, which mean the coordinate was already lock and it was ready to send an information if receive a command from user. The data of coordinate also can be check at serial monitor at IDE program. It will show the longitude, latitude and time taken. The user phone number will be exposed on the serial monitor. This program had been setup with own term to cooperate between user and the vehicle tracking system. In this program two term was used which is “START” and “STOP”. The “START” term is using to active the system, meanwhile term “STOP” for terminate the system. Figure 12 shows serial monitor when receive “START” command from user via massage from the user. After receive “STOP” command, the system will terminate the connection with user but still routing the latest coordinate. Once the user sent “START” to GSM module. GSM module will cooperate with Arduino and Arduino will extract data that received by GPS module. The system will reply the massage to user.

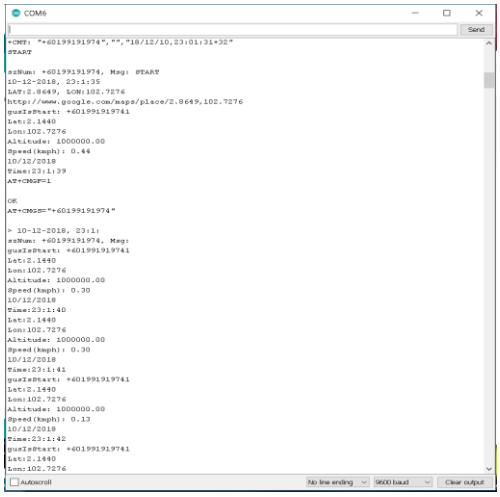

***Fig. 12.** Serial monitor receive “START” command.*

The reply massage will contain coordinate and URL link to Google Maps. Figure 13 shows an example of message when the system was run. Once the system was start, it will constantly updated the current location every one minute. Figure 14 shows when the link was open, the coordinate will be marked with red pin. To terminate the system, user have to sent “STOP” to the GSM module and it will terminate immediately. To use the system again, user just need to send “START” again.

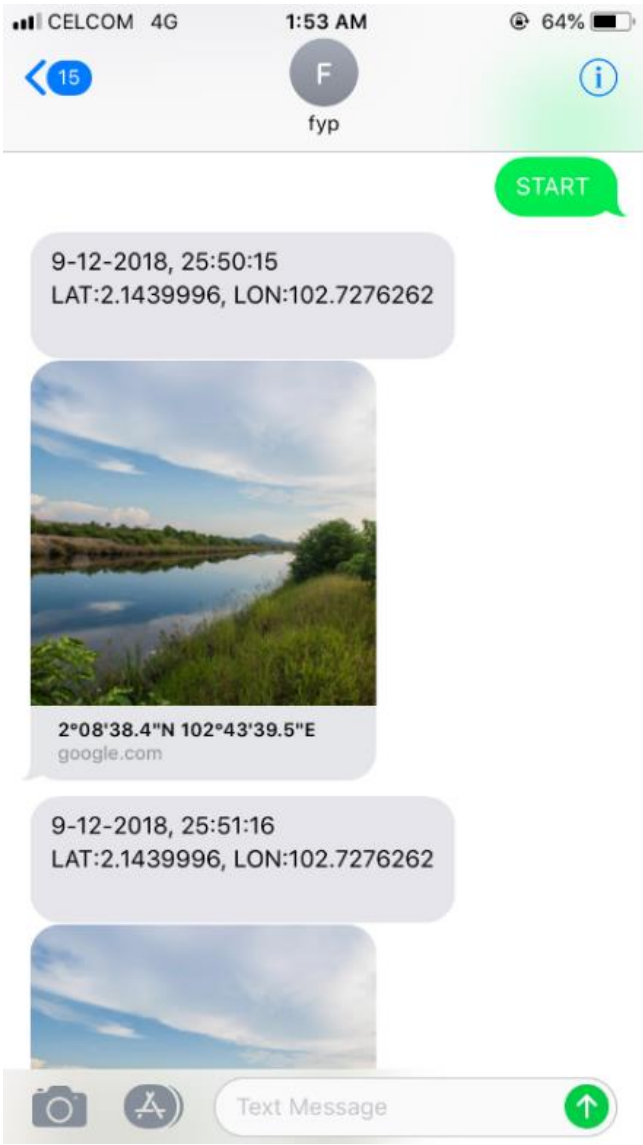

***Fig. 1**. Block Diagram of GPS Based Vehicle Tracking System.*

3.3 Accuracy

Accuracy play the major role in the tracking system. Figure 14 shows how the accuracy of the prototype are taken. The red pin is the dropped pin with the longitude and latitude that get track by GPS Module. While the blue dot shows the real place that the device was located. In this test the coordinate taken are at 30m from the real coordinate. The distance was measured automatically using the application. If the distance between the real coordinate and the track coordinate

decrease, so the accuracy will be increase. The accuracy of this prototype was depending on the place, indoors or outdoors. Table 1 shows the reading of accuracy test.

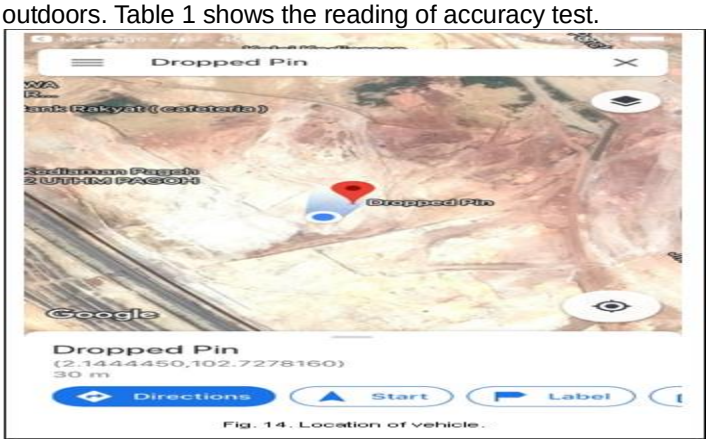

Fig. 14. Location of vehicle.

TABLE 1
THE READING OF ACCURACY TEST

	OUTDOOR	INDOOR
Test 1	7m	30m
Test 2	10m	25m
Test 3	7m	27m

4 DISCUSSIONS

To develop this project "GPS based Vehicle Tracking System", it is divided by two sections which are software and hardware development. For the software development, it has a lot of researches were done, the programming by using the Arduino compiler is the most complicated part of this project. There were a lot of problem facing. Error dialog message pop up every time the program is run. However, all of the problems are solved after the errors have been found. This project was being test at indoor and outdoor. The project was run successfully at outdoor and having some problem at indoor due to GPS module cannot extract the accurate coordinate when there is a roof or obstructer that block the direct signal connection between the GPS and satellite. Also, the reading of coordinate was not exactly at the real place of the devices. The given coordinate was different about 5m to 30m from the real coordinate. Another factor is come from GPS not get strong signal from satellite. This project needs two power sources. For GSM module needs a 9V direct current with 2A from AC to DC adapter while Arduino Mega and GPS module share a power source from USB. The project was tested by using a 9V battery but the power receive at GSM module was not stable. This is because Arduino Mega need 7V to 12V to work, while GSM Module need 5V to start up. The GSM module still cannot work properly when use the battery even use a same voltage with adapter. In order to applied this system in a vehicle. The vehicle needs an external power source that can manage the system.

5 CONCLUSION

The purpose of this study is to develop a system that can track the location of vehicle when the car had been stolen or loss. Otherwise, this project also perhaps to reduce the number of stolen vehicles in our country. The idea is when the vehicle was stolen, the owner will send a massage to GSM module and the massage will be reply by GSM module. The reply massage will contain coordinate and URL link to Google Maps. Once the system was start, it will constantly updated the current location every one minute. When the user clicks on the URL link, the link will bring to Google Map. There, the user can see the location of vehicle with a marker. Using the satellite view at the map, the real location of vehicle can be seen. User can see the road on the map, the time for searching the stolen car can be reduced. Therefore, by using the method user can get the location of the vehicle and real-time vehicle location details. The system can be improved in several ways. First, use the high quality of GPS module to connect with satellite. An example, GPS NEO-6P module where it can collect data more accurate and stay connect to the satellite. Next, the system need to be balanced with the latest technology and the project can be improved by sending data to a server using IOT (Internet of Things). At the end, the location can be known by accessing the website through internet.

ACKNOWLEDGMENT

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