GPS-GSM BASED LOCATION AND POSITION TRACKING SYSTEM

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Abstract

This research work reveals the location and position tracking system based on GPS (Global Positioning System) and GSM (Global System for Mobile Communication) modules. Location and position tracking system is constructed with NEO-7M GPS Module, SIM900A GSM module, MPU-6050 gyroscope sensor and Arduino Mega microcontroller. The constructed system is used for vehicle tracking system. Arduino microcontroller is used as main control device. GPS module connects the GPS satellites and receives geographic coordinate data at regular time interval. MPU-6050 senses the position of object. GSM module transmits the GPS location and position of the system to mobile phone through SMS (Short Message Service). GPS location and position data are sent to database server through GSM network. Location and position of system can be viewed on Google map with the help of software via the internet.

Keyword: GPS module, GSM module, MPU-6050 gyroscope sensor, Google map

Introduction

Tracking system uses the GPS (Global Positioning System) to determine the precise location of a vehicle or person to which the device is attached. The tracking system offers its location information and records the data. The recorded data are transmitted to data base server or sends SMS to predetermined phone number.
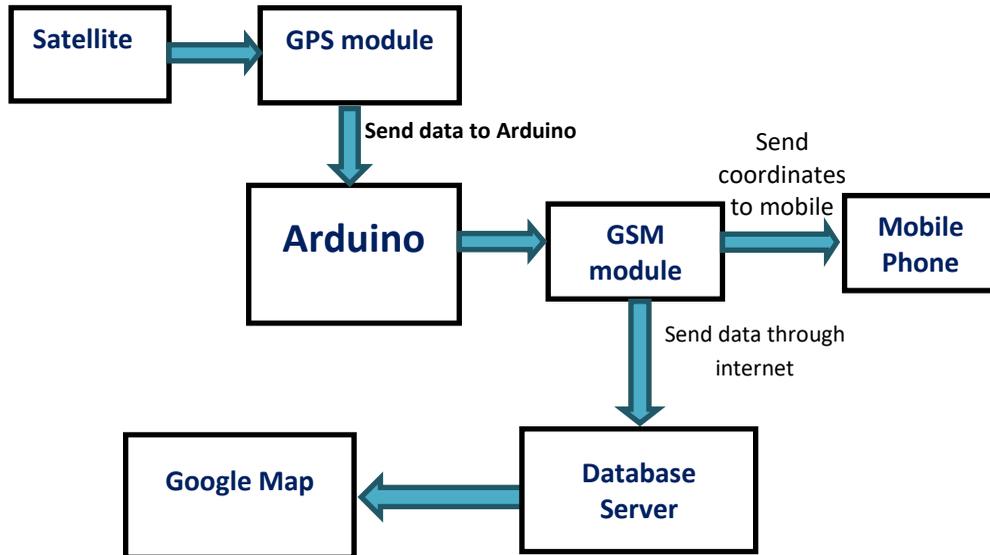
Constructed system includes hardware and software components to track the location and position of vehicle or person. NEO-7M GPS Module, SIM900A GSM module, MPU-6050 gyroscope sensor and Arduino Mega microcontroller are used as hardware component. MySQl server and Google map are used as software components.

Arduino Mega is interfaced serially to a GSM module and GPS sensor. MPU-6050 gyroscope sensor measures the position of the vehicle and NEO-7M GPS Moduleprovides the location. The SIM900A GSM module is used to

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send the data in terms of latitude and longitude via SMS and these data are sent to database server on domain. The location and position of vehicle can be viewed on Google map.

Figure1: Block diagram of GPS-GSM based location and position tracking system

Material and Method

Constructed system is based on hardware and software components to track the location and position of vehicle or person.

Arduino Mega 2560 Microcontroller

Arduino Mega 2560 microcontroller board is used as main controller device. Arduino Mega is based on Atmel ATmega2560 microcontroller. Mega 2560 board has 54 digital input/output pins, 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header (In-Circuit Serial Programming), and a reset button. Photograph of Arduino Mega board is shown in Figure 2.

Figure 2: Photo of Arduino Mega 2560 microcontroller board

NEO-7M GPS Module

The Waveshare NEO-7M GPS Module provides location, heading, and speed and comes in a compact package. It comes with a high-gain active antenna, but also includes an IPX interface for connecting a different active antenna. A rechargeable backup battery will hold data when powered down, but perhaps more importantly it supports hot starts for a fast satellite lock time.A 5-wire cable with a SIP socket on one end and individual sockets on the other makes it easy to connect the Waveshare NEO-7M GPS module. Figure 3 shows the NEO-7M GPS Module.
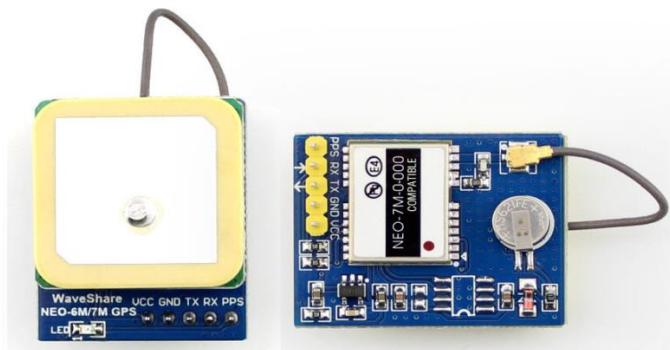
Figure 3: NEO-7M GPS Module

SIM900A GSM Module

Global system for mobile communications (GSM) is digital cellular system used for mobile devices. It is an international standard for mobile which is widely used for long distance communication. SIM900A module allows users to send/receive data over GPRS, send/receive SMS and make/receive voice calls. The GSM/GPRS module uses USART communication to communicate with microcontroller or PC terminal. AT commands are used to configure the module in different modes and to perform various functions like calling, positing data to a site.Figure 4 shows the SIM900A GSM module.

Figure 4: SIM900A GSM Module

MPU 6050 Sensor

MPU 6050 is the combination between a MEMS 3-axis gyroscope and a 3-axis accelerometer on the same silicon die together with an onboard Digital Motion Processor™ (DMP™) capable of processing complex 9-axis MotionFusion algorithms, the MPU-6050 does away with the cross-axis alignment problems that can creep up on discrete parts. Figure 5 shows MPU 6050 sensor.
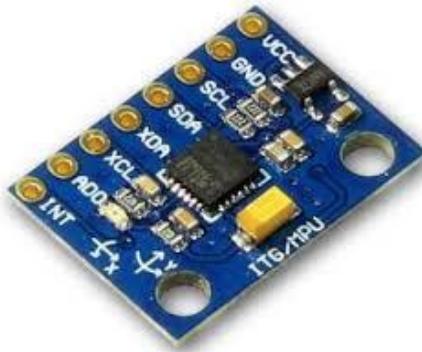
Figure 5: MPU 6050 sensor

Domain Name

A domain name is an identification string that defines a realm of administrative autonomy, authority or control within the Internet. Domain names are formed by the rules and procedures of the Domain Name System (DNS). Any name registered in the DNS is a domain name. Domain names are used in various networking contexts and for application-specific naming and addressing purposes. In general, a domain name represents an Internet Protocol (IP) resource, such as a personal computer used to access the Internet, a server computer hosting a web site, or the web site itself or any other service communicated via the Internet.

cPanel

cPanel is an online Linux-based web hosting control panel that provides a graphical interface and automation tools designed to simplify the process of hosting a web site. cPanel utilizes a three-tier structure that provides capabilities for administrators, resellers, and end-user website owners to control the various aspects of website and server administration through a standard web browser.It is designed to function either as a dedicated server or virtual private server. Application-based support includes Apache, PHP, MySQL, Postgre SQL, Perl, and BIND (DNS). Email-based support includes POP3, IMAP, and SMTP services. cPanel is accessed via https on port 2083.
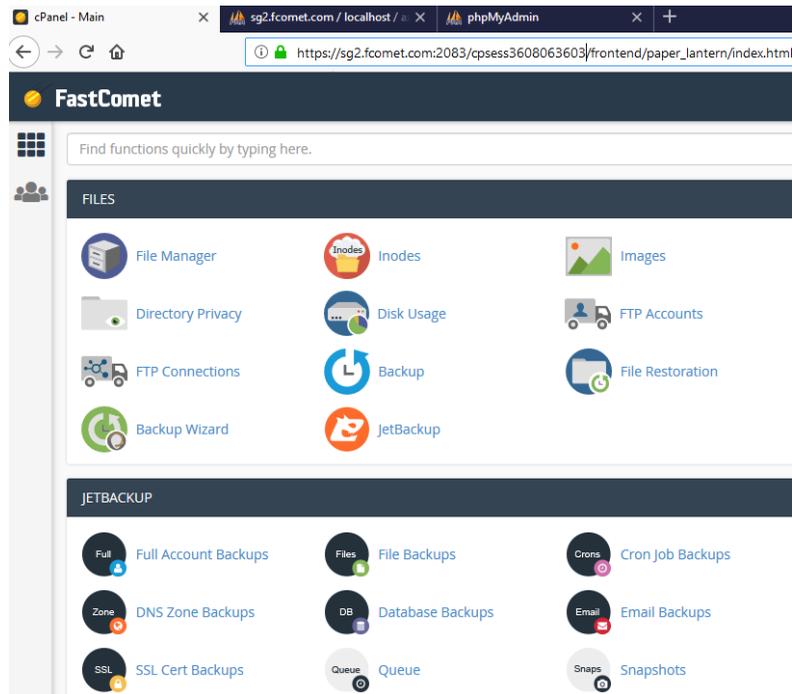
Figure 6: cPanel from domain

Hardware Interface

Tx pin (Yellow wire) of GPS module is directly connected to digital pin No.10 of Arduino. Rx pin (Green wire) of GPS module is directly connected to digital pin No.11 of Arduino. Ground pin (Black wire) is directly connected to digital pin GND of Arduino. Vcc pin (Red wire) is directly connected to digital pin 3.3V of Arduino as shown in Figure 5.

Circuit connections of GSM module is Tx pin (Green wire) of GSM module is directly connected to digital pin Rx of Arduino. Rx pin (Yellow wire) of GSM module is directly connected to digital pin Tx of Arduino. SDA and SCL pins of MPU6050 are connected to pin 20 and 21 of Arduino respectively.

Ground pin (Black wire) is directly connected to digital pin GND of Arduino. GSM module is also powered by 12V supply.
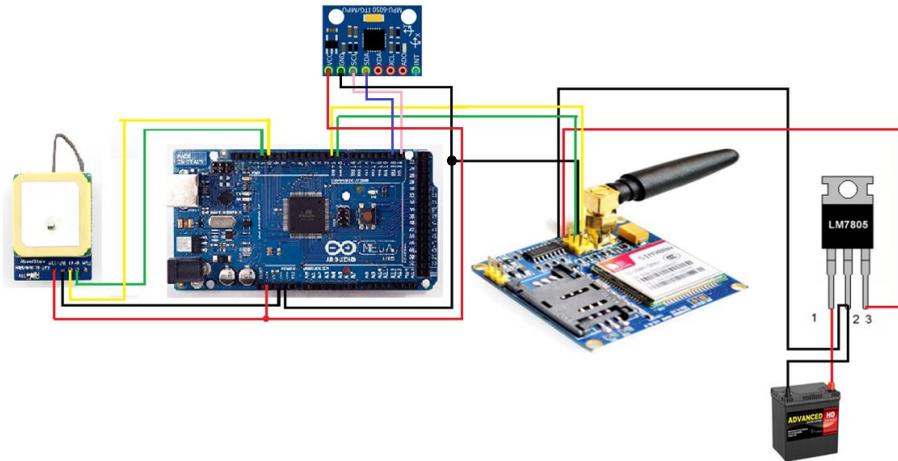
Figure 7: Circuit diagram of tracking system

Software Interface

Creating Database in MySql

phpMyAdmin is a free software tool written in PHP, intended to handle the administration of MySQL over the Web. phpMy Admin supports a wide range of operations on MySQL and Maria DB. Frequently used operations (managing databases, tables, columns, relations, indexes, users, permissions, etc) can be performed via the user interface, while you still have the ability to directly execute any SQL statement. Figure 7 shows the database in MySql server.

Creating PHP Script

PHP is a general purpose scripting language that is well suited to web development and can be embedded into HTML. To send measured data to database server, PHP script is created as shown in Figure 8.

Figure 8: Creating Database in MySql database server

Figure 9: PHP code for accessing data (GET method)

Results and Discussion

This research work is designed using ATmega1280 microcontroller which is used as main control device for tracking the location and position of any vehicle by using GPS and GSM modules.

Figure 10 shows the serial output of the Arduino when program runs the tracking system. GPS module sends the location information including latitude, longitude, altitude, date, satellites as shown in Figure 10.Table 1 shows the coordinates of location collected from SMS message. Table 2 shows the location data in Excel format. MPU-6050 gyroscope sensor measures the position of the vehicle and sensor's data are shown in Table 3.

GPS Visualizer as shown in Figure 11 is an online utility that creates maps and profiles from geographic data. Input can be in the form of GPS data (tracks and waypoints), driving routes, street addresses, or simple coordinates. These data are sent to GPS Visualizer web page and export it to Google Earth. Figure 12shows the location tracking of exported data on Google maps output. Figure 13 shows SMS message from GPS tracking system. Figure 14 shows the photos of constructed system.
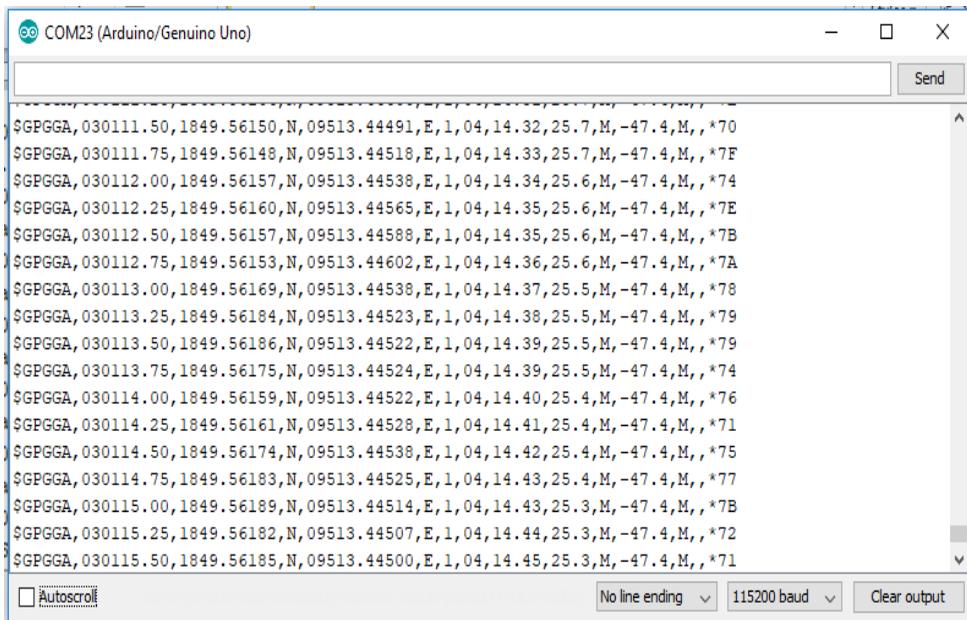

Figure 10: GPS data shown on serial output of Arduino

Table 1: Location data collected from SMS messages

No	SMS link
1	http://google.com/maps/place/18.77481,95.22179\r\n
2	http://google.com/maps/place/18.78514,95.22205\r\n
3	http://google.com/maps/place/18.78374,95.22226\r\n
4	http://google.com/maps/place/18.78200,95.22282\r\n
5	http://google.com/maps/place/18.78029,95.22299\r\n
6	http://google.com/maps/place/18.77856,95.22320\r\n
7	http://google.com/maps/place/18.77666,95.22318\r\n
8	http://google.com/maps/place/18.77537,95.22321\r\n
9	http://google.com/maps/place/18.77515,95.22218\r\n
10	http://google.com/maps/place/18.77517,95.22217\r\n
11	http://google.com/maps/place/18.77518,95.22215\r\n
12	http://google.com/maps/place/18.77479,95.22181\r\n
13	http://google.com/maps/place/18.77480,95.22187\r\n
14	http://google.com/maps/place/18.77475,95.22184\r\n

Table 2: Location data in Excel Format

No	Latitude	Longitude
1	18.77475	95.22184
2	18.7748	95.22187
3	18.77479	95.22181
4	18.77518	95.22215
5	18.77517	95.22217
6	18.77515	95.22218
7	18.77537	95.22321
8	18.77666	95.22318
9	18.77856	95.2232
10	18.78029	95.22299
11	18.782	95.22282
12	18.78374	95.22226
13	18.78514	95.22205
14	18.77481	95.22179

Table 3: Position of Vehicle

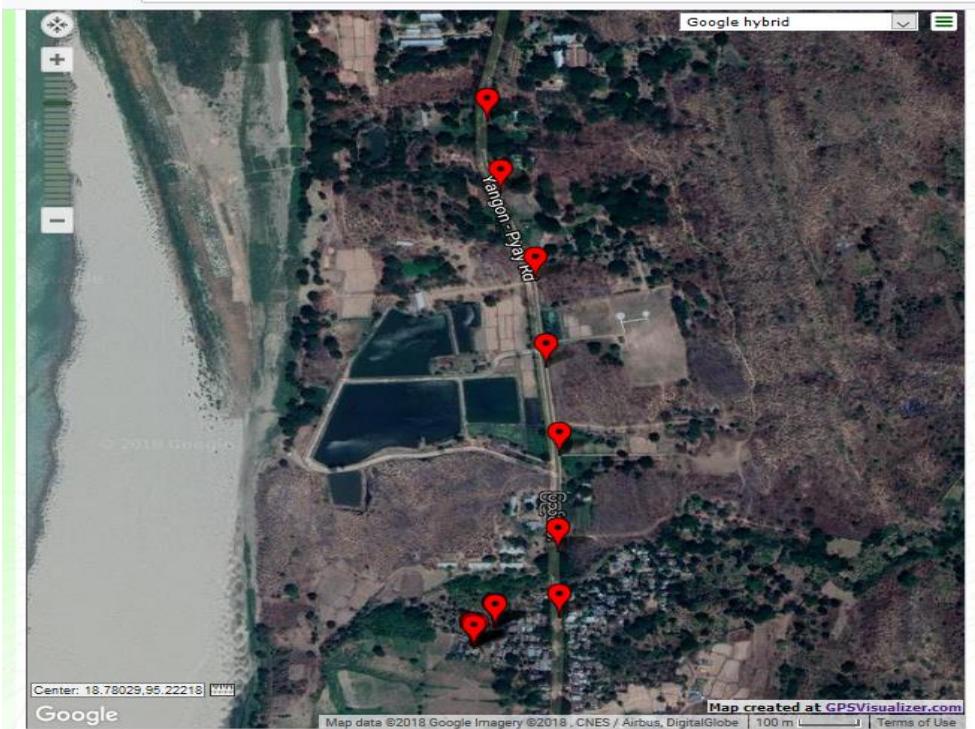| No	Position
1	Normal
2	Normal
3	Normal
4	Normal
5	Normal
6	Normal
7	Normal
8	Normal
9	Normal
10	Normal
11	Normal
12	Normal
13	Normal
14	Normal
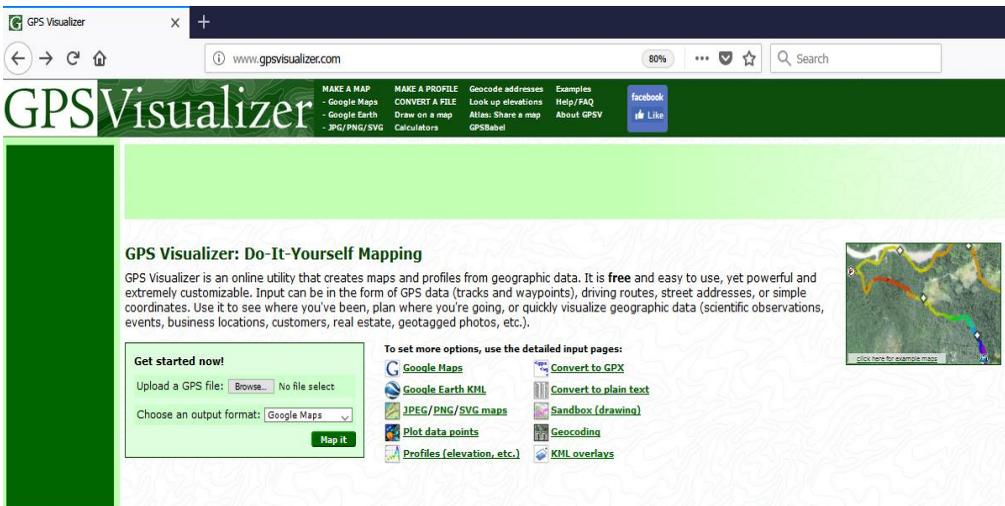
Figure 11: GPS Visualizer web page

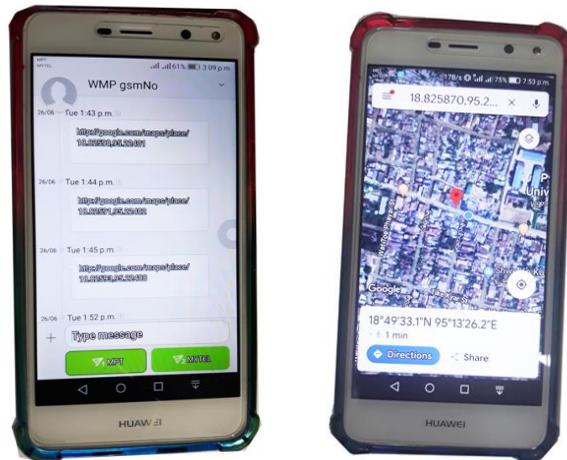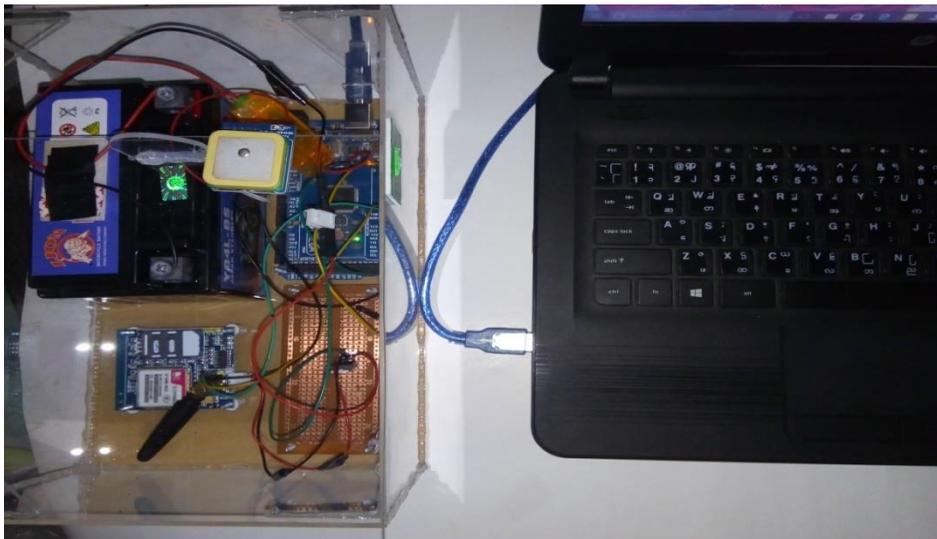**Figure 12:** Location Tracking on Google Maps output

Figure 13: Received SMS message and viewed on Google map

Figure 14: Photo of GPS-GSM Based Location and Position Tracking System

Conclusion

The GSM modem was configured and tested in the tracking system to monitor the vehicle's location via SMS and online on Google map. To display the position on Google map it needs the Google map API. The Arduino is the brain of the system and the GSM modem is controlled by AT commands that enable data transmission over GSM network while the GPS provide the location data. Whenever the GPS receives a new data it is updated in the database and hence tracking of object can be seen on Google map.

Acknowledgements

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