Smart Asset tracking

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Abstract—**Tracking system for automobiles implementing GPS technology is thriving suitably in this period. This technology is secure and consistent where all client/owners prefer. In this proposal a tracking device is designed implementing GPS and GSM Technology which is controlled by STM32 Microcontroller. GPS module used is Quectel L76 and GSM modem is SIM800C. The proposed thesis is for eventually monitoring the vehicle in real time. Proposed system is mainly an embedded application. It incessantly oversees the motion of the vehicle and gives an account of the vehicle whenever owner insists. When owner requests for the position of vehicle through SMS, system responds to the approach and sends current location of vehicle with Google Map link. The location of vehicle can also be witnessed in digital record using certain software tool using Internet. An open web server is implemented to exert in the desktop. The PHPadmin database is employed to pile up the GPS data of the vehicle. This database web server majorly works by PHP language. By retrieving the data from server the location is displayed in the software tool Node-RED via Maps. Node-RED platform mainly works on JavaScript code functions. In the local host of Node-red, the current location of the vehicle is viewed. This designed application can help in case of theft of vehicles.**

Keywords — *GPS, GSM, Quectel L76, STM32, Node-RED, PHP, SIM800C.*

I. INTRODUCTION

The tracking system for vehicles is entirely self assurance. GPS technology helps to reveal and monitor the location of the vehicle. The GPS tracking device is installed inside the vehicle, thereby it can provide present spot of the vehicle. Also as database web server is implemented the GPS location data is saved for the future references. This proposed system serves as fundamental equipment for tracing vehicle whenever client wants to. This system is an essential device for tracking car any time the owner wants to oversee it. It can be much helpful for the classy and luxurious vehicle to prevent from theft. The GPS data stored in database server is reclaimed using particular software tool and pictured on maps using internet.

The proposed GPS tracking device consists of hardware and software. The device includes modern hardware and software parts. The hardware parts are STM32 microcontroller, GPS module Quectel L76 and GSM modem SIM800C which are interfaced in the way to function as tracking device. GPS module has GPS antenna which receives the signals through satellites and it is conveyed to the controller. GPS technology works by technique called Trilateration. When signal is transmitted by satellite, a circle is created with certain radius, when second satellite is detected second circle intersects with first circle and is narrowed down. Ultimately, when third satellite is detected, one more circle is created. All three circles are intersected and location is determined.

Data information is in the form of coordinates. This data is drawn from controller via GSM and location status is sent to the specified owner via SMS with Google Map link. Along with updating location through SMS, a proposed thesis also has application of wireless database web server. Implemented server here mainly built by PHP language where all data location information of the vehicle is stored. Gathered GPS data in server is viewed in the software tool Node-RED via local host using maps.

The Main aim of the proposed project is to precisely locate the vehicle in real time and adequately monitor the vehicle locations through SMS tracking mode and eventually keep an eye on vehicle by using database web server.

This paper is organized as follows. Section II includes the methodology which describes the design of the system and working. Section III provides the specifications of hardware and software modules that are integrated together. Section IV explains the implementation and the results obtained. The conclusions are presented in Section V.

II. METHODOLOGY

GPS tracker is for vehicle concerned with GPS positioning technology and GSM wireless Communication. Aiming at vehicle tracking, by obtaining GPS navigation information outline constraints and GSM wireless data transmission. The insight of the tracker is in gaining the precise position of the vehicle.

For any device or model to work effectively and efficiently, the system requires certain hardware and software assets to prompt on the system. The proposed model has STM32F1 microcontroller, GPS and GSM module to gain the precise location of the vehicle. Figure 1 shows Outline schematic of the proposed system.
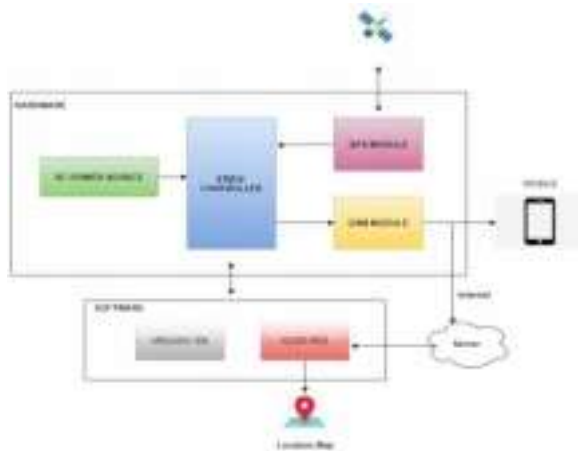

Fig .1 Outline schematic of the proposed system

GSM is a digital technology used for transmitting data services. The GSM functions allow the program to interact with a cellular engine in the device. In the proposed system GSM is used mainly for SMS communication. STM32controller is interfaced to GPS module and GSM modem serially. The GPS Module sends data coordinates, the data is read and processed by the STM32controller. The course data is sent to the owner"s mobile all the way through GSM modem. The model is fixed in the vehicle in a hidden or discreet. Thereafter, it can simply track vehicle by means of phone number of the SIM attached to the GSM modem and inevitably get the location of the vehicle in the form of an SMS on the mobile phone with Google map location and eventually vehicle location is monitored using internet. GPS data is stored in the database server and is viewed in maps.

Executing software programming tool Node-RED, outcome or the precise location of the vehicle is monitored using internet. GPS data is stored in the database server is viewed in maps using this tool.

A. Hardware Design

Quectel L76 is a GPS module which receives signal from satellites. Raw data obtained are latitude, longitude and time from GPS. GPS module is interfaced to STM32 through UART peripherals. GPS module interfaced sends data to controller.

SIM800C is a GSM module which transmits data. It permits communication between the controller and the GSM network. It enables wireless communication with devices. GPS data obtained from GPS module is transferred to particular device/ mobile phone via SMS through controller. GSM module is interfaced to STM32 through UART serial pins. GSM module interfaced to the STM32 controller transmits data to specified device through controller.

To make Arduino IDE communicate through UART uploading codes, FTDI is required. Mainly for serial communication FTDI is required as it has USB port.

B. Software Design

The code of GPS-GSM in Arduino is formulated using Arduino IDE (Integrated Development Environment) to get the GPS data from GPS module and also send location details via SMS to the user/client and store location in database server.
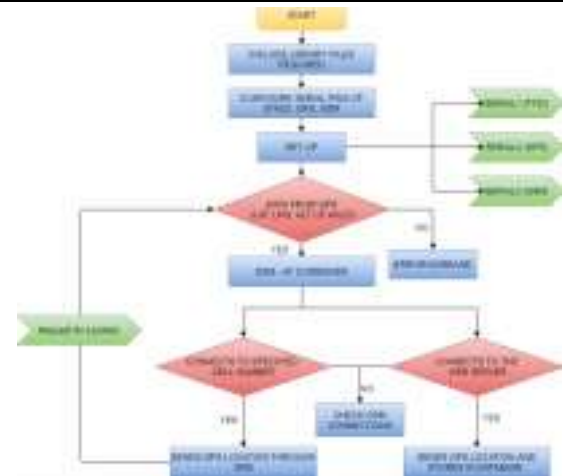

Fig .2. Flowchart of GPS-GSM programming

The operation of GPS-GSM programming starts by including library files for GPS and STM32. Next process is to figure out UART pins of STM32 as serial1, serial2 and serial3. STM32F1 controller used here has three UART peripherals. Serial1 UART pins are interfaced to FT232, serial2 UART pins are interfaced to GPS module, serial3 UART pins are interfaced to GSM module. The setup() function includes serial.begin()for communicating with serial monitor. Next consecutive process as in flowchart is loop function where data sent by GPS is read by controller. If the data obtained is valid or rational, the data is sent to GSM, unless it shows garbage values. GSM functions as a mobile station when SIM card is inserted. As per the AT commands given it communicates with mobile network.

Once all set the GSM sends GPS data obtained to the provided mobile number through SMS. SMS contains current precise latitude, longitude, altitude, time with Google map location. Further when location is requested, process goes back to the loop and cycle goes on. Updated location is sent to the specified number, hence vehicle is tracked. Apart from SMS, the location is also updated in the Database web server. The flow chart of the GPS-GSM programming is as shown in Fig. 2.

In the proposed system, location data of the vehicle is stored in the PHP text files. GSM module is connected to web server by the AT commands given and data is stored in files. The flow chart of database is as shown in Fig.3.
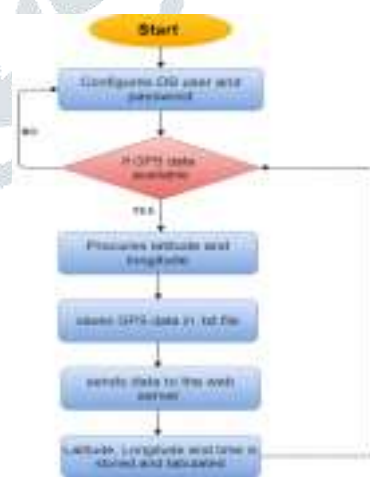

Figure.3. Flowchart of Database

AT command is sent by the GSM module when response is OK, it"s working fine. Now the database user and password are configured in PHP .txt files. When configuration is all right, the GPS data is saved in the PHP .txt files. PHP script code is written for the web server page. Saved data is sent to the database web server platform called „phpadmin", here the latitude, longitude and time are recorded.

Node-RED is application software tool used in this proposed work for displaying location in maps and eventually monitor the location of vehicle. Vehicle location data stored in database is displayed in maps. Node-RED is mainly used for cabling hardware devices mutually. Application Programming Interface (API) and online facilities can also be implemented in different and unique ways. It mainly follows JavaScript code to run a

specific function.

Fig .4. Flow Diagram for GPS in Node-RED

The operation in Node-RED begins when „http request" node used for building http requests. Its function is to Get web pages from website, API request is made, sends and receives JSON data to the website. The html node is implied which outlines its appearance with the editor. It holds three separate segment, each enclosed by its own „<script>" tag.

Here Function1 represents the Java code which receives the latitude, longitude, altitude data obtained. Function2 stands for code to display GPS data elements obtained in function 1. Function3 corresponds to the Java function written to trace the location on map through the data obtained by Function1. Finally location is marked out in world map. Also time function is executed and time is also displayed. The flow diagram for GPS in Node-RED is as shown in Fig. 4.

II. HARDWARE AND SOFTWARE DESCRIPTION

Selecting the modules for the application is itself large extent significant. In this chapter, the selection of components and software specifications is discussed.

A. GPS module

The GPS module needs to be preferred according to the requirement. The requirement is to obtain the precise location of 1 to 2m. The GPS module is as shown in Fig. 5. Quectel L76 is precisely a GNSS module rather than GPS module. A component equipped with GNSS feature, it makes use of navigational satellites. It supports tracking and acquisition channels. It has horizontal position accuracy of 1 to 2.5 m. It has sensitivity acquisition and tracking of -148dBm and -165dBm respectively. This module is Ultra Low power tracking device. For time service NMEA can also be used.

Fig .5. Quectel L76 GPS module

B. GSM module

SIM800C is GSM/GPRS module which is quad-band. It works on various frequencies. The GSM chosen is as shown in Fig. 6. This GSM has compact size of 17.6*15.7*2.3mm.
It supports many application namely smart phone, handheld PC and other devices.

Fig.6. SIM800C GSM Module

C. FTDI

For serial implementation FTDI USB to TTL serial converter devices are used. For communicating and to develop boards for many microcontrollers, FTDI is favored. Namely for ESP and Arduino Boards which has no interfacing facility, this device promotes to make use of it. It uses 3.3 to 5V DC and indeed it is a UART board mainly applicable for serial communication. The FTDI used here is FT232 IC which has a USB interface. Fig. 7 shows FT232.

Fig .7. FT232

D. Microcontroller

The STM32F103C8T6 is the microcontroller element used in the proposed structure which fit into the STM32 microcontroller profile. The core advantage of using the STM32F103C8T6 is that it can be programmed simply in Arduino IDE. The image of STM32F103C8T6 controller is shown in figure 8.

Fig .8. STM32 Microcontroller

STM32 as the term indicates it is a 32-bit microcontroller imparted by ST Microelectronics. It is predominantly built on the ARM Cortex M processor and provides a 32 bit output limit that unifies exceedingly vast implementation, real-time capability and permits low power, low voltage function.

E. Arduino IDE

Arduino IDE version 1.8.13 is employed with inherent libraries to obtain the data coordinates from GPS module and thereby send via SMS through GSM. Arduino library called TinyGPS++ is used for translating NMEA data imparted by GPS module. It digs out position, date, time, altitude from GPS.
STM32duino library is installed to use STM32 controller in Arduino IDE software. Tool board STM32 generic series is installed for uploading the program.

F. 000webhost

000webhost is open and free web server platform with PHP and MySQL. For analysis purposes and for researches it provides better stage. Free Website can be built in this platform. For testing purposes it serves as a local web server. PHP is widely used script language for web server. HTML, text, JavaScript code and CSS can be included in the PHP files. PHP files can be revised or changes as per our requirements.

G. Database

Data means information or statistics which has to be stored. Base is known as the foundation or support. Finally, database is a compilation of facts or data which is arranged systematically hence, data can be controlled, renewed and gathered up without difficulty. For precise function a particular database can be designed and created. The software called database management

system (DBMS) is built to direct the database. Implementing this software, developers can build or deal with data facts as per their constraints. DBMS provides agreement, reliability and protection.

H. Node-RED

Node-RED is the software tool mainly used for displaying data and used for monitoring applications. This software runs by JavaScript code function. In the proposed work, the data values obtained from GPS module namely latitude, longitude and altitude are stored in the database server. These data elements are retrieved in Node-RED and vehicle location is monitored in real-time.

III.EXPERIMENTAL RESULT

Main criterion of the proposed work is vehicle tracking which is analyzed in this segment. Initially, the GPS data output obtained is conferred. Further data obtained is transferred through GSM via SMS and also location is traced through Local host in Node-RED. Ultimately, the precise location obtained is manifested in maps is also presented here.

The proposed GPS-GSM model is powered. First, the GPS module has tested for its proper operation. GPS performs in all the weather state. The GPS receivers translate the signals and analyze the precise location. The GPS in essence needs time to catch the signal and actually locate the mole. For this the antenna of GPS should be open to the Sky to receive signals untimely. GSM Module requires AT commands to cooperate with controller, which are correspond owing to serial communication. Data obtained from GPS is transferred through controller. GSM sends SMS messages.
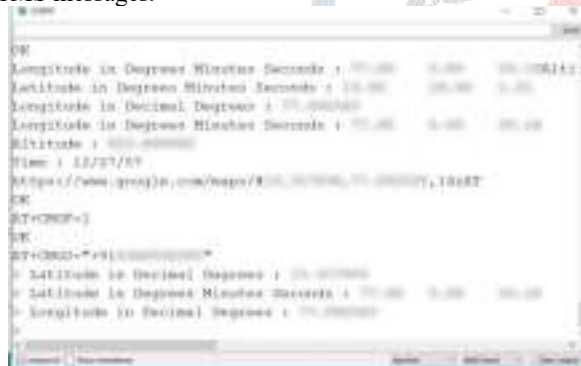

Fig.9. Snapshot of the GPS data obtained in serial monitor

Fig 9 illustrates the data obtained from GPS module which is obtained by interfacing GPS (Quectel L76) and STM32 controller and also interfacing GSM and STM32 controller. As shown in above figure latitude, longitude, altitude data is obtained from GPS module. While after AT commands are executed desired data is sent to specified cell number as indicated in the code. "OK" in serial monitor indicates the GSM is performing all right. Also Google Map location link is sent through SMS is also revealed in serial monitor.

Fig 10(a) shows the screenshot of the SMS sent to the user for monitoring location of the vehicle. SMS comprises latitude, longitude and altitude of the vehicle. Along with the SMS, a link is affixed such that client can witness the location straight through Google map as shown in figure 10(b).

(b)   (a)

Fig.10. (a) Snapshot of the SMS with Google Map link (b) View of the location in Google Maps

The GPS data obtained from GPS module is primarily sent to the GSM via SMS and Google map location can be viewed in mobile as all devices nowadays have this application. Including digital mapping using internet is also required. Database server is implemented where GPS data is stored thereby vehicle is monitored effectively. Implementing software programming tool Node-RED, a result or the precise location of the vehicle is presented in the world map and can be traced anywhere .

Fig.11. Snap image of the GPS Data in web server

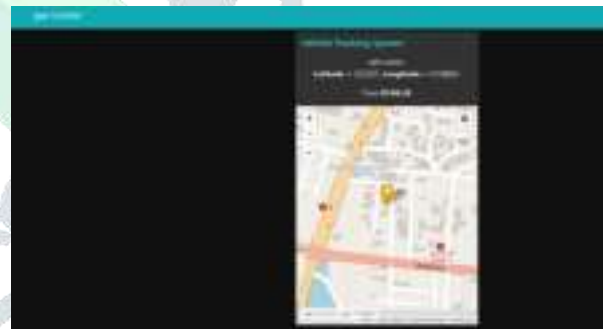Fig 11 shows the GPS data stored in the database server with latitude, longitude and time.

Fig.11. Snap image of the location in local host

Above fig 11 shows the GPS data latitude and longitude in degrees and time. Implementing this data, it is shown in the world map. World map and data are displayed in the local host of Node-RED.

IV.CONCLUSION

The proposed model is summarized and developed for vehicle monitoring with the assistance of the STM32 microcontroller, FT232, GPS module, GSM module. By interfacing STM32 Controller with GPS and GSM module, the data obtained from GPS is sent to GSM through controller. SIM inserted in GSM module sends data to cell number mentioned in AT commands, along with Google map location. Including SMS tracking mode, web server database is also implemented for real-time tracking of vehicle. The location of vehicle is monitored in local host of Node-RED.

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