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GPS and GSM Based Vehicle Tracker

S. M. A. Motakabber, AHM Zahirul Alam, Mohamed Reda Maurice Francis and Syed Ahmad Fawwaz Wafa

Dept of ECE, Kul. of Eng., International Islamic University Malaysia (IIUM), Jalan Gombak, 53100 Kuala Lumpur, Malaysia

*Corresponding author: amotakabber@iium.edu.my

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Abstract—Nowadays, electronic wireless vehicle tracking is becoming essential for preventing car theft and emergency services in vehicle accidents. There are three types of vehicle tracking systems in the market. Each has its advantages and disadvantages. Based on the working principle, these trackers are classified as cellular phone-based trackers, wireless passive trackers, and real-time satellite trackers. This paper has discussed designing and developing a vehicle tracking system using an Arduino microcontroller, GSM, and GPS modules. The proposed design is a different approach to these vehicle tracking systems. The function of the tracker is done in three steps; first, it connects the hardware components and tests the connectivity; when the secure connectivity is confirmed, it executes the write command for the connected GSM and GPS modules. Finally, it tracks the target vehicle, collects the GPS coordinates, and processes the data using the software. The proposed design has been verified by MATLAB simulation, and the results obtained are satisfactory for both simulation and practical examination.

Keywords: *GPS, GSM, Tracker, Vehicle tracking, RFID, Arduino microcontroller*

1. INTRODUCTION

The GSM (Global System for Mobile Communications) is a level made by the European Telecommunications Standards Institute (ETSI) to classify the protocols for second-generation (2G) digital communication designed for cell phones, which prevailed in Finland in July 1992. As of 2014, it has become the practical worldwide standard for mobile networks.

However, the GPS (Global Positioning System) is a global navigation satellite system that supports the location and time information to a GPS receiver anywhere on or close to the globe. There is an unblocked vision of four or more GPS satellites. The GPS works freely on any phone or internet receiving, although those technologies can increase the GPS positioning information's advantage. GPS supports many critical locating abilities for the army, social, and trading consumers worldwide. The US government designed the system, controls it, and allows it to be independently attainable to anyone with a GPS receiver. However, the United States government can suitably decline entry into the system. Integrating both technologies can produce high capabilities and usefulness for positioning, communication, and safety.

2. TRACKING SYSTEM WITH SENSORS

Rathinakumar and Manivannan (2012) proposed three modules for the car tracking system, automatic velocity monitor system, detecting accidents module and protection access module, as shown in Fig. 1. A control module, an RF transmitter (Tx) and an RF receiver (Rx) are used to monitor spontaneous speed. The contactless sender can transmit the information up to 30 meters away from the car. The RF module used a free spectrum carrier frequency of 418 MHz. The RF sender is placed in a suitable location, and the RF receiver is put in the car. When the vehicle attains a zone like a school or U-turn, it spontaneously decreases the velocity. When it reaches out of the location, it will spontaneously recover its velocity. Based on this, an accident probability is going to be decreased. The data transmitting modules, GSM, GPS, and various sensors have been implemented in the car. If accidents happen, the vibration sensor tests the vibration level. Suppose it overrides the threshold boundary. The module tries to find a chance of an accident at a specific location. The GPS detects the car position and transmits the data through the GSM module to the base station.

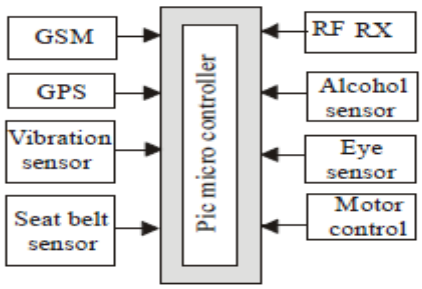

Fig. 1: Block diagram for the vehicle tracking system [1]

Nowadays, vehicle stealing cases are more significant than ever before to secure vehicle-efficient security with the only credible anti-stealing gadget. The vehicle protection gadget offers efficient security to the car. A vehicle with an electronic control unit protection system can help the owner immediately shut off doors when pressing a button. The main types of electronic control units (ECU) are manual or automatic. These systems could not give the absolute protection and attainability of the car in case of stealing. Thus, an improved system potentially uses a firmed system based on GSM technology [2].

2.1. Controller Area Network

In 2014 Prakash and Sirisha proposed an improved system with a monitoring system inside the car. This project aims to introduce a mobile connection to the firmed system. The automotive industry employs CAN (Controller Area Network) in-car network for engine management, body electronics such as door and roof monitor, air condition and light, for fun monitoring. Many car manufacturers have also started to design CAN-based car automation. CAN communications are employed in engine management to connect various ECUs. The vehicle manufacturing industry put a basic level of the protection system, like a warning system. SMS is an excellent method of connecting the traditional alarm because it is achievable and not expensive.

The scheme's concept is to adjust the various quality of the existing protection system, which will alarm the car's driver by transmitting SMS. When an invasion upon the car gives the resolution to stop car stealing in the cheaper than sophisticated protection vehicle system.[3].

2.1.1. A tracking system with RFID

In this proposed system, an RFID reader will be installed beneath the car to follow the landmarks of locations to known places like schools, hospitals, petrol stations, temples, etc. Every road will be connected with RFID tags. These RFID tags will include the data, such as the names of the locations around it. The presented burglary control system regains a geographical place and supplies a means to monitor the car's additional motion. The system is designed to make a trait that would control the vehicle's speed by (motor switching on/off) just onto reception of an established program in advance of the user, who may be at a distance through mobile phones.

Arduino is a low-cost microcontroller that uses simple interfacing, IoT [4] and many applications. A tracking system was proposed in [5] that included an Arduino to help make the process quicker. Once the vibration sensor gets the vibration measures the vibration from the accident's friction, the Arduino will send an SMS message containing the location through a GSM module; the location is obtained from GPS.

The concept of this design is to send data of the accident to the emergency car and relatives. GSM module is chosen to send the data by sending SMS messages and GPS technology to locate the vehicle. We use a GSM modem that has a SIM card. GPS location is included in the SMS sent to the ambulance to have precise information about the accident's place and time. Thus, a GPS module is used to elicit the accident place, and the GPS info should include the latitude, longitude, and altitude values. To function the GPS and GSM modules, an Arduino UNO board is used that contains a microcontroller. Arduino is an easy-to-use gadget that can be connected with some small sensors or modules. It is clear that the Arduino will transmit the SMS message by the GSM module by placing the GPS in the message gained from the GPS module. A vibration sensor is used to detect an accident and it is located in the vehicle. The vibration sensor is in the vehicle to perceive the vehicle's vibrations. When the driver collides, the vehicle strikes the land. The vibration sensor examines the vibrations resulting from the hit, and then the Arduino will transmit a message comprising data of the accident and its place. The Arduino microcontroller sends a short message to the mobile phone via a GSM module along with the facts that by accident

occurred and the exact position from the GPS module. The utilization of automobiles is on the rise as a great deal as injuries occur. The venture's overall characteristic is to detect the coincidence of the usage of the GSM and GPS modules interfaced with the Arduino controller. When the vehicle is subjected to an accident, the vibration sensor senses the amount of the vibration. When the amplitude is extra than the fixed restrict, the program is being triggered. The controller, instead of cutting-edge vicinity using GPS and switch that place the use of GSM to the emergency variety designated within the program and the coincidence car identity number.

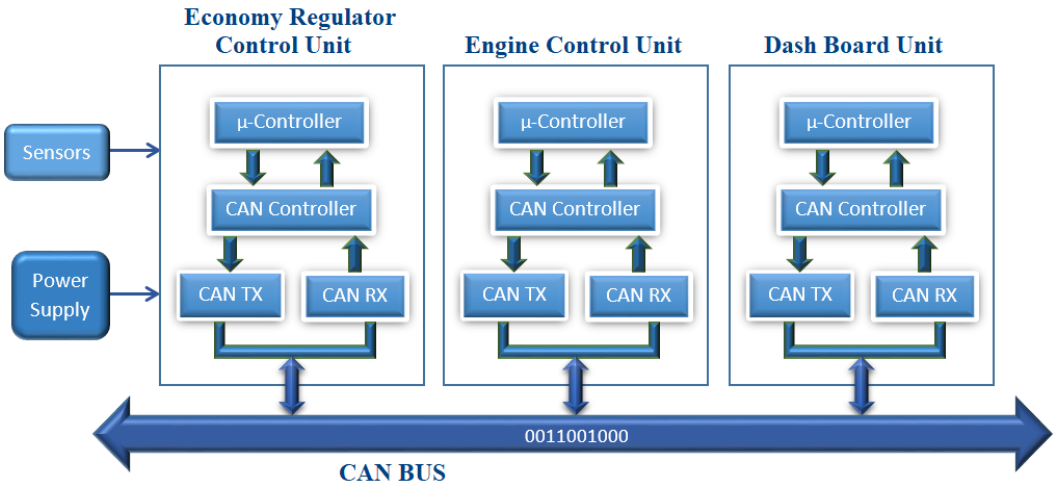

Fig. 2 Modified block diagram for the vehicle tracking system [3]

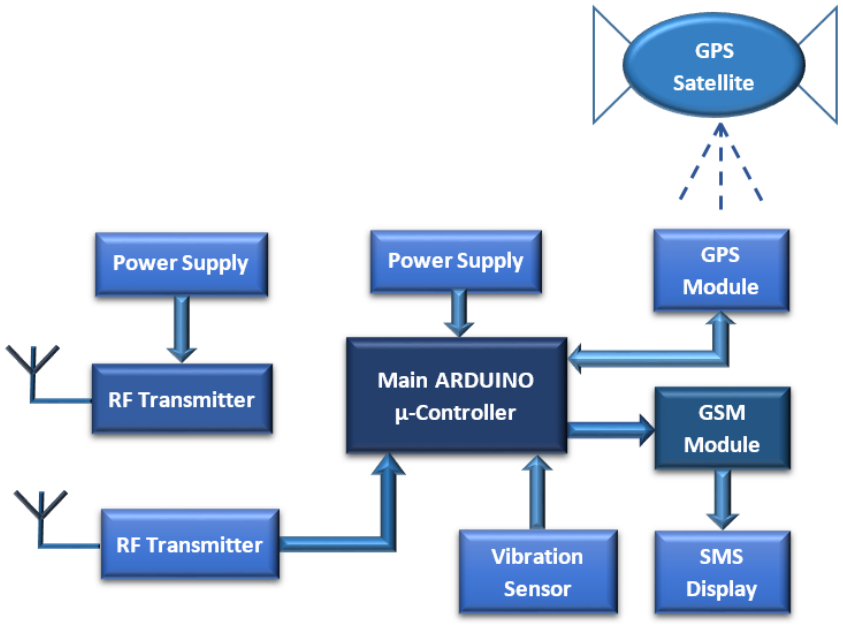

Fig. 3: Block diagram for the Arduino based system

3. DESIGN OF GPS GSM BASED VEHICLE TRACKER

MB102 Solderless Mini Breadboard: It has 400 holes, and its size is 8.5cm X 5.5 cm. The breadboard lets the user put on and off parts, and thus if there will be alterations or the user wants to make a quick circuit, it will be much faster than soldering up the circuit. Many breadboards that share the same size can be joined horizontal or vertical parallel. Breadboards are environmentally friendly. Jumper wires are an essential part that connects two or more devices. They come in many colours to be picked up the right one when many are on the breadboard.

Battery or power bank: to charge the whole system

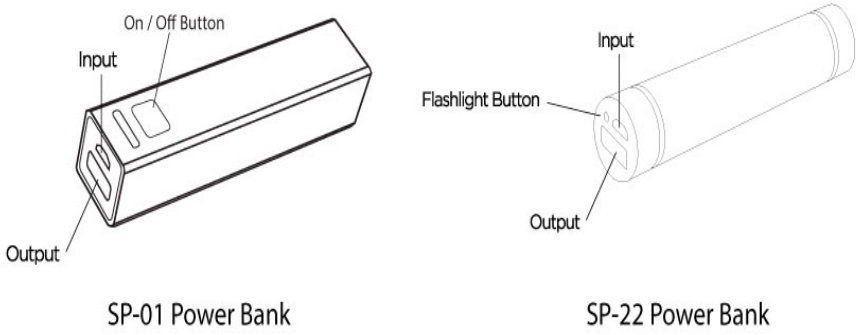

Fig. 4: Examples of power banks

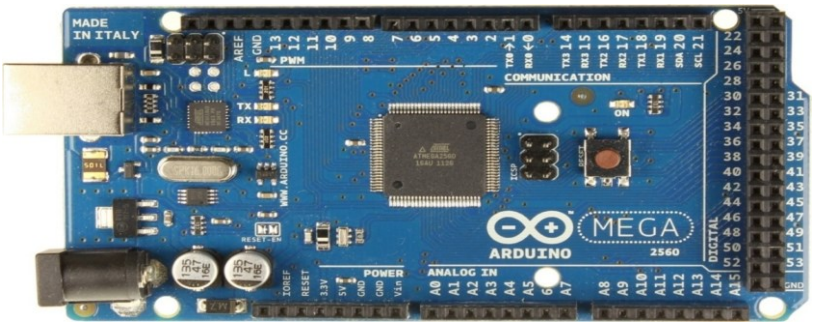

Fig. 5: Arduino MEGA 2560

3.1 SIM900A GSM GPRS Wireless Extension Module Board

The SIM900A is an inexpensive and easy Arduino GSM and GPRS module. It is available in the markets. The SIM900A is a complete Dual-band GSM/GPRS module in an SMT system that could be rooted in the user process, enabling gains from tiny dimensions and ineffective gains. It features an industry-standard interface, and the SIM900A delivers GSM/GPRS 900/1800MHz performance for voice, SMS, Data, and Fax in a small form factor and with little power consumption. With a small configuration of 24mm x 24mm x 3 mm, SIM900A can fit almost all the applications' space requirements

Fig. 6: SIM900A GSM GPRS Wireless Extension Module Board

3.2 GY-NEO6MV2 GPS Tracking Module with Antenna MWC AMP2.5

It comprises a ceramic antenna; EEPROM power-off data save; info saving battery; LED signal indicator lamp. Antenna size: 25 x 25mm; Module size: 25 x 35mm; Install hole dia.: 3mm; Default baud rate: 9600; Compatible with different flight controller modules NEO6MV2 GPS module has 4 plugs: Rx, Tx, Vcc, and GND, and that is simple to integrate with using Software Serial on a serial interface on an Arduino Mega. There is only one little problem: The module uses 3v3 logic, which is incompatible with Arduino's 5v. However, a simple voltage divider can solve this issue.

Fig. 7: GY-NEO6MV2 GPS Tracking Module

There is more than a manner to connect a GSM module to an Arduino. The connection between Arduino and GSM module is serial in style. Therefore, it's miles supposedly the use of serial pins of Arduino (Rx and Tx). Thus, if the device is used, connect the GSM module's Tx pin to the Rx pin of Arduino and the Rx pin of the GSM module to the Tx pin of Arduino.

An SMS message is to be despatched to the device, and it sends lower back the modern-day GPS vicinity inside the shape of an SMS. The GPS location is a Google Map hyperlink. The device constantly updates the GPS place to the most effective quantity unique within the code.

The Arduino MEGA controls the complete process with a GPS Receiver and GSM module on this undertaking. GPS Receiver is used to detect the car coordinates, and a GSM module is used to send the coordinates to the user via SMS.

The GSM module receives a despatched message linked to the system and sends the info to the Arduino MEGA. Arduino MEGA reads it and extracts the main message from the whole message, then compares it with the predefined message inside the Arduino MEGA. Arduino reads coordinates by extracting GPS info and sending it to the consumer through the GSM module if any fit takes place. The message consists of the coordinates of an automobile place.

Communication technologies developments have long considered passed the best functionality to get admission to others while shifting. Today, cell conversation devices are getting a whole lot extra sophisticated and offer extra than the capability to preserve communication. Smartphone GPS tracking is one of those advances.

All smartphones frequently ship a radio sign, despite the fact that no calls are occurring. As an end result, cellphone organizations were capable of predicting a smartphone's location for decades with the use of triangulation facts from the towers receiving the sign. However, introducing the GPS era into smartphones has intended that phone GPS monitoring now makes these records lots more correct.

The era of finding an area is based totally on measuring electricity stages and antenna styles. It uses the idea that a smartphone always communicates wirelessly with one of the nearest base stations, so it's far recognized which base station's smartphone is speaking. It is also known to be close to the respective base station.

Real-time monitoring is also useful from a safety viewpoint because it shall we car owners to specify the car's particular area at any time. In addition, the vehicle's GPS tracking system may be a useful resource for police training sessions wherein the automobile is taken to if it's far stolen.

The GPS module used on this assignment is GY-GPS6MV2 and wishes an electricity supply of 3V to 5V. It has a ceramic antenna and a sturdy signal connection. The EEPROM saves the configuration parameter records whilst the strength is down. It comes with a statistics backup battery. The LED signal lighting whilst running; it's

miles a visible way to see the module captures data. It has a default baud rate of 9600. It is well-matched with various flight manage modules and relatively small in length with a small antenna.

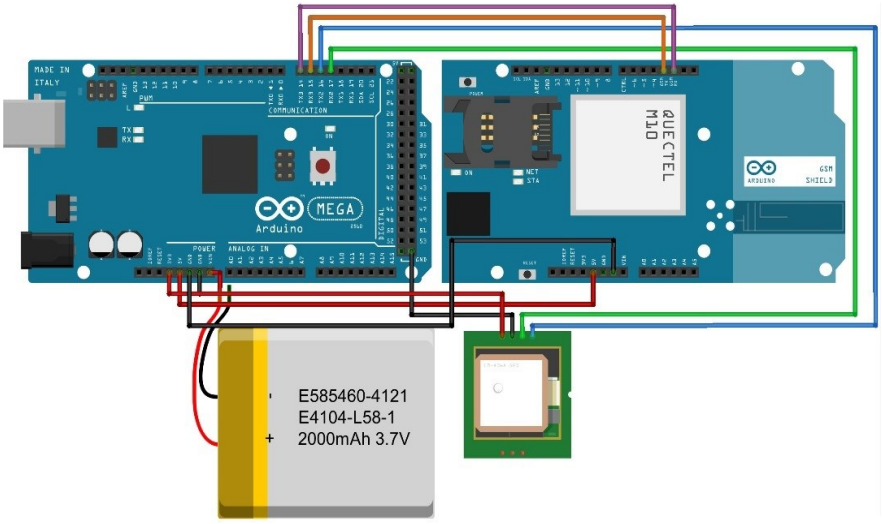

Fig.8: Proposed tracking module

SIM900A modem is made with twin-band GSM/GPRS primarily based SIM900A modem from SIMCOM. It operates on frequencies 900/ 1800 MHz. SIM900A can seek these bands mechanically. AT Commands can also set the frequency bands. The baud fee is configurable from 1200-115200 thru AT command. The GSM/GPRS Modem has an inner TCP/IP stack to hook up with the internet through GPRS. SIM900A is an extremely compact and reliable wi-fi module. It is a complete GSM/GPRS module in an SMT kind and designed with a strong unmarried-chip processor integrating AMR926EJ-Score, allowing you to advantage from small dimensions and cost-effective solutions.

Arduino Mega ATmega1280 microcontroller board has 54 digital enter/output pins, 16 analogue inputs, 4 UARTs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It has the entirety required to aid the microcontroller; plug it right into a PC with a USB cable or fee it with an AC-to-DC adapter or battery to get started out. The working voltage is 5V; recommended enter voltage stages from 7V to 12V but needs to know not exceed the 20V limit.

The Arduino Mega might be run by using a USB connection or an outside power supply. The electricity supply is selected automatically. External (no longer USB) charging ought to come from a battery. Leads from a battery can be inserted inside the ground and Vin pin headers of the POWER connector.

The ATmega1280 has 128 KB of flash reminiscence to keep codes (four KB used for the boot loader), eight KB of SRAM and four KB of EEPROM.

ATmega1280 has several facilities for connecting to a PC, any other Arduino, or other microcontrollers.

ATmega1280 has an applicable poly fuse that protects your PC's USB ports from shorts and overcurrent. Although most computer systems offer inner safety, the fuse gives an extra layer of protection. If greater than 500mA is applied to the USB port, the fuse will automatically prevent the connection till the fast or overload is taken away,

The venture is appealing because its uses are obvious in terms of protection and economics for the same old consumer. Furthermore, the GPS and GSM modules and the Arduino Mega are small in length, making the product usable for motors and any shifting items.

4. RESULTS AND DISCUSSION:

The prototyping circuit for the proposed tracking systems is shown in Fig. 8.

The circuit shows the hardware, including the Arduino Mega, GPS & GSM modules. The GPS module generates the vehicle location and updates the longitude and latitude, as shown in Fig. 9. The accuracy of the *GY*-GPS6MV2 GPS module is very high and goes up to almost 80%.

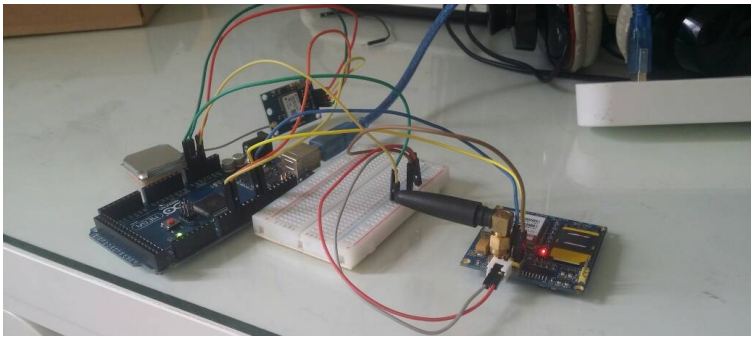

Fig. 8: Hardware prototyping circuit

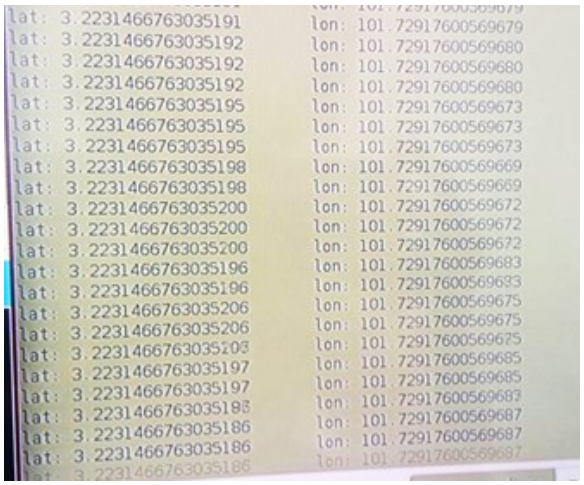

Fig. 9: Display the longitude and altitude of the Tx module

Fig. 9 shows the longitude and altitude generated by the GPS module over an hour. The GPS module then sends the data to the GSM module, sending the data to the smartphone-like in the picture below.

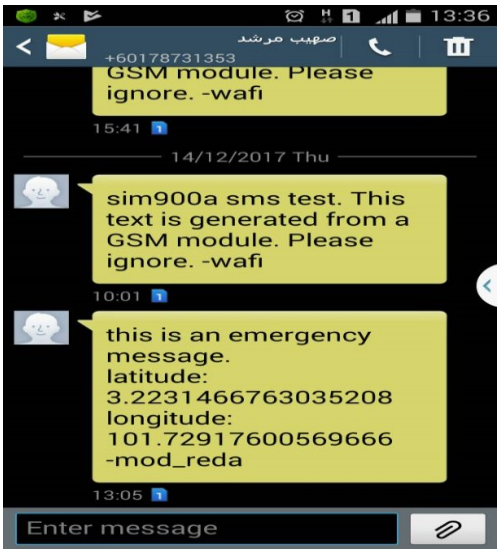

Fig. 10: SMS data

The picture in Fig.10 shows the data received as the SMS service of the mobile phone.

5. CONCLUSION

The proposed tracking and management system with GPS and GSM modules have been completed, and efficient data transmission and monitoring are experimentally verified. The project allows real-time control letting rightful applications be made. It is suggested that the use of this system will result in significant updates for vehicle tracking systems. The proposed method has multiple benefits. It could be applied for a lost car to track when dealing with the alarming vehicle management system. In the future, sensors can be used in these systems to improve their strength further. The sensors detect car mode info to the server, which could help the data process and intelligent tracking management.

The GPS and GSM technologies are implemented to reduce civilians' dangers and the extreme situation because of accidents or theft. Therefore, the ambulance or police service should take the instant step, minimizing the risks.

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