Vehicle Tracking System by Using GPS, GSM, and Arduino Technology

Firas Muhammad Zeki Mahmood

Department of Informatics and Software Engineering, Cihan University-Erbil
Kurdistan Region – Iraq

Abstract- The fleet system uses a very well-established technology called the vehicle tracking system, the fleet system is the owner of the automobile and vehicle movement of goods around the globe, this technology is very reliable and safe. There's a proposition of a real-time tracking system in this paper and it's going to create a system that can be used for positioning and tracking of any vehicle by using Global System for Mobile communication and Satellite navigation system (Global positioning system). This system is designed as an application and will continuously indicate the status of the vehicle by monitoring its movement on demand. The device used for tracking to know the vehicle's location in real-time is made up of the SIM900A module, Arduino Uno R3, and NEO 6M GPS module. For accomplishing this the Arduino Uno R3 has to be serially interfaced with the GPS and GSM modules. For reporting the location of the vehicle continuously from a remote place the GSM module is used, while the other GPS module is continuously updating the Arduino of data such as latitude, speed, longitude, and distance traveled by using the satellite. For viewing the position of the vehicle on the map Google Map is used. By using the application the user can send a message of a number that is registered on the GSM that's attached to the Arduino, by doing this. The user will be able to receive information like longitude, google map lining of the vehicle, and latitude by a text message. This proposal contains vehicle security, salesman tracking, and private drivers.

***Index Terms*— Vehicle Tracking, Arduino, GPS, GSM, and Satellite.**

I. Introduction

GSM, which stands for Global System for Mobile Communication, and GPS, which stands for Global Positioning System is based on the location and tracking system of a vehicle, also the real-time location of the vehicles, the mapping, and reporting of their information value. The upper the services provided by the above mentioned. The design of the GPS-based vehicle tracking system is for the specific location of vehicles and the intimating of the position of SMS [3]. A GPS modem is included which retrieves the vehicle location in longitude and latitude terms. There is a geographic position used along with time information by the GPS [4]. There is an onboard module within the system residing in a tracked vehicle alongside a station monitoring data from a variety of vehicles. There is a GPS receiver and a GSM modem within the onboard module [5]. How the hardware is placed makes it invisible. The system continuously sends the data of the location to the monitoring unit, used as a cover unit. The location is used for information distribution to the police if the vehicle is stolen [6] [7]. That affects other pieces of technology that are made for it. There is an automatic return reply to the mobile indicating the vehicle's position in latitude and longitude terms following the request of a user. There has been a developed program used for the locating of a vehicle's exact position and navigating a moving vehicle [1]. There is tracking that can be allowed anywhere at any time regarding the target, under any weather conditions. It is user-friendly, installable very easily, accessible, and used for a variety of purposes [2]. Vehicle tracking systems are useful and essential for the tracking of a car that its owner monitors. Nowadays it is a popular move for people with expensive cars. It is an anti-theft car that helps recover a stolen car [8][9]. The technology of it is known as Vehicle Tracking Systems and has ensured the security of many vehicles. The hardware that is fitted into it sends location data from the system embedded within it to find the location, following a vehicle theft [10].
After the request of a user, the GPS coordinates are sent to the specified mobile that made the request, providing the user with latitude and longitude terms through a Google Maps link [11].

II. System procedure

The vehicle's tracking system project's circuit connection is quite simple. The GPS module's Tx pin has a direct connection to Arduino's PIN 8 and the Rx pin has a connection to Arduino's PIN 9. There have been serial communication allowed on pins 8 and 9, through the use of Software Serial Library, and turned them into Rx and Tx. Pins 0 and 1 are used by default by the Software Serial library for serial communication, allowing more communication on Arduino's other digital pins. For the Arduino's GPS Module to be powered, a 3.3 Volt supply is used. The Tx and Rx pins in the GSM module have a connection to the Arduino's digital numbers 6 and 7. Again, through Software Serial Library, there has been room for serial communication on pins 6 and 7 to Rx and Tx respectively. An external 12V supply powers the GSM module. There are LCD optional data pins, D4, D5, D6, and D7, which connect to Arduino's PINs 5, 4, 3, and 2. The Arduino's PINs 12 and 11 are connected to the command pins RS and EN of the LCD, with the RW pin being directly connected to the ground. The contrast and brightness of LCD are set through A Potentiometer.

III. Connecting GSM Module to Arduino

Two ways connect the GSM module and Arduino, in both of which is a serial communication between the Arduino and the GSM module. There is a need to use serial pins of Arduino,

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Rx, and Tx. Following that method, the Tx Arduino pin may be connected to the GSM module, and then the Rx pin of the GSM module to the Tx of the Arduino.

The ground Arduino pin then better be connected to the GSM ground pin Module [12]. That concludes three connections, finalizing the wiring. This results in a load of various programs that communicate with the GSM module, making it functional. There is a problem regarding this, that when programming the Arduino, it uses serial ports for the loading program of the Arduino IDE. In case of those pins being used in wiring, there won't be a successful load to Arduino. Therefore, there is a need for Rx and Tx wire disconnection with every program burned to the Arduino [13].

After the successful load of the program, the pins can be reconnected and the system begins to work. For that difficulty to be avoided, there is an alternative method used, where two digital Arduino pins are used for serial communication. There is a need for the use of two PWM-enabled Arduino pins. There is a decision made for pins 6 and 7 to be used, which are PWM-enabled pins. The method can be carried out by the Arduino's Software Serial Library.

The Software Serial is a library of Arduino that allows the communication of serial data through various other Arduino pins. There is a presentation of the circuit diagram below, that connects the GSM module and Arduino, using the circuit for the sending and receiving of Arduino and GSM modems. See fig.1.

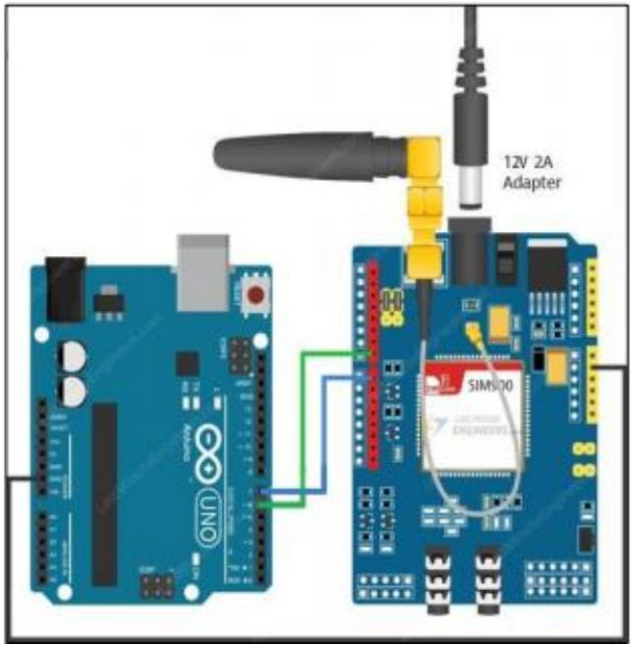

Fig. 1: System Procedure [14].

IV. Automatically turn on GSM shield

Although before, turning the shield on was a non-automatic act, instead of a manual turn now there is an automatic press of the Power key that turns on the shield see fig 2. The process is as follows:

1. R1 and R3 connected to the shield and soldered.
2. Connection of D9 on the shield to the A5 pin in the Arduino. See fig. 3.
3. Pin D9 of Arduino made HIGH for a round of 5 seconds by the software. This is as if when press the power button.

Fig. 2: R1 and R3 connections

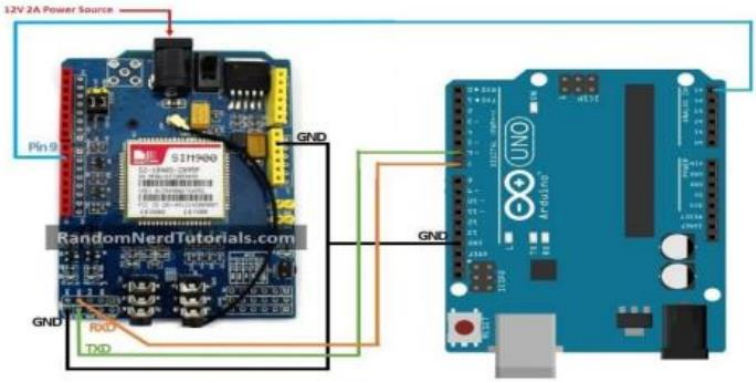

Fig. 3: D9 and A5 connection to Arduino [11].

V. Booting the GSM Module

1. Insert and lock the SIM card to the GSM module (ensure that the SIM card has no PIN lock).

2. When connecting the adapter to the GSM module, turn it ON (it must be auto started)

3. Wait for approximately a minute and check the blinking rate of the "status LED" or the "network LED". The GSM module takes a bit longer to reach the connection with the phone mobile network.

4. With successful connection establishment, there will be continuous blinking of the status/network LED every 3 seconds. It could attempt to make a call to the mobile number of the GSM module's sim card, sending and receiving SMSs.

VI. GSM Module AT Commands

AT Commands can interface GSM Module. Below are some GSM AT commands. See Table I.

TABLE I
GSM AT commands

AT Command	Description
AT	Handshaking with SIM900
AT+CMGS=PHONE_NUMBER (in international format)	Send SMS to the number

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AT+CMGF=1\r	Set the SIM900 to text mode
ATDP+ PHONE_NUMBER (in international format)	Call the number
AT+CMGR=1\r	Read the second SMS from the inbox
AT+CMGR=2\r	Read the second SMS from the inbox
ATA	Receive an incoming call
ATH	Hang up a call
AT+CREG?	Check SIM registration in the network
AT+CCID	Read SIM information to confirm plugging
AT+CSQ	Signal quality test

VII. Connecting GPS Module with Arduino

The NEO-6M GPS module is made of four pins: VCC, RX, TX, and GND [15]. The Arduino and the module communicate through serial communication with the TX and RX pins, See Table 2, the wire connections show in fig 4.

TABLE II
Connecting GPS Module with Arduino

NEO-6M GPS Module	Wiring to Arduino UNO
GND	GND
VCC	5V
TX	TX pin defined in the software serial
RX	RX pin defined in the software serial

Fig. 4: Connecting GPS Module with Arduino

VIII. Connecting LCD Module to Arduino

The following pins need to be connected for the LCD to be connected to the Arduino board [16]. fig.5:
- LCD VSS pin to the ground.
- LCD VDD pin to a +5v power.
- LCD V0 pin to an output of variable resistor
- LCD RS (Register Select) pin to an Arduino digital pin 12
- LCD RW (Read/Write) pin to a ground
- LCD E (Enable) pin to an Arduino digital pin 11
- LCD D4 pin to an Arduino digital pin 5
- LCD D5 pin to an Arduino digital pin 4
- LCD D6 pin to an Arduino digital pin 3
- LCD D7 pin to an Arduino digital pin 2
- LCD A (Anode) pin to a +5v power
- LCD K (Cathode) to the Ground then connect with a resistor in series have 220-ohm.

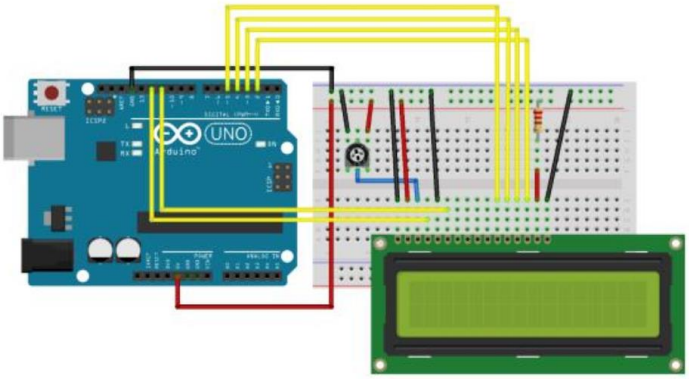

Fig. 5: LCD connection with Arduino

IX. Connections of all system

Final connections of all of the subsystems. See figs 6 and 7.

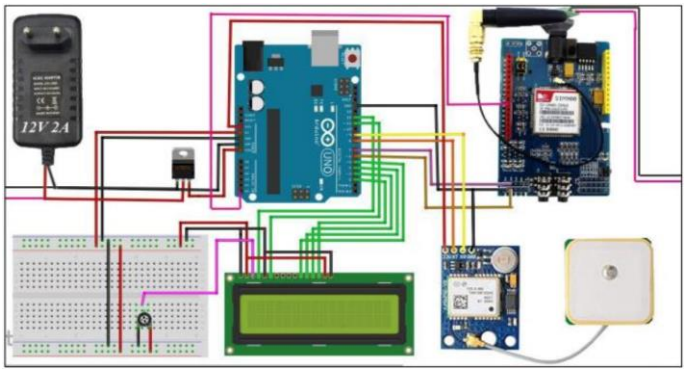

Fig. 6: Connections of the system

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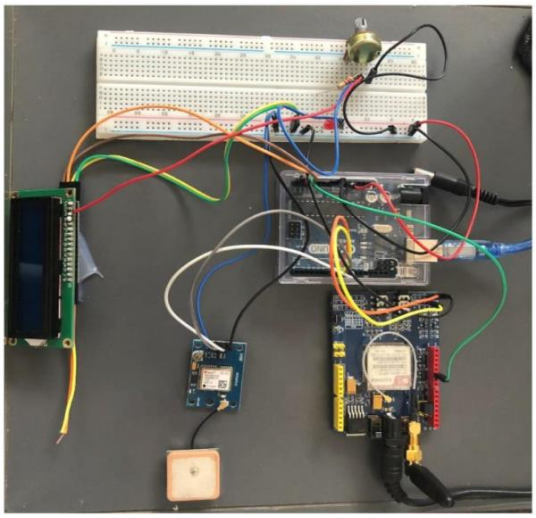

Fig. 7: Picture of connections of the system

X.Design and place in Vehicle

The components of the project that are hardware must be hidden, they're either put beside the car engine or under the hoods, there are two different ways for providing the hardware components with power, either by connecting them to the car battery or providing an external battery [17].

XI. Results

1. The Tracking process can be done while want to detect the current location of the vehicle at any time by sending an SMS (not every SMS, only the defined SMS). Then
2. The device inside the vehicle will send an SMS including Latitude and Longitude. While for quickly seeing the navigation of the vehicle, the SMS includes Map URL.
3. Message from vehicle: "The Car Current Location is: LATTITUDE=36.916649, LONGITUDE=44.180685 and shown in Google Maps. http://maps.google.com/maps/@36.916649,44.180685 Please take some action. Thank you". See fig. 8.

Fig. 8: Picture of vehicle location Latitude and Longitude on LCD

Conclusion

There will be better fleet management with a vehicle tracking system which in turn results in a larger profit, better route, and schedule planning can result in better time management which can result in the person being able to handle more and larger jobs in less time. Vehicle tracking can be beneficial in both business and personal situations as it can increase security, communication medium, productivity, safety, and performance monitoring.

This system can play a major role in the day-to-day lives of people in the next few years, this paper can present an efficient real-time vehicle tracking system that can be customized, flexible and accurate. This is done by using GSM, GPS, and GPRS networks that are suited for a variety of applications all around the globe. By combining both GPRS and GPS we can be provided with real-time continuous tracking, Google map API is used for displaying the position on google map.

The brain of the GSM module and the system is the Arduino and the GSM is controlled by AT commands that allow transmission of data to the GSM module, meanwhile, the GPS is providing the data about the location. When GPS receives new data the database gets updated which is why it will be able to see the new location on google maps, when it comes to vehicle tracking the system can provide information about the location of the vehicle like the altitude, speed, latitude, satellites, course, and date.

As the results of the industrial devices, the outcomes of the system are also good, for the future by using actuators and sensors a wide variety of services can be added to the system, any work that is put into this project in the future is to incorporate differently sensors into the system that can decrease the possibility of vehicle lose.

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