

# Android App Based Vehicle Tracking Using GPS And GSM

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**Abstract:** Global Positioning System (GPS) is used in numerous applications in today's world. A real time vehicle tracking system using the GPS technology is proposed in this paper. The project Android App based Vehicle Tracking Using GSM AND GPRS mainly focuses in tracking the location of the vehicle on which the device has been installed. It will then send the data in the form of latitude and longitude coordinates through SMS on the user's mobile where the coordinates will be plotted in the Android app automatically. Initially, the GPS installed in the device takes input from the satellite and stores it in the microcontroller's buffer. In order to track the vehicle, the mobile user has to call on the SIM number that is registered in the GSM module of the device. Once the call is received, the device authenticates the calling number. If authenticated, the location of the vehicle is sent to the registered mobile number in the form of SMS. After sending the message, the GSM is deactivated and the GPS is activated again. The coordinates of the location received in the SMS can be viewed on the android app. The hardware part described in the paper comprises of GPRS, GSM module, LCD to view the coordinates, ATmega Microcontroller MAX 232, Arduino, RS232 and relay.

**Index Terms:** Vehicle Tracking, GSM, Android App, Sensors, Google Maps, Arduino, SIM, GPS

## 1. INTRODUCTION

The GPS GSM based system combines GPS and GSM technologies. It is widely used in many applications and millions of users are benefitted by it everyday. The product is mainly intended to increase the security and safety amongst the transportation system. This vehicle-tracking device can be installed in any vehicle to prevent thefts or to monitor the route of the vehicle. Whenever a vehicle is stolen or is lost, the device will send the coordinates of latitudes and longitudes that will help to locate the vehicle on user's mobile. The tracking system covers most of the highways, major cities, towns and most of the accessible villages and works efficiently in areas with better mobile connectivity. This paper explains an embedded system, which is used to know the location of the vehicle using the popular and readily available technologies like the Global Positioning System (GPS) and Global System for mobile communication (GSM). The main feature of our design is that it proposed to use a development board, which will have GPS and GSM module not as a separated module but closely linked with a microcontroller as in Tanotis Gboard Pro GSM/GPRS SIM900 Development Board ATmega328 Microprocessor. The advantage of using that development board is that it will reduce the size of whole system and it will reduce the power loss in terms of heat through external wirings used for the connection of GPS and GSM module with the microcontroller. Along with that, it will also increase the durability of the entire system. The ATmega328 microcontroller will provide the interfacing to various hardware peripherals. To know the location of vehicle, the mobile user has to click on the Track location button in the android app. The message will be automatically sent to the SIM present in the GSM module present in the device. The system will respond by sending the coordinates (sensed by the GPS module) of the vehicle on the registered mobile user and these coordinates will be plotted on the map.

## 2. LITERATURE REVIEW

In [1], GPS and GSM technologies have been used in a way so that they can track the location of the stolen vehicle. In this system the car stays in an active mode while the owner is using it otherwise it is in its active mode. Then in the active mode if there is any disturbance, it is sensed by the IR sensor. It sends the location of the car to the owner. When the owner replies then the engine motor speed decreases and gradually

switches off and the doors are locked. Hence, preventing the thief from escaping. Our device is inspired from this system with an additional functionality of an Android app. In [2], the authors designed the automobile anti-theft system and gave a detailed description. The system comprises of single-chip C8051F120. Vibration sensors are used to detect the theft. The energy consumption is decreased and the durability of the system is increased by closely linking the GPS and the GSM modules with the microcontroller. It is less expensive as it does not involve the use of sensors to detect the theft. The user can know the location of the stolen vehicle with the android app. In [6], for vehicle safety purposes, a real time visual tracking system is designed by Kai-Tai Song and Chih-Chieh. We have used a novel method to track the location of the vehicle with an android app. It is user friendly. The user just needs to launch the app on his phone and press the "Track location" button to know the exact location of the vehicle. Also, the app automatically plots the coordinates on the map. In [10], the paper explains us the way the power is supplied, distance measurement using ultrasound sensors, fuel measurements using ultrasound sensors. It also explains us the technology like GPS and GSM modem SIM300. In our model, we have used SIM 900. It is a quad band model and offers improved GPS functionalities in web based system than the SIM300. Also, SIM300 can only work in 900, 1800 and 1900 MHz band whereas SIM900 can work in 850, 900, 1800 and 1900 MHz band. In [11], the vehicle engine, ECU-electronic control unit, fuel pumping system was explained. The proposed algorithm for password protection with message sending and receiving is that when an SMS is sent from the owner's mobile to the SIM number installed in the GSM module. The received message will be sent to the Arduino. Then the arduino sends a signal for the purpose of stopping the fuel pump from work through the relay, therefore stopping the fuel delivery to the injectors and thereby stopping the car. A message is sent as an acknowledgement to the user after the stopping of the car. In our device, we are also using an authentication method so that the location of the vehicle is only sent to the owner of vehicle. In [17], the vehicle is controlled and automated using the a ARM processor LPC2148 which has a GPS, GSM, Accelerometer sensor, compass sensor. The model facilitates tracking and routing of automobiles in a large area. The car goes on moving and changing its location continuously. The GPS sends the

location of vehicle in term of longitudes and latitudes. Then the GSM sends a message to the owner and as soon it is received it is plotted on the Google Earth. In order to identify the direction of the moving vehicle, the device is installed with a compass sensor. Also, in order to know the state of the vehicle whether it is moving or not, an accelerometer sensor is used. In [18], S. Sahitya, N. Swetha designed a tracking system, which could be used in real life scenarios. The primary components used in designing were GSM and GPS. Google Maps is used to plot and view the location of the coordinates that have been sent on a desktop or mobile device by plotting the coordinates. We have eliminated the job of manually plotting the coordinates on the map. This job is automatically done by the app itself. In [19], the existing system of using Google Maps, automatic transit direction has been replaced with RFID –radio frequency identification for safety of private and public automobiles. It is a wireless identification system which can monitor any object, human or animals. RFID improves the overall performance and cost. It also speaks about the use of GSM in telling us the exact location. In [21], the system that is proposed by the authors is a real-time implementation of the website that is based on the GoogleMap. The location sending procedure involves connecting cellular antenna by the GPRS module. On receiving the location coordinates via GPS module, the position is sent to the database servers. The vehicle location is then displayed on the website after the data is received from the database servers. In [22], an experimental evaluation of GSM and GPS module has been given. It clearly gives us the details of hardware and software components of the system. The hardware design consists of the mobile unit and the control station. The software design tells the way in which GPS and mobile and GSM interacts with each other and different condition available. The difference in using ordinary and differential GPS.

### Comparison of the existing GPS devices installed in vehicles with the android app based vehicle-tracking system

The existing GPS devices installed in the vehicles allows you to know the location of the destination. The GPS network comprises of 27 global positional satellites. In each of the 6 orbital planes, there are four satellites, which ensure that they cover the entire world. Each satellite transmits a radio signal, which is processed by the receiver in the car. A minimum of three or four satellites is required to know the position of the destination entered. This method is known as trilateration. However the existing GPS navigation system installed in the cars does not provide any provision to the owner in case he/she wants to know the location of the vehicle. This is where Android app based vehicle tracking system comes into the picture. This system is designed for all the cars and the users with Android phones. The Android is the most widely used mobile OS. Its availability and popularity amongst the users is the reason that we have designed the app for Android users to target and benefit more audience. The interface of the app is easy to understand. The user just has to press one button in order to know the location of the vehicle. On pressing the button, an SMS will be sent to the device installed in the vehicle. This device will first authenticate the number from which the SMS is sent. If found valid, it will send the coordinates of the location to the owner's mobile. Once the SMS is received, the coordinates of the location will be

immediately plotted by the app itself and the location of the vehicle will be known. This device will help the owner to always keep an eye on its vehicle.

## 3. METHODOLOGY

### 3.1 Block Diagram

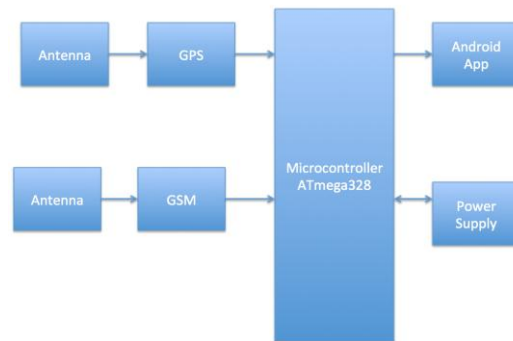


Figure 1: Block diagram

### 3.2 Diagram Description

The microcontroller 8052 is used for interfacing the hardware peripherals. There is serial interfacing between the 8052 microcontroller and the GSM Modem and GPS receiver. The working of the system involves taking the input from the GPS. This input is then sent to the RS232. It is then sent to MAX232 where the data is formatted so that it could be sent to the receiver pin (Rx) of the microcontroller. After this, the data is stored in the microcontroller buffer and then sent to the MAX232 via the TX (Transmitter pin). The data is sent into GSM via the RS-232 protocol by MAX232. On demand that is by pressing the 'Track location' button in the android app, it will send the location of the device to the registered mobile user. The location of the vehicle will be shown to the user on the designed android app. The code for the device is written and tested in Arduino IDE. The Arduino IDE is a cross-platform application where the code is written, debugged and tested. The android app is designed in android studio.

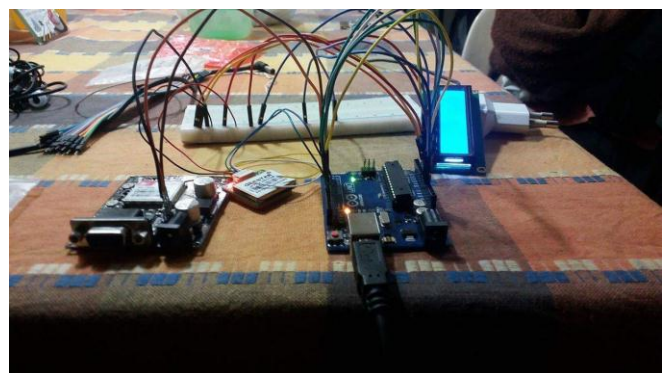


Figure 2: Transmitter section inbuilt within the vehicle

## 4 FUNCTIONALITIES AND OVERVIEW OF THE SYSTEM

### 4.1 GPS Technology:

GPS (Global Positioning System) works in all the weather conditions be it storm be it flood, covering the entire world 24\*7 through out the year absolutely for free. This satellite based navigation system has GPS satellites, which orbit the Earth two times in a day. Each and every satellite sends a unique signal to the GPS receivers. The GPS receivers then decode the signals and then calculate the exact location of the user. The receiver basically takes the time taken by it to receive signals as the source of calculating position.

### 4.2 GSM Technology

The working of Global System for Mobile Communication (GSM) is just like a mobile phone. It is basically a modem on which a SIM is installed and it operates over a subscription. GSM networks mainly comprises of three major systems:

- The Switching System (SS),
- The Base system (BS)
- Mobile Station (MS).

Features of GSM900

- Mobile to BTS (uplink): 890-915Mhz
- BTS to Mobile (downlink): 935- 960 MHz
- Bandwidth: 2\* 25MHz



Figure 3: GSM900

Duplex Frequency Spacing	45MHz
Carrier Separation	200KHz
Frequency Channels	124
Time Slots/Frame (Full Rate)	8
Voice Coder Bit Rate	13 Kbps
Modulation	GMSK
Air transmission rate	270.833333
Access method	FDMA/TDMA
Speech Coder	RPE-LTP-LPC

#### 1. The Switching System(SS)

SS consists of five databases that perform distinct functions. Call processing and subscriber related functions are its prime tasks. It has five databases which are as follows

- Home Location Register(HLR),
- Visitor Location Register(VLR),
- Authentication Centre(AUC),
- Mobile Switching Centre (MSC)
- Equipment Identity Register (EIR).

#### 2. The Base Station System (BSS)

BSS has further two divisions viz. BTS and BSC. The base transceiver station (BTS) consists of radio transceivers. The number of transceiver stations increases with the size of the area. The main job of base station controller is to manage the radio resources for one or more transceiver stations. The connection between the mobile station and the mobile services center is facilitated by it.

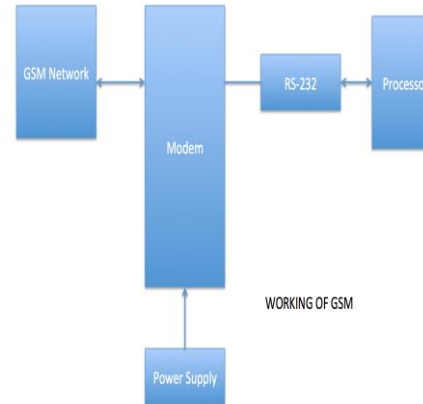


Figure 4: Working of the GSM modem along with Arduino Uno

### 3. Mobile Station

The mobile station consists of mobile equipment and a smart card, which is commonly known as SIM (Subscriber's Identity Module). It permits clients to have entry to subscribed administrations regardless of a particular terminal. Keeping in mind the end goal to make and get the calls, the SIM is embedded to the GSM terminal. In order to identify the mobile equipment it uses International Mobile Equipment Number (IMEI). The SIM card is fitted with International Mobile Subscriber Identity that is utilized as a part of the recognizable proof of the supporter of the framework and identifying the subscriber. The IMEI and IMSI are autonomous.

#### Elements of GSM1800

- Portable gear to BTS (uplink): 1710-1785 MHz
- BTS to Portable gear (Downlink): 1805-1880 MHz
- Bandwidth: 2\*75 MHz

### 4.3 Microcontroller

ATMega328 is the ATMEL Microcontroller on which Arduino UNO is based. It is a single chip microcontroller created by AMTEL in mega AVR family. AVR is a family of microcontrollers developed by Atmel. It facilitates the interfacing of the GPS and the GSM module. Its use reduces the cost of the system, and its small and compact design makes the device handy.

### 4.4 MAX232

Max 232 is an integrated circuit consisting of 16 pins, which converts the signal from RS232 serial port to proper signal that are used in TTL compatible digital logic circuits. It is a dual transmitter and receiver that are used to convert the RX, TX, CTS and RTS signals. In order to convert the voltage levels for TTL devices, we use the MAX 232 integrated circuit mostly in the RS-232 communication systems.

TIA-232 Line type and Transmission Logic	TIA-232 Voltage	TTL Voltage to/from MAX232
Rx/Tx Logic 0	+3V to +15V	0V
Rx/Tx Logic 1	-3V to -15V	5V
Control Signals Logic 0	-3V to -15V	5V
Control Signals Logic 1	+3V to +15V	0V

#### 4.5 RS232 Protocol

Recommended Standard Number 232 (RS-232) an asynchronous protocol for the serial data exchange. It defines common ground for voltage and signal level between Data Terminal Equipment (DTE) and Data Communications Equipment (DCE). Your PC is a DTE gadget, while most different gadgets are normally DCE gadgets. The attributes, timing, meaning of signals, physical size and pin out of connectors are defined by this standard.

Data Circuits	Control Circuits	Voltage
0(space)	Asserted	+3 to +15V
1(mark)	Deasserted	-15 to -3V

#### 4.6 Arduino IDE

The code to be uploaded in the Arduino is written, tested and debugged in Arduino IDE. It is an IDE (Integrated Development Environment) for the Processing programming language and the Wiring project.

#### 4.7 Android App

The Android app included in the project has been written, tested and debugged in the Android Studio. The Figure 5 shows the app interface when the app is opened on the Android user. Once the user presses the 'Request Location button', an SMS to the device is sent to fetch the coordinates of the vehicle's location. This location is then plotted in the app.

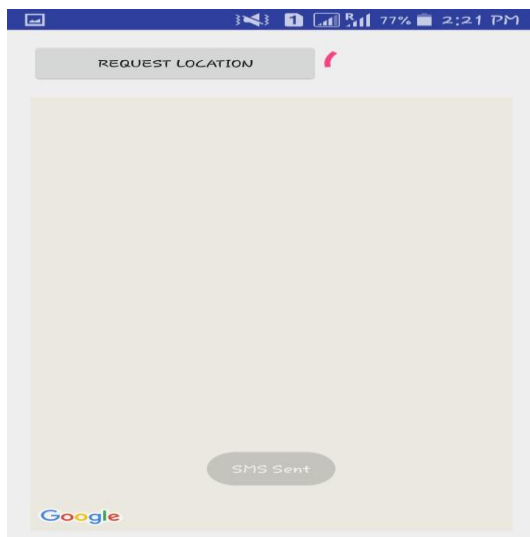


Figure 5: Android app interface of the receiver section

## 5 EXPERIMENTAL RESULTS

The device was tested in Vellore Institute of Technology. It was found that the location of the vehicle was predicted effectively in most of the cases. However, the location shown in the app can have an error of approximately 10 meters due to limitation in the hardware.

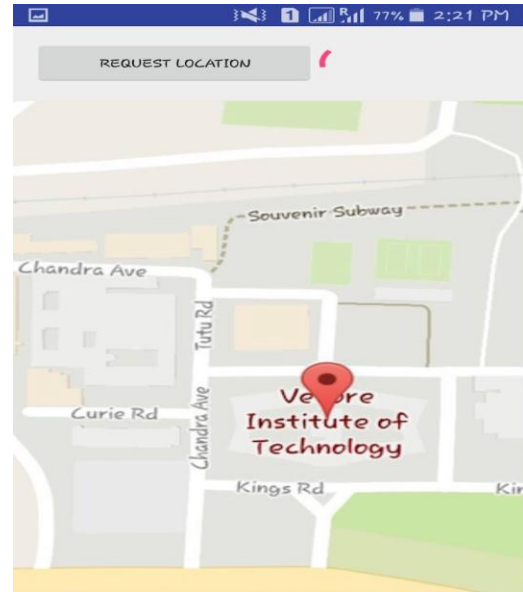


Figure 6: The location of the vehicle

## 6 USABILITY

It is very user-friendly. In order to know the vehicle's location, all a user has to do is to type a text message on the mobile and send it to the SIM number installed in the device. It is secure as only the location of the device will be sent to the registered mobile user.

## 7 APPLICATIONS

The vehicle tracking system can be used in a number of areas

- The main users of the product are the transportation companies. Companies and start-ups that provide cabs can install the device in their vehicles to ensure the safety of passengers and vehicle.
- Schools could also install the device in school vans can keep a constant check on the route of the vans for the sake of students' safety.
- It could be used in Bus stands by the managers to effectively predict and display the timing of the arriving buses for the waiting passengers.

## 8 FUTURE SCOPE

A server can be created to record the route of the vehicle. The hardware can be made more intelligent by installing sensors like fire sensors and proximity sensors. In case of fire, the device will automatically send the message to the registered mobile user. Proximity sensors will be highly helpful in case the vehicle installed with the product has met with an accident. The product could be installed in the taxis after further enhancements in the software. The owner could schedule the pickup spots for the next customer. The customer could track the status of the vehicle while he is waiting. After some addition of hardware and proper modification in the software

the product could also be used to turn off the vehicle's engine in case if the vehicle is stolen. It is possible to make the device wearable by reducing the size of the hardware so that not only for finding the location of vehicle but the device could also be used to find the location of a person.

## 9. CONCLUSION

In today's world, the security of the vehicles is at stake. The incidents of theft are common. This compels the consumer to install a tracking device, which will help them to know the location of their lost or stolen vehicle. The vehicle-tracking device provide the user to know his/her vehicle's location in real time. The product designed is user-friendly anyone with a little knowledge of smartphone can use the system. It is easy to install the system in the vehicle and it require low maintenance. The coordinates received show the correct location on the google map using the android app. Also, the size of the device is compact since the GSM and GPS modules are not present as separate module.

## 10. ACKNOWLEDGMENT

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