Vehicle Security and Tracking System

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Abstract—Technology achieves success only when it meets every strata of people. This is vehicle security and tracking system which uses RFID, GPS and GSM technology, which would be the cheapest anti-theft system. It uses RFID for a better locking system and when the user sends the correct message, the controller will trigger the device to fetch the location of the vehicle using the GPS module and it is sent as a text message using the GSM module. Once this is done, sequence to turn off the engine is started. The advantage of this system is that it helps the owner in tracking the vehicle at a greater pace with more accuracy, and reduces the complexities compared to the other system, besides being the cheapest alternative anti-theft system as well.

Keywords: Vehicle security, Tracking, RFID, GPS, GSM, Sim808, Raspberry Pi

I. INTRODUCTION

The number of vehicles on road is increasing very rapidly, so are the vehicle thefts. People are concerned with the security of their possessions, which increases the society’s need for vehicle anti-theft products.

Various vehicle anti-theft devices have been developed lately. However, the result is still disappointing since all kinds of devices have its drawbacks. Most of the systems aim to prevent a break in. The most commonly used ones are mechanical lock device; it is a steering wheel lock. It is relatively cheap but inconvenient to use. It can be easily disarmed by skilled thieves. In car alarm devices, public may not be aware when they hear an alarm. Likewise, a skilled burglar can stop the alarm. Also, these car alarm systems do not cover large areas. Once the car is stolen, the police and owner find it difficult to retrieve it.

Hence, to address the limitations of existing vehicle tracking and security systems, it is proposed with advanced anti-theft system. This will lessen the burden on the police force as the owner can themselves retrieve the vehicle from its location. It takes lesser effort from both the sides and the probability of retrieval increases. This is an investment which will profit both the users and security personnel.

II. SYSTEM OVERVIEW

Basic idea behind this is to implement the Vehicle security system. The system will have two parts, a security and a tracking system. In the security side, a better locking system is provided using RFID. It provides better protection in comparison to mechanical locks.

In case the security is still broken through by stealing the RFID itself, the owner can make use of the other part of device containing GSM, GPS, device to kill the engine and a controller of operations. System will be able to control the vehicle using GSM based SMS service as a communication media where at both end users need a GSM based modem or phone.

When the owner finds the vehicle to be missing, a predefined message needs to be sent to activate the tracking system. This triggers the device to shut down engine and it stimulates the GSM module in forwarding the vehicle location in terms of latitude and longitude using GPS back to the owner.

III. WORKING PRINCIPLE

The security part of the system will contain RFID tag and a RFID reader. The tag acts as the key which can be used to open and lock the vehicle. This system is more difficult to hijack than the mechanical lock as the RFID tag is unique. Even then there is a possibility that the robber takes the tag itself. In that case the owner can activate the tracking system.

The owner will know that vehicle has been taken away. The user sends a formatted message to the vehicle where this message is received by the GSM modem and transferred to the main control module. Based on the command received by the GSM modem, the operation is done. The command will
make the control module execute instructions to turn the engine off and acquires the location of vehicle.

The GPS device will be planted on the vehicle whose location is to be tracked. This GPS device sends signals of a particular frequency to satellites. The satellites, in return, send data to the GPS device. From this data, the latitudes and longitudes of the GPS device can be extracted. As the device is planted on the vehicle, so the current location of the vehicle in terms of latitudes and longitudes is retrieved.

Now, this data from the GPS device is to be sent to the user. GSM modem sends this information via SMS. Another GSM modem at the user end i.e. mobile phone which will receive the SMS sent by the vehicle.

To switch the engine off, either the vehicle’s circuitry or the ignition system needs to be controlled. As controlling the former may damage the vehicle permanently - it causes the system to crash suddenly - control of the engine ignition is chosen for graceful shutdown and protect the internal circuitry.

**Figure 1: The overall block diagram**

A. **RFID**

An RFID system consists of two separate components: a tag and a reader. Tags are analogous to barcode labels, and come in different shapes and sizes. The tag contains an antenna connected to a small microchip containing up to two kilobytes of data. The reader, or scanner, functions similarly to a barcode scanner; however, while a barcode scanner uses a laser beam to scan the barcode, an RFID scanner uses electromagnetic waves.

Unlike the barcode, the tag need not to be within the line of sight of the reader, so it may be embedded in the tracked objects. To transmit these waves, the scanner uses an antenna that transmits a signal, communicating with the tags antenna. The tags antenna receives data from the scanner and transmits its particular chip information to the scanner. Two types of RFID are passive and active RFID. Passive RFID consist of passive tags collect energy from a nearby RFID readers interrogating radio waves. Active RFID consist of active tags have a local power source such as battery and may operate at hundreds of meters from the RFID reader. This is needed to implement a better and safer locking system. Serial communication (synchronous) is used between RFID and main control module (SPI interface). Connection between RFID and Raspberry Pi is shown in figure 2. Cost of passive RFID is less compare to active RFID and here we are using RFID for locking (security purpose) system no need of detection of RFID from longer distance so passive RFID is used. MFRC522 is used which is a passive RFID used.

**Figure 2: Install Pins between Raspberry Pi and RFID-RC522**

B. **GSM**

A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. GSM (Global system for mobile) uses a process called circuit switching. This method of communication allows a path to be established between two devices.
Once the two devices are connected, a constant stream of digital data is relayed. The GSM modem specific commands are adapted to the services offered by a GSM modem such as text messaging. One of the key features of GSM systems is Short Message Service (SMS). User can reach and communicate anytime of the day or night no matter where.

This is connected to the Vehicle so that user can send command to Vehicle. This device reads incoming command in the form of SMS and then system takes action as per command.

Sim808 is the GSM modem used, it is the integration of both GSM and GPS. Serial (asynchronous) communication is used between GSM and main control module (UART). Connection is shown in figure 3. AT commands are used to send and receive messages (SMS).

C. GPS

The signal of time is sent from a GPS satellite at a given point. Subsequently, the time difference between GPS time and the point of time clock which GPS receiver receives the time signal will be calculated to generate the distance from the receiver to the satellite. The same process will be done with three other available satellites. It is possible to calculate the position of the GPS receiver from distance from the GPS receiver to three satellites. It is required to find the vehicle’s location.

Sim 808 can be used for this purpose. UART connection is used between sim 808 and Raspberry Pi. Connection between sim808 and Raspberry Pi is shown in figure 3. AT commands are used to get the information about the location of the car.

AT commands are instructions used to control a modem. AT is the abbreviation of ATtention. Every command line starts with "AT" or "at". That's why modem commands are called AT commands.

**AT COMMANDS USED**

1. To read an SMS from the module command used:
   AT+CMGR=n, where n is the index number of the message in the Inbox.

2. To set the GSM modem in SMS Text Mode or SMS PDU Mode command used:
   AT+CMGF=<mode><CR>
   **Parameters**
   <mode>: 0 = PDU Mode, 1 = Text Mode
   <CR> = ASCII character 13

3. To send an SMS message to a GSM phone command used:
   AT+CMGS=<number><CR><message><CTRL-Z>
   **Parameters**
   <CR> = ASCII character 13
   <CTRL-Z> = ASCII character 26
   <mr> = Message Reference

4. To List Received Messages in Text Mode command used:
   AT+CMGL=<stat><CR>
   **Parameters**
   <stat>: Status = “ALL”, “REC UNREAD” or “REC READ”
   <index>: Index number of the message
   <oa>: Originator address
   <alpha>: Originator name (if available in the phonebook)
   <scts>: Service Center Time Stamp
   <data>: The content of the text message
   <CR>: ASCII character 13
   <LF>: ASCII character 10

5. To delete a received message command used:
   AT+CMGD=<index><CR>
   **Parameters**
   <index>: Index number of the message
   <CR>: ASCII character 13

**Figure 3: Connection between Sim 808 and Raspberry Pi**

GPS dongle can also be used. Using this we can save the gpio pins used for connection and we can directly obtain the raw data of longitude and latitude.
D. MAIN CONTROL MODULE

This is the main command processor which will take command and then control the Vehicle engine. It will act as the brain of the system controlling all other parts i.e., GSM, GPS and others.

Raspberry Pi is used as main control module. Which takes input from RFID, GSM and GPS module and controls the operation of engine according to the message sent by the owner of the car. Raspberry Pi works with different types of os that enables applications and the computer operator to access the devices on the computer to perform desired functions. Raspbianos is used which is open source as its source code is freely available. It is free to use.

A programming language is a formal constructed language designed to communicate instructions to a machine, particularly a computer. Programming languages can be used to create programs to control the behavior of a machine. So, to control the system, languages like C, C++, python can be used. Python language is used which is simple and easy.

IV. RESULTS

SECURITY: If wrong RFID tag is used message is sent to user as “Wrong key used”

TRACKING: If user sends the message as “Stop” then Raspberry Pi kills the engine using ignition kill switch.

If user sends the message as “Loc” then current location (latitude and longitude) is sent to user mobile.

Messages sent and received by user
FUTURE ASPECTS

- Extended use of this system in car dispatch management field is possible, which has vast potential for future development.
- Voice feedback system can be provided.
- The system can be developed to secure the tyres and other parts since they can be individually taken away.

V. CONCLUSIONS

In this section we will discuss the advantages and limitation of the proposed work.

- No additional costs involved:
  
  There aren't any side costs involved other than maintaining network connection which is lifetime these days. There are also no infrastructure establishment costs.

- Low Operating Cost:
  
  Using GSM and GPS keeps your operating costs down because GSM uses Short Message Service, which keeps bandwidth and time down. Cost of each message is around 10 paise.

- Reliability:
  
  GSM and GPS are very reliable systems. There is hardly any down time unless a severe electrical storm was to damage a transceiver or cell somewhere.

- Global Coverage:
  
  GSM and GPS covers almost the entire globe. So your chances of using your cell phone to make a call and the call going through are almost 100% at best.

- Low Power Consumption:
  
  GSM and GPS modules do not use a large amount of power. They rely on so little energy to operate. Sim808 requires 3.3V, 500mA.

- It does not work in areas where there is no network coverage.

- Does not ensure the protection of other parts of the vehicle.

This system combines the advantages of RFID, GSM and GPS together. The key of the automobile is an RFID card which is contactless, security and convenient. The microprocessor for the vehicle adopted enhances the reliability.

Hence, this is a vehicle anti-theft monitoring system based on GPS technology and GSM technology. The owner can simply use mobile phone to locate and monitor the car in real time, which provides the technical foundation for the development of wireless network vehicle anti-theft system.

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