Vehicle Theft Identification and License Authentication Using IoT

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Abstract. In this 21st century, it is difficult to trace the device on real-time platforms. To overcome this complex situation leads to developing a fingerprint cum GPS/GSM tracking prototype. This prototype model proposes that the system will get the location of the vehicle, i.e., latitude and longitude of the vehicle, and the tracing is done with the SMS sent on the receiver's phone by sending SMS via GSM module to make the vehicle security feature to work online that is stored and can be viewed real-time by sending data by ESP module serving as a wireless fidelity module. The theft vehicle is then detected by sending the message from the tracker to the owner's phone. On the receiver's phone, the owner will get the emergency message, where the owner can send back the SMS to the GSM module to stop the vehicle motor using a microcontroller.

Keywords: Fingerprint sensor, Wi-Fi (wireless fidelity), GSM/ GPS module, wireless communication, Arduino.

1. Introduction
The system proposed using a biometric fingerprint sensor to verify the authenticity of the driver who is driving the vehicle. If the authenticity is not proven, then the SMS is sent to the owner's phone with the vehicle's latitude and longitude. Now with the same SMS facility on the phone, the phone owner can send back the SMS to shut down the vehicle's engine, and the same data is stored and displayed on the Node MCU server. Several systems use Bluetooth to implement anti-theft systems [3] and fingerprint recognition for user recognition [5].

The fingerprint is a unique biometric signature that can be used to identify individual people uniquely. The computer is good at matching the fingerprint pattern and recognizing it fast and accurately. There are different methods for authenticating the fingerprint that as an optical fingerprint scanner and capacitive scanner.

The basic principle on which the optical fingerprint scanner works on the scanner uses the glass prism, which controls TIR. The LED generates the light, usually in green color, which enters through the one side of the prism at a certain angle so that TIR occurs. The image sensor, which is a camera, is used to capture the prism's reflected light. This all process occurs when the person puts the finger on the sensor. During the Idle time (when no finger is placed), the light is completely reflected off from the sensor's surface, and a plane image is generated by the image sensor [7].

GPS module (NEO 6) is a stand-alone type of receiver with a high-performance positioning engine. They come in a miniature packet with a flexible and cost-effective receiver with high connectivity.
option. These modules are battery-operated and space-effective. They have a dedicated real-time acquisition engine that instantly generates parallel time and frequency void space data from the satellite.

GSM/GPRS has a modem RS232 which consists of a dual-band driver engine SIM 900A working on frequencies 900-1800 MHz. The modem has an RS232 interface that can be well connected to the PC and microcontroller, i.e., MAX-232. The AT command's baud rate is 9600-115200, which has an internal TCP/IP stack connected to the internet via GPRS. The M2M interface is capable of SMS, Voice, and data transfer Applications. The module needs a 5v regulated power supply to make the uninterrupted audio calls SMS and attending the incoming calls through simple internet.

ESP (Espressif modules) is known as ESCP (Espressif system smart connectivity platform), which has high high-performance integration of wireless SOCs (System on chip). These modules are specially designed for 1 Space and power reduction and less consumption, especially for constrained mobile platforms. They have the ability to unsurpassed embed WIFI with other systems. These modules are available in the market as the lowest cost product and most space effective in size.

2. Working of the Project

2.1. Overview

As discussed earlier aim to demonstrate function that to stop the car by using the SMS technology if the unauthorized fingerprint is imprinted, and in the further advancement of the system, we aim to integrate the whole system with the alcohol sensor so that it can stop the car engine if the value of alcohol level is detected to the set threshold value. Then the data is uploaded to the Node MCU server.

2.2. Methodology

The figure 1 shows the block diagram of the proposed system. Fingerprint-The fingerprint scanner works on both 3.3 and 5.5v, which has the regulator on the PCB. The 5v supply has direct input to the regulator, whereas the 3.3v supply bypasses the regulator and is directly fed to the fingerprint scanner's controller. This fingerprint sensor is connected to the development board, which consolidates the signal [4]. With the help of this board, we decrease the number of ports plugged into the controller. All the fingerprint enrollment and removing of the fingerprint are done by the button present on the board. This board is readily available in the market. This board has an ATmega controller, which has the preinstalled [10].

Code, so we don't require the main Arduino memory's memory as the external board does the entire finger enrollment and connects the LCD directly to it. And one port from this board can be used to send the command to the main Arduino controller to control the motor.

Gas sensor-these sensors are series of MQ-x (basic) where x ranges from 1-9 used to measure or detect a particular gas. The circuit contains an OpAmp comparator and an output pin which is digitally enabled. These sensors detect gases like CO, hydrogen, LPG, alcohol, propane. These gases are measured using an analog pin, which works on 5v, and is TTL driven. Its pin is directly plugged into the controller, and the power supply is drawn from the junction of 12v, 5v and GND created in the prototype.

GPS and GSM-A) GPS module (NEO-6M) used in this prototype is from u-blox, which tracks up to 22 satellites on 50 channels. The sensitivity is of - 161db tracking and consumption of current are only about 45mA. It has a TTFF (Time To First Fix) positioning engine system, which has a default baud rate of 9600bps [14]. B) GSM900 is a very cheap and reliable module integrated with the Arduino controller board. It supports the communication band of 900Mhz (for the Indian region), and for the other region like the USA, this range is about 850Mhz, so that we can use the GSM module of that frequency range [2]. It only requires the 12v and 1Amp DC power supply. Its range can also be enhanced using the antenna or just attaching the wire at the antenna port. More instruments attach to it, so in this prototype, two Arduino GPS/GPS are connected to the second controller and another component to the first one [8].
RFID reader-The radio frequency identification technology can also be used to authenticate the user. In this system, we have a two-component RFID reader and an RFID verification card. This card consists of copper winding and the microchip, which contain a 12 digit unique code. When this card comes near (range=1cm-5cm) the RFID reader, the coil’s field carries the signal and charges the coil inside the card (if it is a passive reader), then the code store inside the microchip is sent back to the reader. This signal can be used as the trigger for the other function performed by the controller. Using this number that is unique for the user, we can access the document of the person who is being uploaded to the server. In the prototype and data is uploaded directly to the controller in the code [13].

Node MCU-Node MCU (microcontroller unit) is a basic inexpensive unit mounted on ESP8266. It has a self-contained WIFI network, and when it hosts the application, boot up is done by the external flash derive, and it has an inbuilt cache that can improve the performance. It integrates the switched antenna, RF balun (which is used to join the balanced line to the unbalanced line), amplifier, low noise filter, and power regulator module [17]. ESP8266 uses a 32-bit processor and the Wi-Fi facility mounted on the single board, attached to GPIO (general purpose input-output device) and external sensor. The software development kit has its sample code, which can be used to check the device's basic functionality.

Motor-This is a 12v and 30rpm motor, which is very easy to use and does not require high power motor drivers to control the motor. It can be used with an Arduino controller easily by using the onboard voltage regulator and H-bridge module. The motor has gear for the shaft to obtain optimum performance.

2.3. Hardware Components
The main components of the system are:

- Alcohol Sensor
• Fingerprint
• GSM module
• GPS module
• Node MUC
• Motor
• RFID Technology

2.3.1. Alcohol Sensor. In MQ3 shown in figure 2, detection of alcohol is done by the detection of the resistance variation, which results in a variation of the voltage and that can be measured by the module on which the sensor is mounted. A potentiometer can adjust the threshold value as this sensor has sensitivity toward pollution and methane gas. MQ-3 module can also detect alcohol, benzene, methane, etc. In MQ-3, the sensing material is SnO2 [6].

Figure 2: Gas Sensor (MQ-3)

If the alcohol content is increased, the conductivity of the material increases [10,11]. As we set the alcohol sensor’s value, if the alcohol value is above the threshold, then the vehicle will stop. This threshold is different from the alcohol sensor threshold, which is used for the value of the digital out pin of the MQ-3 module. The pin description is shown below figure 3 and figure 4. Pin Description of Module: The pin layout is described in table 1 & 2.

Figure 3: Parts Diagram of MQ-3

Figure 4: MQ-3 Module
Table 1: Pin description of MQ-3 [13]

| Pin name          | Description                                           |
|-------------------|-------------------------------------------------------|
| Vcc               | Power Pin operated at the voltage of +5v              |
| Gnd               | System Ground(V=0)                                    |
| Digital output(DO)| This pin produces the Digital output. And the value of the Binary 1/0 can be adjusted by the potentiometer |
| Analog output(AO) | Pin gives the voltage, and the value depends upon the resistance variation by alcohol. |

Table 2: Pin layout description

|   | Description                                                      |
|---|-----------------------------------------------------------------|
| 1 | H – Pin Two H – pin are connected to the Supply and the other to the Ground |
| 2 | A-Pin Pin-connected to the supply                                  |
| 3 | B-Pin A and B are interchangeable pins. One of them will act as the output, and the other will act as the pulled-up ground. |

Features of MQ-3 Alcohol Sensor:
- Easy SIP header interface
- It can be used with any microcontroller.
- Good sensitivity to alcohol gas
- Cheap and long-lasting
- A simple external circuit is required.

Specification of MQ-3 Alcohol Sensor:
- Power: 5Vdc – 165mA
- Current: 150mA
- Digital output: TTL(Transistor Transistor Logic) Digital (logic 0=0.1v and logic 1=5v)
- Analog output: Maximum concentration can result in up to 4v
- Interface: 1 TTL input(HSW), 1 TTL output(ALR)
- Heat consumption is less than 750mW.
- Temperature Working range 14 to 122 F
- Dimension : 32x22x16mm

2.3.2. Finger Print sensor (RJ307). This is the optical fingerprint sensor figure 5 that works when the finger is put on the prism. Otherwise, all the light got reflected. Suppose we put the finger on the glass due to friction ridges on the hand. In that case, the air pocket pattern on the prism surface affects the evanescent field differently. This effect is called Frustrated Total internal reflection (FTIR) [7]. There is a change in reflected light, and this light is focused on the lens. The image sensor at the back of the lens passes the data to the Arm processor, where the fingerprint is stored. The pin description of the fingerprint module is shown in table 3. The verification of the fingerprint is done. The whole data is connected to the external processor. The data is transmitted serially by the USB or UART port (universal asynchronous receiver and transmitter). The total idea of the fingerprint sensor is based on the Total Internal Reflection (TIR). The figure 6 shows the pin layout of fingerprint module.
Figure 5: Optical Fingerprint Sensor

Table 3: Pin description of the fingerprint sensor

| Name | Type  | Description                                      |
|------|-------|--------------------------------------------------|
| +5v  | INPUT | Power supply                                     |
| GND  | Ground| Supply Ground                                    |
| TXD  | Output| TTL(Transistor-Transistor Logic) data out        |
| RDX  | INPUT | TTL(Transistor-Transistor Logic) data IN         |
| Touch| OUT   | When it is high means that the finger is detected|
| 3.3v | IN    | Finger detection power                           |

Specification of RJ (307):
- The power supply is 6V.
- The current value is 50mA.
The interface can be UART and USB
- Baud rate is 9600*N bps, N=1 to 12
- The image can be taken in 0.5s.
- The character file size is 256 Bytes
- The template size is 512 Byte.
- The false acceptance rate is 0.001%
- The false recognition rate is 0.1%
- Temperature can vary from -10-40 degrees Celsius.

In this way, verification of the driver's authenticity, if it is verified the vehicle, will start. If an unauthorized fingerprint is punched, it will stop the vehicle, and SMS will be sent to the owner and the current vehicle location.

2.3.3. GSM module (SIM900).
SIM900A is GPRS/GSM module. It is used in many computers and PDA (Personal digital assistant). SIM900A is the 68 terminal device mounted on the board so that the external devices can use each port. It uses UART communication. It is a dual-band engine that works on the EGSM 900 MHz and DCS 1800 MHz. Both frequencies are harmful to the living organism, but the intensity's impact is more than the frequency. It is a multi-slot device and very cheap. It provides the services such as SMS, Voice calling, and internet at a very slow speed. Use the SIM800 module instead of this module because it is a little bit less complex and meets the prototype we use for the project. The SIM900A required the +4.0V Power supply and can be extended to the range of 4.5v but higher power that will cause damage to the module [12]. The pin diagram of GSM module is shown in figure 7.

![SIM900 Pin Diagram](image)

**Figure 7:** Pin Diagram of GSM module

SIM900A GSM module Features:
- The power supply of voltage is 3.4v-4.5v
- In sleep mode, current consumption is about 1.5mA
- Dual-frequency EGSM900 and DCS1800
- Keypad and display interface
- MIC and audio output
- UART interface
- AT command communication
- Data Transfer: 85.6Kbps (Download)/42.8Kbps (upload).

2.3.4. GPS Module. This device is u-Blox [9] NEO-6M global positioning system module very cheap
in cost it has a ceramic patch antenna and has a backup battery and an onboard memory. It sometimes
does not get the proper signal, so choosing the tracker appropriately is more important. Its voltage
range is 3.3-5v. It has an adjustable UART interface for serial communication, and the default baud
rate for communication is 9600. It has Right-hand circular polarized polarization. It has a patch
antenna. This patch antenna is generally oriented parallel to the geographic horizon antenna must have
a full view of the sky [1].

The coordinate which you get can be used to get the location by using the coordinate software,
which will give the street address. This module can be directly plugged into the Arduino development
board, and we can directly download the library "Tiny GPS++" and upload the example code in it.
In this way, we can verify the module and check its precision.

In the vehicle theft prototype, we propose that when the wrong biometric is punched, the location is
sent to the owner's mobile phone. The corresponding data is uploaded to the node MCU server.

2.3.5. Node MCU (ESP8366EX). In this Espress if system smart connectivity platform (ESCP). It has a
combination of chipsets that provide the facility of WIFI networking so that it can be used to access
the internet to get the data or to upload the data to the server or the PHP page, which can be accessed
worldwide. It uses the 32bit processor and has a general input-output pin (GPIO), and it can use the
same software Environment used in Arduino to work IDE for node MCU. Change the type of board in
the tool option in the IDE. It uses the UART and the I2C communication to interact which the other
controller, its antenna, which is connected to the RF balun, which is used to connect the balanced line
to the unbalanced line [16, 17]. The block diagram of the system is shown in Figure 8.

**Figure 8: Block Diagram of ESP8366EX**

In the project, this is used to upload the data to the server, such as alcohol value and RFID value, and
the GPS location, but it requires the internet connection to be uploaded to the server. Figure 9 shows
the pin diagram of the module.

Feature of the Module:
- 802.11b/g/n
- Low power is consumed
- Support antenna diversity
- Wi-Fi 2.4Ghz
- Support three modes- active mode, sleep mode, and deep sleep mode.
2.3.6. Motor. In this project use of 12v and 30 rpm motor as the power consumed is less than the other motor[18]. It is a simple DC motor made of gear, and the shaft has 3mm threaded at the end of the shaft. It can be controlled by simple circuitry such as the L298N H-bridge module, which is a cheap module and can be easily plugged with the motor. No need for an Arduino microcontroller to control it. But in the project, use a relay to provide the motor’s power, and the other part of the circuit is done [19].

2.3.7. RFID. In RFID technology, we use the EM-18 module, which is mounted on the external board. This is a very cheap module and can be integrated with basic technology, which requires basic verification to check the person’s authenticity. The module operates at the frequency of 125 kHz. It comes with an on-chip antenna and can be powered up by the 5v power supply. The device can be plugged into the microcontroller, and data can be transmitted and received by the Tx and Rx pin on the module [14]. The specification of the EM-18 module is shown in table 4.

| Specification of EM-18 module |
|-----------------------------|
| **RF frequency** | 125Khz |
| **Standard** | EM4001 64bit |
| **Interface** | TTL serial interface |
| **Protocol** | ASCII |
| **Baud rate** | 9600bps |
| **Reading distance** | 100mm |
| **Antenna** | Integrated |

2.4. Software Required
Arduino IDE is shown in figure 10. It is the open-source software, so with the same IDE, we can do all the task as NODE MCU can also be coded with the same IDE it has different version according to
the operating system use, and the testing of all the board can be easily done by simply adding the library of the module as it is an open-source IDE and those libraries include the basic example which is readily available. The pin description is also available in the code. It provides the serial monitor to provide the pin and the print command output, which is used in the command line.

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3. Result and Discussions
As shown in figure 13 first enroll the fingerprint and load the person's data on the RFID tag for the EM-18 reader module. The motor will rotate when the power supply is plugged in when we punch the fingerprint sensor's finger, so the verification is done if the fingerprint matches the database. If it matches, the motor will continue to rotate, and if the wrong fingerprint is punched. The motor will stop and go to the processor's delay loop, and the same scenario will occur with the RFID reader when the wrong card is punched, then the motor will stop. Stopping the motor will lead to the sending of latitude and longitude location of the vehicle to the owner through the SMS facility by using the GSM module in which the SIM card is inserted as shown in Figure 11.

And the data can be viewed on the IoT module's web page and by plugging the LCD panel on the Arduino microcontroller as shown in Figure 12.

![Arduino IDE tool](image-url)

Figure 10: Arduino IDE tool

![Image of the Message received on the owner Mobile](image-url)

Figure 11: Image of the Message received on the owner Mobile
4. Conclusion
This project has developed Anti-Theft Vehicle Security System, which incorporates RFID, fingerprint sensor, and alcohol sensor. The absence of tracking and monitoring function has been resolved in this prototype. The IoT module gives us cloud services with live tracking. The low-cost Wi-Fi module and GSM control the vehicle's safety by sending the location message to the owner. The vehicle also has an emergency button that, when pressed, continuously sends the SMS to the owner and the cloud systems.

5. Future Enhancement
As we see in the prototype figure 13, the size of the device is large. We need to go for more miniature size modules with high sensitivity in nature to reduce the size. This project can add facial recognition to verify the vehicles' Driver or owner, similar to the mobile phone. And we can add the alcohol sensor inside the car. The distance is kept appropriate. It can only detect the alcohol level in driver-only not and does not detect the alcohol level due to passengers inside the car.

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