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# Automotive Security and Safety System Using ARM Microcontroller

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## Abstract

In this paper we proposed a system which can improve the safety and security in vehicle. Automobile industry and automobile market is in a high speed development state for several years. Automobile's appearance impact and changes people's life, it's becoming the progressive symbol of modern society. However, as the sharp rise of the automobile quantity, vehicle thief case is increasing. Car theft has been a persisting problem around the world. Due to the insecure environment the ratio of vehicle theft increases rapidly. Because of this is manufacturers of luxury automobiles has the responsibilities for taking steps to ensure the authorization for the owners and also in built the anti theft system to prevent the car from theft. The existing system was, Car alarm techniques are used to prevent the car theft with the help of different type of sensors like pressure, tilt and shock & door sensors. These systems however bear some limitations such as high cost, high false-alarm rate, and easy to be disabled. In order to solve these problem recent advancements in computer hardware and software have enabled automobile industry to develop affordable automated biometrics-based identification and verification systems. Many biometrics, including face detection, facial features, hand geometry, handwriting and voice have been used for the identification and verification of individuals. Each biometric has its own advantages and disadvantages, and choosing the best one for a specific application is influenced by both performance criteria and operating environment.

**Keywords**: ARM, GSM, Sensors, SMS, car safety, Fingerprint sensor, Alcohol sensor, Fuel sensor.

## Introduction

The basic need of is to provide security & safety to the car. This will be accomplished with the help of fingerprint recognition module, alcohol detection sensors, fuel detection sensors, car accident detection. The main concept in this design is introducing the mobile communications into the embedded system. This will be accomplished with the help of Global System of Mobile wireless communication technology. We will use microprocessors based on ARM technology, which will greatly improve the overall performance of the system. The application of Different modems makes real-time Car safety & security system. It will effectively improve the security & safety of the car. Based on these reasons, the system will meet the requirement of the antitheft & safety system of the car. An efficient automotive security system is implemented for anti-theft using an embedded system occupied with a Global Positioning System and a Global System of Mobile. The client interacts through this system with vehicles and determines their current locations and status using Google Earth. The user can track the position of targeted vehicles on Google Earth. Using GPS locator, the target current location is determined and sent, along with various parameters received by vehicle's data port, via Short Message Service (SMS) through GSM networks to a GSM modem that is connected to computer.The design & development of a theft control system for an automobile, which is being used to prevent/control the theft of a vehicle. The main concept in this design is introducing the mobile

Communications into the embedded system. The main aim of the project is to design and develop an advanced vehicle locking system in the real time environment. The user can send a STATUS message from his cell phone and as soon as the Global System of Mobile module gets the message, it will check for the user's authentication and if found to be valid, it will immediately send the details of the locations like the latitude and the longitude using GPS module. So the user can get to know the exact location of the vehicle.

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## Literature Survey

Literature review should include current thinking, findings, and approaches to the problem.

Montaser N. Ramadan et al. [1] introduces an efficient automotive security system. This system is implemented for anti-theft using an embedded system occupied with a Global Positioning System and a Global System of Mobile. The client interacts through this system with vehicles and determines their current locations and status using Google Earth. The user can track the position of targeted vehicles on Google Earth. Using GPS locator, the target current location is determined and sent, along with various parameters received by vehicle's data port, via Short Message Service (SMS) through GSM networks to a GSM modem that is connected to computer or laptop. The GPS coordinates are corrected using a discrete Kalman filter. In this paper, a low-cost vehicle tracking and monitoring system is presented.

Pravada P. Wankhade et al. [2] presents the design & development of a theft control system for an automobile, which is being used to prevent/control the theft of a vehicle. The main concept in this design is introducing the mobile communications into the embedded system. The main aim of the project is to design and develop an advanced vehicle locking system in the real time environment. The user can send a STATUS message from his cell phone and as soon as the Global System of Mobile module gets the message, it will check for the user's authentication and if found to be valid, it will immediately send the details of the locations like the latitude and the longitude using GPS module. So the user can get to know the exact location of the vehicle. The drawback of this paper is that Global System of Mobile modem provides information to the user on his request.

Vinoth Kumar Sadagopan, et al. [3] presents a novel anti theft control system for automobiles that tries to prevent the theft of a vehicle. They made a modest attempt to bring in a low cost and effective vehicle theft control system. The major advantage of this system is that the whole work can be made with a meager amount of investment and can be used in any automobiles and thus bringing in less sophisticated and simple technology.

P. Bagavathy et al. [4] Introduces a new Global System of Mobile -based vehicle anti-theft system. Speed sensors and vibration sensors are used to achieve dual theft-proof of automobile. Owner can receive the alarm message quickly and accurately, also can monitor the car by phone if necessary. The low-cost system has achievability and good usability. With the development of information technology, Global System of Mobile networks will be perfect and the system will have better prospects.

Lili Wan et al. [5] presents an automotive security system to disable an automobile from re-starting and its key auto systems from activating through remote control when it is stolen. This security technology is also very effective solution to prevent the automobile stealing with the aim of reselling key auto systems. This is achieved by introducing four layers of security features written in the form of firmware and embedded on the electronic control units. Hence, this system deters thieves from committing the theft because they will gain little economic benefits from his theft in spite of the risks he will be taking. Therefore, our automotive security technology is a most effective anti-theft solution at current stage. The experimental results show that the owner can securely control his vehicle within a few seconds, and the running time of our security software is acceptable.

Jules White et al.[6] introduces Automatic Traffic Accident Detection and Notification with Smartphone's" This paper describes how smart phones, such as the iPhone and Google Android platforms, can automatically detect traffic accidents using accelerometers and acoustic data, immediately notify a central emergency dispatch server after an accident, and provide situational awareness through photographs, GPS coordinates, VOIP communication channels, and accident data recording.

After doing the above literature survey it is decided that to prepare block diagram, study of different sensors & modules for car monitoring, tracking & controlling and test its characteristics so as to improve the performance of car security system.

## Proposed System

So we have to increase safety and security from the theft by using different sensor. Therefore our automotive security technology is a most effective anti-theft solution at current stage. The experimental results show that the owner can securely control his vehicle within a few seconds, and the running time of our security software is acceptable. After doing the above literature survey it is decided that to prepare block diagram, study of different sensors and modules for car monitoring, tracking and controlling and test its characteristics so as to improve the performance of car security system.

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| Pin Number | Name | Type | Function Description |
|---|---|---|---|
| 1 | Vin | In | Power input |
| 2 | TD | In | Data output. |
| 3 | RD | Out | Data input. |
| 4 | NC | – | Not connect. |
| 5 | NC | – | Not connect. |
| 6 | GND | – | Signal ground. Connected to power ground |

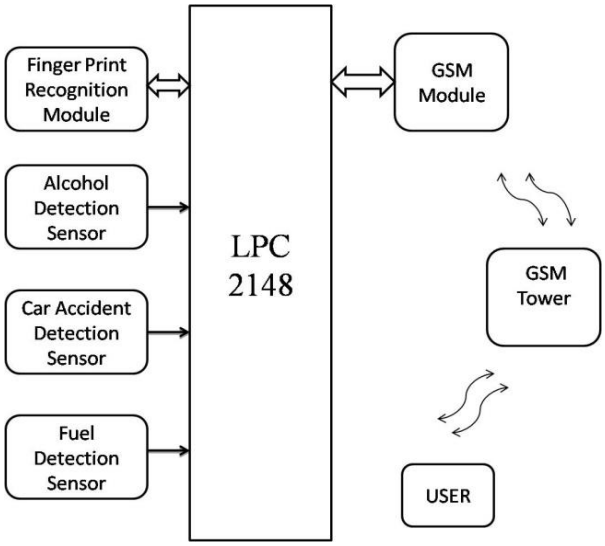



**Figure1: Block Diagram**

## Hardware Design

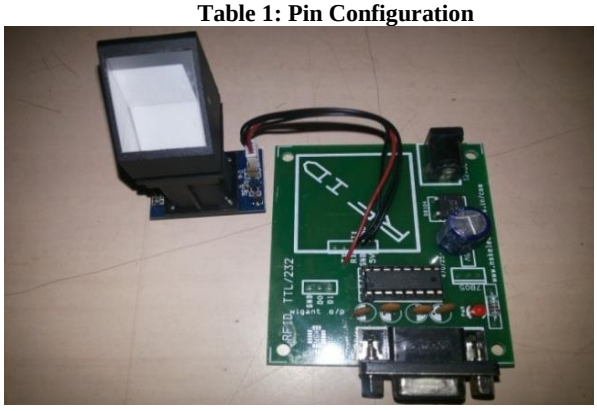
### Microcontroller LPC2148

The LPC2148 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine microcontroller with embedded high speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. The ARM7TDMI-S is a general purpose 32-bit microprocessor, which offers high performance and very low power consumption. The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers (CISC). This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small .

### Fingerprint Identification Module R303A

Fingerprint processing includes two parts: fingerprint enrolment and fingerprint matching (the matching can be 1:1 or 1: N). When enrolling, user needs to enter the finger two times. The system will process the two time finger images, generate a template of the finger based on processing results and store the template. When matching, user enters the finger through optical sensor and system will generate a template of the finger and compare it with templates of the finger library. For 1:1 matching, system will compare the live finger with specific template designated in the Module; for 1: N matching, or searching, system will search the whole finger library for the matching finger. In both circumstances, system will return the matching result, success or failure.
Notepad:- The system sets aside a 512-bytes memory (16 pages* 32 bytes) for user's notepad, where data Requiring power-off protection can be stored. The host can access the page by instructions of PS_WriteNotepad and PS_Read Notepad.

**Table 1: Pin Configuration**



Figur2: Fingerprint module

### Alcohol SENSOR MQ-3

Structure and configuration of MQ-3 gas sensor is shown in figure3. sensor composed by micro AL2O3 ceramic tube, Tin Dioxide (SnO2) sensitive layer, measuring electrode and heater are fixed into a crust made by plastic and stainless steel net. The heater provides necessary work conditions for work of sensitive components. The enveloped MQ-3 have 6 pin ,4 of them are used to fetch signals, and other 2 are used for providing heating current. Electric parameter measurement circuit.

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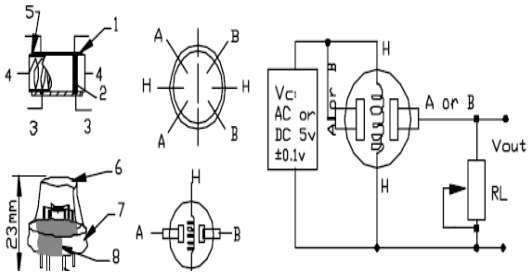


**Figure 3: Alcohol Sensor**

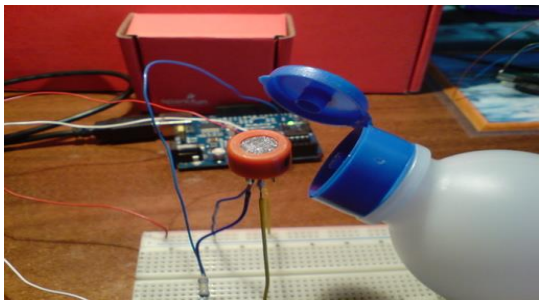

**Figure 4: Alcohol Detection**

| g-Select2 | g-Select1 | g-Range | Sensitivity |
|---|---|---|---|
| 0 | 0 | 1.5g | 800 mV/g |
| 0 | 1 | 2g | 600 mV/g |
| 1 | 0 | 4g | 300 mV/g |
| 1 | 1 | 6g | 200 mV/g |

**Table 2: Parts and Materials**

**Accelerometer MMA7260QT**

The MMA7260QT low cost capacitive micro machined accelerometer features signal conditioning, a 1-pole low pass filter, temperature compensation and g-Select which allows for the selection among 4 sensitivities. Zero-g offset full scale span and filter cut-off are factory set and require no external devices. Includes a Sleep Mode that makes it ideal for Hand held battery powered electronics. The device consists of two surface micro machined capacitive sensing cells (g-cell) and a signal conditioning ASIC contained in a single integrated circuit package. The sensing elements are sealed hermetically at the wafer level using a bulk micro machined cap wafer. The g-cell is a mechanical structure formed from semiconductor materials (poly silicon) using semiconductor processes (masking and etching). It can be modelled as a set of beams attached to a movable central mass that move between fixed beams. The movable beams can be deflected from their rest position by subjecting the system to acceleration.

g-Select:-The g-Select feature allows for the selection among 4 sensitivities present in the device. Depending on the logic input placed on pins 1 and 2, the device internal gain will be changed allowing it to function with a 1.5g, 2g, 4g, or 6g sensitivity. This feature is ideal when a product has applications requiring different sensitivities for optimum performance. The sensitivity can be changed at anytime during the operation of the product. The g-Select1 and g-Select2 pins can be left unconnected for applications requiring only a 1.5g sensitivity as the device has an internal pull-down to keep it at that sensitivity (800mV/g).

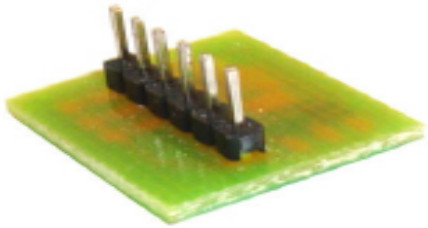

**Figure5: Acceleration Sensor**

| NO. | PARTS | MATERIALS |
|---|---|---|
| 1 | Gas sensing layer | Sno2 |
| 2 | Electrode | Au |
| 3 | Electrode line | Pt |
| 4 | Heater coil | Ni-Cr alloy |
| 5 | Anti-explosion network | Stainless Steel |
| 6 | Base | Bakelite |
| 7 | Tube pin | copper |

**Table3: g-Select Pin Descriptions**

**Fuel Detection Sensor**

The AKCP Fuel Level Sensor is a float-type liquid level Sensor, used to monitor the fuel level in your storage tank. The intelligent sensor port powers the sensor. It is compatible with any of the security Probe series base units, or the E-sensor 8 expansion modules. You can instantly be alerted should there be any drop below critical levels in your fuel. Advance alerting of possible fuel leaks or theft will ensure your tanks never run dry again. Setup is simple, with the security Probe autosense function and a simple 2-step calibration. Unlike other liquid float level sensors, calibration is performed to the sensor prior to mounting. No need to fill your tanks with water in order to calibrate the sensor, saving time, and mitigating harm to your engine caused by water left in the tanks. The sensor comes with a 40ft (10.2 meter) weatherproof cable that connects the float level assembly to the sensor adapter. Custom lengths of up

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to 2,300ft (700 meters) are available upon request. A supplied 5ft CAT5 cable links the sensor adapter to the security Probe base unit.

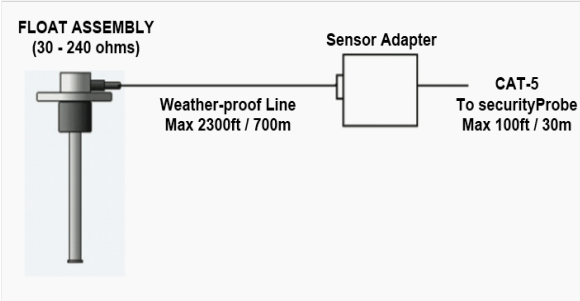


**Figure6: Float level Sensor**

**Figure7: Float level Sensor with ARM**

**GSM Modem**

In this project for car accident detection, it is necessary to eliminate the large time span between the accidents occurs and when first responders are dispatched to the scene. To fulfil this requirement GSM modem SIM 300 is selected. GSM modem is a wireless modem that works with a GSM wireless network. It is used to automatically detect traffic accidents & immediately notify to service provider after an accident. GSM modem has low power consumption of 0.25A during normal operations and around 1A during transmission. Operating Voltage required for GSM is 7 – 15V AC or DC. Its operating baud rate is 9600bps. GSM normally have 3 waves GSM 900, DCS 1800 and PCS1900. GSM modem SIM 300 is shown in Figure 3.13. SIM 300 is connected to the ARM controller through MAX232 via serial port.

The commands that are using to provide communication are AT commands. In proposed system AT commands are used for sending message to the service provider. Here are some AT commands to send the SMS.

- send the command - AT+CMGF=1
- Modem will then send the text - OK
- Then send - AT+CMGS="NUM" **(**where NUM is service provider's number**)**
- Modem will then send the text - TYPE THE MESSAGE

  Enter the message and then press ctrl+z to send

  SMS.

## Software Design

The development environment for the system software is Keil with the embedded C program language. Flow Chart of the program is presented in Figure 8. It shows that the system includes the features such as fingerprint detection, car accident detection, alcohol detection.

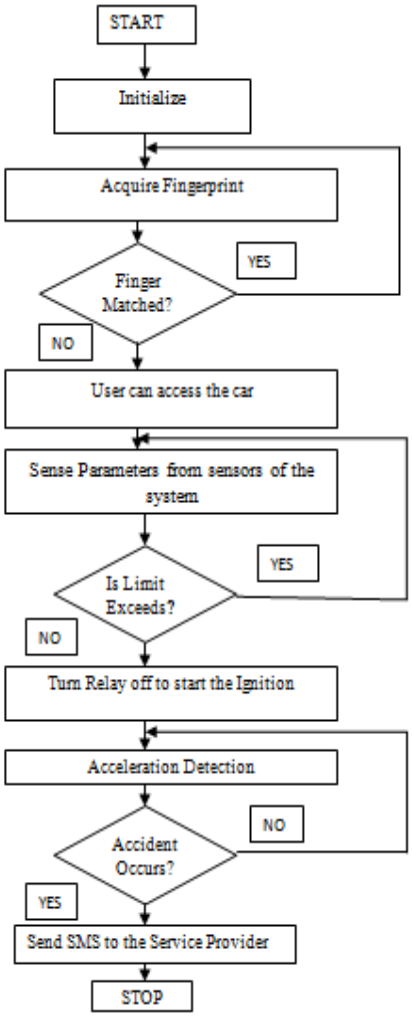


**Figure8: Flow chart for sensor**

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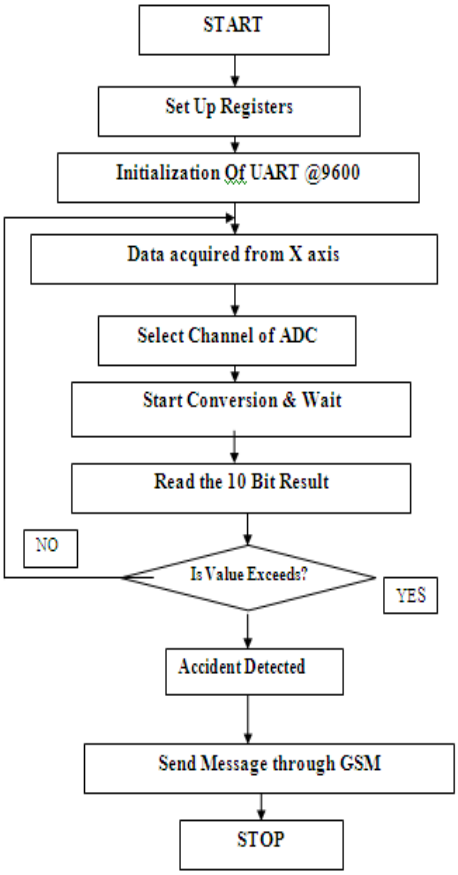


**Figure9: Flow chart for the GSM Interfacing**

## Result and Discussion

### Sensor Parameters Results

Figure 10 shows LCD displays the reading of the acceleration sensor and alcohol sensor. Set point for the alcohol sensor is 100 millilitres. 'A' indicates the output of alcohol sensor. If the concentration of the alcohol exceeds the set point, then LCD displays "Off" as shown. 'OFF' or 'ON' indicates the status. 'X' and 'Y' indicates the X-axis and Y-axis reading of acceleration sensor. At 0g condition, the X axis gives output 1.65v. Set point for the acceleration sensor is 2g.


**Figure 10: Reading of the acceleration and alcohol sensor**

### Fingerprint Module

Interfacing of fingerprint module with LPC 2148 is shown in figure 11 the sequential operation of the system, so in accordance with the systems function we are getting respective message on the LCD. For Antitheft system, fingerprint module is used. Initialization of the system is shown. In that LCD displays "Biometric test ARM controller" shows the system asks for finger. LCD displays "Impress Finger". If finger matches then LCD displays "Matched=ID" as shown in figure and if finger not matches then LCD display Match Retry.

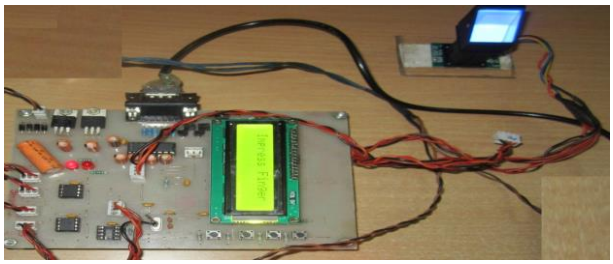

**Figure 11: Interfacing of fingerprint module with LPC 2148**

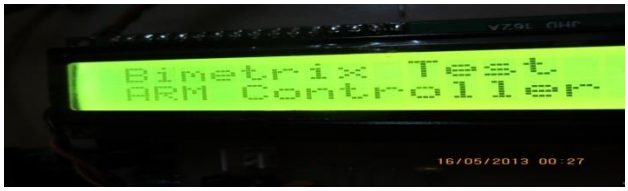


**Figure12: Initialization of the system**


**Figure13: Asks for finger**


**Figure14: Finger matches**


**Figure15: Finger not matches**

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**GSM Results**

GSM modem is used to send the message of accident detection to the service provider**.** Figure 16 shows GSM interfacing. If acceleration of the car is greater than set point then message sent to service provider. The message "Accident!" received by service provider is shown in figure 17.

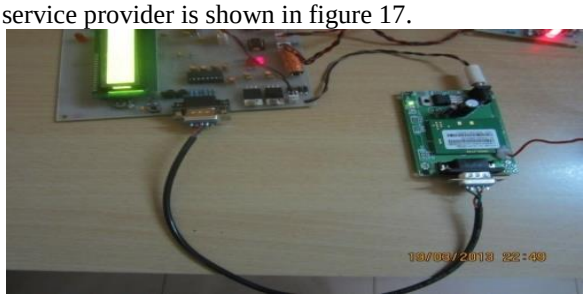

**Figure16: GSM interfacing**

**Figure17: GSM Testing**

**Alcohol sensor and Fuel Detection Sensor result**

Alcohol sensor and Fuel Detection Sensor gives maximum output voltage for minimum distance and level. Response time for alcohol sensor is quick. As the concentration of the alcohol increases, output voltage of the sensor increases. So anti drunken driving system and gas leak detection system has high sensitivity. GSM modem used for accident detection can send information over a large distance. So there is no any limitation in case of distance. In fingerprint module, in case of valid users for 20-25 times entry it gives 100% identification. And in case of invalid user, system not works. Image acquiring time is less than 0.5 sec. So this antitheft system has higher accuracy. In fuel detection sensor when fuel is decreases the output voltage also decreases.

| Type Of Sensor | Detection at distance in cm | Output voltage in mv |
|---|---|---|
| Alcohol Sensor (100 ml) | 10 | 106 |
| | 20 | 86 |
| | 30 | 65 |
| Fuel Sensor (200 ml) | 20 | 112 |
| | 30 | 95 |
| | 50 | 61 |

**Table 4: Performance Analysis of sensors**

## Conclusion

The design and implementation of this system allows safety and security system to the car. A simple, cost effective anti-theft security system has been successfully designed and constructed. This system detects drunken Drivers & and reduces the accidents caused drunk driving. This system also detects an accident and sends information to service provider. The technologies of fingerprint recognition, the GSM / GPRS wireless transmission have good perspective in the auto safety domain's application The advantage of the system is that the status of vehicle owner could be identified effectively which prevents the criminal from stealing. In addition to this, this system will reduce the accidents and save the human lives. On the whole, this system is very cost effective and efficient. This system can be easily implemented in real time

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