International Journal of Multidisciplinary and Current Research ISSN: 2321-3124
Research Article Available at: http://ijmcr.com

Intelligent Anti-Theft Car Security System based on Arduino and GSM Network

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Accepted 18 June 2016, Available online 23 June 2016, **Vol.4 (May/June 2016 issue)**

Abstract

Nowadays, car thieves are becoming more organized and advanced, existing in parking garages at home, office, building and store. The security system thus will need to be more advanced than currently have been embedded in the private and public cars. In this paper, designing a low cost and an efficient anti-theft security circuit based on an Arduino microcontroller is proposed. The system can be fixed as a backup plan inside the vehicles to prevent them from being stolen by thieves. The system has the capability of locking the doors and the ignition system of the vehicle and at the same time notifies the owners of the vehicle through a GSM network with an SMS alert message.

Keywords: *Network Communications, Electronic Circuit, Automatic Control, Arduino Microcontroller, GSM Shield, Bipolar Transistors.*

Introduction

Most of the people believe that car robberies can just happen in a shabby neighborhood. The individuals, however, should be mindful so as not to be attracted towards cheats by doing regular mistakes. The car burglary is a standout amongst the most recognized and most experienced criminal practices. It can actually happen at about anytime and anyplace. The responsibilities physical ownership can be modified without the legitimate proprietor's assent. Robbery counteractive action has been familiar to declare the possession at whatever point the legitimate proprietor is physically truant. The only possible way out of such problems is to implement an additional security system in the car. The system should be able to perform reasonably well even in unfavorable circumstances to meet the desired level of security. An anti-theft system is any gadget or strategy utilized to anticipate or prevent the unapproved assignments of valuable belongings. In some cases, it has the ability to send an alert notification message via networks to the owner or the nearest police station [1, 2]. Nowadays new ways for vehicle security are one of the essential concerns. The possibility of thefts is encouraged the security system makers to use modern technology that enhanced safety as well as security. Thus, a cost-effective, intelligent car security system is required. The existing car anti-theft systems are as simple as car alarm and flashing light techniques, which makes use of different type of sensors, such as pressure, shock and proximity sensors. The drawbacks of such conventional systems are their relatively simple features, which can easily be hacked by the hi-tech thieves. For example, they can hack into the vehicles electronic security system and then program another empty key, which can give them access to the vehicle without their having to break the windows or locks of the vehicle.

Therefore, in order to make the vehicle as secure as possible, an additional backup security might be required to protect twice the vehicle from being stolen. In this paper a new strategy with a proper design is proposed, which is a prototype of a system that has capability of detecting the thief and then notify the car owner via an alert Short Message Service (SMS). Here, the core of system is based on an Arduino Uno open-source microcontroller [3]. Figure 1 shows the overview block diagram of the working system.

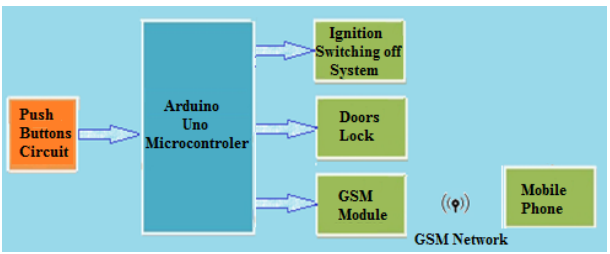

Fig 1: Anti-theft security based Arduino microcontroller block diagram

Related Work and Background

There are different types of security systems for cars and vehicles ranged from very simple to quite sophisticated

systems. Authors and researchers have proposed and described various security ideas for vehicle and home in their literature. For examples, in Ref. [4], a method is proposed to track and lock the theft vehicle using Global Positioning System (GPS) and Global System for Mobile (GSM) technology. The security device can go to sleeping mode while the owner or an authorized person is handling the vehicle otherwise, would have to be in active mode. Here, the mode of operation can be changed either remotely or by the owner of the vehicle. In the active mode, if any disturbance found on any side of the vehicle doors, then the infrared (IR) proximity sensor senses the noise signals and sends alert notifications to the microcontroller. The system then issues an alert message informing the owner about the status and location of the vehicle. In [5], the author has demonstrated a smart home electronic system that one can remotely control their home appliances via SMS communication using Arduino microcontroller platform. Moreover, the system can also notify the house owner about any intrusion or movement around the restricted properties via an alert SMS. A mobile phone was used to control the devices via the SMS services, sending turning ON/OFF commands and receiving notifications about the occurred activity in the house.

The authors of Ref. [6] have proposed another efficient automotive security system using embedded GPS and GSM networks. Here, the client can interact with this networks with the vehicle and identifies its location using Google Earth. The users can then track the location of the stolen vehicle on Google Earth. The location of the target via the embedded GPS locator can be determined and then along with other parameters received by all the data ports of the stolen vehicle can be sent to the GSM modem connected to a PC or laptop via an SMS, using the embedded GSM networks. In addition, to secure more the vehicle, the user of a group of users can also turn off the fleet vehicles by blocking the gas feeding line, if any burglars try to run it. The system can also be very secure and efficient in detailing any emergency situations, such as crash reporting or engine failure. In Ref. [7], the design and operation of an easy to use and cheap anti-theft and vehicle tracking system have been proposed. An embedded system coupled with a single GPS module and GSM network is used. It has the capability of providing the real-time location of the vehicle and reporting about the theft, which can most effectively guide the owner via SMS messages. Similar to the previously mentioned papers, the GPS reads the current coordinates of the stolen vehicle and then reports the data to the client via GSM networking, employing the GSM modem. Moreover, one from the client's mobile or the tracking server can stop the stolen vehicle by simply sending an SMS message to the in-vehicle tracking system to turn off its ignition system.

Proposed System

A brief description of the complete system is given in this section before detailing the specifications for each individual unit of the system. Figure 2 (designed by Fritzing [8]) shows the system architecture diagram of the system. The core of the system is based on the open-source microcontroller Arduino Uno board, controlling all the operations of the electronic circuits connected to its digital input- and output pins. The system has the capability of locking the doors of the vehicle and turning off the ignition system as soon as the car has been accessed by an unauthorized person. Subsequently, a GSM modem, which is also attached to the Arduino Uno board, can send an alert SMS to the car owners to be notified. In this work, similar to the work of authors of Ref. [4], the system can be set to be either in sleeping mode, when the owner or an authorized person is handling the vehicle, or otherwise, would be in the active mode. Here, the mode of operation can be changed remotely using RF wireless remote control switch. The entire system has been fixed underneath of the driver seat using a prototype breadboard model as shown in Fig. 2.

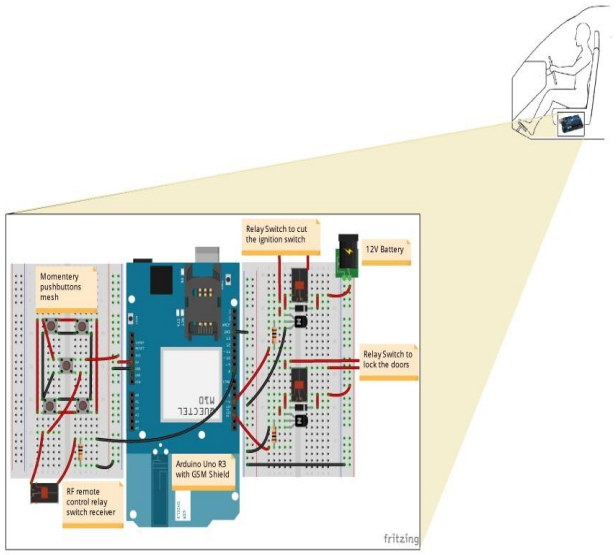

Fig 2: A prototype of the system architecture.

Hardware Design

Essentially, the hardware of the system consists of: a RF wireless remote control switch unit to activate and deactivate the security system remotely, an Arduino Uno R3 microcontroller board, a prototyping breadboard for the complementary electronic circuits, a SIM900 GSM shield for Arduino Uno [9], and several supplementary circuits that support this security system. The circuit configuration of this device is shown in Fig. 3. The first dashed-line enclosure represents the RF wireless remote control switch unit that used to set the security system to be either in sleeping mode or in active mode. This allows that the security system to be inactive if the car owner is accessing the vehicle and active to protect the vehicle from stealing. In this work, the commercial 433 Mhz RF remote control switch (TIANRUI-T126E) was used, which

has been modified to be operated by the main battery of the vehicle. However, one can use an Arduino specified RF remote controller, such as 315 Mhz RF wireless transmitter and receiver kit module for Arduino UNO R3. This remote controller can be attached to the circuit of the car remote controller, which makes the system to be more secure due to that the embedded remote control switch has the authority to switch the security system ON or OFF only for the car owner. On the other hand, it has the advantage of keeping the owner from misusing the system.

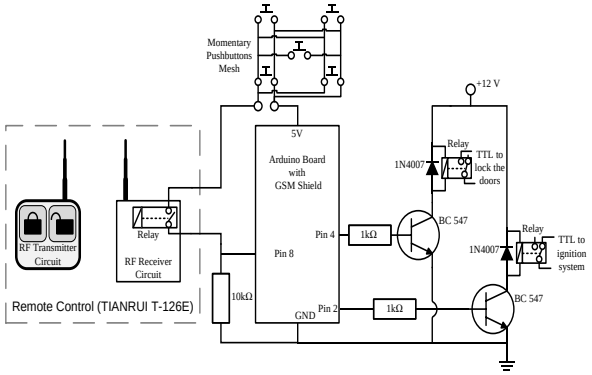

Fig 3: Security system electronic circuit

Multiple momentary pushbutton switches, which act as input sensors, are used to activate the Arduino program. Here, in this work, the pushbuttons are fixed underneath of the driver seat, connecting with each other in parallel to form a square-shaped mesh that has located at each corner and the center of the mesh, as shown in the top Fig. 3. Then the relay switch of the RF remote control receiver was connected in series with the pin 8 and the memntory pushbuttons. A 10kΩ is then connected between pin 8 and pin GND. This circuit configuration, which is called state change detection or edge detection in Ref [10], can allow the Arduino to read the status of the digital input pin 8 whether it is HIGH or LOW. In the case, when the system is in active mode (*i.e.*, the relay switch is in close loop) and one or any other pushbutton switches is open (*i.e.*, unpressed) there is no connection between the legs of the pushbutton, therefore, the pin is connected to GND (*i.e.*, via the 10kΩ resistor) gives rise a zero voltage and an LOW signal would be read pin 8. Consequently, the programmed code uploaded to the Arduino does not apply any alarming events to the output circuits. However, when one or any other pushbuttons are closed (*i.e.*, pressed), it forms a connection between its two legs, connecting the circuit to the 5 volts source, therefore that a HIGH signal would be read by the pin 8. As a result, the Arduino generates and sends HIGH TTL logic signals to the supplementary output circuits through pins 2 and 4 to cut off the ignition circuit and lock the doors, respectively. In parallel to this function, an alert SMS via the GSM shield can send the owner to be notified. On the other hand, in the case when the system is in sleeping mode, the pin 8 goes to LOW due to that the relay switch is open.

A typical NPN transistor relay switch circuits were employed for transferring the TTL logic outputs from the Arduino output pins 2 and 4 to the ignition systems and doors locking, respectively. As shown in Fig. 3, the GND pin is common between the input and the output circuits; the high power 12-volt car battery is used to supply the 12-volt relay switches of the doors locking system and ignition circuit. In the active mode, the Arduino board puts pin 2 and 4 in HIGH states (*i.e.*, 5 volts) once the seat buttons have been pressed. This voltage is then used to drive the NPN transistor, resulting that a high current is going through the relay switches, turning them ON.

System Flowchart

The work of this proposed system is declared step by step by using the following flow chart shown in Fig. 4.

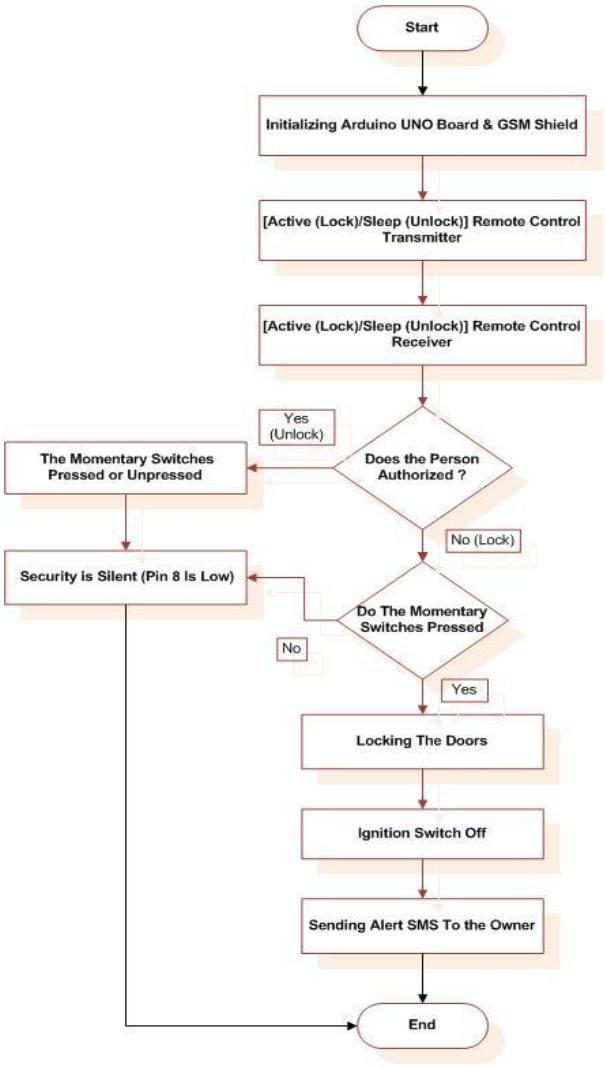

Fig 4: System flow chart

Conclusion

In this work, a new strategy security system, which is entitled by **Intelligent Anti-Theft Car Security System based on Arduino and GSM Network,** is proposed. It was intended to be used as a backup unit along the other

conventional systems for ensuring more safety and security to the vehicle. It has the ability to lock the doors and turning off the ignition system of the vehicle, when any unauthorized person is triggering the system via pressing the pushbutton switches, which are fixed underneath of the driver seat. A GSM modem, which is attached to the Arduino Uno board, can notify the car owners via an SMS alert. This system offers many advantages with respect to other car security systems since the system employed the Arduino Uno microcontroller. It is low cost, simple, flexible, and easy to be installed and communicated. . It is also designed to be expandable with more functions to be added to the system by using more input and output pins of the Arduino Uno board.

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