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Research paper

Implementation of smart anti-theft car security system based on GSM

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Abstract

Recently, in the last few years, it has been noticed that the theft of cars and the use of stolen cars in suspicious acts by robbers has been increased. The robbers use modern and new methods to theft of different cars. It is therefore necessary to find serious solutions to protect vehicles from theft. In this system the Arduino microcontroller, vibration sensor, GSM SIM 800L module and Bluetooth HC-05 are using to implement the system, the vibration sensor used the purpose of detecting the vibration resulting from the operation of the engine of the car when the vibration detected the message is sent through the GSM unit and the alarm whistle turning "ON" in order to alert the owner of the car. When the car owner wants to operate his car should be entering the secret code to run the car engine through the 4*4 keypad and also requires to send specific command from the smart mobile phone through the Bluetooth to make car engine turning "ON" and otherwise the car does not work, when the thief tries to enter the password more than twice the alarm will be turning "ON" and all cases will appear on the screen of special software was chosen for this purpose all these to make the system reliable and more secure.

Keywords: *Arduino UNO; GSM; Bluetooth; Vibration Sensor; Keypad.*

1. Introduction

In the last few decades, car thieves are becoming more regular, advanced, and have extent experience to robbery the cars existing in garages at office, home or in public parking garages. If we looked about history of car theft we will see that in 1981, a lot of motors and cars were robbed, the total value of robbed over 3.4 billion dollars. This represent a major loss and a major number of cars than ever before. In fact, the introduction of improved security measures in the late 1970s appears to have capped a car theft rate which had more than redoubled in the previous decade, so that the 1980s indeed testified a slight descend in car thefts. However, the obvious decline in the robbery rate does not mean that the problem has reduced in severity, so there are several reasons to consider that the problem has changed in ways that gauntlet until the most foolproof anti-theft devices. First, car theft is no longer an issue of juvenile joyriding. It is become an adult crime increasingly. The rate of persons arrested for car theft who were less than the age of ~8 decrease from 56 percent in 1970 to 40 percent in 1981. A synchronous decrease in cases clearance rate is proportional with the decrease in juvenile participation: younger are usually easier to catch than adults, since they are inexpert at hiding their crimes and may prevalence stories of their exploits. among schoolmates and friends. The commensurate excess in arrests of adults, who are more difficult to identify. and apprehend, suggests that many more of them are active in car theft than before. More than 93 percent of vehicle thefts happen in metropolitan regions where car theft stays a pervasive problem. Western states, in special, experience high average of car theft, while nationally a car or truck was robbed every 28.8 seconds in 2007. The FBI Uniform Crime Reports Issued by in September 2008 Indicates 1.1 million car thefts in 2007, with an estimated value of $7.4 billion [1] [2].

Even with improved security, safety systems and increased awareness among vehicle owners, vehicle theft has not yet been curbed down to a significant measure. A simple revamping of the car's exterior makes it impossible to track the stolen vehicles and so only a very small percentage of thefts are successfully recovered. Because of the costly nature of motor vehicles, owners are now being forced to spend more and more money on car insurance and other policies [3].

The ability of thefts is encouraged the security system designer to the use modern technologies that enhanced safety and the security also. The low cost-effective and smart car security system is important. The existing car anti-theft systems are as simple such the car alarm or flashing light, which makes the using of various of sensors such as pressure, vibration and proximity sensors. The drawbacks of such conventional systems are their relatively simple features, which can easily be hacked by the hi-tech thieves This is why the theft of cars is constantly increasing as there is no deterrent to repelling the glare with these simple conventional devices [4].

Modern security systems are built on the basis of precise controls where it is possible to design a protection system that alerts the user by sending a text message and can use GPS for the purpose of tracking the vehicle and send a text message for the purpose of stopping it and can be used Internet stuff to do this work that these innovative and modern methods are capable to limit car theft [5].

2. System parts

Many sensors and other devices were used in the experiment of this work. Therefore, this part was dedicated to describing those devices.

2.1. Arduino UNO

An Arduino is a single-board microcontroller and a software suite for programming it to been embedded system. The hardware consists of a simple open hardware design for the controller with an Atmel AVR processor and on-board I/O support. The software consists of a standard programming language and the boot loader that runs on the board. In other words, an Arduino is a tiny computer that you can program to process inputs and outputs between the device and external components you connect to it. The Arduino UNO is a completed microcontroller board based on the ATmega328 microcontroller. Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs light on a sensor, a finger on a button, or a Twitter message and turn it into an output activating a motor, turning on an LED, publishing something online. by sending a set of instructions to the microcontroller on the board can make the microcontroller to doing the required work. The Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing [6], [7]. The figure. 1 illustrates the Arduino UNO microcontroller.

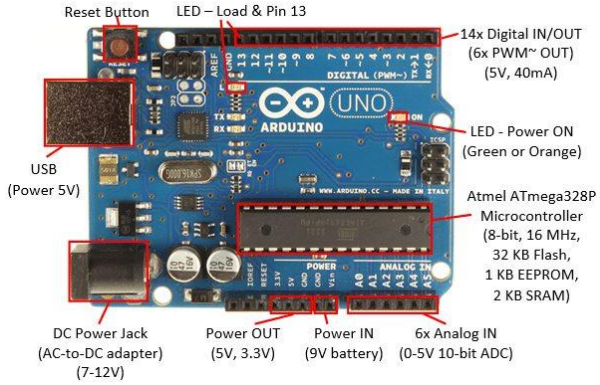

Fig. 1: Arduino UNO Microcontroller.

Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike. The table (1) describe the specifications of Arduino UNO [8].

Table 1: The Specifications of Arduino UNO Microcontroller

Arduino UNO Microcontroller	Description
Rated operating voltage	5v
Recommended input voltage level	7V to 12V
Input/output digital pins	14
Analogue Input pins	8
DC current per the I/O pin	40 mA
DC current of 3.3v pin	50 mA
Flash memory	32 KB of which 0.5KB used for boot loader
SRAM	2 KB
EEPROM	1 KB
Clock speed	16000 KHZ

2.2. Vibration sensor

This sensor used to measure the vibration level, sensor module produce logic states depends on vibration and external force applied on it. When there is no vibration this module gives logic LOW output. When it feels vibration then output of this module goes to logic HIGH. The working bias of this circuit is between 3.3V to 5V DC. The vibration sensor Comes with breakout board that includes comparator LM 393 and Adjustable on board potentiometer for sensitivity threshold selection, and signal indication LED. There are a lot of applications can have created by measuring Vibration level, but sensing vibration accurately is a difficult job. the figure .2 illustrate the SW-18015P vibration sensor [9].

Fig. 2: The SW-18015P Vibration Sensor.

2.3. GSM SIM800L

GSM is abbreviation of Global System for Mobile communications, the SIM800L module supports quad-band GSM/GPRS network, available for GPRS and SMS message data remote transmission. The SIM800LGSM communicates with microcontroller via UART port, supports command including 3GPP TS 27.007, 27.005 and SIMCOM enhanced AT Commands. It also has built-in level translation, so it can work with microcontroller of higher voltage than 2.8V default. Besides, the board also supports A-GPS technique which is called mobile positioning and gets position by mobile network. This features make it can also be a tracker module. The figure .3 illustrate the SIM 900 L GSM module and the table .2 illustrate the specifications of SIM800L GSM [10].

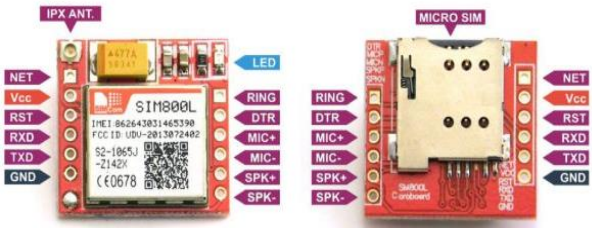

Fig. 3: The SIM800L GSM Module.

Table 2: Specifications of SIM800L GSM Module

GSM SIM800L	Description
Supply voltage	3.8V- 5V
Recommended supply voltage	4V
Power consumption	• sleep mode < 2.0mA • idle mode < 7.0mA • GSM transmission (avg.): 350 mA. • GSM transmission (peek): 2000 mA. • Module size: 25 x 23 mm
SIM card socket	Micro SIM
Supported frequencies	Quad Band (850 / 950 / 1800 /1900 MHz)
Antenna connector	IPX
Working temperature range	-40 do + 85 ° C

2.4. Bluetooth HC-05

Bluetooth is a wireless technology standard for exchanging data over short distances, HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature). The HC-05 can operate as either a slave or master device. Slave devices cannot initiate connections; they can only accept them. Master devices can initiate and (depending on the actual module)

sometimes accept them. If you want to use the module with a mobile device such as an Android phone, the phone will be the master device and so the HC-05 will need to be the slave. Figure .4 illustrate the HC-05 Bluetooth module [11].

Fig. 4: HC-05 Bluetooth Module.

2.5. Arduino keypad

Matrix keypads use a combination of four rows and four columns to provide button states to the host device, typically a microcontroller. Underneath each key is a pushbutton, with one end connected to one row, and the other end connected to one column. These connections are shown in Figure.5, In order for the microcontroller to determine which button is pressed, it first needs to pull each of the four columns (pins 1-4) either low or high one at a time, and then poll the states of the four rows (pins 5-8). Depending on the states of the columns, the microcontroller can tell which button is pressed. Keypads are used in all types of devices, including cell phones, fax machines, microwaves, ovens, door locks, etc. in this paper the keypad will used in the purpose of car turning ON/OFF [12].

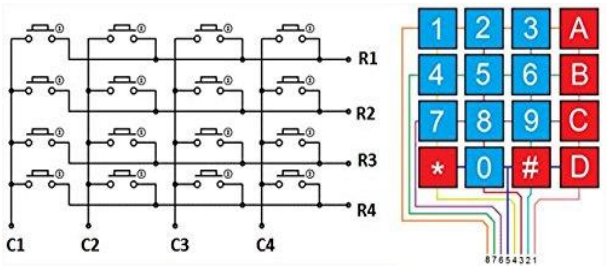

Fig. 5: The Arduino Keypad with Connection Diagram.

3. System design and implementation

This section includes an explanation and clarification of the system that was built to protect cars from theft and contains the lowest steps of work and design as well as the results obtained after the operation of the system.The system was built on the basis of the Arduino microcontroller, vibration sensor and the GSM unit when the thief tries to steal the car and open one of the doors or the operation of the engine this will produce vibration, the vibration sensor will sense the resulting vibration and sends a voltage signal to the Arduino, in this case the Arduino will stop the engine of the car electrically and through the GSM unit is sending a message to the owner of the car for the purpose of alert from the theft and at the same time is activated alarm whistle.To make the system more reliable and secure the Bluetooth module was used to monitor the status of the car, when the owner of car tries to operate his car will require him to enter the secret code (i.e. specific password) through the keyboard and send command through the smartphone through Bluetooth otherwise the car will not work at all. In case the thief attempts to tamper with the car and enter the secret code for more than two times, the alarm will be activated and the owner will be alerted by the application that is installed in the smartphone. The figure.6 illustrate the block diagram of the implemented system.

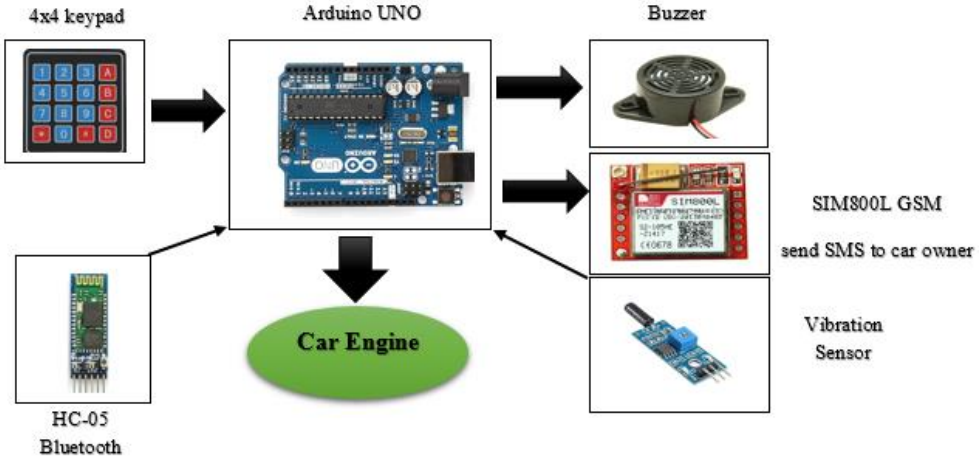

Fig. 6: The Block Diagram of Implemented System.

The figure.7 illustrate the implemented system, where the LED represent the car engine and the transistor using as a switch because the buzzer drawn a big amount of power as compared with the power output from the Arduino UNO so, the buzzer feeding from external source and the Arduino will just give a pulse in order to turning the transistor “ON”. The GSM module was used in this work Suffers from feeding power where it needs a high current so the Arduino must be fed from an external source, in the work the adapter chosen with 12V and 2000 mA

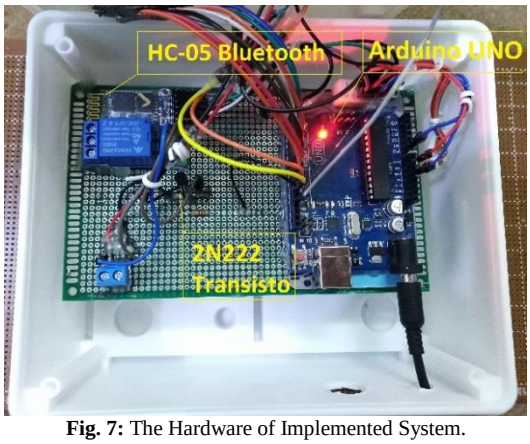

Fig. 7: The Hardware of Implemented System.

The figure.8 shows the vibration sensor of the implemented system, where the vibration sensor will be the main module in the detection of vibration, which in turn sends a signal to the microcontroller and then the Arduino sent the alarm message to the owner of the vehicle.

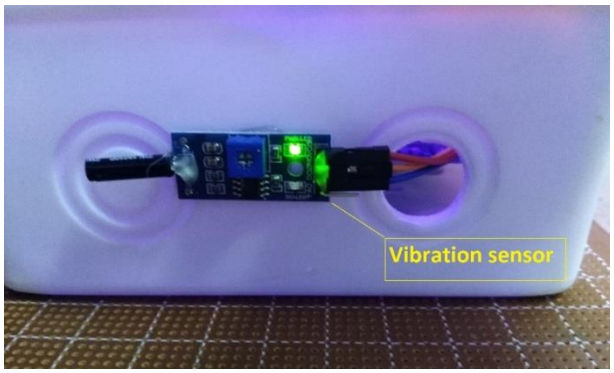

Fig. 8: The Vibration Sensor of Implemented System.

4. Results

In this section, the results obtained will be discussed after running the system that was built the. The BlueTerm application installed in the Android mobile phone in order to connect the mobile phone with Bluetooth of the Arduino, this application allows the user from sending the command (i.e. character or number) to the Arduino and entering the password through the keypad to make the car in standby mode. When the vibration detected the GSM module send SMS to alert the car owner as shown in figure.9.

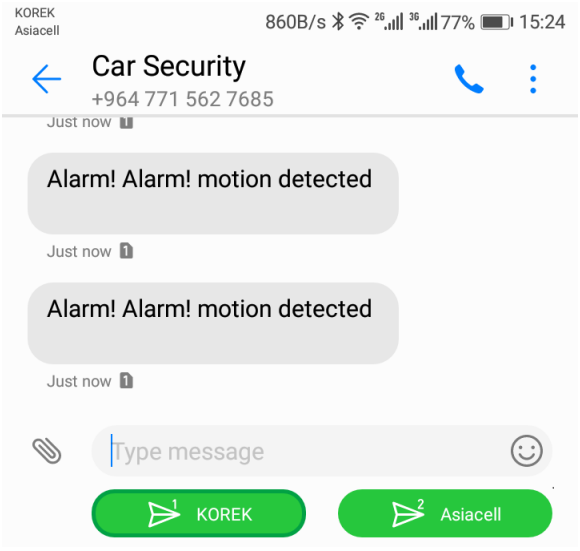

Fig. 9: The Practical Test of the Implemented System.

When the thief tries to tamper with the car and try to enter the password error more than twice, the alarm whistle will work and in the same time will appear a warning to the owner of the car on the application BlueTerm application as shown in figure.10.

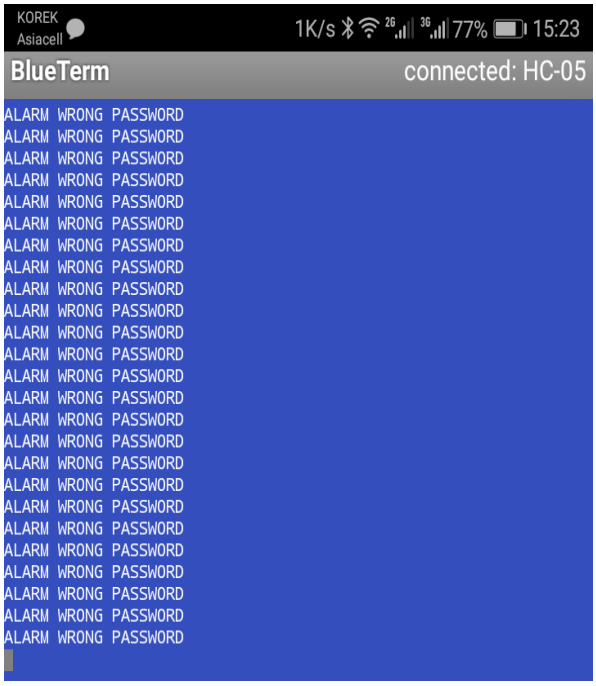

Fig. 10: The Alert Message inside Blueterm Application.

5. Conclusion

Given the recent increase in car theft and the enjoyment of car thieves by modern ways and experience it has become necessary to resort to modern and effective means to reduce car theft .In this paper the system was built to protect cars from theft by detecting the vibration resulting from the operation of the car engine system based on the Arduino microcontroller and the GSM module, the system was operated and get the results mentioned above after conducting the practical examination and show that the system works well such systems are effective to reduce car theft.

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