IJREAT International Journal of Research in Engineering & Advanced Technology, Volume 3, Issue 5, Oct -Nov, 2015
ISSN: 2320 – 8791 (Impact Factor: 2.317)
www.ijreat.org

Anti-Theft Vehicle System Using Automatic Actuating Fuel System Enhanced By Emergency Vehicle Warning System

Muntaser Momani

Department of Mechanical Engineering, Faculty of Engineering Technology, Al-Balqa' Applied University, P.O. Box 425530, Amman-Jordan

ABSTRACT

In this Paper a modern safety devices with SIM-card are used and shown how car owner can control and avoid his car from theft. In this work, the hardware components and their software are implemented. The required peripherals in the system are built to insure the effective work of the system. The hardware components are, Global System for Mobile Communication (GSM), Arduino and Relay. In this work, the work principle and diagrams of the system are clarified in details.

Keywords: SIM card, GSM, Arduino, Relays, Flow chart, Block Diagram.

INTRODUCTION

A vehicle can be stolen in less than 60 seconds and most of those stolen vehicles are never recovered [1]. More than a million cars are stolen every year, which associates to about one car every 26 seconds [2, 3]. So vehicle owners should be careful about their vehicles security and safety, Modern vehicles must be provided with developed security systems. For instance in Jordan, According to statistics public security director (PSD) sources for years 2014, the number of vehicle theft cases is 2500 [4].Old vehicles have high risk of being stolen. They are easy to steal because they often don't have effective anti-theft devices. Some new cars, vans, light trucks and SUVs (*sport utility vehicle)* must be equipped with anti-theft engine immobilizers.

1. Global System for Mobile Communication (GSM)

Global system for mobile communication (GSM) as shown in fig. 1 is a wide area wireless communications system that uses digital radio transmission to provide voice, data, and multimedia communication services. A GSM system coordinates the communication between a mobile telephones (mobile stations), base stations (cell sites), and switching systems. The electronic components and programmed integrated circuit are needed; some peripherals in the system are required to work effectively.

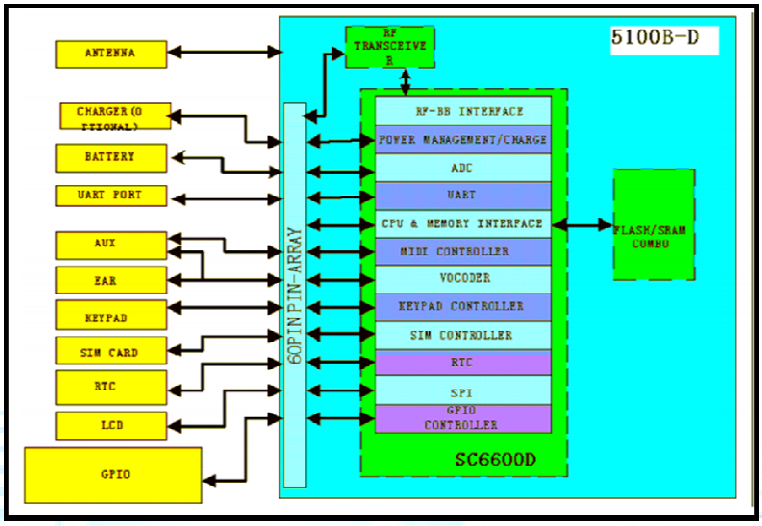

Fig. 1 block diagram of GSM

The SM5100Bshown in figure 2 is a miniature, quad-band GSM 850/EGSM 900/DCS 1800/PCS 1900 module, these combinations can be integrated into a great number of wireless applications. This module features two UARTS, an SPI interface, and two 10-bit ADCs. It also supports Li-ion battery charging, a 4x6 keypad, and an LCD interface. Inputs/outputs are available for a speaker and microphone. An antenna does come attached to the module. Power supplied to the module should be regulated between 3.3-4.2VDC (3.6V nominal) [ ].

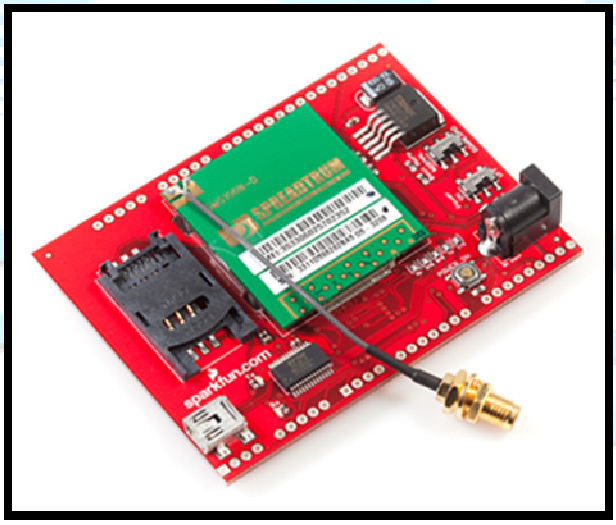

Fig. 2 GSM - SM5100B

2. The Arduino UNO

This Arduino which is used as shown in Fig 3 in this work is a sophisticated single-board computer that can be programmed to sense and control the physical world around it. It can take input from a variety of sensors connected to its input pins. It can process the

information locally or can send data to another computer for remote computation. The processed information can then be used to make decisions and/or control motors or other actuators connected to the board's output pins. The board can operate on an external supply of (6 to 20) volts. If supplied with less than 7V; the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V; the voltage regulator may overheat and damage the board. The recommended range is (7 to 12) volts.

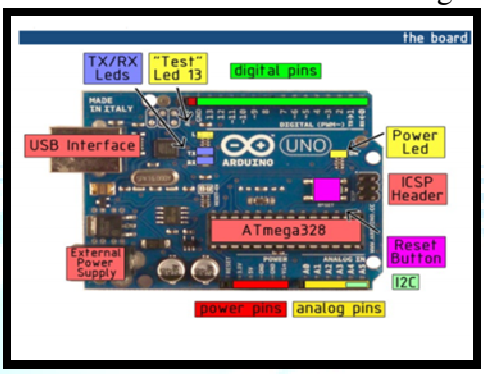

Fig.3.The Arduino

3. Relays

A relay is an electrical switch that uses an electro-magnetic solenoid to control the position of a mechanical power contactor. The output contacts on the electromechanical output relay are direct wired to the output terminals.

4. The working principle of the system

The work of the system can be described in the block diagram shown in Figure 4.

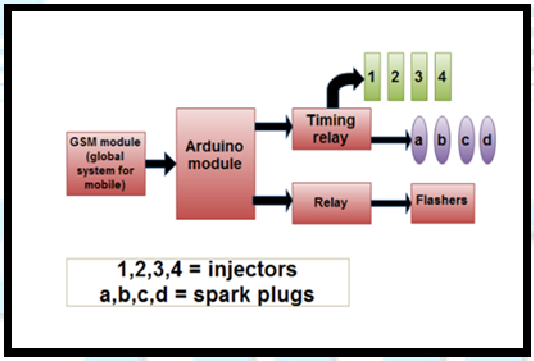

Fig. 4 Block diagram of the system work in general

The system starts operating when a text message was sent from any phone number to the SIM card used in the GSM modem, this message must be determined from it. The GSM receives the message and sends a signal to the Arduino which is responsible to interact with this signal for the purpose of deactivate the ignition system, injection system and the fuel pump by using a suitable relays ,so that will cause the vehicle to decelerate and leads to turning the engine off . Additional purpose of the Arduino is turning on the four directions blinking, and then it sends “done” message to the user to emphasize the success of the operation. All these processes between sending the text message and

completing the system operation take a short period of time between (10-15) seconds. To know where the vehicle is; call the police and to inform the police.

When the vehicle was found, it cannot be turned on immediately for more safety. So if the vehicle will be back work again, another determined message must be sent to the SIM card from any phone number to deactivate the anti-theft system, and the vehicle will turn on after 10-15 seconds as shown in fig. 4.

5. The Software of the used system

5.1 The Block Diagram of antitheft system

Block diagram shown in Figure 5 displays the block diagram of the system.

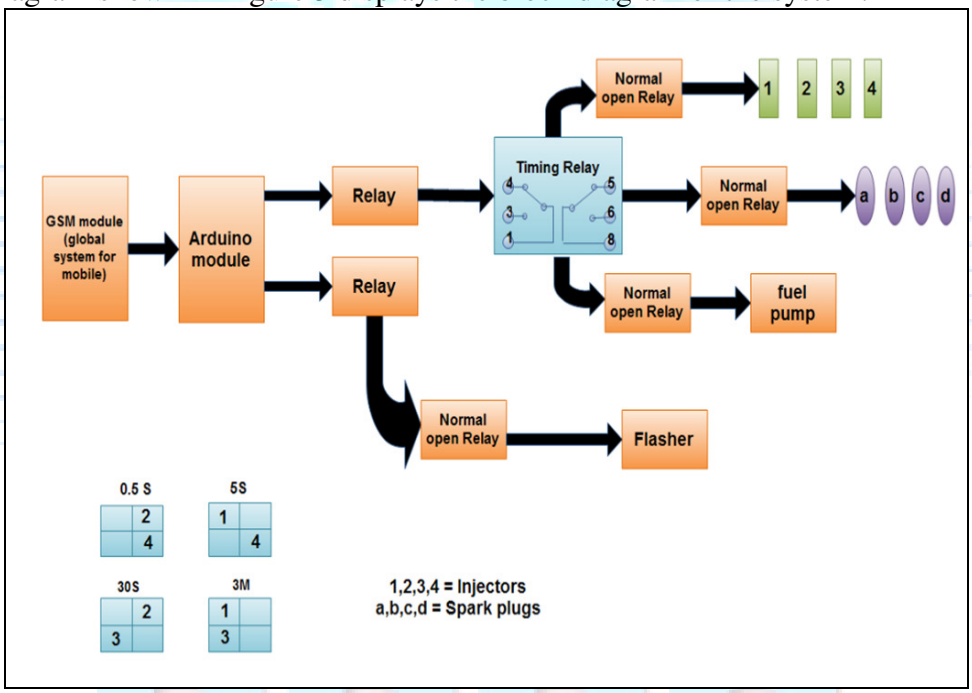

Fig. 5 The Block diagram of the system in details

The system starts operating when a text message was sent from any phone number to the SIM card used in the GSM modem and this message must be determined. The GSM receives the message and sends a signal to the Arduino which is responsible to interact with this signal for the purpose of deactivate the ignition system, injection and fuel pump by using a suitable relays and that will cause the vehicle to decelerate which leads to turning off the engine. Additional purpose of the Arduino is turning on the four directions blinking, and then it sends "done" message to the user to emphasize the success of the operation. All the process between sending the text message and completing the system operation takes a short period of time between (10-15) seconds. To know where the vehicle is; call the police and give their number of the SIM card. When the vehicle was found, it cannot be turned on immediately for more safety. So if the vehicle will be back

to work again, another determined message must be sent to the SIM card from any phone number to deactivate the anti-theft system, and the vehicle will turn on after 10-15 seconds. The Flow chart of the anti-theft system which is shown in fig.6.

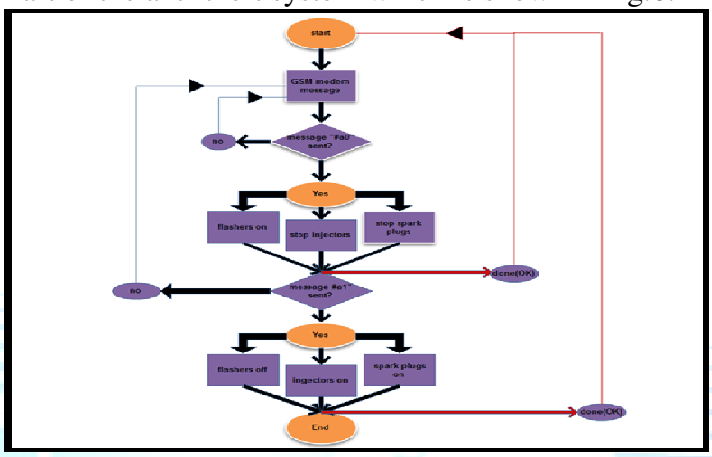

Fig 6. Flow chart of the anti-theft system

To achieve the target of applying anti-theft vehicle system, the hardware must be combined with software. This can be obtained by programming the Arduino with its language to get desired result. The full connections will be explained in details by showing block diagrams and figures. In addition, the code which can operate the control system will be clarified. The system has been programmed by Arduino language.

5.2Connections between GSM and Arduino:

GSM start operates when the amount of voltage fed with 5 volt, it can be done by connecting GSM with Arduino. Arduino must be applied to voltage equal to 9 volts from the vehicle battery, adapter, or external battery. To power the GSM, connect Vin from GSM with pin 5V from Arduino, then connect GND to GND, as shown on figure 7.

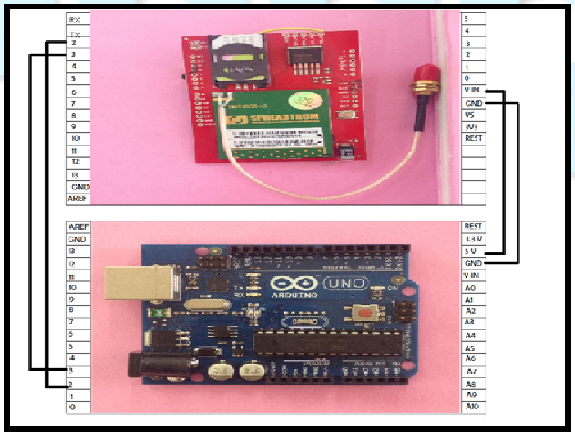

Fig. 7 Connections GSM – Arduino

To transmit and receive signals between GSM and Arduino, connect pin 2 to pin 2 and pin 3 to pin 3, these pins represent the transmitter and receiver between them to transfer signals. When determined message sent from any number to the SIM card in the GSM, GSM will receive this message and send it to the Arduino to make sure that this message is correct then the system start operating. After that vehicle owner mobile will receive confirmation message "done" from GSM to know that the system is working, while the vehicle is slow down until stops completely.

5.3 Connecting Arduino with Arduino relays

By connecting 3.3V pin to V_{cc} of relays, and GND to GND, then the relays are powered at 3.3 volts in V_{cc} point. To get the output signal from the Arduino to the relays, pin 4 must be wired with (IN1) and pin 13 must be wired with (IN2). Where (IN1) and (IN2) represent the input of first and second relay from the Arduino relays, and they fed with 5 volt to operate, that appears in figure 8.When the Arduino received signals it will activate the Arduino.

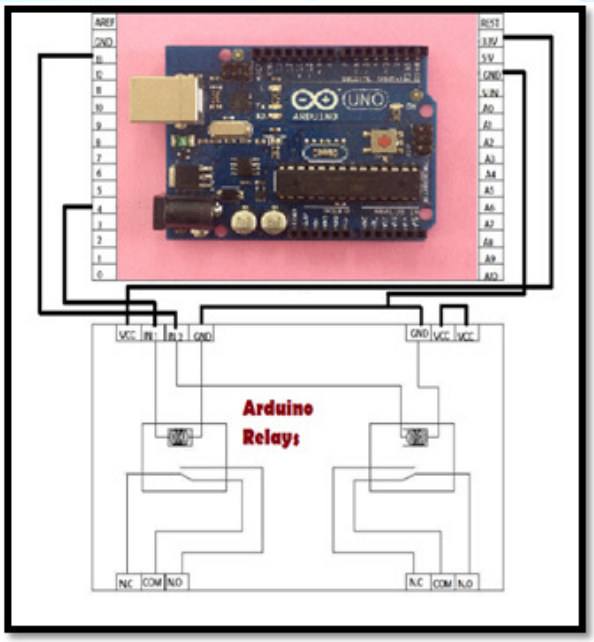

Fig. 8 Connections between Arduino – Arduino relays

5.4 Connecting first relay of Arduino relays with external (N.O) flasher relay

The used relays have two circuits:

1- Control circuits.
2- Load circuit.

Output signal from relay will be connected to load circuit of external flasher relays which is fed with 12 volt from the power supply. The first terminal of control circuit connected to GND while the second terminal connected to the flasher, observe figure

9.When the first relay activated it will send voltage to the control circuit of external flasher causing the load circuit to close.

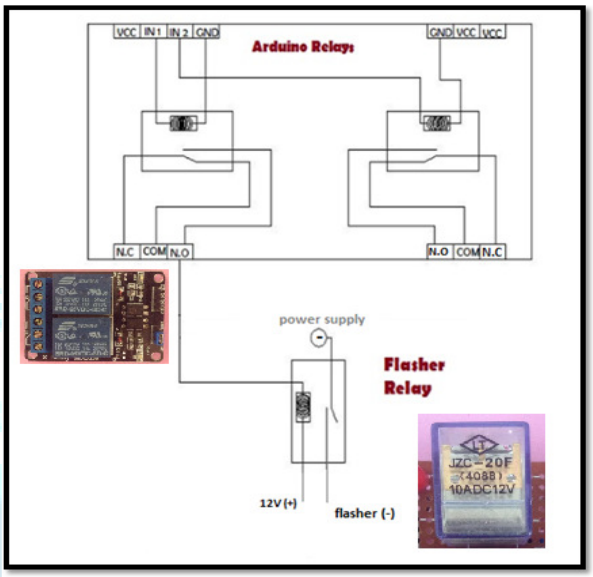

Fig. 9 Connections of first relay from Arduino Relay – Flasher relay

5.5 Connecting external (N.O) flasher relay with flasher

The connecting of external flasher relay with flasher as shown in fig 10. Flasher has three terminals (Earth, Load, and Power).

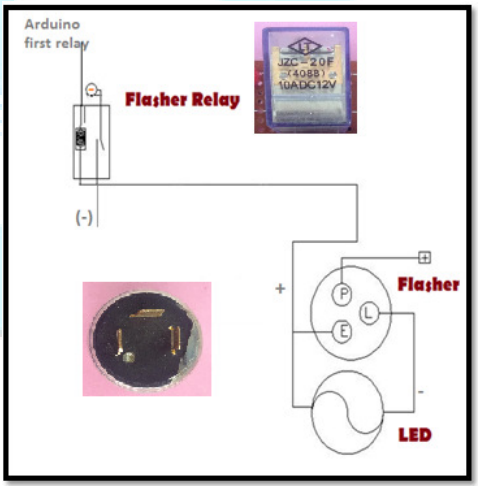

Fig. 10 Connecting External flasher relay – Flasher

Earth terminal (E) connected to the terminal of the load circuit from external flasher relay, Load terminal (L) connected with flashing lamps, and the last terminal Power (P) normally connected to the power supply. When the external flasher relay closed, the flasher will operate immediately.

5.6 Connecting second relay of Arduino relays with timer relay

Timer relay has eight terminals (1,2,3,4,5,6,7,8), but only four terminals were used (1,2,3,7).Terminal 3 (-) connected to the output of the second from relays, terminal 2 (+) connected to the power supply, terminal 7 (-) connected to GND, finally terminal 1 (-) connected with 1st terminal of the control circuit of external three relays, as shown on figure 11.

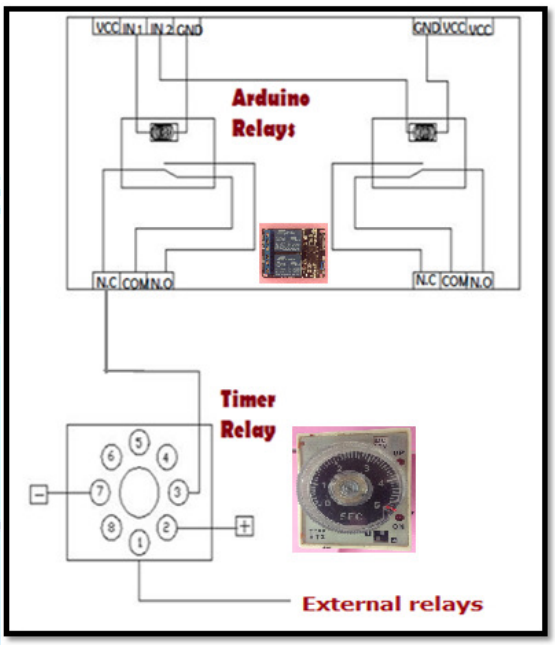

Fig. 11 Connecting Arduino second relay – Timer relay

After the timer relay fed with 5 volt, it will make delay about 30 seconds before activates the three external relays.

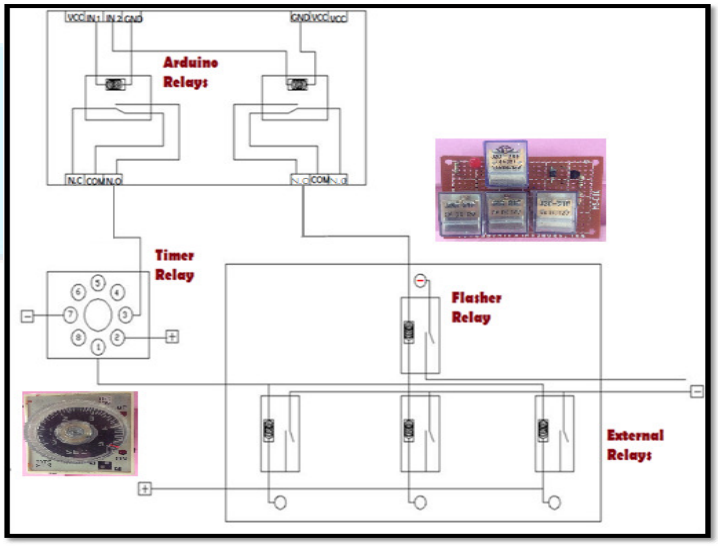

Fig. 12 Connecting timer relay – External three relays

These relays are normally open which used to control actuators of ignition and fuel delivery systems relays. The 2nd terminal of control circuits from these relays are connected to power supply and the 1st terminal of load circuits of all relays are connected together then to GND as shown in fig 12.When the timer relay activated after 30 seconds, it will give these relays voltage to operate.

5.7 Connecting the first relay of the external three relays with (N.C) fuel pump control relay:

The 2ndterminal of load circuit from the first relay connected to control circuit of (N.O) fuel pump control relay them to GND. The load circuit connections of the fuel pump control relay:

-One side is connected directly to fuel pump relay in the vehicle.

- The other side is connected to fuel pump which is normally grounded.

When the first relay closed it will cause the fuel pump control relay to open which working on the fuel pump to stop working.

5.8 Connecting the second and the third external relay with (N.C) ignition and injection control relay:

Connections of ignition and injection control relays used:

- Control circuit connections:
  - First side of control circuit connected to the load circuits of second and third external relays.
  - Second side connected to the power supply like other previous relays.
- Load circuit connections:
  - First side of load circuit connected with engine control relay in the vehicle.
  - Second side divided and wired to the coil and injector which are normally wired to the Engine Control Module (ECM) switch earth.

When the second and the third external relay closed it will cause the (N.O) ignition and injection control relay to open and stopped working of ignition and injector. Figure 13 shows the connection of Timer relay - External relay – With fuel pump, Ignition coil and Injector.

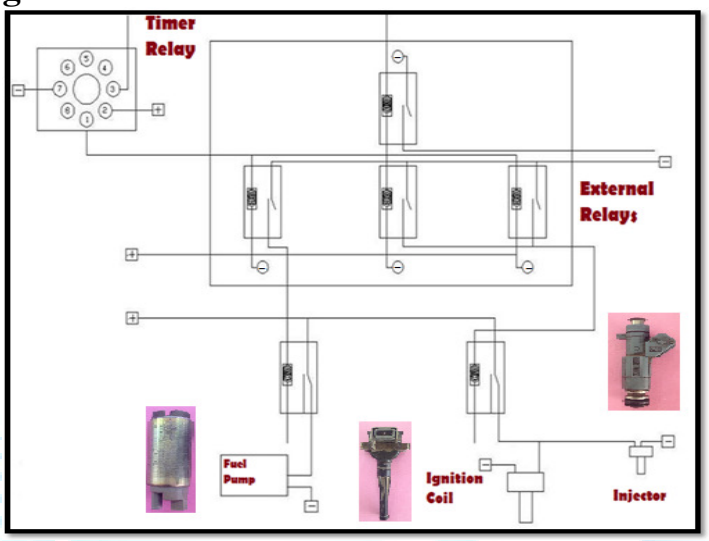

Fig. 13 Connections of Timer relay – External relay – With fuel pump, Ignition coil and Injector

A practical connections of the system shown in fig. (14a, 14b).

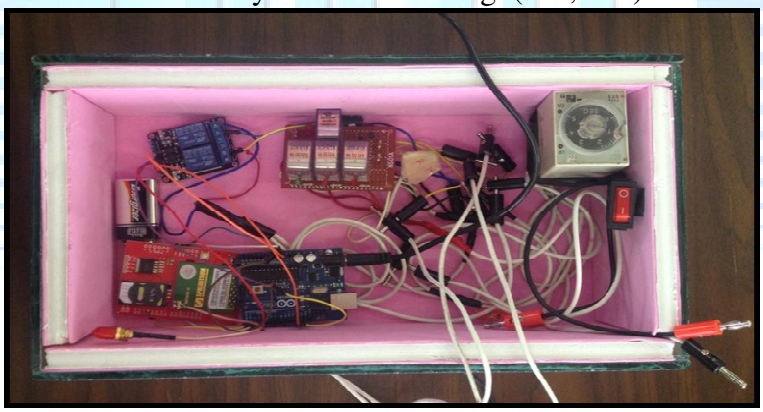

Fig. 14 a connections of GSM – Arduino – Arduino Relays – Flasher Relay – External Relays – timer Relay

Fig. 14 b Connections of Fuel Pump Control Relay – Ignition and Injection Control relay –Flasher – Ignition Coil – Injector – Fuel pump

CONCLUSIONS

The anti-theft system valid for every time and place, which means that it can be mounted on any vehicle of any type; whether a small car or public transport bus or truck … etc,. The thief can disconnect the vehicle battery, which may cause disabling the system, so it was one of the features of the system to activate it with an external battery (9 volts), which is the amount that the system needed to begin work, this provides to activate the system in all cases. The system works in all cases, the owner can locate the vehicle by contacting the police and give them the SIM card number used within the GSM then the police can determine the actual location of the vehicle specifically which allowing retrieving it. All of these features and others may be the reason that the system becomes globally and spreads in all countries in order to try to reduce and minimize the problem of car thefts so the owner could help fading over time. While applying experimental there were some obstacles appeared as expected when testing any control system. These obstacles resulted from applying a voltage above the limits which is allowed to damage some component used in the system such as Arduino and voltage regulator. Also, these obstacles have been evanesced by determining and adjusting the value of the input voltages on each piece, each according to their needs.

REFERENCES

[1]Asrar news, 18/8/2013, Article: low rate of car theft.
[2]From article how to avoid your car, edited by Edited by Carolyn Barratt, Emma, Chris Hadley, Teenreporter and Teresa, Maluniu.
[3]From article The 5 Best Alarms and Anti-Theft Devices for Your Vehicle, edited by John Troiano, Yahoo Contributor Network, Mar 22, 2011.
[4]Study on working of fuel injection equipment, by(B.BHANU CHENDRA, R.SIVA RAMA KRISHNA, J.VIRENDER KUMAR), Department of mechanical engineering G.R.I.E.T.
[5]Hartmann, Gerard (2007-08-05).). Hydroretro.net. Retrieved 2014-01-20.
[6]http://www.aa1car.com/library/fuel_pump.htm.
[7]Spark Plug operation, selection, and maintenance, Dr. Von H. Jarrett, Extension Agricultural Engineer, Utah State University.
[8]The Bosch Automotive Handbook, 8th Edition.
[9]http://www.555-timer-circuits.com/flashing-led.html.
[10]Mason, C. R., Art & Science of Protective Relaying. Retrieved October 9, 2011.
[11]"Cellular History". Etsi.org. European Telecommunications Standards Institute. 2011. Archived from the original on 5 May 2011. Retrieved 5 May 2011. "The task was entrusted to a committee known as GroupeSpécial Mobile (GSMTM), aided by a 'permanent nucleus' of technical support personnel, based in Paris.
[12]Motorola Demonstrates Long Range GSM Capability – 300% More Coverage with New Extended Cell [dead link].

[13] Owano, Nancy (27 Dec 2011). "GSM phones -- call them unsafe, says security expert". Archived from the original on 27 Dec 2011.Retrieved 27 Dec 2011. "Nohl said that he was able to intercept voice and text conversations by impersonating another user to listen to their voice mails or make calls or send text messages. Even more troubling was that he was able to pull this off using a seven-year-old Motorola cell phone and decryption software available freed off the Internet."
[14+15]Spark Fun Electronics ®
[16]Michael Rosen, Akron, "Method and system for automated detection of mobile telephone usage by drivers" OH (U.S).
[17]Arduino Robotics, John-David Warren, Josh Adams, HaraldMolle, 2011.
[18]UNDERSTANDING RELAYS, Kevin R. Sullivan.
[19]Magnecraft Solutions Guide, Edition 105A.
[20]Cardlogix corporation -The secure choice- , guide products.
[21]Article (The Semiconductor Transistor).
[22]Using transistors as switches By Dan Morris.
[23](Electronics Components: Diodes) Electronics All-in-One for Dummies by Doug Lowe.
[24]"Nick Holonyak, Jr. 2004 Lemelson -MIT Prize Winner", LED for Lighting Applications By Patrick Mottier