Global System for Mobile (GSM) based Ignition Control System for Vehicles

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Abstract: This work is focused on design of Global System for Mobile (GSM) based security module and it's interfacing to vehicle, which allows user to remotely disable the vehicle. The security system consists of two cell phones and a security module. Security module with an embedded cell phone is placed in vehicle while other cell is used by user. During enable mode, the embedded cell phone forward alert signal to user phone and get control signals from user for the security module. Two methods are providing to send control signals. One method uses a simple message service to disable ignition of the vehicle and other method uses call to cut off fuel of the vehicle. The system is easy to install and can be operated from anywhere. The concept of this product has vast potential for further extensions and advancements and can be installed for other systems and places for security.

Keywords: *Global System for Mobile (GSM), Short Messaging Service (SMS), Control Signals, Subscriber Identification Modules (SIM).*

1. Introduction

Vehicle theft is supposed to be most expensive theft from mobile assets. At the end of 2015, more than 12.3 million vehicles reported stolen in overall world and only 7.5 million vehicles were discovered while the remaining may have been ringed, busted or broken down in parts and sale out as spares [1]. To solve the widespread problem numerous vehicle tracking, identification and security systems are working. These systems are generally divided into 02 groups: Wide Area Tracking systems (WATS) and Short Range Point Identification (SRPI), [2].

According to 278 task force of European Technical Committee, the security systems recognized by its functionality and classified in following five classes:

- Vehicle recording systems
- Vehicle identification systems
- Vehicle remote immobilization systems
- Vehicle signalling systems
- Vehicle location systems.

Advance vehicle tracking, identification and security are not installed at every part of the world especially in developing countries, the reason is that the cost is very high. GSM cellular system is available in most of the parts of the world, [3].To operate this security module user pay the fee for access to the service, and onetime payment for the purchasing security module, there is no extra installation and operational charges are there for that security system. This low cost Vehicle Security Module is small enough to be easily hidden away in vehicles, boats, trailers, vehicle vans and even suitcases This device provides a security and can be implemented with any device but here it is interfaced to vehicles. It enables to keep in touch with vehicle at all times from any part of the world where GSM network works [4]. An automotive subsystem consists of one or more Electronic Control Units (ECUs), [5] such as ignition and fuel, this device can stop vehicle to control both points. It satisfies all three aspects of any vehicle security system such as huge value loads, personal protection and tacking and recovery of theft vehicles. In this paper we developed a economical security module based on existing GSM systems

This paper is outlined as follows. Section 2 outline related research work, section 3 presents working specification of GSM based security system. In section 4 designing specification is presented. Section 5 discusses about hardware implementation. The last section provides conclusions and future work.

2. Research Background

Vehicle security is main concern for vehicle owner, owner preferred to have vehicles equipped with security systems from traditional central locking system to advanced theft detection systems. To secure vehicles as mobile asset number of security and tracking systemshave been introduced. The work [6] focuses on engine lock by SMS and support tacking of vehicle via GPs and GSM system. The system is connected with emergency cell where from a vehicle could be move to the proper location of accident. A inductive proximity sensor based chip is designed for security systems of vehicles [7], the system sends text message to owner after sensing key and start vehicle subsequent to identified the owner by the of car is identified by proper password set by the owner, after 3 improper password entries mgs transfer to police station with the registration number and location of vehicle. Another problem of security is dialled in [8] where a GSM based security system passes a call to owner about the apprehensive activity of vehicle, the activity is proceed after sensing alcohol level at driver seat. In [9] a security system contained by the vehicle that detect the mishap location by sending a message. Security system consists of GPS and GSM modules, GSM module is used to send a SMS containing precise location of the vehicle. The work of [10] focused blocking of vehicle in case of stolen, the blocking is done in response of a SMS by registered owner,

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use of microcontroller based GSM communication helps to recognize the missing vehicles. [11] A GSM and GPS based tracking system introduced that offer the security and tracking functions for their vehicles. The system permits the owner to track the different parameters of their vehicles in the response of SMS, the parameters included as the speed, position, water level etc. Our proposed system is based on the work done in [11], in our work we controlled the both ignition points CNG and Fuel. This system is limited to alert and control the remote vehicle up to the coverage of GSM

3. Working Specification

Security system consists of two cell phones and a security module. Security module with an embedded cell phone is placed in vehicle while other cell phone is used by user. To operate this security system following steps are used.

Step A: Insert the Subscriber identification modules (SIMs) into two cell phones. Save and set SIM numbers in the embedded cell phone. Be sure they are in order of priority (1, 2) position for embedded and user phone respectively.

Step B: Vehicle owner leave away from the vehicle, and activate the security module and set the mobile on sending message position.

Step C: In the enable mode of security module once the vehicle ignition on, the message will automatically send embedded mobile to user mobile with few seconds.

Step D: In the response of SMS by embedded cell phone, user can send control signals to embedded cell phone in two ways: Short message service to disable ignition of the vehicle and call to cut off fuel of the vehicle. In both ways vehicle stopped running. With the help of GSM network, the lost Vehicle could be easily found out.

4. Designing Specification

The system is compatible with a cell phone, the operation of which is fairly transparent to the user. Full-Duplex communication (allowing signal acknowledgements, and so on) is a necessary requirement. As a link would quickly exhaust any useful application. This project is designed in a way to quickly inform to the owner of the stolen vehicle. This security system works on instruction in a shape of SMS to shutoff the vehicle engine and call to block fuel. Functionality and reliability are thus mutually dependent requirements. Over all objectives is to provide a reliable security system. The system uses GSM is to send control thus provide large coverage in overall world where the service is available.

A. Physical Layout:

The diagram in below figure illustrates the system implementation

- When vehicle owner leaves away from the vehicle, just activate the security system, the vehicle is under alert condition.
- Once the vehicle is unconventionally started, SMS will be sent out to the pre-set telephone number in few seconds.
- Once the SMS received on the pre-set mobile number, the vehicle owner immediately replies on the same number by SMS or by call to shut off the engine or block fuel of the vehicle.

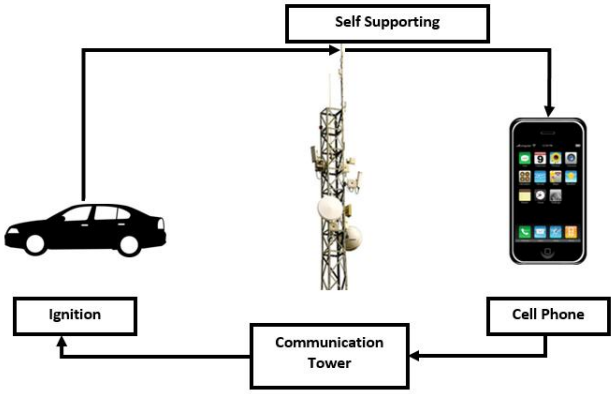

Figure.1. Block Diagram

B. Block diagram for ignition cut off

Step – a: When the vehicle ignition trigged on, the relay –1 gets on and send the instruction to mobile –1 (instruction is in 0 or 1 shape) that send the message as mobile –1 receive the instruction it send the message on mobile – 1, with in few seconds. Mobile –1 receives the message from mobile –2 which is fitted in your vehicle.

Step– b: As the message received by the message mobile – 1 which is embedded with security module. Reply of that message on same number.

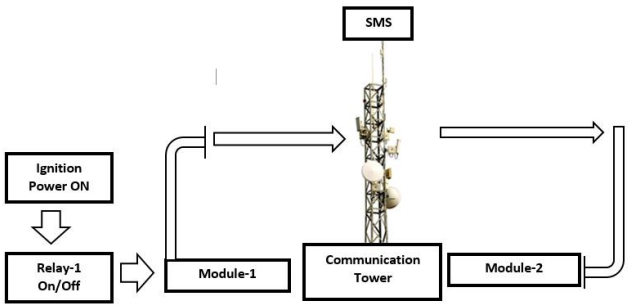

Figure. 2. Security Module to Vehicle Owner

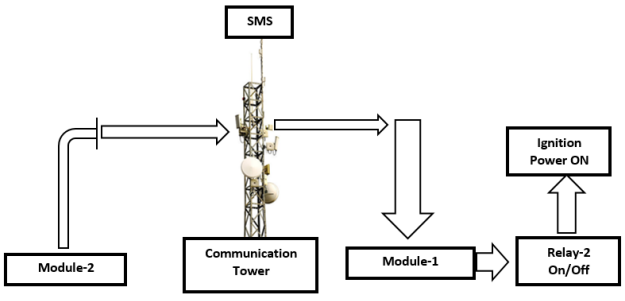

Figure.3. Vehicle Owner to Security Module

Then mobile –1 receives the message and send the command to relay –2, which is already in "ON". As the relay –2 receives the command it will cut off the power to the ignition and vehicle engine will shut off.

C. Block diagram for fuel cut off

To block the vehicle's fuel, the vehicle owner reply the alert SMS by call from the mobile –1 to mobile –2

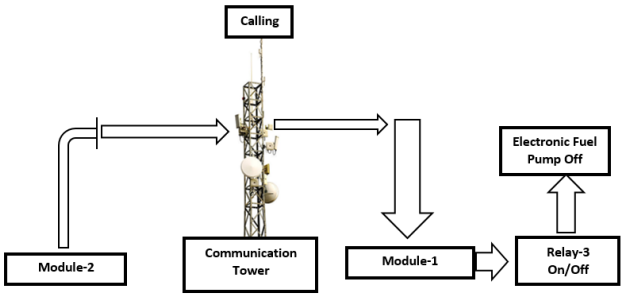

Figure. 4. Call from Vehicle Owner to security Module.

5. Hardware Implementation

Labelled diagram of Security module is under, in followed sub sections there will be detail description of every section of the security system.

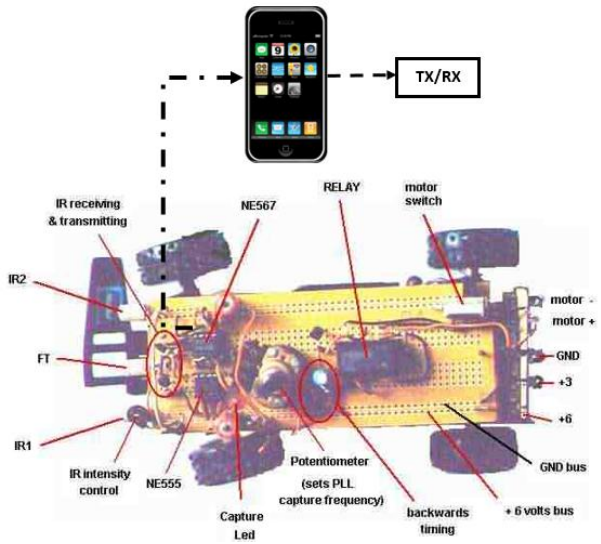

Figure. 5. Labelled diagram of Security module

A. Description of Circuit stages:

The circuit diagram is divided in three stages, below is the working of each stage.

1st stage. Message send by the embedded mobile to security module.

2nd stage. Action takes by the security module after receiving the reply of that message.

3rd stage. Action performed by the security module after receiving the miss call from the user mobile.

The security module consists of three relays used and many components that have been used but these relays are playing a very important role in this hardware.

One relay is designed to send message, another one will start to work when message received and third one when the miss call is received from user mobile.

a. 1st stage - Message send by the embedded mobile

In this section, when the vehicle ignition will be switched on, the 555 timer IC is used to generate the pulse in the square wave form, here the variable resistor of 5kΩ and capacitor of 470µF is available to vary the time duration or delay between the pulses which are adjust by the variable resistor. Time will be set in milliseconds or microseconds. After this section of oscillation the next step is amplification, here C1383 transistor, in the common emitter configuration is used. The pin no: 2 which is the input of the 555 timer IC is connected with the +12v in series switch (ignition switch), capacitors, resistor and variable resistor are also connected with pin no: 2, the output of the 555 time IC is taken out from pin no: 3 and combine with the amplification section (Transistor C1383). Thus unless the switch is not in close position the message cannot be sent. The relay and light emitting diode (LED) is connected in parallel with the collector terminal of transistor. The LED is defining the signal level before and after sending the message, the LED and relay are continuously ON as connected with the +12v, as soon as after the amplification the signal will be generated from the collector terminal of the transistor, the LED and relay will switched off.

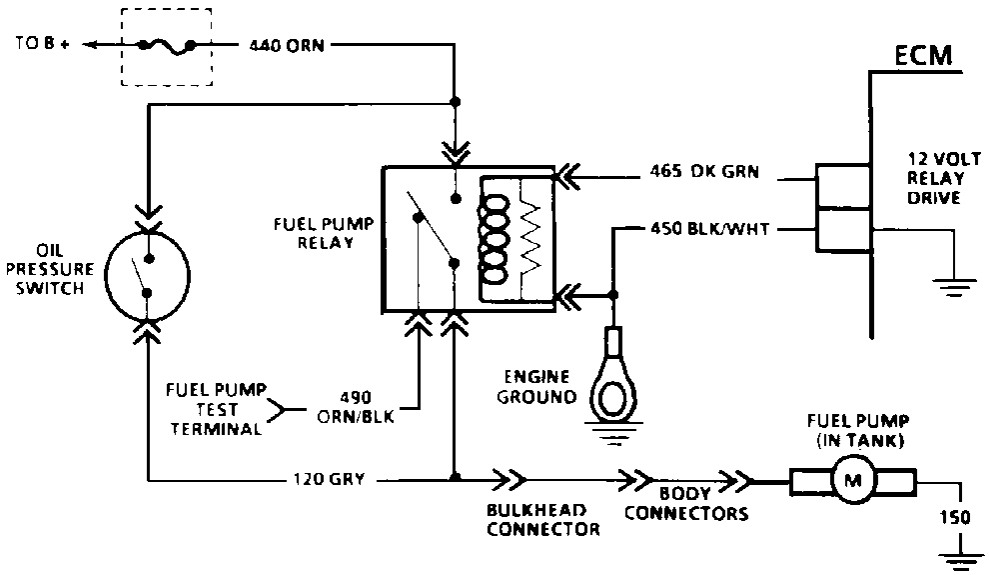

Figure.6. First stage of the circuit

As the relay becomes in closed position the control pass to the mobile section and the message will be send through the embedded mobile to user mobile.

b. Stage 2- Action takes by the security module after receiving the reply of that message

After the sending of message from the embedded mobile with the circuit by 1st stage the, the reply of that message will be generated by 2nd stage. As the 2nd stage of circuit diagram is related to the destination point mean receives the direct current (dc) voltage from the mobile, because in the vibrator side of the mobile the dc voltage is generated. Here we are just picking the voltage from the vibrator side. We set the mobile at the position that whenever the mobile receive the message it will be vibrate and the dc voltage picked up for the process. In this section the opto-coupler is playing a vital role of protection and to separate and filter the signal which is generated by vibrator of the mobile; it will also remove the alternate current (ac) distortion between the signals and provide the accurate pulse. The mobile receive the message, the voltage is transmitted in the shape of lightthrough opto-coupler. These voltage is not sufficient for the further process, for this purpose here the transistor is using as an amplifier in the common emitter configuration. The LED is connected with the collector terminal of the transistor in parallel, when the transistor generates the voltage high through collector the LED will glow, so after getting the output from the collector terminal of the transistor, the output will goes to the pin no: 2 of the 555 timer IC.

555 IC will generate the signal to driven the HEF4017B decode counter. The output from the 555 timer IC is taken from the pin no: 3 and it goes to the pin no: 14 of the decade counter. The working of the decode counter is to operate the next system in the circuit on the bases of ON / OFF (0/1) logic. After the decade counter the LED is connected before the transistor to indicate the flow of signal that the signal have passed from the decade counter to C1383 transistor for the amplification of the voltage. With the collector terminal of transistor the protection diode 1N4007 is available to protect the relay from the high voltage. Now the relay is in open position as the relay gets the voltage it will become in closed position and the ignition will be cut-off so the vehicle engine will be shuts off.

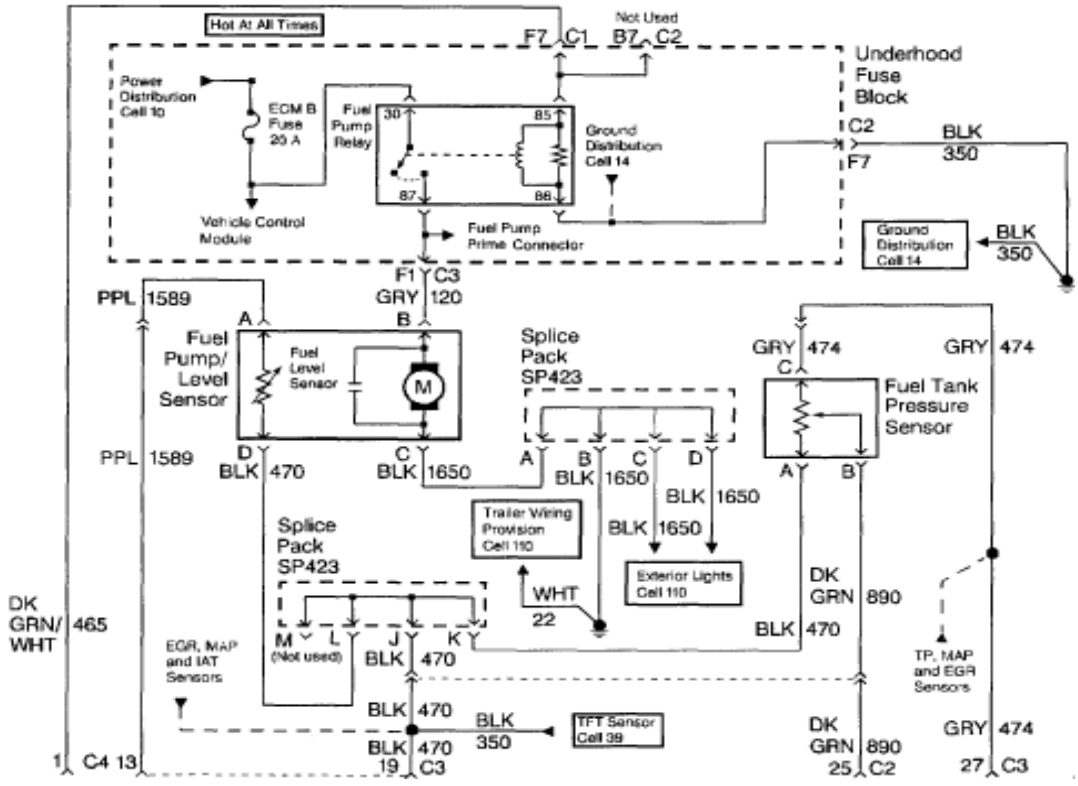

Figure.7. 2nd stage of the circuit

c. 3rd stage-Action performed by the security module after receiving the call from the user mobile

The 3rd stage is same as the 2nd stage only the difference is that here instead of message calling function is implemented on mobile which is connected with circuit. After receiving the call the ac voltage is generated on the bell side in mobile, on this ac voltage the opto-coupler will filter that voltage, remove the dc distortions and give the accurate pulse without any distortion. Which will be processed same as stage -2. After that process the relay will close and the fuel of the vehicle will be cut-off by the electronic fuel pumps.

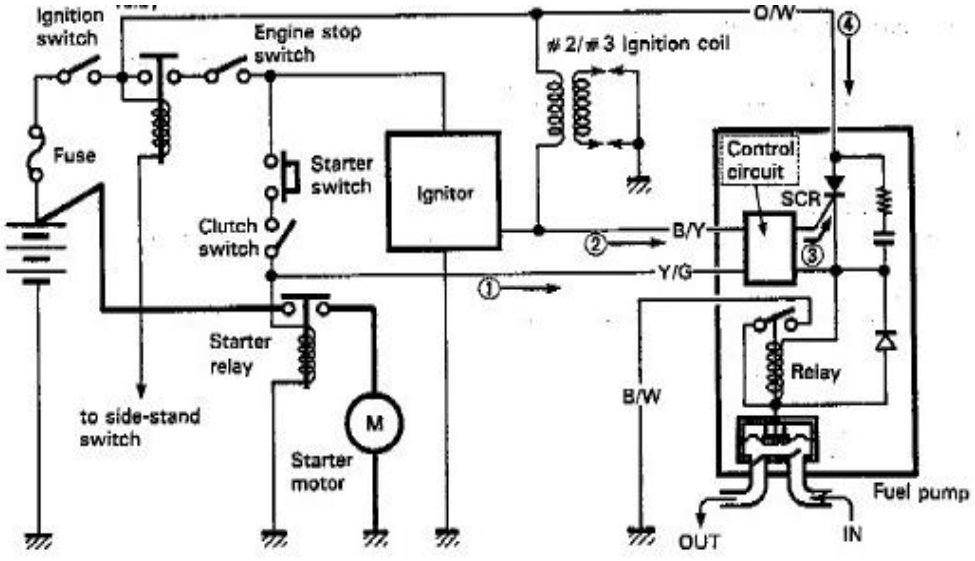

Figure.8. 3rd stage of the circuit

d. Power consumption

The security module consumes less power, about +12v of vehicle when turn on and the other component of the hardware draws minimal power, about 1Ampere. It will only be activated when the vehicle owner leaves the vehicle. After the all operations the circuit will be refreshing to start vehicle or to unlock the fuel pump and set again in active mode.

6. Conclusion

The tracking systems which have a strong base and give a surety to track and monitor vehicle in any condition are available now days. However the cost of these systems is very high (compared to our developed security system). In this work the main achievement is to provide a security to vehicle and protect your vehicle from thieves at very low cost. This system can be operated in the cost of just accessing the GSM network from any part of the world where GSM service is available, the system can work on Tri band of GSM. It responding by two ways where remotely the engine can be stopped by a SMS and the fuel can be locked by a phone call. There are some drawbacks of the security module, as this security module can only be operated only with particular SIM, whose number is stored in the embedded cell phone. If any problem with that SIM or service that system will not work with any other device.

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