



DESIGN AND IMPLEMENTATION OF AN EFFICIENT VEHICLE SECURITY SYSTEM



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Abstract: The design and implementation of an efficient vehicle security system was carried out in this paper. This includes various design stages such as door intruder detector unit, touch sensor unit, alarm unit, ignition control unit, light control unit and door lock control unit. All the above stages were integrated together into a single compact unit. Care was taken in the selection of the components and sensors used in order to achieve the efficiency and performance required from the system. The system protects by turning on the door lock and turning off the ignition of the vehicle.

Keywords: Alert, cell-phone, efficient, GSM, security, touchpad

Introduction

Automobile manufacturers have been integrating different kinds of security systems to automobiles for so many years now; this is to ensure that automobile users are provided with all the security needed to ensure the safety of the vehicle. Since a large percentage of vehicle users use cell phones as their primary means of staying in contact with their family, friends and offices, this brought about the idea of developing a system that allows users (drivers and vehicle owners) to stay in constant communication with their automobile. Security has become a major concern for our world, and to most vehicle users, automobile manufacturers employed the idea of vehicle security system which do not just help the human agent but could on their own completely provide all the necessary security requirements without supervision. An Automobile Security System (ASS) as a form of a vehicle security system combines the installation of an electronic device in a vehicle, or fleet of vehicles with purpose-designed computer software to enable the owner to track the vehicle's location while collecting data in the process. In this kind of security system, a telecommunication system and method is used for instructing a device interfaced with a vehicle's electrical system to activate or deactivate specific electrical device such as the ignition, car lock system and the electronic fuel injector using a cellular network. This can be accomplished by utilizing a mobile terminal or a unit containing the mobile terminal receiver, herein after referred to as a "GSM MODEM" or "Radio Interface Unit" (RIU), which is interconnected to a "Power Interface Unit" (PIU).

The PIU directly interconnects to the vehicle's electrical system and ignition. This system enables the vehicle user to access their vehicle's electrical system from remote places simply by dialing the cellular phone number (a number associated with the RIU/GSM MODEM) from another mobile phone. The RIU when triggered will either send notifications via SMS or call to the vehicle user or receive instructions from the same user to activate or deactivate electrical devices depending on the nature of instruction given by the user. With ASS the user can perform functions such as locking the doors, switching off ignition, monitoring temperature, turning on light, cutting off the electronic fuel injector and having different reactions for several situations

Singhet *al.* (2015) implemented a smart anti-theft system for vehicle security that uses GPS and GSM system to prevent theft and to determine the exact location of vehicle.

Hnin P. H. and Hla M. T., designed and constructed an advanced car security system using GSM to transmit alarm signal and control instructions through SMS.

Kiruthiga *et al.* (2015) implemented a real time biometrics based vehicle security system with GPS and GSM Technology. It uses fingerprint recognition technique to allow access to the vehicle and if access is disallowed, an SMS is sent to the owner.

Ghodgekarand Tank (2015) designed a vehicle security system based on GSM technology. A microcontroller coordinates the operations so that the vehicle is protected by sending a message over GSM network to the user.

Bhatt *et al.* (2015) implemented a smart vehicle security system using GSM and GPS. The system automatically stops the vehicle on receiving an authorizing SMS from the owner thereby protecting it.

Ruchitaand Anuradha (2012) implemented a GSM based car security system which senses different parameters. On detection of any compromise, an audible alarm is triggered and an SMS is initiated to the user.

Amusa *et al.* (2012) designed an SMS-enabled car security system using Sony Ericsson GSM modem (GM47) and microcontroller ATtiny 2113. Commands were issued via text messages to which the system responds in order to protect the vehicle.

This paper presents the design and implementation of an efficient vehicle security system that serves as protection from intruders and theft by sounding the alarm and turning off the ignition so that the vehicle will remain stationary.

The hardware design

The hardware design is the heart of the project. This is the physical implementation where the various components used for the design were incorporated together on a vero board through soldering. It consists of many units which includes the sensor units, the alarm unit, the Digital logic unit, the monostable/triggering unit, the ignition control and the light control unit otherwise known as the Switching unit.

Sensor unit design

The sensor unit design deals with the incorporation of different sensors in the design so as to assist the security system achieve its aim of securing automobiles. This unit consists of the door intruder detector and the touch sensor.

Door intruder detector

In the design of the door intruder detector, a contact device is used. A contact device is basically a switch. As a sensor, an external associated circuitry monitors its contacts and generates an alarm signal when they make contact (touch) or separate. Manual switches have ideal ON and OFF resistances in that when their contacts are closed (ON), the resistance is ON and when open (OFF), the resistance is infinite. A door intruder detector circuit is as shown in Fig. 1.

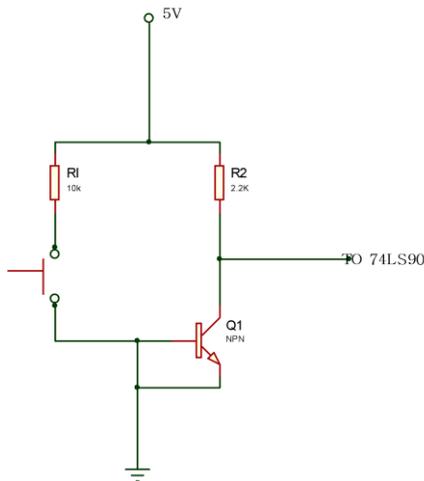


Fig. 1: Door intruder circuit

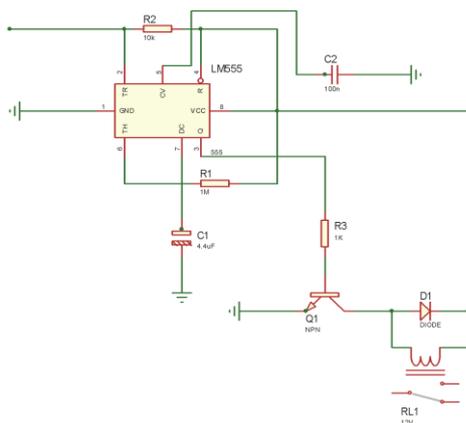


Fig. 2 Touch sensor circuit

Touch sensor

A 555 timer configured as a monostable multivibrator is used in the design of the touch sensor as illustrated in Fig. 2. Initially before the trigger is applied, V_{out} is low, shorting pin 7 to ground and discharge C. to trigger the one-shot, a negative going pulse is applied to pin 2 opening the discharge transistor (pin 7). Now the capacitor charges from 0V up towards VCC through the 1MΩ resistor. When it crosses the threshold of $2/3 V_{CC}$, it results to the shorting of the discharge transistor. The capacitor discharges rapidly to 0V and the one-shot in its stable state (V_{out} =Low) until another trigger is applied.

Alarm unit design

The relay is connected the normally open mode such that the relay switches to turn on the buzzer when the relay is ON, and the COM and the NO pins make contact with each other. For the relay circuit to be activated, a base current is required at the base of the NPN transistor for the relay to come ON. When the base current flows into the transistor, the magnetic core of the relay gets magnetized and the normally open (NO) pin of the relay which is connected to the load (bulb), makes contact with the common (COM) pin and thus a complete circuit is formed and the buzzer starts buzzing. Fig. 3 shows the alarm circuit. A Transistor is used to establish the current necessary to energise the relay. When a positive pulse from the 74ls90 counter is applied to the base, the transistor turns ON, establishing sufficient current through the coil of the electromagnet to close the relay. Relay coils produce brief high voltage “spikes” when they are switched off and this can

destroy transistors and the ICs in the circuit. So to prevent the damage, a protection diode is connected across the relay coil.

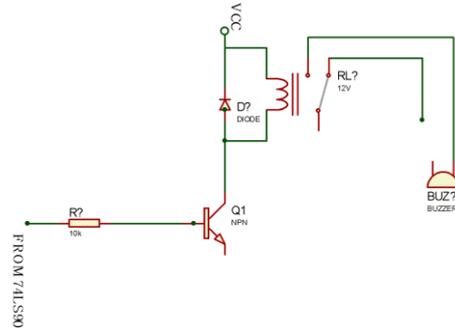


Fig. 3: Alarm circuit

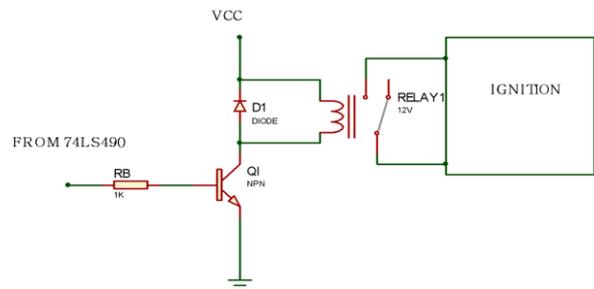


Fig. 4: Ignition control circuit

Ignition control circuit

The ignition control circuit comprises a transistor and a relay. The base of the transistor is connected via a resistor to pin 2 of the 74LS90 counter. The car ignition circuit is connected to the output of the relay. When the command ON/OFF is issued, the pin 2 of the 74LS90 goes HIGH/LOW. This HIGH/LOW state switches ON/OFF the transistor which in turn switches ON/OFF the relay thereby CLOSING/OPENING the car ignition circuitry. Opening the circuitry turns OFF the ignition while closing the circuitry turns ON the ignition. This is illustrated in the Fig. 4.

The light control circuit

The circuitry for the light control is made up of a transistor and a relay as illustrated in Fig. 5. The operation follows the same steps as that for the ignition control. However, the base of the transistor is connected to pin 3 of the 74ls90 counter. Therefore, the ON/OFF sets pin 3 HIGH/LOW which CLOSSES/OPENS the car light circuitry that is connected to the output of the relay. Closing the circuitry turns ON the light while opening the circuitry turns OFF the light.

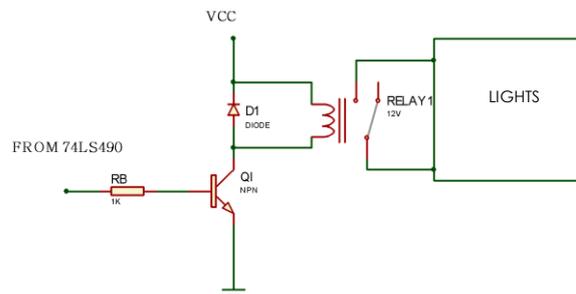


Fig. 5: Light control circuit

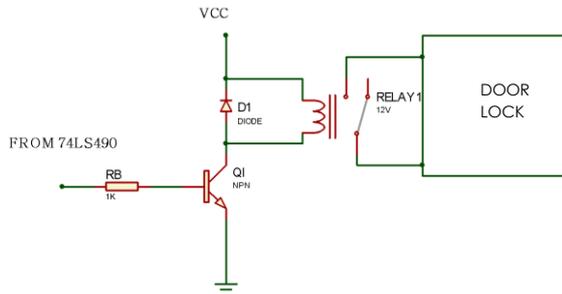


Fig. 6: Door lock control circuit

Door lock control

This is basically the same as light control circuit both in composition and principle of operation as shown in fig 6. The output of the relay is connected to the control lock system and when a breach in security is detected, a buzzer is set ON. Depending on the command issued, the car control lock system can be locked and unlocked.

Voltage regulator

The voltage regulator circuit is simply a circuit comprising mainly of ICs 7805 and 7812 which are used to regulate the voltage going to the GSM MODEM and the CIRCUIT respectively. The input to both ICs is 12V. Pin 2 of the ICs are both grounded, while the output pins 3 of the ICs give out 5V for the 7805 and 12V for the 7812. The IC 7805 was used due to the low voltage requirement of the GSM MODEM as against that which is fed to the rest of the circuit as shown in fig 7.

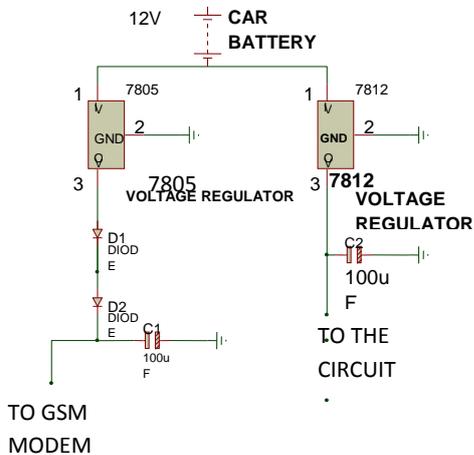


Fig. 7: Voltage regulator

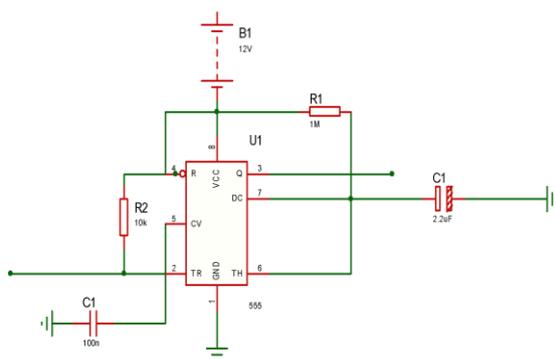


Fig. 8: Monostable circuit

Triggering/monostable circuit

This circuit diagram shows how a 555 timer IC is configured to function as a basic monostablemultivibrator as seen in Fig. 8. A monostablemultivibrator is a timing circuit that changes state once triggered, but returns to its original state after a certain time delay. It got its name from the fact that only one of its output states is stable. It is also known as a 'one-shot'.

In this circuit, a negative pulse applied at pin 2 triggers an internal flip-flop that turns off pin 7's discharge transistor, allowing C1 to charge up through R1. At the same time, the flip-flop brings the output (pin 3) level to 'high'. When capacitor C1 as charged up to about 2/3 Vcc, the flip-flop is triggered once again, this time making the pin 3 output 'low' and turning on pin 7's discharge transistor, which discharges C1 to ground. This circuit, in effect, produces a pulse at pin 3 whose width t is just the product of R1 and C1, i.e., $t=R1C1$.

From our analysis, $C1=2.2\mu\text{f}$ and $R1=1\text{M}\Omega$
Hence, $t= 2.2\mu\text{f} * 1\text{M}\Omega$ which gives a pulse width of 2.2 seconds.

The reset pin, which may be used to reset the timing cycle by pulling it momentarily low, should be tied to the Vcc if it will not be used.

System integration and testing

The individual sensory units were first implemented on breadboard before they were permanently soldered on the vero board. The soldering of the components was done with lead and with 30-watt soldering iron. After the soldering, each of the sensors and units were tested and they were found to be working perfectly as a system. The entire circuit diagram is shown in fig 9.

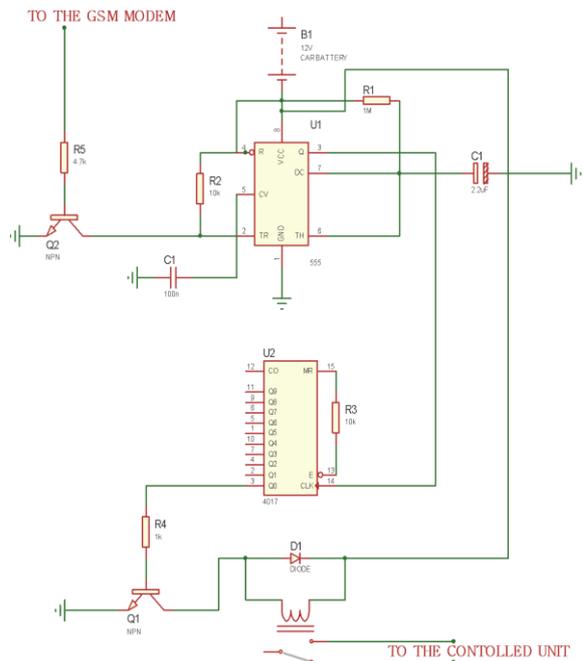


Fig. 9: Circuit diagram

Results and Discussion

The door intruder detector unit was tested by closing the contact switch which immediately sounded the alarm connected to it. The touch sensor unit energized the relay when it was activated which shows that it worked perfectly well. The alarm unit, ignition control unit, light control unit and door lock control unit all worked perfectly by sounding the buzzer as well as turning on and off the ignition, the light and the door lock respectively when triggered.

Conclusion

The design and implementation of an efficient vehicle security system was successfully carried out with all the different units making up the system working perfectly. It worked well to efficiently serve as a vehicle security system. It serves as protection from intruders gaining entrance through the door by sounding the alarm, it also serves to protect the vehicle from being stolen by turning off the ignition so that the vehicle will no longer move from its current position.

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