Design of Open Architecture System to Reduce the Likelihood of a Vehicle Getting Stolen or Carjacking

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Abstract

This paper is a practical design and implementation of an electronic protection system for protection from motor vehicle theft and safety for the driver. It is a specific form of computer-based information system that complies with International safety regulations and can be used in any types of cars, ships, trains, and airplanes. Nationwide in the US in 2005, there were an estimated 1.2 million motor vehicle thefts, or approximately 416.7 motor vehicles stolen for every 100,000 inhabitants. (Federal Bureau of Investigation, 2009) It can be interfaced with navigation, control system for the protected vehicles. The system can control and displays information of controlled vehicles which can be powered for the fuel pump, electricity for the ignition system, audio and visual alarms or others. The designed system can prevent the operation of the engine unless the right store code is entered, also it can let the engine operate only for certain specific previously determined time, or reduce the speed of the engine at certain conditions or stop the engine completely in case of danger for example if the driver fell into sleep in this case in our design depending on gyro as a sensor for that. It may also display additional navigation-related information, such as Sailing Directions, speed, or remains fuel. The system is powered by 12 V dc supply available in all types of vehicles, to start operation to enter the password for the key board. Further, it was demonstrated that the program is used in actual work for the system to the microcontroller type16F84A. The software is preferred for design using software PIC Basic for microcontroller. This Program is a window based Software and friendly user. To detect the driver sleep, different techniques can be employed such as camera day or night, passive infrared detector, muscle sensor (neck or hand), flex or pressure sensor, gyro on head (mechanical), and mind activity sensation. A gyro can be designed with USB interface, in which compass model was designed with Honeywell`s HMC5883L-3 axis magnetometer I²C, 2.7 to 6.5 V TTL-USB and microcontroller 16F877, in addition, it was able to electrically resolve better than 0.1 degree rotation and accuracy from 1 to 2 degree. The output from this gyro model is taken via USB port for monitoring purpose and through a relay used as one of the controls to the microcontroller type 16F84A which will result in the required action like reducing the speed or stopping engine. Our design covers various methods of prevention to reduce the likelihood of a vehicle getting stolen. These include physical barriers, which make the effort of stealing the vehicle more difficult by allowing the vehicle to start only if the right password contains the correct code which is present in the stored microcontroller to give start signal for ignition. Adding to those chances of theft can also be reduced with various deterrents which give the impression to the thief that she/he is more likely to get caught if the vehicle is stolen; including: car alarm systems that are triggered if a breaking and entry into the vehicle occurs and trying to start the engine. Kill switch circuits were designed to frustrate or slow down the efforts of a determined car thief. Kill switches are located between crucial parts of the starting system, between the battery source and the coil, or the fuel pump. A car cannot start without first flipping these kill switches to closed position hided in obscured areas, under the dashboard, beneath the seat, behind a chair etc.

Keywords

Safety and Protection; Car Control; Signal Processing; Sensors

Introduction

Motor vehicle theft (sometimes referred to as grand theft auto by the media and police departments in the US) is the criminal act of stealing or attempting to steal a car. Property losses due to motor vehicle theft in 2005 were estimated up to $7.6 billion. (Federal Bureau of Investigation, 2009) Since then the number of motor thefts nationally has declined. The most recent statistics, for 2009, showed an estimated 794,616 thefts of motor vehicles nationwide, representing property losses of nearly $5.2 billion. (Federal Bureau of Investigation, 2009) Different kinds of control were used on vehicle engine like start up and stop, engine speed, supply of electricity to the ignition system, start alarm, Also the sleep of the driver can be detected using our designed gyro model. There are different ways to steal the vehicle like a-theft of an unattended

vehicle without key(s): the removal of a parked vehicle either by breaking and entry, followed by hotwiring or other tampering methods to start the vehicle, or else towing. b-theft with access to keys: known in some places as "Taken Without Owner's Consent (TWOC)". The unauthorized use of a vehicle in which the owner has allowed the driver to have possession or easy access to the keys c-opportunistic theft: the removal of a vehicle that the owner or operator has left unattended with the keys visibly present, sometimes idling. d-carjacking: refers to the taking of a vehicle by force or threat of force from its owner or operator. In most places, this is the most serious form of theft, since assault also occurs. In some carjacking, the operators and passengers are forced from the vehicle while the thief drives it away, while in other incidents, the operator and/or passenger(s) are forced to remain in the vehicle as hostages. Some less common carjacking result in the operator forced to drive the assailant in accordance with the assailant's demands, (Find Law for Legal Professionals) and Fraudulent theft:. In our design, it was not only tried to find the counter action for the previous different ways to steal the vehicle but also protect the driver when fell into sleep. Moreover, our designed system is used to protect from jump an unattended running car while the owner is at the ATM, dropping off videos, etc.

Tool and Ways Commonly Used for Stolen and Various Methods of Prevention

FIG. 1 CARS WITH SMASHED WINDOW

FIG. 2 SHATTERED GLASS MARK THE SPOT WHERE A PARKED VEHICLE WAS STOLEN

The Protction System Circuit Diagram and Mother Board

Tool and ways commonly used for stealing and various methods of prevention to reduce the likelihood of a vehicle getting stolen slide hammer puller to break into the door locks and the cylinder lock, multimeters or a test light to find a power source, spare wires and/or a screwdriver to connect the power source to the ignition and starter wires, a generic rod and hook toolkit to slip between the car window and car frame and to open the lock behind the window. A common one is called the "Slim Jim". Many keyless ignition/lock cars have weak (Eli Biham; Dunkelman, Orr; Indesteege, Sebastian; Keller, Nathan, 2008; Bono, Stephen C.; Green, Matthew; Stubblefield, Adam; Juels, Ari; Rubin, Aviel D.; Szydlo, Michael, 2005)or no cryptographic protection of the unlock Signal. Proof-of-concept "thefts" of top-of-the-line luxury cars have been demonstrated by academic researchers using commercially available tools such as RFID microreaders, but it is unknown whether the attack has been used for actual theft a firearm or other weapon such as a baseball bat, or a utility knife or a box cutter to break open a window or threaten a passenger if inside the car.(Gold Coast City Council, 2014; http://www.edunds.com/car-review/Top-10)

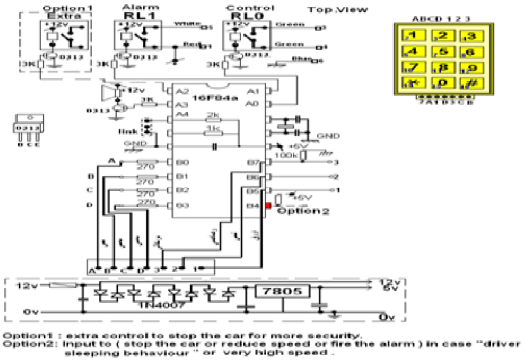

FIG. 3a CIRCUIT DIAGRAM FOR THE PROTECTION SYSTEM

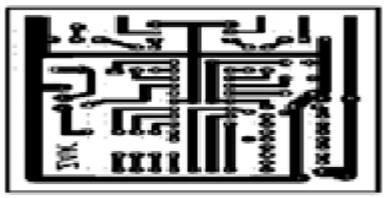

FIG. 3b PROTECTION SYSTEM BOARD LAY OUT

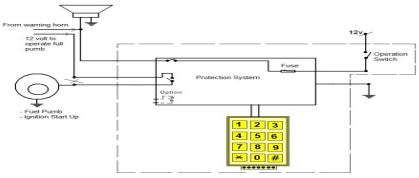

FIG. 4 CAR CONNECTIONS

Methods and Technique to Detect the Driver Sleep

To detect the driver sleeping, different techniques can be applied such as camera day or night, passive

infrared detector, muscle sensor (neck or hand), flex or pressure sensor, gyro on head (mechanical), and mind activity sensation. It was able to design a gyro with USB interface as shown in fig 5, in which Compass Module was used with Honeywell's HMC5883L 3-Axis Magnetometer, I2C, 2.7-6.5V, TTL-USB and micro-controller 16F877. For programming of the micro-controller software PIC basic pro was employed, and we can electrically resolve better than 0.1 degree rotation and accuracy from 1 to 2 degree., thus monitoring the driver head movement, and by analyzing the head movement we can detect driver status, for example the movement of the head to max rear or front inclination angle, in this case of sleep, the pump feeding can be prevented.

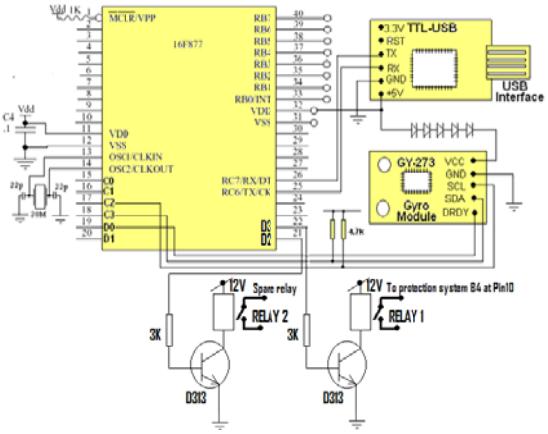

FIG. 5 THE COMPLETE CIRCUIT DIAGRAM FOR GYRO

The Gyro System Design

The designed system is 3-axis digital compass. It was tried to use a cheap and good resolution with a small size. The used Anisotropic Magnetoresistive (AMR) technology provides advantages over other magnetic sensor technologies. These anisotropic, directional sensors feature precision in-axis sensitivity and linearity. These sensors' solid-state construction with very low cross-axis sensitivity was designed to measure both the direction and the magnitude of Earth's magnetic fields, from milli-gauss to 8 gauss.

To get the data from the module, we need I²C interface so a micro controller chip 16F877 can be used to read this data. The design includes a small PCB with Micro Chip "Pic16F877" micro controller and the supporting hardware. We get the I²C data to C2, C3 and an interrupt pin to D0 to indicate data ready. Still the data should be read on a PC displayed that the microcontroller was connected to TTL-USB converter to read Data from Microcontroller. In addition, a small 5v power was made. To supply the Module with 3.3 volts, we applied the 5 v to 4 diodes in forward to have the required voltage drop; then made an external pull up resistor (4.7K) to the SCL & SDA. The I2C software is available. The output from relay 1 is fed to the protection system B4 at pin 10.

Passive Infrared Sensor

FIG. 6 PIR MOTION SENSOR

PIR "Piezoelectric sensors allow sensing motion or movement, which is always used to detect whether a human has moved in or out of the sensors range or not. In our design, this sensor was used to detect driver sleeping then the appropriate action was taken; moreover, PIR output was in connection to the microcontroller inside protection system as shown in figure 4. PIR sensors are small, inexpensive, low-power, easy to use and don't wear out. For that reason, they are commonly found in appliances and gadgets used in homes or businesses; often referred to as PIR, "Passive Infrared", "Piezoelectric", or "IR motion" sensors.

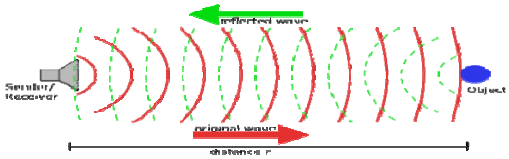

FIG. 7 THEORY OF OPERATION FOR PIR MOTION SENSOR

PIRs are basically made of a piezoelectric sensor (which you can see above as the round metal can with a rectangular crystal in the centre), which can detect levels of infrared radiation. Everything emits some low level radiation, and the hotter something is, the more radiation it emits. The sensor in a motion detector is actually split into two halves. The reason for that is that we are looking to detect motion (change) not average IR levels. The two halves are wired up so that they cancel each other out. If one half sees more or less IR radiation than the other, the output will swing high or low. This output in an input to the microcontroller will lead to stop of fuel pump or ignition coil.

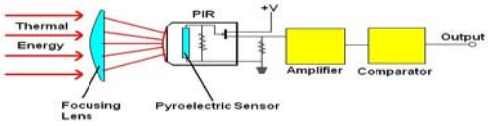

FIG. 8 PIR MOTION SENSOR DIAGRAM

This is suitable for recording the surface temperatures

ranging from about -70 to 1,000°C. In our design, the object was the vehicle driver. The sensors convert the thermal radiation sent from one object in a wavelength range of 0.7 to 20 μ m into an electrical signal that is processed into a signal that can be evaluated. What is important here is the D: S ratio (distance: spot) that the measuring field diameter is indicated at a given distance. Complete coverage of this field by the object's surface whose temperature is to be monitored is optimal.

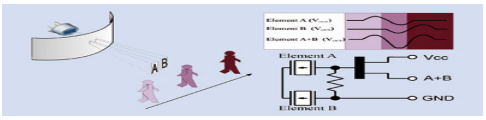

FIG. 9 PIR MOTION SENSOR CIRCUIT

The Complete system design

The complete designed system is shown in figure 10, and this complete system has installed the programmed microcontroller 16F84A. Two types of key board can be employed, as shown in figure 11 they can be of press type or sticker type according to the requirement, then the flat cable was applied which can be used for extension between the key board and the complete system. Figure 12 shows some form of master key.

FIG. 10 REPRESENTS THE COMPLETE DESIGNED SYSTEM

FIG. 11 REPRESENTS THE TWO TYPES OF KEY BOARDS

FIG. 12 SOME SORTS OF MASTER KEY

Conclusion

In this design, it was tried to find the countermeasure for most different ways to steal the vehicle, and the designed system can be used not only to prevent from theft but also to protect from Jump into an unattended running car while the owner is at the ATM, dropping off videos, and protection of the driver when falling into sleep by stopping the engine. Circuits were designed to prevent, or frustrate or slow down the efforts of a car thief, and other circuit for gyro. Moreover, it can reduce the speed of the engine or stopped at certain conditions. Design allows straightforward programming interface to the system used to simplify the task of integration into different user environment. Parallel cable interface to the host makes the system cheaper. The system achieved the high level of security and can be used to more complex designs according to requirements. It can be used in wide scale in commercial as protection and alarm system for any vehicle. Further, a new and systematic design was presented in this paper using microprocessors. A new and comprehensive model is shown that uses appropriate code words, independent of the vehicles details. Protection and alarm are given to any vehicles (M. S. Zaghloul, M Saleh, 2011)

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