

Intelligent Vehicle Safety and Security Monitoring System Using ECU&VSU Technology

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Abstract. Technologies are expanding to cherish our humanity in today's new and advanced world. There is a huge advancement in vehicle monitoring technologies in day to day life. Still more number of road accidents are taking place around us, especially when driving the vehicles after alcohol consumption. Moreover thefts are also happening around us. So security is also important for the own vehicles. The above discussed problems make us on to focus our objective to decrease the road accidents and security related issues using Arduino platform. It intended to give an idea of accomplishing safety and security systems in vehicles like cars for future evolution. It includes the concepts of Alcohol Detection and Bio-metric analyzation. The above mentioned concepts are to be achieved using Electronic Control Units(ECU) like Alcohol MQ3Sensor and Vehicle Security Units (VSU) like bio-metric sensor, anti-theft locking devices, etc. It is assumed to be succeed by providing safety and security to the vehicles with the above approaches.

1. Introduction

An electronic control unit (ECU) is a device in a vehicle that controls(by processing the inputs)an electrical system which is present in that vehicle. It's main part is a microcontroller and code for controlling ECU is written using embedded software. Some of the functions of the ECU in a car includes brakes control, engine control, climate or temperature control etc [5]. Today most of the bike accidents or car accidents are taking place due to drunk-driving.The driver after alcohol consumption will not be in a conscious state or a balance condition so this may risks the lives of people both in the vehicle and on the road. So alcohol detection is needed before starting the vehicle in order to achieve safety. Previously smart helmet is introduced for bike riders which detects alcohol consumption along with usage of mobile phones while driving. It is also like following traffic rules because helmet is used. There are some other methods in which GPS and GSM units will trace the location of the vehicle by accessing or knowing latitude and longitude and alerts the drivers relative if any accident occurred and to the police if they are drunken [6]. Here in this paper we introduced an alcohol detection system which can be placed at the steering so that alcohol is detected even in the driving action if consumed and slowly engine turns off. This can be achieved using MQ3 sensor which senses the alcohol level through driver's breath and controls the engine through ECU principle.

Vehicle Security Unit(VSU) includes anti-theft locking devices, GPS system, car lock altering system etc. For example the anti-theft device is meant to shut down the electrical system of a car if it is being stolen. It is activated when the vehicle is locked, and then the driver must then do a series of steps before it unlocks. Security related issues can be resolved with the previous methods like conventional or regular locks but again there is a disadvantage that door can be opened using duplicate key. With these locks, there are also some riddles if we lost keys of lock and we have to bring through those keys with us. In addition to lock methods, patterns or orders or structures in the locks also increase security. But again it also has some disadvantage that is lock can be opened if anyone somehow predicts or cracked the passwords or patterns. So biometric system is introduced with relay module and solenoid lock [7]. Previously OTP generated method is used for door access control system. Security can also be achieved with the pin lock method. The bounce or any other jerk which occurs from the vibration that takes place in the vehicle if any anonymous person trying to access the vehicle is also detected using different methods to achieve security [8]. Apart from all these methods, the finger print scanning method is more efficient method for high level security. The action of biometric checking and accessing also comes under security. These systems increase security to the vehicles to a great extent. Here in this paper we introduced a biometric system at car door to detect the theft. The robbery can be predicted by the process of comparing scanned figure print of a person whoever tries to open the door with owner's or authorized figure print and decides whether to give access or not with the change in the movement of servo motor.

2. Literature Survey

The existence of alcohol in the environment is detected by MQ3 sensor. If the alcohol concentration is higher the specified limit then that reading will be given to ARDUINO and alert will be sent to the police or any specific person as a message saying that the car is not safe through the sim(This sim is embedded in the SIM900A module)[1]. MQ3 sensor detects the existence of alcohol by examining a driver's breath and turns off the car engine after a specific amount of alcohol is detected and buzzer and LCD display are used to alert the nearby people repeatedly.[2]The writer says that security can be increased by using patterns in the locks .But again it also has some disadvantage that is lock can be opened if anyone somehow predicts or cracked the passwords or patterns. Hence biometric system is more efficient.[3]The writer depicts the system in two different parts. First part is the app in the mobile and second part is hardware system. This app is coded or designed for mobile OS android . This app allows the user to manage finger prints that is adding or removing finger prints. The hardware module is controlled by Arduino Uno microcontroller.[4]

3. Methodology

Safety and Securirty system is carried out using Arduino platform especially with Arduino Uno microcontroller. Below figure is the block diagram for this system. Below figure shows the flow chart for the overall functioning of the system in a simple way.

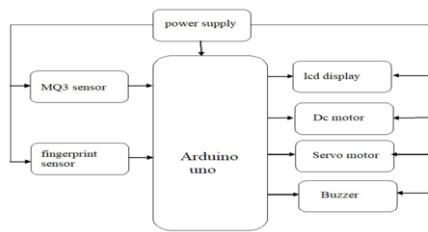


Figure 1. Hardware module for safety and security system



Figure 2. Flow chart for the proposed system

3.1 Arduino Uno

Arduino is an open source electronics platform. Arduino boards are capable of studying inputs such that light on a sensor, a finger placed on a button etc and turn it into an output or response such that activating or deactivating a motor, turning on or off an LED etc. So an Arduino programming language and Arduino Software IDE are required to pass signals or instructions to the microcontroller on the board and get response from the board. Mainly this project is carried out using Arduino Uno microcontroller. It is shown in the figure 3 and the pin description is shown in figure 4. It consists of 14 digital input/output pins out of which six pins are PWM outputs and another six are analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button.



Figure 3. Arduino Uno

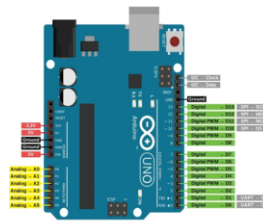


Figure 4. Pin description of Arduino Uno

For the biometric system, the code which is written in arduino allows the user to add finger prints and store in the memory . It also allows to scan the finger print and verifies whether that finger print is stored or not. If the scanned finger print is found to be stored in the memory then door access is given to be open. Otherwise door access is declined and buzzer is used to alert the user. LCD display is used to show the results that is either authorized or unauthorized for the scanned finger print. For the alcohol detection system, the consumed alcohol level is measured with the MQ3 sensor and if the level is below the limit then the car engine turns on and alarm turns off. If the alcohol level is above the limit then the car engine automatically turns off and alarm turns on. The alcohol limits ,the conditions for engine to turn on or off, the conditions for buzzer to turn on or off etc are set using programming with the Arduino.

3.2 Fingerprint sensor

Finger print sensor is a kind of sensor which is meant for biometric authentication. These scanners captures the pattern of ridges and valleys from a finger and then processed by some software and inspects it with the already registered fingerprints on file. If that finger print matches, thereby granting access. The finger print sensor which is used is shown in the figure 5. It's specification is R307. From total six wires of finger print sensor, four wires are used for arduino interfacing. From these four wires, two wires are used for power and the other two wires for data. The red wire of finger print sensor is connected 5v pin of arduino, black to GND pin, yellow to D2 and white to D3 pin of Arduino uno.

3.3 Servo Motor

The servo motor is simply a direct current motor which is supervised for particular angular rotation. It has a connected motor to a sensor for position feedback. A simple servo motor is shown in the figure 6. Here in this project servo motor is used to represent the door for the biometric system. If the scanned finger print matches with the any of the registered finger prints in the file then the servo motor rotates in one particular direction (to represent the opened lock for door) and again rotates in opposite direction with some time gap (to represent the closed lock for door).

3.4 MQ3 Sensor

It detects gas leakages like Alcohol, CH₄, Hexane, LPG. It has high reactivity and speedy response time, so that readings can be taken in the short run. It senses input that is alcohol level from the driver's breathe and turns it into output or response to control the engine. The three terminal MQ3 sensor is connected to A0, GND, 5v supply pins of arduino uno. It is shown in the below figure.

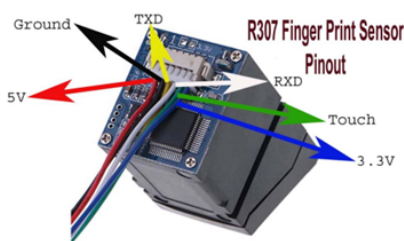


Figure 5. Finger print sensor



Figure 6. Servo Motor

3.5 DC Motor

It is an electric machine that transforms electrical energy into mechanical energy. It uses mechanical fields produced from the electric fields generated which drives the rotation of rotor fixed within the output shaft. Here the DC motor is used to represent the car engine. If detected alcohol level by the alcohol sensor is below the specified

limit then DC motor starts rotating to represent that engine get started. Otherwise it stops rotating. A simple DC motor is shown in the below figure. The positive terminal of motor driver is connected to 5v pin through battery and I1, I2 pins of motor driver are connected to D8,D9 pins respectively of Arduino uno.

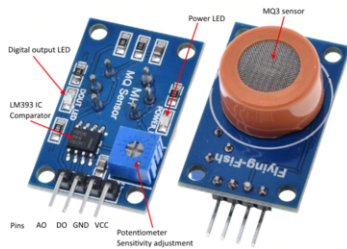


Figure 7. MQ3 gas sensor

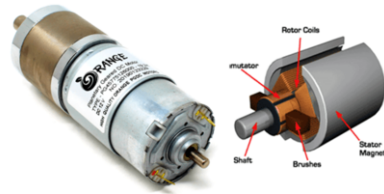


Figure 8. DC motor

3.6 Buzzer and LCD display

Buzzer is a device that converts audio signals into sound signals. It is used for alerting the user whenever unauthorized person tries to start the car or if the driver consumed alcohol. The D12 pin of Arduino Uno is connected to buzzer. LCD display is used to display the results.



Figure 9. Buzzer



Figure 10. LCD Display

4. Execution and Result

The code is executed successfully using Arduino IDLE. For the biometric system, before opening the door, user has to place the finger on the sensor and if the finger print matches with any authorized finger print, then LCD displays “authorized” as shown in the figures 12 and servo motor rotates to give access as shown in the figure 14. Otherwise it shows “unauthorized”. The following figures clearly depicts the working and results of the biometric system.

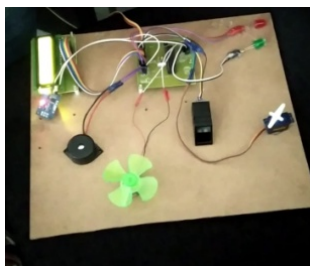


Figure 11. Circuit setup



Figure 12. Authorized



Figure 13. Unauthorized



Figure 14. Rotates in one direction to open door

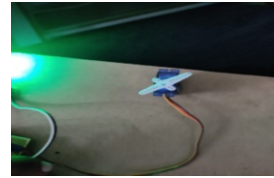


Figure 15. Again rotates in opposite direction with time gap to close the door

For alcohol detection system, if MQ3 sensor detects alcohol from driver's breathe then buzzer starts sounding and DC motor stops rotating and LCD displays "driver is alcoholic". The results of this system is understood clearly with the following figures.

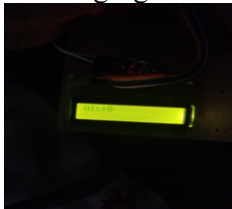


Figure 16. No alcohol is detected

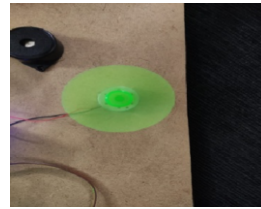


Figure 17. DC motor is rotating



Figure 18. Alcohol is detected



Figure 19. DC motor stopped

5. Conclusion

An optimized solution is provided using Arduino for car monitoring system which provides security for the car using biometric system and safety using alcohol detection system by taking several situations or cases into consideration with high accuracy and efficiency. The components which are used in this system like MQ3 sensor, finger print sensor, DC motor, servo motor etc have high reliability and real time applications. Future scope of this system is to decrease thefts and road accidents with advanced modifications with real time implementation.

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