Design of Driver Alcohol Detection System with Automatic Engine Locking

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ABSTRACT

Drunken Driving is one of the most fatal causes of premature deaths around the world. According to WHO, about 20% of the fatally injured drivers have excess alcohol in their blood in high income countries whereas the figures may be as high as 69% in low and middle income countries. In India alone, there have been 38,000 road mishaps due to drunk driving in the past three years according to the latest report of Ministry of Road Transport and Highways. The objective of this paper is to make human driving safer and overcome such incidences. The present paper describes the process of detection of alcohol in sample breath testing, developed using Arduino and Arduino Integrated Design Environment (IDE). The system will sense the alcohol concentration in breath and control the switching of ignition engine according to the data it receives. Also, it allows the driver a delay time in case the breath is detected after the vehicle has started to avoid traffic mismanagement. Finally, it will send an SMS alert to his/her relatives/close friends to alert them of possible drunken driving incident and prevent it.

Keywords: Alcohol sensor, Arduino, Cloud, Drunk driving, Internet of Things.

1 Introduction

Road transportation is the most common and ever increasing mode of transportation in the present world. Drinking and driving is one of the major causes of road crashes in the world. [2]Consequently, there has been rise in incidents of drunken driving and road rage. Such incidents have made lives dangerous of drivers, fellow drivers and pedestrians alike. Drivers lose control of the vehicles under the influence of alcohol and pose a threat to life and property around them. They not just pose harm to fellow passengers, vehicle drivers and even pedestrians through this irresponsible behavior. [1]While number of safety manuals have been presented and distributed across the governmental, nongovernmental organizations and road safety practitioners to generate awareness among the public, this system provides for a simple, effective and low cost solution to prevent drinking and driving that can be employed at a local or national level. The present paper attempts to model a breath analyser and alcohol detector with the help of Arduino and Arduino Integrated Design Environment (IDE). The system will sense the alcohol concentration and if it exceeds the permitted limit, it will automatically switch off the engine to prevent the driver from driving in a reckless manner. Moreover an alert shall be sent to his friend/relative about his drunken state and GPS location.

2 Literature Review

The paper in [4] employs Arduino to develop a driver alcohol detection system based on breath testing. The paper in [5] uses Arduino to develop alcohol detection for safe driving. The paper in [6] uses MQ3 alcohol sensor for detection, it does send an SMS alert or provide any delay to stop the car in case the sensor detects

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alcohol after the system detects traces of alcohol. R. S. D. R. N. S [7] presents a basic alcohol detection system using an analog gas sensor that switches on or off the system. It uses a very basic Intel 8051 microcontroller that has its limitations to work with multiple interfaces. Furthermore, in [8] the system uses wavelet transformation for alcohol detection that has its own set of challenges and limited effectiveness. The paper in [9] demonstrates practical application of alcohol detection in lab based in Romania. The paper cited in [11] demonstrates an alcohol detection system but can be inaccurate in case the driver wears a mask while driving and does not alert any emergency contact in case of drunk driving.

Thus, the work presented in this paper offers a dynamic and novel approach in the sense that it allows the driver a short delay time instead of arbitrary shutdown of vehicle that may have caused further damage to other vehicle drivers and pedestrians. Furthermore, it sends emergency alerts to contact number with the driver's risky situation i.e. the alcohol level so that the registered number can amend the situation in some manner thereby greatly reducing chances of accidents.

3 Methodology

The following section describes the methodology and functioning of the system. It demonstrates diagrammatically as to how the idea was envisaged (figure 1), followed by the schematic built up of the system (figure 2). It further describes the methodology and functioning of the distinct components employed in the system with their specifications. Finally, it illustrates the system hardware that has been put together keeping the aforementioned guidelines in mind.

3.1 Block Illustration

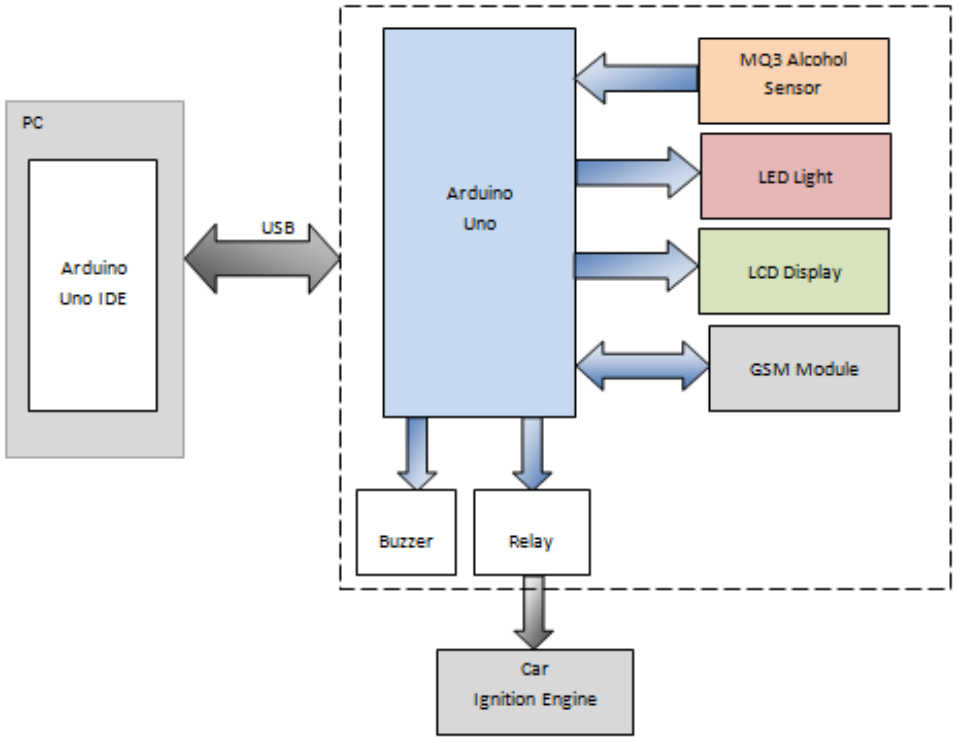

Figure 1: *Block Illustration of the Technique*

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3.2 Schematic Design

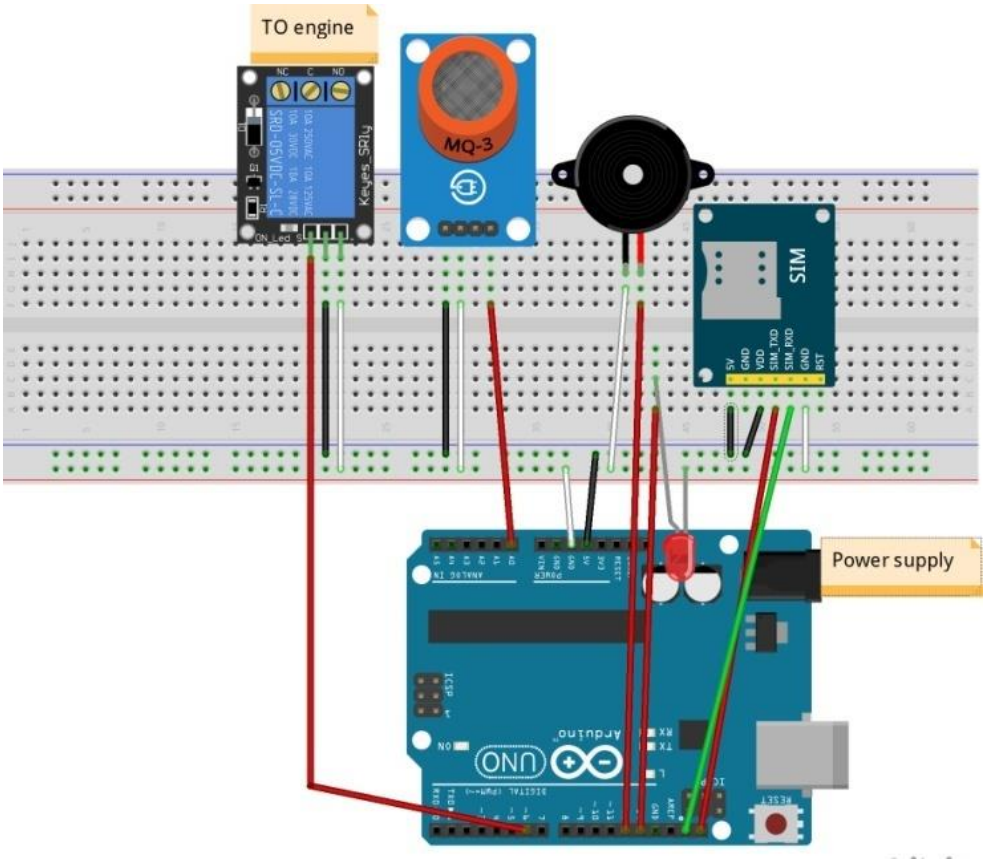

Figure 2: *Schematic Design*

3.3 Methodology and Functioning

The methodology offers a technical working of the system in which the inputs from the alcohol sensor have been taken into consideration, analyzed for its concentration and depending on different scenarios, the system is operated:

3.3.1 Breath in MQ3 Alcohol Sensor as Input

The input from the breath of the individual is fed as an input into the Arduino. MQ3 Alcohol sensor is a semiconductor type sensor that possesses high sensitivity to alcohol and resistance to smoke, gasoline and vapour. It provides an analog resistive output based on alcohol concentration. It requires low power consumption and is compatible with almost all microcontrollers. It has fast response, low cost and long life. It requires heater voltage and simple driver circuit for operation. The sensor can be affixed anywhere on the driver seat like steering wheel front board etc.

3.3.2 Alcohol Concentration is analyzed

The microcontroller has been programmed to detect the threshold concentration of alcohol in the breath. Arduino is an interactive open source platform characterized by low cost and flexible hardware and software. Arduino Uno R3 is the reference model and widely used.It has ATmega328 microcontroller chip (8- bit) at 16Mhz, with 14 digital I/O pins and 6 analog input pins. It is usually powered through USB connection but

can also be powered by DC power socket from batteries. After the aforementioned steps, three different scenarios are possible after taking the input from the sensor and processing with the help of Embedded System:

3.3.2.1 Scenario 1

In case the alcohol concentration exceeds the threshold concentration, the LED turns and piezo buzzer generates noise to indicate the detection of alcohol on driver's breath [7]. The PS series buzzers use unimorph piezoelectric elements for higher efficiency. They are easy to incorporate in different circuits and are high performance buzzers. They are low power devices and can serve as both musical tone oscillator and a buzzer as they are designed for external excitation. Further, the car ignition engine is turned off. This is controlled by a 1 channel, 5V, Relay Module. It is an electro-mechanical switch for controlling higher voltage/current devices. For protection of Arduino board, the relay helps is electrical isolation from the control circuit. It consists of a mechanical switch contacts and low voltage coils. As the current starts flowing in the coil, an electromagnetic field is generated to activate the electrical connection. When the current start to flow through the coil, an electromagnetic field is created that activate an electrical connection.

3.3.2.2 Scenario 2

In case the alcohol concentration is below the threshold concentration, the LED and piezo buzzer remains off and car continues to move or remains in its position.

3.3.2.3 Scenario 3

In case the alcohol concentration is detected when the car is already in motion, the system alerts a message on LCD for 10 seconds to take the car into the service lane and then stops the ignition engine after a delay 20 seconds so as to avoid abrupt stoppage and affect the traffic.

Depending upon the above scenarios, the following step is taken:

3.3.3 SMS Alert sent

In the first and third scenario, as soon as the engine is turned off, a SMS alert is sent through GSM Module to the listed emergency contact to warn them of their loved one driving while drunk. SIM 800L GSM Module is a complete quad-band GSM/GPRS solution in a smt type which can be embedded in the customer applications. SIM 800L supports quad-band 850/900/1800/1900 Mhz. It can also transmit voice, SMS and data information with low power consumption. The system hardware and operational flowchart is depicted in the figure 3 and 4 below.

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3.4 System Hardware Design

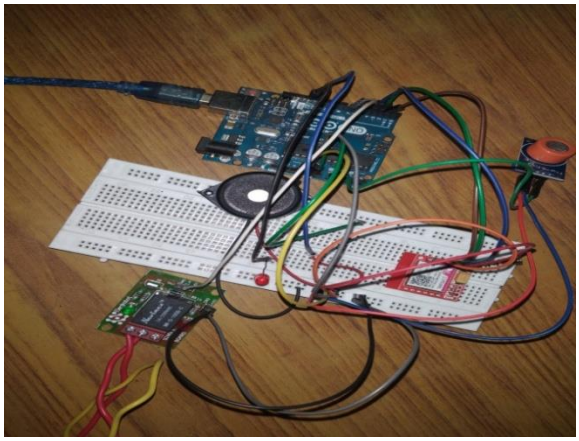

Figure 3: *System Hardware*

3.5 Operational Flowchart

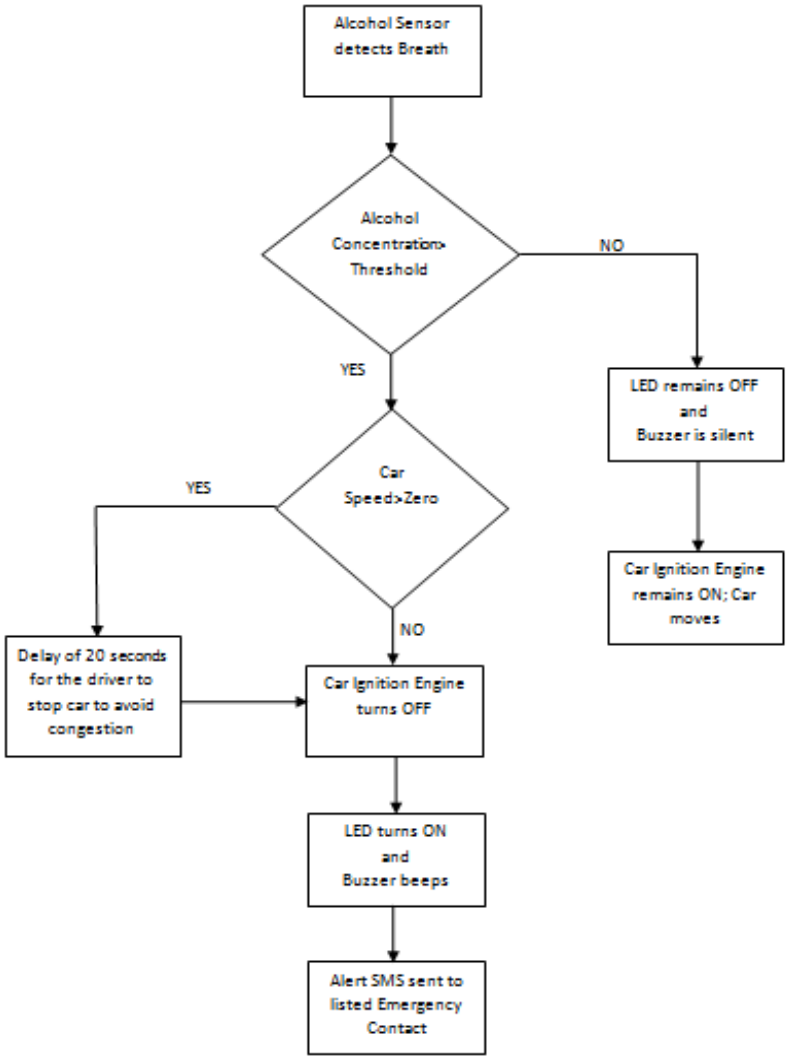

Figure 4: *Operational Flowchart*

4 Experimental Results and Analysis

This section presents an extensive analysis of observations and the results obtained in the working of the system. It also lists the distinguished features of the system.

4.1 Experimental Observations and Analysis

The following were the outcomes of the working of the system:

1. The MQ3 sensor has a variable resistor which varies in accordance to the amount of alcohol present in the air.
2. Resistor value decreases with increase in the amount of alcohol and vice versa. Thus, alcohol level can be determined by measuring the value of the resistance.
3. Blood alcohol content (BAC) which is usually measured in gram/deciliter is determined using the breath alcohol level obtained from the sensor.
4. Regression method was employed to determine the relationship between sensor's resistances ratio and mg/l (BAC) and to compute the blood alcohol content (BAC) in the study.
5. Alcohol level is displayed on the LCD display fitted in the car along with the warning message to stop the car. Besides, the message is being sent with the relevant information to the registered phone number about the drunken driving person.
6. Since Blood alcohol content (BAC) legal limit is 0.03% or 30 mg alcohol in 100 ml blood in India, the system presented calculates the blood alcohol level and with this the mental status of the person is estimated.
7. The system is designed keeping in mind all the operational scenarios for example, if the person is already drunk before consuming the alcohol, if the person is consuming alcohol while driving, if the alcohol is detected after the starting of vehicle, etc. The figure below shows the sensor location.

Figure 5: *Sensor Installation location*

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4.2 Distinguished Features of the System

The system is easy to implement. It is cost effective and efficient to be used in all kinds of automobiles. It can prove its utility in real life scenarios by minimizing the chances of fatalities. The emergency contact listed can be informed and also the police personnel if the need arises if anyone is caught drunk driving.

5 Conclusions

The present proposed system is an IoT application to stop and prevent drink and drive cases to a large extent as well as protect the innocent pedestrians from this unwarranted menace. The paper successfully implements a breath analyser and alcohol detection system. It not just detects alcohol in breath but also turns the car ignition off once alcohol is detected. Moreover, a SMS alert is sent to the phone of the listed emergency contact to avoid any mishap. It is advantageous in the respect that it has low cost, long life and needs a simple driver circuit for implementation. It provides accurate and quick results. Furthermore, it shall aid the police for drunk drivers and provide automatic safety for cars and other vehicles as well.

The future scope of this project may include a [10] GPS transceiver in the system setup and it shall send the location of the driver to the listed emergency contact along with the SMS alert with saving the data on the cloud for future uses. More such Innovations like automatic driving to park the vehicle safely when alcohol is detected using machine learning can be implemented in this model.

References

[1] who.int/roadsafety/projects/manuals/alcohol/en

[2] https://pib.gov.in/Pressreleaseshare.aspx?PRID=1577134

[3] https://www.sundayguardianlive.com/news/drunk-driving-led-38000-road-mishaps-three-years

[4] G. Gasparesc, "Driver Alcohol Detection System Based on Virtual Instrumentation," *IFAC-PapersOnLine*, vol. 51, no. 6, pp. 502–507, 2018, doi: 10.1016/j.ifacol.2018.07.110.

[5] P. Barhate, B. Nemade, and V. D. Chaudhari, "Alcohol Detection System in Vehicle Using Arduino," *Int. Res. J. Eng. Technol.*, vol. 4, no. 6, pp. 287–291, 2017, [Online]. Available: https://irjet.net/archives/V4/i6/IRJET-V4I651.pdf.

[6] P. D. G. Jha and S. Buva, "Alcohol Detection in Real-Time To Prevent Drunken Driving," *J. Comput. Eng.*, vol. 4, pp. 66–71, 2015.

[7] R. S. D. R. N. S, "Vehicle Safety System with Alcohol Detector," *Int. J. Sci. Res. Dev.*, vol. 5, no. 12, pp. 940–942, 2017.

[8] Lea Angelica Navarro, Mark Anthony Diño, Exechiel Joson, Rommel Anacan, Roberto Dela Cruz, "Design of Alcohol Detection System for Car Users thru Iris Recognition Pattern Using Wavelet Transform", 7th int. conf. on Intelligent Systems, Modelling and Simulation.

[9] Anghel, M. A. (2008), Traceability of breath alcohol concentrations in Romania, *OIML Bulletin*, vol. XLVIII, no. 3, pp. 15-20.

[10] Paul Baskett , Yi Shang , Michael V. Patterson , Timothy Trull , Towards A System for Body-Area Sensing and Detection of Alcohol Craving and Mood Dvsregulation , © 2013 IEEE

[11] Pranjali Ingale Patil; Priyanka Barhate; Bhagyashri Nemade; &Vijay D. Chaudhari. 2017. *Alcohol Detection System in Vehicle Using Arduino*, International Research Journal of Engineering and Technology (IRJET). Vol. 04 Issue: 06.