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Alcohol Detection System for Vehicle Control

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Abstract— In the recent years, whole world has seen so many accidents due to drinking. Problem persists even after strict laws or policing. Hundreds of people lose their lives due to driving drunk or coming in the way of someone else who is driving drunk. Drunk drivers not only put themselves at risk, but also those in their vicinity. In this modern era the requirement of automatic device for alcohol detection is essential.With that goal in mind, we worked on an Alcohol Sensor for Vehicle Control using Arduino. We have used Arduino Uno, MQ3 alcohol sensor, a DC Motor (as car), piezoelectric buzzer, LED and resistors. This study developed a prototype of alcohol detection and engine locking system by using an Arduino Uno microcontroller interfaced with an alcohol sensor along with an LCD screen and a DC motor to demonstrate the concept. The system uses MQ-3 alcohol sensor to continuously monitor the blood alcohol content (BAC) to detect the existence of liquor in the exhalation of a driver. Results from testing the proposed system adequately matched the requirements for starting a car's engine once the level of alcohol detected in the breath of the driver is higher than the prescribed level that is permissible by law.

Keywords— Arduino, Alcohol detector, Parts per Million, USB.

I. INTRODUCTION

INDIA has earned the dubious distinction of having a greater number of fatalities due to road accidents in the world. Road safety is emerging as a major social concern around the world especially in India. Drinking and driving is already a serious public health problem, which is likely to emerge as one of the most significant problems soon.

These days, majority of road accidents are caused by drink-driving. Drunken drivers are in an unstable condition and so, rash decisions are made on the highway which endangers the lives of road users, the driver inclusive. The enormity of this menace transcends race or boundary. In India, the problem is being tackled by issuing laws prohibiting the act of drivers getting drunk before or while driving as well as delegating law enforcements agents to arrest and persecute culprits. However, effective monitoring of drunken drivers is a challenge to the policemen and road safety officers. The reason for this stems from the natural inability of human beings to be omnipresent as well as omniscience within the same space and time. This limited ability of law enforcement agents undermines every manual effort aimed at curbing drink-driving. There is therefore the need for an automatic alcohol detection system that can function without the restriction of space and time.In earlier executions of this project, a prototype of road accident avoiding system that havean alcohol sensor MQ-2 which detects the presence of alcohol in human breath was integrated with a PIC16F877/874 microcontroller which acts as the controller, and an LCD as the output. Other proposed systems for detecting drivers that are drunk so as to track them down have been 2 developed. The system uses Advanced RISC Machine (ARM) processor and MQ3 that detects liquor. The MQ3 sensor senses the intensity of liquor by means of an analog to digital converter which is inbuilt in LPC2148 ARM controller. Understanding the current situation regarding traffic safety, we have decided to go for an automated approach using Arduino UNO, as opposed to a traditional microcontroller approach. The Arduino system was selected over a microcontroller due to the following reasons:

- An Arduino board is cheaper in cost, thus reducing manufacturing cost.
- It is easily programmable, which offers flexibility regarding functionality.
- Due to the customizability of an Arduino Board, there is relatively lesser wiring and hence, lesser room for connectivity errors.
- The Arduino Software (IDE) runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.

The objective of this project is to implement a low-cost, scalable, and reliable alcohol detection system in the dashboard/steering wheel of a car. An alcohol sensor will continuously detect theBlood-Alcohol level of the driver and stop the car engine at any time when it detects a hike inthe level compared to the legal limit of consuming alcohol, as set by the government.

II. RELATED WORK

Nowadays in many civilized culture consumption of alcohol is taken as a tradition. The habit is coined with many occasions such as parties and celebrations [3]. Even a small amount of alcohol consumption can change the human behavior as well as his bodily behavior. This type of boddy inability to control can be highly dangerous and can involve car accidents which will risk the persons sitting inside the car also on the persons on the road [5]. Government made several laws like fine, cancellation of license etc. so that this can be minimized. The above mentioned problems shows that there is a need of simple, accurate and instrument to be used by the automobile manufacturers, vehicle users and so that vehicle will not start due to alcohol content in the air inside the vehicle [6,7]. The alcohol consumption is more in younger generation and they drink and cause accidents due to rash driving. Due to the alcohol consumption changes the bloodalcohol concentration and thus changes the body actions. There is a direct connection between blood alcohol and breathe alcohol concentration [4].

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By taking blood samples blood alcohol concentration can be measured and by using sensors breath alcohol content can be measured [7], [8].The first method is done by traffic policeman by taking blood samples of the drivers. The second method uses breath analyzers to sense the breath of the drivers. This method itself is not enough this can be integrated with the car system so that presence of any alcohol content in the vehicle also can be detected [9]. The proposed system is developed on embedded system using Arduino. Ashish Singh et.al [11] developed a alcohol detection system which facilitates the human driving system.

Deepak Garget. al [12] discussed on the development of alcohol detection system using various circuitry.

G. Sudha et.al [13] described in their paper on alcohol sensor based ehicle ignition control using Arduino UNO. Jagadeesh G et.al [14] in their paper explained the development of alcohol detector to minimize traffic accident cases based on alcohol consumption. Mrs. K. Niroshaet. al [15] discussed in their paper on amount of alcohol detection in vehicles and the system is developed using various sensors for the safety of people seating inside the vehicle.

III. METHODOLOGY

Main aim of this work is to develop a hardware to detect alcohol content in drunken driver while driving. Methodology describes the various steps that are followed in developing the prototype. It comprises various steps such as developing the hardware, simulating the circuitry through software, Testing the hardware for results.

A. Block Diagram

Block diagram of the proposed system is shown in Fig.1 which comprises following parts such as Power supply, Alcohol sensor and Ignition system on the input side. Indicating Unit, Alarm and DC Motor on the output side. Power supply consists of various sources for different sections of hardware.

Our system is powered with a 9V battery. A 5V DC supply as required by the microcontroller, sensor and display unit. While other components like DC motor require 1.5V and the LEDs need 2V. The Arduino Uno board has already been designed to operate without the use of transformer, the system can be powered via the USB connection from computer or with an external power supply of 7 to 12V. The External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. Any voltage that is above 12V will make the control device to burn thereby destroying the board. Itis advisable to use voltage between 7 - 12V.

B. Architecture

Figure 2 illustrates the architecture of the system. For the purpose of ensuring the success of this project, we thought it best to simulate our circuitry and code before executing on any hardware. For our simulations, we used an online platform by Autodesk Education–Tinkercad.

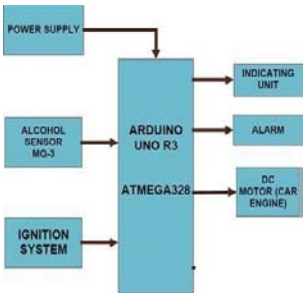

Fig. 1. Block Diagram arrangement

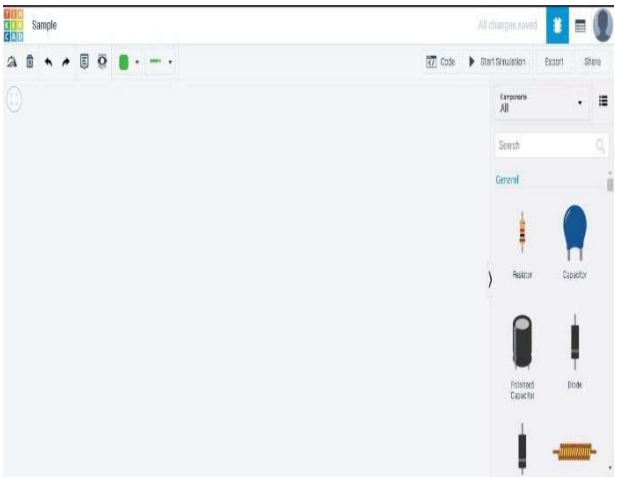

Fig. 2. Architecture of the proposed system

Tinkercad is a multipurpose educational online platform in which students, professionals and any curious minded individual can simulate and design – codeblocks, circuits and 3D designs. For the purpose of this project, we found it most hands-on and practical to use this website for designing and simulating our circuitry. There are multiple blocks of electric circuit designing components in a very diverse and vast library included on the platform, to name a few – resistors, motors, sensors, Diodes and other various electronic components. Here, we used the Arduino board (Arduino UNO R3) and were able to code the board for the simulations using the platform's in-built IDE (Integrated development environment).

C. Arduino Board

Arduinois an open-source hardware and software company, project and user community thatdesigns and manufacturessingle-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control both physically and digitally. Its products are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially in preassembled form oras do-it-yourself. (DIY) kits.

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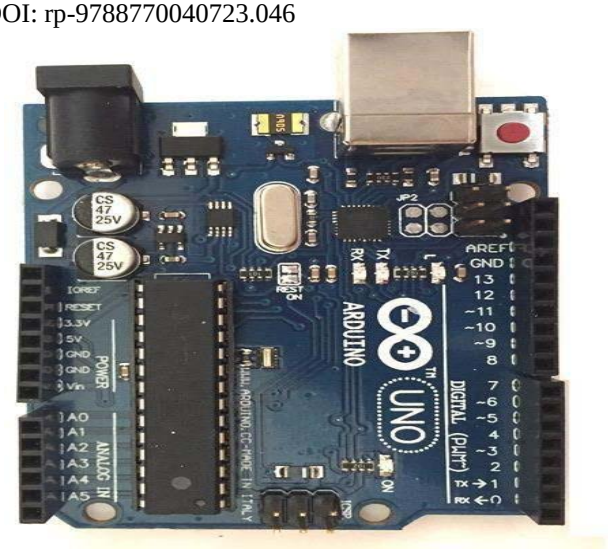

Fig 3.Arduino Board ATmega 328

D. Alcohol Sensor

Fig. 4. Alcohol Sensor- MQ3

MQ-3 gas sensor has high sensitivity to Alcohol, and has goodresistance to disturb of gasoline, smoke and vapor. It has fine sensitivity range around 2 meters. The sensor could be used todetect alcohol with different concentration; it is with low cost and suitable for different application. It has a clear interface type. On the sensor, port pins 1, 2 and 3 tends to the yield, GND and VCC independently.

MQ3 is a heater-driven sensor. That's why it is enclosed in two layers of fine stainless-steel mesh called an Anti- explosion network. It ensures that heater element inside the sensor will notcause an explosion, as we are sensing flammable gas (alcohol).

When SnO2 semiconductor layer is heated at high temperature, oxygen is adsorbed on the surface. In clean air, electrons from the conduction band in tin dioxide are attracted to oxygen molecules. This form an electron depletion layer just below the surface of SnO2 particles and forms a potential barrier. As a result, the SnO2 film becomes highly resistive and prevents electric current flow.

E. Connections with Arduino (Digital)

The module has a built-in potentiometer for calibrating the digital output (DO). By turning the knob of the potentiometer, you can set a threshold. So that when the alcohol concentration exceeds the threshold value, the Status LED will light up and the module will output HIGH.

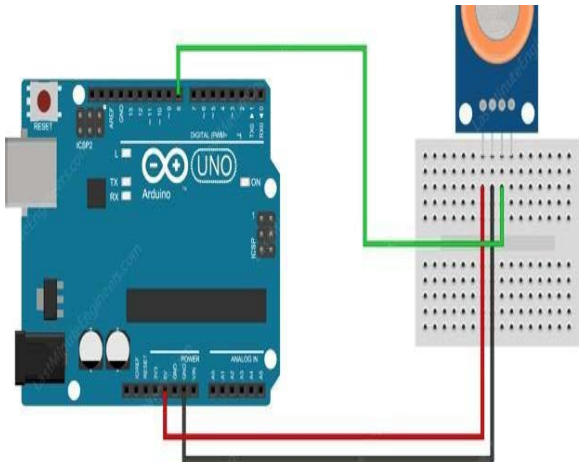

Fig. 5. MQ3 Connection with Arduino (Digital)

F. Piezoelectric buzzer

A piezo buzzer is a type of electronic device that's used to produce a tone, alarm or sound. It'slightweight with a simple construction, and it's typically a low-cost product. Yet at the same time, depending on the piezo ceramic buzzer specifications, it's also reliable and can be constructed in a wide range of sizes that work across varying frequencies to produce differentsound outputs.

G. System Flow Chart

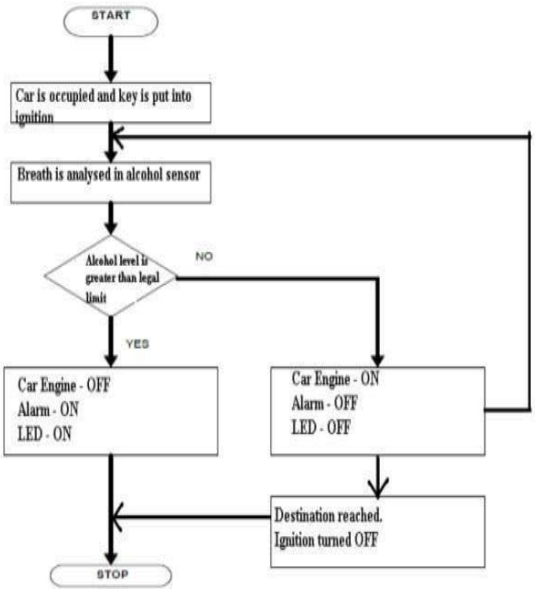

Fig. 6.System Flow Chart

Figure 6 shows flow chart of the system where when an alcohol sensor detect the presence of alcohol the ignition will start and simultaneously the LCD panel will show the presence of alcohol and buzzer will start ringing. In the absence of alcohol the ignition will start and buzzer will be silent.

IV. Result Analysis

The legal limit for alcohol percentage (permissible blood alcohol content) on a driver's breath is given to be 0.03% per 100 ml of blood, which comes out to be 0.03mg of alcohol per 100ml of blood.

Now, considering ratios 0.03mg Alcohol: 100 ml blood

=> 0.3 mg Alcohol: 1000ml blood (1 litre)

TABLE I: SIMULATION RESULT

S.No	Readings	Actions
1	109	Engine ON, LED OFF, AlarmOFF
2	116	Engine OFF, LED ON, AlarmON
3	187	Engine OFF, LED ON, Alarm ON
4	42	Engine ON, LED OFF, AlarmOFF
5	90	Engine ON, LED OFF, AlarmOFF

Permissible Blood alcohol content is = 0.3 mg/L Toconvert that to parts per million :

We first refer to this formula -

%= mg/L ×(22.4 / M) ×((273+T) / 273) ×(1 / 10)×(1013 /P)

Where:

22.4 = The volume of 1 mol at 1 atmospheric pressure at 0ºC273(K): K stands for Kelvin, the unit used to measure thermodynamic temperature; as 0ºC Corresponds to273.15K.

T = The average temperature of the country assumed to be 25 degrees Celsius. 1013(Pa): One atmospheric pressure

P: denotes the atmospheric pressure at the point of measurement (Pa), which is assumed to be 1 atm on average, in India.

On substituting mg/L as 0.3mg/L in the above equation, we get:

% = 0.0159119%

Therefore,

PPM (parts per million) = 159.119

The above calculations tell us, that when the blood alcohol content reaches or crosses a threshold of 159.119ppm, the engine locking and alarm system will be engaged.

On experimentation, we find the above criteria to be matching and conclude the experiment to be a success.

Table 1 shows readings of simulation which respective action of LED, Alarm and Engine.

V. CONCLUSION AND FUTURE SCOPE

Drunken driving is considered as one of the major reason of accidents in worldwide. Drivers under the influence of alcohol shows a clear failure of perception recognition and vehicle control. This causes possibilities for hazardous situations and road accidents involving vehicles and pedestrians causing damage to both.

This paper defines the development of alcohol detection system for vehicle control using Arduino. The main important core element of this device is Arduino. Since the sensor which is used in the system has sensitivity of around 2 meters, it can suit to any vehicle and can easily be hidden from the suspects. The whole system has also an advantage of small volume and more reliability. As the growing public perception is that vehicle safety is more important, advances in public safety gaining acceptance than in the past.

The main advantage of the developed system is to control the number of accidents caused due to alcohol consumption. This system improves the safety of human beings and their property (vehicles, personal belongings in the vicinity of damaged area) and hence providing the effective development in the automobile industry regarding reduction in the accidents caused due to alcohol.

Implementing this project through Arduino allows global access to academics who might take up interest in this project and might want to update the system with new ideas, either innovative or with respect to execution and efficiency. This Arduino code can be accessed easily and built upon further.

This type of a system can also be used outside of the automobile industry, one such application could be automating exhaust fans in certain situations, like professional 10 kitchens, or in cases of fire, as the MQ3 gas sensor is also sensitive to Benzene, CH4, Hexane, LPG and CO. It can also be used for detecting gas leaks in factories by adjusting the impedances and sensitivity accordingly. Once a gas leak is detected the system can internally turn on exhausts and through the means of IOT, can shut down other appliances/devices which may potentially be cause for hazard

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