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Research Article

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Development of a Breathing-guided Device for Calculating the Alcohol Consumption Intensity

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Abstract Due to the rapid increase of vehicles on roads, the probability of road accidents is rising steeply. Drunk driving is considered to be a major cause of road accidents throughout the world. This papr tend to develop a system that would detect the amount of alcohol that is consumed by the driver of the vehicle. The system aims at preventing the user from driving when drunk and thereby intends to reduce the number of accidents occurring due to drunk driving. The model is developed using Arduino Uno and alcohol detection sensor (MQ-3) as its major components. The mode of detection is by placing the sensor close to the mouth of the suspect while the suspect utters a test command which is: "test me". The mode of indication is a buzzer which gives multiple beeps whenever alcohol is detected but alcohol is not detected the buzzer keeps mute.

Keywords Alcohol Intensity; Arduino Uno.

1. Introduction

Alcohol is the oldest and most abused substance in the world. It is a psychoactive substance, but society has allowed its use by the public either socially or for medication. The consequences of alcohol abuse are significant not only in terms of adverse health effects and health care costs but also in terms of lost earnings, loss of life and decreased productivity. Along with the development of the economy, more and more people have cars, and more cars appear on the roads [1]. Breathing exercises play a prominent role in behavioral methods such as yoga, meditation, and biofeedback, which have had some success in treating high BP [2-3]. There may be some rationale for the therapeutic effect of the breathing exercises, as the acute response to slow and stable breathing includes a number of beneficial effects on the cardiovascular system, both at the systemic and the microvascular level. These include increasing baroreflex sensitivity, heart rate variability, microvascular flow and venous return, and reducing BP and peripheral resistance [4-5]. Development of Automatic Alcohol Detectors can be used in various vehicles for detecting whether the driver has consumed alcohol or not. Breathing analyzers can also be used in multiple companies or organizations to detect alcohol consumption by employees.

2. Review of Related work

Previous literature reviewed in this work concentrated on either the design of an Alcohol detecting machine or the attachment of this device into another working unit like the vehicle application [6]. Author [7] conducted on outpatient maintenance programs members using a smart phone as a support system. their study makes the job easy on supervisors and law enforcement agencies to check defaulting groups and issue corrections, however it Helps with the connection of persons to organization intended to assist alcohol dependent patients – Inability of such measures to work in developing countries and as such limits the ability for proper supervision of subjects. Author [8], proposed a system that will preventing a car accelerating when the sensors notice alcohol in the breath of the driver. The work Improvement in the power supply, the maximum distance of testing and false triggering enables this device to scale through it counterparts. However, it Would help reduce high way and pedestrian accidents but their work is not geared to function on already inbuilt car model as it would only be possible in future complex models. Author [9] proposed a Detection Alcohol in a Car and prevents the ignition for starting the car. It Very easy to use, accurate but looks fragile and lacks technical or professional knowledge. The maximum distance of testing and false triggering enables this device to scale through it counterparts. [10] Thungon, P. D., et al summarizes the progress made over the years on the alcohol detection systems, with a focus on recent advancement towards developing portable, simple and efficient alcohol sensors. Chemical sensors and biosensors are proven ways of sensing alcohol, this methods are not advised due to setbacks cost of chemicals, Time of testing and more. The maximum distance of testing and false triggering enables this device to scale through it counterparts. However, this paper is designed to make the use of a breathing-guided device portable, cheap, non-invasive, and at available for mass production in a country like Nigeria. Steps were taken to improve the power supply, the maximum distance of testing and false triggering. Consequently, this study will give massive opportunities to road users and law enforcement agencies to carry out their investigations efficiently and in time. This, therefore, leads to a better society at large free from the negative effects of alcohol consumption.

3. Design Consideration

Before the design was carried out so many factors were first considered by taking reference from the already existing designs. Some of the considerations are the power supply, the maximum distance of testing and false triggering

4. Methodology

The methodology is the design approach taken after running the feasibility study of the design.

a) The design was first analyzed on a jotter with a block diagram.
b) After the block diagram each component part was simulated on proteus.
c) The proteus simulation gave rise to the schematic diagram.
d) This led to component sourcing.
e) The whole components were tested individually using a multimeter.
f) From the schematic diagram the circuit was implemented on a breadboard.
g) When the design was confirmed working the components were transferred to the Vero board for soldering.
h) After soldering the circuit was tested and it was working well.
i) Finally, the project packaging.

5. Block Diagram

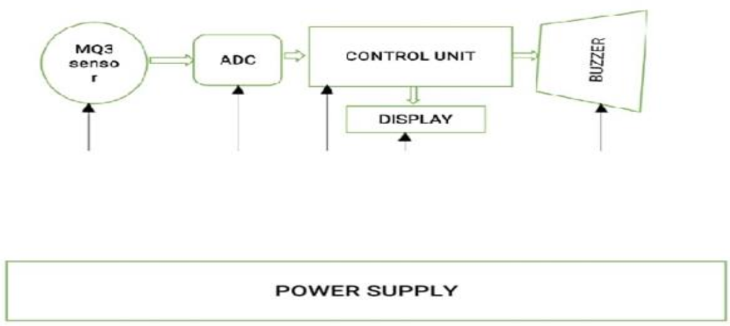

Figure 1: Block Diagram

MQ-3 Alcohol Sensor

The sensor is used to detect when there is a gas leakage and the amount of the gas concentration by giving out a voltage output depending on the gas leakage concentration.

ADC:
Because the microcontroller can only interpret binary code the ADC Which stands for analog to digital converter receives analog signals from the alcohol sensor and converts it to binary code readable by the microcontroller.

The Control Unit:
This is the brainbox of the system and is where all the peripherals of the system are attached. It's made of the microcontroller ATMEGA328 oscillator and the pull up and the pulldown resistors. ATMEGA328 receives ADC value from the alcohol sensor and using some arithmetic expressions calibrates it to a readable value and is then displayed on the LCD The microcontroller on the board is programmed using Arduino IDE software.

The DISPLAY:
The display is a 16x2 LCD which gives a visual output to the user. The microcontroller converts binary output from the ADC to ASCII code and sends the code to the LCD.

The Buzzer: Is a notification which instantly beeps on the detection of high content of alcohol.

The Power supply:
Every electronic circuit needs a power supply. The power supply consists of 9V battery with a filter capacitor and a voltage regulator which regulates the voltage to 5V for the microcontroller, alcohol sensor, and the LCD.the power supply consists of the battery, the capacitor and the voltage regulator. The input supply of the power supply is 9V battery while the voltage needed by the microcontroller is 5V which led to including 7805 voltage regulator to the circuit. But before we proceed it's necessary to calculate the power demand or in other words the net load of the system

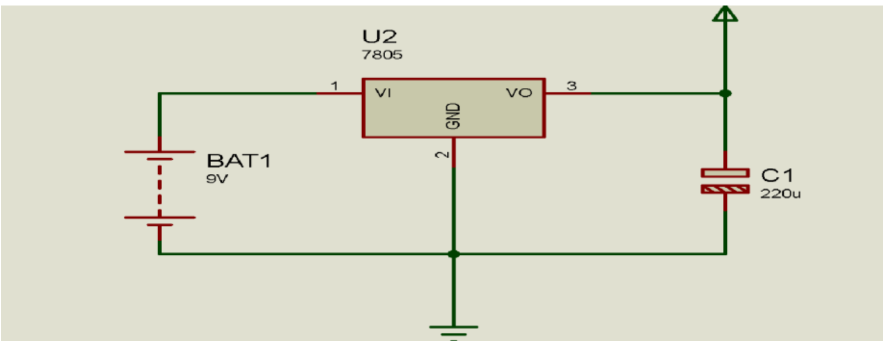

Figure 2 Power supply circuit

Solving for the voltage regulator capacitor
For voltage regulator

$$C = t/\Delta V$$
$$Where\ t = 1/50 = 0.02S$$
$$\Delta V = 9 - 5$$
$$= 4V$$
$$C = /0.02$$
$$C = 200uf$$
$$C = 220uf\ \ nearest\ available\ value$$

The LCD design:
The display used in the design is a 16×2 LCD display that I bought for about. The part 16×2 means that the LCD has 2 lines, and can display 16 characters per line. Therefore, a 16×2 LCD screen can display up to 32 characters at once. It is possible to display more than 32 characters with scrolling though. The code in this article is written for LCD's that use the standard Hitachi HD44780 driver. These displays can be wired in either 4-bit mode or 8-bit mode. Wiring the LCD in 4-bit mode is usually preferred since it uses four less wires than 8-bit mode. In practice, there isn't a noticeable difference in performance between the two modes.

Here's a diagram of the pins on the LCD I'm using. The connections from each pin to the Arduino will be the same, but your pins might be arranged differently on the LCD. Be sure to check the datasheet or look for labels on your particular LCD:

Figure 3 LCD

Also, you might need to solder a 16 pin header to your LCD before connecting it to a breadboard. Follow the diagram below to wire the LCD to your Arduino: The resistor in the diagram above sets the backlight brightness. A typical value is 220 Ohms, but other values will work too. Smaller resistors will make the backlight brighter. The potentiometer is used to adjust the screen contrast. I typically use a 10K Ohm potentiometer, but other values will also work. Here's the datasheet for the 16×2 LCD with all of the technical information about the display:

6. Programming the Arduino

All of the code below uses the Liquid Crystal library that comes pre-installed with the Arduino IDE. A library is a set of functions that can be easily added to a program in an abbreviated format.

To program the Arduino, MQ-3 Alcohol Sensor, LED & Buzzer with Arduino IDE, we need to define all the Input/Output pins.

Here we have defined the threshold value of MQ3 reading above which it should trigger an action.

Global integer to store the analog reading from the MQ-3 sensor. It ranges from 0 to 1023.

In void setup first we are declaring all the input and output pins.

Then we started the Serial Output for debugging the program.

In a loop part first we read the analog value from MQ3 and then sends the value to UART for debugging

Finally, If the value from the MQ-3 Alcohol sensor detects alcohol it turns on the LED and Buzzer. Otherwise the LED and Buzzer are off

7. Result

The circuit was first designed on proteus after which it was implemented on the breadboard for proper testing. The component test was carried out with the multimeter. For the resistors and transistors, battery and regulators was used for continuity text, and voltage test. The modules were tested by following the troubleshooting instruction in the datasheet. The main implementation was done on a Vero board. Soldering iron and lead to assemble the component on the Vero board after which I did the final packaging.

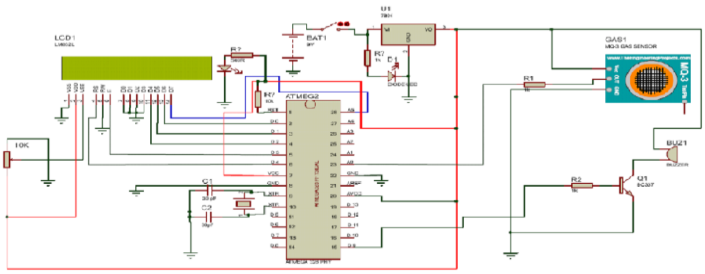

Figure 4: Circuit diagram

In the circuit current flows from the battery to the voltage regulator and at the output of the regulator, the voltage is regulated to 5V. The MQ3 is always connected to the 5V power supply Vcc to pin 1, GND to pin 2 and at pin 3 of the MQ3 is connected a 1k resistor which is the RB of the Q3. Normally when there is no gas sensing the D0 output of the MQ3 is always at logic 0 which keeps While the A0 remains below 100 Once there is gas sensing the A0 goes higher than 100. According to the code on the firmware whenever the ADC value goes above 100 the alcohol value begins to update on the LCD

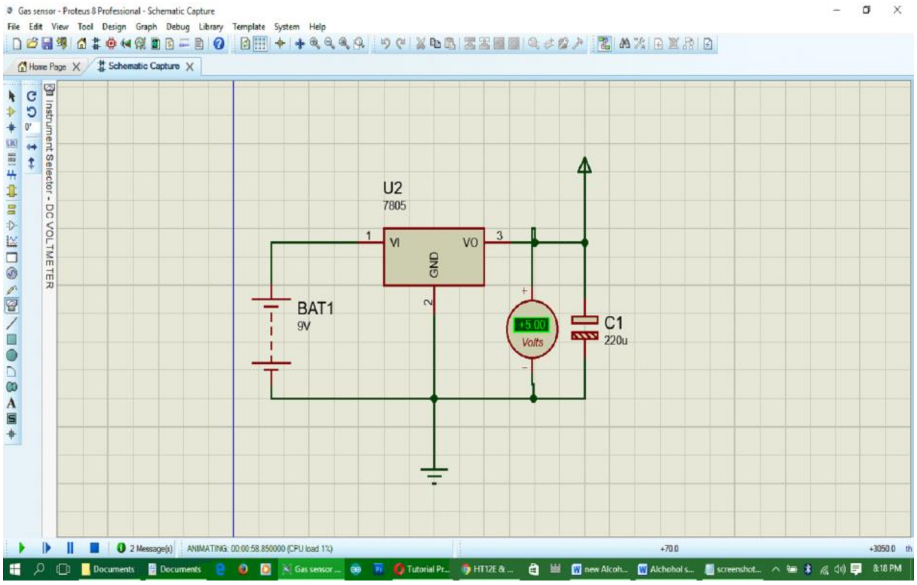

Figure 5: The power supply simulation screenshot

Using the proteus simulation software, it placed a voltmeter between the output of the 7805 regulator and it read 5 Volts showing that the regulator was able to regulate the voltage from the battery from 9V to 5V.

8. Discussion

When the system was powered there was 0 value on the screen. A shot of beer, sipped it, and breathed on the sensor and it displayed 6%. Tried out vodka, sipped it, and breathed on the sensor. It displayed 12% and on line 2 it displayed drunk. went ahead to try out stout breathed on the sensor it displayed 8%. But when I tried fresh palm wine it couldn't sense so it was opened the system and adjusted the sensitivity of the module and it responded by showing 4%. The gas sensor works with the principle of monitoring when there are molecules of ethanol gas between an Aurum electrode. Basically, the alumina tube and the coils are the heating system. If the coil is heated up, SnO_2 ceramics will become the semi-conductor, so there are more movable electrons, which means it is ready to make more current flow. Then, when the alcohol molecules in the air meet the electrode that is between alumina and tin dioxide, ethanol burns into acetic acid then more current is produced. So the more alcohol molecules there are the more current we will get. Because of this current change, one can get different values from the sensor. That's why after taking a sip of alcohol and oozed my breath which had the content of ethanol the Aurum electrode was able to conduct which caused the comparator circuit on the module to give output.

Table 1 Alcohol Testing result for field survey

S/N	Name (First_name)	Type of Drink	Result in %	Status
1	Mike	Beer	0.06 i.e 6%	Drunk
2	Emeka	Vodka	0.12 i.e 12%	Drunk
3	Tony	Stout	0.08 i.e 8%	Drunk
4	Chinedu	Palm wine	0.04 i.e 4%	Buzzed

Cost Analysis of the Developed System

Table 2 shows details of the materials and their associated costs involved in the production of the developed device.

Table 2: Bill of Engineering and Material Evaluation

S/N	Items	Quantity	Unit Price	Amount (N)
1	Resistors	5	100	500
2	Capacitors	5	100	500
3	MQ3 Sensor	1	4,000	4,000
4	Charger	1	1200	1,200
5	Transistors	1	500	500
6	Arduino Uno	1	10,000	10,000
7	Buzzer	2	500	500
8	9v Battery	1	800	800
9	LCD	1	1,000	1,000
10	Box	1	4,000	4000

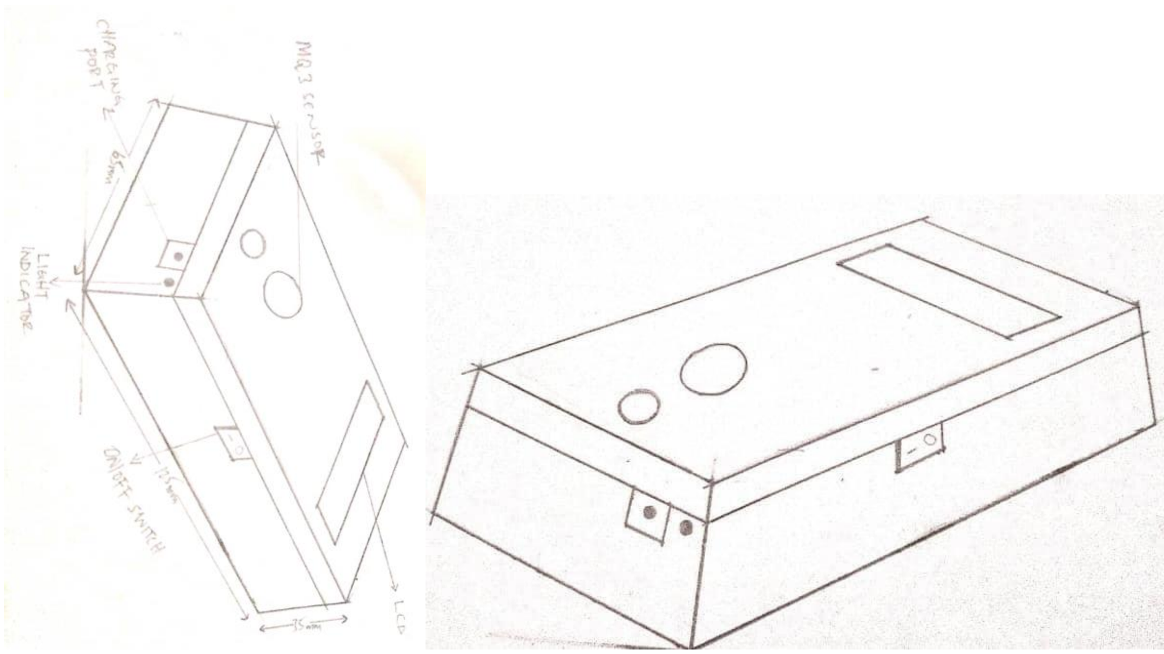

Figure 6: Isometric view

Figure 7: Image of Completed Device with charging port

9. Conclusion

This paper is a handy type of alcohol detector that can detect whether someone is drunk or not. The mode of detection is by placing the sensor close to the mouth of the suspect while the suspect utters a test command which is “test me”. The mode of indication is an LCD which displays the percentage of consumed alcohol.

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