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Construction of Digital Alcohol Sensing Device for Motorists

Oyediji Funke T.,Olokun Mayowa S., Yakubu Anakobe J.

Department of Computer Engineering, Federal Polytechnic, Ile-Oluji, Nigeria.
Department of Computer Engineering, Federal Polytechnic, Ile-Oluji, Nigeria.
Department of Civil Engineering, Federal Polytechnic, Ile-Oluji, Nigeria.

ABSTRACT: With the evolution of cars and increasing frequency of motorists on roads, road accident is a global concern. With respect to the number of deaths and injury recorded from road traffic accidents estimated to be 1.5 million and 50 million respectively by 2020 (WHO, 2018) and Nigeria with an annual average of 33.7 deaths per 100,000 people (WHO, 2019). These accidents are mostly caused by reckless and uncautious drivers who ignore the danger about drinking alcohol while driving. In a bid to reduce accidents caused by drunkard drivers, a device that detects alcohol concentration in breath of motorists to be used by Road Safety Authorities is constructed.
In this work, the electronic device detects alcohol in the breath of motorists with the aid of an alcohol sensor (MQ-3) working circuit, PIC (microcontroller circuit), the liquid crystal display (LCD) circuit to display the sensitivity of alcohol coupled with the alarm circuit to give sound. The software module is programmed on microcontroller to sends the information to the encoder using C – Programming language.
The components embedded on Arduino UNO for automation. The alcohol detector is able to detect alcohol in the breath of motorist which will aid in reducing the rate of drunkards drivers and road crash. This device can also be used in companies and commercial places where alcohol consumption is prohibited.

KEYWORDS: *Alcohol, Arduino UNO, Microcontroller, Liquid Digital Display (LCD)*, automation.

I. INTRODUCTION

Alcohol consumption is very common in our society nowadays, it is rampant among the youth and adult. It is consumed without gauge or measure thereby causing harm to the body, and brain. The aftermath ranges from unguided behavior to body cell destruction. Today, most people drink alcoholic products excessively for many reasons; some for fun, while some to keep they out of depression. This excess usage acts on the central nervous system and alters brain functions thereby degrading the quality of the user and interactivity. This typically results in the temporary changes in perception mood, consciousness and behavior leading to harmful effects to physical and mental health or hazard to others living with them because they can be aggressive. Alcohol abuse can cause physical effects such as poor vision, poor coordination, poor reaction to speed mental effects, poor concentration and lack of morale. Low self–esteem and heavy drinkers are at risk and so harmful potentially while sometimes life threatening with liver problems. When someone drinks, liver breaks down for excessive contact with alcohol also the blood becomes corrosive. Obesity is one of the biggest factors of faulty liver. It can also cause liver failure type-II diabetes.

The alcohol sensor will detect the alcohol content in human breath and send result to microcontroller display unit. Alcohol sensor (MQ3) is suitable for detecting alcohol concentration like breath alyzer. It has a high sensitivity to small value of Blood alcohol concentration (BAC) and fast response time, provides a digital output based on alcohol.

This device can detect the amount of alcohol in the body by placing in the mouth or by breathing on it, it will calculate the amount of alcohol substance in the body system and to check alcohol level just as we exhale carbon dioxide when we breath out. Any alcoholmeter device can measure this alcohol content by sensor circuit In this work, the alcohol sensor will detect the amount of alcohol in the body and it will display the amount by digital display circuit, this device will help people to know the amount of alcohol in the blood or in the system thereby preventing the motorist to drive at the time which might lead to accident.

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II. LITERATURE REVIEW

Oloyede et al., (2018) developed a alcohol sensor that can be controlled and operated by an ATMEGA 16 controller titled "Alcohol Detecting and Notification System for Control Drink Driving" their design can sense the surrounding at limited distance and this sensed information is fed to an ATMEGA 16 Microcontroller that processes and sensed data by comparison with a present threshold value. This method in many ways might proof inefficient because it could be easily maneuvered or bypassed, if the phone goes off the safety goes off as well.

Absar et al., (2018) also designed drunken driver detection and system with automated braking system. Its uses eye blink detector to detect and the system will generate warning signal to alert the driver, GPS and GSM technology we track the exact location of the accidental vehicle. When the driver didn't response to the warning signal, an automated pneumatic brake system is used to stop the vehicle within a distance. Geeta and Marur (2015) designed smart electronic system which continuously monitors the alcohol content in the air surrounding by the body of the protagonist. It uses global positioning system (GPS) to capture the location and sends information to the authorities with the help of a Global System for Mobile (GSM) device with the onetime password. All the functions in the project are carried out with the help of ARM 7 based LPC 2148 microcontroller. The system can be restarted only after the password is entered.

Keerthan et al., (2018) designed alcohol sensor which is integrated with the directing wheel, titled "Drunk Driving Detection using Car Ignition Locking" this framework is meant for making vehicle driving more secure than previously and shield the mishap from happening due to the liquor utilization of the driver. This work proposed the detection of alcohol utilizing alcohol sensor associated with arduino. Its uses arduino processor to check drunk driving and work a bolt on the vehicle with embedded system which mixes both programming and equipment which can play out some particular capacities. It has the ability to respond fast

Ranjana et al., (2019) developed a system to detect the alcohol content level of a driver titled "vehicle engine lock system for theft and alcohol detection" its uses MQ3 sensors embedded in the steering the vehicle to content of alcohol taken by drivers. This proposed explores the possibility at very first using technology. It's also use to track the theft of vehicle if there is using fingerprint recognition technique. It involve certain inherit error.

III. METHODOLOGY

This work consists of various units that makes up the system: the power supply unit, the alcohol detection unit and the digital display unit. A liquid crystal display (LCD) display unit that will display the result in digital form using Arduino UNO microcontroller, to design a system consisting of alcohol sensor, using MQ3, to detect the presence of an alcohol by analyzing a person's breath or detect the amount of alcohol in body level through sensor. As shown in the block diagram figure. In this project the alcohol sensor we detect the amount of alcohol in the body or in any container with alcohol content and it will display the amount through digital display circuit. This project will help people to know the amount of alcohol in their blood so that it will guide them not to drink excesses of alcohol.

The alcohol sensor will detect the alcohol content from human breath and send its value to microcontroller. Alcohol sensor (MQ3) is suitable for detecting alcohol concentration just like your common breathalyzer. It has a high sensitivity to small value of blood alcohol concentration (BAC) and fast response time, provides digital output based on alcohol.

In this work, the alcohol sensor is constructed with an Arduino UNO using MQ-3 sensor. This is a sensor that is not only sensitive to alcohol, particularly ethanol, which is the type of alcohol which is found in wine, beer, and liquor. This type of sensor circuit will be used as MQ-3 Alcohol sensor circuit built with an Arduino, a breathalyzer to check a person's blood alcohol level. Just as we exhale carbon dioxide when we breathe out, we also will breathe out some alcohol if we have alcohol in our blood. Any alcoholmeter device can measure this alcohol content. The more ethanol in your blood, the more there is in the air on exhalation. This alcohol content gives a good indication for if a person is drunk and how drunk they are. The amount of alcohol exhaled in the air is proportional to the amount of alcohol which will be found in a person's blood. Alco meters use a built-in formula to estimate blood alcohol content from exhaled air alcohol content

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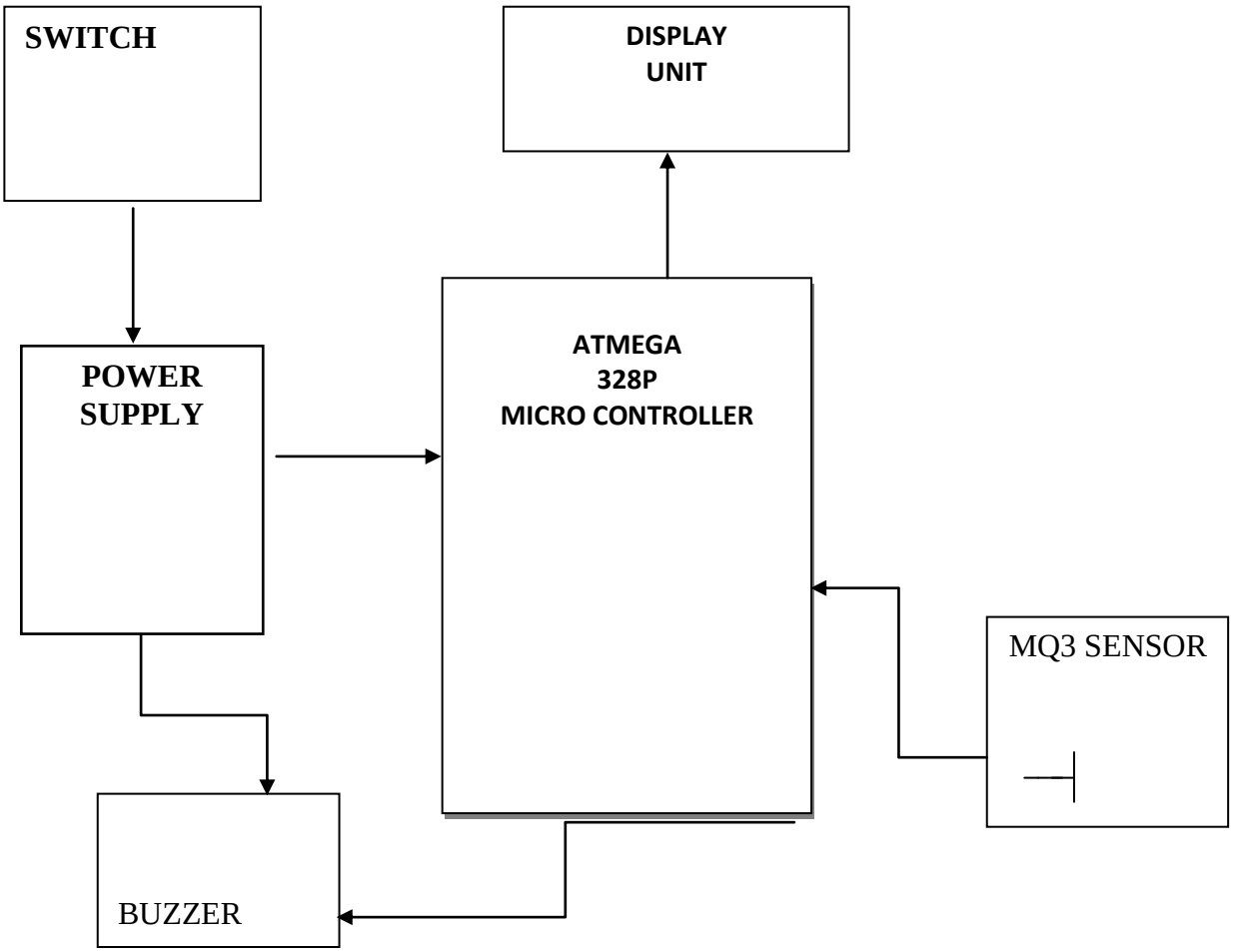

Figure 3.1: Block diagram of the digital Alcohol Sensor

Selection of material

a) MQ3 alcohol sensor
b) ATMEGA328P
c) Liquid crystal display (LCD)
d) Crystal oscillator
e) Capacitor
f) Resistors
g) Variable resistor
h) Buzzer
i) Battery

(a) **Alcohol sensor (MQ3)**

This analog gas sensor-MQ3 is suitable for alcohol detection; this sensor can be used as a breath analyzer. It has high sensitivity to benzene. The sensitivity can be adjusted by the potentiometer. The sensitive material of MQ-3 gas sensor is SnO2, which with lower conductivity in clean air. When the target alcohol gas exist, the sensors conductivity is higher along with the gas concentration rising, use of simple electro circuit, convert change of conductivity to correspond output signal of gas concentration.

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Figure 3.2: MQ3 Alcohol sensor

Specification of MQ-3 Alcohol sensor

- Sensor type – semiconductor
- Easy SIP header interface
- Compatible with most of the microcontrollers
- power standby mode
- Requires heater voltage
- Good sensitivity to alcohol gas
- Fast response and high sensitivity
- Long life and low cost
- Requires simple drive circuit
- 5v operation
- High sensitive to alcohol

(b) **ATMEGA328P**

This Atmega328P is a high performance, low power controller from Microchip. ATMEGA328P is an 8-bit microcontroller based on AVR RISC architecture. It is the most popular of all AVR controllers as it is used in ARDUINO boards. The ATmega328 is a single-chip microcontroller created by Atmel in the megaAVR family (later microchip technology acquired Atmel in 2016). It has a modified Harvard architecture 8-bit RISC processor core. Atmega328 is the microcontroller chip used in Uno, it's a 8 bit AVR microcontroller from ATMEL (Now Microchip).

Specification of ATMEGA328P

CPU 8-bit AVR
Number of pins 28
Operating voltage(V) +1.8 VTO +5.5V
Number of programmable I/O line 23
Program memory or flash memory 32kbytes [10000 write/ erase cycles]
Program memory type flash

Figure 3.3: Microchip atmega 328

(c) **Liquid crystal display**

Liquid crystal display is a form of virtual display used in electronics devices, in which a layer of a liquid crystal is sandwiched between two transparent electrodes. Liquid crystal display works on the principle of blocking light rather than emitting light. Liquid crystal display (L.C.D) is an electronic display module and is used for displaying the

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information sent by the microcontroller. The LCD module is a dot-matrix liquid alphanumeric, and symbols. A 16 x2 LCD display is very commonly used in various devices and circuits. If alcohol is detected it displays the message indicating "alcohol detected.

Features of liquid crystal display
Lighter weight
Cost effective
Less eyestrain
It reduced radiation
Space economy
Better screen privacy
Specification of liquid crystal display
Spatial performance
Temporal performance
Color performance
Brightness and contrast ratio

Figure 3.4:Liquid crystal display (16 x 2)

(d) Crystal oscillator

A crystal oscillator is an electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a precise frequency. It makes use of the mechanical resonance of the vibrating crystal, which has piezoelectric signal with a high-precision frequency. Crystal oscillators are considered superior ceramic resonators as they have higher stability, higher quality, lower cost and are smaller in size.The crystal oscillator circuit usually works on the principle of the inverse piezoelectric effect. The applied electric field will produce a mechanical deformation across some materials. thus, it utilizes the vibrating crystal's mechanical resonance, which is made with a piezoelectric material for generating an electrical signal of a particular frequency.

Feature and specification of crystal oscillator
18pf of load capacitance
Frequency tolerance(Ef/f) range is + and – 30ppm
Oscillation mode: fundamental mode
Shunt capacitance less than 7Pf
Insulation resistance: 500 M ohms
Resonance resistance 40ohms (max)

Figure 3.5: crystal oscillator

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(e) Capacitor

A capacitor (originally know as condenser) is a passive two terminal electrical component used to store energy electrostatically in an electric field. This capacitor will be used to stored electric charge, consisting of one or more pairs of conductor s separated by an insulator.

Function of a capacitor

Its function is to store the electrical energy and give this energy again to the circuit when necessary.

It charges and discharges the electric charge stored in it.

It also blocks the flow of DC and permits the flow of AC.

Figure.3.6: Capacitor

f) **Resistor**

A resistor is a passive two terminal electrical component that implements electrical resistance as a circuits. A resistor is an electrical component that limits or regulates the flow of electrical current in an electronic circuit. Resistors can also be used to provide a specific voltage for an active device such as a transistor. This resistor will be used to reduce current flow, to signal levels, to divide voltages, bias active element and terminate transmission lines, among other uses.

Figure 3.7: Resistor

(g) **Variable resistor**

This variable resistor will be used to adjust value of electric resistance. A variable resistor is in essence an electro-mechanical transducer and normally works by sliding a contact (wiper) over a resistive element.

(h) Buzzer

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. A " piezo buzzer" is basically a tiny speaker that can be connected directly to an Arduino, from the Arduino, you have to tell it which pin the buzzer is on, what frequency (in Hertz, Hz) you want and how long (in milliseconds) you want it to keep making the tone

Feature and specification of buzzer

Rated voltage: 6v DC
Operating voltage: 4-8V DC
Rated current: <30Ma
Sound type: continuous beep
Small and neat sealed package
Resonant frequency:-2300 Hz

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Figure.3.8: Buzzer

(i) 9volt battery

A 9-volt battery is a common size of battery that was introduced for the early transistor radios. A battery is a device that converts chemical energy contained within its active material directly into electric energy means of an electrochemical oxidation-reduction (redox) reaction. This type of reaction involves the transfer of electrons from one material to another via an electric circuit.

Battery type	capacity (mAh)	typical drain (Ma)
AA	2400	50
AAA	1000	10
N	650	10
9 Volt	500	15

Battery capacity is measured (typically in Amp-hr) of the charge stored by the battery, and is determined by the mass of active material contained in battery. The battery capacity represents the maximum amount of energy that can be extracted from the battery under certain specified conditions.

Figure.3.9: 9 volt battery

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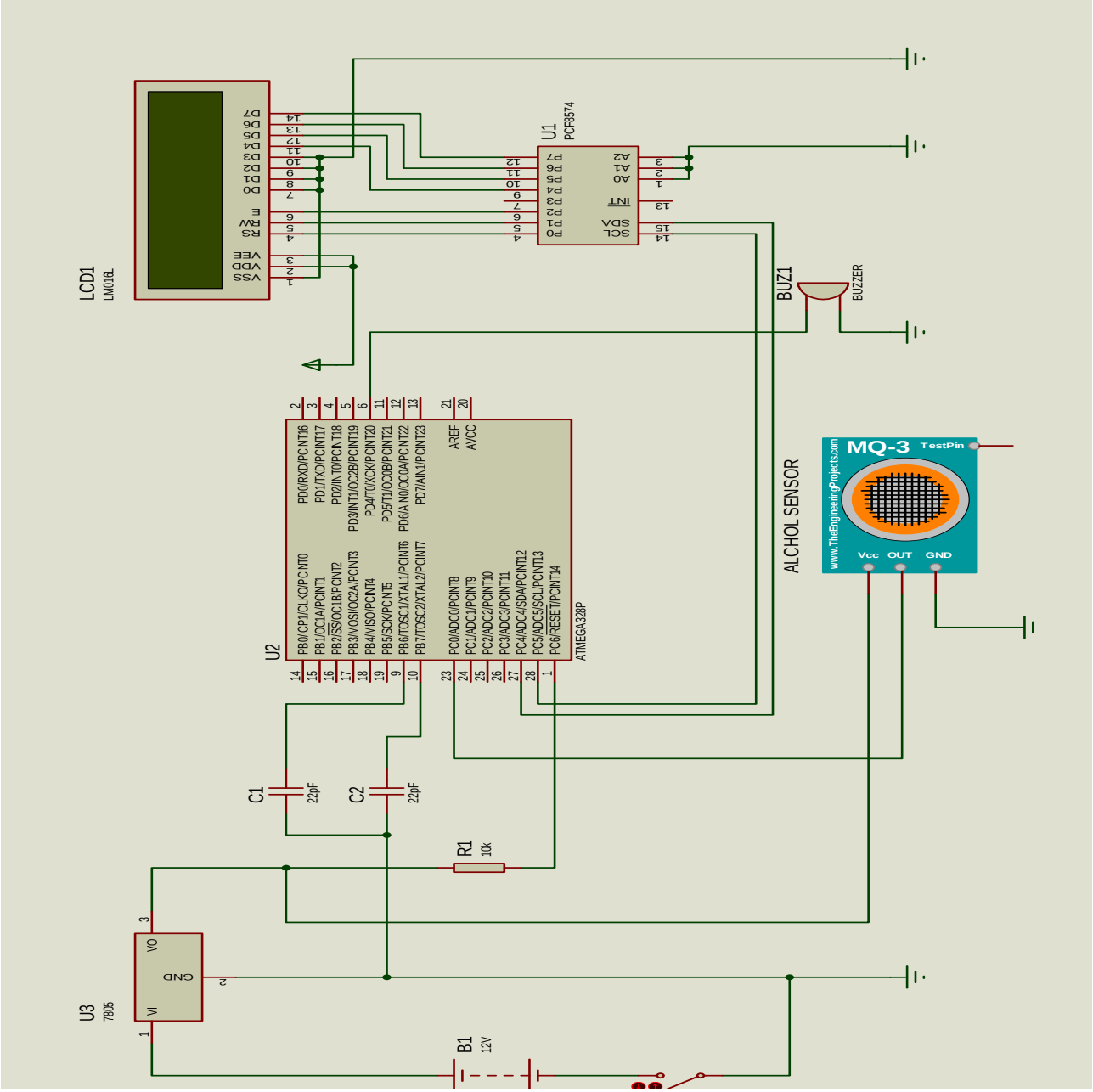

Figure.3.10: Circuit Diagram of the Digital Alcohol Sensor

Design of the Digital Circuit using Proteus 8.1 software

In this section, the designed Digital Alcohol Sensor circuit was simulated and tested in order to check the performance and possible error as shown in figure 3.10. The connection is passed and performance efficient.

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IV. CONSTRUCTION PROCEDURE

In this research ATMEGA328 having 28pins, was used, pin1, pin7, pin8, Pin9, pin10, pin, 27 and pin,28. The pin1 is known as (RST) in the arduino, 10k resistor was connected to pin1 and connect together with pin7, pin8 and pin9 will be used as the oscillating pin to generate the frequency The microcontroller will be embedded into the ferro board, with which the code will have been run into the microcontroller before been insert into the ferro board. 9volt battery will be used to power the microcontroller; resistor will be used to step-down the 9volt to 5volt.
To connect the sensor, there are 4 leads. 2 of them are for power. The +5v terminal of the sensor connects into the 5V terminal of the arduino board. The GND terminal of the sensor connects into the GND terminal of the arduino. This establishes power for the sensor. The other 2 connections are the analog and digital output of the sensor. These connect to analog pin AO and digital pin D8, respectively.

a) Power Supply Unit

This device is powered with a 9v battery. A 5v dc supply is required by the microcontroller, sensor and display unit. While other component like the LEDS need 2v. The resistor is used to step down 9v to 5v in order to power the microcontroller without being damage.
Construction layout as shown in figure 3.11

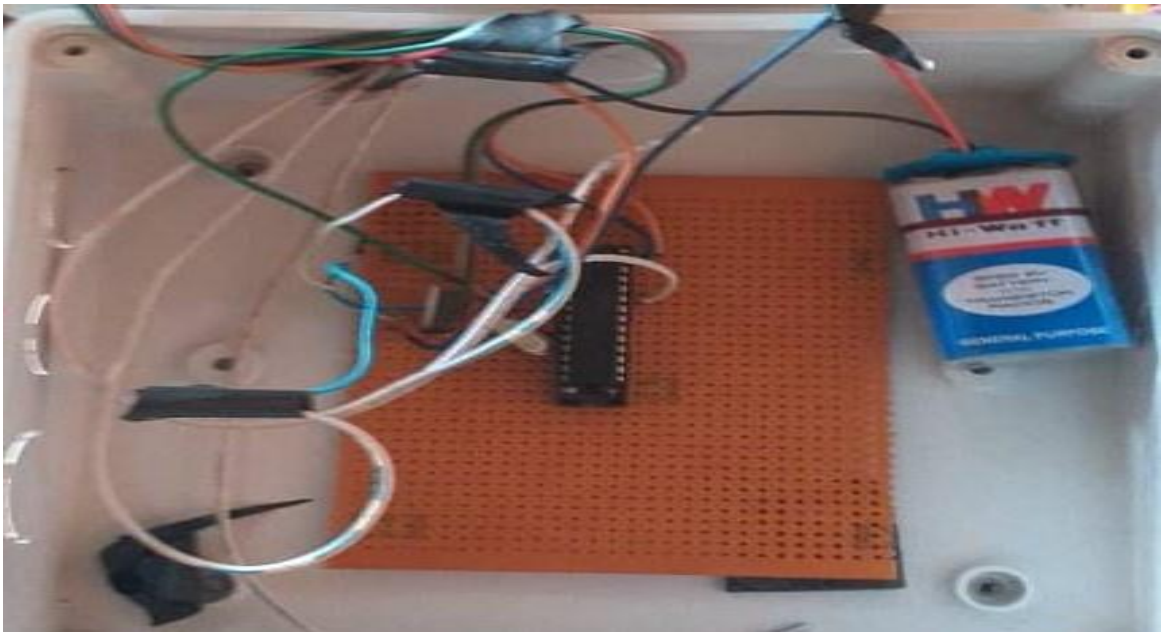

Figure: 3.11: Construction layout

The flow diagram shows the connection of the display system, if the device is been switch on the (LCD) Liquid Crystal Display that will display if alcohol is detected or not as shown in figure 3.11

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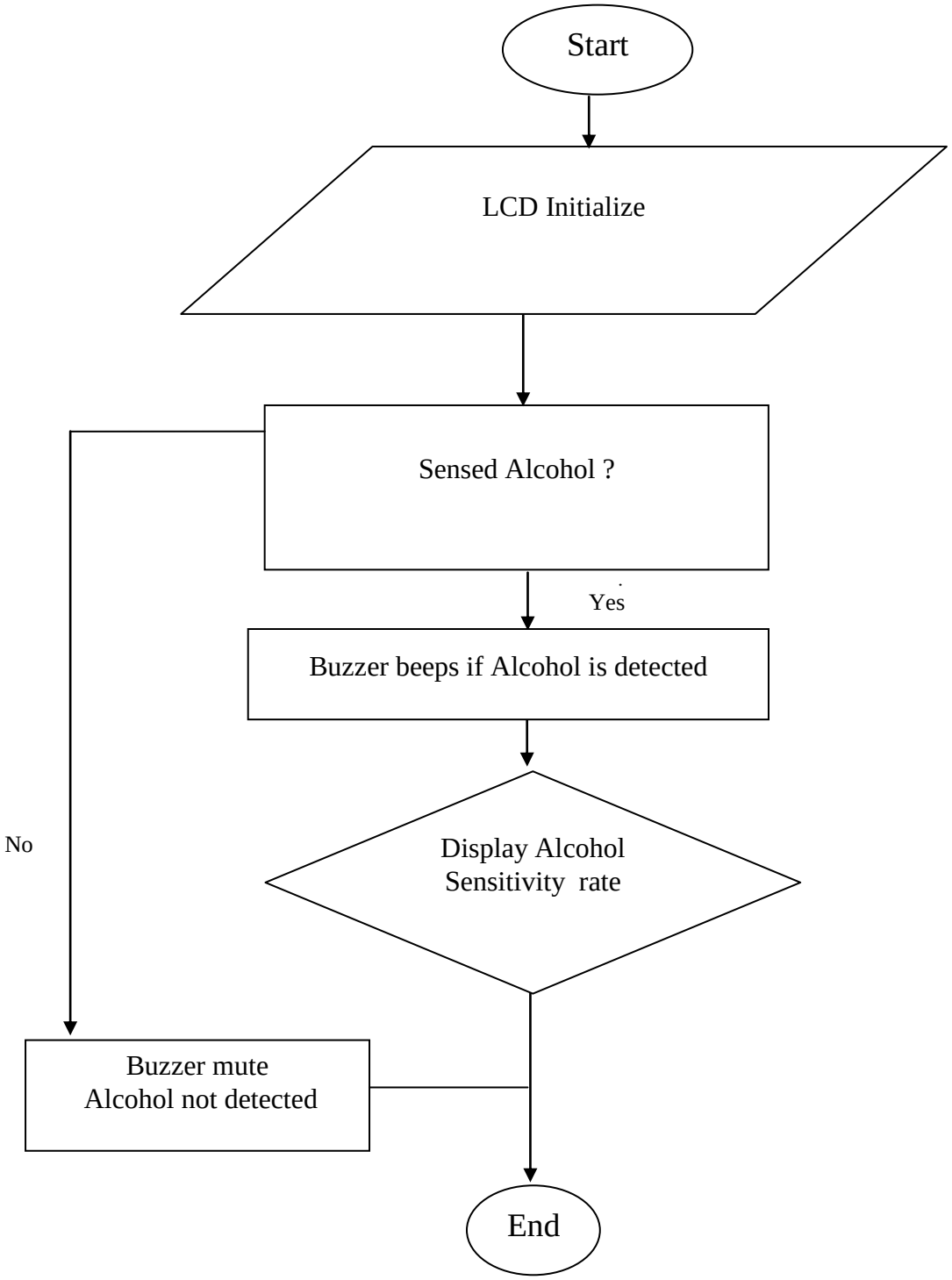

Figure 3.12: Flow diagram of the Digital Alcohol Sensor

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V. RESULTS

This device is able to detect the content of alcohol in human body by using the sensor (MQ-3), and display the result by the digital display
To connect the sensor, there are 4 leads. 2 of them are for power. The +5v terminal of the sensor connects into the 5V terminal of the Arduino board. The GND terminal of the sensor connects into the GND terminal of the Arduino. This establishes power for the sensor. The other 2 connections are the analog and digital output of the sensor. These connect to analog pin AO and digital pin D8, respectively.
The main function of the PIC microcontroller in this work is to read the sensor output value and display the corresponding percentage of the sensor output on an LCD display, which is the liquid crystal display.

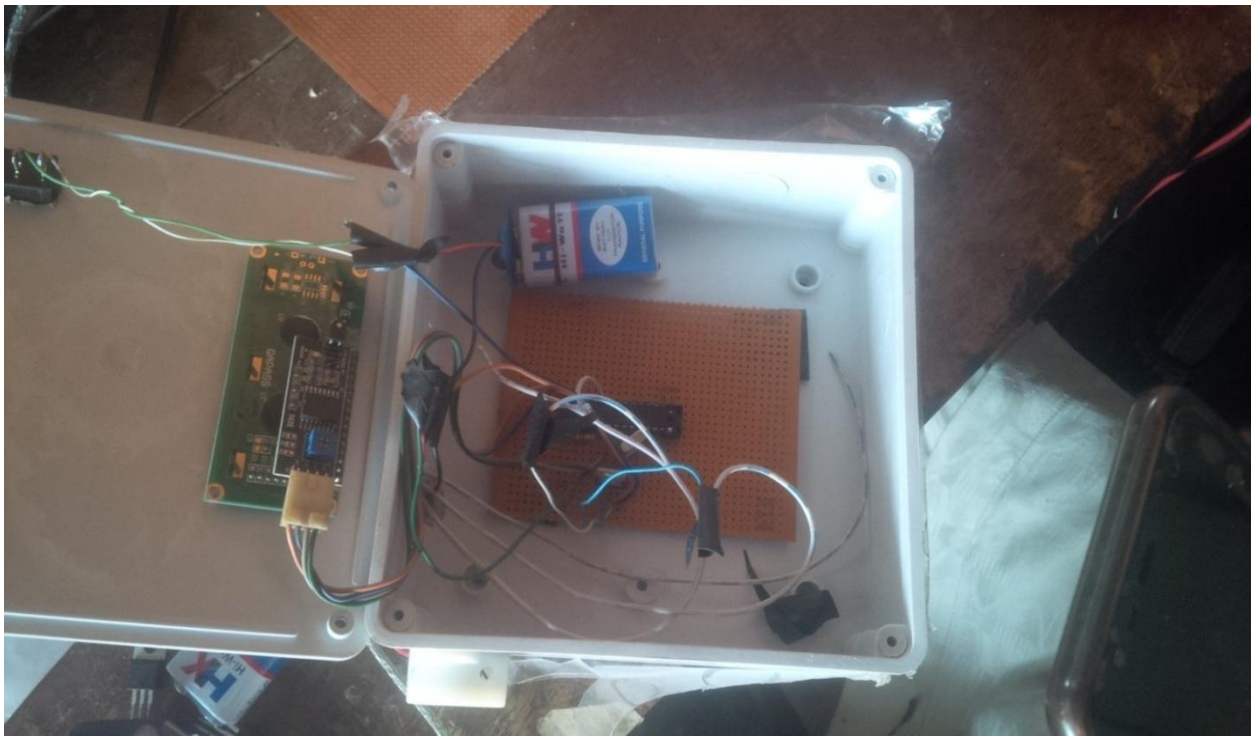

Figure 4.1: Overview construction of entire circuit

Figure 4.1 diaplsys the constructd Disgital Alcohol Sensor the entire circuit which all componect is connected such as the PIC microconroller, the resistor, the capacitor the 9volt power supply, that power the device and also supply voltage to the microcontroller, the liquid crystal display that serves as the digital output of the device and we have the alcohol sensor MQ3 and also the buzzer at the side of the device.
The software (programming language) that was used consists of the code written in C programming language for communication between the microcontroller and the LCD connection in other to send the message from the microcontroller through liquid crystal display to the display unit in other to be displayed the result

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Figure 4.2: The result of display LED

VI. DISCUSSION OF RESULT

This device works well when there is presence of alcohol in any liquor and if person take in alcohol, this device is able to sense alcohol content and it will display the output result in digital form with percentage level of alcohol detected as shown in figure 4.2.
The usefulness of the MQ-3 is to sense if there is presence of alcohol and send it to microcontroller, and microcontroller will send it corresponding value as output result.
C Language using Arduino IDE was used to run the code to give output result

VII. CONCLUSION

In conclusion, after the implementation of this alcohol sensor, the LED is able to display in digital form. The design was implemented to reduce the rate of road accident from motorists also for use of Road Safety Authorities. The system has many upcoming applications in companies, organizations, and in public in order to detect drunken motorists. The C Programming language was use to run the code in order to give output result for the work. The major improvement of this design is high sensitive of the sensor and fast response through the microcontroller.

VIII. RECOMMENDATIONS

For further research, the following are thereby recommended:

1. Companies should implement and utilize this Digital Alcohol sensor to detect alcohol consumption of employees.
2. Research should be done on this study in order to improve the efficiency and the usage of the device; it should be upgraded and connected to Road Safety Authority Central Office database where all reports and locations can be reported directly and legal action taken on offenders.

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IX. APPENDIX

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
//#include <LiquidCrystal.h>

// LiquidCrystal_I2C lcd(0x27,16,2);  // set the LCD address to 0x27 for a 16 chars and 2 line display
LiquidCrystal_I2C lcd(0x3F,16,2);
//LiquidCrystallcd()

#define alarm 4

floatpercentLev;
intoldLev, newLev;

void mq3Routine(){
newLev = analogRead(A0);

if(newLev> oldLev+5 || newLev< oldLev-5){
int mapped = map(newLev, 0, 1023, 0, 600);
percentLev = mapped / 600.0 * 100.0;  oldLev = newLev;
  }
}

void setup(){
pinMode(alarm, 1);
lcd.init();                    //   initialize the lcd
lcd.backlight();
lcd.print("ALCHOL DETECTOR"); //Display a intro message
lcd.setCursor(0, 1);   // set the cursor to column 0, line 1
lcd.print("BY Daniel  "); //Display a intro message
delay(3000); //Wait for display to show info
lcd.clear(); //Then clean it
}


void loop(){
mq3Routine();  lcd.setCursor(0,0);  lcd.print("Alcohol: ");
lcd.print(percentLev, 1);  lcd.println("%   ");

if(percentLev>= 40.0){
digitalWrite(alarm, 1);
lcd.setCursor(0,1);  lcd.print("Alcohol Detected");
  }
else{
digitalWrite(alarm, 0);
lcd.setCursor(0,1);  lcd.print("                ");
  }


//  int vout1 = analogRead(A0); // Read the analogue pin
//float vout = vout1/204.6;
//Serial.print(vout1);
//Serial.print("DU");
//Serial.print(vout);
//Serial.println(" vout");
//float R = (11000-vout*2200)/vout; // calculate the resistance
////float R = pow( X, -1);
//Serial.print(R); // light dependant resistance
//Serial.println(" Resistance.");
//float lux= (pow( R, (1/-0.8616)))/(pow( 10, (5.118/-0.8616))); //lux calculation
//Serial.print(lux);
//Serial.print(" Lux.");
//Serial.println("");
//delay(300); //delay for a second
////lux2
//float lux2 = 65.9 * (pow( vout1, 0.352));
//Serial.print(lux2);
```

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```
//Serial.print(" lux form2\n");
//lcd.setCursor(0,0);
//lcd.print("LDR Lux Meter");
//lcd.setCursor(0, 1);
//lcd.print("Lux = ");
//
//lcd.setCursor(9,1);
//lcd.print(lux2);
////lcd.print(lux2);
//delay(250);
}
```