SMART

BREATHALYZER 1.0

Measurable BAC Range : 0.00%-0.09%

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This device is intended to measure alcohol in human breath. Measurements obtained by this device are used in the diagnosis of alcohol intoxication.

User Manual

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INTRODUCTION

The **Smart Breathalyzer 1.0** is an advanced version of alcohol screening device, used for the detection of alcohol in the breath and to get analytical reports. The Smart breathalyzer 1.0 provides a digital result, displaying an estimate of the subject's BAC (Blood Alcohol Content). Before you begin testing, it is very important to read the entire owner's manual. This device will automatically calibrate to temperature and humidity of the environment every time you switch on the device.

Alcohol and its effects on the human body When a person consumes alcohol, the alcohol is absorbed from the mouth, throat, stomach and intestines into the bloodstream. The alcohol in the bloodstream exchanges with air deep in the lungs. The percent of alcohol in a person's blood (BAC) is proportional to the percent of alcohol in a person's breath (BrAC). The Smart breathalyzer 1.0 measures a subject's deep lung air alcohol level and converts it to the estimated BAC. "BAC" means Blood Alcohol Concentration. It is measured in %.

How does alcohol affect my body?
Alcohol is a depressant. It has a relaxing effect on the muscles in your body. The muscles of your eyes relax and lose focus. Your eyesight will become fuzzy and you may experience double vision. Brain activity is slowed. Your judgment, reflexes, and coordination are all negatively affected. Some vision impairments that occur when you have been drinking include:

- Narrowing of your field of vision
- Reduction in your depth perception
- Decreased ability to see in darkness
- Increased sensitivity to glare and a longer time for your eyes to readjust from the glare

Some mental (brain) impairment can occur when you have been drinking, including:

- Reduced awareness of danger
- Becoming overly confident and reckless
- Difficulty in making decisions
- Reduction in balance
- Slowed reflexes
- Impaired judgment

Variations among individuals and other factors, such as altitude and air temperature, affect the degree of intoxication. Some individuals may become intoxicated at low BAC levels. A low BAC on a breath alcohol tester does not mean that a person's reaction times can respond to any emergency encountered. Individuals should not drink alcohol and drive or use any machinery after consuming alcohol.

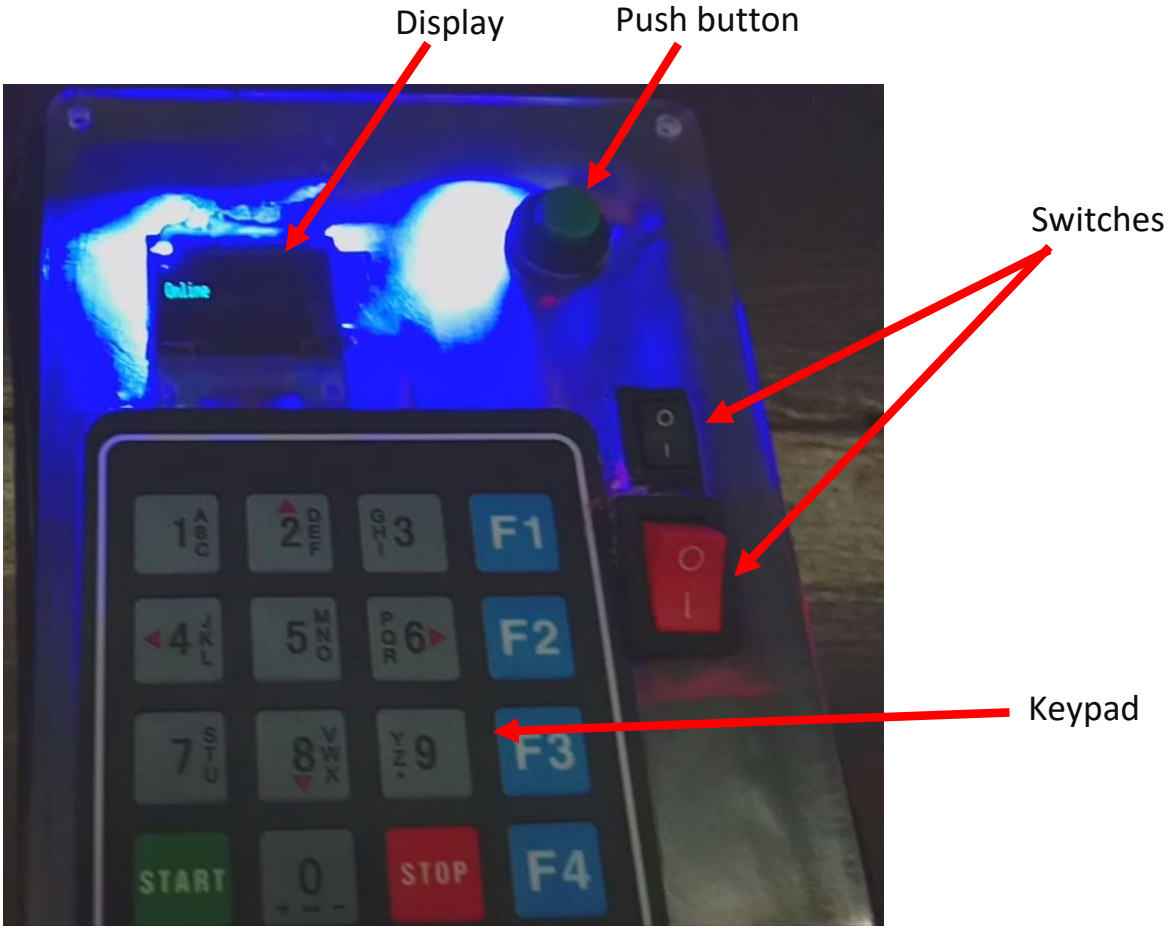
Dose-specific Effects of Alcohol

BAC (% by vol.)	Behavior	Impairment
0.001–0.029	• Average individual appears normal	• Subtle effects that can be detected with special tests
0.030–0.059	• Mild euphoria • Relaxation • Joyousness • Talkativeness • Decreased inhibition	• Concentration
0.060–0.099	• Blunted feelings • Reduced sensitivity to pain • Euphoria • Disinhibition • Extraversion	• Reasoning • Depth perception • Peripheral vision • Glare recovery
0.100–0.199	• Over-expression • Boisterousness • Possibility of nausea and vomiting	• Reflexes • Reaction time • Gross motor control • Staggering • Slurred speech • Temporary erectile dysfunction
0.200–0.299	• Nausea • Vomiting • Emotional swings • Anger or sadness • Partial loss of understanding • Impaired sensations • Decreased libido	• Severe motor impairment • Loss of consciousness • Memory blackout
0.300–0.399	• Stupor • Central nervous system depression • Loss of understanding • Lapses in and out of consciousness • Low possibility of death	• Bladder function • Breathing • Dysequilibrium • Heart rate
0.400–0.500	• Severe central nervous system depression • Coma • Possibility of death	• Breathing • Heart rate • Positional alcohol nystagmus
>0.50	• High possibility of death	

Specifications

Dimensions	5.5 x 4.0 x 2.5 inches
Weight	200g
Sensor Technology	MQ3 Alcohol sensor
Detection Range	0.00 – 0.09 B.A.C
Warm Up Time	60-80 seconds
Operating Temperature	25-34 °C
Maximum Operating Time	30 minutes

Components Diagram



Operation

STEP 1 : To on the device switch on both the switches.

STEP 2 : There are two menus called calibrate and start breathalyzer. You can change options using F2 and F3 buttons in the keypad respectively. Calibration menu is for company use only. You cannot change it. So to take readings you have to press F2 to start the breathalyzer function.

STEP 3 : Wait until display shoes “press the push button”. After that you can take readings by pressing the push button.

STEP 4 : Insert a mouthpiece into the Mouthpiece slot.

STEP 5 : Press the push button and give the device to take the breath sample

STEP 6 : Press the push button and give the device to take the breath sample

STEP 7 : Enter the license number and vehicle number when asked using keypad(Note that backspace is the F4 key in the keypad)

Calibration

The Smart Breathalyzer 1.0 is calibrated during manufacture using test results and mathematical formulas. Known alcohol concentrations are passed through the sensor to set baseline values for testing. During testing, the unit compares users' breath samples to these baseline values.

The accuracy of breath alcohol testers can fluctuate after six to twelve months of normal use, depending on the number of tests performed and operating conditions. It is because the alcohol sensor used in the device will not function well. If this product is providing inconsistent test results, is not providing any test results, or provides unusually high or low test results, the Sensor should be replaced and calibrate by the company.

The product should be recalibrated at least every six to twelve months depending on frequency of use and operating conditions.

During recalibration, the company will reset the sensor baseline values and also perform a full diagnostic check to ensure the accuracy and reliability of the product.

Precautions

1. Do not blow smoke, food, or liquids into the Smart Breathalyzer 1.0 as this will damage the sensor.

2. Do not test in areas with strong winds, smoke, or in an area where a large amount of alcohol is being consumed.

3. Charge the device when you see battery low indication.

4. Send your tester in for periodic calibration service as required.

5. The Smart Breathalyzer 1.0 is designed to be used in a temperature range of (20-36)°C.

7. Avoid testing in the presence of any substances that contain methyl alcohol, isopropyl alcohol or acetone. These substances may interfere with the results of the test.

8. For Hygiene reasons, use a new mouthpiece for each test subject.

9. You cannot use the results of this product in court. You have to send the person who caught drunk to do a blood test.

10. Do not use the Smart Breathalyzer 1.0 as a tool to determine whether you should operate a motor vehicle or equipment, or perform any other dangerous act.

10. Do not drink and drive. Always have a designated driver when alcohol is being consumed.

Requirements for the Test Subject

Before sampling, the test subject should breathe normally and calmly. The test subject must be able to provide the required minimum respiratory level. For this purpose, the breathing flow must be constant for a certain minimum blowing period. When the deep lung air comes out the breath rate will be in a constant range. That will be the minimum blowing period.

Description of Design Components

MQ3 Gas Sensor

The MQ3 gas sensor is alcohol sensor which is used to detect the alcohol concentration on your breath. This sensor provides an analog resistive output based on alcohol concentration. When the alcohol gas exist, the sensor's conductivity gets higher along with the gas concentration rising. It is suitable for various applications of detecting alcohol at different concentration. It is widely used in domestic alcohol gas alarm, industrial alcohol gas alarm and portable alcohol detector.

Features

- High sensitivity to alcohol and small sensitivity to Benzine
- Stable and long life
- Fast response and High sensitivity
- Only supported for Arduino Platform

Hardware Overview

This is an Analog output sensor. This needs to be connected to any one Analog socket in Arduino (A0).

The output voltage from the Gas sensor increases when the concentration of gas increases. Sensitivity can be adjusted by varying the potentiometer. The best preheat time for the sensor is above 24 hours.

Connection to Arduino

Arduino	Sensor
5V	VCC
GND	GND
NC	NC
Analog A0	SIG

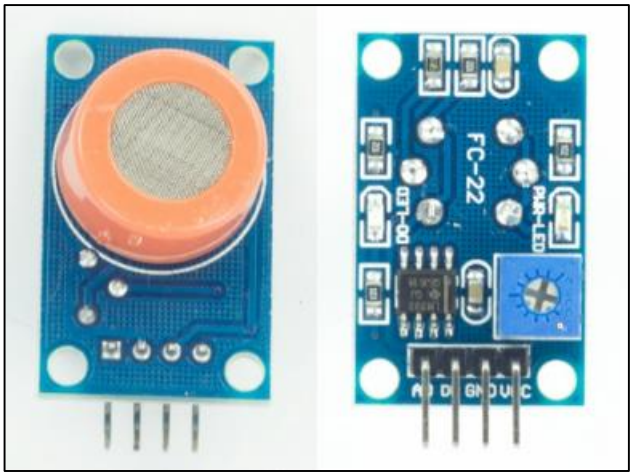


Figure - MQ3 Gas Sensor

Technical Overview

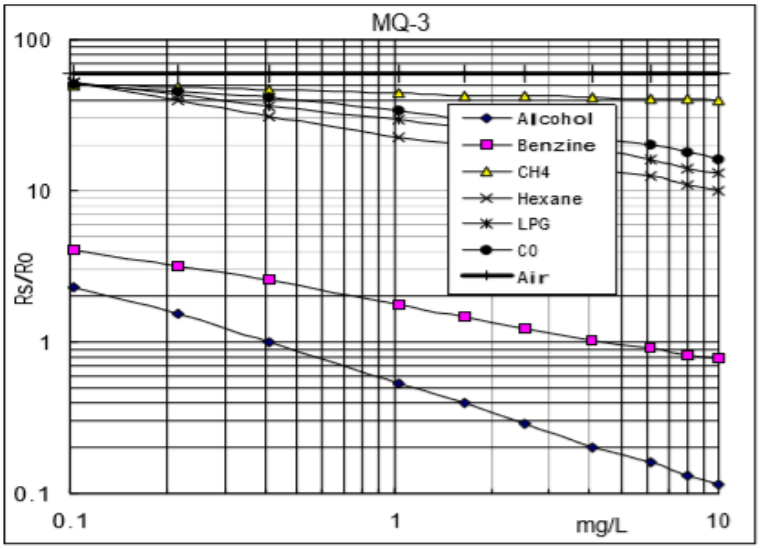


Fig.2 sensitivity characteristics of the MQ-3

Fig.3 is shows the typical sensitivity characteristics of the MQ-3 for several gases.
in their: Temp: 20℃、
Humidity: 65%、
O_2 concentration 21%
RL=200kΩ
Ro: sensor resistance at 0.4mg/L of Alcohol in the clean air.
Rs:sensor resistance at various concentrations of gases.

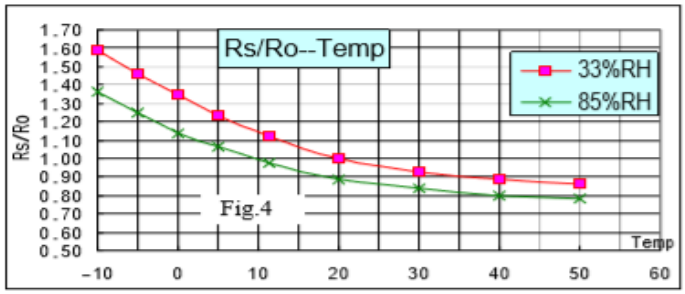


Fig.4 is shows the typical dependence of the MQ-3 on temperature and humidity.
Ro: sensor resistance at 0.4mg/L of Alcohol in air at 33%RH and 20 ℃
Rs: sensor resistance at 0.4mg/L of Alcohol at different temperatures and humidities.

Reference – MQ3 Datasheet

As shown in Figure 4 Temperature and humidity can affect gas sensor reading considerably. Therefore we're going to use Temperature-Humidity Sensor for the calibration of the device to be used in any environmental condition.

GSM Module

GSM module is used to transfer data from Smart Breathalyzer to the remote server via GPRS. The model we are using is SIM808 GSM module. SIM808 module is a GSM and GPS two-in-one function module. It is based on the latest GSM/GPS module SIM808 from SIMCOM, supports GSM/GPRS Quad-Band network and combines GPS technology for satellite navigation.

Features

- Supports multiple frequencies (Quad-band 850/900/1800/1900MHz)
- GPRS multi-slot class12 connectivity: max. 85.6kbps (down-load/up-load)
- Supports charging control for Li-Ion battery
- Supports Real Time Clock
- Supply voltage range 3.4V ~ 4.4V
- Supports 3.0V to 5.0V logic level
- Low power consumption, 1mA in sleep mode
- Supports GPS NMEA protocol
- Standard SIM Card
- Operating Temperature range -400C ~ 900C

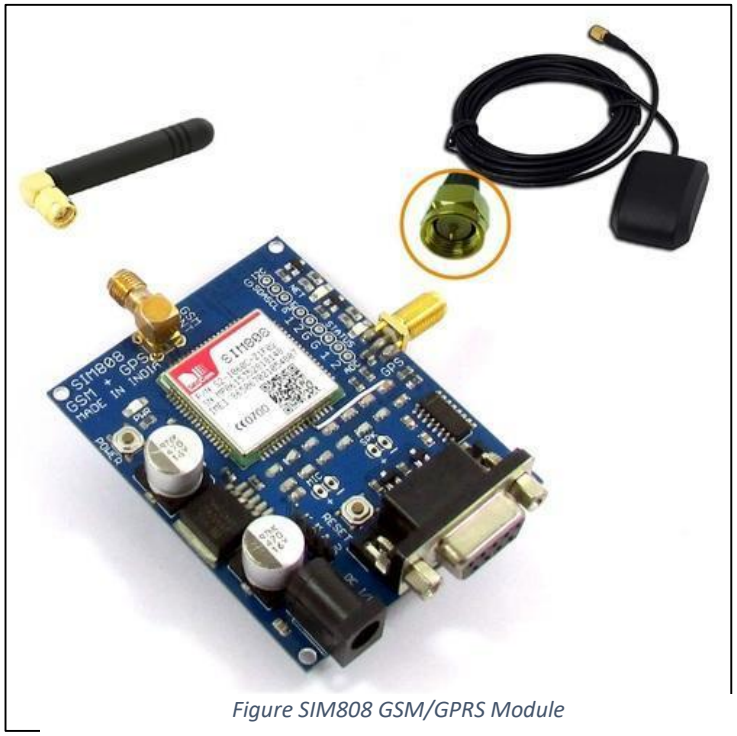


Figure SIM808 GSM/GPRS Module

ATMEGA 2560

The **Arduino Mega 2560** is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.

We previously used Atmega 328 MCU. But due to insufficient flash memory we jumped to an Arduino Mega board.

Technical Overview

Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	54 (of which 15 provide PWM output)
Analog Input Pins	16
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	256 KB of which 8 KB used by bootloader
SRAM	8 KB
EEPROM	4 KB
Clock Speed	16 MHz
LED_BUILTIN	13
Length	101.52 mm
Width	53.3 mm

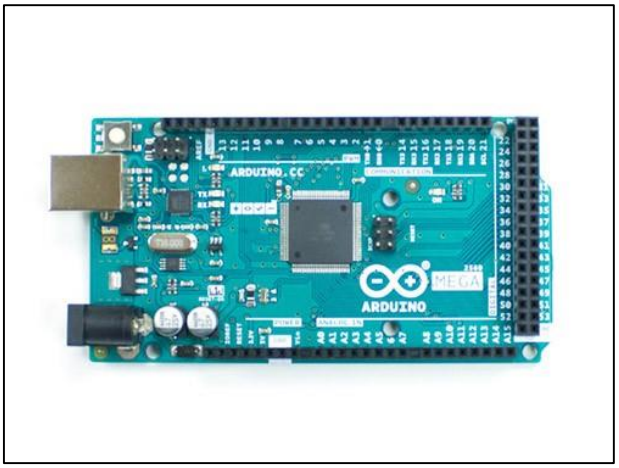
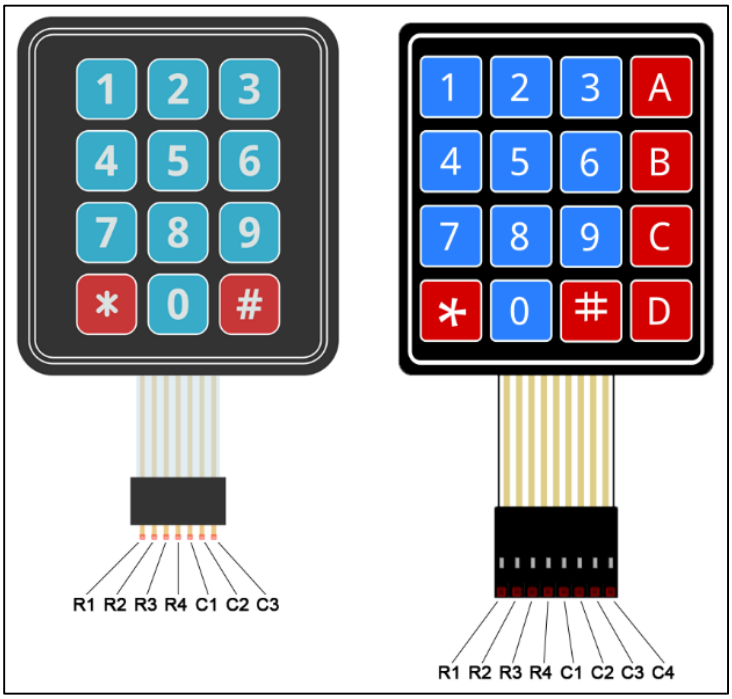


Figure Arduino Mega 2560

KEYPAD

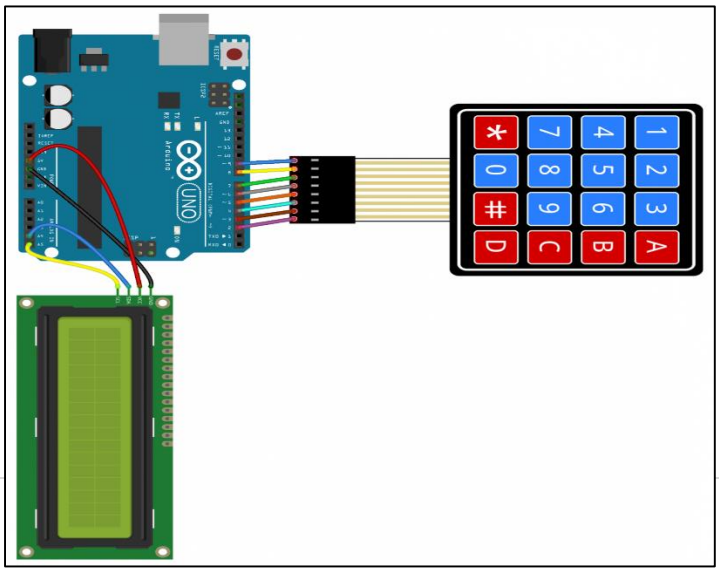
A 4X4 keypad is used to enter Vehicle number, Driver license ID to be sent to the remote database. This keypad is embedded to the device and it is used to controlling the Breathalyzer too.

Hardware Overview



Connecting Keypad to LCD display

Connect the ground and V_{cc} pins of the LCD to the Arduino, then connect the LCD's SDA and SCL pins to 20, 21 respectively on Arduino mega.



Design of Smart Breathalyzer

Following diagrams are the design images of the device. Device was printed using a 3D Printer and top and bottom was sealed with two Perspex sheets.

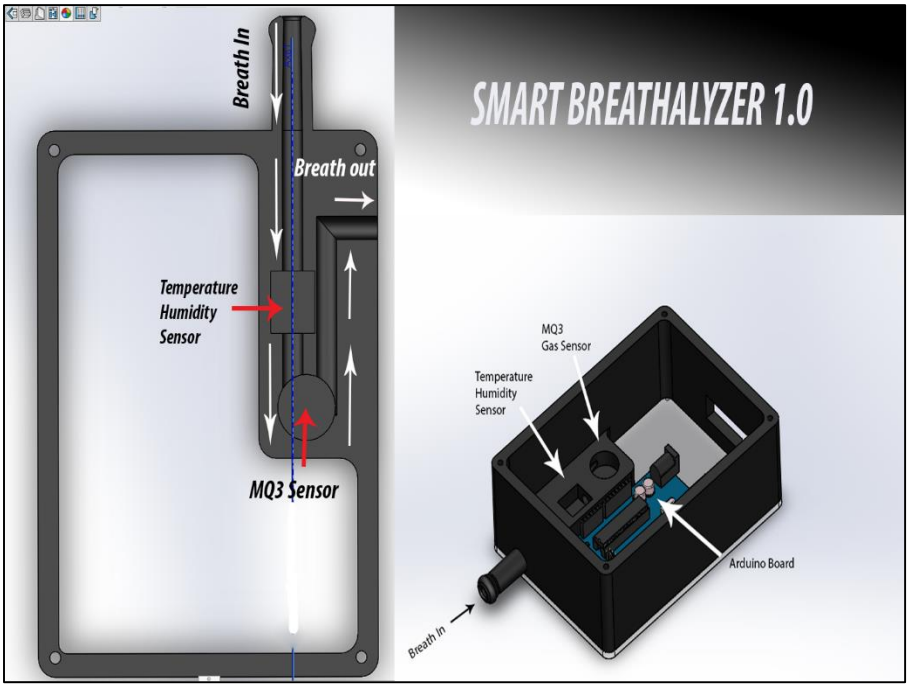


Figure - Design by Solid Works

Figure – Actual Device After Printing

Web and Network Application Design

A GSM module connected at each end is used to communicate between the device and the remote server.

GPRS is used to transfer data packets from the end node to the remote server via the Internet.

TCP is used as Transport Layer protocols and IP is used as Network Layer Protocol.

Back end

The following technologies are used to develop the back end web application

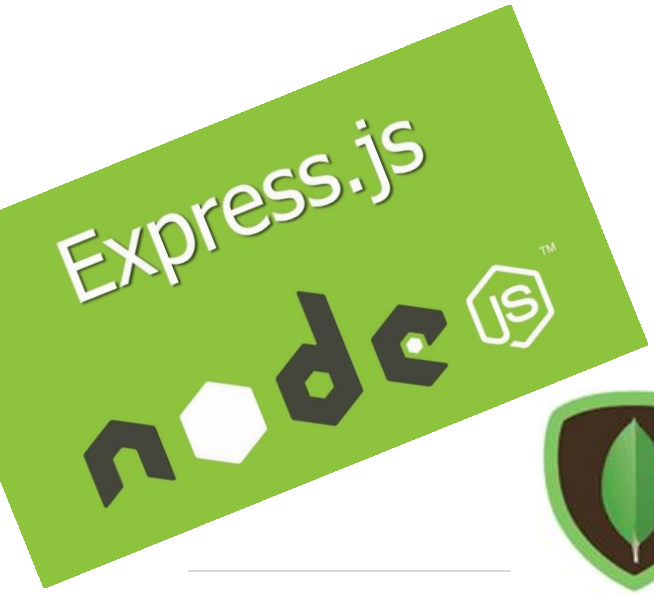
1) Node.js with Express

Node.js is a JavaScript runtime built on Chrome's V8 JavaScript engine. Node.js uses an event-driven, non-blocking I/O model that makes it lightweight and efficient. In our Web App only CPU intensive computation is the decrypting part. Therefore we thought of using Node.js with Express. Advantage with using Node.js is its fast than PHP backend programs and we are using JSON storage Object DB MongoDB so that we can take out the whole process with Javascript.

2) Heroku free Web Hosting Service

Heroku installation is very easy. There is a free tier just to be sufficient for hosting our web app and test. In case if we want to scale our project easily. For instance we can add AWS on Heroku with just a click. No expertise is needed to work with.

3) MongoDB - Database



mongoDB

Test results obtained from MQ3 alcohol sensor

Weight(kg)	Percentage(%)	Amount of alcohol(ml)	Time after ingestion(min)	Rs/R0	BAC percentage(%)
52	8.8	330	20	1.44	0.05
52	8.8	330	40	1.44	0.05
52	8.8	330	60	1.16	0.04
52	8.8	330	180	4.27	0.01
72	40	180	40	1	0.09
72	40	180	60	1	0.09
72	40	180	100	1.06	0.08
90	40	133	40	1.15	0.07
90	40	133	60	1.28	0.06
90	40	133	180	2.04	0.03
90	40	133	240	2.68	0.02
Any	-	-	-		0.00

Callibaration of MQ3 gas sensor using test results

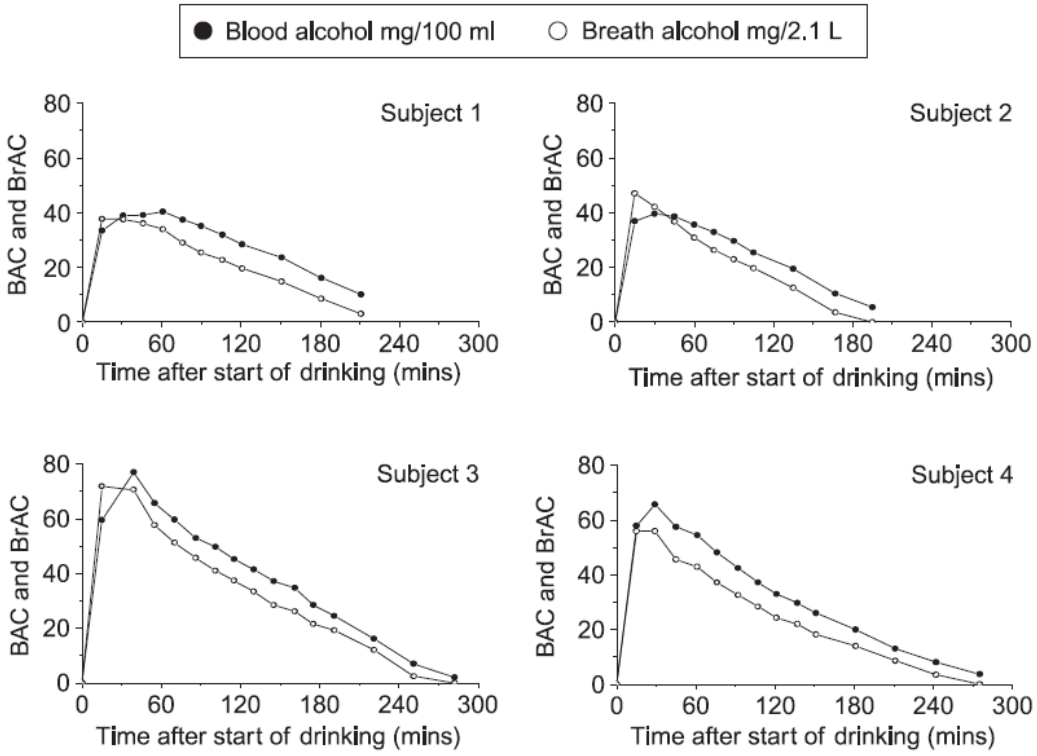
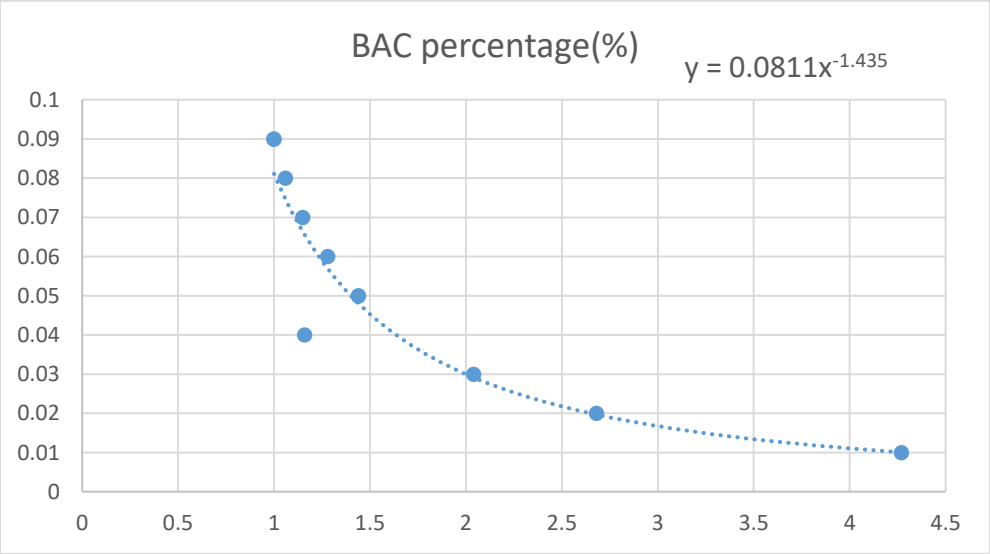


Figure – VARIATION OF BAC AND BrAC WITH TIME (Mins)

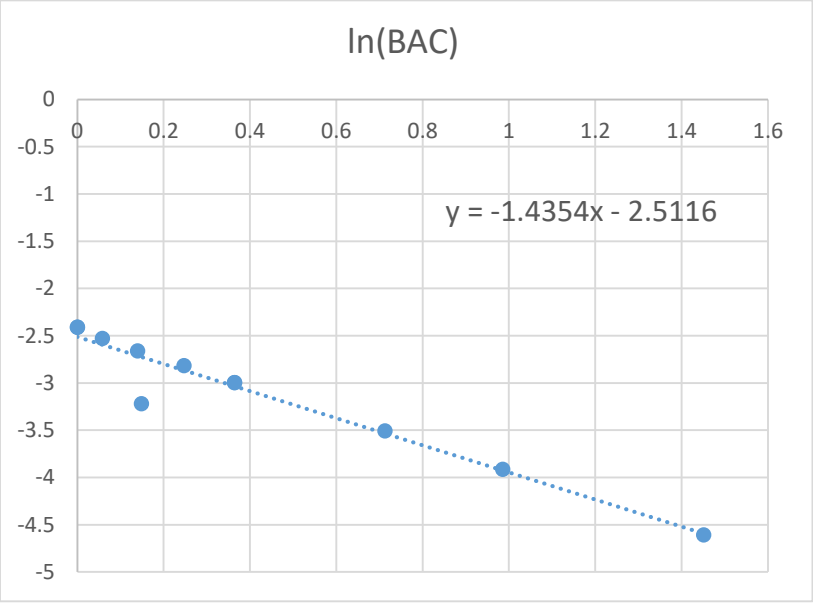
VARIATION OF BAC WITH Rs/Ro (Sensor Value)

Rs/R0	BAC percentage(%)
1.44	0.05
1.44	0.05
1.16	0.04
4.27	0.01
1	0.09
1	0.09
1.06	0.08
1.15	0.07
1.28	0.06
2.04	0.03
2.68	0.02



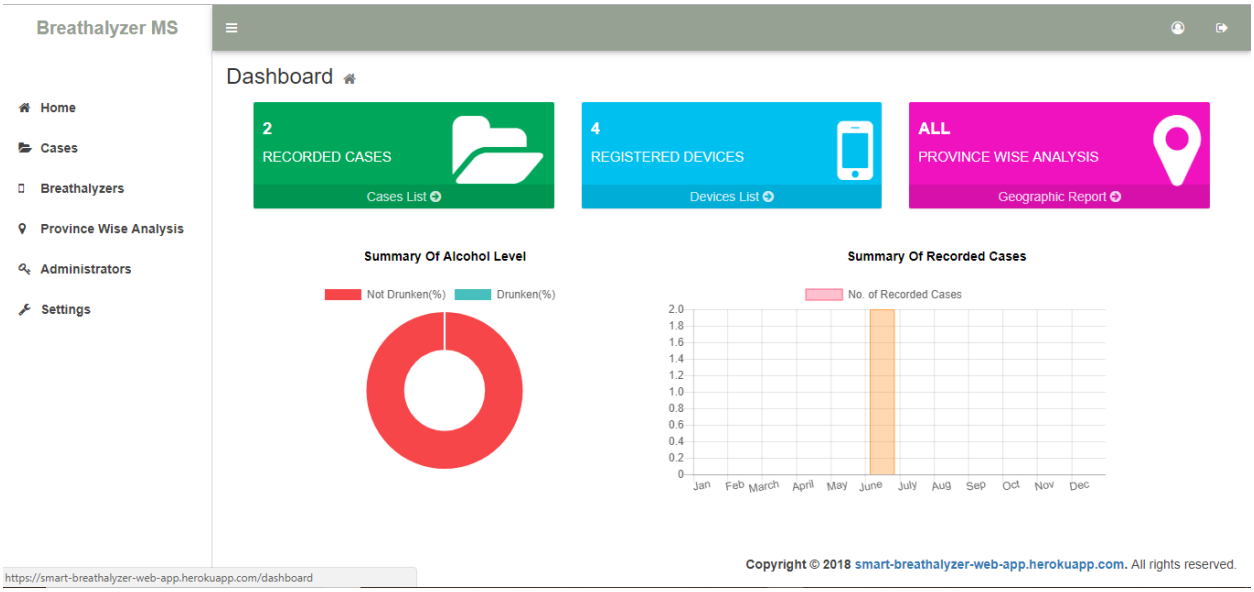
VARIATION OF log(BAC) WITH log(Rs/Ro)

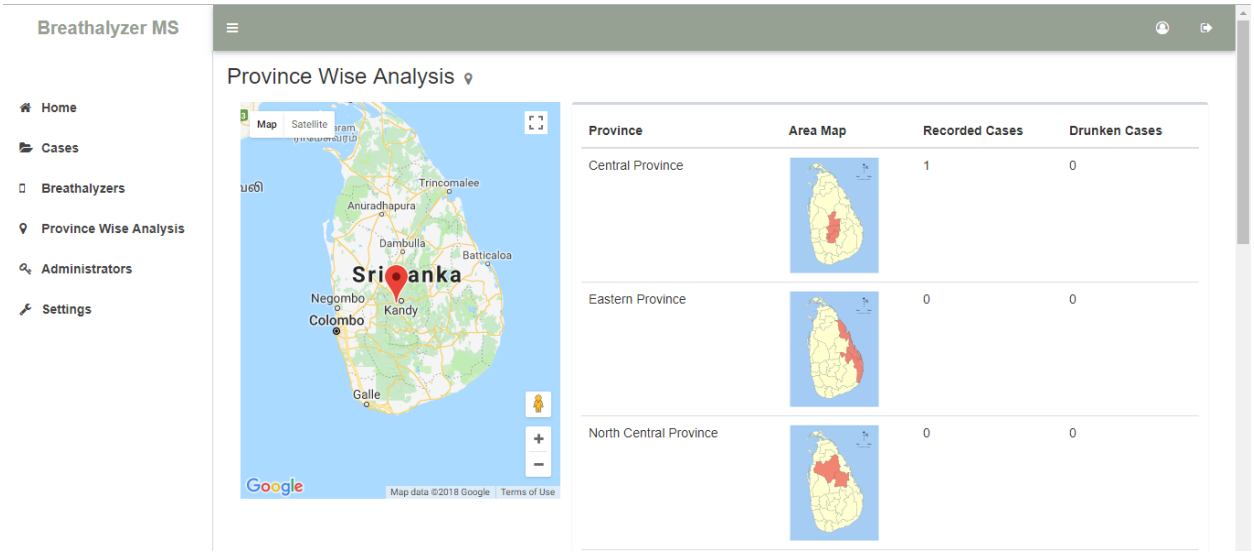
Rs/R0	ln(Rs/R0)	BAC percentage(%)	ln(BAC)
1.44	0.364643	0.05	-2.99573
1.44	0.364643	0.05	-2.99573
1.16	0.14842	0.04	-3.21888
4.27	1.451614	0.01	-4.60517
1	0	0.09	-2.40795
1	0	0.09	-2.40795
1.06	0.058269	0.08	-2.52573
1.15	0.139762	0.07	-2.65926
1.28	0.24686	0.06	-2.81341
2.04	0.71295	0.03	-3.50656
2.68	0.985817	0.02	-3.91202



This equation will give accurate results for BAC % for two decimal places.

Testing of server





Testing Sending Data to Server

```
process.env.NODE_ENV = 'test';

let mongoose = require("mongoose");
let Book = require('../app/models/cases');

let chai = require('chai');
let chaiHttp = require('chai-http');
let server = require('../server');
let should = chai.should();

chai.use(chaiHttp);

describe('Cases', () => {
    beforeEach((done) => {
        Book.remove({}, (err) => {
           done();
        });
    });
  describe('/GET cases', () => {
      it('it should GET show all the cases', (done) => {
        chai.request(server)
            .get('/cases')
            .end((err, res) => {
                res.should.have.status(200);
                res.body.should.be.a('array');
                res.body.length.should.be.eql(0);
              done();
            });
      });
  });
```

Results :

```
Listening on port 8080


  Cases
    /GET cases
      √ it should GET (show) all the cases (243ms)


  passing (1s)
```

Testing devices registered

```
describe('/POST case', () => {
    it('it should not POST a case without device ID ', (done) => {
      let case = {
          lic: "B2246116",
          veh: "ABC4094",
          alco: 0.04%,
          lat:84.56,
          lng:78.25
      }
      chai.request(server)
          .post('/cases')
          .send(case)
          .end((err, res) => {
              res.should.have.status(200);
              res.body.should.be.a('object');
              res.body.should.have.property('errors');
              res.body.errors.should.have.property('device_id');
              res.body.errors.pages.should.have.property('kind').eql('required');
            done();
          });
    });

  });
});
```

Results :

```
Listening on port 8080


  Cases
   /POST cases
     √ it should not POST a case without device ID (50ms)


   passing (1.5s)
```