SMART BREATHALYZER TEST

GROUP 11

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ABSTRACT

Blood Alcohol Content (BAC) is used to define intoxication and provides a rough measure of impairment. Although the degree of impairment may vary among individuals with the same blood alcohol content, it can be measured objectively. Most countries don't allow driving motor vehicles above prescribed levels of blood alcohol content.

The alcohol level at which a person is considered legally impaired varies by country. The list below gives limits by country. These are typically blood alcohol content limits for the operation of a vehicle.

0.02% - CHINA, US

0.03% - INDIA, JAPAN, RUSSIA

0.08% - SRI LANKA, ENGLAND, SINGAPORE

Standard Drink Sizes (Australia)

- 375ml can of light beer (2.7% alcohol) = 0.8 standard drinks
- 375ml can of mid-strength beer (3.5% alcohol) = 1 standard drink
- 375ml can of full strength beer (4.8% alcohol) = 1.4 standard drinks
- 100ml glass of wine (13.5% alcohol) = 1 standard drink
- 150ml glass of wine (13.5% alcohol) = 1.5 standard drinks
- 30ml shot of spirits (40% alcohol) = 0.95 standard drinks
- 440ml can of pre-mix spirits (approx. 5% alcohol) = 1.7 standard drinks
- 440ml can pre-mix spirits (approx. 7% alcohol) = 2.4 standard drinks

SOURCE - WIKIPEDIA

Approximate blood alcohol percentage (by vol.)[5]

One drink has 0.5 US fl oz (15 ml) alcohol by volume

Drinks	Sex	Body weight								
		40 kg 90 lb	45 kg 100 lb	55 kg 120 lb	64 kg 140 lb	73 kg 160 lb	82 kg 180 lb	91 kg 200 lb	100 kg 220 lb	109 kg 240 lb
1	Male	–	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.02
	Female	0.05	0.05	0.04	0.03	0.03	0.03	0.02	0.02	0.02
2	Male	–	0.08	0.06	0.05	0.05	0.04	0.04	0.03	0.03
	Female	0.10	0.09	0.08	0.07	0.06	0.05	0.05	0.04	0.04
3	Male	–	0.11	0.09	0.08	0.07	0.06	0.06	0.05	0.05
	Female	0.15	0.14	0.11	0.10	0.09	0.08	0.07	0.06	0.06
4	Male	–	0.15	0.12	0.11	0.09	0.08	0.08	0.07	0.06
	Female	0.20	0.18	0.15	0.13	0.11	0.10	0.09	0.08	0.08
5	Male	–	0.19	0.16	0.13	0.12	0.11	0.09	0.09	0.08
	Female	0.25	0.23	0.19	0.16	0.14	0.13	0.11	0.10	0.09
6	Male	–	0.23	0.19	0.16	0.14	0.13	0.11	0.10	0.09
	Female	0.30	0.27	0.23	0.19	0.17	0.15	0.14	0.12	0.11
7	Male	–	0.26	0.22	0.19	0.16	0.15	0.13	0.12	0.11
	Female	0.35	0.32	0.27	0.23	0.20	0.18	0.16	0.14	0.13
8	Male	–	0.30	0.25	0.21	0.19	0.17	0.15	0.14	0.13
	Female	0.40	0.36	0.30	0.26	0.23	0.20	0.18	0.17	0.15
9	Male	–	0.34	0.28	0.24	0.21	0.19	0.17	0.15	0.14
	Female	0.45	0.41	0.34	0.29	0.26	0.23	0.20	0.19	0.17
10	Male	–	0.38	0.31	0.27	0.23	0.21	0.19	0.17	0.16
	Female	0.51	0.45	0.38	0.32	0.28	0.25	0.23	0.21	0.19
Subtract approximately 0.01 every 40 minutes after drinking.										

Smart Breathalyzer Test is a project which is mainly targeted for the Police Department in Sri Lanka. Until now they use conventional balloon test to identify drunk drivers. Providing an easy, efficient and more secure IOT based solution to replace old conventional method our aim is to reduce vehicle accidents caused by drunken drivers.

Our project is to innovate a Breathalyzer. This device can communicate with a remote server sending Alcohol level, Vehicle number and Driver license ID. This device has its own unique id registered in the server. Once the police officer checks a driver and breath alcohol level is over the limit device will automatically prompt to enter Vehicle Number and Driver License ID and send all the data to remote server, Otherwise driver is safe to go. (Alcohol level after testing is displayed on the device). To get alcohol level above given statistics, graphs and formulas are used. Smart Breathalyzer device consists of an Arduino Mega board, a keypad, MQ3 alcohol sensor, Temperature-Humidity sensor, LCD display, GSM/GPRS module and a switch.

A web app is created to access and organize data in the remote database. Web App is accessible only for authorized officers and using web app police department can generate statistical reports, view recorded data. But they cannot edit any data, sent from device to database, from the Web App.

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

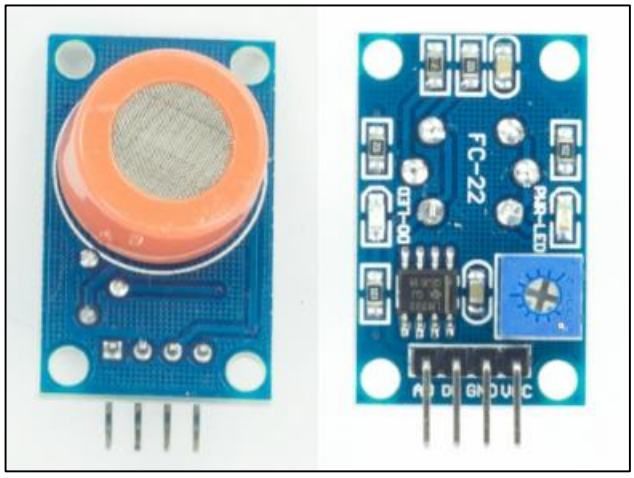


Figure - MQ3 Gas Sensor

Technical Overview

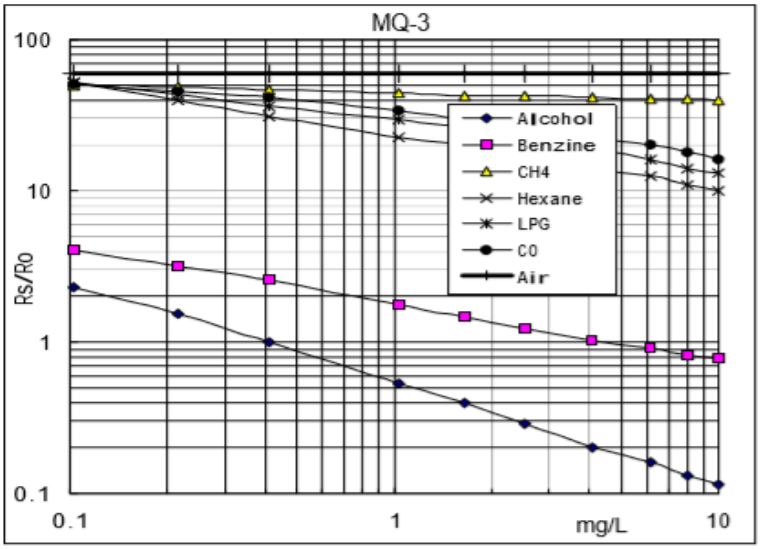


Fig.2 sensitivity characteristics of the MQ-3

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.

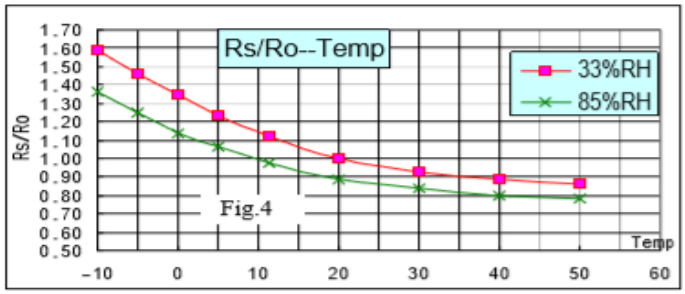


Fig.4 is shows the typical dependence of the MQ-3 on temperature and humidity.
Ro: sensor resistance at 0.4mg/L of Alcohol in air at 33%RH and 20 ℃
Rs: sensor resistance at 0.4mg/L of Alcohol at different temperatures and humidities.

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

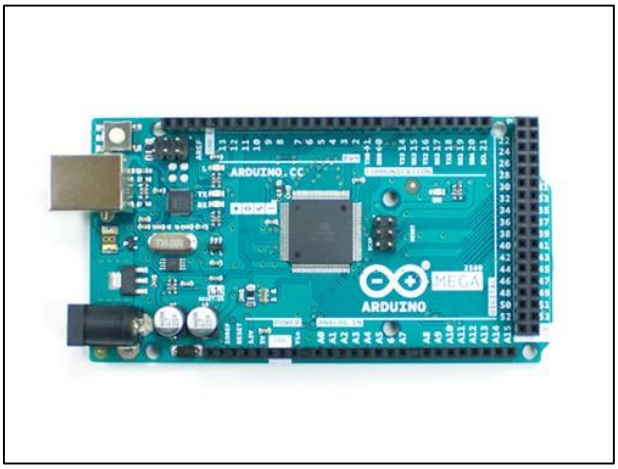
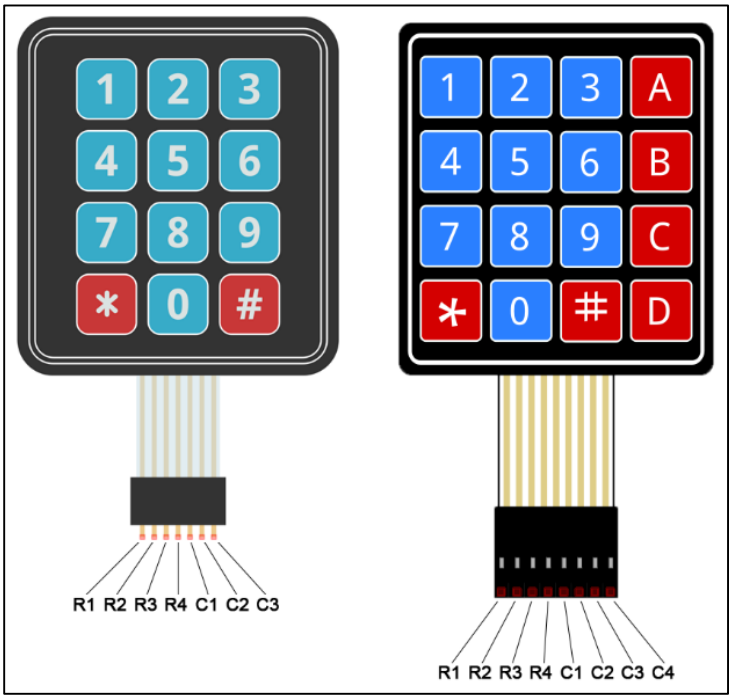


Figure Arduino Mega 2560

KEYPAD

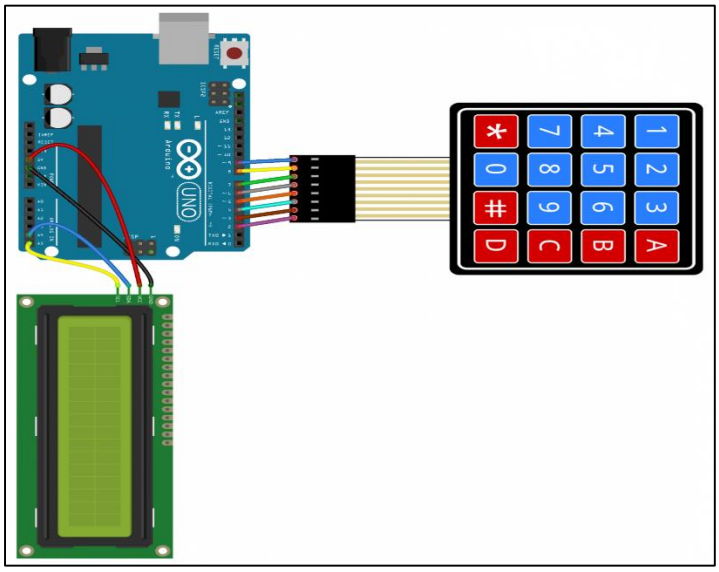
A 4X4 keypad is used to enter Vehicle number, Driver license ID to be sent to the remote database. This keypad is embedded to the device and it is used to controlling the Breathalyzer too.

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.

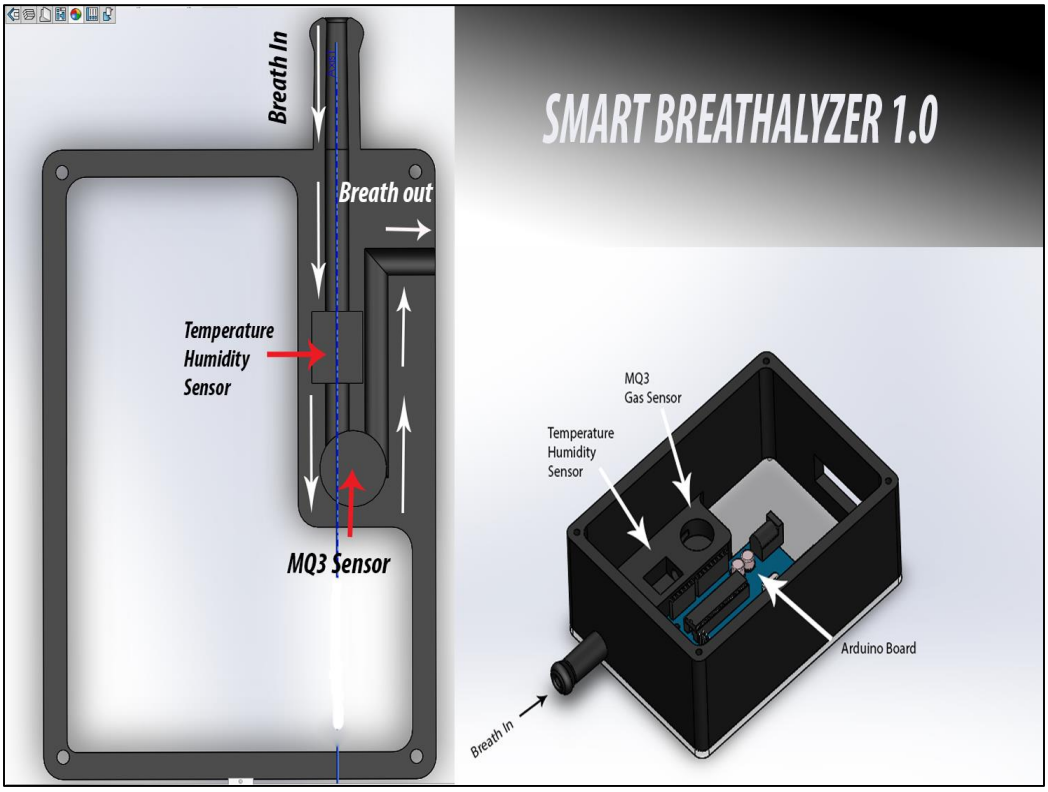


Figure - Design by Solid Works

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

Computer and Network Security

Driver License Number and Vehicle Number are the data that has to be sent to the central server from the device. Like SSL we are encrypting data from device and the decrypted and stored on the remote database.

When considering server

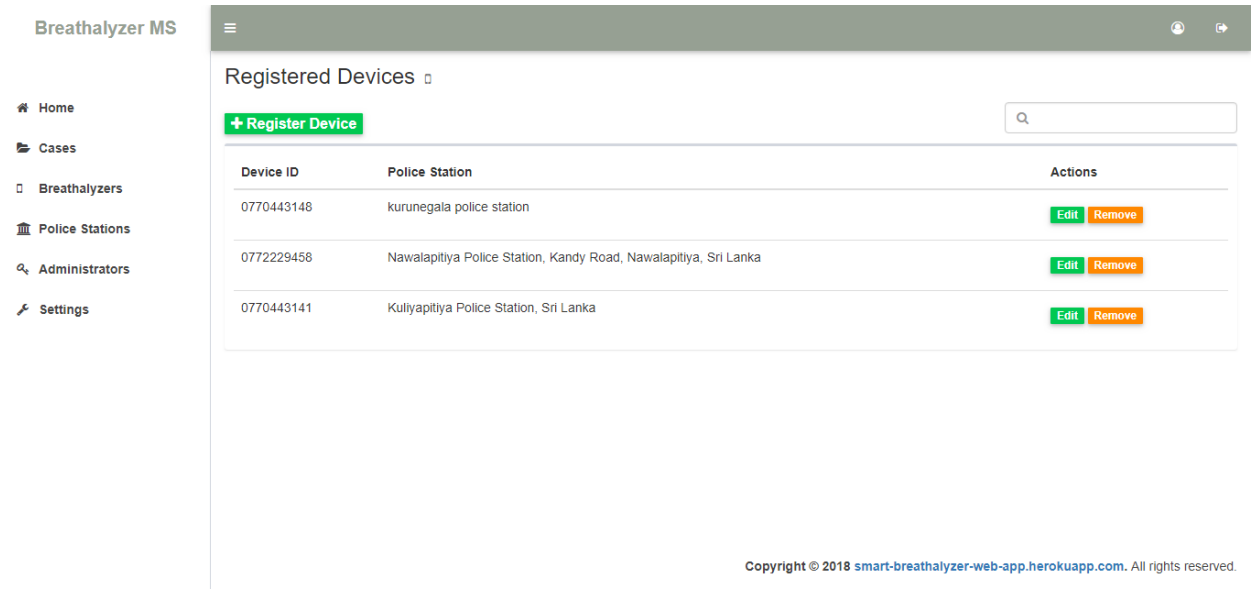
1. Accessing website should be secured (Only authorized persons should enter)

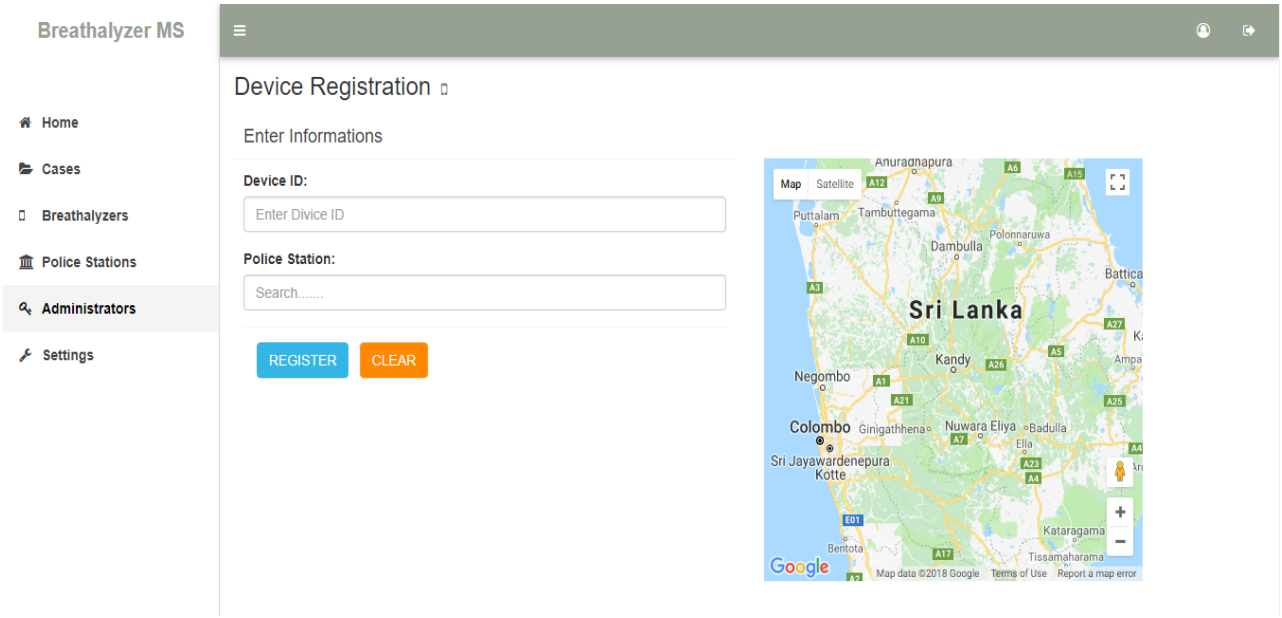
2. Should establish a secure connection between device and server such that no any external device can enter data to server.

We're hoping to give solutions to each of these problems in our implementation.

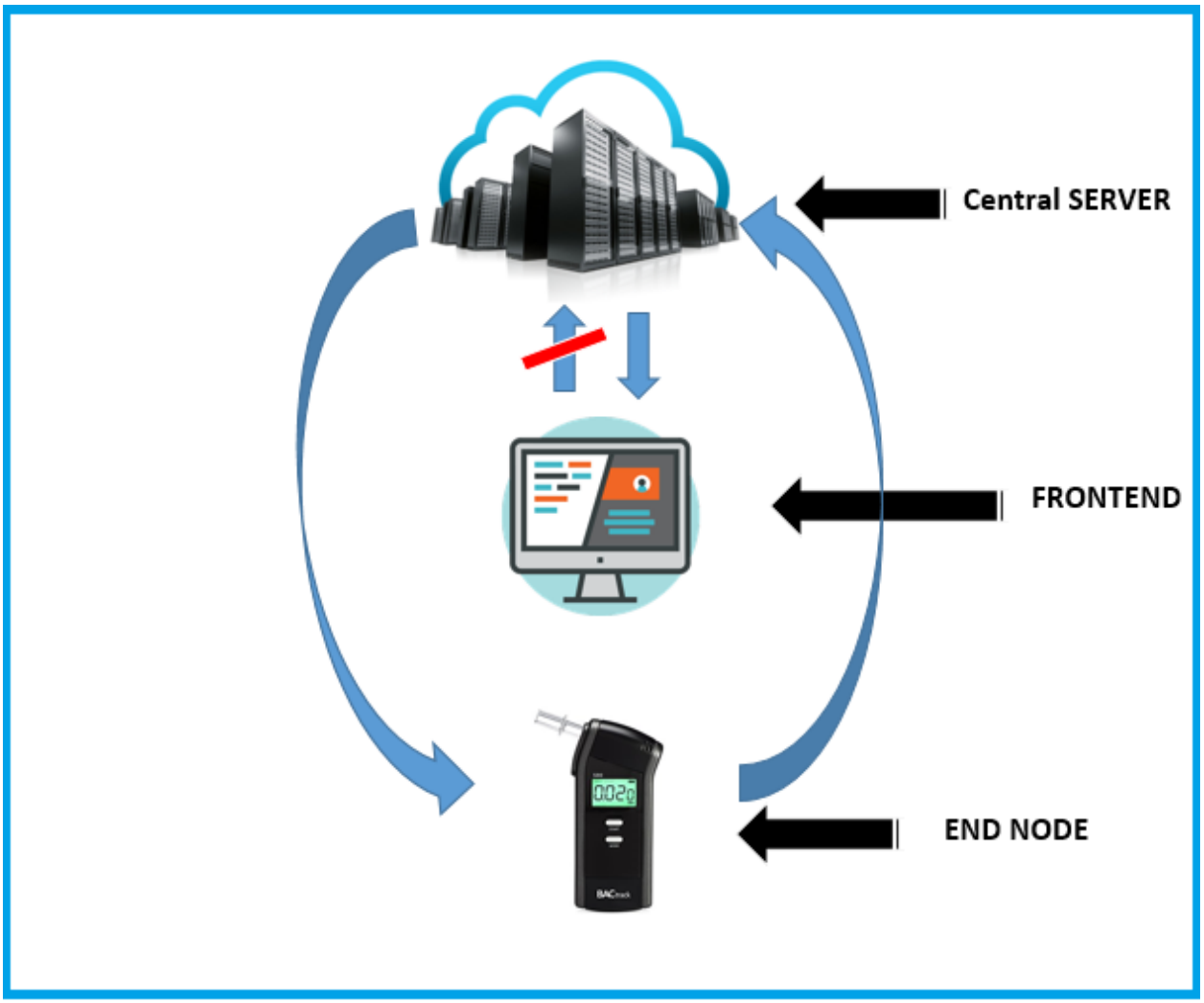
Considering the fact there is not much CPU intensive tasks we hope to utilize AES in encrypting/decrypting data when sending to remote server because it is very secure with its large key with 128,196 or 256 bits.

Establishing a secure connection between device and server such that no any external device can enter data to server.





Finalized design overview



Budget

Description of Work	Anticipated Costs(Rs)
SIM808 Shield	5150.00
4*4 Keypad	150.00
GPS Antenna	425.00
MQ3 Alcohol Sensor	275.00
DHT11 Temperature/Humidity Sensor	250.00
OLED Display	680.00
Arduino Mega	1800.00
Jumper Cables	300.00
Laser Cutting	850.00
AC/DC Adapter	320.00
Battery	1500.00
Total	Rs 11,700.00

Finalized Device