GE107 Project Report

On

HEALTH MONITORING SYSTEM

Under the guidance of
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November 2022

TITLE OF THE PROJECT: Health Monitoring System

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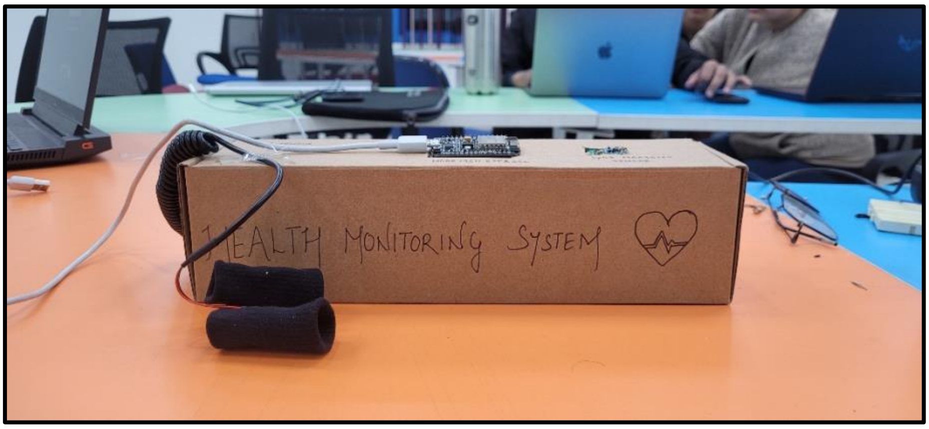
BRIEF:

- **OBJECTIVE:** To create a Health Monitoring System for calculating BPM (Beats Per Minute), SPO2 (Percentage of oxygen in blood) and GSR (Galvanic Skin Resistance).

- **CORE FUNCTIONALITIES:**
  1. **BPM (Beats Per Minute):** It helps to find out if your heart is pumping enough blood thus working efficiently. A normal resting heart rate for adults ranges from 60 to 100 beats per minute. Generally, a lower heart rate at rest implies more efficient heart function and better cardiovascular fitness. For example, a well-trained athlete might have a normal resting heart rate closer to 40 beats per minute.
  2. **SpO2:** The SpO2 reading on a pulse oximeter shows the percentage of oxygen in someone's blood. A normal level of oxygen is usually 95% or higher. Some people with chronic lung disease or sleep apnea can have normal levels around 90%.
  3. **GSR (Galvanic Skin Resistance):** Galvanic Skin Response (GSR) is a measuring unit of surface resistance skin or conductivity. It measures the change in electrical activity, which takes place due to the shift in sweat gland activity. An increase in sweat gland activity can take place due to both positive (“joyful”) and negative (“scary”) events. A person’s stress level can be calculated using GSR values.



HEALTH MONITORING SYSTEM

SPECIFICATIONS:

➢ SOFTWARE SPECIFICATIONS:

- Arduino IDE 1.8.19
- Cayenne Cloud System (powered by myDevices)

➢ HARDWARE SPECIFICATIONS:

- Node MCU ESP8266
- SpO2 MAX30100 Sensor
- GSR v 1.2 Sensor
- Jumper Wires
- USB Type-B Cable
- Adapter AC-to-DC
- 5V Lithium Battery

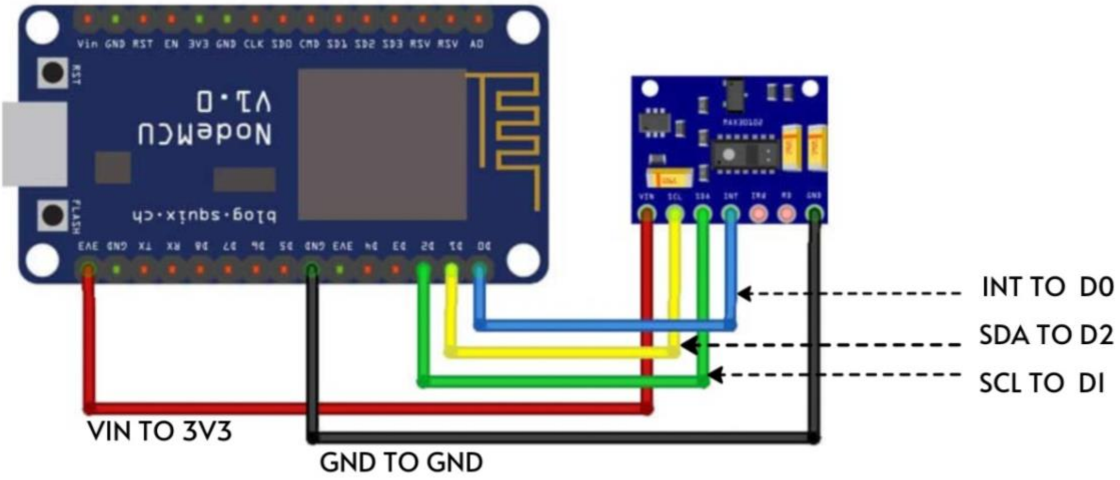
Node MCU

Sp02 Sensor

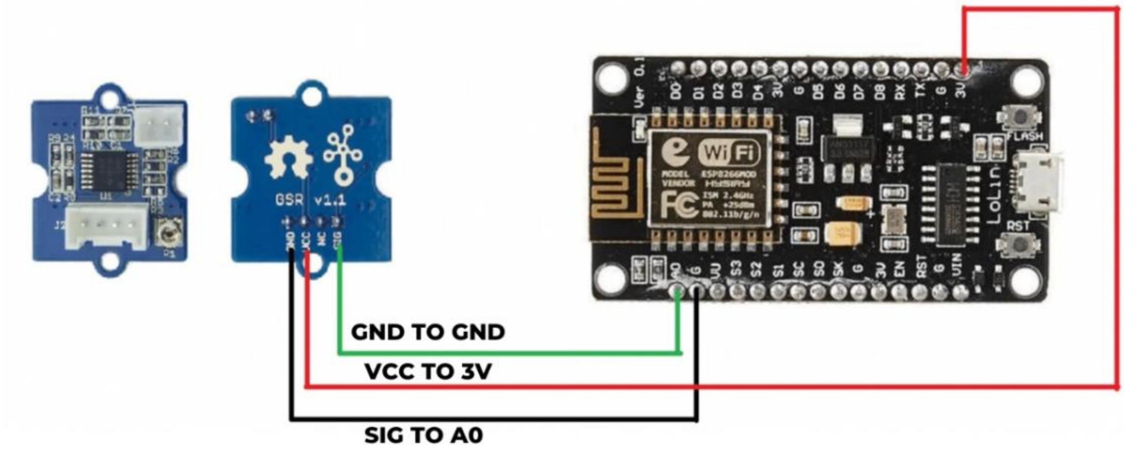
GSR v 1.2

CIRCUIT DIAGRAM:

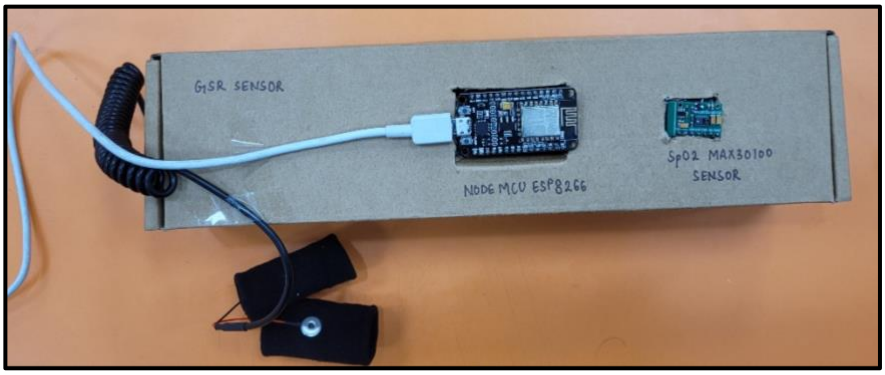
➢ SpO2 Sensor Circuit Diagram:



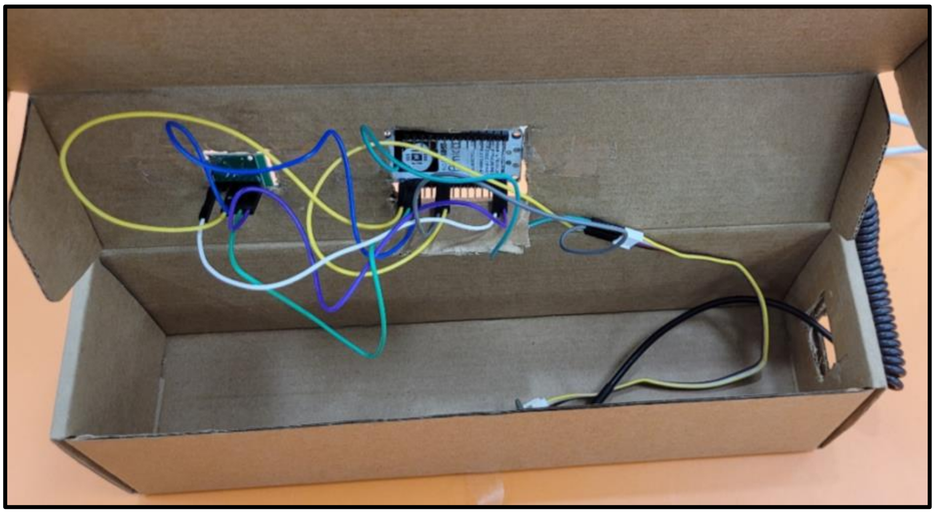
- **GSR Sensor Circuit:**



IMAGES:



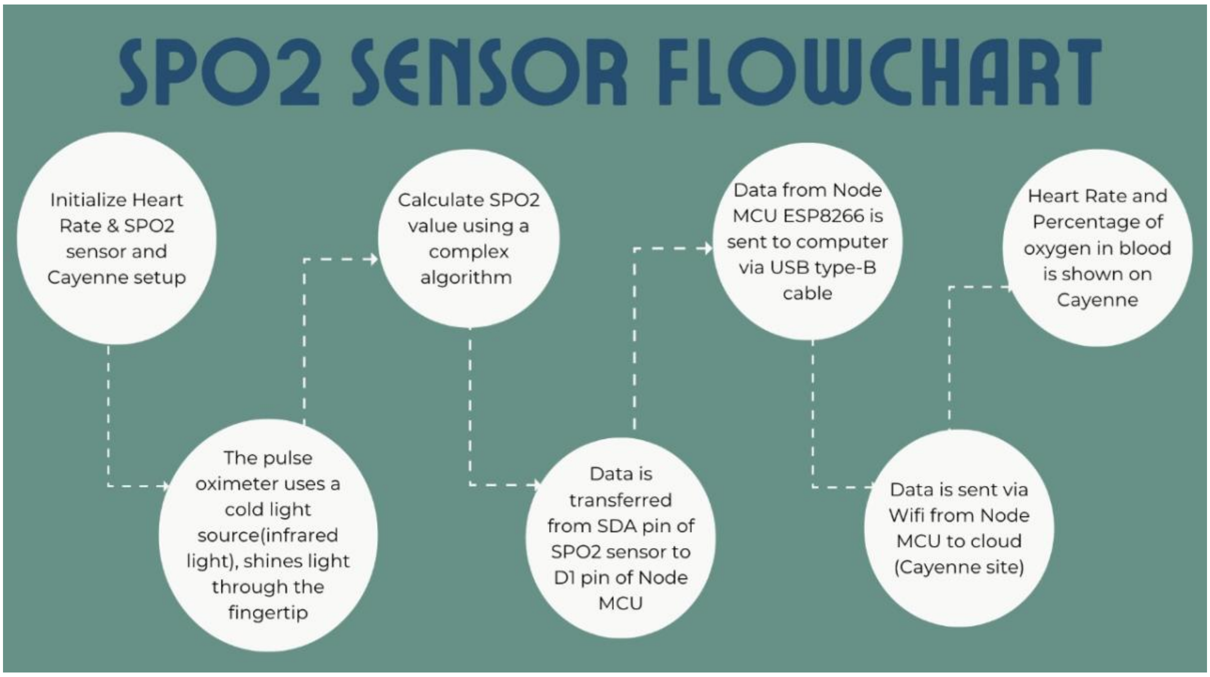
HEALTH MONITORING SYSTEM



ACTUAL CIRCUIT

DATA FLOW DIAGRAM:

➢ SpO2 Sensor Circuit:



SPO2 SENSOR FLOWCHART

Initialize Heart Rate & SPO2 sensor and Cayenne setup

The pulse oximeter uses a cold light source(infrared light), shines light through the fingertip

Calculate SPO2 value using a complex algorithm

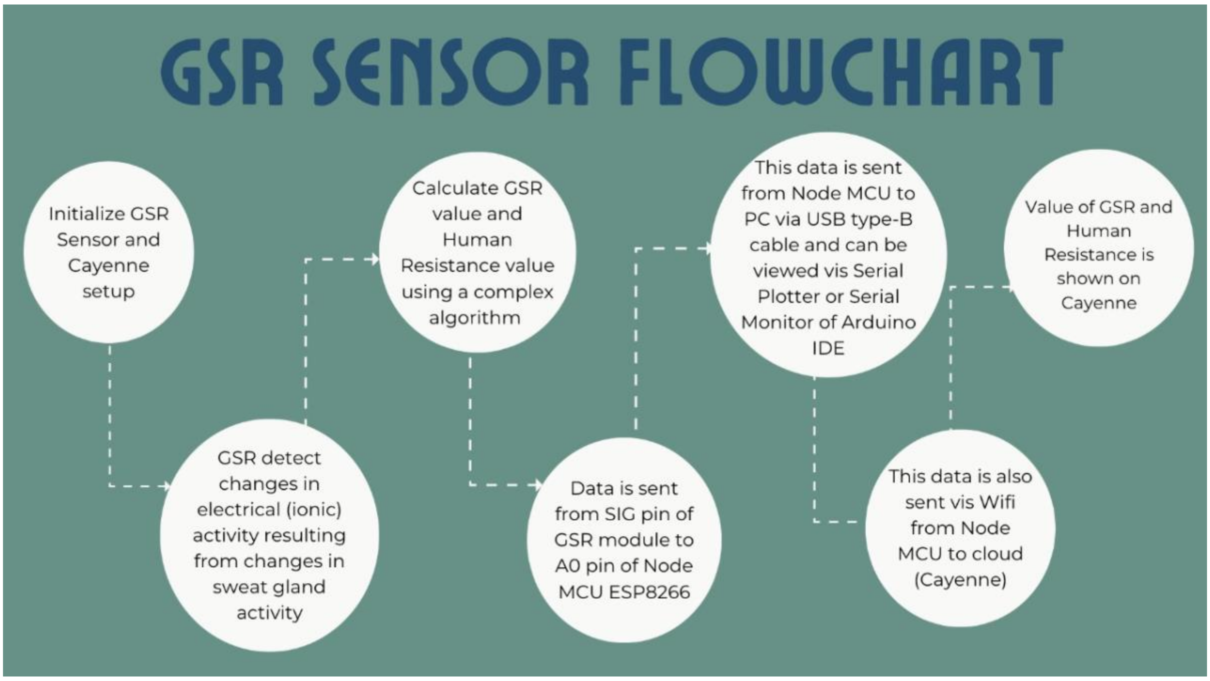
Data is transferred from SDA pin of SPO2 sensor to D1 pin of Node MCU

Data from Node MCU ESP8266 is sent to computer via USB type-B cable

Data is sent via Wifi from Node MCU to cloud (Cayenne site)

Heart Rate and Percentage of oxygen in blood is shown on Cayenne

➢ GSR Sensor Circuit:



GSR SENSOR FLOWCHART

Initialize GSR Sensor and Cayenne setup

GSR detect changes in electrical (ionic) activity resulting from changes in sweat gland activity

Calculate GSR value and Human Resistance value using a complex algorithm

Data is sent from SIG pin of GSR module to A0 pin of Node MCU ESP8266

This data is sent from Node MCU to PC via USB type-B cable and can be viewed vis Serial Plotter or Serial Monitor of Arduino IDE

This data is also sent vis Wifi from Node MCU to cloud (Cayenne)

Value of GSR and Human Resistance is shown on Cayenne

MODULES USED:

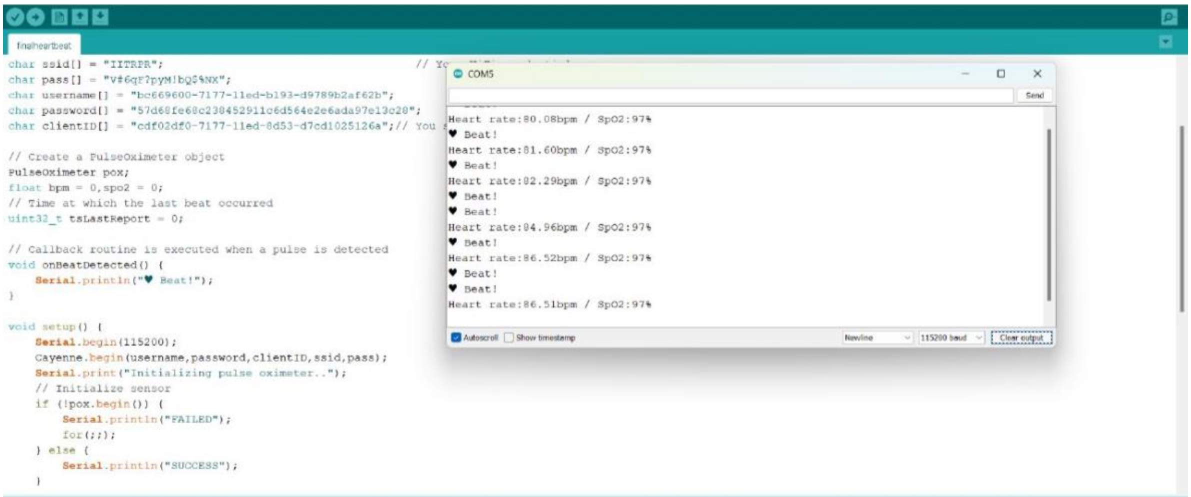
- **Node MCU ESP8266:** The NodeMCU (Node MicroController Unit) is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266.

- **SpO2 MAX30100:** SpO2 sensors measure your blood oxygen saturation i.e. the amount of oxygen present in blood. It is an integrated pulse oximetry and heartrate monitor sensor solution. It combines two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse oximetry and heart-rate signals.

- **GSR v 1.2:** The GSR sensor measures the varying levels of the skin conducting the electric current. Higher levels of perspiration on the skin lead to a greater conductance of electrical currents.

TESTING DETAILS:

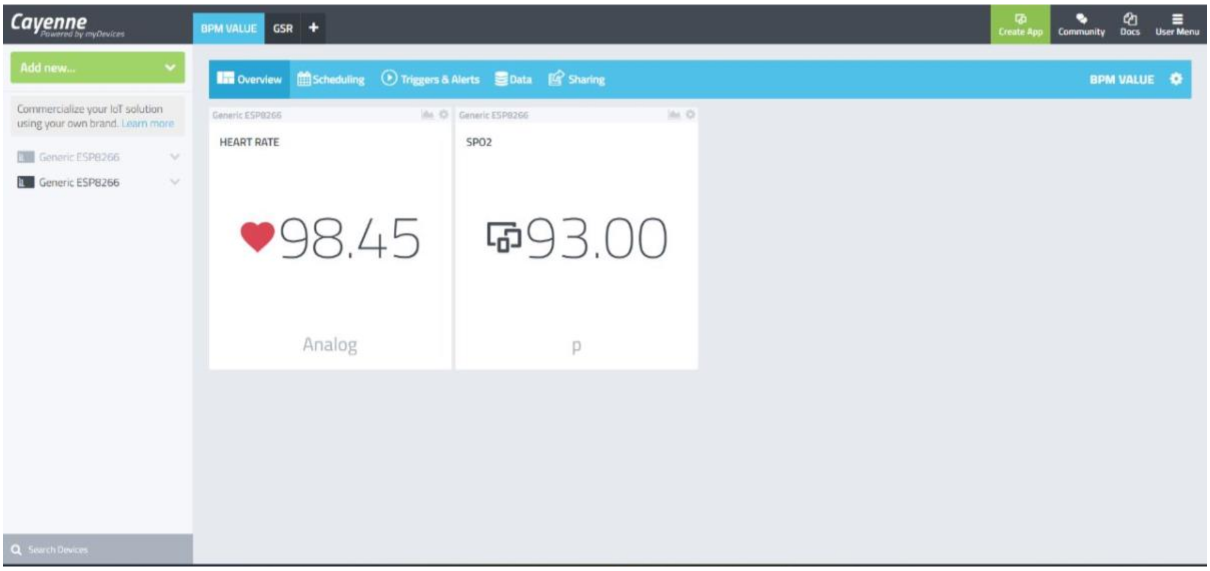
- **IMAGES:**
  - **SpO2 sensor testing:**



```
char ssid[] = "IITRPR";                                    // Yo
char pass[] = "V#6qF?pyM!bQ$%NX";
char username[] = "bc669600-7177-11ed-b193-d9789b2af62b";
char password[] = "57d68fe68c238452911c6d564e2e6ada97e13c28";
char clientID[] = "cdf02df0-7177-11ed-8d53-d7cd1025126a";// You

// Create a PulseOximeter object
PulseOximeter pox;
float bpm = 0,spo2 = 0;
// Time at which the last beat occurred
uint32_t tsLastReport = 0;

// Callback routine is executed when a pulse is detected
void onBeatDetected() {
    Serial.println("♥ Beat!");
}

void setup() {
    Serial.begin(115200);
    Cayenne.begin(username,password,clientID,ssid,pass);
    Serial.print("Initializing pulse oximeter..");
    // Initialize sensor
    if (!pox.begin()) {
        Serial.println("FAILED");
        for(;;);
    } else {
        Serial.println("SUCCESS");
    }
```

```
Heart rate:80.08bpm / SpO2:97%
♥ Beat!
Heart rate:81.60bpm / SpO2:97%
♥ Beat!
Heart rate:82.29bpm / SpO2:97%
♥ Beat!
♥ Beat!
Heart rate:84.96bpm / SpO2:97%
♥ Beat!
Heart rate:86.52bpm / SpO2:97%
♥ Beat!
♥ Beat!
Heart rate:86.51bpm / SpO2:97%
```

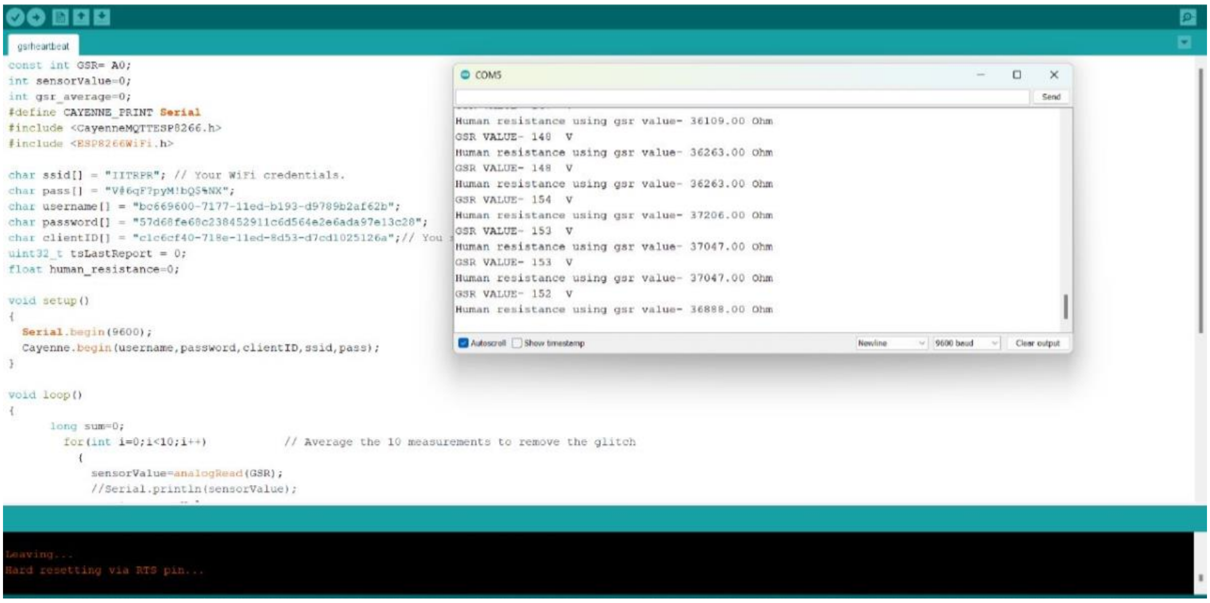
Serial Monitor showing BPM and SpO2 values



HEART RATE
98.45
Analog

SPO2
93.00
p

- **GSR Sensor Testing:**

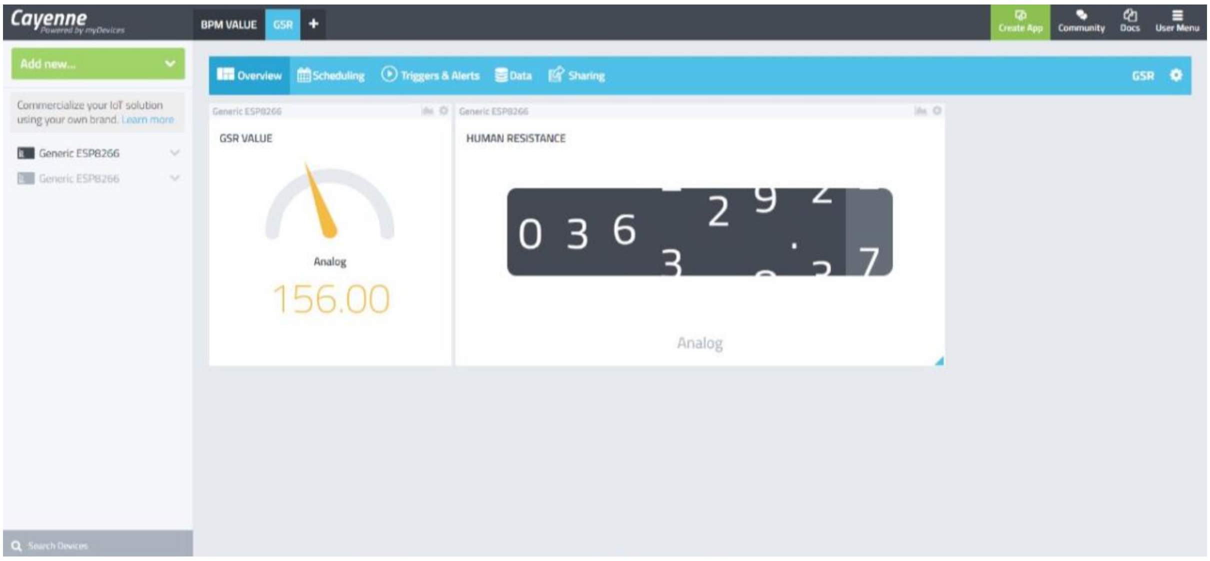


```
const int GSR= A0;
int sensorValue=0;
int gsr_average=0;
#define CAYENNE_PRINT Serial
#include <CayenneMQTTESP8266.h>
#include <ESP8266WiFi.h>

char ssid[] = "IITRPR"; // Your WiFi credentials.
char pass[] = "V$6qF?pyM!bQS%NX";
char username[] = "bc669600-7177-11ed-b193-d9789b2af62b";
char password[] = "57d68fe68c238452911c6d564e2e6ada97e13c28";
char clientID[] = "c1c6cf40-718e-11ed-8d53-d7cd1025126a";// You
uint32_t tsLastReport = 0;
float human_resistance=0;

void setup()
{
  Serial.begin(9600);
  Cayenne.begin(username,password,clientID,ssid,pass);
}

void loop()
{
      long sum=0;
        for(int i=0;i<10;i++)           // Average the 10 measurements to remove the glitch
          {
            sensorValue=analogRead(GSR);
            //Serial.println(sensorValue);
```

```
Human resistance using gsr value- 36109.00 Ohm
GSR VALUE- 148  V
Human resistance using gsr value- 36263.00 Ohm
GSR VALUE- 148  V
Human resistance using gsr value- 36263.00 Ohm
GSR VALUE- 154  V
Human resistance using gsr value- 37206.00 Ohm
GSR VALUE- 153  V
Human resistance using gsr value- 37047.00 Ohm
GSR VALUE- 153  V
Human resistance using gsr value- 37047.00 Ohm
GSR VALUE- 152  V
Human resistance using gsr value- 36888.00 Ohm
```

```
Leaving...
Hard resetting via RTS pin...
```

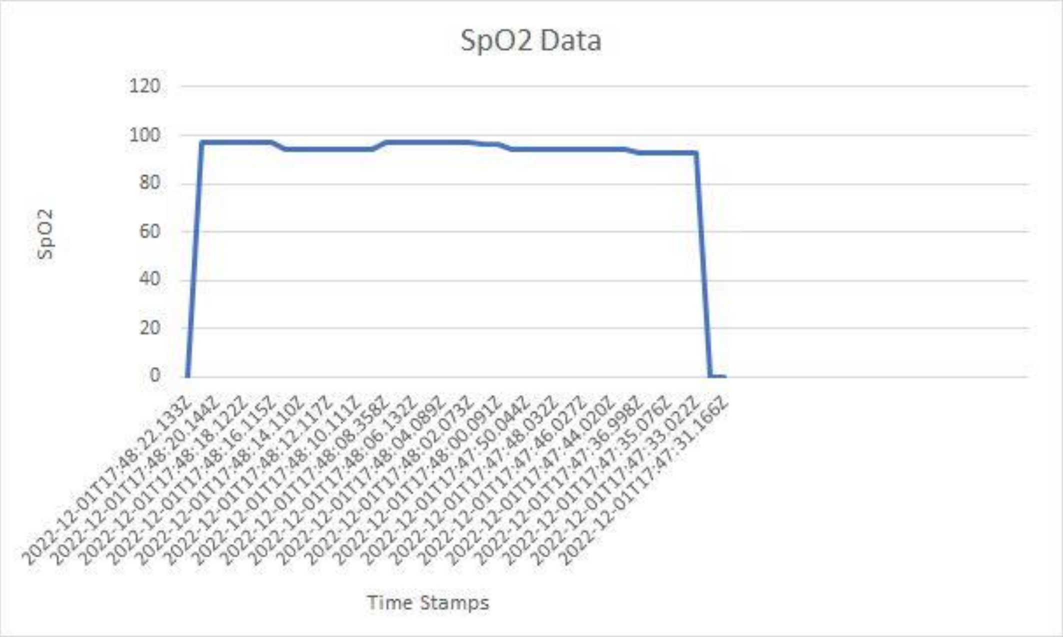
Serial Monitor showing GSR and Human Resistance values



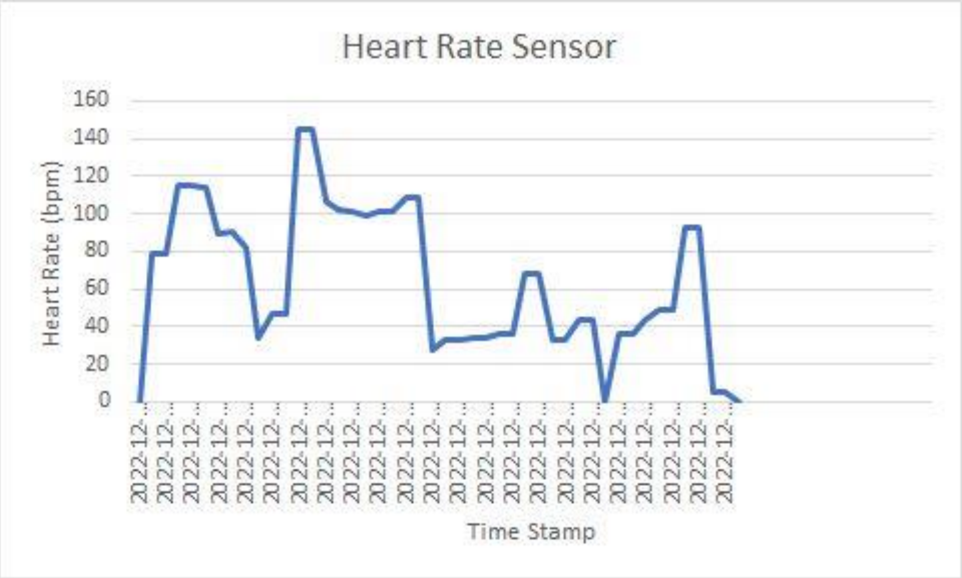
Reading shown on cloud service

- **GRAPHS:**

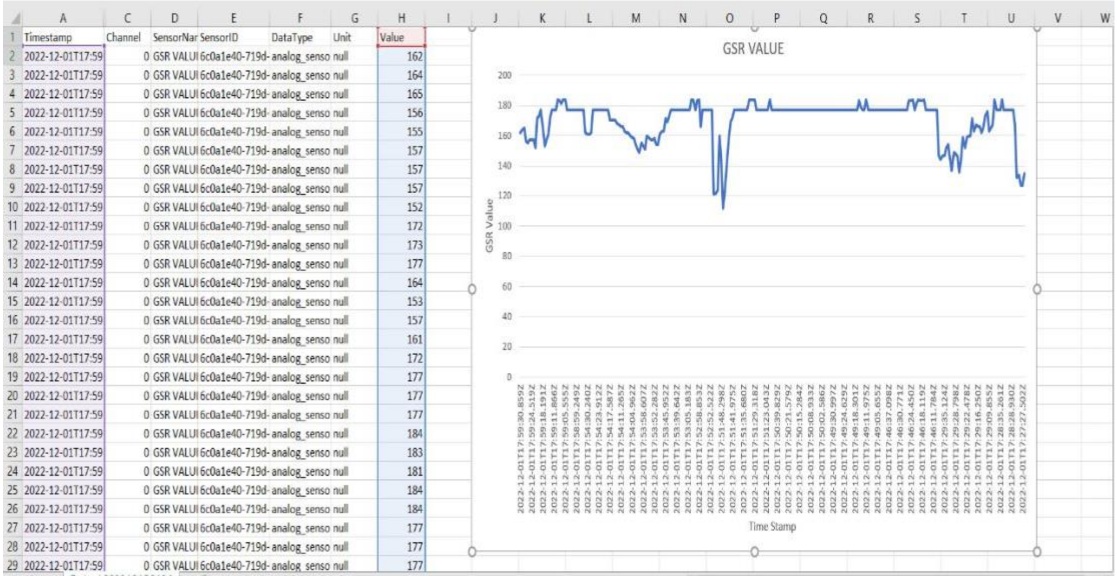
SpO2 VALUE



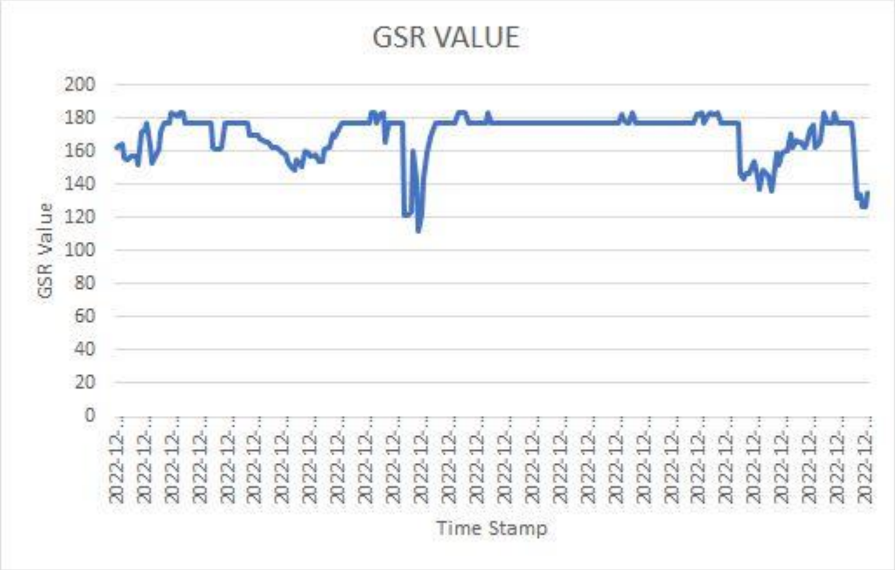
BPM VALUE



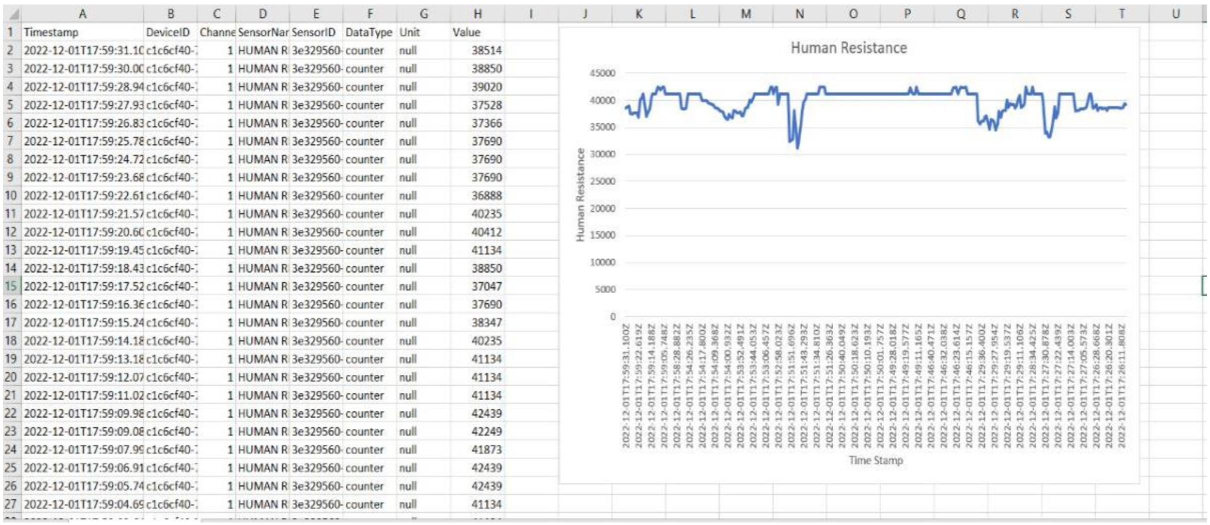
GSR VALUE



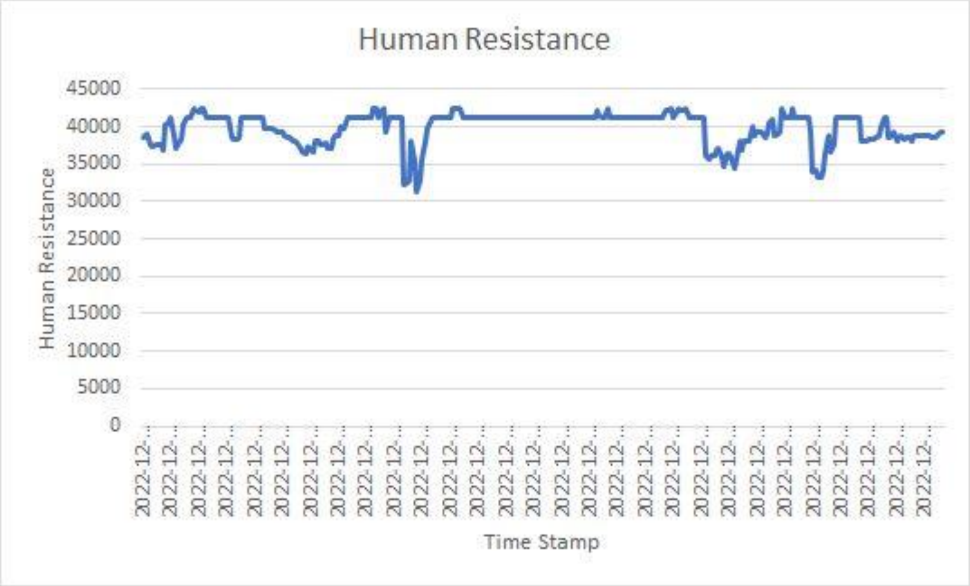
	A	C	D	E	F	G	H
1	Timestamp	Channel	SensorNar	SensorID	DataType	Unit	Value
2	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	162
3	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	164
4	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	165
5	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	156
6	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	155
7	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	157
8	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	157
9	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	157
10	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	152
11	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	172
12	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	173
13	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	177
14	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	164
15	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	153
16	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	157
17	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	161
18	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	172
19	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	177
20	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	177
21	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	177
22	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	184
23	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	183
24	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	181
25	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	184
26	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	184
27	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	177
28	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	177
29	2022-12-01T17:59	0	GSR VALUI	6c0a1e40-719d-	analog_senso	null	177



HUMAN RESISTANCE



	Timestamp	DeviceID	Channe	SensorNar	SensorID	DataType	Unit	Value
2	2022-12-01T17:59:31.10	c1c6cf40-	1	HUMAN R	3e329560-	counter	null	38514
3	2022-12-01T17:59:30.00	c1c6cf40-	1	HUMAN R	3e329560-	counter	null	38850
4	2022-12-01T17:59:28.94	c1c6cf40-	1	HUMAN R	3e329560-	counter	null	39020
5	2022-12-01T17:59:27.93	c1c6cf40-	1	HUMAN R	3e329560-	counter	null	37528
6	2022-12-01T17:59:26.83	c1c6cf40-	1	HUMAN R	3e329560-	counter	null	37366
7	2022-12-01T17:59:25.78	c1c6cf40-	1	HUMAN R	3e329560-	counter	null	37690
8	2022-12-01T17:59:24.72	c1c6cf40-	1	HUMAN R	3e329560-	counter	null	37690
9	2022-12-01T17:59:23.68	c1c6cf40-	1	HUMAN R	3e329560-	counter	null	37690
10	2022-12-01T17:59:22.61	c1c6cf40-	1	HUMAN R	3e329560-	counter	null	36888
11	2022-12-01T17:59:21.57	c1c6cf40-	1	HUMAN R	3e329560-	counter	null	40235
12	2022-12-01T17:59:20.60	c1c6cf40-	1	HUMAN R	3e329560-	counter	null	40412
13	2022-12-01T17:59:19.45	c1c6cf40-	1	HUMAN R	3e329560-	counter	null	41134
14	2022-12-01T17:59:18.43	c1c6cf40-	1	HUMAN R	3e329560-	counter	null	38850
15	2022-12-01T17:59:17.52	c1c6cf40-	1	HUMAN R	3e329560-	counter	null	37047
16	2022-12-01T17:59:16.36	c1c6cf40-	1	HUMAN R	3e329560-	counter	null	37690
17	2022-12-01T17:59:15.24	c1c6cf40-	1	HUMAN R	3e329560-	counter	null	38347
18	2022-12-01T17:59:14.18	c1c6cf40-	1	HUMAN R	3e329560-	counter	null	40235
19	2022-12-01T17:59:13.18	c1c6cf40-	1	HUMAN R	3e329560-	counter	null	41134
20	2022-12-01T17:59:12.07	c1c6cf40-	1	HUMAN R	3e329560-	counter	null	41134
21	2022-12-01T17:59:11.02	c1c6cf40-	1	HUMAN R	3e329560-	counter	null	41134
22	2022-12-01T17:59:09.98	c1c6cf40-	1	HUMAN R	3e329560-	counter	null	42439
23	2022-12-01T17:59:09.08	c1c6cf40-	1	HUMAN R	3e329560-	counter	null	42249
24	2022-12-01T17:59:07.99	c1c6cf40-	1	HUMAN R	3e329560-	counter	null	41873
25	2022-12-01T17:59:06.91	c1c6cf40-	1	HUMAN R	3e329560-	counter	null	42439
26	2022-12-01T17:59:05.74	c1c6cf40-	1	HUMAN R	3e329560-	counter	null	42439
27	2022-12-01T17:59:04.69	c1c6cf40-	1	HUMAN R	3e329560-	counter	null	41134



CONCLUSION: Thus, in a nutshell, we calculated the BPM (Beats per Minute), Percentage of oxygen in blood and Galvanic Skin Resistance using GSR and SpO2 sensor. The values of basic vitals obtained in this project are stored in the Cayenne cloud and are analysed later. It can be further used in future for calculating a variety of different parameters.

FUTURE IMPROVEMENTS: This model can become the basis of creating a fully automated system for monitoring health. Integrating the present model with more sensors and machine learning model, a smart automated healthcare device can be created.