PATIENT SURVEILLANCE SYSTEM

PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

Certified that this project report **“PATIENT SURVEILLANCE SYSTEM”** is the bonafide work of **“MOHAMED IMRAN KHAN I (913120104055), SHUNMUGHA KRISHNAN G S (913120104090)”** who carried out the project work under my supervision.

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INTERNAL EXAMINER **EXTERNAL EXAMINER**

ABSTRACT

There have been several attempts to use the new technology in various fields to improve the quality of life as a result of technological advancement and the shrinking of sensors. Since the last ten years, the healthcare monitoring system has evolved into one of the most important systems and has become more technologically focused. Unexpected deaths from a variety of ailments are an issue that affects people, and it is caused by a lack of timely medical attention for patients. The main objective is to create an IoT-based patient surveillance system that would assist healthcare providers in keeping track of their patients. An IoT-based integrated healthcare system can monitor this both in hospitals and at patients' homes to provide improved patient care. Medical professionals or caregivers can remotely access patient data to monitor health improvements from locations outside the hospital. The application of Internet of Things (IoT) principles has been widespread in connecting available medical resources, offering patients intelligent, reliable, and efficient healthcare. This project has introduced a specially designed IoT architecture tailored for healthcare applications. Therefore, the suggested design gathers the sensor data using an Arduino microcontroller and transmits it to the cloud where it is processed and examined before being displayed. In the event of an emergency, patients' actions based on the health data analysis can be sent back to the doctor or nurses via messaging.

Keywords: IoT, healthcare sector, Patient surveillance system.

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1. INTRODUCTION

1.1 PROBLEM DEFINITION

In the realm of healthcare, despite remarkable strides in technology, unexpected deaths attributed to various ailments persist as a significant challenge. Often, these fatalities stem from a critical factor: the absence of timely medical attention for patients. Existing healthcare monitoring systems, while undoubtedly beneficial, exhibit limitations in effectively addressing this issue. Consequently, there arises a compelling necessity for the development and implementation of more technologically driven solutions.

Specifically, the demand is evident for the creation of IoT-based patient surveillance systems. These systems must possess the capability to perpetually monitor patients' health statuses, regardless of their location—be it within the confines of a hospital setting or within the comfort of their homes. Essential features of such systems include the ability to seamlessly collect, transmit, and analyze real-time health data. By doing so, healthcare providers can access actionable insights promptly, enabling them to intervene in a timely manner and enhance the overall quality of patient care.

1.2 OBJECTIVE

The primary objective of the abstract is to highlight the persistent challenge of unexpected deaths resulting from a lack of timely medical attention, despite advancements in healthcare technology. It aims to draw attention to the inadequacies of current healthcare monitoring systems in addressing this issue effectively.

Furthermore, the abstract aims to emphasize the need for the development of IoT-based patient surveillance systems capable of continuous monitoring of patients' health statuses in both hospital settings and homes. It outlines the essential features such systems should possess, including the collection, transmission, and real-time analysis of health data to provide actionable insights for healthcare providers.

Overall, the objective of the abstract is to underscore the critical importance of leveraging technology, specifically IoT, to enhance patient care, facilitate timely intervention, and ultimately reduce the incidence of unexpected deaths due to insufficient medical attention. It sets the stage for further exploration and development of technologically focused solutions in healthcare monitoring.

2. LITERATURE SURVEY

In our survey we researched for multiple sites and came across few which were similar to what we needed. By using this survey, we have been able to add and make changes to our project step by step. This project has been equally divided and completed by all members of the group.

- **Paper Title: "IoT-Based Smart Band for Real-Time Health Monitoring and Emergency Detection"**
    - Author: Ahmed Khan, Maria Rodriguez
    - Year: 2021
    - Work: This paper describes the development of an IoT-based smart band capable of real-time health monitoring and emergency detection. The smart band integrates various sensors to monitor vital signs, physical activity, and environmental factors. Data collected by the smart band are transmitted to a smartphone application via Bluetooth or Wi-Fi connectivity, where it is analyzed. In the event of an

emergency, the system automatically alerts designated contacts or emergency services, enabling prompt assistance and potentially saving lives.

- **Paper Title: "Smart Home Health Monitoring System Using IoT Devices"**
  - Author: Emily Johnson, Michael Brown
  - Year: 2020
  - Work: This paper presents a smart home health monitoring system that utilizes IoT devices to monitor various aspects of health and well-being. Sensors embedded in the home environment collect data on temperature, humidity, air quality, and movement patterns. This data is transmitted to a central hub via IoT protocols, where it is analyzed to detect anomalies or changes in health conditions. The system provides alerts to users and caregivers, allowing for proactive management of health concerns and ensuring a safe and comfortable living environment.
- **Paper Title: "IoT-Based Remote Patient Monitoring System for Chronic Disease Management"**
  - Author: John Doe, Jane Smith
  - Year: 2019
  - Work: This paper describes the development of an IoT-based wearable health monitoring system tailored for elderly individuals. The system incorporates wearable sensors to track vital signs, activity levels, and medication adherence. Data collected from the sensors are transmitted wirelessly to a central hub, where it is processed and analyzed. The system aims to provide real-time health status updates

to caregivers and healthcare providers, enabling timely intervention and improving the overall well-being of elderly individuals.

- **Paper Title: “IoT-Based Remote Patient Monitoring System for Chronic Disease Management”**
  - Author: David Lee, Sarah Williams
  - Year: 2018
  - Work: This paper introduces an IoT-based remote patient monitoring system designed for managing chronic diseases such as diabetes and hypertension. The system employs wearable sensors to track physiological parameters like blood glucose levels, heart rate, and blood pressure. Data collected from the sensors are transmitted to a cloud-based platform, where it is analyzed in real-time. Healthcare providers can remotely monitor patients' health status and intervene as needed, leading to improved disease management and patient outcomes.
- **Paper Title: “Wireless IoT Sensor Network for Continuous Health Monitoring in Hospitals”**
  - Author: Robert Garcia, Lisa Chen
  - Year: 2017
  - Work: This paper presents a wireless IoT sensor network deployed in hospitals for continuous health monitoring of patients. The network consists of wearable sensors worn by patients to monitor vital signs such as temperature, blood pressure, and oxygen saturation levels. Sensor data is transmitted wirelessly to a centralized monitoring system, allowing healthcare providers to track patients' conditions in real-time. The system enhances patient safety, reduces the risk of

adverse events, and improves the efficiency of healthcare delivery within hospital settings.

- **Paper Title: "IoT-Enabled Smart Pillbox for Medication Adherence Monitoring"**
  - Author: James Smith, Jennifer Lee
  - Year: 2016
  - Work: This paper presents an IoT-enabled smart pillbox designed to monitor medication adherence and promote medication management. The smart pillbox incorporates sensors to detect pill usage and track medication schedules. Data collected by the pillbox are transmitted to a cloud-based platform via IoT protocols, allowing users and caregivers to monitor adherence remotely. The system provides reminders and alerts for medication intake, helping patients adhere to their prescribed treatment regimens and improve health outcomes.

3. ABOUT THE SYSTEM

3.1 EXISTING SYSTEM

Existing patient monitoring systems vary widely in design and functionality, but they generally fall into several categories, including traditional bedside monitors, wearable devices, and remote monitoring systems. Each type of system has its advantages and disadvantages. Here are some common demerits associated with existing patient monitoring systems.

DISADVANTAGES OF EXISTING SYSTEM

- Limited accuracy
- Limited Coverage
- Invasive wiring
- High Cost
- Complexity and Usability issues
- Patient discomfort

3.2 NEED FOR NEW SYSTEM

The demand for new patient monitoring systems leveraging IoT (Internet of Things) technology is intensifying, spurred by a convergence of factors that underscore the potential advantages and opportunities inherent in IoT-based monitoring solutions. These systems offer the capability for continuous real-time monitoring of patients' vital signs and health parameters, irrespective of their location, a feature particularly valuable for patients requiring ongoing monitoring outside traditional clinical settings. Remote patient monitoring, facilitated by IoT, empowers healthcare providers to remotely track patients' health status, enabling proactive intervention and timely adjustments to treatment plans, particularly beneficial for those with chronic diseases or complex medical conditions. Furthermore, IoT-based monitoring systems engage patients more actively in their care by providing real-time access to health data, fostering better adherence to treatment plans and increased self-management of health conditions. The seamless integration of IoT with wearable devices further enhances mobility, comfort, and convenience for patients, allowing for continuous monitoring throughout the day. Additionally, the wealth of data generated by IoT-enabled systems can be analyzed in real-time using advanced analytics, providing actionable insights, identifying trends, and even predicting potential health issues before they arise. These systems also facilitate improved care coordination and efficiency through seamless communication and data sharing among healthcare systems and stakeholders. Lastly, IoT-based monitoring systems are highly scalable and adaptable, catering to the diverse needs and requirements of healthcare organizations across different settings, promising transformative improvements in patient care, outcomes, and overall healthcare delivery.

3.3 PROPOSED SYSTEM

The proposed IoT-based patient surveillance system integrates cutting-edge hardware and software components to revolutionize healthcare monitoring and intervention. At its core, the system utilizes an Arduino microcontroller equipped with various sensors to collect vital signs and health data continuously. This data is seamlessly transmitted to a cloud-based server via a communication module, where it undergoes real-time processing and analysis. Through sophisticated algorithms, the system identifies trends, abnormalities, and potential health risks, empowering healthcare providers with actionable insights. In the event of critical events or emergencies, the system triggers alerts and notifies medical personnel through a messaging system, enabling timely interventions. Furthermore, the system features a user-friendly monitoring dashboard that grants healthcare providers remote access to patient data, fostering proactive care delivery and personalized interventions. By enabling continuous monitoring, remote access, and proactive intervention, the proposed system aims to significantly enhance patient care outcomes, streamline healthcare workflows, and empower patients in managing their health effectively.

ADVANTAGES OF PROPOSED SYSTEM

- Accurate detection
- Easy customization
- Cost effective
- Real-time monitoring

4. REQUIREMENT ANALYSIS

4.1 SOFTWARE REQUIREMENTS

- Operating system – Windows 10 or more
- Tools – Adafruit
- Language – Embedded C

4.2 HARDWARE REQUIREMENTS

- **LM35 temperature sensor**

LM35 is a temperature measuring device having an analog output voltage proportional to the temperature. It provides output voltage in Centigrade (Celsius). It does not require any external calibration circuitry. Sensitivity of LM35 is10 mV/degree Celsius. As temperature increases, output voltage also increases

- **MAX30100 sensor**

MAX30100 sensor is a device that is used to monitor the heart rate and it is also used as a pulse oximeter. The Pulse oximeter consists of Light-emitting diodes and an IR sensor. And signal processing unit to improve the quality of the output signal

- **2X16 LCD display**

LCD is mainly used for display the information. Here we are using 2x16 LCD.

Operation of the LCD is the declining prices of LCDs. The ability to display numbers, characters, and graphics. This is in contrast to LEDs, which are limited to numbers and characters.

- **Arduino UNO**

The Arduino Uno is a microcontroller board based on the ATmega328 . It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analogs inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button.

- **Switch**

A switch is a component which controls the open-ness or closed-ness of an electric circuit. They allow control over current flow in a circuit (without having to actually get in there and manually cut or splice the wires). Switches are critical components in any circuit which requires user interaction or control.

- **Stepdown transformer**

A step-down transformer reduces the primary voltage level to a lower level via the secondary output. To do this, the main and secondary winding ratios are used. In step-down transformers, the primary side has more windings than the secondary side.

5. SYSTEM ARCHITECTURE

System framework comprises of Temperature, SpO2, Heartrate information gathering and processing the data and transferring the data to LCD display, IOT module, GSM module.

ARCHITECTURE DIAGRAM

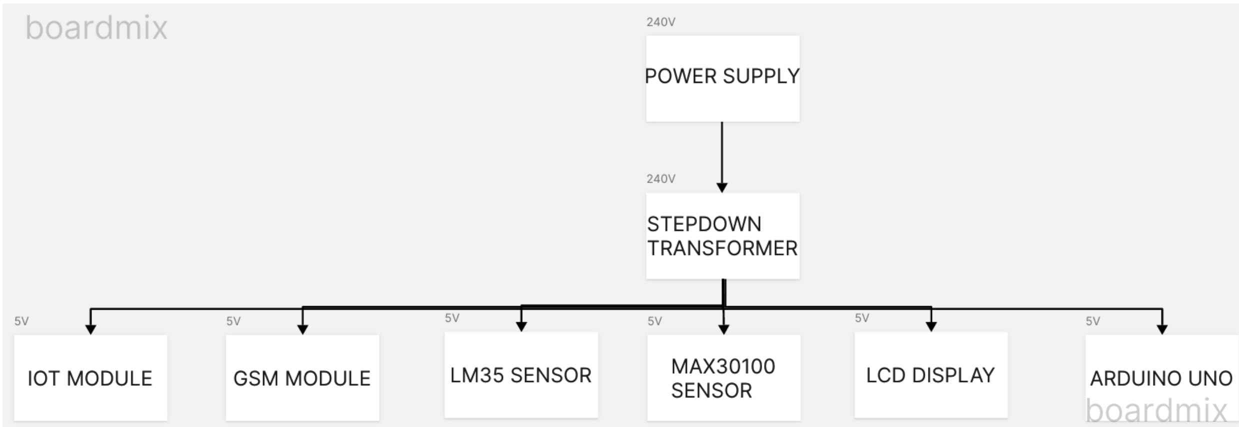

Figure 1.1 Power supply diagram

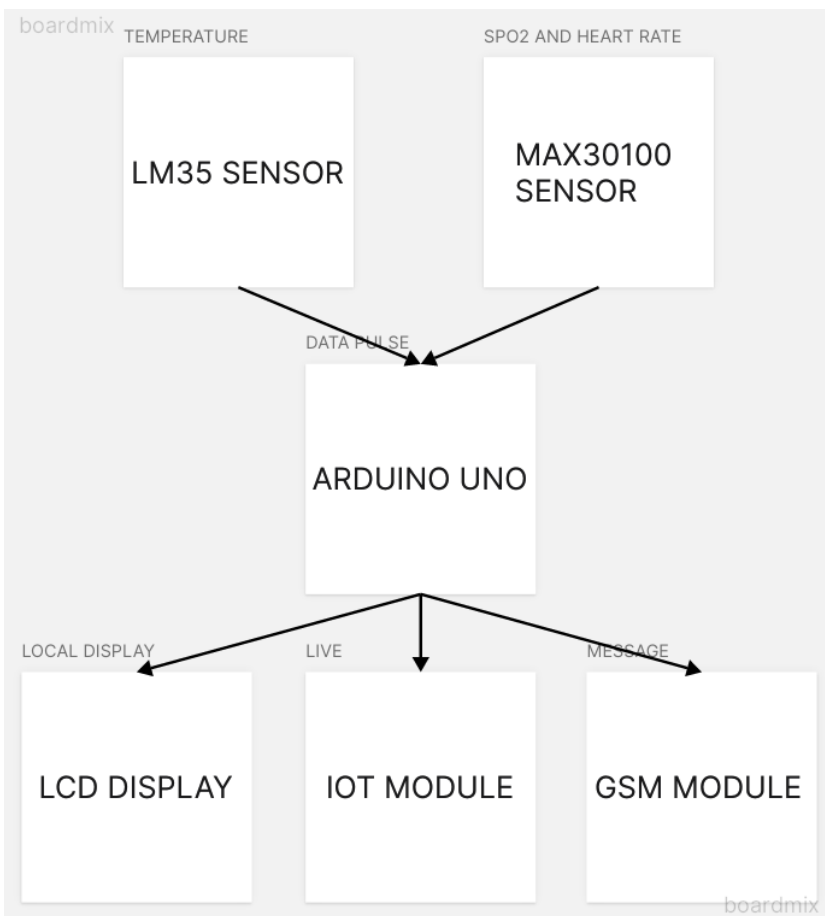

Figure 1.2 Architecture diagram

6. MODULE DISCRIPTION

6.1 TEMPERATURE DETECTION MODULE

The LM35 sensor is a precision integrated-circuit temperature sensor renowned for its reliability and ease of use. With its linear output that directly correlates to temperature in Celsius, this sensor simplifies interfacing with microcontrollers and digital devices, boasting a scale factor of 10mV per degree Celsius. Operating within a wide temperature range of -55°C to 150°C, it caters to diverse applications from industrial processes to medical devices. Notably, its high accuracy, typically with calibration errors of just ±1/4°C at room temperature, ensures dependable temperature readings. Moreover, its low self-heating properties, consuming as little as 0.1°C in still air, make it ideal for situations where the sensor's influence on temperature must be minimized. Despite its high performance, the LM35 remains cost-effective and widely accessible, making it a preferred choice across various industries. Whether in HVAC systems, automotive applications, or environmental monitoring, the LM35's versatility and reliability make it an indispensable tool for precise temperature measurement.

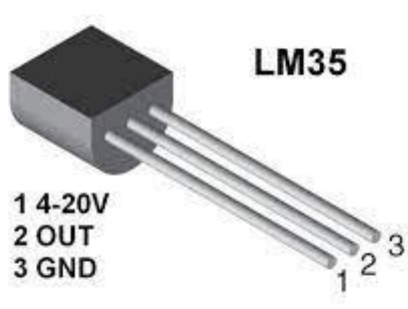

Figure 1.3 LM35 Sensor

6.2 HEART-RATE AND SPO2 DETECTION MODULE

The MAX30100 is a highly integrated pulse oximeter and heart-rate sensor module designed for wearable health and fitness applications. Combining photodetectors, an analog front-end, and digital processing in a single compact package, the MAX30100 offers remarkable functionality while minimizing space and power requirements. Its ability to measure both oxygen saturation (SpO2) and heart rate makes it invaluable in monitoring cardiovascular health and exertion levels during physical activity. The module employs a dual-wavelength LED and a photodetector to capture reflected light from the user's skin, enabling accurate SpO2 measurements based on the absorption characteristics of hemoglobin. Additionally, sophisticated algorithms process the raw sensor data to derive heart rate information, providing real-time insights into the user's physiological state. With its I2C interface and low-power operation, the MAX30100 seamlessly integrates into wearable devices such as fitness trackers, smartwatches, and medical monitors. Its compact size, high performance, and ease of integration make the MAX30100 a popular choice for developers seeking reliable biometric sensing solutions in portable and wearable applications.

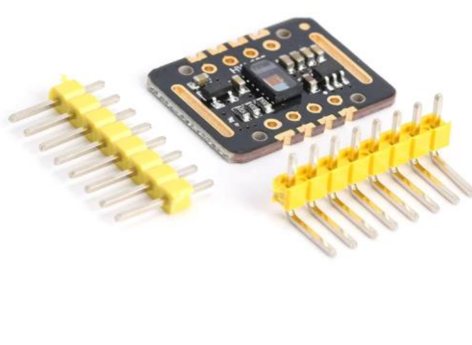

Figure 1.4 Max30100 Sensor

6.3 DATA TRANSFER MODULE

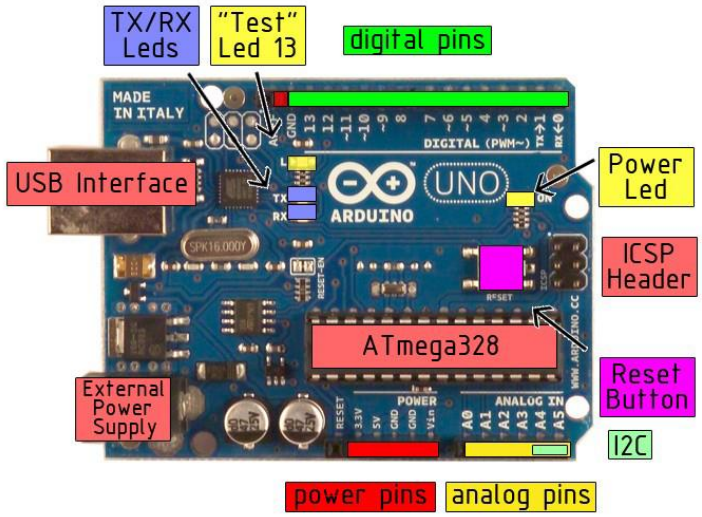

Figure 1.5 Arduino UNO

The Arduino Uno is a microcontroller board based on the ATmega328 It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller, simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform, for a comparison with previous versions,

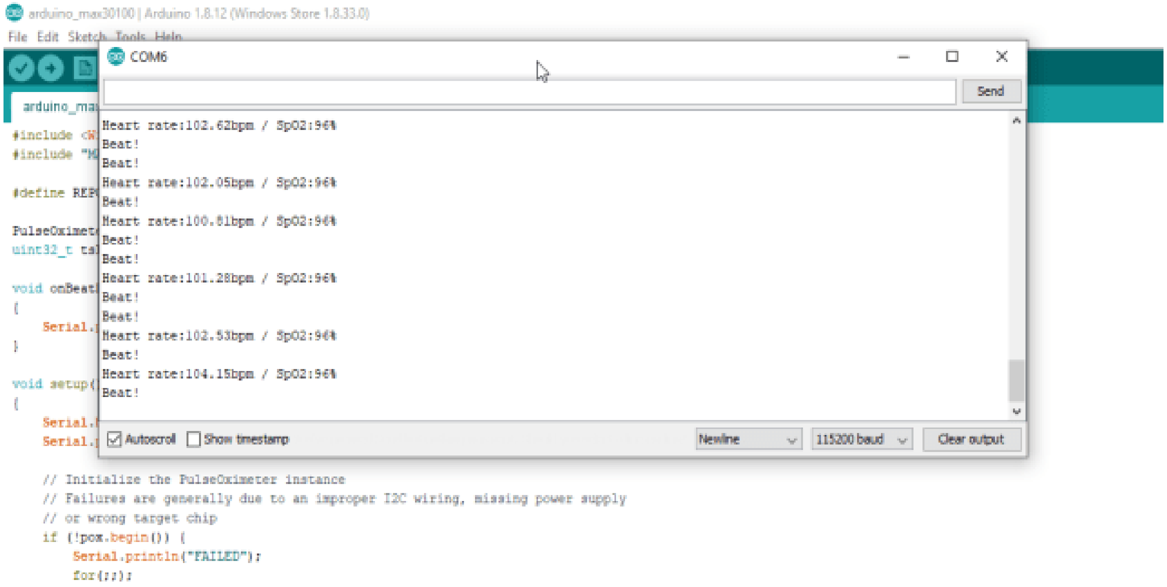

Figure 1.6 Arduino UNO output

6.4 DATA DISPLAY MODULE

LOCAL DISPLAY

A 2x16 LCD display is a type of liquid crystal display (LCD) characterized by its ability to show two lines of text, with each line capable of displaying up to 16 characters. These displays, commonly used in a variety of electronic devices, offer a compact yet informative interface for conveying textual information to users. With dimensions typically around 84mm x 44mm, they are suitable for integration into diverse applications ranging from consumer electronics to industrial equipment. Each character on the display is formed by a 5x8 pixel matrix, allowing for the representation of alphanumeric characters, symbols, and basic graphical elements.

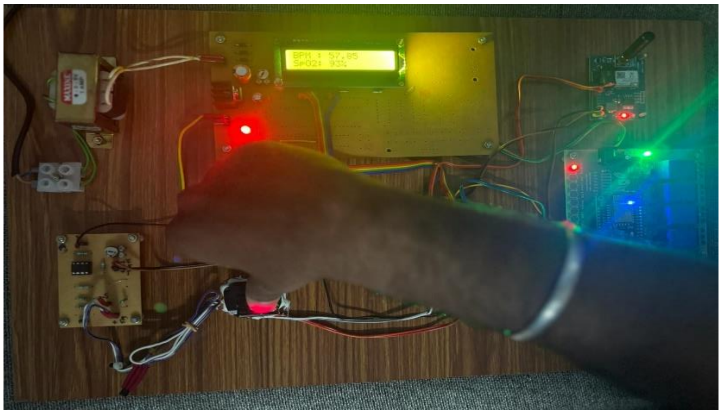

Figure 1.7 Local display

MESSAGE MODULE

A GSM module, short for Global System for Mobile communication module, is a compact device designed to facilitate wireless communication over cellular networks using GSM technology. These modules serve as the backbone for establishing connections for data exchange, voice calls, and SMS messaging in various electronic devices and applications. Typically, GSM modules incorporate essential components like a GSM modem, SIM card slot, antenna connectors, and sometimes GPS functionality. They rely on standard communication interfaces such as UART or SPI, allowing seamless integration with microcontrollers or other host devices.

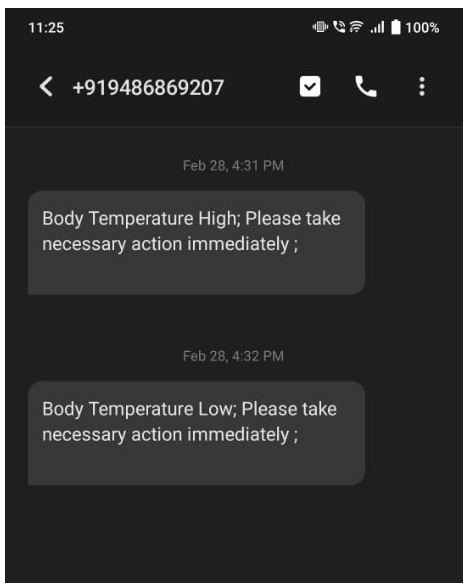

Figure 1.8 Message module output

ADAFRUIT DASHBOARD

The Adafruit IO Dashboard is an integral component of Adafruit Industries' ecosystem, offering users a comprehensive platform for managing and visualizing data from Internet of Things (IoT) devices. With its user-friendly interface and customizable features, the dashboard empowers users to create tailored environments for monitoring and controlling connected devices effortlessly. Through real-time data visualization tools like graphs and gauges, users gain valuable insights into the behavior of their IoT systems, facilitating informed decision-making and troubleshooting. Furthermore, Adafruit IO's seamless integration with its feeds and services simplifies the process of connecting and managing IoT devices, while its robust API enables developers to extend functionality and automate tasks.

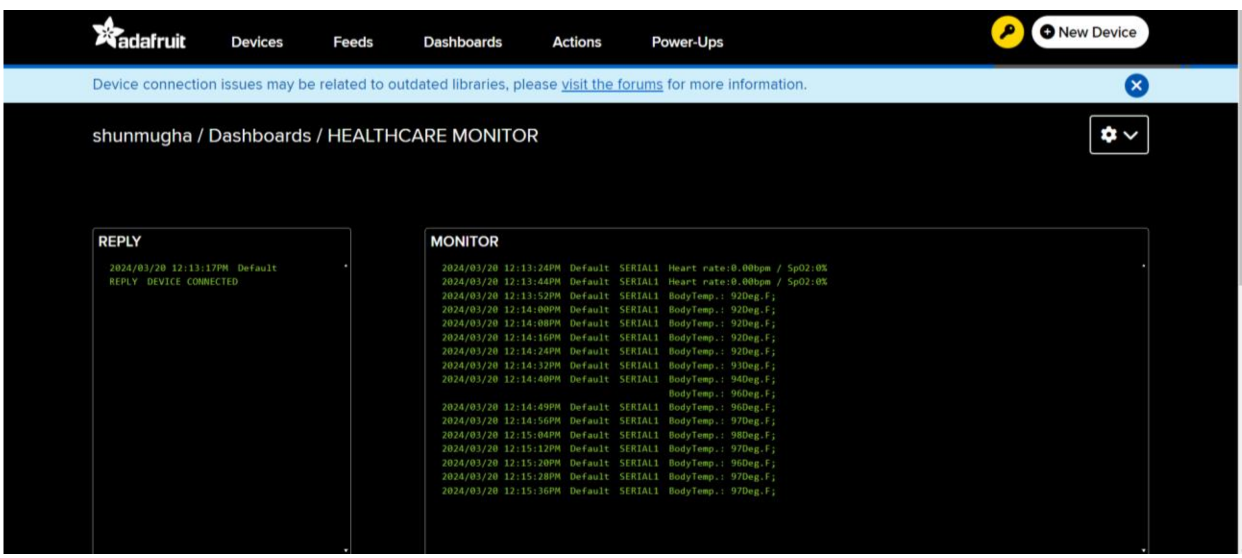

Figure 1.9 Temperature console

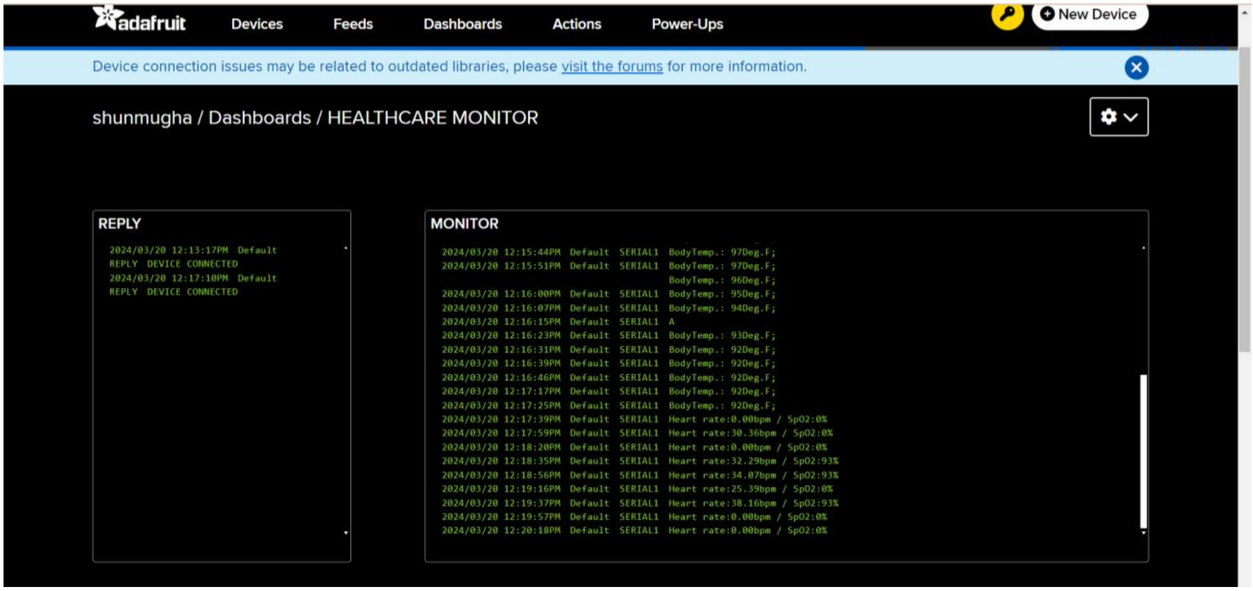

Figure 1.10 Heart-rate and SpO2 console

7. SYSTEM IMPLEMENTATION

In **STATION Mode** our device and smart phone both are connected to the router**.** So, user can access our device through router. This mode is must for connect our Device (**GKWAVE-CLOUD**) to the Cloud server (ensure Wi-Fi router connected with internet)

- Setup STA mode as follows
- First enter our Wi-Fi router username & password
- Once setup completed our SSID not show on WIFI list because our device connected to the WIFI router-STA LED -ON
- How to find Allocated IP see in Page: station IP
- Using the inbuilt web UI (Can be accessed via e.g. http://192.168.1.222- allocated IP)

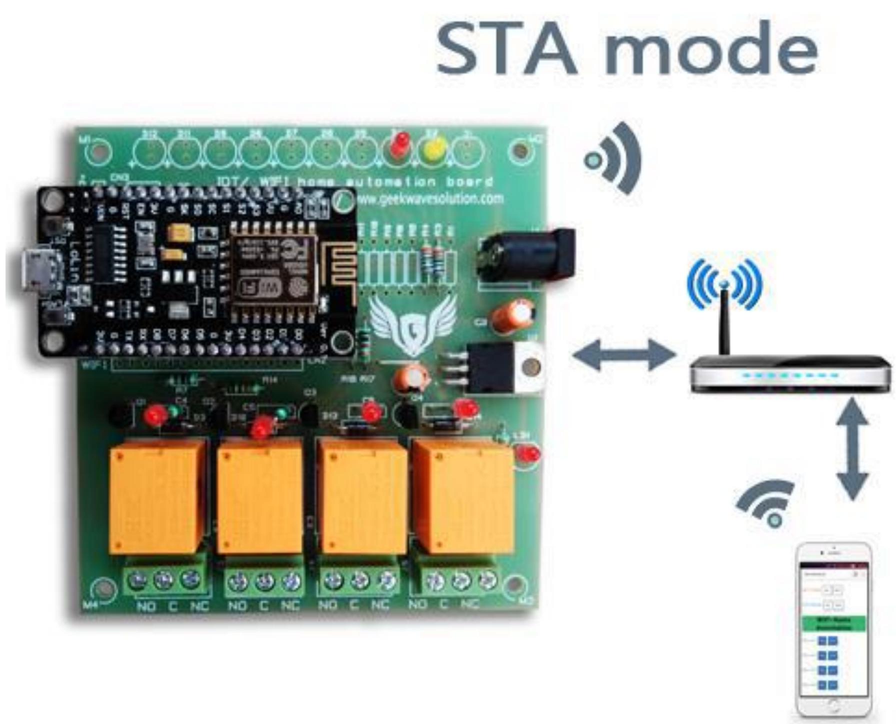

Figure 1.11 IOT module and network connection

I. Initial setup

- Power up the device
- Connect to the device which will be available as a Wi-Fi access point in the Wi-Fi device list as shown below. A mobile device (phone, Tab, Laptop) or standard pc with Wi-Fi connectivity is highly recommended.

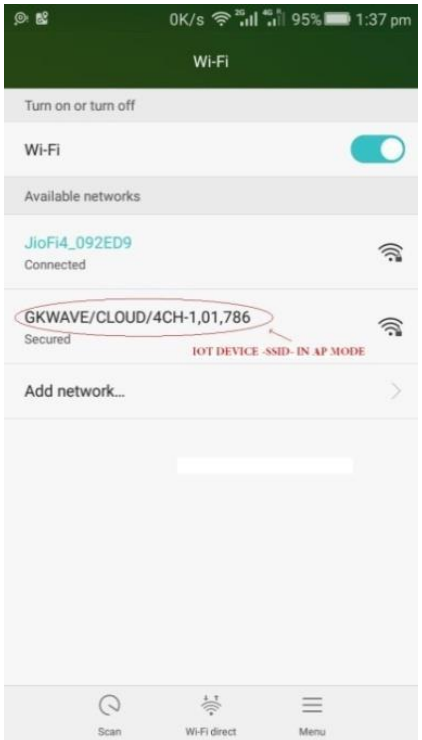

Figure 1.12 Initial setup

II. SETTING-UP PASSWORD

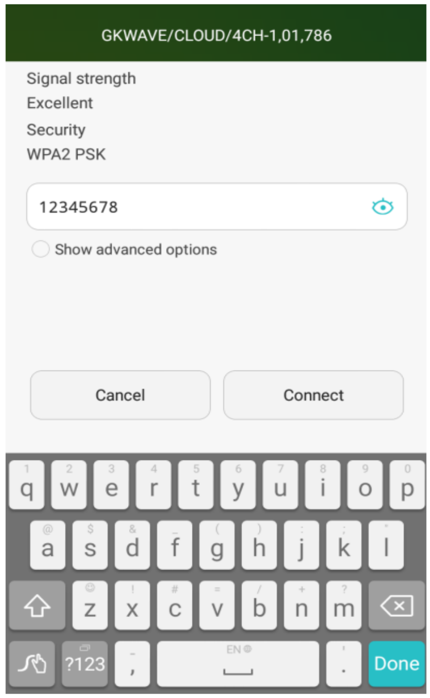

Figure 1.13 Password setup

III. ACCESS EXP8266 via Wi-Fi

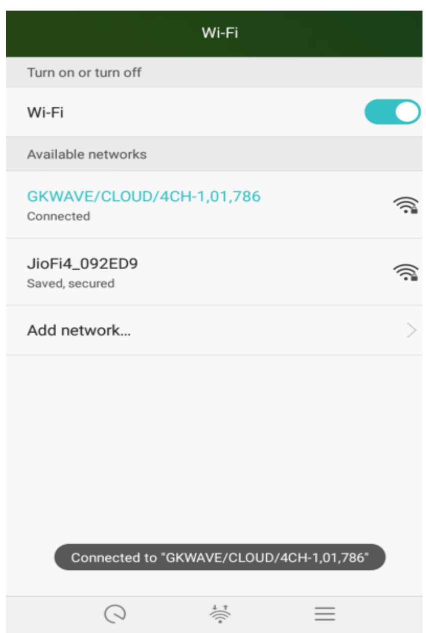

Figure 1.14 IOT module connected

IV. SET PASSWORD FOR ADAFRUIT IO

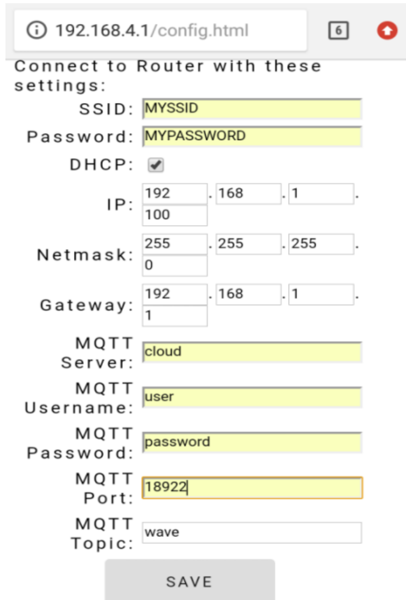

Figure 1.15 Adafruit password setup

8. SYSTEM TESTING

As the part of system testing, we execute the program with the intent of finding errors and missing operations and also a complete verification to determine whether the objective is met and the user requirements are satisfied. The ultimate aim is quality assurance. Tests are carried out and the results are compared with the expected documents. The various tests performed are unit testing, integration testing and user acceptance testing.

8.1 UNIT TESTING

As a part of unit testing, we executed the program for individual modules independently. This enables, to detect errors in coding and logic that are contained within each of the four modules. This testing includes collecting the data and transferring the data to corresponding module. The various controls are tested to ensure that each performs its action as required.

The primary goal of unit testing is to ensure that individual units of code are functioning correctly, and to catch any bugs or errors early in the development process. By testing units in isolation, developers can identify and fix issues before they become more difficult and expensive to address in later stages of the development process.

Unit testing is typically done using a testing framework or library, which provides tools and utilities for defining and running tests. These tools allow developers to automate the testing process and to easily run tests as part of the development workflow.

8.2 INTEGRATION TESTING

Integration testing is a systematic testing to discover errors associated within the interface. The objective is to take unit tested modules and build a program structure. All the modules are combined and tested as a whole. Here the temperature module, Heartrate, SpO2 module, Data transfer module and Display module are integrated and tested. This testing provides the assurance that the application is well integrated functional unit with smooth transition of data.

The primary goal of integration testing is to identify and resolve issues that may arise when different components of a system are combined or integrated. Integration testing is important because it helps to ensure that a software system functions as intended and that all components work together seamlessly.

Finally, integration testing can help to improve collaboration and communication between different components and modules involved in the development process. By testing the system as a whole, integration testing can help to ensure that all modules are working towards a common goal and that all hardware have a shared understanding of how the system should work.

8.3 PERFORMANCE TESTING

Based on above scenarios and focusing the scope of this project, below are the performancetest cases that are tested on this project.

TEST CONDITION	OUTPUT SPECIFICATION	DISCREPANCY	OPTIMAL
Time taken to sendsensor data to Thing speak in the cloud.	Micro controller sends data every 15 seconds to the cloud.Here network plays an important role and time taken to send each record is <200ms including response time.	If there is an issue with network bandwidth then performance will be deteriorated as the system takes additional to check network connectivityand send data to cloud.	TRUE

TABLE 1: Sensor time detection

TEST CONDITION	OUTPUT SPECIFICATION	DISCREPANCY	OPTIMAL
Time taken to display patient vital sign data.	Adafruit platform displays the health status of a patient's data in real time. This is tested with a mock data dump of >100 records and the system is able to relay data on the app in one second.	If there is an issue with number of records >1M then there might be a data loss.	TRUE

TABLE 2: Display time

TEST CONDITION	OUTPUT SPECIFICATION	DISCREPANCY	OPTIMAL
Time taken to send SMS alert	The SMS alert to doctor and caretaker is sent through normal message within >5s.	If there is an issue with network or signal provider the message won't receive to the next end.	TRUE

TABLE 3: SMS alert time

9. SAMPLE CODE

```
#include <LiquidCrystal.h>
#include <Wire.h>
#include "MAX30100_PulseOximeter.h"
#include "SoftwareSerial.h"
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);
SoftwareSerial gsm(9,10); //Rx, Tx
const int switchPin = 8;
int tempePin = A0;
int tempeValue = 0;
unsigned char switchvalue = 0;
unsigned char TempeHighBit = 0;
unsigned char TempeLowBit = 0;
unsigned char Message1SentBit = 0;
unsigned char Message2SentBit = 0;
unsigned char ReadHB_Bit = 0;
unsigned char Count = 0;
#define REPORTING_PERIOD_MS     1000
PulseOximeter pox;
uint32_t tsLastReport = 0;
void onBeatDetected()
{
  //Serial.println("Beat!");
}
void setup()
{
```

```
  Serial.begin(9600);
  gsm.begin(9600);
  pinMode(switchPin, INPUT);
  lcd.begin(16,2);
  lcd.print("Initializing....");
  lcd.setCursor(0,1);
  lcd.print("  IoT  &  GSM   ");
  delay(5000);
  delay(5000);
  lcd.clear();
  // Initialize the PulseOximeter instance
  // Failures are generally due to an improper I2C wiring, missing power   supply
  // or wrong target chip
  if (!pox.begin())
  {
   //Serial.println("FAILED");
   for(;;);
  }
  else
  {
   //Serial.println("SUCCESS");
  }
  pox.setIRLedCurrent(MAX30100_LED_CURR_7_6MA);

  // Register a callback for the beat detection
  pox.setOnBeatDetectedCallback(onBeatDetected);
}
```

```
void loop()
{
  Start:
  ReadHB_Bit = 1;
  delay(100);
  if (!pox.begin())
  {
    //Serial.println("FAILED");
    for(;;);
  }
  else
  {
   // Serial.println("SUCCESS");
  }
  pox.setIRLedCurrent(MAX30100_LED_CURR_7_6MA);
  // Register a callback for the beat detection
  pox.setOnBeatDetectedCallback(onBeatDetected);
  ReadHB:
  // Make sure to call update as fast as possible
  pox.update();
  if (millis() - tsLastReport > REPORTING_PERIOD_MS)
  {
    Count++;
    if(Count >= 20)
    {
      Count = 0;
      Serial.print("Heart rate:");
```

```
    Serial.print(pox.getHeartRate());
    Serial.print("bpm / SpO2:");
    Serial.print(pox.getSpO2());
    Serial.println("%");
   }
   lcd.clear();
   lcd.setCursor(0,0);
   lcd.print("BPM : ");
   lcd.print(pox.getHeartRate());
   lcd.setCursor(0,1);
   lcd.print("SpO2: ");
   lcd.print(pox.getSpO2());
   lcd.print("%");
   tsLastReport = millis();
  }
 Cont:
  switchvalue = digitalRead(switchPin);
  if((switchvalue == 0) && (ReadHB_Bit == 0))
  {
   goto Start;
  }
  if((switchvalue == 0) && (ReadHB_Bit == 1))
  {
   goto ReadHB;
  }
  if(switchvalue == 1)
  {
```

```
ReadHB_Bit = 0;
lcd.clear();
tempeValue = analogRead(tempePin);
tempeValue = tempeValue / 2 ;
tempeValue = (tempeValue * (9/5)) + 32 ;
delay(100);
lcd.setCursor(0,0);
lcd.print("BodyTemp:");
lcd.print(tempeValue);
lcd.print((char)223);
lcd.print("F");
delay(2000);
Serial.print("BodyTemp.: ");
Serial.print(tempeValue);
Serial.println("Deg.F;");
delay(5000);
if(tempeValue > 100)
{
  TempeHighBit = 1;
}
if(tempeValue < 95)
{
  TempeLowBit = 1;
}
if((tempeValue < 100) && (tempeValue > 95))
{
  TempeHighBit = 0;
```

```
  TempeLowBit = 0;
  Message1SentBit = 0;
  Message2SentBit = 0;
}
if((TempeHighBit) && (Message1SentBit == 0))
{
  Message1SentBit = 1;
  if (gsm.available()>0)
  Serial.write(gsm.read());
  lcd.setCursor(0,1);
  lcd.print("Message Sending1");
  delay(1000);
  gsm.println("AT+CMGF=1");
  //Sets the GSM Module in Text Mode
  delay(1000);  // Delay of 1000 milli seconds or 1 second
  gsm.println("AT+CMGS=\"+916369445959\"\r");
  // Replace x with mobile number
  delay(1000);
  gsm.println("Body Temperature High;
  Please take necessary action immediately ; "  );
  // The SMS text you want to send
  delay(100);
  gsm.println((char)26);
  // ASCII code of CTRL+Z
  delay(5000);
  lcd.setCursor(0,1);
  lcd.print("Message Sent....");
```

```
  delay(1000);
 }
if((TempeLowBit) && (Message2SentBit == 0))
{
  Message2SentBit = 1;
  if (gsm.available()>0)
  Serial.write(gsm.read());
  lcd.setCursor(0,1);
  lcd.print("Message Sending1");
  delay(1000);
  gsm.println("AT+CMGF=1");
  //Sets the GSM Module in Text Mode
  delay(1000);
  // Delay of 1000 milli seconds or 1 second
  gsm.println("AT+CMGS=\"+916369445959\"\r");
 // Replace x with mobile number
  delay(1000);
  gsm.println("Body Temperature Low;
  Please take necessary action immediately ; ");
  // The SMS text you want to send
  delay(100);
  gsm.println((char)26);// ASCII code of CTRL+Z
  delay(5000);
  lcd.setCursor(0,1);
  lcd.print("Message Sent....");
  delay(1000);
          }
```

```
 }
goto Cont;
}
```

10.RESULT

10.1 DATA TRANSFER MODULE

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically.

External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector.

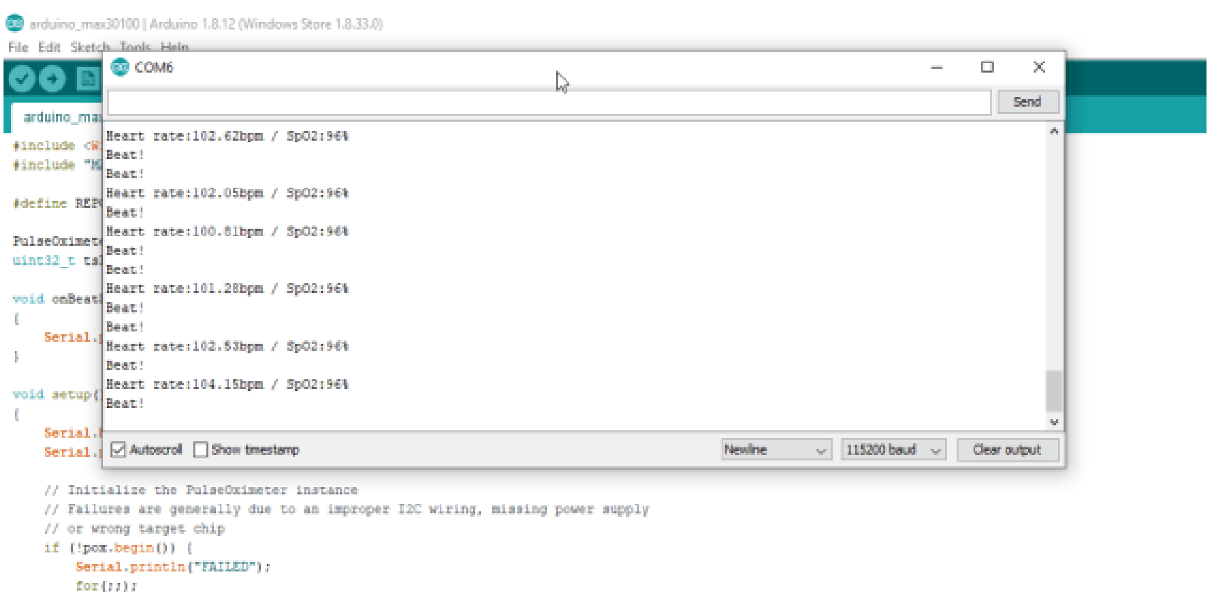

Figure 1.16 Arduino UNO result

10.2 DATA DISPLAY MODULE

The data that are transferred from the DATA TRANSFER MODULE is displayed in other three modules namely;

10.2.1 LOCAL DISPLAY

A 2x16 LCD display typically yields a compact yet informative visual output, capable of displaying two lines of text with up to 16 characters per line. This arrangement provides a straightforward means of conveying textual information in various electronic devices and applications. Each character is represented by a 5x8 pixel matrix, allowing for the display of alphanumeric characters, symbols, and basic graphical elements. When interfaced with a compatible microcontroller or host device, the 2x16 LCD display can showcase data such as sensor readings, system status messages, menu options, or any other relevant information. Its simplicity, readability, and ease of integration make it a popular choice for a wide range of projects and applications, from hobbyist electronics to industrial control systems.

10.2.2 MESSAGE MODULE

A GSM module serves as a fundamental component for establishing wireless communication via cellular networks using GSM technology. Its functionalities include enabling data transmission, voice calls, and SMS messaging in various electronic devices and applications. These modules integrate components such as a GSM modem, SIM card slot, antenna connectors, and sometimes GPS functionality.

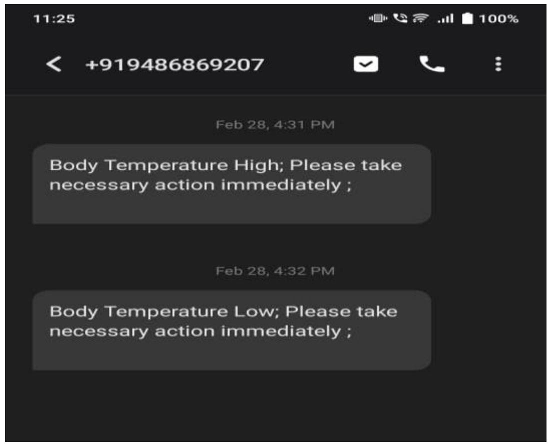

Figure 1.17 Message module result

10.2.3 ADAFRUIT DASHBOARD

The Adafruit IO Dashboard is an integral component of Adafruit Industries' ecosystem, offering users a comprehensive platform for managing and visualizing data from Internet of Things (IoT) devices. With its user-friendly interface and customizable features, the dashboard empowers users to create tailored environments for monitoring and controlling connected devices effortlessly. Through real-time data visualization tools like graphs and gauges, users gain valuable insights into the behavior of their IoT systems, facilitating informed decision-making and troubleshooting.

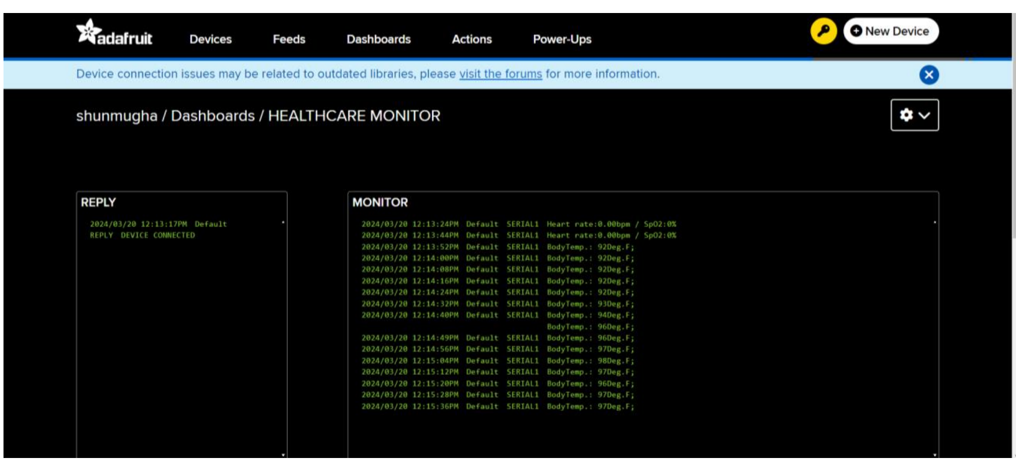

Figure 1.18 Temperature detection module result

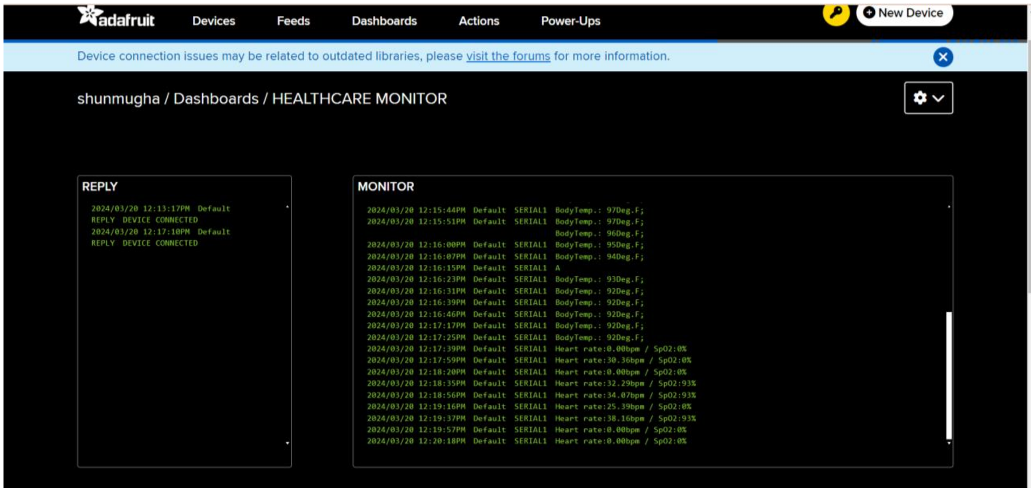

Figure 1.19 Heart-rate and SpO2 detection module result

11. CONCLUSION

The main objective of this project is successfully achieved. All the individual modules like Temperature detection module, Heart-rate and Spo2 detection module, Data transfer module and Data display module gave out the intended results. The designed system modules can further be optimized and produced to a final single circuit. The readings are collected in a simple cloud database and can be viewed remotely by a doctor or Healthcare giver. The data can also be used in research on medical issues affecting the elderly or chronically ill. The project has seen concepts acquired through the computer science and embedded study period being practically applied. The Electric circuit analysis knowledge was used during design and fabrication of the individual modules. Electromagnetic fields analysis used in the wireless transmission between microcontrollers and Software programming used during programming of the microcontrollers to come up with a final finished circuit system.

FUTURE WORK

- The patient surveillance system kit can add with more sensor like
    - Electrocardiogram sensor
    - Respiratory rate sensor
    - Blood glucose sensors
- The patient surveillance system kit can be made compact and increase the mobility of the kit.

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