NATIONAL INSTITUTE OF BUSINESS MANAGEMENT

SCHOOL OF COMPUTING AND ENGINEERING

HIGHER NATIONAL DIPLOMA IN SOFTWARE ENGINEERING

KANDY 24.1F

INTERNET OF THINGS SECOND PROGRESS REPORT

ADVACE HEALTH CARE MONITORING MONITORRING SYSTEM

GROUP NO - 10

SUBMITTED BY:

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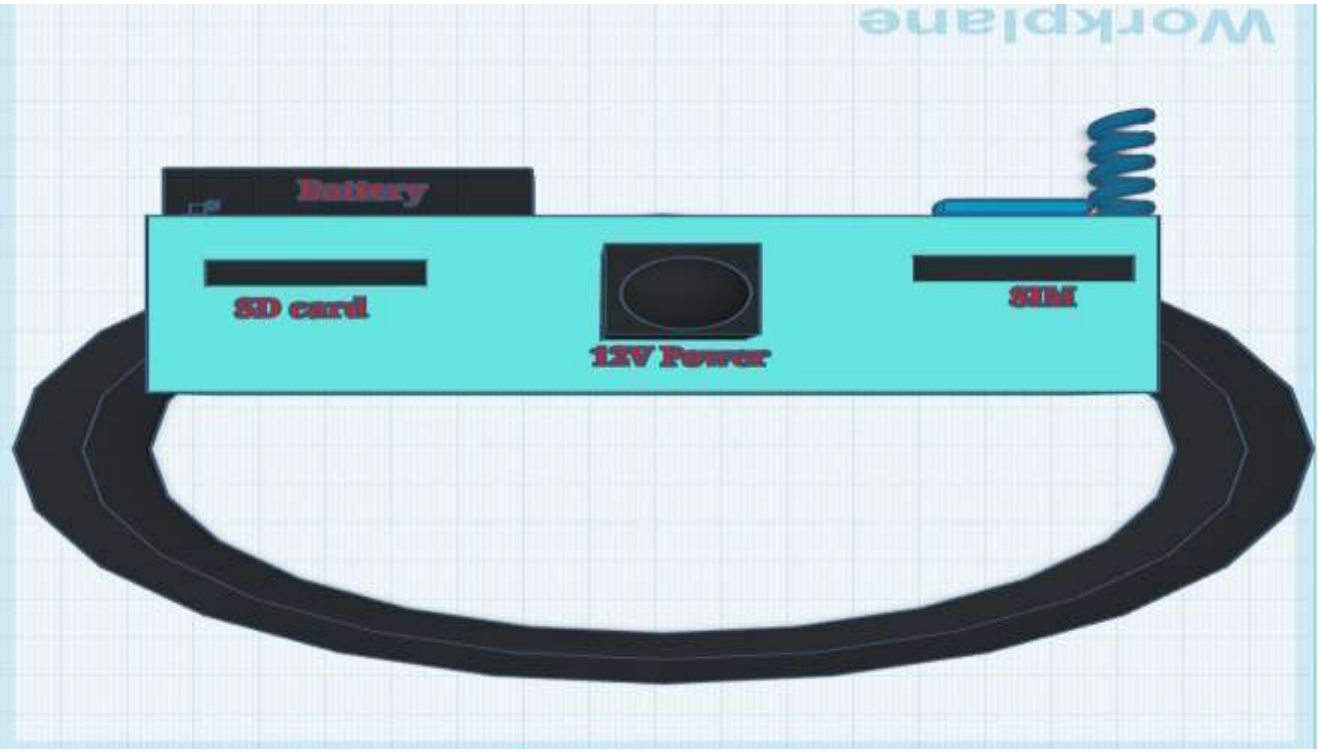
MECHANICAL DESIGN

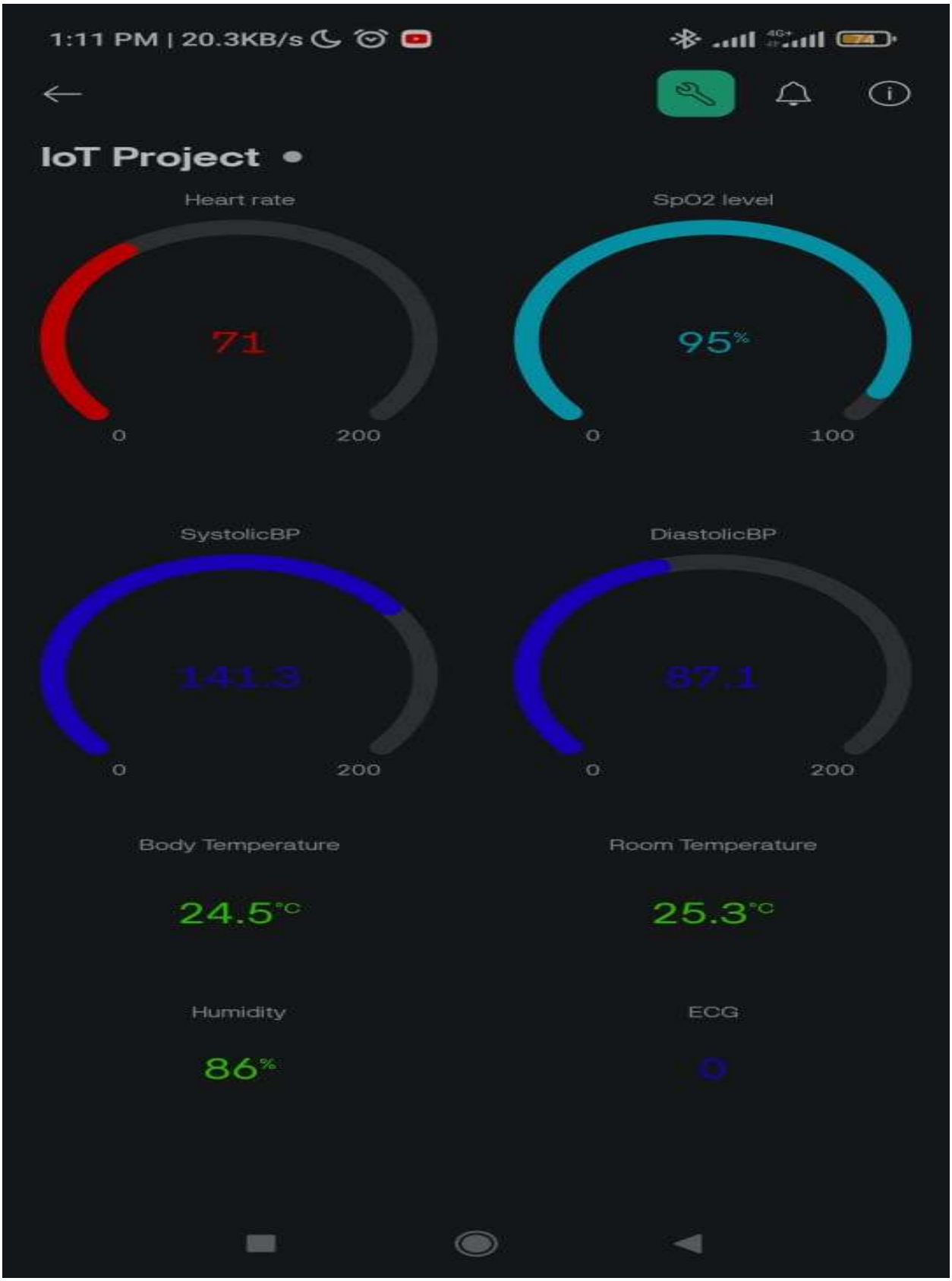
We used Tinker cad website to create the 3D Design of our final Project product.

Its Easy to wearable like a watch for patients.

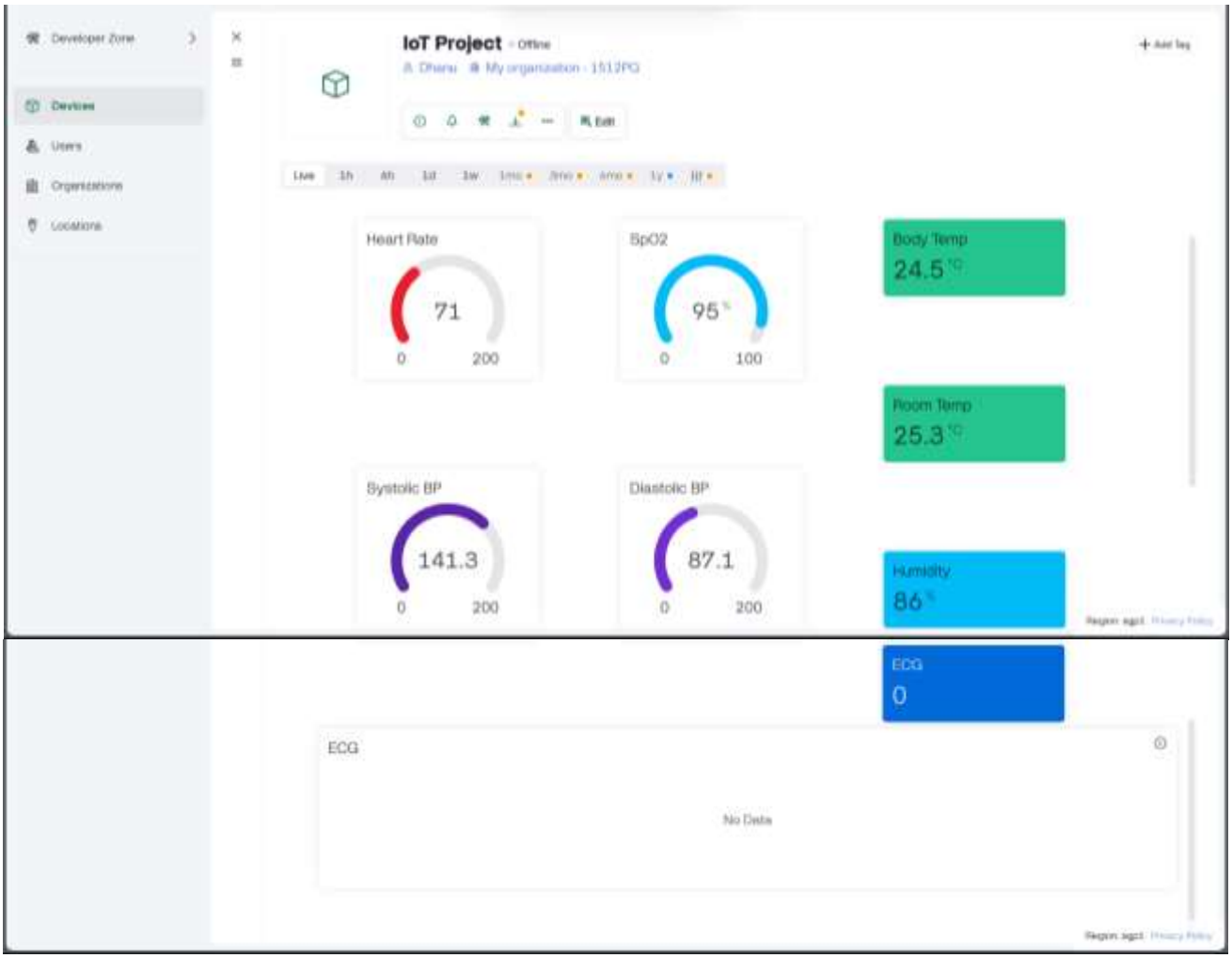
Product 3D Model



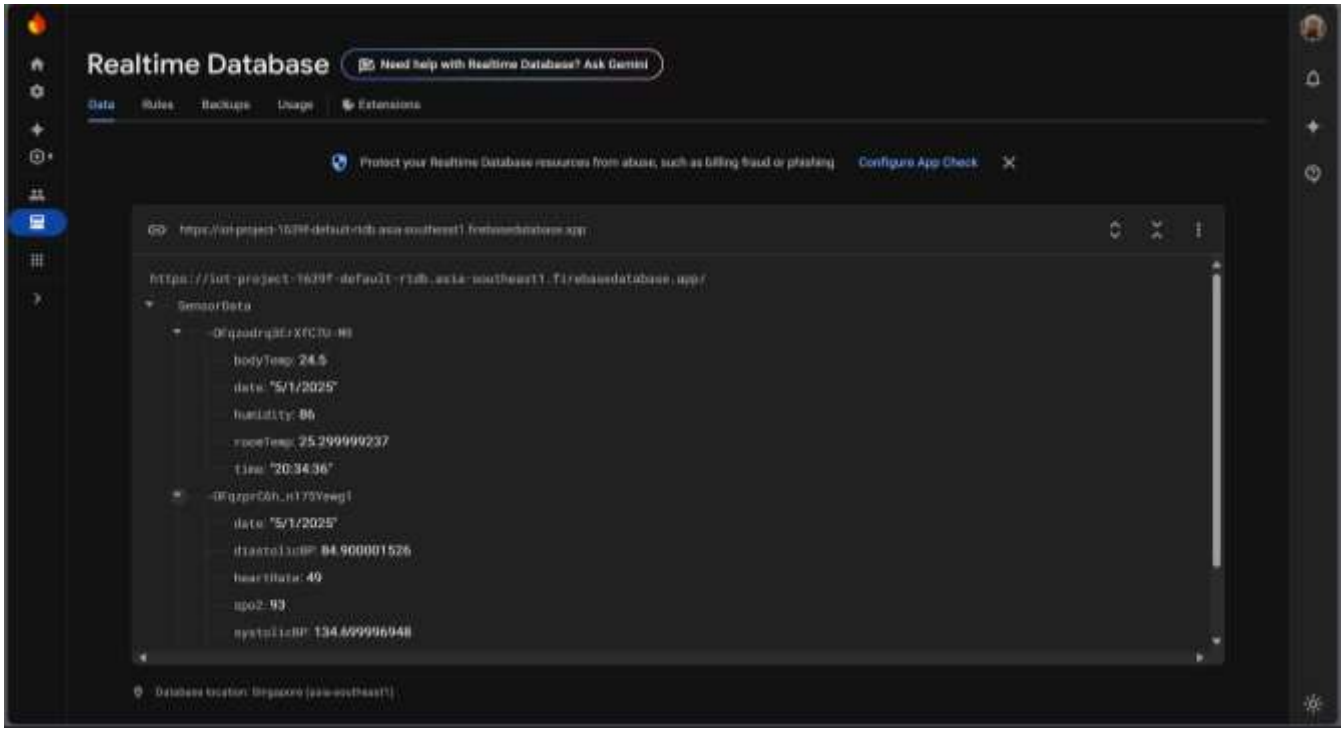
BLYNK mobile App dashboard



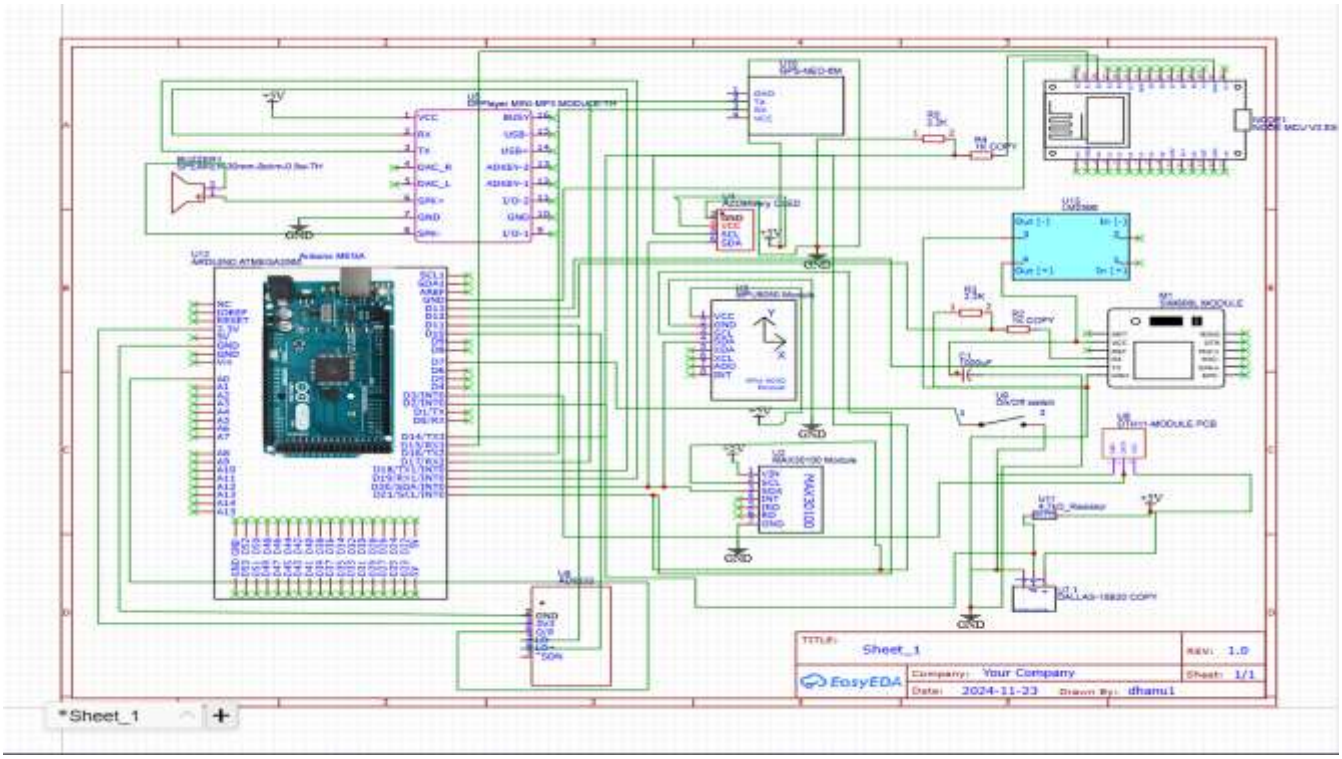
BLYNK WEB dashboard



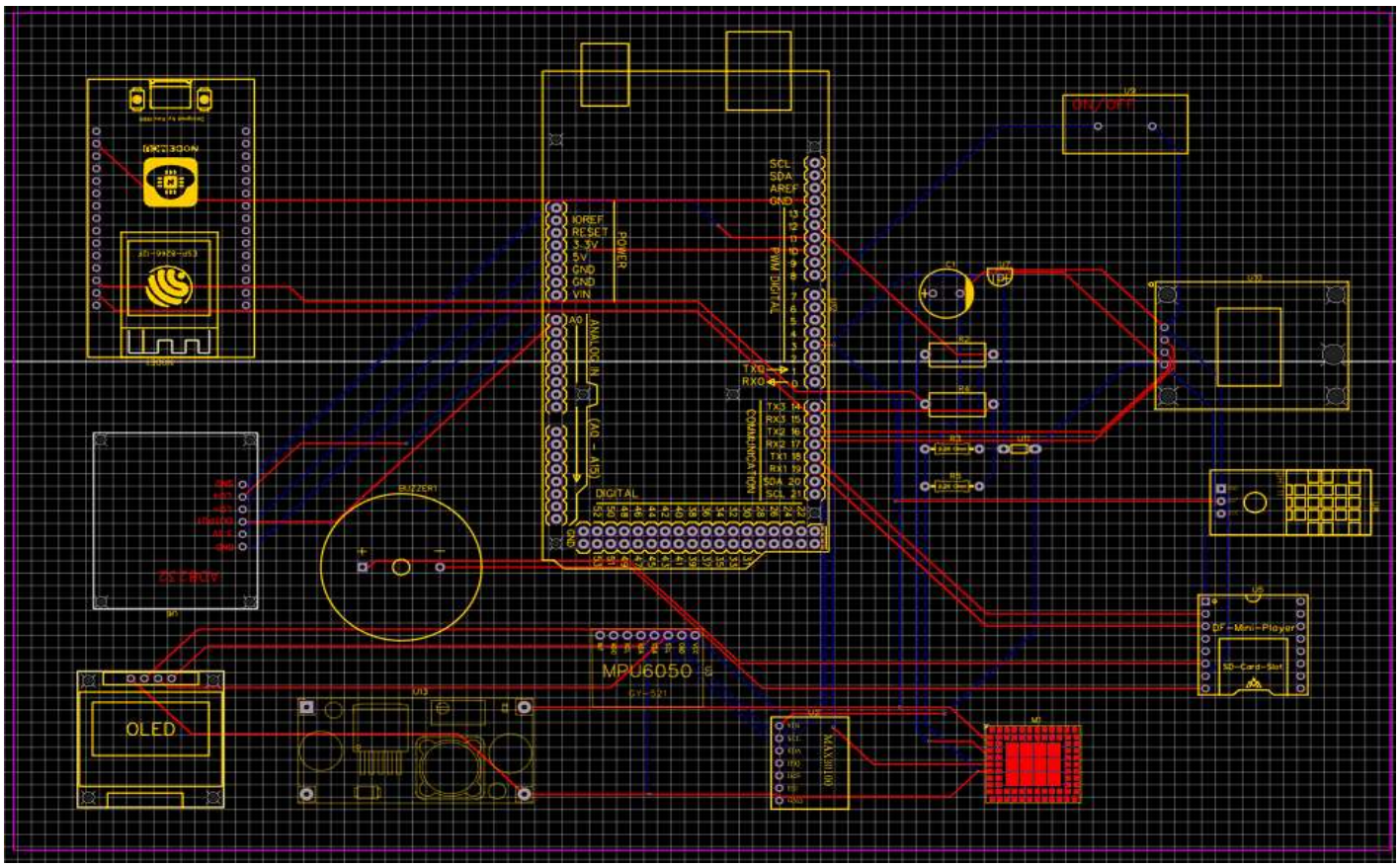
Firebase dashboard



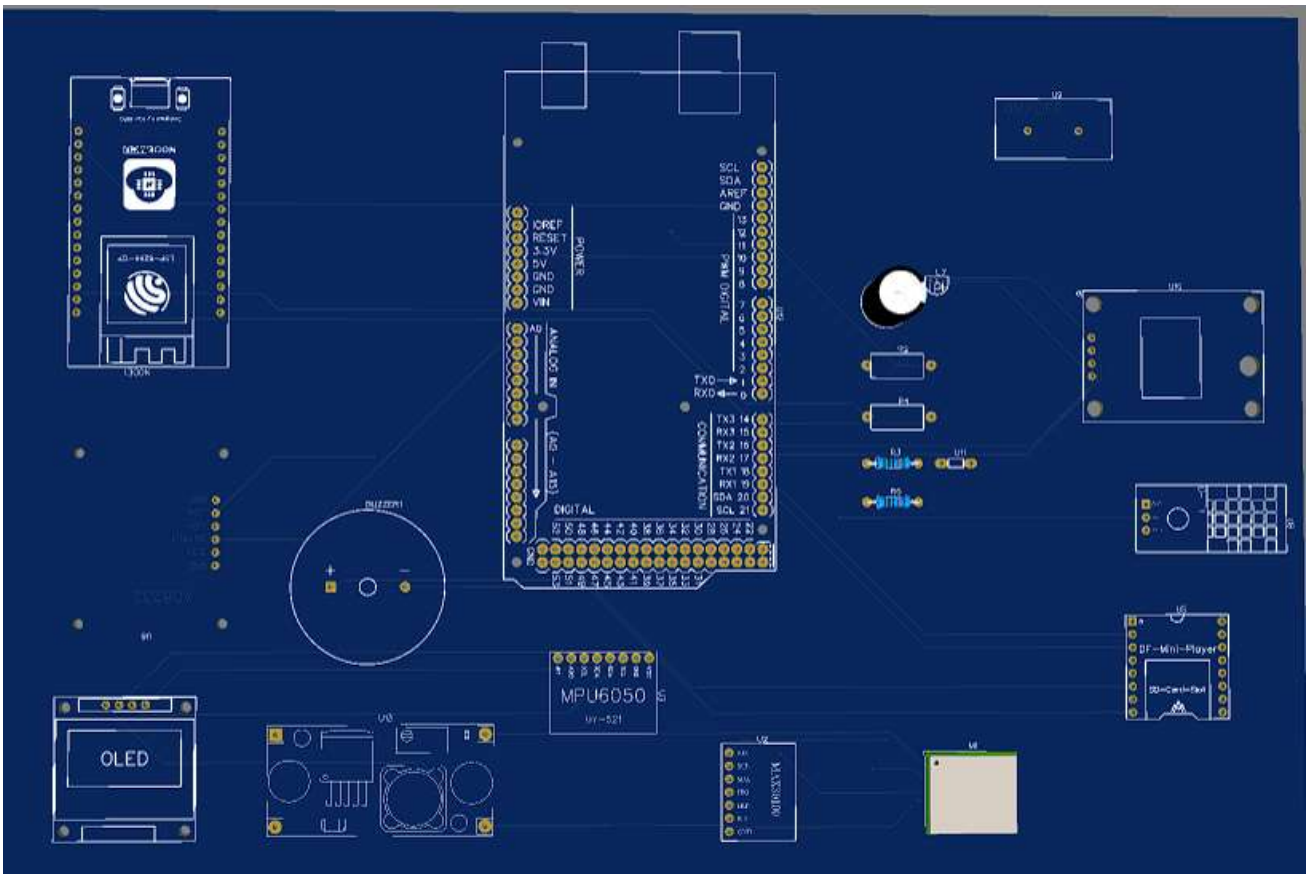
Product Schematic Diagram



Product PCB Diagram



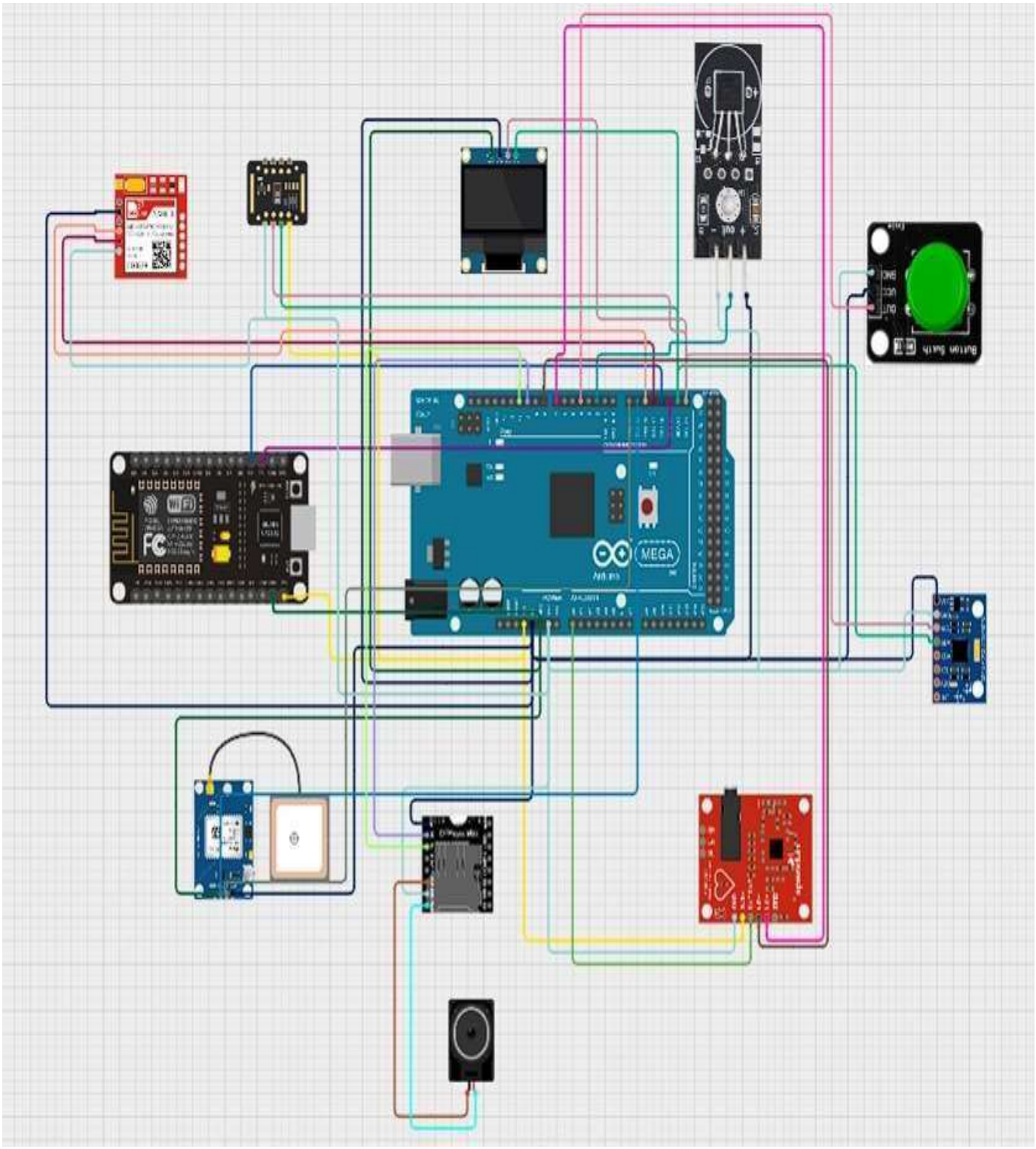
Product PCB Diagram



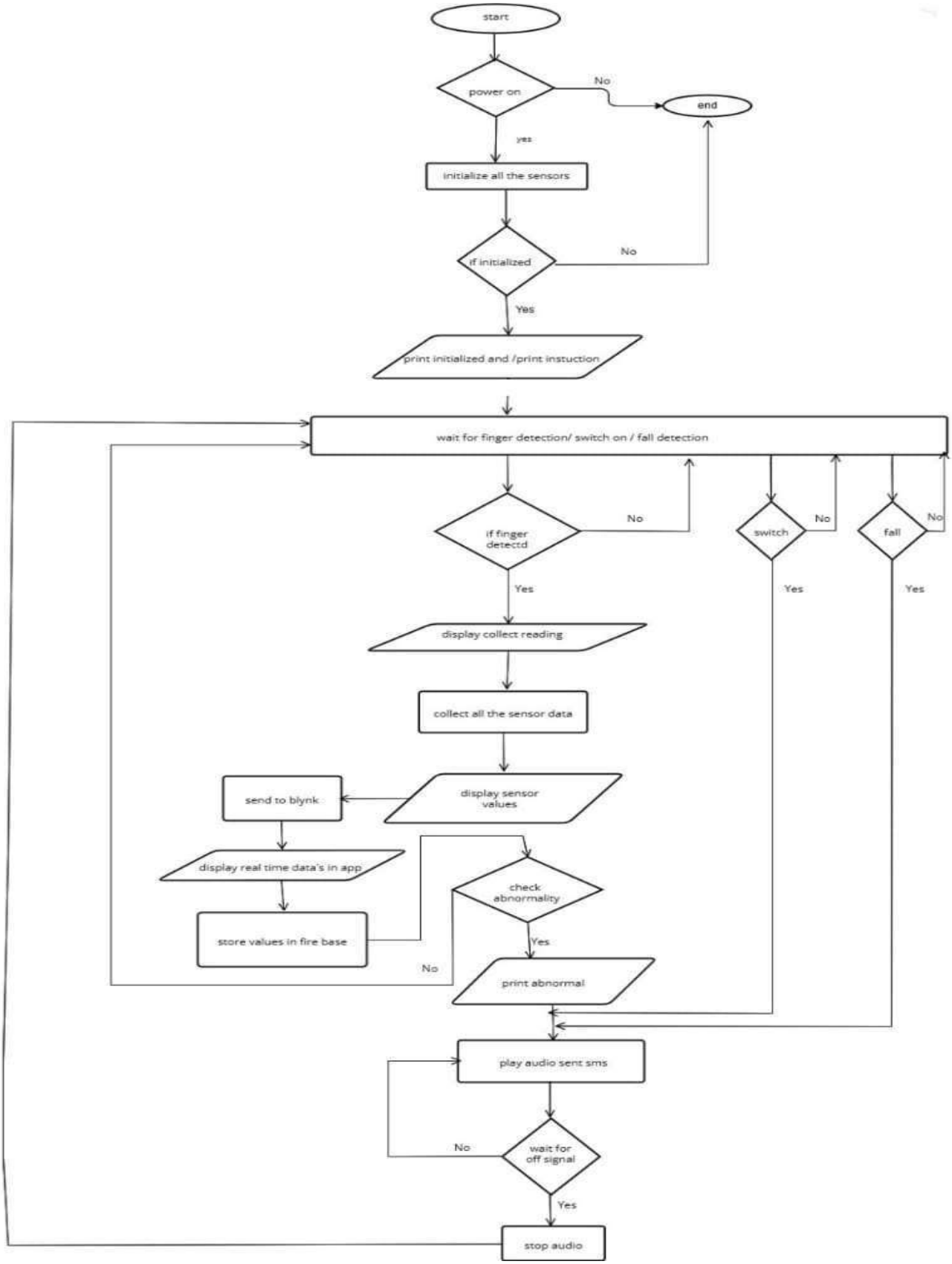
BOM (BILL OF AMOUNT)

Item Name	**Qty**	**Price(LKR)**
Arduino mega	1	5390
SIM800L	1	1255
OLED **0.96-inch** Display	1	780
MAX30100	1	590
ECG(AD8232)	1	1750
DF-Mini player	1	525
Speaker	1	360
Data cable	1	290
GPS-Module(NEO 6VM)	1	1350
DS18B20(waterproof temp)	1	450
MPU6050	1	595
Switch	1	75
LM2596	1	280
Clopper Clad board(FR4 Type)	1	1350
Ferric Chloride(FeCl3)	1	170
Sandpaper(100gsm)	1	100
Photo sheet	1	200
ESP8266	1	1570
DTH11	1	590

CIRCUIT DIAGRAM



FLOW CHART


start
power on
No
end
yes
initialize all the sensors
if initialized
No
Yes
print initialized and /print instuction
wait for finger detection/ switch on / fall detection
if finger detectd
No
switch
No
fall
No
Yes
Yes
Yes
display collect reading
collect all the sensor data
send to blynk
display sensor values
display real time data's in app
check abnormality
store values in fire base
Yes
No
print abnormal
play audio sent sms
No
wait for off signal
Yes
stop audio

TIMELINE (GANTT CHART)

	WEEK 01	WEEK 02	WEEK 03	WEEK 04	WEEK 05	WEEK 06	WEEK 07
PLANNING							
Discuss the topic							
ANALYZING							
Identify components and gathering							
DESIGN							
Designing the prototype							
DEVELOPMENT							
Start to build the project							
IMPLEMENTATION							
Develop the project features							
SUBMIT THE PROJECT REPORT							

PROGRAMMING CODE

Arduino Code

```
#include <Wire.h>
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>
#include "MAX30100_PulseOximeter.h"
#include <MPU6050.h>
#include "DFRobotDFPlayerMini.h"
#include <OneWire.h>
#include <DallasTemperature.h>
#include <DHT.h>
#include <SoftwareSerial.h>
#include <TinyGPS++.h>



// OLED Display settings
#define SCREEN_WIDTH 128
#define SCREEN_HEIGHT 64
#define OLED_RESET -1
Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, OLED_RESET);

// MAX30100 sensor settings
PulseOximeter pox;
#define REPORTING_PERIOD_MS 1000  // Report every 1 second
uint32_t tsLastReport = 0;

// Blood pressure calibration constants
#define BASELINE_SBP 120
#define BASELINE_DBP 80
#define CALIBRATION_CONSTANT_SBP 0.3
#define CALIBRATION_CONSTANT_DBP 0.1
#define MAX_READINGS 20
int heartRateBuffer[MAX_READINGS] = { 0 };
int bufferIndex = 0;
int bufferCount = 0;

// MPU6050 Fall Detection settings
MPU6050 mpu;
#define FALL_THRESHOLD 200
#define STABILIZATION_THRESHOLD 20
#define STABILIZATION_TIME 1000

bool fallDetected = false;
unsigned long stabilizationStartTime = 0;
bool fingerDetected = false;


#define FPSerial Serial1
```

```
DFRobotDFPlayerMini myDFPlayer;

// Data wire is plugged into port 2 on the Arduino
#define ONE_WIRE_BUS 2
#define TEMPERATURE_PRECISION 9  // Lower resolution

// Setup a oneWire instance to communicate with any OneWire devices (not just
Maxim/Dallas temperature ICs)
OneWire oneWire(ONE_WIRE_BUS);

// Pass our oneWire reference to Dallas Temperature.
DallasTemperature sensors(&oneWire);

int numberOfDevices;  // Number of temperature devices found

DeviceAddress tempDeviceAddress;  // We'll use this variable to store a found device
address


// Button switch input pin
#define BUTTON_PIN 7  // Define the button pin


// DHT11 sensor settings
#define DHTPIN 3       // Pin connected to the DHT11 sensor data pin
#define DHTTYPE DHT11  // Define the type of DHT sensor
DHT dht(DHTPIN, DHTTYPE);


// Define the threshold values for abnormal readings (adjust as needed)
#define ABNORMAL_HEART_RATE_LOW 40
#define ABNORMAL_HEART_RATE_HIGH 200
#define ABNORMAL_SPO2_LOW 70
#define ABNORMAL_SPO2_HIGH 100
#define ABNORMAL_TEMP_LOW 33.0
#define ABNORMAL_TEMP_HIGH 38.5
#define ABNORMAL_ECG_THRESHOLD 20  // Threshold for abnormal ECG reading (adjust as
needed)
#define ABNORMAL_ECG_THRESHOLD_LOW 2
#define ABNORMAL_SystolicBP_HIGH 180
#define ABNORMAL_SystolicBP_LOW 100
#define ABNORMAL_DiastolicBP_HIGH 120
#define ABNORMAL_DiastolicBP_LOW 70



// Define the Serial Pins for SIM800L
#define SIM800_TX 12
#define SIM800_RX 13
```

```
// Initialize the SIM800L module
SoftwareSerial sim800Serial(SIM800_RX, SIM800_TX);

// Emergency phone number
#define EMERGENCY_PHONE "+94752051204"
// Emergency phone number hospital
#define EMERGENCY_PHONE2 "+94712051203"


const int ecgPin = A0;      // Connect to the OUT pin of AD8232
const int loPlusPin = 10;   // Connect to LO+ pin of AD8232 (optional)
const int loMinusPin = 11;  // Connect to LO- pin of AD8232 (optional)



static const int RXPin = 22, TXPin = 23;    // RX and TX pins for GPS
static const uint32_t GPSBaud = 9600;       // Change to 9600 for better
compatibility with SoftwareSerial
static const unsigned long timeout = 5000;  // 30 seconds timeout for GPS


TinyGPSPlus gps;  // Create an instance of the TinyGPSPlus object
// SoftwareSerial ss(17, 16);  // Set up SoftwareSerial on pins 22 (RX) and 23 (TX)









// Callback for MAX30100 on beat detection
void onBeatDetected() {
  fingerDetected = true;
}

// Function to reset for a new blood pressure reading
void resetForNextReading() {
  fingerDetected = false;
  bufferIndex = 0;
  bufferCount = 0;

  memset(heartRateBuffer, 0, sizeof(heartRateBuffer));

  if (!pox.begin()) {
    Serial.println("FAILED to reinitialize MAX30100 sensor");
    return;
  }
  pox.setIRLedCurrent(MAX30100_LED_CURR_24MA);

  display.clearDisplay();
```

```
  display.setCursor(0, 0);
  display.println("Place your finger");
  display.println(" & other sensors");
  display.println("to start reading.");
  display.display();
  Serial.println("Place your finger & other sensors to start reading.");
}

// Function to calculate and display average blood pressure
void calculateAndDisplayAverage() {
  if (bufferCount == 0) {
    Serial.println("No valid readings captured.");
    display.clearDisplay();
    display.setCursor(0, 0);
    display.println("No valid readings.");
    display.println("Try again.");
    display.display();
    return;
  }

  int totalHeartRate = 0;
  for (int i = 0; i < bufferCount; i++) {
    totalHeartRate += heartRateBuffer[i];
  }

  int averageHeartRate = totalHeartRate / bufferCount;
  float averageSystolicBP = BASELINE_SBP + CALIBRATION_CONSTANT_SBP *
averageHeartRate;
  float averageDiastolicBP = BASELINE_DBP + CALIBRATION_CONSTANT_DBP *
averageHeartRate;
  float averageSpO2 = pox.getSpO2();

  display.clearDisplay();
  display.setCursor(0, 0);
  display.print("Avg Heart Rate: ");
  display.print(averageHeartRate);
  display.println(" bpm");
  display.print("Avg SpO2: ");
  display.print(averageSpO2, 1);
  display.println(" %");
  display.print("Avg Sys BP: ");
  display.print(averageSystolicBP, 1);
  display.println(" mmHg");
  display.print("Avg Dia BP: ");
  display.print(averageDiastolicBP, 1);
  display.println(" mmHg");
  display.display();

  Serial.println("Final Average Readings:");
  Serial.print("Heart Rate: ");
  Serial.print(averageHeartRate);
```

```
  Serial.println(" bpm");
  Serial.print("SpO2: ");
  Serial.print(averageSpO2, 1);
  Serial.println(" %");
  Serial.print("Systolic BP: ");
  Serial.print(averageSystolicBP, 1);
  Serial.println(" mmHg");
  Serial.print("Diastolic BP: ");
  Serial.print(averageDiastolicBP, 1);
  Serial.println(" mmHg");

  delay(2000);

  // Post-reading instruction
  display.clearDisplay();
  display.setCursor(0, 0);
  display.println("Remove your finger.");
  display.println("Place it again for");
  display.println("a new reading.");
  display.display();


  Serial.println("Remove your finger. Place it again for a new reading");

  printTemperature(averageHeartRate, averageSpO2, averageSystolicBP,
averageDiastolicBP);
}

// Initialize MPU6050
void initFallDetection() {
  Serial.println("Initialize MPU6050");
  while (!mpu.begin(MPU6050_SCALE_2000DPS, MPU6050_RANGE_2G)) {
    Serial.println("Could not find a valid MPU6050 sensor, check wiring!");
    delay(500);
  }
  mpu.calibrateGyro();
  mpu.setThreshold(3);
  Serial.println("MPU6050 initialized successfully");
}

// Function to check for falls
void checkForFalls() {
  Vector normGyro = mpu.readNormalizeGyro();
  float totalGyro = sqrt(normGyro.XAxis * normGyro.XAxis + normGyro.YAxis *
normGyro.YAxis + normGyro.ZAxis * normGyro.ZAxis);

  // Only check for falls if the button is not pressed (if the switch is off).
  if (!fallDetected && totalGyro > FALL_THRESHOLD) {
    fallDetected = true;
    Serial.println("ALERT: Fall detected!");
    display.clearDisplay();
```

```
    display.setCursor(0, 0);
    display.println("Fall Detected!");
    display.display();
    myDFPlayer.play(1);
    // Play the audio for 1 second if the button is pressed
    if (digitalRead(BUTTON_PIN) == HIGH) {
      while (digitalRead(BUTTON_PIN) == LOW) {
        myDFPlayer.play(1);  // Play the first track (0001.mp3)
        delay(1000);         // Play audio for 1 second
      }
    }
    sendSMS(EMERGENCY_PHONE, "Emergency Alert: Fall Detected!");
    stabilizationStartTime = millis();
  }

  // If a fall is detected, check if the user has stabilized.
  if (fallDetected) {
    if (totalGyro < STABILIZATION_THRESHOLD) {
      if (millis() - stabilizationStartTime >= STABILIZATION_TIME) {
        fallDetected = false;
        Serial.println("Stabilization complete. Fall state cleared.");

        display.clearDisplay();
        display.setCursor(0, 0);
        display.println("Stabilized.");
        display.println("Place your finger");
        display.println("to start reading.");
        display.display();

        myDFPlayer.stop();  // Stop the music only after stabilization
        resetForNextReading();
      }
    } else {
      stabilizationStartTime = millis();
    }
  }
}




int ECGcalculation() {
  int ecgValue = analogRead(ecgPin);  // Read the ECG signal from A0

  // Lead-off detection
  int loPlusStatus = digitalRead(loPlusPin);
  int loMinusStatus = digitalRead(loMinusPin);

  if (loPlusStatus == 1 || loMinusStatus == 1) {
    Serial.println("Lead off detected!");
```

```
    return 0;
  } else {
    // Output the ECG value
    Serial.println(ecgValue);
    // Send values to NodeMCU using Serial3
    Serial3.print("ECG: ");
    Serial3.print(ecgValue);
    return ecgValue;
  }

  delay(10);  // Small delay for smoother serial output
}


// function to print the temperature for a device
void printTemperature(int averageHeartRate, float averageSpO2, float
averageSystolicBP, float averageDiastolicBP) {

  // Request temperatures from DallasTemperature sensor
  Serial.print("Requesting temperatures Hold Sensor...");
  display.clearDisplay();
  display.setCursor(0, 0);
  display.print("Requesting temperatures");
  display.print(" Hold Sensor...");
  display.display();
  delay(10000);
  sensors.requestTemperatures();  // Send the command to get temperatures
  Serial.println("DONE");

  float tempC = sensors.getTempC(tempDeviceAddress);
  if (tempC == DEVICE_DISCONNECTED_C) {
    Serial.println("Error: Could not read temperature data");
    return;
  }

  Serial.print("Temp C: ");
  Serial.print(tempC);
  Serial.print(" Temp F: ");
  Serial.println(DallasTemperature::toFahrenheit(tempC));  // Converts tempC to
Fahrenheit

  // Send values to NodeMCU using Serial3
  Serial3.print("Body Temp: ");
  Serial3.print(tempC);
  // Serial3.print(", Room Temp: ");

  // Read room temperature and humidity from DHT11 sensor
  float temp = dht.readTemperature();  // Celsius temperature
  float hum = dht.readHumidity();      // Humidity

  // Check if the readings are valid
```

```
  if (isnan(temp) || isnan(hum)) {
    Serial.println("Failed to read from DHT sensor!");
  } else {
    Serial.print("Room Temperature: ");
    Serial.print(temp);
    Serial.println(" °C");
    Serial.print("Humidity: ");
    Serial.print(hum);
    Serial.println(" %");

    // Send data to NodeMCU over Serial3
    Serial3.print(",Room Temp: ");
    Serial3.print(temp);
    Serial3.print(", Humidity: ");
    Serial3.println(hum);
  }

  // Send more sensor data (e.g., averageHeartRate, averageSpO2, averageSystolicBP,
averageDiastolicBP)
  Serial3.print("HeartRate: ");
  Serial3.print(averageHeartRate);
  Serial3.print(",SpO2: ");
  Serial3.print(averageSpO2);
  Serial3.print(",SystolicBP: ");
  Serial3.print(averageSystolicBP);
  Serial3.print(",DiastolicBP: ");
  Serial3.println(averageDiastolicBP);



  // Check for abnormal readings
  checkForAbnormalReadings(averageHeartRate, averageSpO2, tempC, averageSystolicBP,
averageDiastolicBP);

  delay(5000);
}


// function to print a device address
void printAddress(DeviceAddress deviceAddress) {
  for (uint8_t i = 0; i < 8; i++) {
    if (deviceAddress[i] < 16) Serial.print("0");
    Serial.print(deviceAddress[i], HEX);
  }
}


// Function to handle the button press and play sound continuously while pressed
void handleButtonPress() {
  static bool lastButtonState = LOW;
  bool currentButtonState = digitalRead(BUTTON_PIN);  // Read the state of the
button
```

```
  bool gpsx = false;

  if (lastButtonState == LOW && currentButtonState == HIGH) {  // Button pressed
    Serial.println("Emergency button pressed. Sending SMS...");
    myDFPlayer.play(1);
    sendSMS(EMERGENCY_PHONE, "Emergency Alert: Immediate assistance needed!");
    delay(1000);
    sendSMS(EMERGENCY_PHONE2, "Emergency Alert: Immediate assistance needed!");
    delay(1000);

    // Start time tracking to check for 60 seconds timeout
    unsigned long startMillis = millis();

    // Check GPS data for 60 seconds
    while (millis() - startMillis < timeout) {
      if (Serial2.available() > 0) {
        char incomingByte = Serial2.read();
        Serial.print("Received byte: ");
        Serial.println(incomingByte, DEC);  // Print the raw byte received from GPS

        if (gps.encode(incomingByte))  // Decode the GPS data
        {
          if (gps.location.isValid())  // Check if location is valid
          {
            Serial.println("Sending Location SMS...");
            sendLocationViaSMS();  // Send valid GPS location via SMS
            // return;                // Exit after sending valid location
            gpsx = true;
          }
        }
      } else {
        Serial.println("Waiting for GPS data...");  // Added to check if the GPS is
sending anything
      }
    }

    // If no valid location is found after 30 seconds, send the default location via
SMS
    // sendSMS2("Location not found. Sending default location.");
    if (gpsx == false) {
      sendDefaultLocationViaSMS();
    }
    myDFPlayer.stop();

    display.clearDisplay();
    display.setCursor(0, 0);
    display.println("Stabilized.");
    display.println("Place your finger");
    display.println("to start reading.");
    display.display();
```

```
    myDFPlayer.stop();  // Stop the music only after stabilization
    resetForNextReading();
  } else if (lastButtonState == HIGH && currentButtonState == LOW) {  // Button
released
    myDFPlayer.stop();                                                // Stop the
music
  }

  lastButtonState = currentButtonState;  // Update the last state
}



void sendLocationViaSMS() {
  String location = "Live Location: " + String(gps.location.lat(), 6) + ", " +
String(gps.location.lng(), 6);
  String message = location + "  Date: " + String(gps.date.month()) + "/" +
String(gps.date.day()) + "/" + String(gps.date.year());
  sendSMS2(message);
  displayInfo();
}

void sendDefaultLocationViaSMS() {
  // Sending the default location via SMS if no GPS data is found
  String defaultLocation = "Location: 7.299093, 80.634076 ";
  sendSMS2(defaultLocation);
  displayDefaultLocation();
}

void sendSMS2(String message) {
  Serial.println("Sending Location SMS...");
  sim800Serial.println("AT");  // Test the connection
  delay(1000);

  sim800Serial.println("AT+CMGF=1");  // Set SMS text mode
  delay(1000);

  sim800Serial.println("AT+CMGS=\"+94712051203\"");  // Recipient phone number
  delay(1000);

  sim800Serial.println(message);  // The message to send
  delay(1000);

  sim800Serial.write(26);  // ASCII code for Ctrl+Z (End of message)
  delay(5000);             // Give some time for SMS to send
  Serial.println("Sending SMS Completed");
}

void displayInfo() {
  Serial.print(F("Location: "));
  Serial.print(gps.location.lat(), 6);  // Latitude with 6 decimal places
```

```
  Serial.print(F(", "));
  Serial.print(gps.location.lng(), 6);  // Longitude with 6 decimal places
  Serial.print(F("  Date: "));
  if (gps.date.isValid()) {
    Serial.print(gps.date.month());
    Serial.print(F("/"));
    Serial.print(gps.date.day());
    Serial.print(F("/"));
    Serial.print(gps.date.year());
  } else {
    Serial.print(F("INVALID"));
  }
  Serial.println();  // New line
}

void displayDefaultLocation() {
  // Display the default location if no GPS signal is found
  Serial.print(F("Location: 7.299093, 80.634076  Date: INVALID"));
  Serial.println();  // New line
}




// Function to check if the readings are abnormal
void checkForAbnormalReadings(float heartRate, float spo2, float tempC, float
averageSystolicBP, float averageDiastolicBP) {
  bool abnormal = false;

  // Check if heart rate is abnormal
  if (heartRate < ABNORMAL_HEART_RATE_LOW || heartRate > ABNORMAL_HEART_RATE_HIGH) {
    abnormal = true;
    Serial.println("Abnormal Heart Rate!");
  }

  // Check if SpO2 is abnormal
  if (spo2 < ABNORMAL_SPO2_LOW || spo2 > ABNORMAL_SPO2_HIGH) {
    abnormal = true;
    Serial.println("Abnormal SpO2!");
  }

  // Check if body temperature is abnormal
  if (tempC < ABNORMAL_TEMP_LOW || tempC > ABNORMAL_TEMP_HIGH) {
    abnormal = true;
    Serial.println("Abnormal Body Temperature!");
  }

  int ecgvalue = ECGcalculation();
  // Check if ECG reading is abnormal
  if (ecgvalue > ABNORMAL_ECG_THRESHOLD || ecgvalue == ABNORMAL_ECG_THRESHOLD_LOW) {
```

```
    abnormal = true;
    Serial.println("Abnormal ECG reading!");
  }


  if (averageSystolicBP < ABNORMAL_SystolicBP_LOW || averageSystolicBP >
ABNORMAL_SystolicBP_HIGH) {
    abnormal = true;
    Serial.println("Abnormal Body ABNORMAL_SystolicBP!");
  }

  if (averageDiastolicBP < ABNORMAL_DiastolicBP_LOW || averageDiastolicBP >
ABNORMAL_DiastolicBP_HIGH) {
    abnormal = true;
    Serial.println("Abnormal Body ABNORMAL_DiastolicBP!");
  }

  // If any reading is abnormal, play the sound
  if (abnormal) {
    myDFPlayer.play(1);  // Play a specific sound (e.g., alert sound)
    display.clearDisplay();
    display.setCursor(0, 0);
    display.println("Abnormal readings detected!");
    display.display();
    sendSMS(EMERGENCY_PHONE, "Emergency Alert: Abnormal readings detected!");
    delay(2000);
    myDFPlayer.stop();
  }
}



// Function to send SMS using the SIM800L module
void sendSMS(const char* phoneNumber, const char* message) {
  sim800Serial.println("AT");  // Test if the SIM800L is responding
  delay(1000);

  sim800Serial.println("AT+CMGF=1");  // Set SMS mode to text
  delay(1000);

  sim800Serial.print("AT+CMGS=\"");  // Command to send SMS
  sim800Serial.print(phoneNumber);   // Phone number
  sim800Serial.println("\"");

  delay(1000);

  sim800Serial.println(message);  // Message content
  delay(1000);

  sim800Serial.write(26);  // ASCII code for Ctrl+Z to send the message
  delay(5000);             // Wait for the message to be sent
```

```
  Serial.println("SMS sent successfully!");
}

// Function to check if SIM800L is initialized
bool checkSIM800L() {
  sim800Serial.println("AT");  // Test if the SIM800L is responding
  delay(1000);

  // Check for the "OK" response
  if (sim800Serial.available()) {
    String response = sim800Serial.readString();
    if (response.indexOf("OK") != -1) {
      return true;  // SIM800L is initialized and responding
    }
  }

  return false;  // SIM800L did not respond correctly
}









void setup() {

  FPSerial.begin(9600);  // Initialize the serial communication with DFPlayer Mini
  Serial.begin(115200);
  pinMode(loPlusPin, INPUT);   // Configure LO+ as input
  pinMode(loMinusPin, INPUT);  // Configure LO- as input
  // Initialize button pin
  pinMode(BUTTON_PIN, INPUT_PULLUP);

  if (!display.begin(SSD1306_SWITCHCAPVCC, 0x3C)) {
    Serial.println("SSD1306 allocation failed");
    for (;;)
      ;
  }
  display.clearDisplay();
  display.setTextSize(1);
  display.setTextColor(SSD1306_WHITE);

  if (!pox.begin()) {
    Serial.println("FAILED to initialize MAX30100 sensor");
    display.println("FAILED to initialize MAX30100 sensor");
    display.display();
    for (;;)
      ;
  }
  pox.setIRLedCurrent(MAX30100_LED_CURR_24MA);
```

```
  pox.setOnBeatDetectedCallback(onBeatDetected);

  // Initialize DFPlayer Mini
  if (!myDFPlayer.begin(FPSerial, /*isACK = */ true, /*doReset = */ true)) {
    Serial.println(F("Unable to begin! Please check the connection and SD card."));
    display.println("Unable to begin! Please ");
    display.println("check the connection and SD card.");
    display.display();
    while (true) { delay(0); }  // Halt the program if DFPlayer is not detected
  }

  Serial.println(F("DFPlayer Mini initialized."));
  myDFPlayer.volume(10);  // Set the volume (0 to 30)

  // Start up the library
  sensors.begin();

  // Grab a count of devices on the wire
  numberOfDevices = sensors.getDeviceCount();

  // locate devices on the bus
  Serial.print("Locating devices...");

  Serial.print("Found ");
  Serial.print(numberOfDevices, DEC);
  Serial.println(" devices.");

  // report parasite power requirements
  Serial.print("Parasite power is: ");
  if (sensors.isParasitePowerMode()) Serial.println("ON");
  else Serial.println("OFF");

  // Loop through each device, print out address
  for (int i = 0; i < numberOfDevices; i++) {
    // Search the wire for address
    if (sensors.getAddress(tempDeviceAddress, i)) {
      Serial.print("Found device ");
      Serial.print(i, DEC);
      Serial.print(" with address: ");
      printAddress(tempDeviceAddress);
      Serial.println();

      Serial.print("Setting resolution to ");
      Serial.println(TEMPERATURE_PRECISION, DEC);

      // set the resolution to TEMPERATURE_PRECISION bit (Each Dallas/Maxim device
is capable of several different resolutions)
      sensors.setResolution(tempDeviceAddress, TEMPERATURE_PRECISION);

      Serial.print("Resolution actually set to: ");
      Serial.print(sensors.getResolution(tempDeviceAddress), DEC);
```

```
      Serial.println();
    } else {
      Serial.print("Found ghost device at ");
      Serial.print(i, DEC);
      Serial.print(" but could not detect address. Check power and cabling");
    }
  }

  dht.begin();  // Initialize DHT sensor
  Serial.println("DHT11 Sensor Initialized");

  sim800Serial.begin(9600);  // Start communication with SIM800L module
  delay(10000);

  // Test the SIM800L with a simple AT command
  sim800Serial.println("AT");  // Send AT command
  delay(1000);                 // Wait for a response
  if (sim800Serial.available()) {
    String response = sim800Serial.readString();
    Serial.println("SIM800L Response: " + response);
  } else {
    Serial.println("SIM800L did not respond.");
  }

  // Check if the SIM800L module is responding
  if (checkSIM800L()) {
    Serial.println("SIM800L initialized successfully.");
  } else {
    Serial.println("SIM800L initialization failed.");
  }

  Serial2.begin(GPSBaud);  // Start communication with GPS at the defined baud rate

  Serial.println("GPS initialization.");
  // while (FPSerial.available()) {
  //   char c = FPSerial.read();
  //   Serial.print(c);  // Print raw NMEA data to Serial Monitor
  // }
  // Wait for GPS to send valid data
  // if (Serial2.available() > 0) {
  //   Serial.println("\nNeo-6M GPS Module initialized successfully!");
  // } else {
  //   Serial.println("\nNeo-6M GPS Module initialization failed!");
  // }


  // Serial3.begin(115200);  // For communication with NodeMCU (Serial3 uses pins 14
and 15)


  // // Start time tracking to check for 60 seconds timeout
  // unsigned long startMillis = millis();
```

```
  // // Check GPS data for 60 seconds
  // while (millis() - startMillis < 50000) {
  //   if (Serial3.available() > 0) {
  //     Serial3.println("Hello from Arduino Mega!");
  //     Serial.println("Hello from Arduino Mega!");
  //   } else {
  //     Serial.println("Hello");
  //   }
  // }

  Serial3.begin(9600);  // Serial3 test
  Serial.println("Starting Serial3 Loopback Test");

  Serial3.println("Hello from Mega!");  // Send test data
  Serial.println("Sent to NodeMCU: Hello from Mega!");
  delay(1000);  // Delay to slow down communication for debugging

  if (Serial3.available()) {
    String response = Serial3.readStringUntil('\n');
    Serial.println("Received from NodeMCU: " + response);
  } else {
    Serial.println("No response from NodeMCU");
  }

  delay(1000);  // Slow down for debugging




  initFallDetection();
  resetForNextReading();
}


void loop() {







  pox.update();
  checkForFalls();
  handleButtonPress();  // Continuously check for button presses

  static unsigned long startTime = 0;
  static bool waitingForReadings = false;

  if (fingerDetected && !waitingForReadings) {
    waitingForReadings = true;
    startTime = millis();
```

```
    display.clearDisplay();
    display.setCursor(0, 0);
    display.println("Collecting readings...");
    display.println("Keep steady.");
    display.display();

    Serial.println("Collecting Readings.....Keep steady.");
  }

  if (waitingForReadings) {
    if (millis() - startTime <= 10000) {  // Collect readings for 10 seconds
      float heartRate = pox.getHeartRate();
      float spo2 = pox.getSpO2();
      float tempC = sensors.getTempC(tempDeviceAddress);  // Get body temperature
      int ecgReading = ECGcalculation();                  // Get the ECG reading

      if (heartRate > 40 && heartRate < 200 && spo2 > 70 && spo2 < 100) {
        heartRateBuffer[bufferIndex] = round(heartRate);
        bufferIndex = (bufferIndex + 1) % MAX_READINGS;
        if (bufferCount < MAX_READINGS) bufferCount++;
      }
    } else {
      waitingForReadings = false;
      calculateAndDisplayAverage();
      resetForNextReading();
    }
  }

  // ECGcalculation();
}
```

NodeMcu (ESP8266) Code

```
#define BLYNK_TEMPLATE_ID "TMPL6BcIXK908"
#define BLYNK_TEMPLATE_NAME "IoT Project"
#define BLYNK_AUTH_TOKEN "3PLpTKpeBSAiO7_7SZXcuOiCGAlKKetZ"

#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#include <SoftwareSerial.h>
#include <Firebase_ESP_Client.h>
#include <NTPClient.h>
#include <WiFiUdp.h>
#include <TimeLib.h>
#include "addons/TokenHelper.h"
#include "addons/RTDBHelper.h"

// Wi-Fi credentials
char ssid[] = "DARK PHOENIX";
```

```
char pass[] = "123asd07a";

// Firebase setup
#define API_KEY "AIzaSyASOLXA-khPFKOGeMqyfR_c8moY_PAhcnY"
#define DATABASE_URL "iot-project-1639f-default-rtdb.asia-
southeast1.firebasedatabase.app/"

FirebaseData fbdo;
FirebaseAuth auth;
FirebaseConfig config;
FirebaseJson dataJson;
bool signupOK = false;

// Virtual pins for Blynk
#define V1 1  // Heart Rate
#define V2 2  // SpO2
#define V3 3  // Systolic BP
#define V4 4  // Diastolic BP
#define V5 5  // Body Temp
#define V6 6  // Room Temp
#define V7 7  // Humidity
#define V8 8  // ECG

// SoftwareSerial for Mega communication
#define NODEMCU_TX D1
#define NODEMCU_RX D2
SoftwareSerial MegaSerial(NODEMCU_RX, NODEMCU_TX);

// NTP setup
WiFiUDP udp;
NTPClient timeClient(udp, "pool.ntp.org", 0, 3600000);

unsigned long lastReceivedTime = 0;
const unsigned long noDataInterval = 5000;

void setup() {
  // Serial communication for debugging
  Serial.begin(9600);
  MegaSerial.begin(9600);

  // Blynk and Wi-Fi initialization
  Blynk.begin(BLYNK_AUTH_TOKEN, ssid, pass);
  while (WiFi.status() != WL_CONNECTED) {
    delay(1000);
    Serial.print(".");
  }
  Serial.println("\nConnected to Wi-Fi");

  // Firebase initialization
  config.api_key = API_KEY;
  config.database_url = DATABASE_URL;
```

```
  if (Firebase.signUp(&config, &auth, "", "")) {
    signupOK = true;
    Serial.println("Firebase signup successful");
  } else {
    Serial.printf("Firebase signup failed: %s\n",
config.signer.signupError.message.c_str());
  }
  config.token_status_callback = tokenStatusCallback;
  Firebase.begin(&config, &auth);
  Firebase.reconnectWiFi(true);

  // NTP initialization
  timeClient.begin();
  timeClient.setTimeOffset(19800);  // Adjust for UTC+5:30
}

void loop() {
  // Sync time
  timeClient.update();
  setTime(timeClient.getEpochTime());
  String currentTime = String(hour()) + ":" + String(minute()) + ":" +
String(second());
  String currentDate = String(day()) + "/" + String(month()) + "/" + String(year());

  if (MegaSerial.available()) {
    String receivedData = MegaSerial.readStringUntil('\n');
    Serial.println("Received from Mega: " + receivedData);
    lastReceivedTime = millis();

    // Parse and handle data
    if (receivedData.indexOf("HeartRate:") != -1) {
      String heartRate = receivedData.substring(receivedData.indexOf("HeartRate:") +
10, receivedData.indexOf(",SpO2"));
      int heartRateValue = heartRate.toInt();
      Blynk.virtualWrite(V1, heartRateValue);
      dataJson.add("heartRate", heartRateValue);
    }

    if (receivedData.indexOf("SpO2:") != -1) {
      String spo2 = receivedData.substring(receivedData.indexOf("SpO2:") + 5,
receivedData.indexOf(",SystolicBP"));
      double spo2Value = spo2.toFloat();
      Blynk.virtualWrite(V2, spo2Value);
      dataJson.add("spo2", spo2Value);
    }

    if (receivedData.indexOf("SystolicBP:") != -1) {
      String systolicBP = receivedData.substring(receivedData.indexOf("SystolicBP:")
+ 11, receivedData.indexOf(",DiastolicBP"));
      double systolicBPValue = systolicBP.toFloat();
      Blynk.virtualWrite(V3, systolicBPValue);
```

```
      dataJson.add("systolicBP", systolicBPValue);
    }

    if (receivedData.indexOf("DiastolicBP:") != -1) {
      String diastolicBP =
receivedData.substring(receivedData.indexOf("DiastolicBP:") + 12);
      double diastolicBPValue = diastolicBP.toFloat();
      Blynk.virtualWrite(V4, diastolicBPValue);
      dataJson.add("diastolicBP", diastolicBPValue);
    }

    if (receivedData.indexOf("Body Temp:") != -1) {
      String bodyTemp = receivedData.substring(receivedData.indexOf("Body Temp:") +
10, receivedData.indexOf(","));
      double bodyTempValue = bodyTemp.toFloat();
      Blynk.virtualWrite(V5, bodyTempValue);
      dataJson.add("bodyTemp", bodyTempValue);
    }

    if (receivedData.indexOf("Room Temp:") != -1) {
      String roomTemp = receivedData.substring(receivedData.indexOf("Room Temp:") +
10, receivedData.indexOf(", Humidity"));
      double roomTempValue = roomTemp.toFloat();
      Blynk.virtualWrite(V6, roomTempValue);
      dataJson.add("roomTemp", roomTempValue);
    }

    if (receivedData.indexOf("Humidity:") != -1) {
      String humidity = receivedData.substring(receivedData.indexOf("Humidity:") +
9);
      double humidityValue = humidity.toFloat();
      Blynk.virtualWrite(V7, humidityValue);
      dataJson.add("humidity", humidityValue);
    }

    // Add time and date to Firebase JSON
    dataJson.add("time", currentTime);
    dataJson.add("date", currentDate);

    // Push data to Firebase
    if (Firebase.RTDB.pushJSON(&fbdo, "SensorData", &dataJson)) {
      Serial.println("Data sent to Firebase");
    } else {
      Serial.println("Failed to send data to Firebase: " + fbdo.errorReason());
    }

    dataJson.clear();  // Clear the JSON object for the next iteration
  }

  if (millis() - lastReceivedTime > noDataInterval) {
    Serial.println("No data received from Arduino Mega in the last 10 seconds");
```

```
    lastReceivedTime = millis();
  }

  Blynk.run();
}
```