HackOrbit 2025

ByteBash

PROBLEM STATEMENT

OPEN INNOVATION

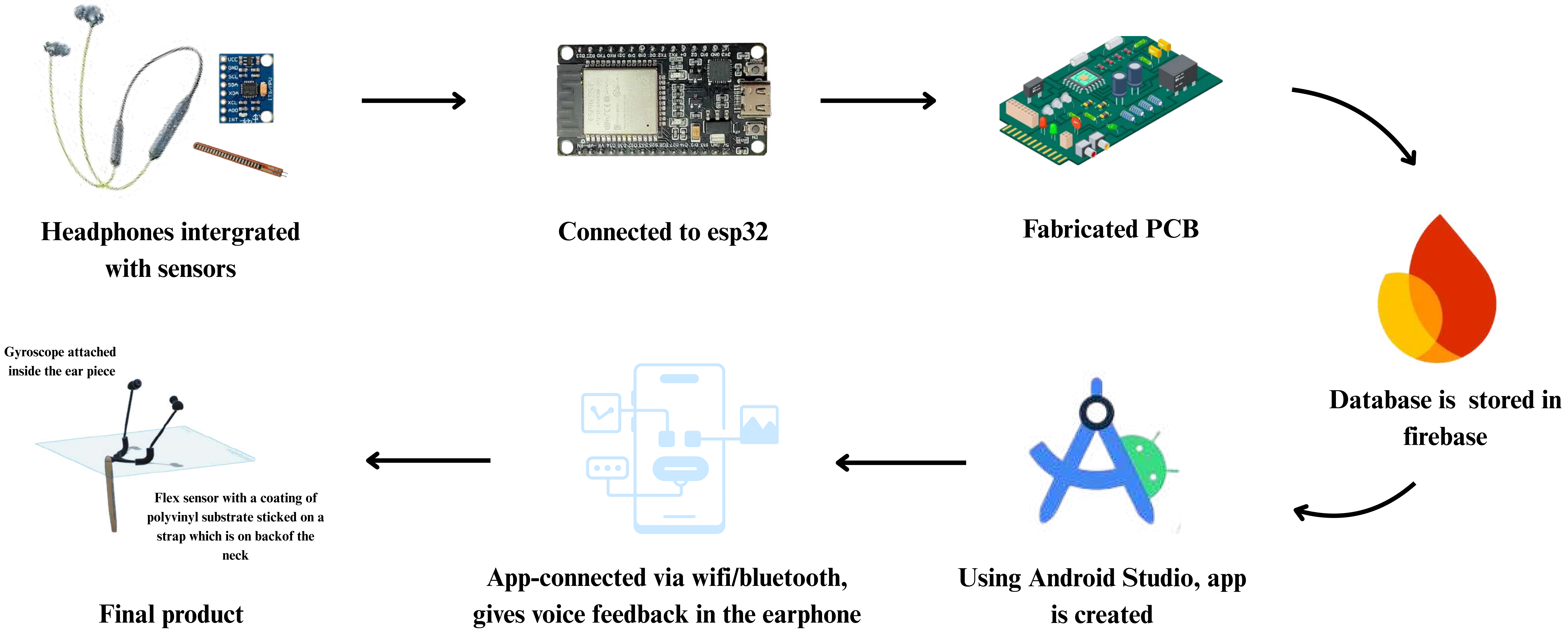
To Develop a wearable device that monitors a user's posture using gyroscope and flex sensors with real-time feedback.

PROPOSED SOLUTION

Poor posture has become a widespread issue in this modern era, especially for IT professionals. So people often suffer from back pain and end up spending on medications, X-rays and other treatments.

Aimed at the moto“Prevention is Better than cure”,we have designed a wearable device that monitors user’s posture using gyroscope and flex sensors, providing real-time feedback to correct poor posture.

FLOWCHART / DIAGRAM



Headphones intergrated with sensors

Connected to esp32

Fabricated PCB

Database is stored in firebase

Using Android Studio, app is created

App-connected via wifi/bluetooth, gives voice feedback in the earphone

Gyroscope attached inside the ear piece

Flex sensor with a coating of polyvinyl substrate sticked on a strap which is on backof the neck

Final product

FLOWCHART / DIAGRAM

1. First, we integrate a gyroscope into Bluetooth headphones, similar to how sensors are already embedded in wireless devices.

2. A flex sensor is positioned on the back of the user’s body, powered and controlled through the headphones

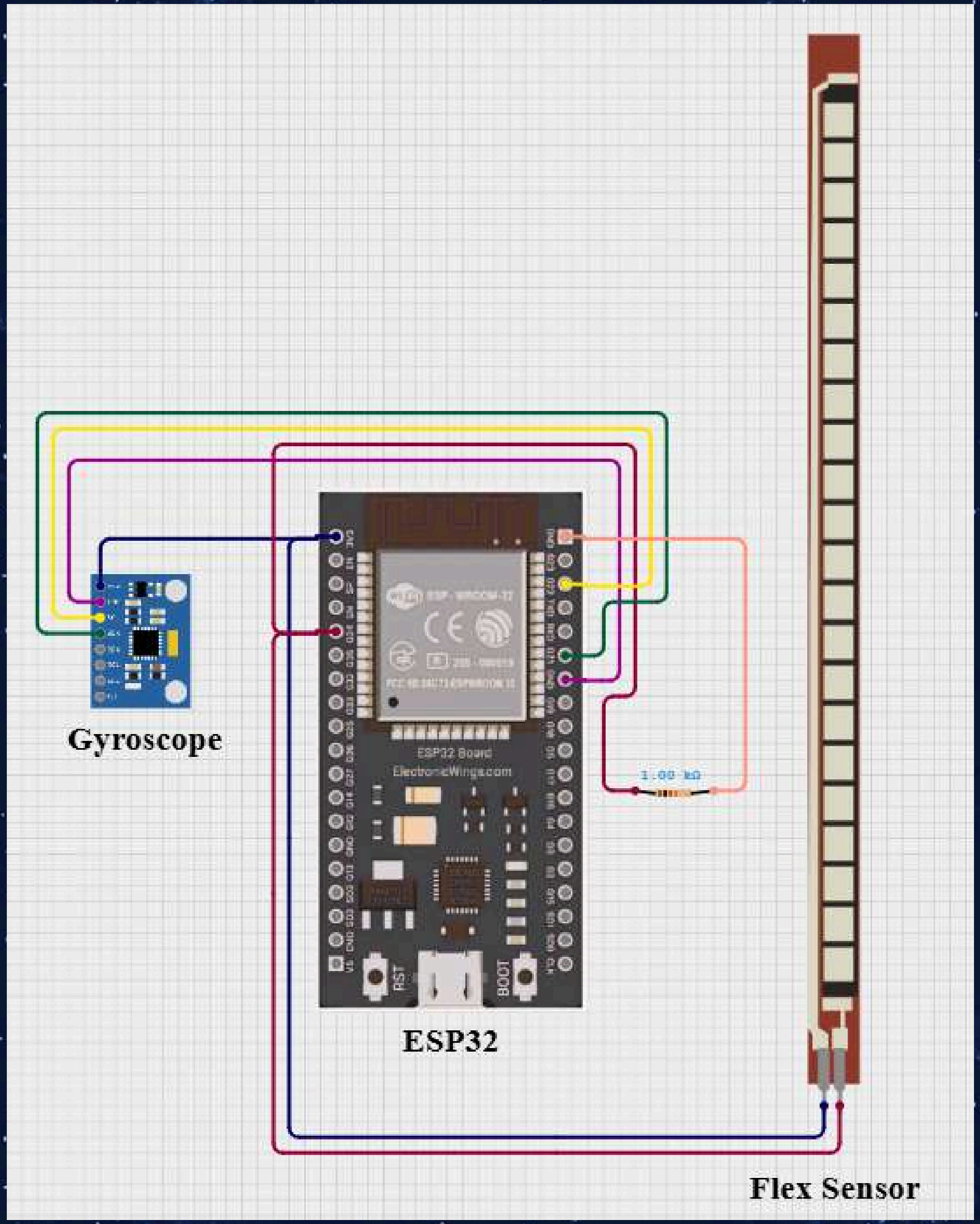
3. The gyrsocope along with the flex sensor, now senses the bending and slouching position, continously sending the data to the PCB.

4. The firmware consists of the PCB connected with the database using bluetooth /wi-fi wirelessly

5. Together, the sensors and the fabricated PCB continuously monitor the user's posture using the database.

6. If poor posture is detected, the system provides voice alerts through the headphones and sends notifications via the app.

CONNECTIONS



```
#include <Wire.h>
#include <MPU6050.h>
MPU6050 mpu;

// Define I2C pins for ESP32
#define I2C_SDA 21
#define I2C_SCL 22

// Flex sensor pin
const int flexPin = 36;  // GPIO36 / VP

// Acceptable ranges
const float HEAD_PITCH_MIN = -15.0;
const float HEAD_PITCH_MAX =  15.0;

const float HEAD_ROLL_MIN  = -10.0;
const float HEAD_ROLL_MAX  =  10.0;

const float BACK_ANGLE_MIN = 0.0;
const float BACK_ANGLE_MAX = 30.0;

void setup() {
Serial.begin(115200);
delay(1000);

// Initialize I2C
Wire.begin(I2C_SDA, I2C_SCL);

// Initialize MPU6050
mpu.initialize();

Serial.println("Initializing MPU6050...");
if (mpu.testConnection()) {
Serial.println("MPU6050 connection successful ✅"); }
else {
Serial.println("MPU6050 connection failed ❌");
while (1);  // Stop here if MPU6050 not found }
delay(1000); }

void loop() {
 // --- Read MPU6050 raw data
 int16_t ax, ay, az;
 int16_t gx, gy, gz;
 mpu.getMotion6(&ax, &ay, &az, &gx, &gy, &gz);
```

```
void loop() {
 // --- Read MPU6050 raw data
 int16_t ax, ay, az;
 int16_t gx, gy, gz;
 mpu.getMotion6(&ax, &ay, &az, &gx, &gy, &gz);

 // --- Compute Pitch and Roll
 float pitch = atan2(ay, sqrt(ax * ax + az * az)) * 180.0 / PI;
 float roll = atan2(-ax, az) * 180.0 / PI;

 // --- Read Flex Sensor (Back Angle)
 int flexADC = analogRead(flexPin);
 // ESP32 ADC = 0 - 4095
 // Calibrate min/max for your flex sensor
 float flexAngle = map(flexADC, 1000, 3000, 0, 90);
 if (flexAngle < 0) flexAngle = 0;
 if (flexAngle > 90) flexAngle = 90;

 // --- Check if values are within range
 bool postureOK = true;

 if (pitch < HEAD_PITCH_MIN || pitch > HEAD_PITCH_MAX) {
 Serial.print("⚠️ ALERT: Head Pitch Out of Range! Pitch = ");
 Serial.print(pitch, 1);
 Serial.println(" deg");
 postureOK = false;
 }

 if (roll < HEAD_ROLL_MIN || roll > HEAD_ROLL_MAX) {
 Serial.print("⚠️ ALERT: Head Roll Out of Range! Roll = ");
 Serial.print(roll, 1);
 Serial.println(" deg");
 postureOK = false;
 }

 if (flexAngle < BACK_ANGLE_MIN || flexAngle > BACK_ANGLE_MAX) {
 Serial.print("⚠️ ALERT: Back Angle Out of Range! Back Angle = ");
 Serial.print(flexAngle, 1);
 Serial.println(" deg");
 postureOK = false;
 }
```

FEATURES AND NOVELTY

FEATURES

- Customized PCB design for circuit working.
- Precise Gyroscope and Flex sensor for sensing.
- Real-time voice feedback via earphones.
- The app keeps record of the user’s database.

NOVELTY

- Integrated gyroscope within earphones.
- Low-cost sensing system.
- Overcomes all the cons faced by camera system posture detection and other wearable devices.
- Personalized app with user-friendly features and compatible for office goers.

DRAWBACK AND SHOWSTOPPERS

DRAWBACKS

- Limited Battery Life at times.
- Require direct contact and specific placement to be accurate.
- Detect only angle, not contact force.

SHOWSTOPPERS

- Heat is produced due to wireless transmission.
- Inaccurate sensor calibration due to external factors
- Fabrication of PCB may be tricky due to the integration of sensors.

BYTEBASH

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Thank you