BreatheEasy System Operation Manual

1. System Overview

The BreatheEasy system consists of three main components:

1. **Smart Band:** An Arduino Nano-based wearable with sensors (PPG, etc.).
2. **Mobile App (Flutter):** Runs on your Android phone. Connects to the Smart Band via Bluetooth and sends data to the PC for processing.
3. **APIs (PC Server):** Two Python programs running on your PC that process the sensor data from the app and return the Apnea Index result.

2. Prerequisites & Setup (PC)

Before you begin, ensure you have the following installed on your PC:

- **Anaconda** (or Miniconda)
- **Arduino IDE**
- **Visual Studio Code** (with the Flutter extension)
- The provided code folders: mL_api, PPG2ECG_api, and breatheasy (Flutter app).

2.1. Setting Up the APIs

1. **Open Anaconda Prompt.**
2. **Create and activate the first API environment:**

Navigate to the mL_api folder containing the ecg_testbackup1.yaml file

cd path/to/mL_api

Create the conda environment from the YAML file

conda env create -f ecg_testbackup1.yaml

Activate the environment

conda activate mL_api_env (Note: Replace 'mL_api_env' with the name defined in the YAML file)

3. **Repeat the process for the second API:**

cd path/to/PPG2ECG_api

conda env create -f ppg2ecgbackup1.yaml

conda activate ppg2ecg_env (Again, use the correct environment name)

4. **Run both APIs:** Open each API project in VSCode. Ensure the correct Conda environment is selected for each (bottom right of VSCode). Run each one.

Note: for the ppg2ecg API you must download the weights from the originals developers repo mentioned in the references section in this project's Github page.

2.2. Finding Your PC's IP Address

You will need this for the app configuration.

- **Windows:** Open Command Prompt and type ipconfig. Look for the "IPv4 Address" under your active network adapter.
- **macOS/Linux:** Open Terminal and type ipconfig getifaddr en0 (or use ifconfig).

3. Smart Band (Arduino Nano) Firmware

The firmware is pre-installed. If you need to re-upload it:

1. **Open the smart band's cover and carefully lift the Nano to access its micro-USB port.**
2. **Connect it to your PC.**
3. **Open Arduino IDE.**
4. **Install Board Package:**
    - Go to Tools > Board > Boards Manager...
    - Search for and install **"Arduino Mbed OS Nano Boards"** (v3.0.1).
5. **Install Required Libraries:** Go to Sketch > Include Library > Manage Libraries... and search for and install these:
    - MAX3010x by Maxim Integrated
    - Arduino_BM1270_BMM150 by Arduino
    - Arduino_HS300x by Arduino
    - Arduino_LPS22HB by Arduino
    - ArduinoBLE by Arduino
    - Adafruit GFX Library (install all dependencies when prompted)
    - Adafruit SSD1306 (install all dependencies when prompted)
6. **Upload Firmware:**

- Open the Final_SDP_Submission.ino sketch.
- Select the board: Tools > Board > Arduino Mbed OS Nano Boards > Arduino Nano 33 BLE.
- Select the correct COM port under Tools > Port.
- Click the **Upload** button (→).
- **If upload fails:** Double-press the Nano's reset button to put it in bootloader mode (orange LED will blink) and try uploading again.

4. Mobile App Setup & Configuration

1. **Open the** breatheasy **Flutter project in VSCode.**
2. **Configure the IP Address:**
   - Navigate to the file: lib/homepage/apiservices.dart.
   - Find the two lines containing IP addresses (e.g., http://192.168.x.x:8000).
   - Change both addresses to your **PC's IP address** you found earlier.
3. **Connect an Android phone** with USB debugging enabled.
4. **Run** main.dart in debug mode to install the app on your phone.

5. Operating Procedure

1. **On the Phone:**
   - Ensure the app has the permissions: **Location, Nearby Devices, and Files & Media**. You may need to restart the app after granting these.
   - Ensure your PC and phone are on the **same Wi-Fi network**.
2. **On the Smart Band:**
   - Turn it on using the switch. The display should show **"Awaiting Connection"**.
   - Place the PPG sensor on your **index finger**. It should be snug but not tight, allowing normal blood flow.
3. **Pairing:**
   - Open the BreatheEasy app.
   - Navigate to the **Bluetooth** section.

- Tap on **"ArduinoNanoBLE"** under "Discovered Devices". It will move to "Connection Status" when paired.

4. **Recording Data:**
    - Return to the home page.
    - Click **"Start"** to begin measuring and sending sensor data.
    - When finished, click **"Stop"**. The recording duration will be displayed.
5. **Viewing Results:**
    - Click **"Show my Data"**.
    - Select the ppgData.csv file from your phone's Downloads folder.
        - *Note: This file is overwritten with every new recording.*
    - The app will send the data to the APIs on your PC and display the calculated **Apnea Index**.
        - *A result of 0 typically means no apnea events were detected, which could be because you don't have apnea or you were awake during the recording.*