Part 1 – Common Part: Group Work Description

1. Introduction

The main goal of this laboratory session was to gain practical experience with the sensors and features of the Arduino Nano RP2040 Connect.
Through a series of exercises, we explored the RGB LED, temperature sensor, microphone, and IMU (Inertial Measurement Unit). Each exercise built on the previous one, culminating in an integrated posture-monitoring device capable of detecting back angle and environmental conditions.
The work was carried out collaboratively, with each team member contributing to coding, testing, debugging, and documentation.

2. Exercise 1 – Internal RGB LED

The first exercise focused on controlling the board's built-in RGB LED. In the sketch *Exercise1_RGB*, the LED cycled through red, green, and blue every half-second.

Using the WiFiNINA library, we accessed the LED pins and encountered an issue where colors blended incorrectly because inactive channels weren't turned off. We resolved this by setting the other two color channels to LOW before lighting a specific one.
The result was a smooth, continuous color transition, confirming correct operation of the microcontroller.

3. Exercise 2 – Temperature Sensor

The second task extended the LED setup to include temperature readings using the IMU's built-in sensor. In *Exercise2_Temperature*, temperature values were displayed on the Serial Monitor and color-coded via the LED:

- Red: above 32 °C
- Green: between 20 °C and 32 °C
- Blue: below 20 °C

We noticed that the readings were consistently higher than actual room temperature due to internal heating from the processor. To correct this, we applied a small offset in the code, which produced accurate readings. Once calibrated, the LED responded correctly to changes in temperature.

4. Exercise 3 – Microphone

In the third exercise, we explored the board's microphone. The sketch *Exercise3_Microphone* used the Serial Plotter to visualize live sound data, showing clear peaks and valleys corresponding to environmental noise.

This task helped us understand how to interpret audio signals and laid the groundwork for integrating noise detection into the final posture-monitoring system.

5. Posture Detection Device

The final and most challenging task was creating a posture detection system using the IMU and the Madgwick library to calculate the board's orientation.
The system used the RGB LED for visual feedback:

- Green – correct posture (around 90°)
- Blue – leaning forward (below 80°)
- Red – posture warning or excessive noise

Initially, we struggled to determine the correct board orientation for pitch measurement. After testing several positions, we found that tilting the board sideways (across its width) provided stable readings.

We also added the microphone to trigger a red LED warning when noise exceeded a set threshold. The final prototype successfully combined motion and sound sensing, simulating a basic smart ergonomic monitor.

6. Challenges and Problem-Solving

Throughout the laboratory work, the main challenges we faced were:

LED color conflicts: forgetting to set the inactive colors to LOW caused incorrect

color mixing. → Solution: explicitly turn off unused color channels before setting the desired one.
Temperature calibration: the built-in temperature sensor showed higher values.→ Solution: apply an offset correction variable to match real readings.

Posture detection orientation: unclear how to tilt the board for correct pitch readings. → Solution: test multiple orientations until the correct axis response was observed.
Each of these challenges provided valuable learning opportunities about debugging, testing, and interpreting sensor behavior.