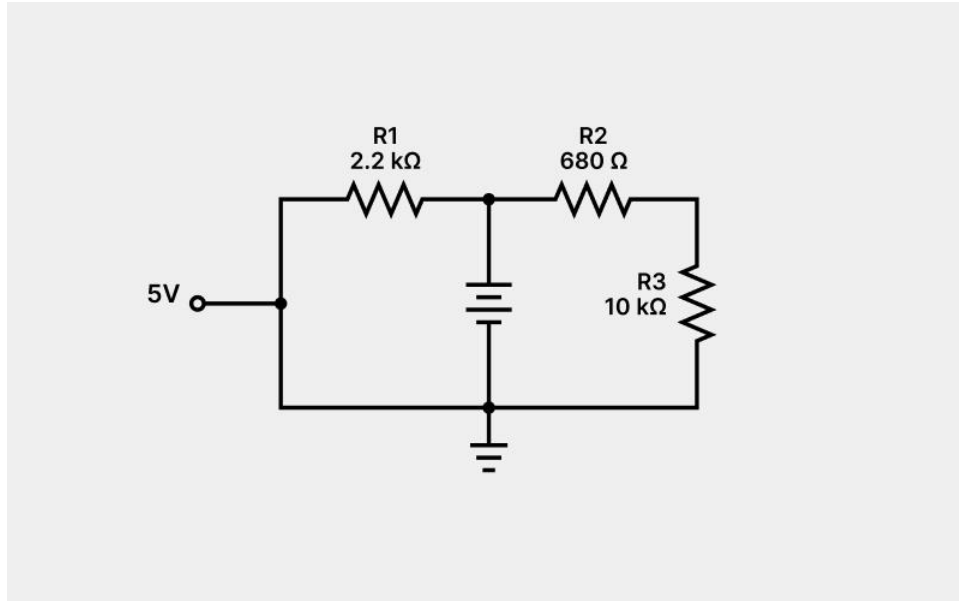


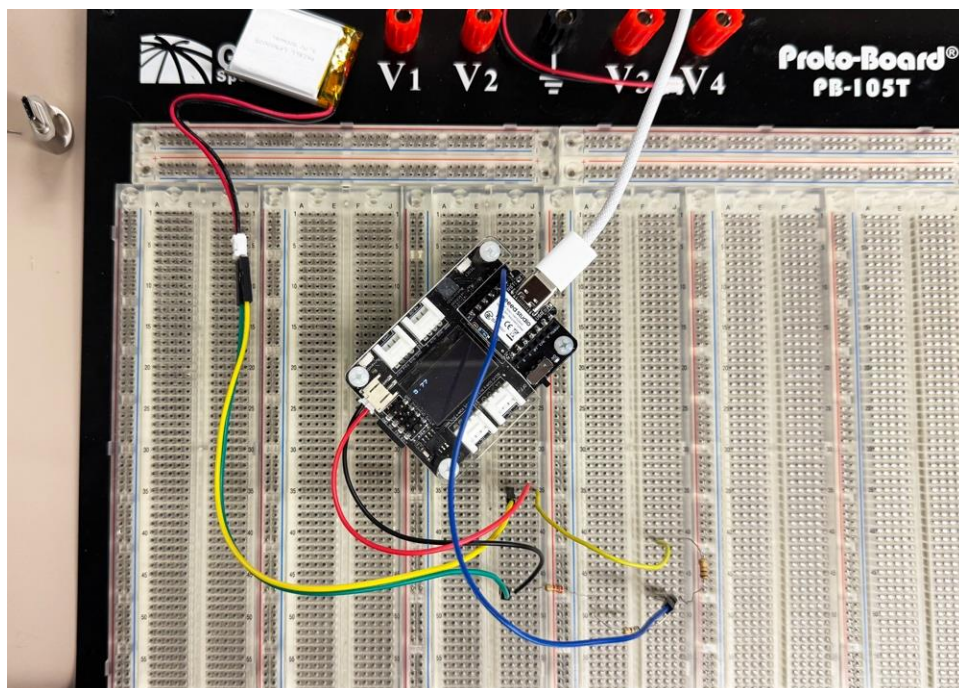
Lab #3: Smart Environmental and Activity Logger

Circuit design

Circuit diagram



Breadboard layout



Voltage divider

Voltage divider equation:

$$V_{out} = V_{in} \left(\frac{R_2}{R_1 + R_2} \right)$$

where:

$$R_2 = 10k\Omega$$

$$R_2 = 2.2k\Omega + 680\Omega = 2.88k\Omega$$

Using 5V reference voltage:

$$V_{out} = 5V \left(\frac{10000}{2880 + 10000} \right)$$

$$V_{out} = \frac{50000}{12880}$$

$$V_{out} = 3.88$$

Question:

While our voltage divider code is functional, we used a threshold of 3.3V for the battery monitor. The microcontroller doesn't operate below 3.3V [1] and the battery has discharge voltage cut-off of 3V [2]. If the device is not operational below 3.3V, we should not be able read V_{out} . Should we have set a higher threshold in our code? How should the V_{out} of our ADC map to the reference voltage?

Data Logging

The function on the next page uses the reading from pin A0 to calculate the battery voltage from the analog-to-digital converter (ADC) and prints the system status on the OLED.

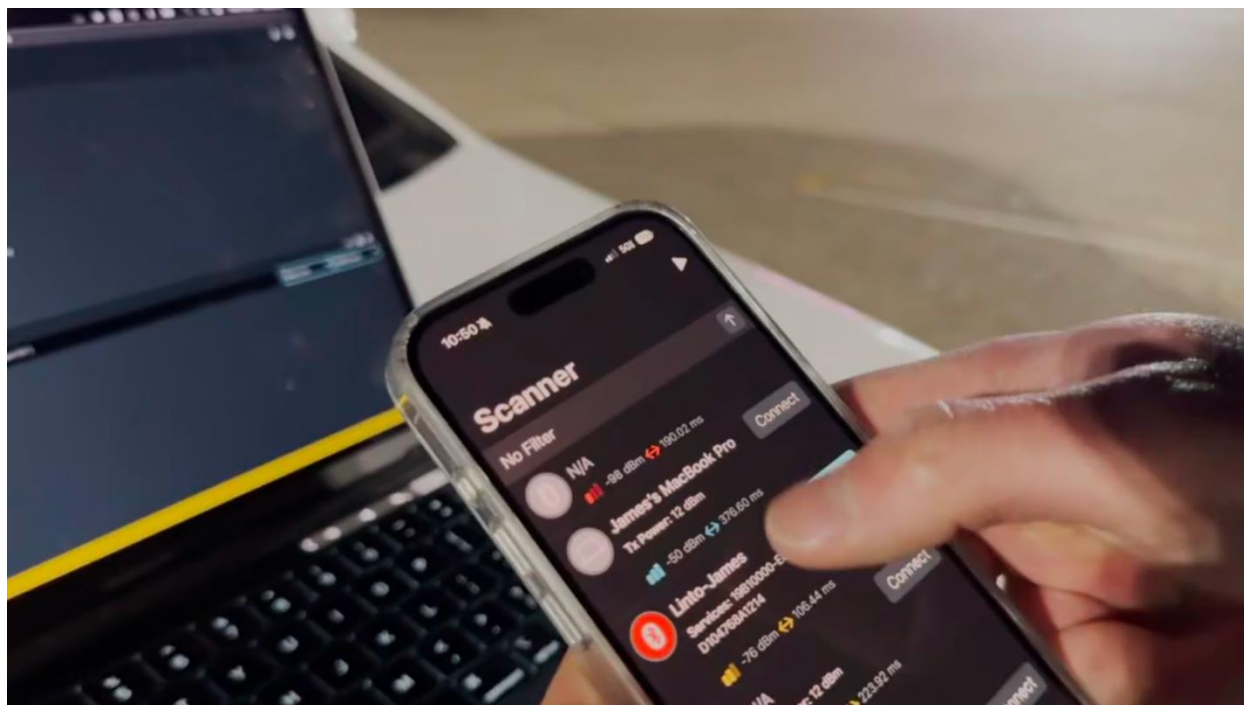
```

188 void getData() {
189
190   if (logging) {
191     // Read the input on analog pin A0:
192     int sensorValue = analogRead(A0);
193
194     // Convert the ADC value to voltage:
195     float measuredVoltage = sensorValue * (referenceVoltage / 1023.0);
196
197     // Account for the voltage divider to get the actual battery voltage:
198     float batteryVoltage = measuredVoltage * ((R1 + R2) / R2);
199
200     if (batteryVoltage > referenceVoltage) {
201       digitalWrite(ledPin, HIGH); // Turn ON if above threshold
202       Serial.println("ON");
203       u8x8.setCursor(0, 2); // (columns, row)
204       u8x8.print("STATUS ON ");
205       u8x8.clearLine(3);
206       u8x8.clearLine(4);
207     } else {
208       digitalWrite(ledPin, LOW); // Turn OFF if below threshold
209       Serial.println("OFF");
210       u8x8.setCursor(0, 2); // (columns, row)
211       u8x8.print("STATUS OFF ");
212       u8x8.setCursor(0, 3); // (columns, row)
213       u8x8.print("Low Battery:");
214       u8x8.setCursor(0, 4); // (columns, row)
215       u8x8.print("Logging Stopped");
216
217       return;
218     }
219

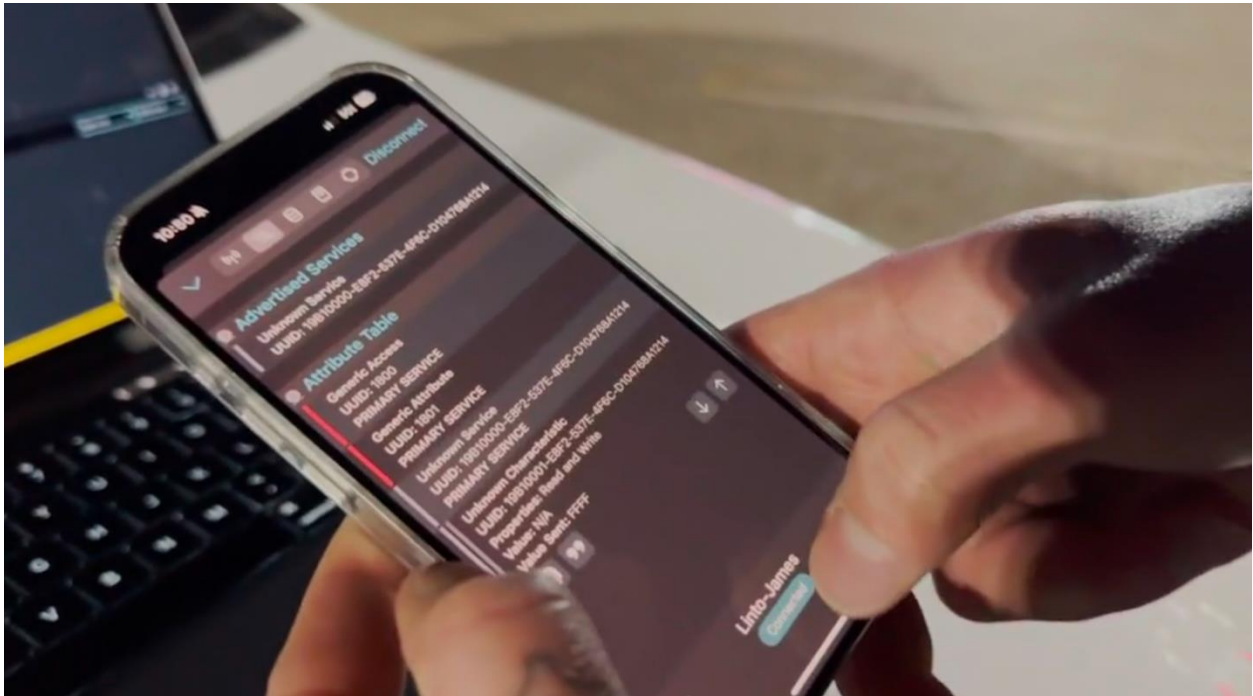
```

Bluetooth connectivity

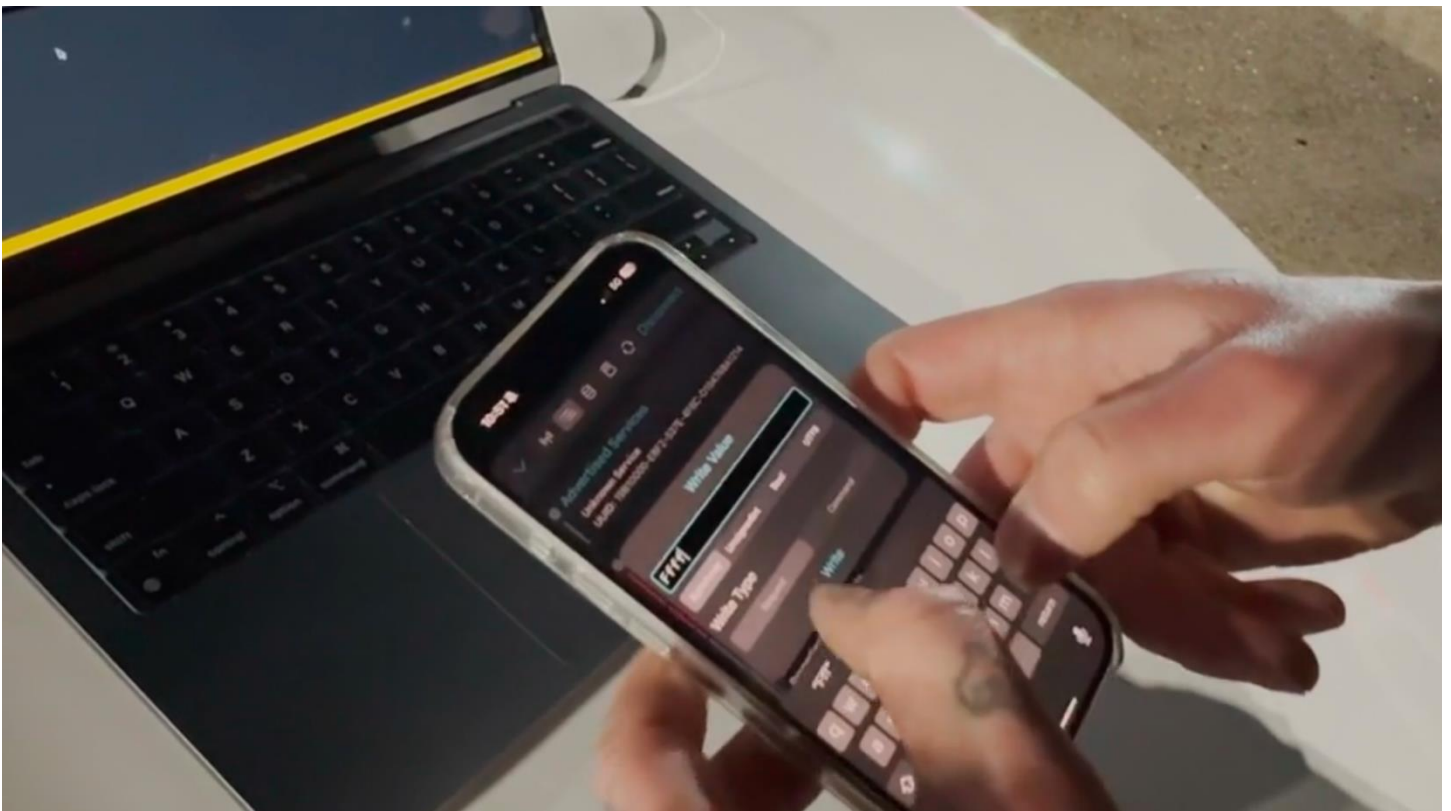
Connecting to our microcontroller using Bluetooth



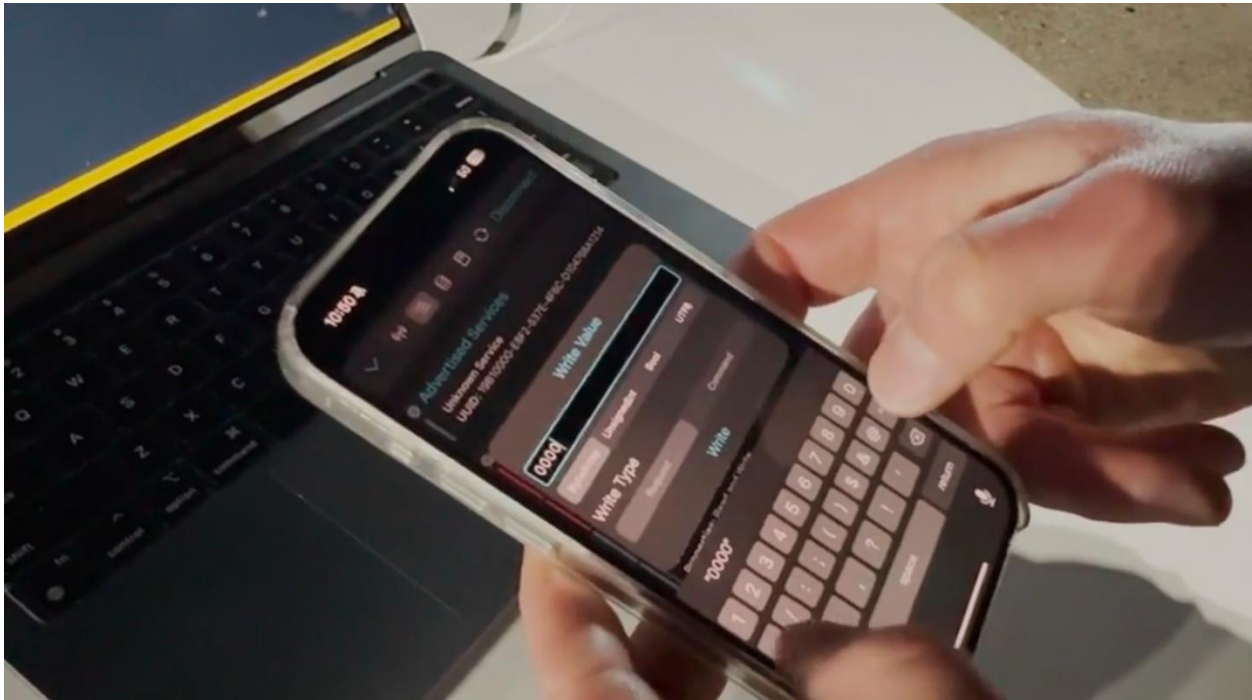
Successful connection



Sending a message to start logging data



Sending a message to stop logging data



Voltage measurement and sensor output

Serial monitor output

```
battery_final | Arduino IDE 2.3.4

battery_final.ino
1 #include <Arduino.h>
2 #include <U8x8lib.h> //Display library
3 #include <Wire.h> //I2C protocol library (the display uses I2C to interact with MCU)
4 #include "LSM6DS3.h"
5 #include "Wire.h"
6 #include <ArduinoBLE.h>
7 #include <PCF8563.h>
8 #include <SPI.h>
9 #include <SD.h>

Output Serial Monitor x
Message (Enter to send message to 'Seeed XIAO BLE Sense - nRF52840' on '/dev/cu.usbmodem101') New Line 9600 baud

ON

Accelerometer:
X1 = -0.1200
Y1 = -0.2089
Z1 = 0.9775

Gyroscope:
X1 = 0.9100
Y1 = -0.2800
Z1 = 1.3300

Thermometer:
Degrees C1 = 23.9688
Degrees F1 = 75.1438

Battery Voltage: 4.10 V
27.00

5/2/25 14:46:7

ON

Accelerometer:
X1 = -0.1166
Y1 = -0.2118
Z1 = 0.9784

Gyroscope:
```

Data written to SD card

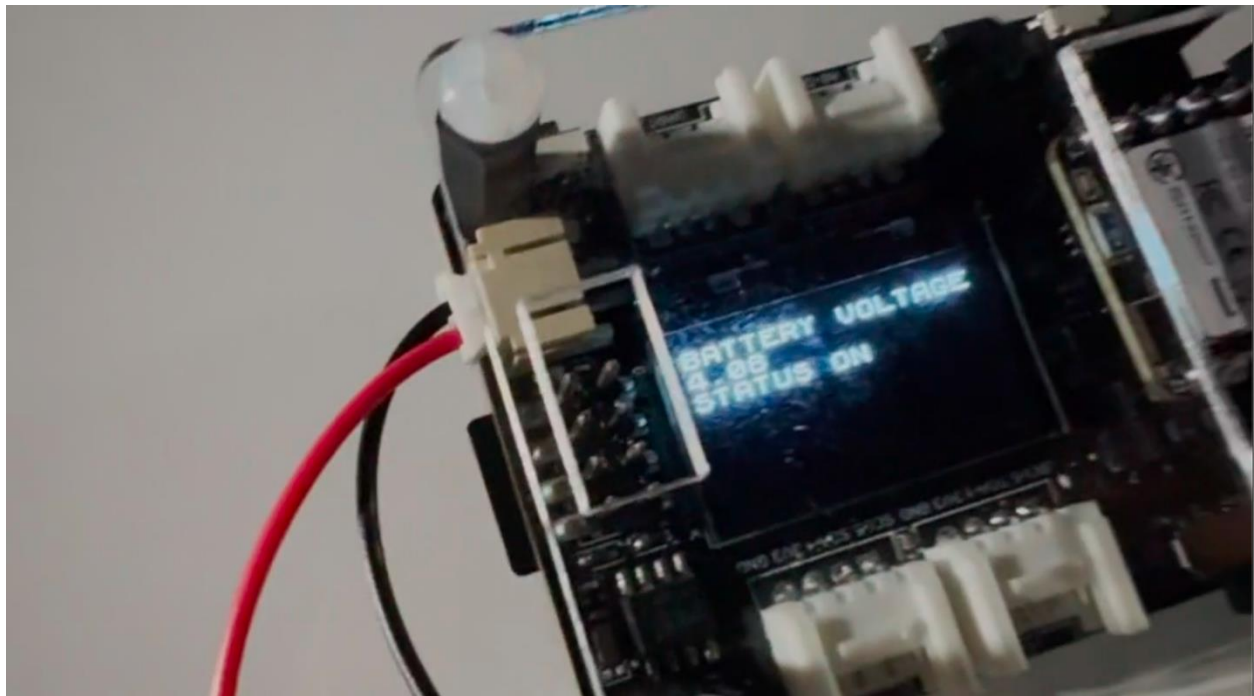
```
DATALOG.TXT
BatteryVoltage: 4.08
Accelerometer X-axis: -0.03,Accelerometer Y-axis: 0.09,Accelerometer Z-axis: 1.00
Gyroscope X- axis: 0.84,Gyroscope Y- axis: 0.07,Gyroscope z- axis: 1.05
Temperature: 21.39 C,70.50 F
Microphone: 78.00
Date: 5/2/25
Time: 14:42:1

977,723,1014
BatteryVoltage: 4.08
Accelerometer X-axis: -0.04,Accelerometer Y-axis: 0.09,Accelerometer Z-axis: 1.00
Gyroscope X- axis: 0.91,Gyroscope Y- axis: -0.35,Gyroscope z- axis: 1.40
Temperature: 21.43 C,70.57 F
Microphone: 11.00
Date: 5/2/25
Time: 14:42:2

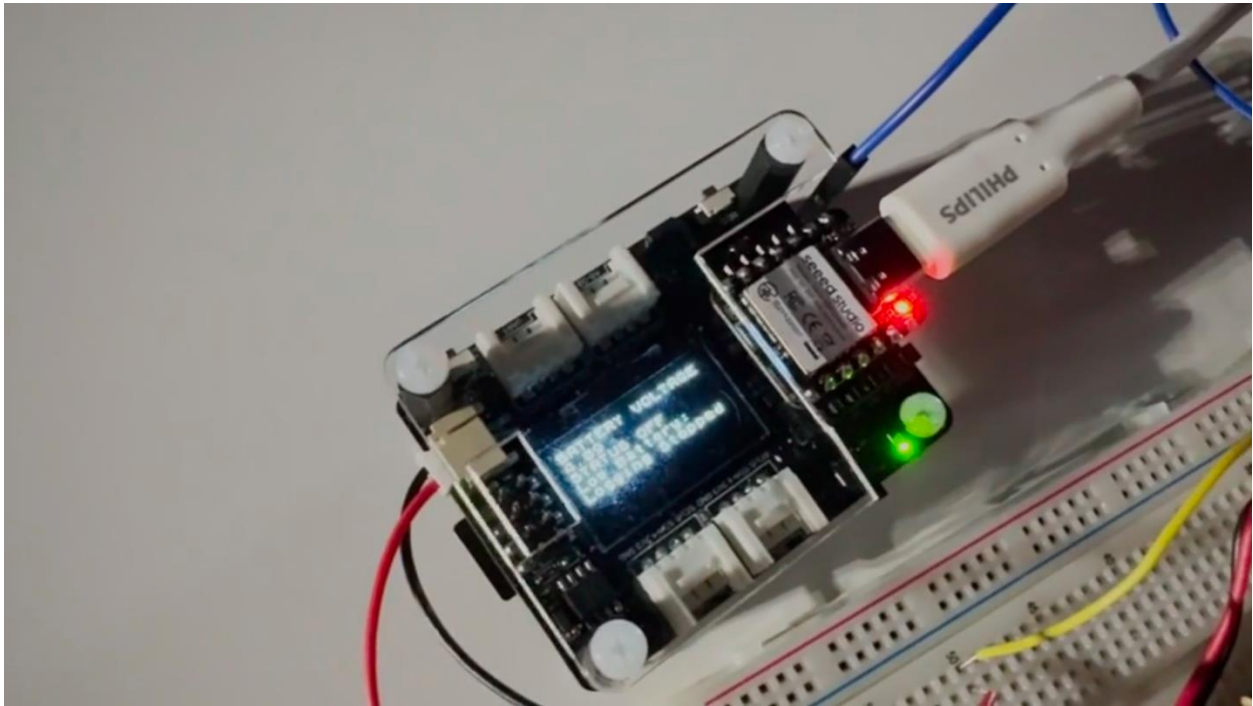
978,728,1013
BatteryVoltage: 4.08
Accelerometer X-axis: -0.03,Accelerometer Y-axis: 0.09,Accelerometer Z-axis: 1.00
Gyroscope X- axis: 0.98,Gyroscope Y- axis: -0.28,Gyroscope z- axis: 1.47
Temperature: 21.47 C,70.65 F
Microphone: 2.00
Date: 5/2/25
Time: 14:42:3

977,727,1014
BatteryVoltage: 4.09
Accelerometer X-axis: -0.03,Accelerometer Y-axis: 0.09,Accelerometer Z-axis: 1.00
Gyroscope X- axis: 0.98,Gyroscope Y- axis: -0.14,Gyroscope z- axis: 1.19
```

Displaying battery voltage and data logging status on the OLED



Displaying a message when battery voltage is below 3.3V threshold



References:

- [1] "Seeed Studio XIAO nRF52840 Sense - TinyML/TensorFlow Lite- IMU / Microphone - Bluetooth5.0." Accessed: Feb. 06, 2025. [Online]. Available: <https://www.seeedstudio.com/Seeed-XIAO-BLE-Sense-nRF52840-p-5253.html>
- [2] "nRF52840 Product Specification." Accessed: Feb. 06, 2025. [Online]. Available: https://docs.nordicsemi.com/bundle/ps_nrf52840/page/keyfeatures_html5.html