Bluno Nano to Mobile App

Introduction

Our objective is to design and implement a comprehensive system that efficiently collects data from various sensors, such as pH, EC, temperature, pressure, and weight sensors. These sensors are connected to individual microcontrollers known as Bluno Nano, which have Bluetooth Low Energy (BLE) capabilities, enabling them to transmit the collected data wirelessly. The system is intended to enable seamless communication between the mobile device and one or more Bluno Nano microcontrollers. Through the BLE technology, the collected sensor data is transmitted to the mobile device in real-time. Additionally, the mobile device not only receives this data but also updates its user interface to provide a user-friendly and up-to-date representation of the sensor readings. Overall, our primary goal is to create an efficient and reliable data acquisition and communication system that enhances the user experience by providing accurate and timely information from the connected sensors to the mobile device.

How It Works?

How the system is working, describe below --

- The Bluno Nano initially advertises itself using BLE (Bluetooth Low Energy) with the name "Bluno" and provides a service that consists of two characteristics: "Serial" and "AT-CTRL."
- The mobile app establishes a connection to the Bluno Nano using the name "Bluno" after discovering it through BLE.
- Upon successful connection, the mobile app identifies and selects the "Serial" characteristic to enable data communication with the Bluno Nano.
- To initiate a sensor pairing process, the mobile app sends the command "pair" to the "Serial" characteristic. In response, the Bluno Nano immediately sends back the "pair" command along with a descriptive tag, which provides information about the specific sensor connected to the Bluno Nano.
- Once the mobile app and Bluno Nano are successfully connected, the Bluno Nano becomes capable of transmitting data to the mobile device upon request.
- When the mobile app sends the command "od" (on demand) to the Bluno Nano, the Bluno Nano reads the sensor's current value and promptly sends this value back to the mobile device.

In summary, the Bluno Nano uses BLE to advertise itself with the name "Bluno" and offers two characteristics ("Serial" and "AT-CTRL"). The mobile app connects to the Bluno Nano, selects the "Serial" characteristic for data communication, and initiates sensor pairing by sending the "pair" command. After successful pairing, the Bluno Nano can send sensor data to the mobile device upon receiving the "od" command.

Sensor's Description

EC Sensor:

Pin Mapping:

EC Sensor's Pin	Bluno Nano Pin
-	GND
+	5 V
A	A5 (Analog Pin)

Required Library:

- DFRobot_EC Library download from here –
  https://codeload.github.com/DFRobot/DFRobot_EC/zip/refs/heads/master
- EEPROM Library download from here –
  https://codeload.github.com/PaulStoffregen/EEPROM/zip/refs/heads/master

How to calibrate the sensor?

To ensure accuracy, the probe needs to be calibrated for its first use and after not being used for an extended period. Here uses two-point calibration and therefore requires standard buffer solutions of **1413us/cm** and **12.88ms/cm**. The following steps shows how to operate two-point calibration --

1. Upload the code to the Bluno Nano board, then open the serial monitor, you can see the electrical conductivity.
2. Wash the probe with distilled water, then absorb the residual water-drops with paper. Insert the probe into the 1413us/cm standard buffer solution, stir gently, until the values are stable.
3. After the values are stable, the first point can be calibrated. Ready to go to calibration mode.
4. Input **enterec** command in the serial monitor to enter the calibration mode.
5. Input **calec** commands to start the calibration. The program will automatically identify which of the two standard buffer solutions is present: either 1413us/cm and 12.88ms/cm. In this step, the standard buffer solution is 1413us/cm.
6. After the calibration, input **exitec** command to save the relevant parameters and exit the calibration mode. Note: Only after inputting **exitec** command in the serial monitor can the relevant parameters be saved.
7. After the above steps, the first point calibration is completed. The second point calibration will be performed below.
8. Wash the probe with distilled water, then absorb the residual water-drops with paper. Insert the probe into the 12.88ms/cm standard buffer solution, stir gently, until the values are stable.
9. After the values are stable, the second point can be calibrated. Ready to go to calibration mode.

10. Input **enterec** command in the serial monitor to enter the calibration mode.
11. Input **calec** commands to start the calibration. The program will automatically identify which of the two standard buffer solutions is present: either 1413us/cm and 12.88ms/cm. In this step, the standard buffer solution is 12.88ms/cm.
12. After the calibration, input **exitec** command to save the relevant parameters and exit the calibration mode.
13. After completing the above steps, the two-point calibration is completed, and then it can be used for actual measurement. The relevant parameters in the calibration process have been saved to the EEPROM of the main control board.

pH Sensor:

Pin Mapping:

pH Sensor's Pin	Bluno Nano Pin
-	GND
+	5 V
A	A5 (Analog Pin)

Required Library:

- DFRobot_PH Library download from here –
https://codeload.github.com/DFRobot/DFRobot_PH/zip/refs/heads/master
- EEPROM Library download from here –
https://codeload.github.com/PaulStoffregen/EEPROM/zip/refs/heads/master

How to calibrate the sensor?

To ensure accuracy, the probe needs to be calibrated for its first use and after not being used for an extended period (once a month ideally). Here, uses two-point calibration and therefore requires two standard buffer solutions of 4.0 and 7.0. The following steps show how to operate two-point calibration –

1. Upload the code to the Bluno Nano board, then open the serial monitor, after you can see pH value.
2. Wash the probe with distilled water, then absorb the residual water-drops with paper. Insert the pH probe into the standard buffer solution of 7.0, stir gently, until the values are stable.
3. After the values are stable, the first point can be calibrated. Ready to go to calibration mode.
4. Input **enterph** command in the serial monitor to enter the calibration mode.
5. Input **calph** commands in the serial monitor to start the calibration. The program will automatically identify which of the two standard buffer solutions is present: either 4.0 or 7.0. In this step, the standard buffer solution of 7.0 will be identified.
6. After the calibration, input **exitph** command in the serial monitor to save the relevant parameters and exit the calibration mode. Note: Only after inputing exitph command in the serial monitor can the relevant parameters be saved.

7. After the above steps, the first point calibration is completed. The second point calibration will be performed below.
8. Wash the probe with distilled water, then absorb the residual water-drops with paper. Insert the pH probe into the standard buffer solution of 4.0, stir gently, until the values are stable.
9. After the values are stable, the second point can be calibrated. Ready to go to calibration mode.
10. Input **enterph** command in the serial monitor to enter the calibration mode.
11. Input **calph** commands in the serial monitor to start the calibration. The program will automatically identify which of the two standard buffer solutions is present: either 4.0 and 7.0 In this step, the standard buffer solution of 4.0 will be identified.
12. After the calibration, input the **exitph** command in the serial monitor to save the relevant parameters and exit the calibration mode.
13. After completing the above steps, the two-point calibration is completed, and then the sensor can be used for actual measurement. The relevant parameters in the calibration process have been saved to the EEPROM of the main control board.

Water Pressure Sensor:

Pin Mapping:

Water Pressure Sensor's Pin	Bluno Nano Pin
Black Wire	GND
Red Wire	5 V
Yellow Wire	A5

How to calibrate the sensor?

Here I get analog voltage from the water pressure sensor. After that the offset voltage is subtracted from the raw voltage. Then the result multiplied with 250 and finally got the pressure. So, here is required to calibrate the offset voltage and change the Offset variable with the calibrated value on the code and upload the code again.

How do you get the offset voltage?

Connect the 3-pin wire to the Bluno Nano (VCC, GND and Signal) without connecting the sensor to the water pipe and run the program for once where we get pressure value. Mark down the LOWEST pressure value through the serial monitor. Then divided the lowest pressure value by 250 and then add the given Offset value (0.483). After that we get the calibrated Offset voltage. Then change the Offset variable with the calibrated value on the given code. After that the sensor get more accurate value.

DS18B20 Temperature Sensor:

Pin Mapping:

Temperature Sensor's Pin	Bluno Nano Pin
Black Wire	GND
Red Wire	5 V
Yellow Wire	Digital 8

Required Library:

OneWire Library download from here –
https://codeload.github.com/PaulStoffregen/OneWire/zip/refs/heads/master

This sensor works on OneWire communications. There is no need to calibrate the temperature sensor.

RS232 Module:

Here, a weight sensor connected with RS232 module. We can gain weight from this module using serial communications.

Pin Mapping:

RS232 Module Pin	Bluno Nano Pin
GND	GND
Vcc	5 V
Rx	Digital 10
Tx	Digital 9

Required Library:

SoftwareSerial Library download from here –
https://codeload.github.com/PaulStoffregen/SoftwareSerial/zip/refs/heads/master

There is no need to calibrate the sensor and this module.