Measurement of Water Temperature at Different Depths Using Arduino Sensors

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Abstract. In this work, we used the Arduino Nano 33 BLE Sense Rev 2 open-source hardware platform to measure water temperatures at depths of 1m, 2m, and 3m. Data were collected and stored with GPS coordinates to analyze environmental conditions. The system's effectiveness was validated through consistent results, making it a viable tool for environmental monitoring.

Keywords/: water temperature, Arduino sensors, environmental monitoring, GPS integration, temperature profiling

1. Introduction

Water temperature significantly influences aquatic ecosystems and chemical processes. Monitoring temperature profiles in water bodies provides crucial environmental data. This study demonstrates an Arduino-based system for measuring water temperatures at varying depths, integrating GPS data to enhance analysis.

2. Methodology

2.1. Equipment

The system included:

- **Microcontroller:** Arduino Nano 33 BLE Sense Rev 2
- **Temperature Sensors:** DS18B20
- **GPS Module:** TZT GY-NEO6MV2
- **Display:** OLED LCD (128x64 resolution)
- **Power Source:** Power bank
- **Data Storage:** MicroSD card module

2.2. System Assembly

The system was designed to measure temperature at depths of 1m, 2m, and 3m. Sensors were securely mounted on a buoy, ensuring waterproofing with Teflon tape. GPS coordinates and temperature data were displayed on an OLED screen and stored on a microSD card.

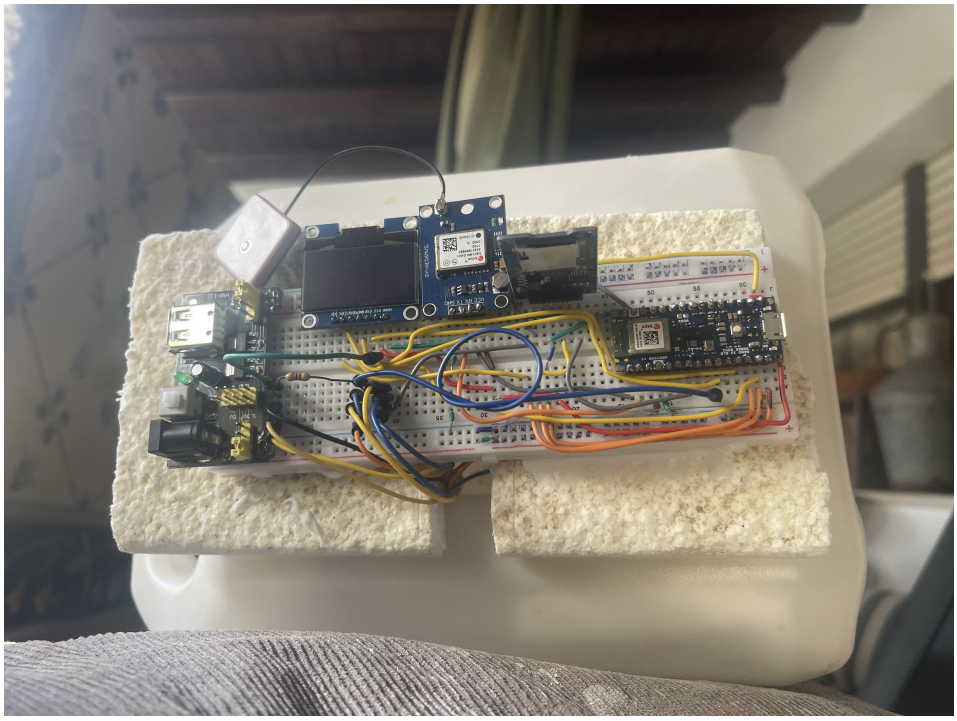

Figure 1. Assembled System: Arduino-based sensor setup for water temperature measurements.

Figure 2. Complete Project: Final implementation of the Arduino-based water monitoring system.

2.3. System Diagram

A detailed diagram showing the functional components of the system is presented below.

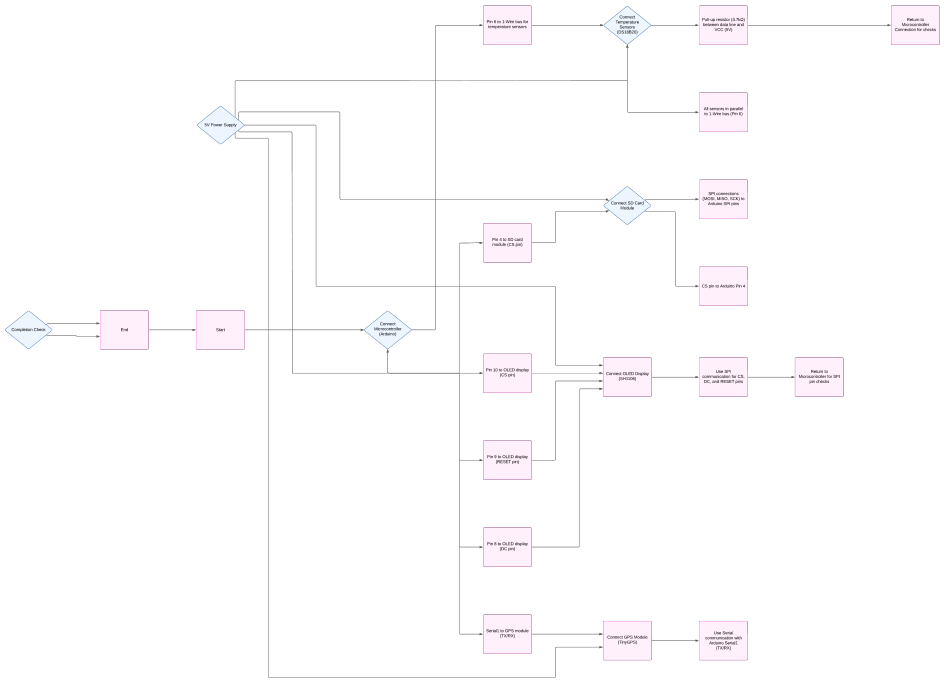

Figure 3. System Architecture: Connections between components including Arduino, sensors, GPS, and microSD module.

2.4. Electronic Circuit Diagram

The circuit integrates a GPS module, three temperature sensors, an SD card for data logging, and an OLED display for real-time data visualization. The diagram below highlights the wiring and connections.

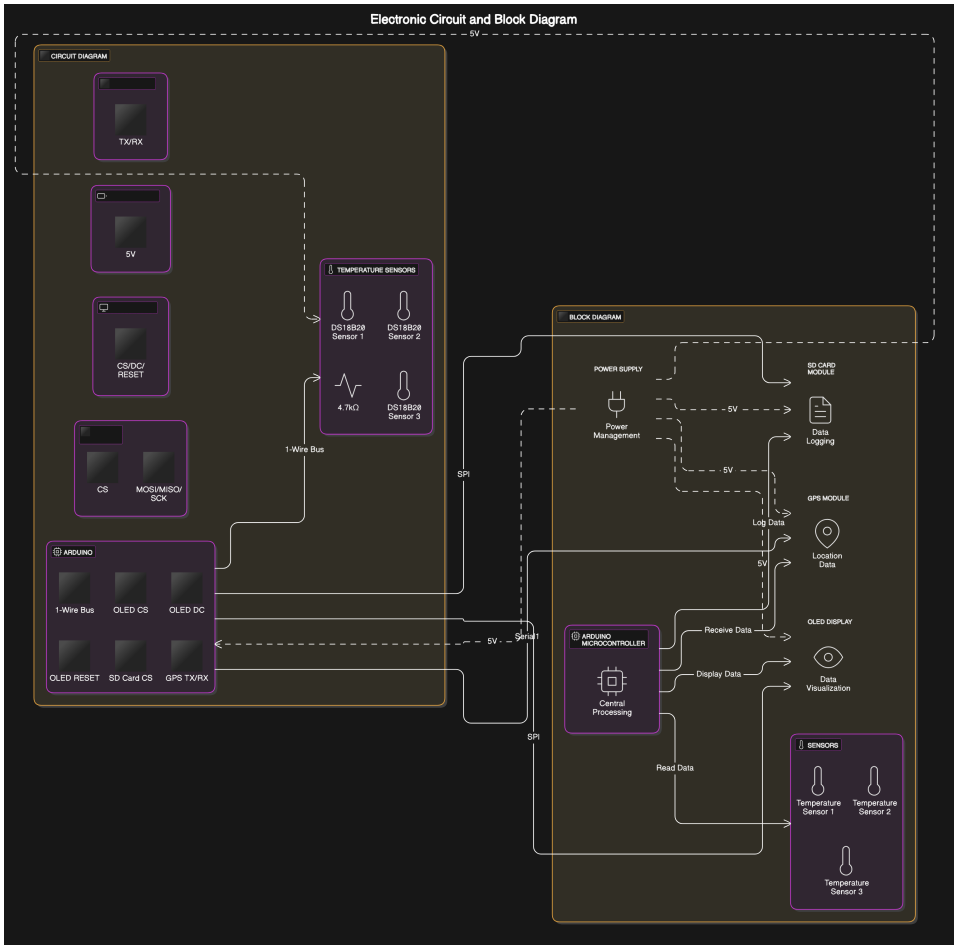

Figure 4. Electronic Circuit Diagram: Connections between Arduino, sensors, GPS, SD card, and OLED display.

3. Results and Discussion

3.1. Temperature Measurements and Locations

Prior to detailing specific measurements, the following figures summarize data from each individual sensor and a combined overview of all sensors:

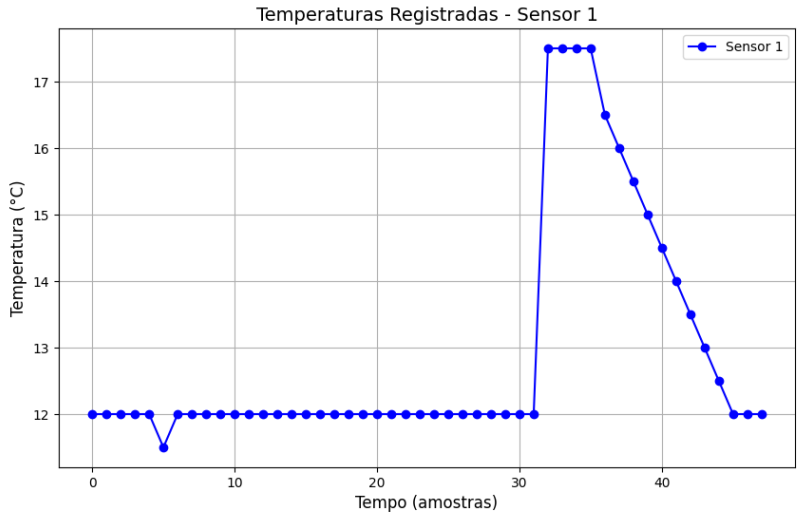

Figure 5. Temperature readings at different locations for Sensor 1 (1m depth).

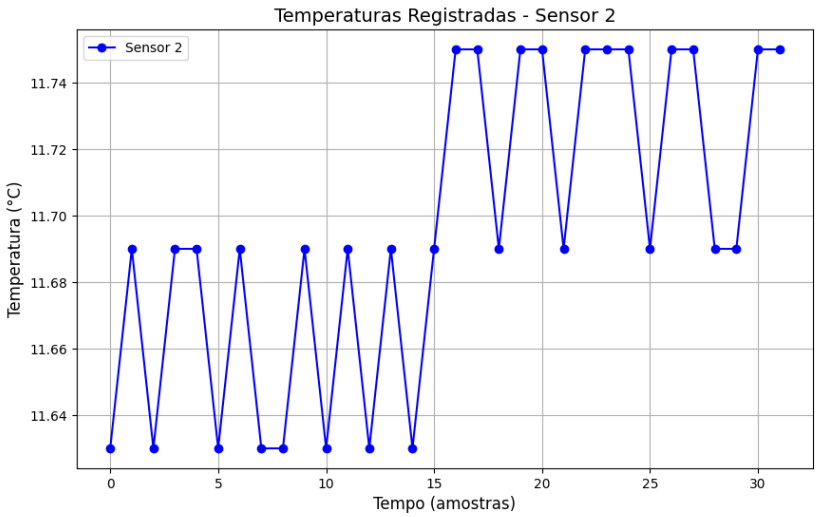

Figure 6. Temperature readings at different locations for Sensor 2 (2m depth).

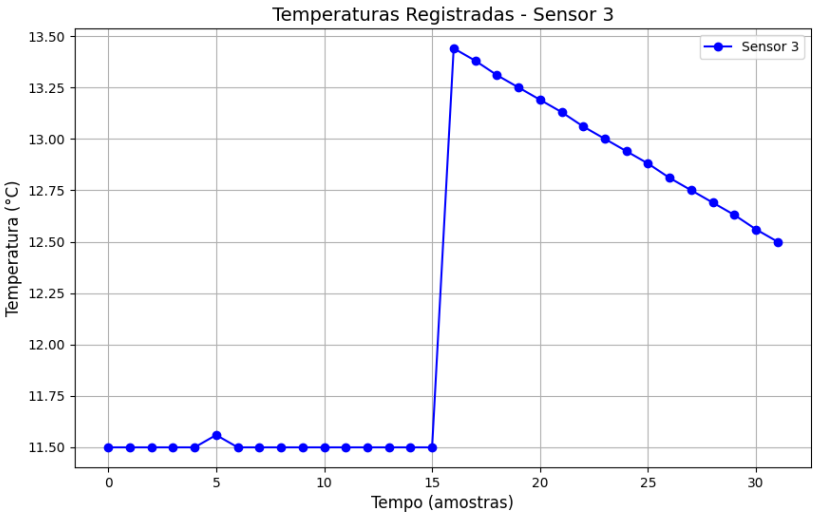

Figure 7. Temperature readings at different locations for Sensor 3 (3m depth).

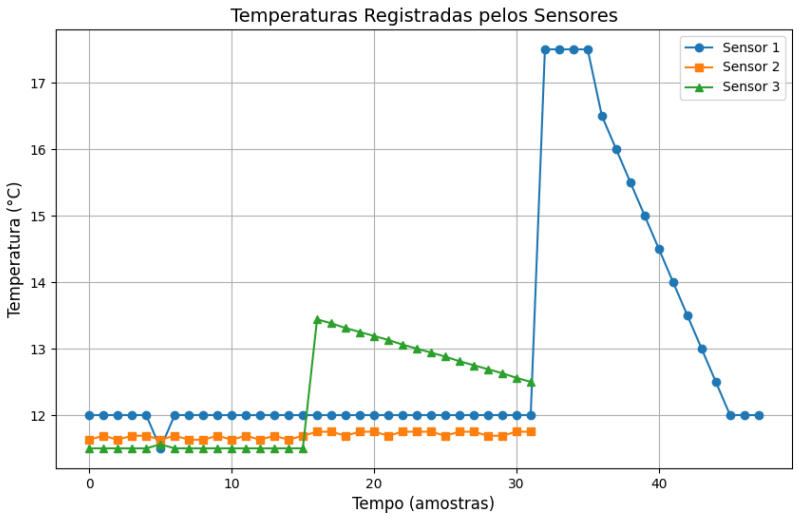

Figure 8. Comparison of temperature readings from all three sensors at different depths.

Following these summaries, Table 1 details the temperature and GPS location data collected using Sensor 1 at 1m depth.

Table 1. Temperature and GPS Location Data - Sensor 1 (1m Depth)

Latitude	Longitude	Altitude (m)	Satellites	Temperature (°C)
37.638234	-7.661751	0.00	7	12.00
37.638234	-7.661751	-5.70	7	11.95
37.638207	-7.661751	-5.70	7	12.10
37.638233	-7.661732	0.10	7	12.05

Similarly, Tables 2 and 3 present data for Sensors 2 and 3 at depths of 2m and 3m, respectively.

Table 2. Temperature and GPS Location Data - Sensor 2 (2m Depth)

Latitude	Longitude	Altitude (m)	Satellites	Temperature (°C)
37.638234	-7.661751	0.00	7	11.66
37.638234	-7.661751	-5.70	7	11.60
37.638207	-7.661751	-5.70	7	11.70
37.638233	-7.661732	0.10	7	11.65

Table 3. Temperature and GPS Location Data - Sensor 3 (3m Depth)

Latitude	Longitude	Altitude (m)	Satellites	Temperature (°C)
37.638234	-7.661751	0.00	7	11.50
37.638234	-7.661751	-5.70	7	11.45
37.638207	-7.661751	-5.70	7	11.55
37.638233	-7.661732	0.10	7	11.48

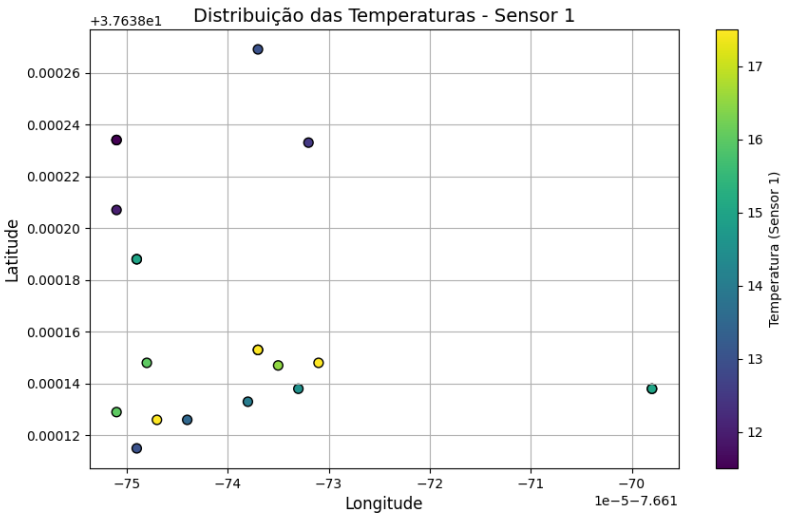

Figure 9. Visualization of GPS location and temperature for Sensor 1.

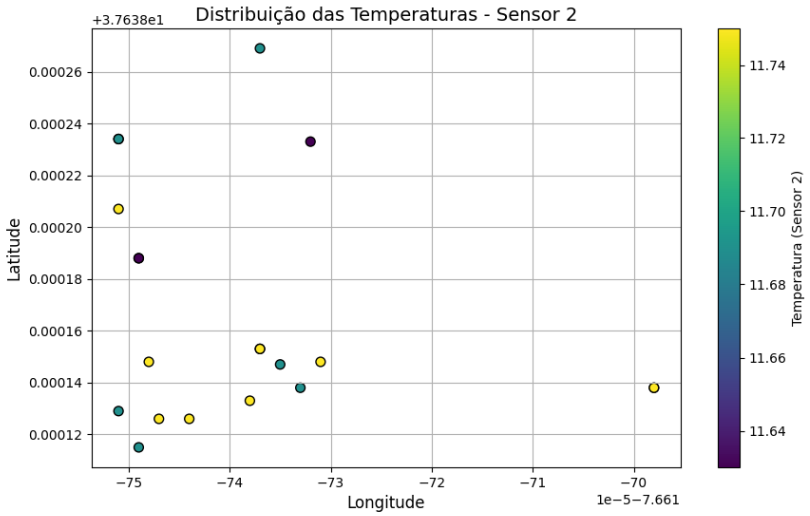

Figure 10. Visualization of GPS location and temperature for Sensor 2.

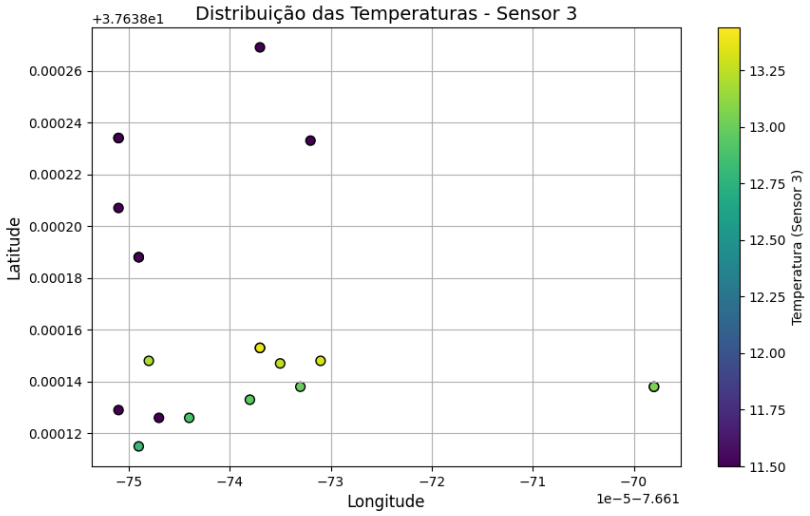

Figure 11. Visualization of GPS location and temperature for Sensor 3.

4. Conclusions

The Arduino-based water temperature monitoring system successfully recorded reliable data. Its portability, low cost, and adaptability make it ideal for ecological research. Future work will focus on real-time data transmission and extended depth measurements.

Acknowledgments

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References

Pereira, N. (2016). Measuring the RC Time Constant with Arduino. *Physics Education*, **51**(065007). DOI: 10.1088/0031-9120/51/6/065007

Arduino Documentation. `https://www.arduino.cc`

DS18B20 Sensor Datasheet. `https://datasheets.maximintegrated.com`