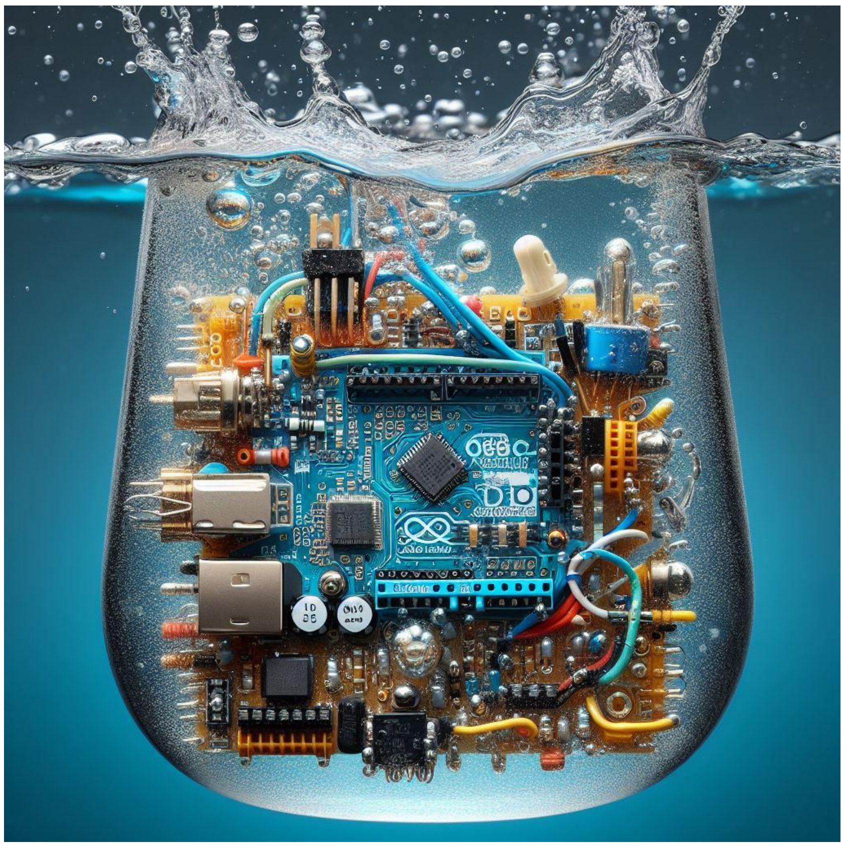
UNDERWATER MICROCONTROLLER

(INTERNSHIP REPORT)



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1.Introduction

I undertook an internship at the company Azorean Aquatic Technologies. The objective of this internship was the development of a device composed of circuits that, when embedded in resin, would be resistant to high pressures experienced when submerged at considerable depths.

To achieve this, it was necessary to create a setup consisting of various sensors and other hardware components. I had to proceed with the assembly, programming, and validation of the values obtained by these sensors. This device can be used to gather data on specific environmental parameters such as temperature, pH, among others.

2.Activities carried out within the scope of the internship

In the context of the internship, I have been developing a project that consists of a device composed of various sensors, with the purpose of both data acquisition and testing the circuit's resistance to high pressures.

To achieve this, I began by working with a microcontroller called Arduino Nano (**Figure 1**), which allows the control of various sensors and other components.

Figure 1- Arduino Nano.

This component is the 'brain' of the prototype being developed; therefore, it is the component that needs to be most protected against high pressures. The protection of this component was achieved through immersion in resin (**Figure 2 and 3**).

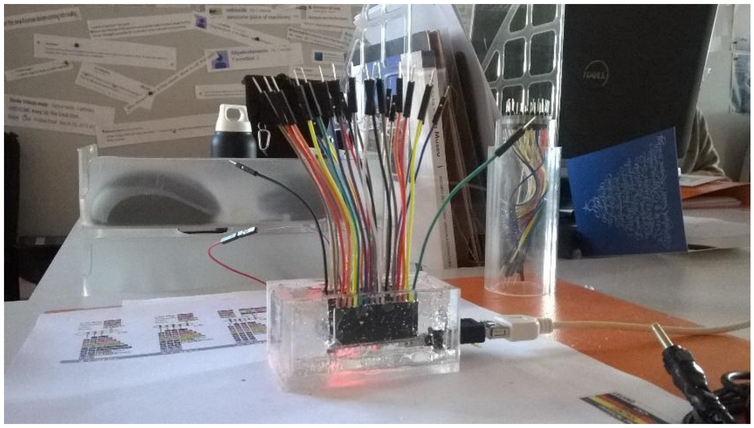

Figure 2 – Arduino Nano immersed in resin (side view).

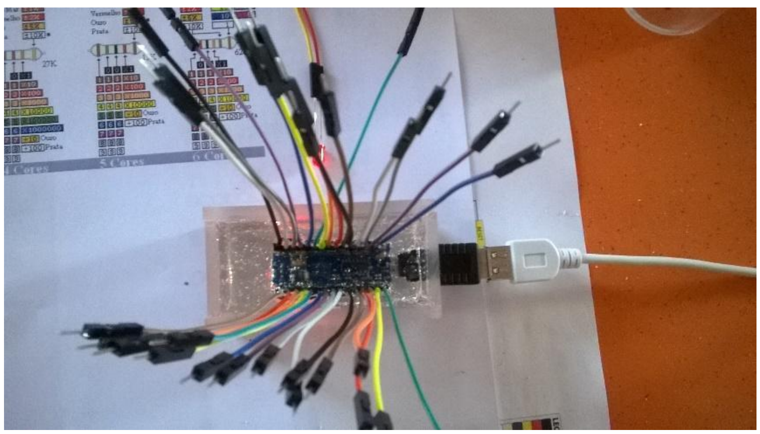

Figure 3 –Arduino Nano immersed in resin (top view).

Next, I researched components with technical specifications that aligned with the work to be developed. I started by looking into pressure sensors. The pressure sensor is crucial, considering that the measured pressure can be used to determine the height of a water column, providing information about the depth at which the device is submerged. The pressure sensor used is shown in **Figure 4**.

Figure 4 – Pressure sensor MS5541 14 Bar.

Next, I researched temperature sensors that could be submerged and withstand high pressures. After selecting the most suitable sensor (**Figure 5**), I had to study technical aspects, such as the correct way to integrate this sensor into a circuit with the microcontroller (Arduino) I am using. Subsequently, I programmed the sensor to obtain ambient temperature values for the measurements I conducted.

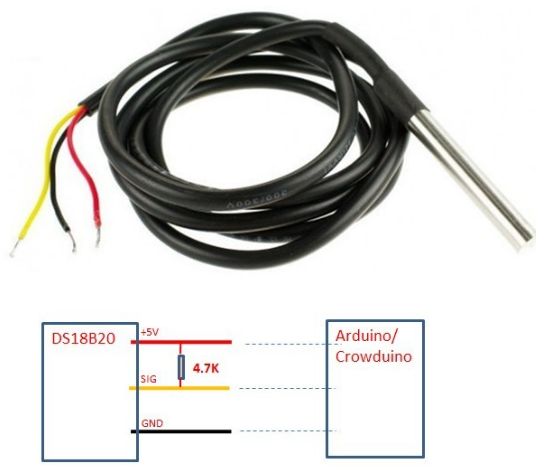

Figure 5 – Temperature sensor DS18B20.

Testing was conducted to determine whether the resin covering components emitting light would cause these components to lose luminous power. For this purpose, an LED and a light sensor were embedded in resin and compared with an LED and a light sensor (**Figure 6 and 7**) that had no substance covering them. In the case of the light sensor, assembly and programming were necessary.

Figure 6 – Photoreceptor (light sensor).

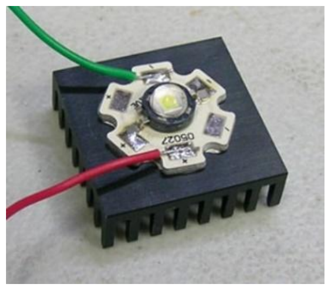

Figure 7 – LED.

In the following image is the circuit that I had to assemble to test the light sensor:

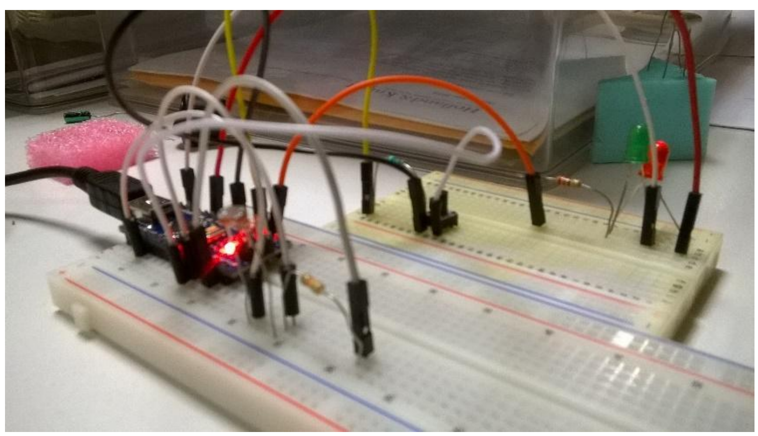

Figure 8 –Circuit composed of the microcontroller (Arduino Nano), light sensor, and two LEDs.

In order to store the data acquired by the sensors, an Micro SD card adapter was obtained, as shown in the following figure (**Figure 9**).

Figure 9 –Micro SD Adapter.

These electronic components had to be connected to a microcontroller (Arduino Nano, **Figure 1**), which, through specific software, enabled the programming of each sensor. For example, I had to convert the values measured by the temperature sensor to obtain the temperature in degrees Celsius.

In the figure below (**Figure 10**), the assembly scheme with various components is shown (Light sensor, temperature sensor, pressure sensor, Arduino Nano, Micro SD Shield, LEDs, resistors, button, and power supply):

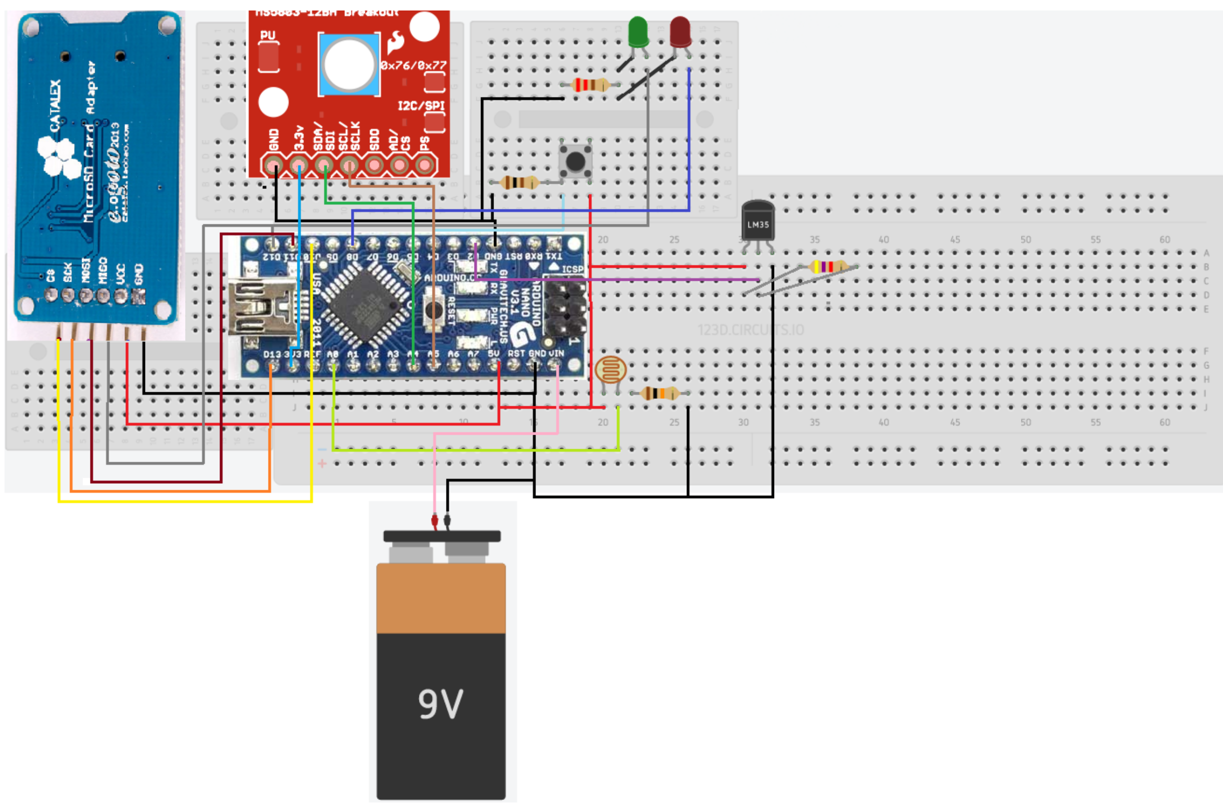

Figure 10 –Assembly diagram with various components involved in the project.

As this device will have some of its electronic components immersed in resin to withstand the pressures it will be subjected to when submerged, accessing the data stored on the memory card becomes complicated. To facilitate data access, it was decided to add a WiFi module (**Figure 11**) to this device.

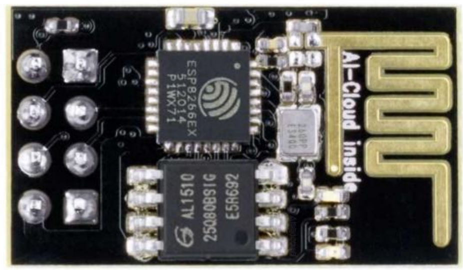

Figure 11 – WiFi Module ESP8266

After much research and study on this module, I managed to send data from the light sensor to a webpage, with a reading of 996 being displayed on the sensor. To make what I described earlier possible, I had to carry out programming to create a web server. The **figure 12** shows what I achieved:

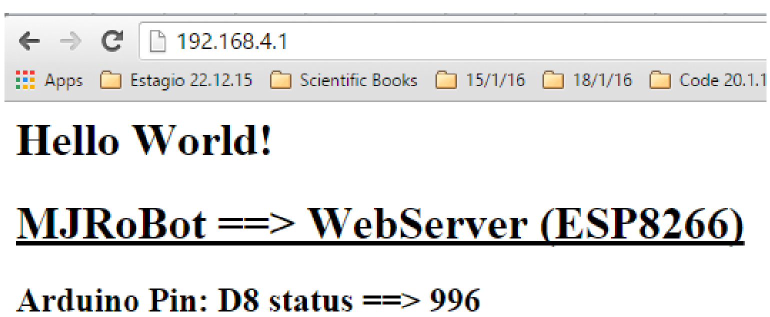

Figure 12 –Web page displaying the value read by the light sensor.

In the **figure 13**, there is an image of the WiFi module ESP8266 in operation:

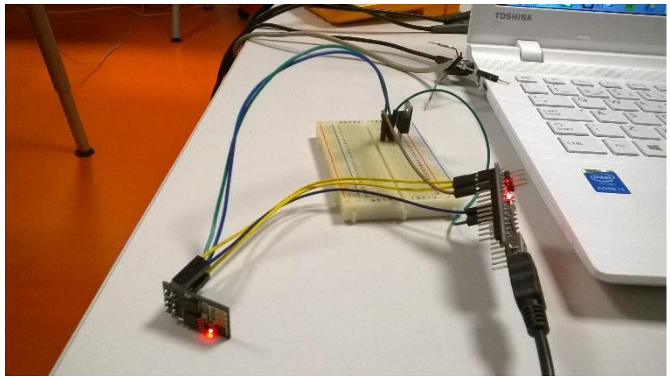

Figure 13 – WiFi module connected to Arduino.

In terms of programming, the components are functioning correctly, and the device casing is complete. However, as it was necessary to order a new pressure sensor due to the malfunction of the previous one, testing of the pressure sensor (a crucial component for the project) is still pending. Once we have the complete assembly scheme properly validated, we can proceed with testing the device at different depths. The **figure 14** shows the casing that will protect the device:

Figure 14 –Prototype casing.

3.References

Pressure sensor:

http://www.ebay.com/itm/MS5541-CM-MODULE-14-BAR-PRESSURE-MINI-SNSR-/301705131674

Arduino Nano:

https://www.robotgear.com.au/Product.aspx/Details/690-Arduino-Micro

Temperature sensor:

:http://www.ebay.com/itm/Waterproof-Digital-Thermal-Probe-or-Sensor-DS18B20-Length-1M-/170821333658

Photoreceptor (light sensor):

http://www.instructables.com/id/How-to-use-a-photoresistor-or-photocell-Arduino-T/

LED:

http://uc.blogdetik.com/712/71253/files/2010/03/luxeon-heatsink2.jpg

Micro SD Adapter:

http://www.ebay.com/itm/Hot-TF-Card-Memory-Shield-Module-SPI-For-Arduino-Micro-SD-Storage-Board-Mciro-SD-/381100174086

WiFi Module ESP8266:

http://cdn3.volusion.com/rxsop.cexkq/v/vspfiles/photos/130-2.jpg?1440691729