WQ-Sensor Array Software & Hardware notes

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This document is for later use and reference when using the sensor array. It covers the hardware parts, assembly, software inner-workings and suggested implementation in ROS2. With this document, future users will be able to service the sensor array, to maintain its functionality or update it.

# 1. Theory of operation

Lorem Ipsum

# 2. Hardware

The main goal of the hardware is to mount all the different parts safe and secure from potential water-damage. Also, it needs to be able to have reliable connection to the hull, as well as be able to change monitoring platforms. The sensors all require direct contact with the water, which means two things. First, the sensors should be mounted on a system that can be submerged, or withstand water, the sensors themselves also should be waterproof. Second, the electronics and processing should be done in a separate box, to eliminate fact that water can enter and interfere with the electronics. This means that two sub-systems make up the sensor-array: a Sensor Box as well as an Electronics Box.

The Electronics Box consists of an of-the-shelve electronics box with an IP67 rating. To facilitate the various electronics-boards, an extra mounting surface was designed and 3D-printed. On this surface, the 4 different sensor-processing boards are placed, as well as the central processing board, a DFRobot Nano, which is a smaller version of the Arduino Leonardo, a small microcontroller with the ability to program its functionality. Finally, power is delivered via the USB port, distributed via a simple distribution board with a 1000uF capacitor to eliminate noise. All connections are made with simple pin-header cables, secured with additional hot-glue.

Image 1. Electronics mounting surface CAD

The Sensor Box is a 3D-printed enclosure, with holes to fit all the sensors. Important here is the following: the ability to secure the sensors; make sure as little as water as possible enters the enclosure; create a mounting system that can be used on a variety of platforms; connect the sensors to the electronics. With this in mind, a boat-shaped box was created in a CAD environment (Fusion 360), with the proper holes in the bottom to fit all the sensors, as well as side-mounted screw-holes to make sure the sensors stay in place. Finally, the lid has holes to ensure the passthrough of the longer pH sensor, the different wires and square holes to with M6 threaded nuts and bolts, for mounting.

Image 2. Sensor Box CAD

## 2.1. Parts

Table 1. Parts-list of the Sensor Array

|  |  |  |  |
| --- | --- | --- | --- |
| **Sensor name** | **Measures** | **Separate Board info** | **Quantity** |
| [Analog pH meter](https://www.dfrobot.com/product-1025.html) | Acidity | BNC connection to breakout | 1 |
| [Turbidity Sensor](https://www.dfrobot.com/product-1394.html) | Clarity | 3-pin ILS mini to breakout | 1 |
| [Waterproof DS180 kit](https://www.dfrobot.com/product-1354.html) | Temperature | 3-wire open connection to breakout | 1 |
| [TDS Sensor](https://www.dfrobot.com/product-1662.html) | Hardness | 2-pin ILS mini to breakout | 1 |
| [Kogger Sonar 2D enhanced](https://kogger.tech/product/sonar-2d-enhanced/) | Depth | Built-in board; serial cable | 1 |
| DFRobotics Nano | Arduino Leonardo | Main control board of the sensors | 1 |
| **Enclosure** | **Material** | **STL name** | **Quantity** |
| Main body hull | PLA | pr\_3D\_main\_hull.stl | 1 |
| Main body lid | PLA | pr\_3D\_main\_lid.stl | 1 |
| Sonar mount | PLA | pr\_3D\_sonar\_mount.stl | 1 |
| Sonar lid | PLA | pr\_3D\_sonar\_lid.stl | 1 |
| [Waterproof Electronics Box](https://www.okaphone.com/artikel.asp?id=481327) | ABS | NaN | 1 |
| Electronics Mount | PLA | pr\_3D\_electronics\_mount.stl | 1 |
| **Additional** | **Dimensions** | **Notes** | **Quantity** |
| Mounting Nut & Bolt | 100mm M6 |  | 2 |
| Sensor hold screw | 40mm M3 |  | 5 |
| Lid screws | 20mm M3 |  | 4 |
| Cable sleeve | 40cm 22mm diameter |  | 1 |
| Cable passthrough | 22mm diameter |  | 2 |
| USB passthrough | 12mm diameter |  | 1 |
| USB cable | 60cm |  | 1 |

## 2.2. Assembly

Pictures and assembly of everything. Step by step.

### 2.2.3. Electronics Box

Pictures and assembly of everything. Step by step.

### 2.2.4. Sensor Box

Pictures and assembly of everything. Step by step.

# 3. Software

## 3.1. Functionality

Explanation of what it does

## 3.2. Arduino code

Raw code

## 3.3. ROS2 code

Raw code

* Product name
* Model or type number
* Intended use
* Features/accessories
* Description of the main product elements
* Description of the user interface
* Safety warnings
* Installation instructions
* Description of how to use/operate the product
* Troubleshooting section and instructions on how to solve problems
* Maintenance information
* Repair information
* Information on disposal of the product and packaging
* Technical specifications
* Table of content
* Index
* Glossary
* Warranty information
* Contact details