AquaPolis

AQUALINK 1.0

USER GUIDE

SECTION 1

Why Aquapolis?

1.1 The water crisis:

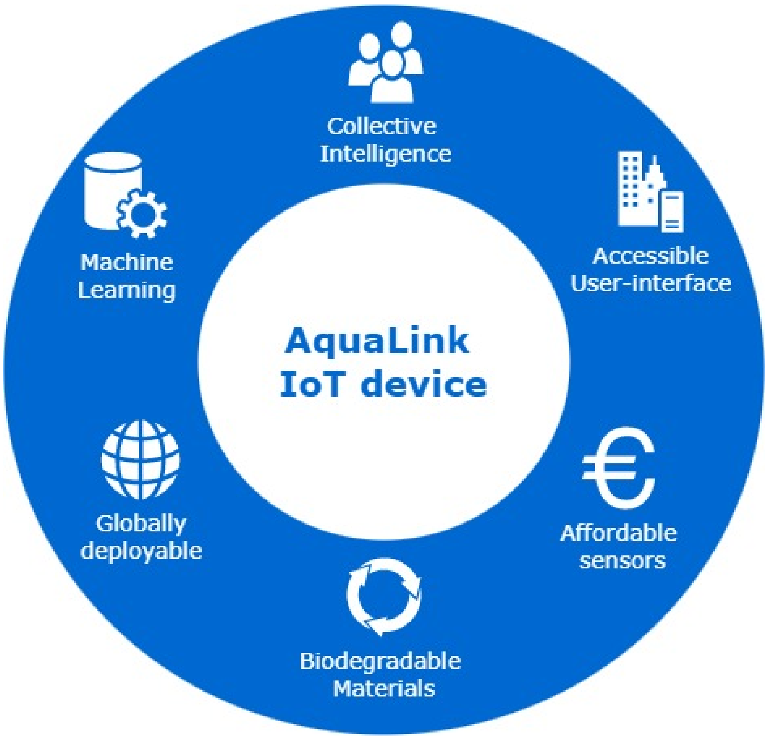
We often focus on the scarcity of water, yet the quality of it is as problematic: unsafe water is in the top 15 causes of death worldwide, counting more than 1.2 million victims only in 2017, as a study by the OurWorldInData highlights. This does not affect only rural areas but also urban ones, as in the recent case of the Flint Water Crisis.

In addition to health implications, this represents an environmental and economical problem as well: as reported from the CDP Global Water Report 2020, water security is a necessary issue to solve in order to achieve our Net Zero Goal and the multiple studies indicates how the financial impact of water risks is more than 5 times greater than the cost of addressing them.

1.2 Our solution:

The first step to solve this problem is to have a closer insight into the quality of the water globally, integrating the data sets already present with new data collected by individuals and institutions on a local scale. We believe that only through collective intelligence we can assure our model and predictions are up to date and can meet the highest quality standards.

From this vision was born AquaPolis, a network of IoT water sensors that can provide an accessible solution both in the immediate and long-term future. Each device can collect measurements of the water's quality at any time, generating predictions on its potability based on a Machine Learning Model trained on big, verified data sets. In addition, the new data, uploaded on a map, helps the model make better predictions in the future, keeping track of the values locally and creating a more accurate view of the water situation globally.



SECTION 2

AquaLink 1.0 specification

2.1 The product:

AquaLink 1.0 is the first product by AquaPolis, an IoT device which measures the quality of the water based on its turbidity and amount of solid particles and uses a Machine Learning Model to accurately predict whether the water is safe to drink.
The information on the quality of the water collected by AquaLink, together with the location of the water source, are recorded on a map accessible on our website. This provides the user with an accurate history of the water quality measurements of their local sources.

2.2 Machine Learning model:

Our machine learning model consists of an ensemble of random forests which take in the received data from on-board sensors to determine the potability of water. Alongside extensive data pre-processing during training, our models have undergone extensive hyper-parameter tuning to ensure a high level of accuracy during classification.

2.3 Specifications:

Aquapolis	Model: 1.0
	Wireless Communication: Wifi (MQTT) Measuring methods: TDS and TSS Multi-use Package includes rechargable battery, raspberry pi, travel case
Dimensions	12 cm x 8 cm x 3 cm Power: 36.5Wh, 5V
Accuracy	TDS: 0 - 1000ppm; 100samples/sec TSS: 0-5 NTU; 100samples/sec
Operation	Operating temperature: 0 - 55°

2.4 The communication:

The device uses a subscribe-publish model on MQTT where our own broker is hosted on a server and routes information to the three clients in our system: device with the sensors, machine learning model, and the web app.

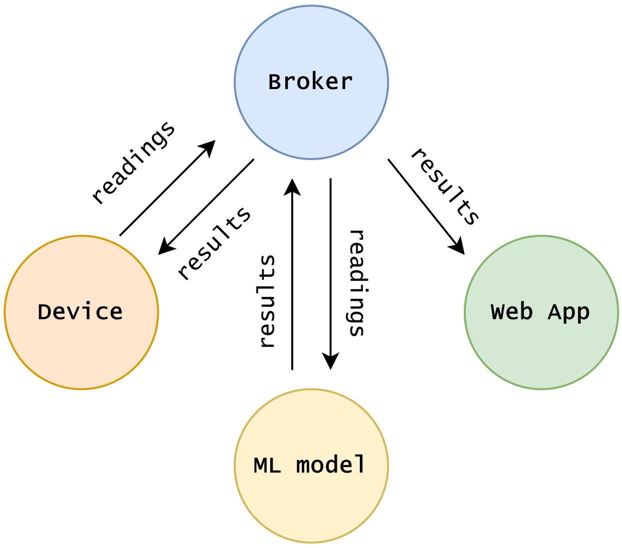


Figure 1: Encrypted communication diagram

Encryption has been implemented in the communication process between the device, broker and webapp to ensure the safeguarding of your personal data whether you are at home or abroad.

2.5 Calibration

Our sensors are individually calibrated using a series of pre-made solutions. This has allowed for a line of best fit to be calculated and saved in the memory of the Raspberry Pi (2). Hence the user can be sure that the sensor is reading all the data correctly and sending to appropriate values to the machine learning model.

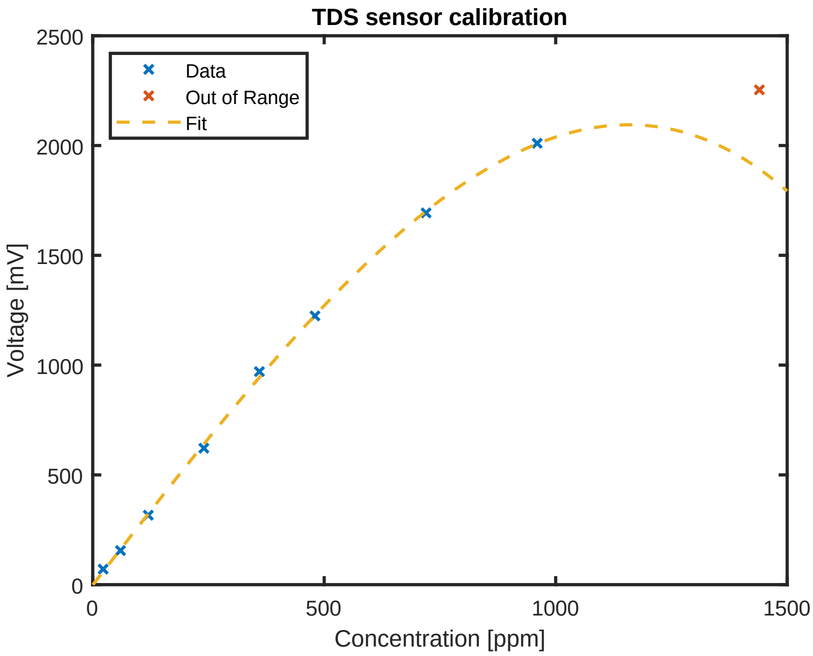


Figure 2: TDS calibration

2.6 Threading

Our design incorporates the multi-threading capabilities of the Raspberry Pi to enable seamless operation between the status LED and the operation of the sensors. A global variable is used to pass the status condition of the program to the LED subsystem in a separate thread.

3

SECTION

User Guide

3.1 How to use AquaLink:

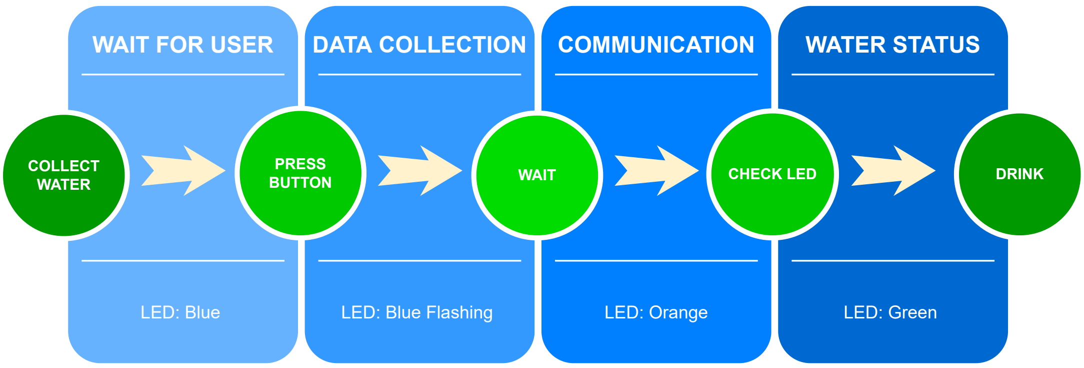


Figure 3: Simplified Visual Guide

We have designed AquaLink to be easy to use and fast to deploy. Using our device, you are going to know whether you sample is potable just following a few simple steps:

1. Collect a water sample to begin testing

2. Ensure the device has power indicated by a blue LED

3. Simply place device with both sensors fully in the water. Make sure that the metal contacts are fully submerged away from the container edges.
4. Press the button to begin water analysis. The LED debugging codes can be found in table 1
5. A **GREEN** LED indicates the water is safe to drink.
6. A **RED** LED indicates the water is **NOT** safe to drink
7. Another reading can be made by pressing the button again

LED Colour	Description
Green	Water is clean - Good to drink
Red	Water is dirty - Bad to drink
Blue	Circuit is powered and on
Blue Flashing	Sensing water quality
Orange	Communicating with server
Red Flashing	Communication has failed - Restart Device

Table 1: LED colour codes