Water Quality Monitoring

An Intelligent Underwater Robotic Smart-Sensing System for Water Quality Testing

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Overview

Water quality testing is important as it can identify possible contaminants in the water. The current methods for water quality testing include using a single sensor to get a random sample for testing each parameter, such as temperature, pH, conductivity and dissolved oxygen, among others, separately. In our work, we are designing a sensor unit comprised of multiple sensors for water quality testing that are able to collect data simultaneously. We also built an underwater robot that is able to travel to different depth in the water. The sensor unit is waterproofed and is then attached to the underwater robot that will be used to collect more encompassing data from different levels of the water column when sampling water quality in lakes in northwest Pennsylvania, including Lake Erie. The robotic unit with the waterproof sensors will be able to collect data underwater for several hours at a time and transmit it to the analytics software autonomously. The software is to be built with the coordination from the environmental water expert to automate data analysis. The results of this project, including the collected data and its analysis, will be shared with other researchers and be used to help students understand variations in water quality measurements.

My research consists of using an underwater robotic system to help collect data; using sensors such as temperature, pH, dissolved oxygen and conductivity. All are important indicators of water quality. The data collected over a period of time is then analyzed with a machine learning algorithm to predict future trends.

Originally, the robotic unit was to be used in Lake Erie. After careful consideration, we determined that Lake Erie was no longer a suitable location for testing. Due to the cheap constriction of the robot, (which consists of pvc pipe, alligator clips, zip-ties, etc.) we worried it would not hold up well in the water during an algal bloom. The propellers would most likely become clogged, as well as the sensors, and the system would no longer be functional.

While determining an alternate location for testing, we determined that the body of the robot could be improved, as well as the code. This project started off with using Arduino, which is a microcontroller with easy-to-use hardware. Although the code that was used was easier to modify, it was decided that the functionalities of an Arduino system were too limited to meet our goals. We then switched to a Raspberry Pi; a microcomputer.

Switching to Raspberry Pi was a success. It is now much easier to retrieve the data that is located on the SD card, calibrate the sensors, and examine the live sensor data. When we were using Arduino, we were unable to view the live data unless the board was attached to a

computer. With Raspberry Pi, we were able to utilize a touchscreen display, so we are able to access the data at the site without the need of a laptop. Due to switching to a new board, we had to purchase new sensors that were compatible.

In addition to switching boards, we also switched to a new location. After talking to various organizations, it was determined that we should test at French Creek instead. Specifically, we should be testing at an outflow point of French Creek, which is to be used in our future work.

The future work of this project is to continue implementing the polynomial regression machine learning algorithm for data analysis, test at the new location, examine possibilities for using a solar panel to recharge the on-board battery, and redesign the robot's frame/body so it is more sturdy. Collecting data at the new location will take multiple months, as data needs to be collected for a long period of time in order for the AI to be accurate.

This research was presented at the Posters on the Hill 2019 conference, as well as The 32nd International Conference of the Florida Artificial Intelligence Research Society.