An Underwater Robotic Smart-Sensing System for Water Quality Testing

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Project Objectives

The current methods for water quality testing either use a single sensor to get a random sample for testing each water quality parameter separately, or data buoys that are able to obtain readings from multiple sensors at a stationary location.

This project presents:

- A single unit comprised of **multiple sensors** that are able to collect data simultaneously for water quality testing.
- This multi-sensor unit attachable to the **underwater robot** to collect data at various depths of the water column for an extended period of time.
- **Data collection** and **data analysis** software to manage the data and assess certain trends in the water quality over time.

Algal Blooms

Lake Erie algal blooms are an annual threat to the health of **more than 11 million people**. Toxins produced by harmful algal blooms have deeply affected the economy and health of the environment and the public. Coastal towns that rely on tourism are negatively affected by toxic algal blooms.

- Drinking water is polluted.
- Local residents and visitors are prevented from boating, swimming, and visiting Lake Erie shorelines.
- Nearby residents are vulnerable to illnesses caused by the toxins.
- Toxins can result in the death of marine life, and severely impact an aquatic ecosystem.

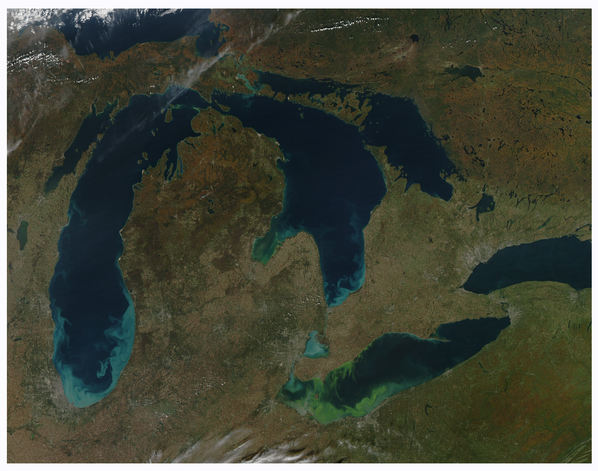

Figure: Great Lakes: October 9, 2011

System Design

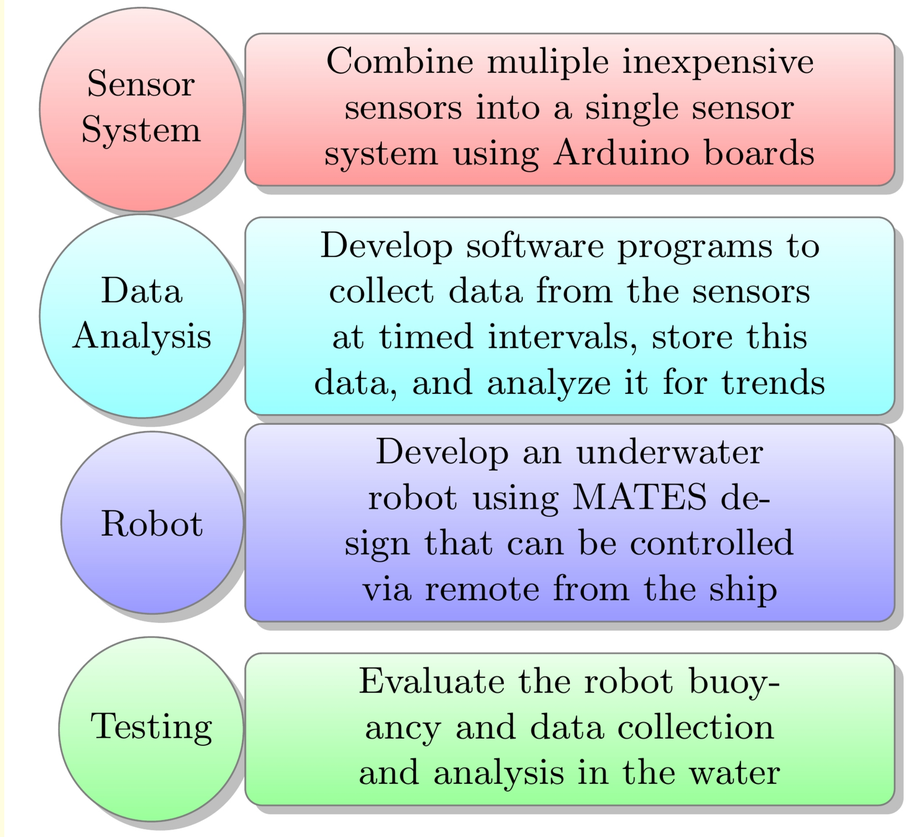

Figure: Different portions comprising the system

Sensor System Prototypes

1. Extend sensors with 30ft cable, keep the board and power on surface.
2. Create a waterproofed unit to house sensors and boards on the robot.

Figure: Soldering sensor wires

Drilling holes for sensors

Robotic Platform

Figure: Project Team with Different Robot Models

- Two remotely operated robotic models were used: the SeaPerch robot (left) and the MATE prototype (right).
- Both robotic platforms are constructed with PVC pipe, mesh, propellers, solder, and other materials, and are easily deconstructable.
- This portion of the project was possible due to the collaborative educational project between Allegheny College and Crawford Central School District.

Sensors

Figure: Arduino board and sensors

To complete our sensor system we used a collection of sensors, Arduino boards, and programs.

- pH, conductivity, temperature, dissolved oxygen sensors were used.
- These sensors are all connected to an Arduino board for automatic data collection and analysis.
- Waterproofed sensors on this robotic system allows for data to be collected for several hours at a time, which is then transmitted to the analytics software.

Testing and Future Work

- First, software and the sensor data collection, management and analysis were evaluated.
- Then, completed robotic system was tested in the pool water.
- In May, measurements from Lake Erie will be taken at different levels of the water column.
- The results of this project, including the collected data and its analysis, will be shared with other researchers and will be used to help students understand variations in water quality measurements.