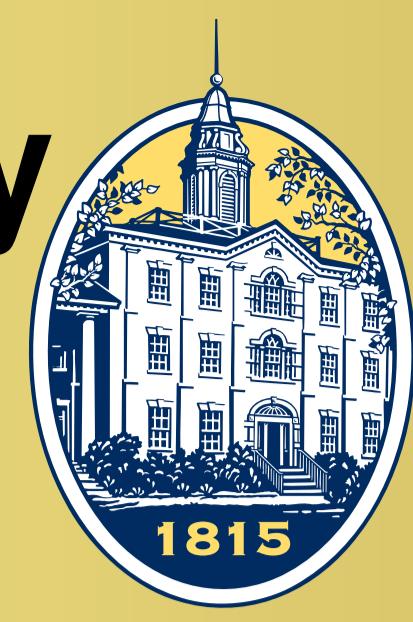


An Underwater Robotic Smart-Sensing System for Water Quality Testing

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PROJECT OBJECTIVES

The current methods for water quality testing either use a single sensor to get a sample for testing each water quality parameter 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 deeply affected the economy and health of the environment and the public.

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



Figure: Great Lakes: October 9, 2011

SENSORS

In our 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

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

- The robotic system was initially tested in the pool for buoyancy and general operation validation.
- All sensors were calibrated and also tested individually.

Sensors	Testing Values
Temperature	40F - 70F
pH	Standard Buffer Solutions 4.0 and 7.0
Dissolved Oxygen	0.5 mol/L NaOH Solution (Sodium Hydroxide)
Conductivity	Standard Buffer Solutions 1413us/cm and 12.88ms/cm

ROBOTIC AND SENSOR SYSTEM

- A **waterproofed case** was designed to house sensors and boards on the robot.
- A remotely operated **robotic platform** was constructed with PVC pipe, mesh, propellers, solder, and other materials, and is easily deconstructable.



Figure: Soldering sensor wires



Drilling holes for sensors

SYSTEM DESIGN

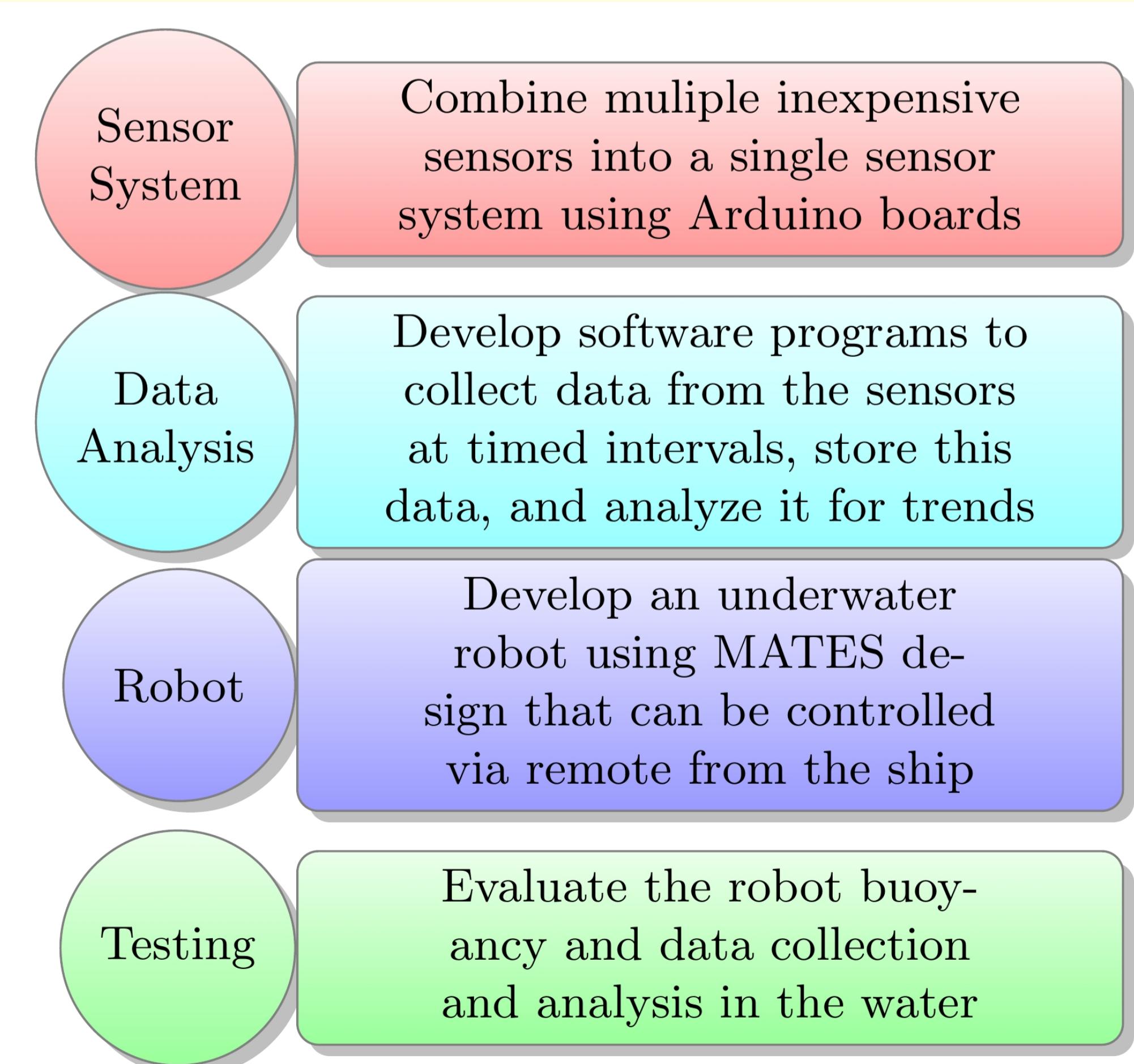


Figure: Different portions comprising the system

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 June, 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.