

Design and Construction of a Buoy to Extend Data Collection Period in Lake Erie

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SEECs, Scholars of Excellence in Engineering and Computer Science, is a scholarship group funded by the National Science Foundation. We consist of 8 sophomore students with various engineering and computer science majors. This program helps us to develop our engineering skills and prepare for a professional work environment.

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Introduction

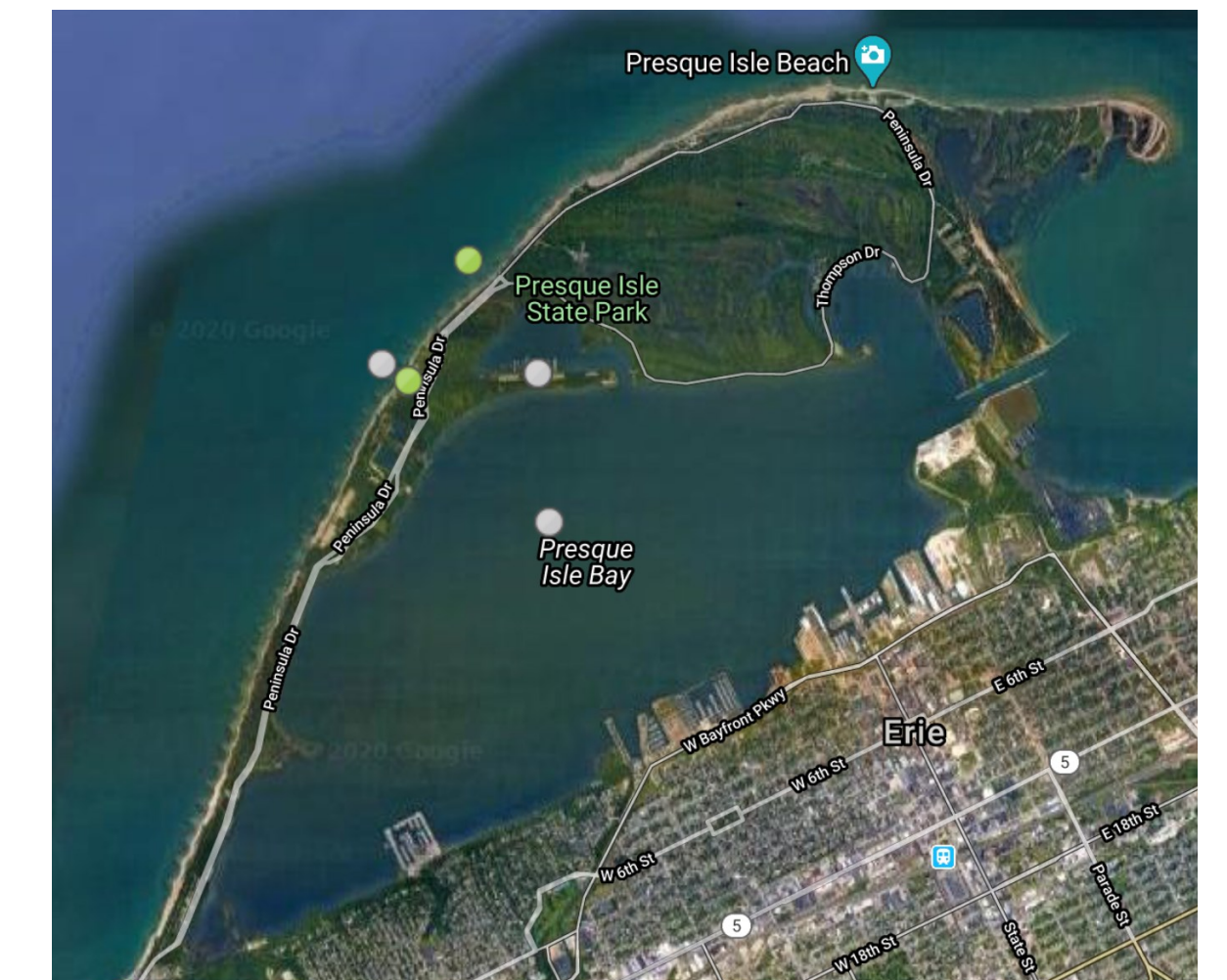
In Lake Erie, there are growing levels of algae. At high levels, it disrupts wildlife and harms humans who swim in the lake. The current buoys track the algae's growth, but they only remain in the water from May – October because Lake Erie freezes. This prevents the recording of six months of data needed for re-search to limit the algae's growth and protect the lake. The Scholars of Excellence in Engineering and Computer Sciences (SECS), a multi-semester program at Gannon University supported by a S-STEM grant from the National Science Foundation, has partnered with the Regional Science Consortium to engineer a submerged device that extends the data collection timeline and stores water quality data from Lake Erie.

Figure 1. Floating buoy on Lake Erie



Both figures were taken from the Regional Science Consortium website. In figure 1, the current data-collecting buoy is shown on the water during weather-permitting months. In figure 2, the location of these buoys around Presque Isle State Park are mapped with a satellite image of Lake Erie.

Figure 2. Location of Buoys on Presque Isle.



Method– Students divided into three separate groups, so multiple tasks of the project could be researched at once.

Electrical Components

- **Arduino Pro Mini:**
= Controller, controls all functions within the buoy and stores data.
- **Atlas RTD EZO:**
= Thermistor Probe, reads temperature and relays it to the Arduino
- **DS3231 RTC:**
-Real Time Clock, allows controller to run functions at specific times and dates.
- **DO Meter :**
= Measures dissolved oxygen, temperature and pressure

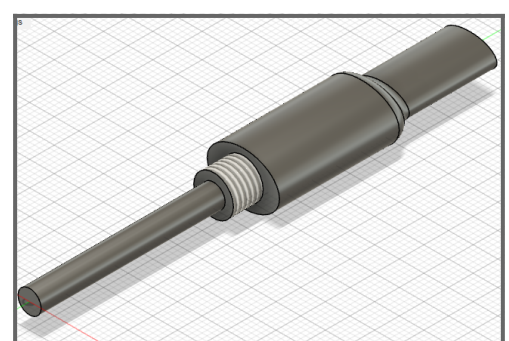
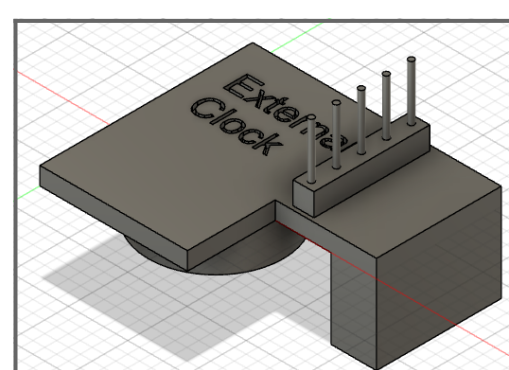
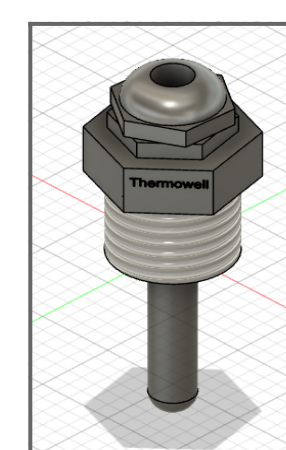
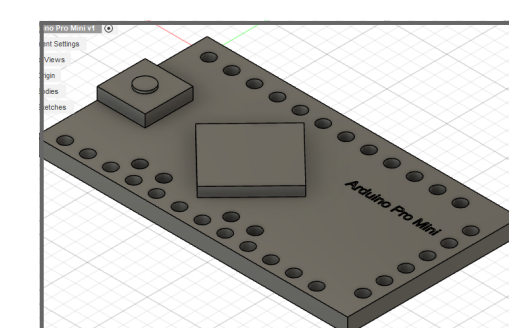
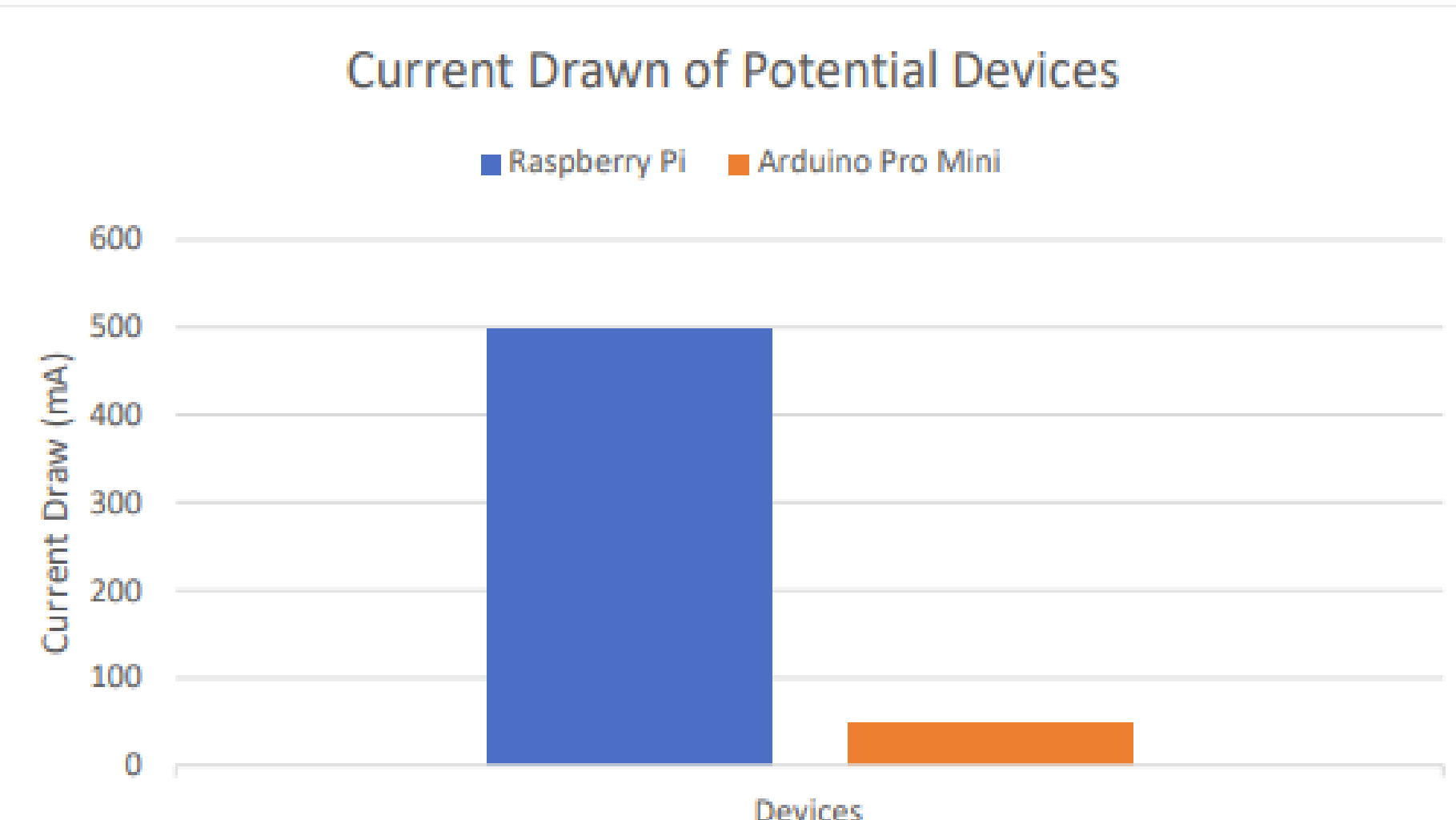


Figure 3. Raspberry Pi vs. Arduino Pro Mini



As shown in the table above, the Raspberry Pi consumes 10 times more power than the Arduino Pro Mini, which means the battery will not last as long; there, the Arduino Pro Mini is the main source for coding.

Containment Design

The container will be built using Gannon University's 3D printers allowing for a custom build.

Containment must follow specific criteria:

- Waterproof to protect electric circuits
- Durable to withstand water pressure and possible damage
- Encase electrical components
- Buoyant to remain in place

To get the most benefits out of the buoy, choosing a good shape is important to promote certain features that will enhance its performance. We are looking into three shape options:

- Spherical
- Pill-shaped
- Box-like



Figure 4. The images represent the various shapes for containment.

Anchorage

- The anchorage system has not yet been finalized.
- The chain material options are either a stainless steel chain or a polyethylene rope due to their affordability and sustainability.
- Because of its weight and density, the anchor will be made of concrete.

Single Chain vs. Multi-chain Anchorage Set-up

Single Chain

With a single chain system, only one chain connects the buoy to its concrete anchor.

The buoy is unlikely to stay in place with only one chain
One chain is more affordable

Multi-Chain

With a multi-chain system, multiple chains connect the buoy to multiple evenly spaced out concrete anchors.

More likely to restrain the buoy keeping it in one spot.
Less affordable

Testing

- **Watertight**— To mimic the lake's underwater conditions, we plan to utilize Gannon's swimming pool to ensure that the containment can withstand the water pressure without leaking.
- **Temperature**— To mimic the lake's winter temperature, components will be tested in a refrigerator to confirm their function in frigid conditions.

Conclusion

Because the project is a multi-semester learning experience, most tasks are still in-process. The biggest concern is constructing containment that could withstand the full deployment. By next September, the goal is to have a complete, successfully tested model. Ideally, the submerged device will enter the water in October and extend the data collection timeline.

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