

Algae Prediction Project

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Problem

- Algal blooms release toxins into the water. This can harm ecosystems and people who rely on the freshwater.
- Gathering data on these blooms will help predict and prevent their harmful effects

Design requirements

- **Functional Requirements:** The project must be able to collect and transmit data from underwater sensors, have low power usage, and low cost per unit.
- **Non-Functional Requirements:** The project must be environmentally friendly and durable
- **Engineering Constraints:** The project must have flexible wires and be waterproof
- **Operating Environment and Intended Use:** The project will be placed in a lake, river, or other body of water to collect data on algal blooms

Design Approach

Modular:

- We wanted to create a modular design to allow for the quick development and production of each separate component.
- The design was split into three components:
 - Housing
 - Sensing
 - Communication
- * each with their own sub categories

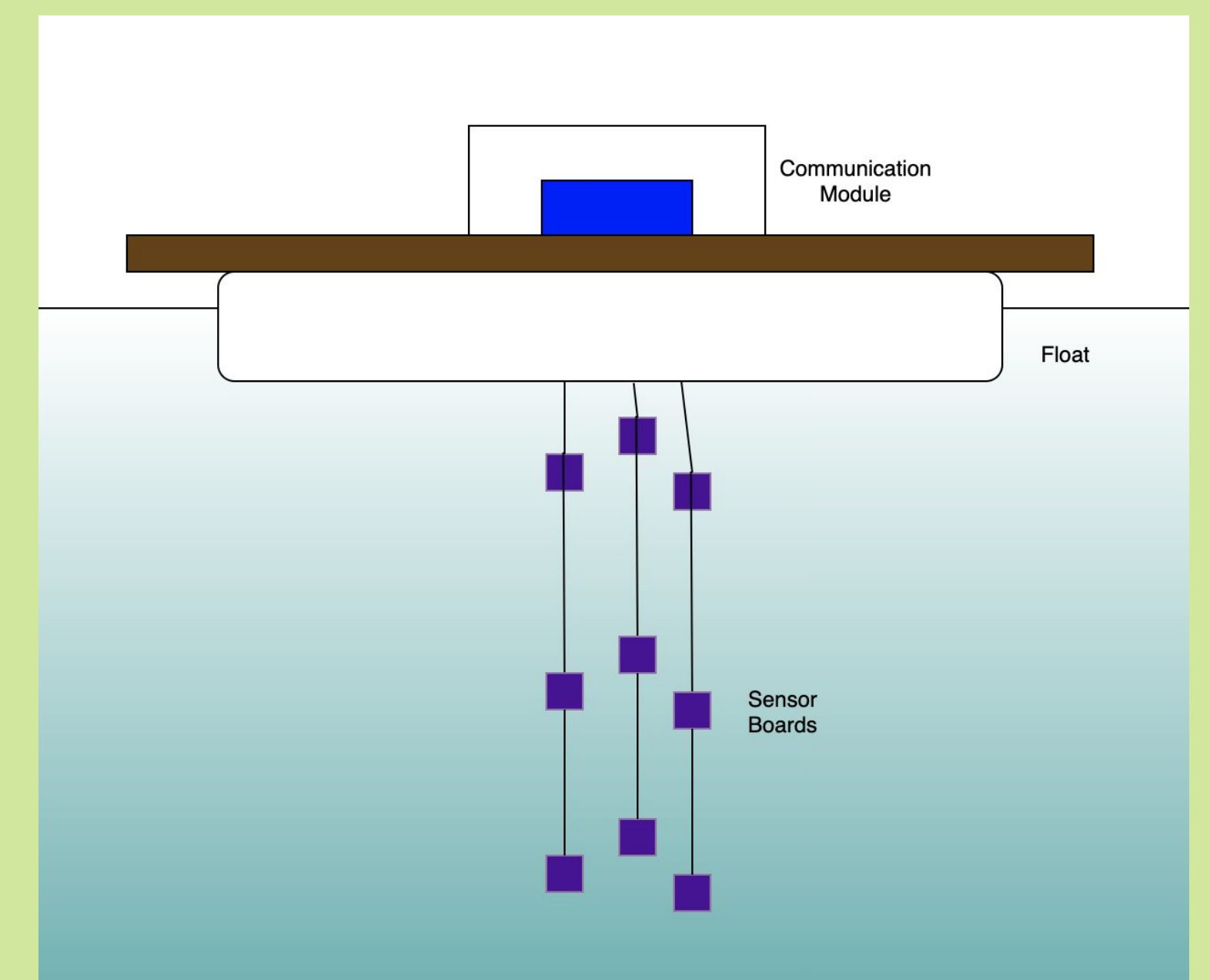


Figure 1: Conceptual Sketch

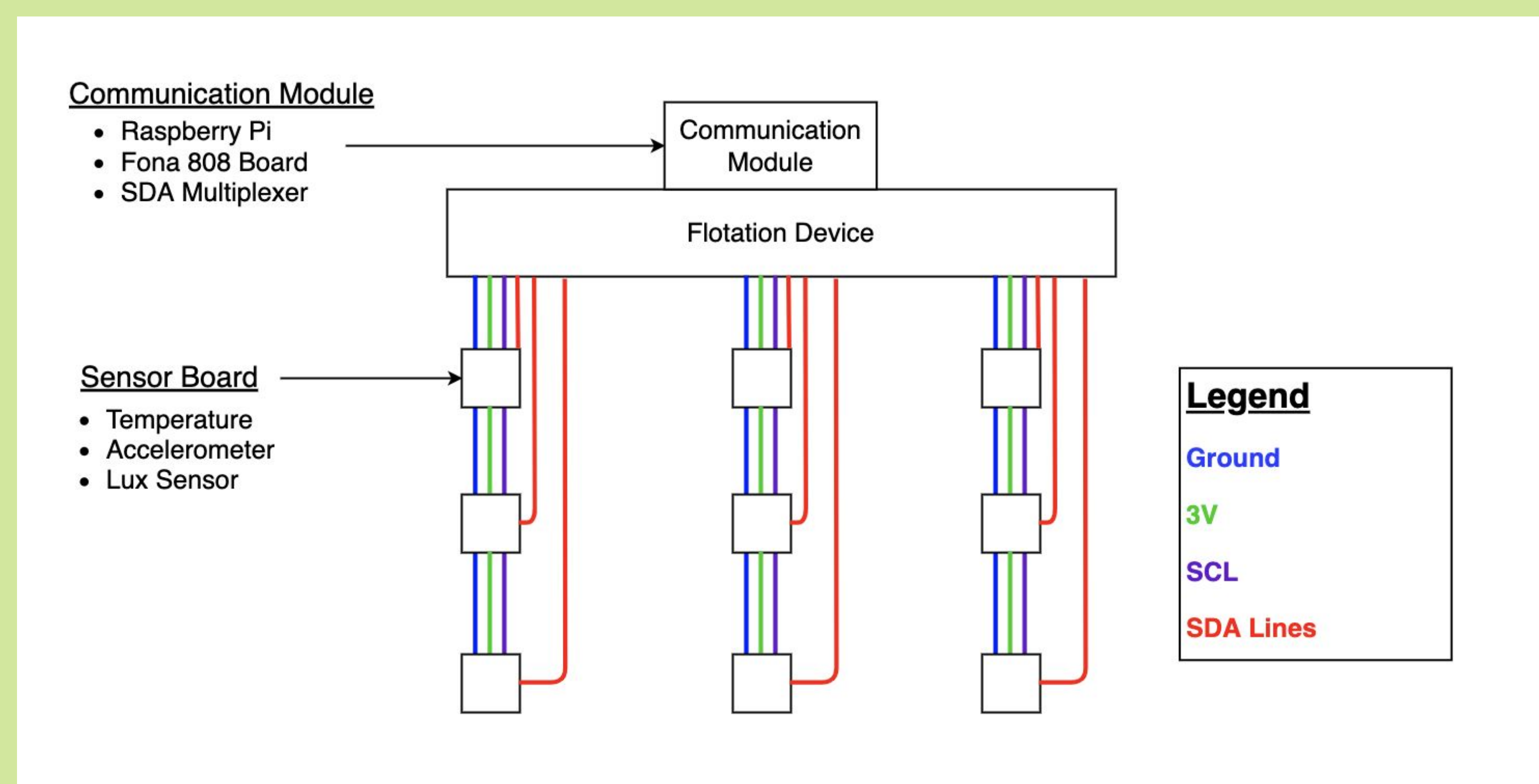


Figure 2: Block Diagram

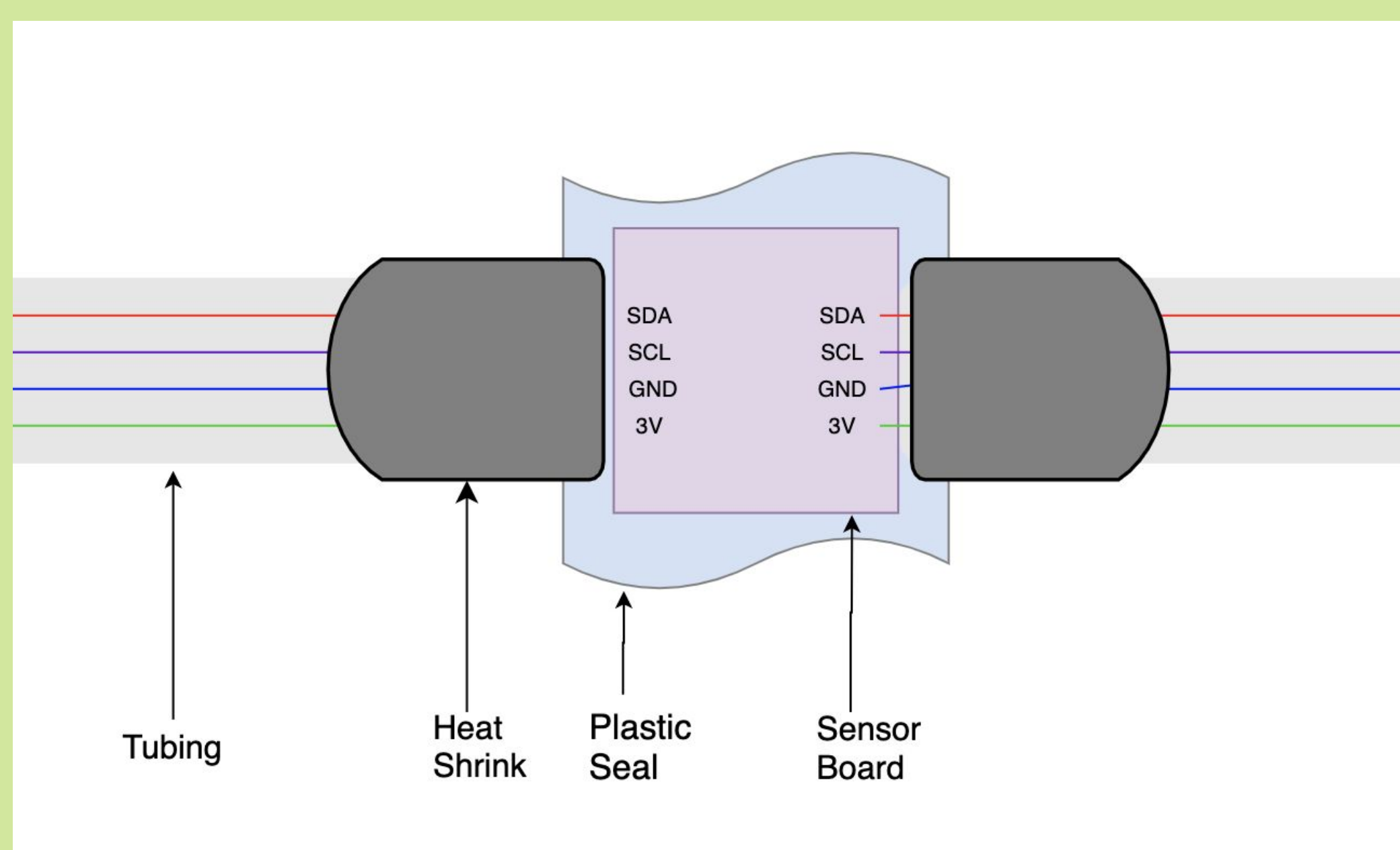


Figure 3: Waterproofed Sensor Board Diagram

Technical Details

Hardware

- **PCB Sensor Board** - Custom designed PCBs for our 3 sensors: light, temperature, and accelerometer
- **Raspberry Pi** - Raspberry Pi 3 with Wifi used for data collection and communication
- **Raspberry Pi Hat** - Hand soldered Perf-board hat module fits onto raspberry pi GPIO pins with solid soldered connections to FONA cell board, mux, and headers for I2C connection
- **Multiplexor** - 16:1 multiplexor used to separate the SDA lines on each leg of our prototype
- **Cellular Board** - FONA808 cellular module makes 2G connection to transmit sensor board data
- **Waterproof Materials** - tubing, heat shrink, and plastic for waterproofing the PCBs and wiring. PVC pipe, wood platform, and plastic container to waterproof the raspberry pi, cellular board, and mux

Software

- **Communication Script** -
- **Sensor Board Python Script** - This script is run on the raspberry pi to communicate with the sensor boards. Allows data requests from a specific PCB on each leg and individual sensors on each PCB

Development Environment

- **Git** - Code repository and version control
- **Programming Languages & IDEs** - IntelliJ, Maven, Java, Python, Linux OS

Testing

Hardware

- Manual testing of sensors and PCBs
- Tested waterproofing techniques

Software

- Unit testing of code
- Tested code to interface with sensor boards
- Data communication between raspberry pi and cellular board
- Testing of sensors for an entire leg

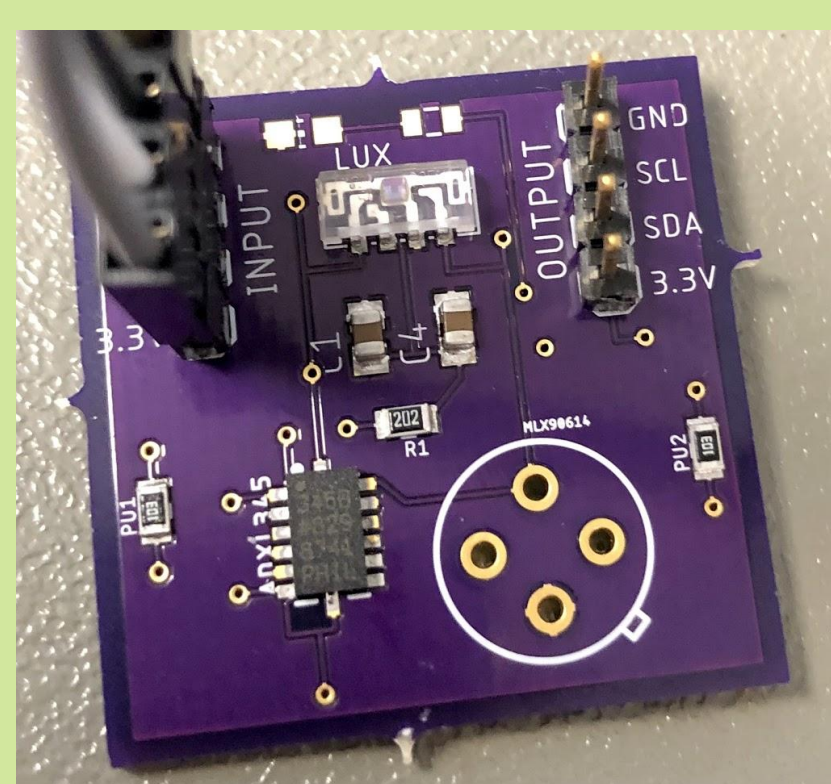


Figure 4: Sensor Board

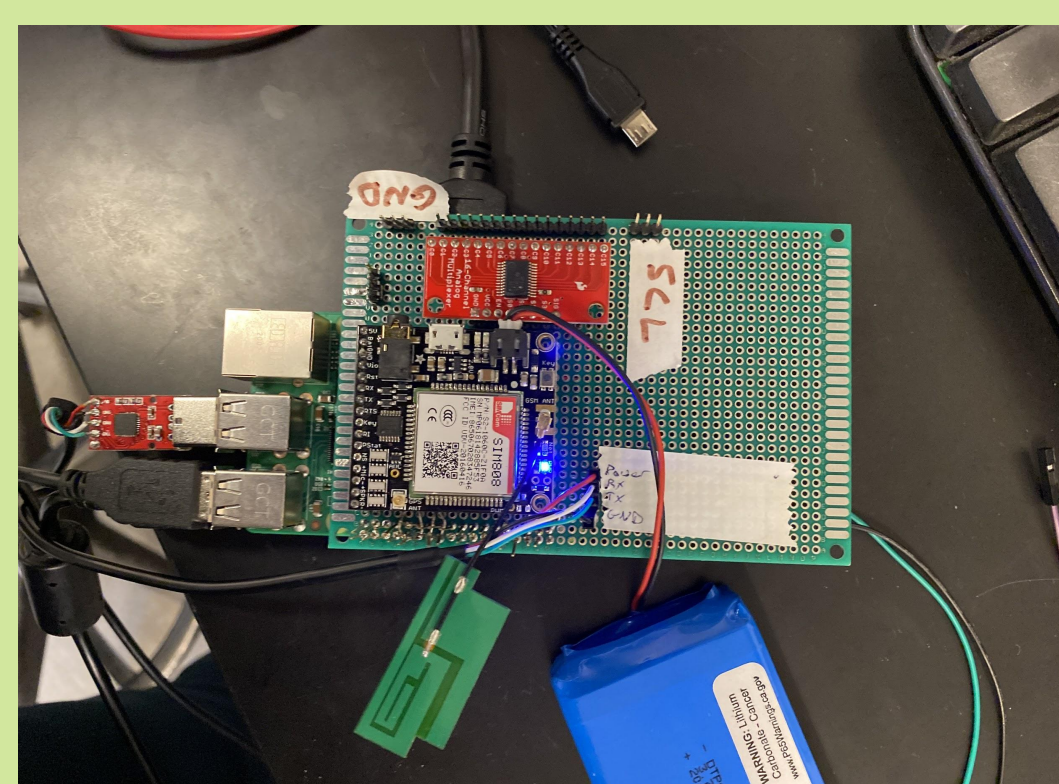


Figure 5: Raspberry Pi Hat Module



Figure 6: Finished System in Water

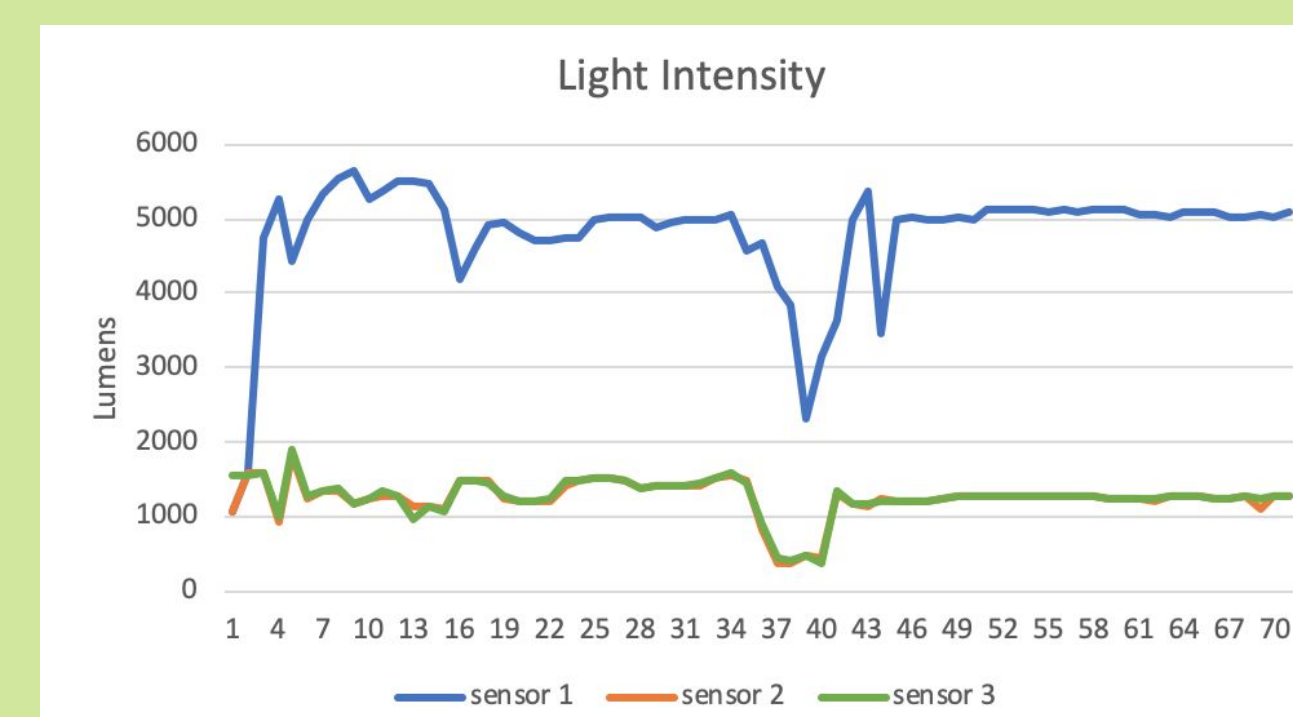


Figure 7: Sensor Data Over Time



Figure 8: The Team and Device