Intertidal Sensor Array For Monitoring Ocean Change Stressors in Oyster Farms

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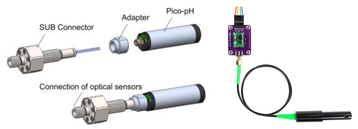
Problem Statement

- Aquaculture is changing due to impacts from climate change
- Current ocean technology is too expensive and not suitable for intertidal regions
- Our objective is to provide a low-cost tool with off-the-shelf components for marine biologists to use to understand climate effects on aquaculture by collecting pH, temperature, and conductivity and salinity data, and logging it to the cloud in real-time
- We are expanding on the previous team's design by improving the system and fixing issues they encountered

System Features and Requirements

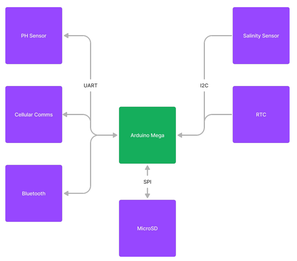
- Uses the Pico-pH for pH and temperature measurements
- Uses the EZO Conductivity sensor for conductivity and salinity measurements
- Communicates with an app via Bluetooth to send data from the device to the web server
- Develop a "Plug-and-Play" prototype for integration of future sensors



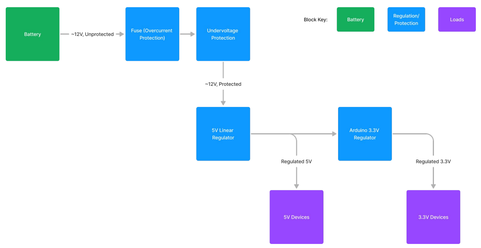
[1] Pico-pH sensor

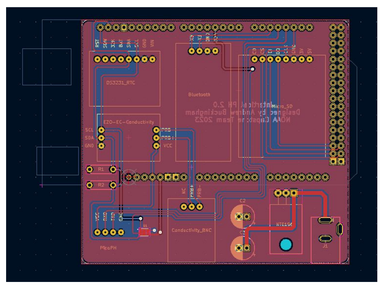
[2] EZO Conductivity Sensor

PCB/Hardware Implementation



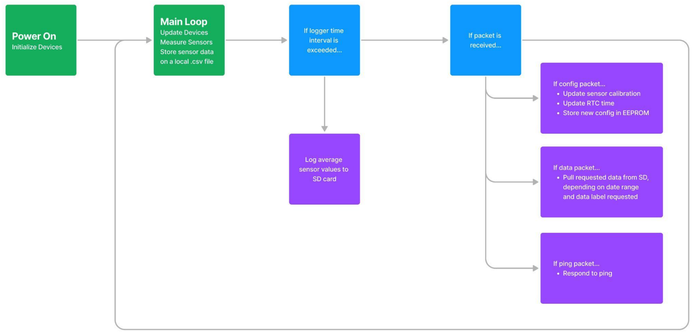
- Arduino Mega 2560 acts as intermediary between all sensors and devices
- Communication achieved through UART, I2C, and SPI interfaces
- Hardware is comprised of a single, shield style pcb, enabling modularity for future additions by stacking additional boards on top of each other
- Simple battery protection system offering overcurrent and undervoltage protection implemented for 12V battery system





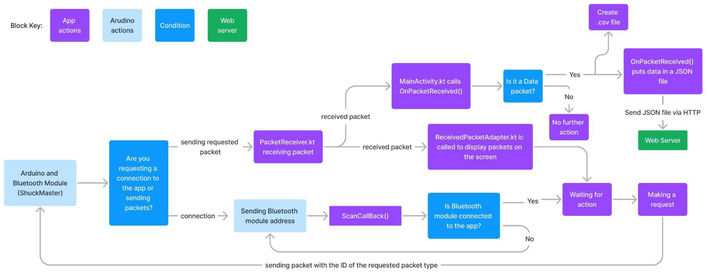
Shuckmaster Implementation

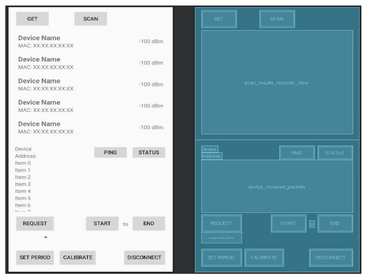
- Shuckmaster.ino is the top-level program that performs the following actions:
  - Take the measurements from the sensors
  - Save the measurements on the SD card and .csv file
  - Send the requested data packets to the Shuckmanager app via bluetooth
  - Update the sensors with given calibration data



Shuckmanager Implementation

- App is needed to locally pull sensor data from the SD card on the device via Bluetooth and send the data to the Oyster Cloud web server
- The app will also create .csv files locally on the phone for easier storage of sensor data

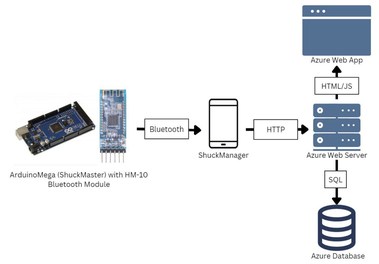




- App is built to be UI friendly since the users will be marine biologists and oyster farmers
- App is also available for download via Google Play Store to increase its accessibility

Oyster Cloud

- Microsoft Azure provides applications and services for us to create a web application
- Azure Database SQL
  - Managed cloud database
- Azure API Gateway
  - Use a REST API to push and pull data from database
- Web application instance pulls data from our backend and displays it on a dashboard in a web-browser



Housing

- The housing was built to protect the electronics from environmental factors
- The Housing is built out of PVC pipe
- Two pass throughs are used to run sensors from inside to outside of the housing
- The Pico-pH probe attaches directly into the housing
- The pictured version of the housing is set up for testing without electronics
- The black protrusions are the wire pass throughs
- The bolt is where the Pico-pH probe attaches
- Designed to not harm any part of the marine environment

Future Work, References, and Acknowledgments

- Implement cellular communication
- Integrate additional sensors
- Design an IOS version of the Shuckmanager app

[1] PyroScience, *"Pico-pH-SUB"*, Version V1.07

[2] AtlasScientific, *"EZO-EC"*, Apr. 2014, [Revised Dec. 2021]

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