ECE4873 Project Summary

Project Title	Prince William Sound Underwater Profiling Vehicle
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Project Abstract	
(250-300 words)	In 1989 an Exxon oil tanker ran aground, spilling more than 11 million gallons of oil into the Prince William Sound. After cleanup efforts damaged the ecosystem even further, Exxon began funding research efforts in the sound that allow for monitoring of the ecosystem and restoration efforts. The scientists currently use a moored profiler that was made by Sea-Bird Scientific which they have added instruments such as a plankton camera. Unfortunately, there are some problems with the current system and Sea-Bird Scientific has discontinued production and support for this profiler. The scientists came to Dr. West over the summer and proposed the idea of designing a new profiler. The new system would overcome the biggest disadvantages of the current system and leave them with a system that they could extend to provide even more functionality in the years to come. After speaking with the scientist we concluded that the biggest problems with the current design, and most important features in the new design were: a way to remotely charge the battery, they currently have to go out on a boat and pull the profiler out to charge it once a month; a way to remotely receive information, they can only receive very simple telemetry, but would like to get scientific data. Our group built a prototype of a new moored profiler that will have a wave power generator that will charge a battery. It will have a long range radio for scientific data transmission. We will also have a digital compass as an example sensor and a winch for deployment. Finally, we will use a Raspberry Pi as the processor and include interfaces that can support the current instruments.

Project Title	WATER: Wave powered Autonomous Tethered Examining Robot
List codes and standards that significantly affect your project. Briefly describe how they influenced your design.	For the point absorber power generator, there are no codes. LoRa, which short for long range, is a long range, low power wireless platform that is used widely in the Internet of Things applications SPI, Serial Peripheral Interface, is the communication interface for the chosen communications module Serial (RS232) is the standard that will be used for communication with the battery pack along with the compass and many of the future sensors
List at least two significant realistic design constraints that applied to your project. Briefly describe how they affected your design.	The project is a maritime application so the project will have to function fully submerged in the ocean. As a result, the products used and design manufactured must be able to withstand a certain threshold of water and still fully operate at ideal levels. The design consists of a lot of connections between hardware devices; therefore, a constraint could potentially come when trying to design and manufacture a product that is able to connect with all the parts proposed. This affected our design as we had to research devices that are easily able to connect with one another and trade certain items wanted with other items that are compatible to the overall design. For example, we had to find a battery board that could easily communicate with the RPi and interface with the battery being trickle charged.
Briefly explain two significant trade-offs considered in your design, including options considered and the solution chosen.	We only have 700 dollars to build a power system, this will constrain the design significantly. Due to this budget, we aren't able to purchase high-end products that could possibly generate potentially desirable power. For example, in real-world applications, companies build these on an industrial scale with high powered generators and machinery to supplement it, which we cannot do. Therefore, we decided to pursue an alternative and simple way of generating this type of power with magnets and coil. We considered designing a custom communications module that would have fit this application better. We also considered a more robust communications module that would have required more custom development, but after discussing with our advisor we realized that we did not have the time or expertise to accomplish this in one semester. Thus, we have traded communications box that has pre-written nython libraries for simple implementation

Briefly describe the	A Raspberry Pi 4 microcontroller will be employed along with a pair of LoRa radio
computing aspects of	bonnets to communicate battery information to a receiving device. The LoRa radio
your projects, specifically identifying hardware-software tradeoffs, interfaces, and/or interactions.	has a 2km, line-of-sight range to communicate this information, but can be extended with directed antennas. The RPi will receive power from the battery via trickle charging from the wave power generator. It will interact with both the LoRa radio and a battery board through code running on the RPi in order to transmit data. The hardware/software interfaces are through RS232 (serial) and SPI. RFM9x LoRa radio will be used along with Adafruit CircuitPython RFM9x module and CircuitPython. This technique will allow the sending and receiving of packets of data. We will also integrate in a digital compass that will communicate with the RPi over a serial interface. Data from the compass and the battery management system is collected and stored at the base station RPi, and finally showcased on a graphical user interface.
	One tradeoff was the complication of a communications module in which we decided to use a less robust module to increase simplicity. Another one is the fact that we need two radios with matching frequencies to complete the job. And lastly, with increase in distance, the speed and bandwidth reduces