DALHOUSIE UNIVERSITY
FACULTY OF ENGINEERING

Dartmouth Ocean Technologies Inc

Wireless Fluorometer for Marine Domain

Department of Electrical and Computer

Team 2: Gordon Walsh, Nick Balzan, Kyle MacNeil, Yasmin Khalifa

"Introduction"

This is the capstone project for a wireless Fluorometer (PIXIE™) for marine environments by Dartmouth Oceans Technologies (DOT) Inc. The four-channel fluorometer identifies substances in marine environments (e.g., Phycoerythrin, Phycocyanin, Chlorophyll, and Crude Oil) through detection of the target's chemical fluorescence. The current version of the PIXIE can be towed behind a ship or an autonomous underwater vehicle (AUX) and send data to the operator's PC in near real-time. To expand the deployment limitations, the DOT team would like to remove the necessity of a wired connection in future designs.

The Pixie™
4-Channel Fluorometer [1]

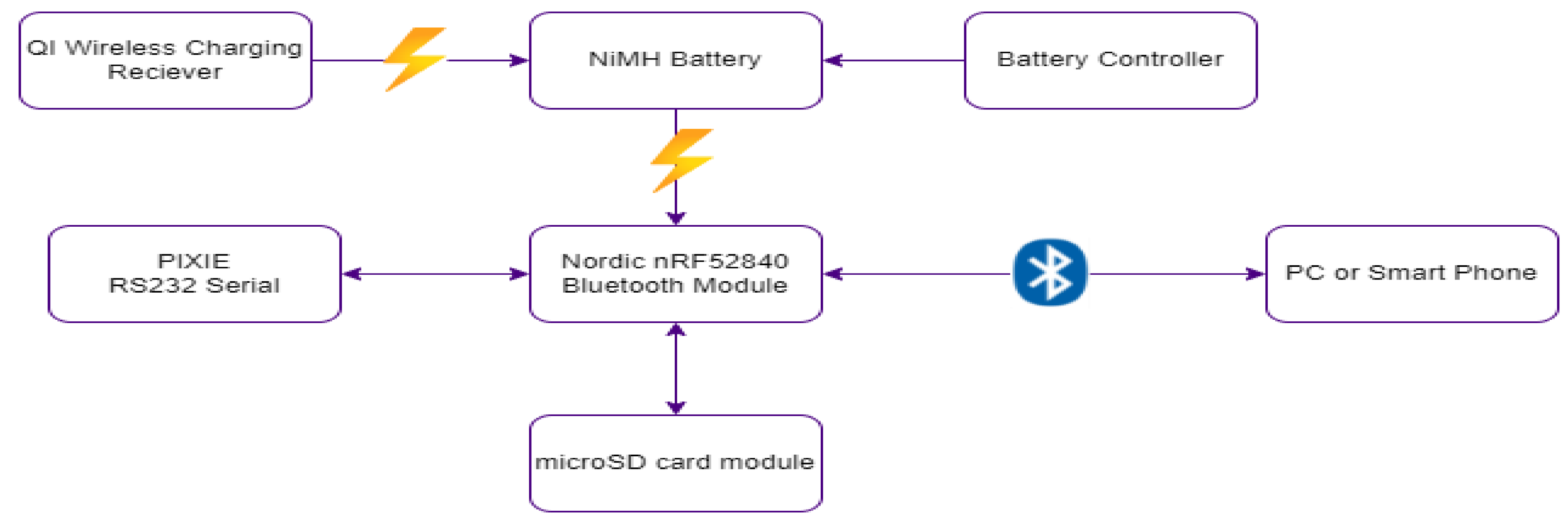
"Project Objective"

The first objective of this project is to design a PCB that facilitates Bluetooth communication between the PIXIE and PC/Smartphone. The PCB must establish a connection with the PIXIE RS232 port, write received Fluorometer data to a microSD card and deliver the data to a PC via Bluetooth Low Energy. The second objective of the project involves designing a wireless rechargeable battery solution for the PIXIE.

"Design Criteria and Constraints"

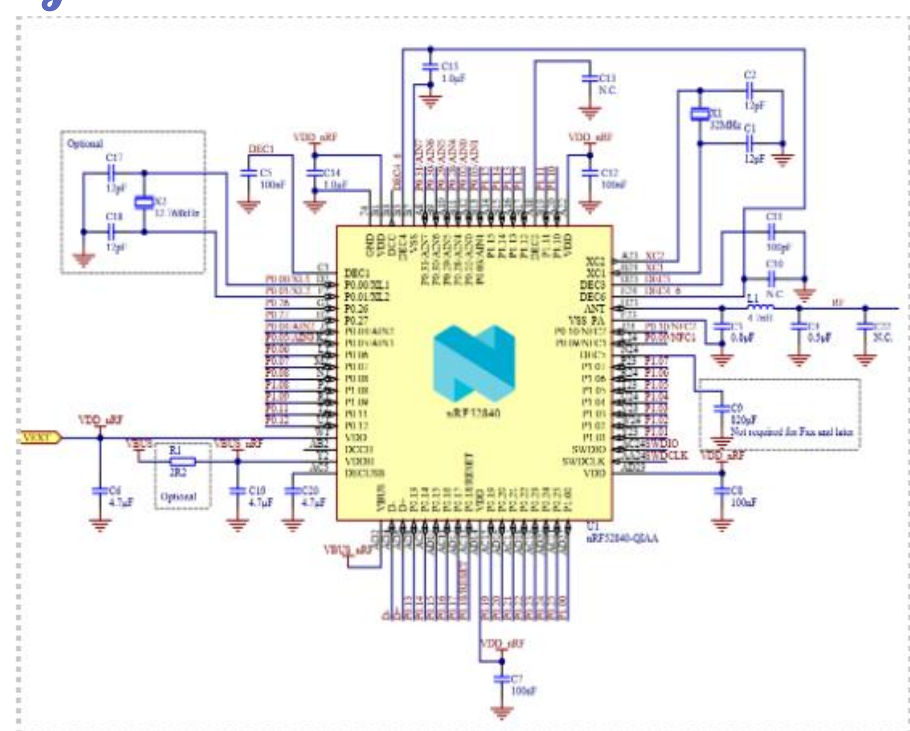
- Receive real-time Fluorometer data from an RS232 connection on board the PIXIE and store it to a microSD card.
- Transmit data on a microSD card to a PC or smartphone via Bluetooth.
- Must be supplied by a rechargeable battery with wireless charging capabilities.
- A GUI must be designed for initiating data capture, data transfer, and viewing the data following a Bluetooth data transfer.
- A total budget of $1000 has been allocated for this project.
- The material type, thickness, and size of the assembly, as well as the existing hardware and software of the current PIXIE cannot be significantly changed.
- Steps must be taken to ensure safe operation in aquatic environments.

"System Architecture"



"Bluetooth System"

The ACN52840 Bluetooth Low Energy module is comprised of a Nordic nRF52840 microcontroller powered by an ARM Cortex M4 processor. The ACN52840 will read incoming serial data from the PIXIE, write the data to a microSD card, and transmit the data through Bluetooth to a PC.



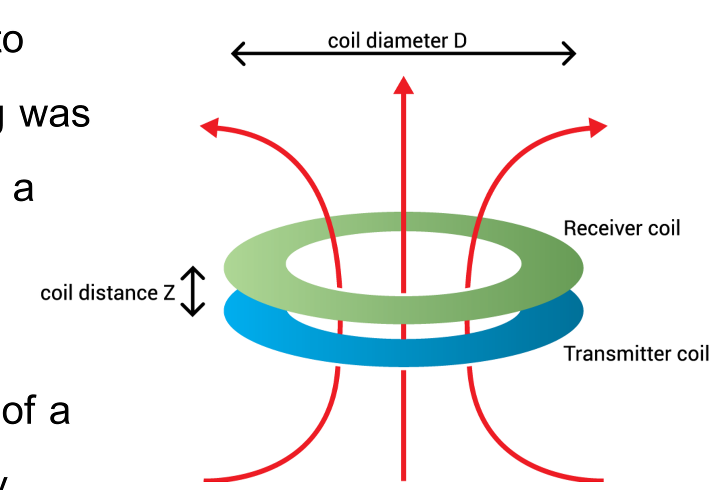
Nordic nRF52840 module circuit schematic [2]

"MicroSD card System"

The microSD card will store the PIXIE's data during collection and save it to a .txt file with the date and timestamp of the run to transmit via Bluetooth. It will be powered through the GPIO pins of the nRF module and will use Serial Peripheral Interface (SPI) for communication. The microSD card will use the FAT32 filesystem commonly used in memory cards between 4GB and 32GB because of its compatibility across multiple OS platforms.

"Wireless Charging"

Due to the aquatic nature of the PIXIE's use cases, it was favorable to avoid adding unnecessary holes or ports; therefore, wireless charging was used. Wireless charging works by using a transmitter coil to generate a magnetic field through a receiver coil which induces a current. To incorporate wireless charging, a Qi wireless charging receiver will be implemented into the PIXIE. Using the Qi standard, the development of a transmitter is avoided, and a Qi-compatible receiver coil can be easily purchased and implemented.



Magnetic Field through Wireless Charging Coils [3]

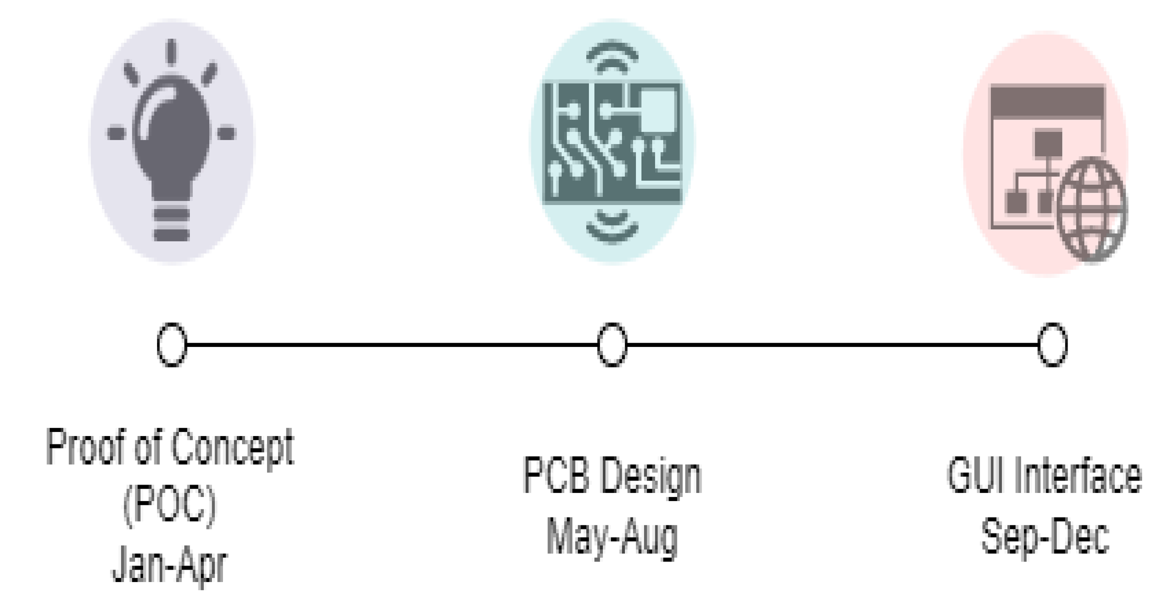
"Battery Controller"

The battery controller will be capable of automatically detecting if the NiMH battery pack requires charging when connected to the wireless charger. When a NiMH battery reaches its fully charged state, an exothermic reaction occurs, causing the battery to heat up, and drop in terminal voltage. The battery charger can detect this increase in the battery temperature and decrease in terminal voltage, which indicates the termination of the charging current. A timer is also used to terminate charging encase both methods fail.

"Timeline and Future Work"

Our schedule divides the project into 3 phases throughout 2022. The remaining tasks for the initial POC phase are:

- Format the microSD card to receive serial data and store it as a .txt file.
- Build the battery pack and ensure wireless charging.
- Demo the proof of concept (POC) board to the client.



"References"

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