OarTracker

Abby Greentree, Braeden Benedict,
Brooks Meadowcroft, Joe McGrath, Nick Rasdon

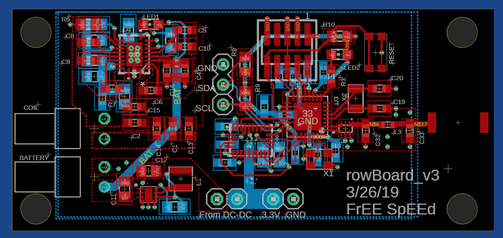
Problem

In rowing, technique is often more important than strength. It is crucial for team members to improve their technique by analyzing the different parts of their stroke. One of the more important technical aspects of rowing is the coordination of movements between rowers: feathering, roll ups, and catches should all be in sync. While there are commercial devices that help with technique analysis by measuring the forces at the oarlocks, there is a need for a low cost device that can be easily added to an existing setup to improve rowers' timing within a boat.

Figure 1: Rowing technique. Top left image is a "catch."

Solution

The solution to the above problem is a device which can provide technique analysis after being attached to any place along the oar with a certain orientation. The PCB within the device consists of three main components: an IMU, a BLE microcontroller, and a wireless charging chip. The IMU gathers linear acceleration and angular velocity data; this data is collected and analyzed by the BLE microcontroller, and stroke data is transmitted to a smartphone, which displays to the user catch timing via an app. The wireless charging chip allows the device to be charged with inductive charging, thus allowing the device to be perfectly sealed and waterproof.



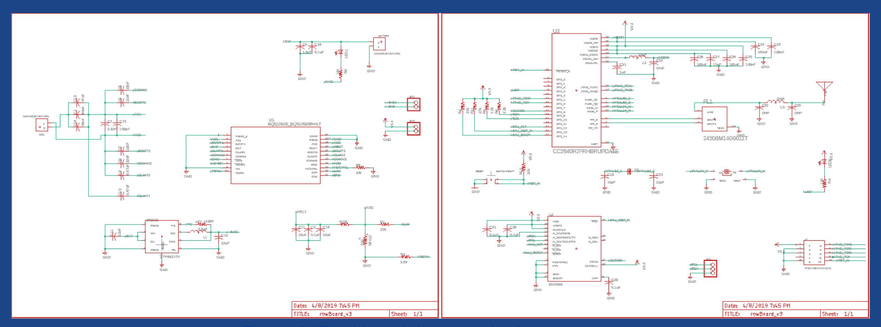


Figure 2: Final board design and schematic

Subsystems

- IMU and BLE Microcontroller: The IMU chip utilized in the device is the BNO080; it consists of an accelerometer, gyroscope, and magnetometer. Communication between the BNO080 and the CC2640R2F (the BLE chip) is completed via I2C.
- Data Processing: Data from the IMU is processed on the BLE microcontroller. Different oar actions/positions are determined with a state machine. These actions are sent to the phone app.
- Cell Phone Application: Information about catch timing and which oars are late/early on the catch is displayed to the user through an iPhone app. The app can connect to seven OarTracker devices, though only two were used for testing.
- Wireless Charging: The bq51050b chip serves as both wireless power receiver and battery charger for the device. Any Qi-compliant charging pad can be used to charge the device.

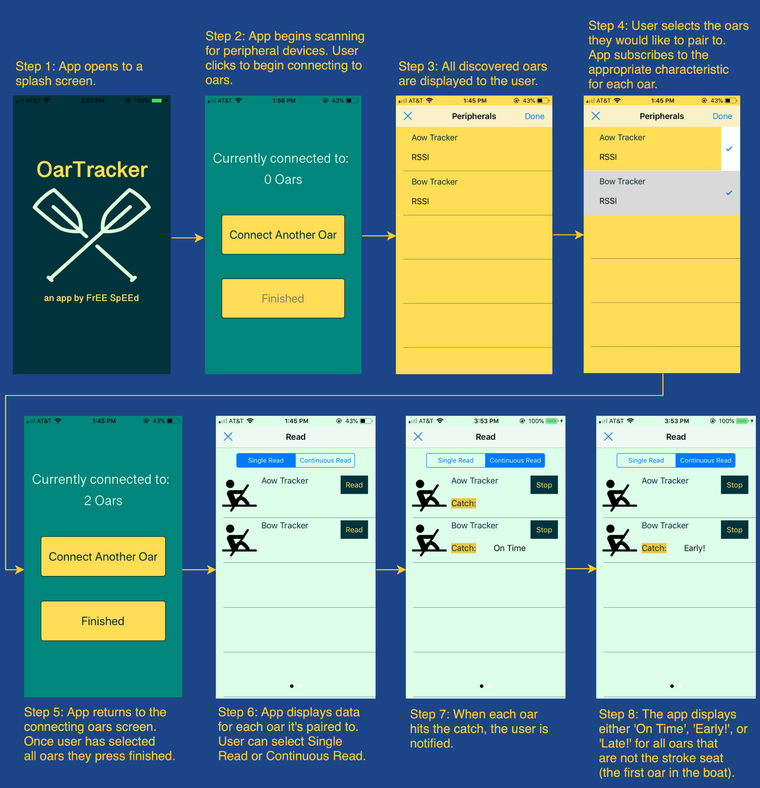


Figure 3: Flow Diagram of the phone app

Data Processing

- The output from our catch identification program is shown below. Red vertical lines indicate a catch, cyan lines indicate squaring the blade to be perpendicular to the water, and magenta lines indicate feathering the blade to be parallel to the water. Dotted red lines indicate a catch while rowing "on the square," which means that the blade is not feathered between strokes. Our program can seamlessly transition between identifying catches while feathering and while rowing on the square.

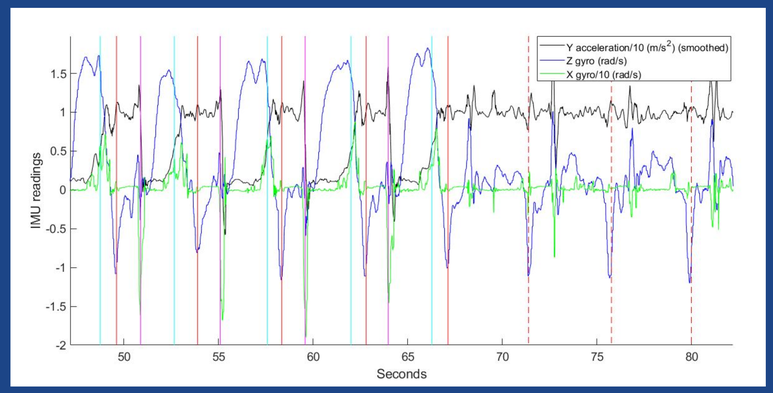


Figure 4: Plot of data output from catch identification program

Future Improvements

- Adding feathering and rollup indications to the phone app subsystem would allow for improved stroke analysis.
- Automatic detection of whether a device is on starboard or port side
- Streaming and saving of raw accelerometer/gyro data to phone for more detailed analysis after a practice
- Waterproof case

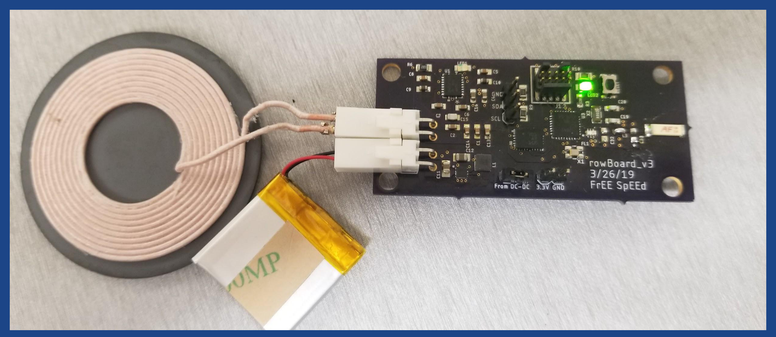


Figure 5: Final board with battery and power transfer coil