Vision Impaired Swim Aid

sdmay20-05:

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Advisor & Client: Lee Harker

Project Vision

The goal of our device is to help vision impaired lap swimmers be able to swim by themselves and gain more confidence while doing so. We also believe this device would be useful to people who aren’t disabled, and simply just struggle to find the wall when doing the backstroke or different strokes.

“Sometimes disabled people tend to feel discouraged from doing things that are difficult. I think this device will make the swimmer feel more secure in the water, and allow them to practice more often by themselves.”

-Brandon Schellhorn, *Teacher for the Visually Impaired*, Iowa Braille School

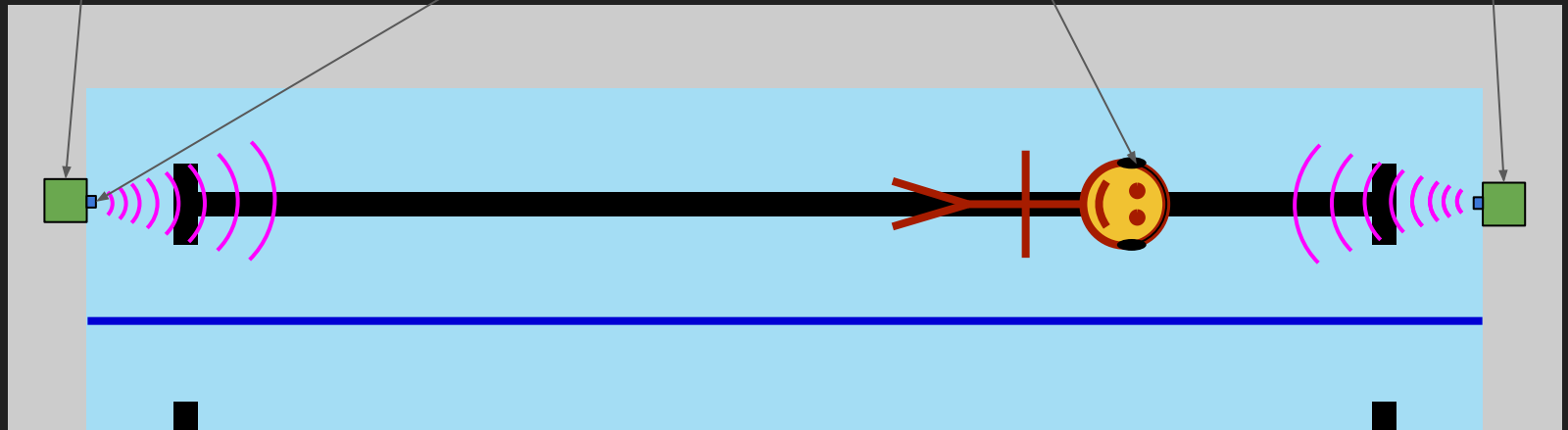
Conceptual Sketch

Control Box
Processes signal from sensor and sends radio signal to headphones to warn the user when they reach the edge.

Sensor
Detects how far the user is from the edge. We are looking into using sonar, ultrasonic, or infrared.

Headphones
Receives radio signal from the control boxes and warns user that they are near the edge with sound in their ears.

2nd Control Box
Sends radio signal to warn when the user is near the other edge.



Functional/Non-functional Requirements

- Functional
  - Waterproof to protect hardware from getting damaged
  - Sensor always needs to detect swimmer
  - The user is going to be vision impaired
  - Headphones need to always be able to tell swimmer when to turn before they hit the wall

- Non-Functional
  - Make aesthetically pleasing

Technical Constraints/Considerations

Technical Constraints

- Our biggest technical constraint is in our sensors, we have decided to use sonar or IR. We are still doing tests, but sonar historically works better so putting our focus there.
- We also decided that we will use an Arduino with transmitter and headphones that we have all found to work.
- Transmitting audio signal the entire distance of pool

Considerations

- So far we have had the ISU swim coach respond to help and said we can talk to his vision impaired/blind swimmer and he could give us some help with the project.
- Brandon Schellhorn, from Heartland AEA, gave us good feedback on how his swimmers get set up in the pool.

Potential Risk and Mitigation

Potential Risk

- Some of the risk that we have to consider for this project is waterproofing the device and keeping the hardware safe.
- Another big issue would be if we do not detect the swimmer before they hit the wall.

Mitigation

- We plan on making sure that all the electronics are water proof so we do not damage them and test to make sure the water will stay out
- Will need to do enough testing with the sensors to make sure it picks up the swimmer. Maybe need two sensors on each side.

Contacts and Research

Steve Moats, Disabilities Coordinator, Iowa State University, smoats@iastate.edu

Micheal Peterson, Coach for ISU swim team, Iowa State University, coachmike@swimacac.com

Bailey Martin, Visually impaired swimmer on ISU swim team, bcmhoursecrazy@gmail.com

Brandon Schellhorn, Coach for the Visually Impaired swimming team, Iowa Braille School/IESBV - Heartland AEA, brandon.schellhorn@iaedb.org

- Almost all competitive swimmers don't use vision to know if they are going straight in the lane. - Micheal Peterson
- Would be nice to allow coaches to talk to the swimmer while swimming. This would especially be nice for beginners. -Bailey Martin
- All of his swimmers have someone bring them to the pool. About 10% of swimmers get tapped while swimming, and one of the biggest issues they have is seeing the T at the bottom of the pool or ribbon while doing the backstroke. -Brandon Shellhorn

Previous Solution AquaEye

- Can only be used with one swimmer at a time
- Swimmer must be in outer lane

Design Diagram

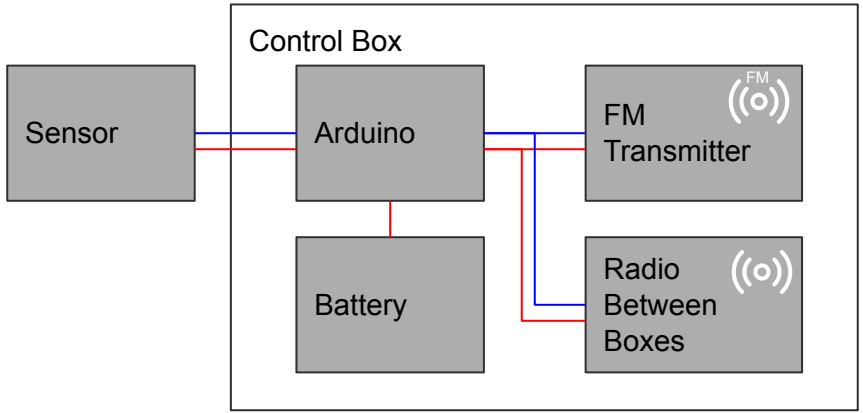
Signal

Power

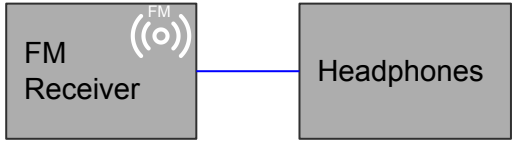
FM Radio

Digital Radio Between Boxes

At each end of the pool (x2)



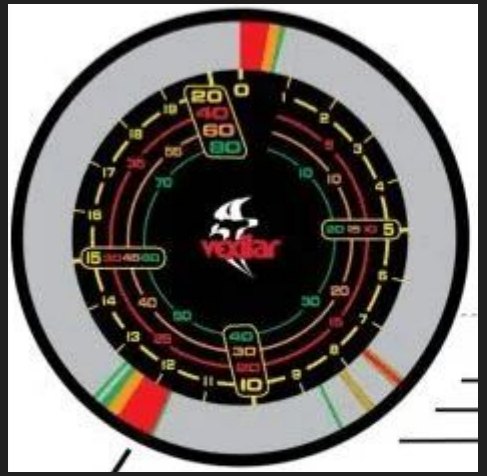
On the swimmer



Prototype Vexilar Sensor

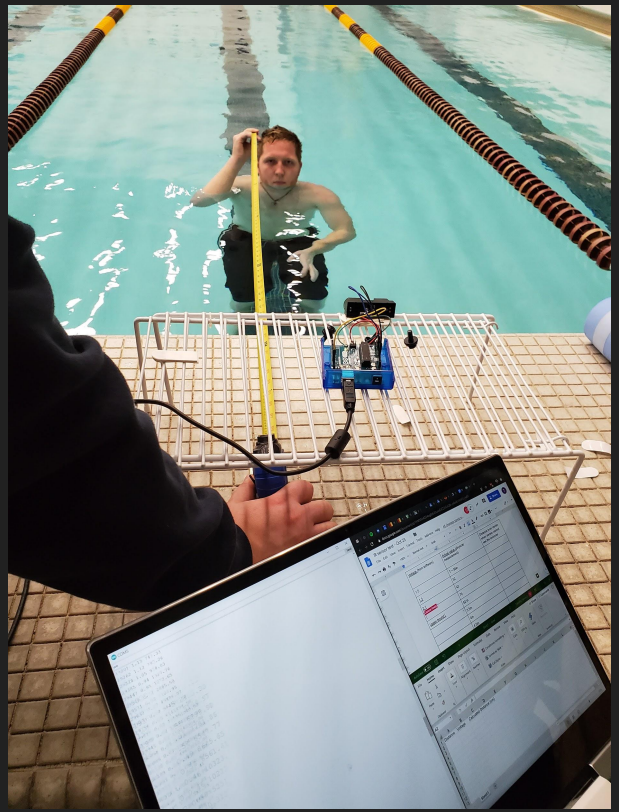
- Designed to find fish vertically in freshwater
- Each line is indicating that there is an object at that depth
- Complications:
  - Not made for pool water
  - Not designed to detect horizontally
  - Detecting walls and pool floor

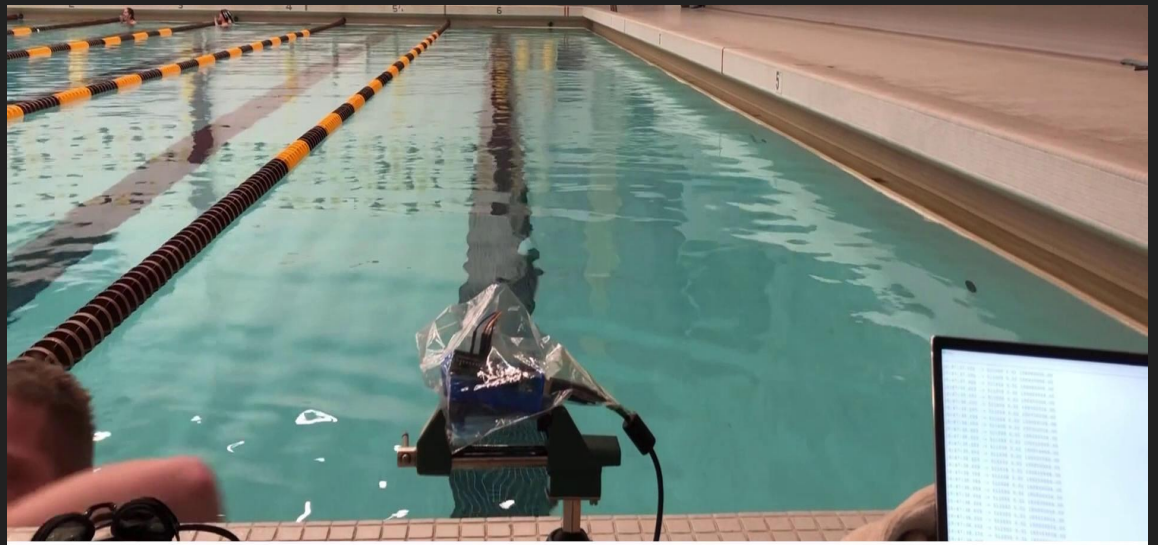
Intended use:

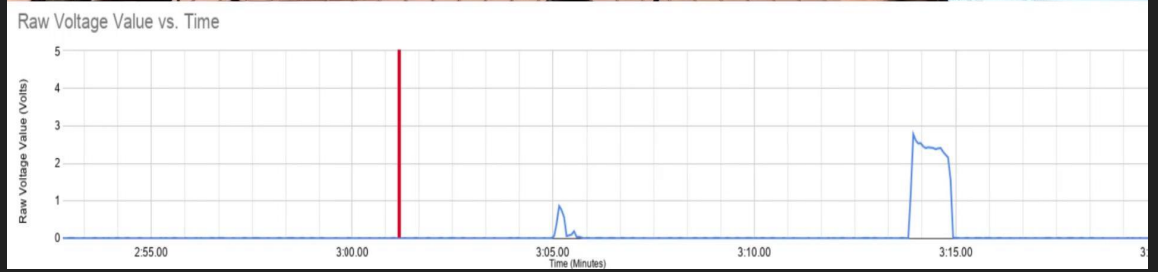


Our Results at Pool:

Prototype Sharp GP2D12 IR







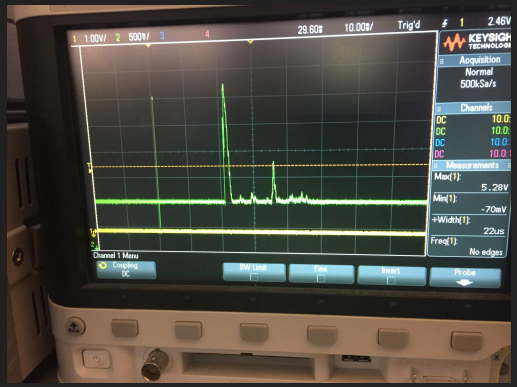
Prototype Sharp GP2D12 IR Conclusion

- Can successfully detect presence of swimmer

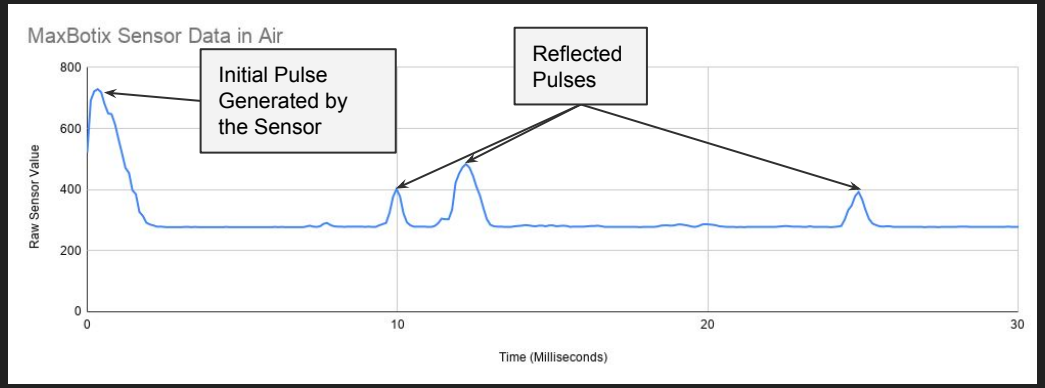
Limitations

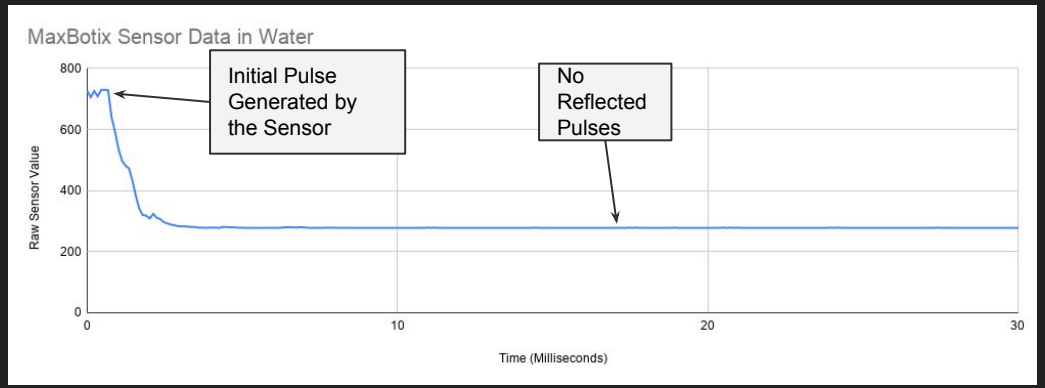
- Can not detect distance of swimmer from edge
- Can not detect the swimmer if no body part is above the water

Prototype MaxBotix MB7072



Prototype MaxBotix MB7072 Conclusion





In our testing we were not able to detect the presence of a swimmer

BlueRobotics Ping Sonar

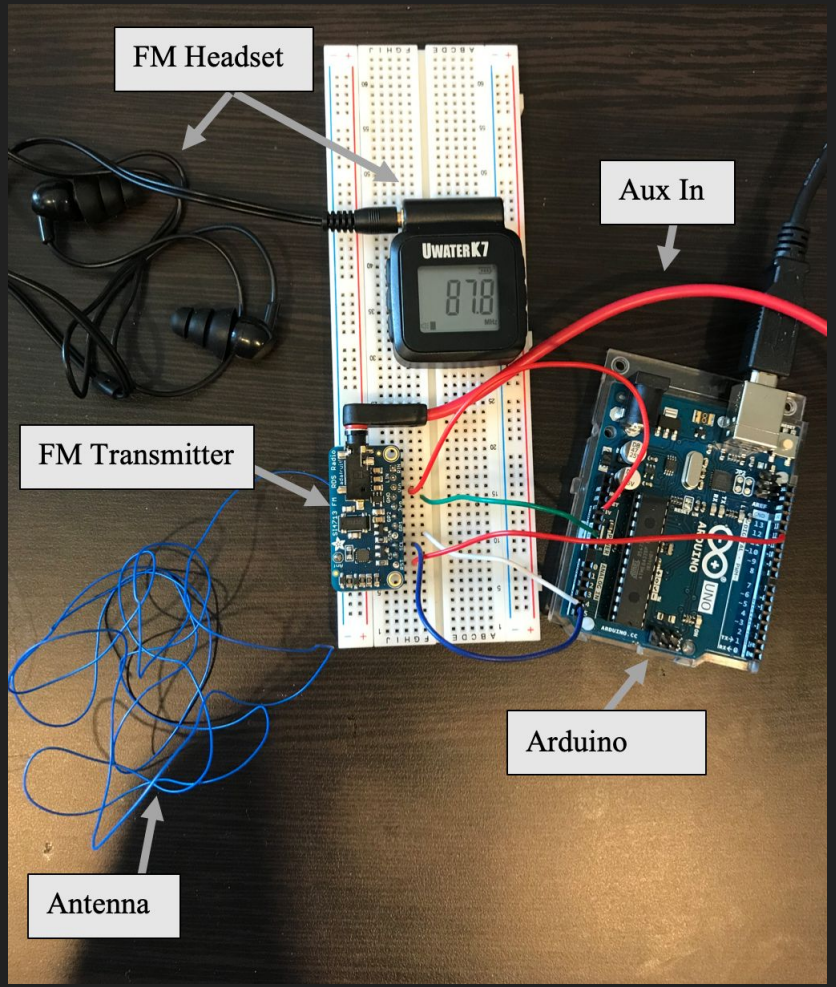
- Alternative to MaxBotix MB7072
- Need to test

Prototype FM Radio

First headphones did not work.

The FM Transmitter will be located at one end of the pool and transmit audio on a certain channel.

Next step is to send the audio signal from the Arduino to the transmitter through the digital RIN and LIN inputs on the transmitter.



Headphone/Transmitter Results

Inside the pool (Pool Length: 75 ft)

Channel 1: 94.1

Distance from transmitter	Signal Quality (0-5)
0 in	5 until 2 inches under water
6 ft (T)	5 until 2 inches under
20 ft	5 until 2 inch under
60 ft	3 until 2 inch under

Channel 2: 89.3

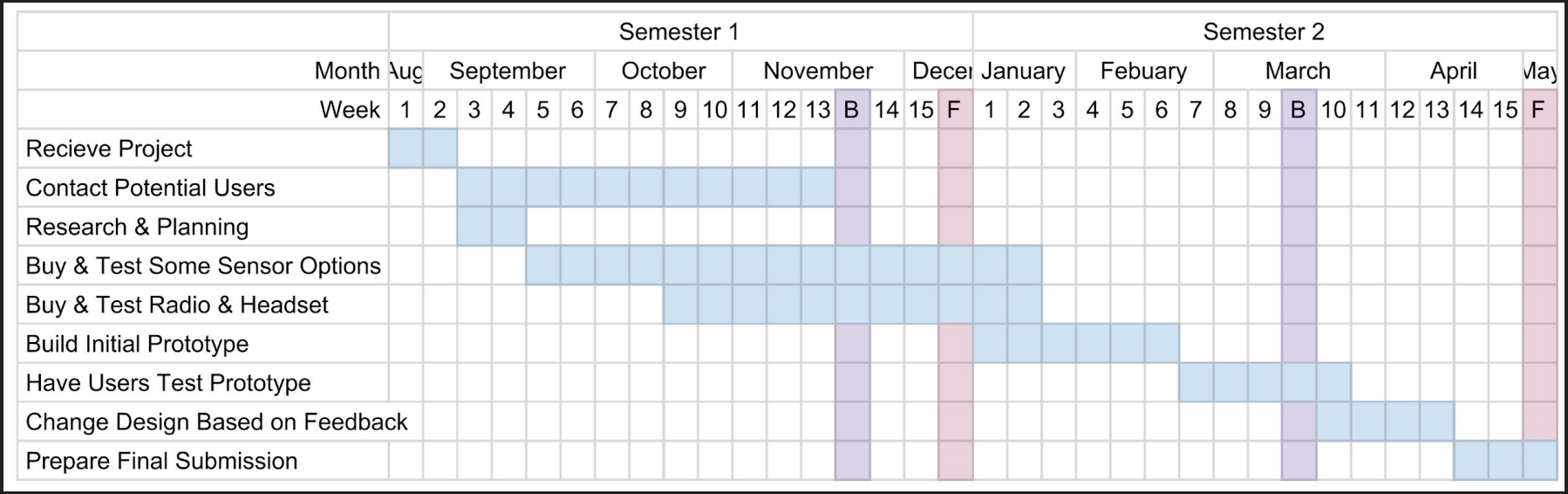
Distance from transmitter	Signal Quality (0-5)
0 in	5 until 15 inch under water
6 ft (T)	5 until 10 inches under
20 ft	5 until 5 inch
60 ft	5 until 2 inch

Channel 3: 99.6

Distance from transmitter	Signal Quality (0-5)
0 in	5 until 5 inch under water
6 ft (T)	5 until 5 inches under
20 ft	4 until 5 inch under
60 ft	4 until 2 inch under

0 - can't make out any music
1- can hear static with soft music
2- half static and half music
3 - low static and decent music
4 - decent music with no static
5 - good music with no static

Project Schedule



Test Plan

- Order second transmitter
    - Test for quality at distance and depth
- Test the BlueRobotics sonar
    - Test for accuracy and consistency
- Connect to second device
    - Test connection quality
    - Begin code development for cycling sensors
- Have initial prototype done by week 6
    - Make sure device works when we use it
- Test with visually impaired
    - Receive input and design notes from intended users

Project Costs (So Far)

Items	Cost
MB7072-200(maxbotic sonar)	$83
GP2YOA710KF(Sharp IR)	$17
Ximimark FM transmitter(still have not got)	$6
RBDS FM Transmitter	$40
Walkercam FM headphones	$35
Uwater FM headphones	$45
Blue robotic sonar	$279
Total	$505

Prototype Costs

IR Prototype	
Sharp IR Sensor (4)	$68
Arduino (2)	$60
RBDS FM (2)	$80
Uwater FM Headphones	$45
Total	$253

Sonar Prototype	
Blue robotic sonar (2)	$558
Arduino (2)	$60
RBDS FM (2)	$80
Uwater FM Headphones	$45
Total	$743

Conclusion

Sensors

Sharp IR : 1.) Can be used to detect swimmer presence, not distance
2.) Could need to implement more than one on each side to cover the lane

MaxBotix Sonar: We were not able to get this to detect the swimmer in the water

BlueRobotics Sonar: Will test next semester

Conclusion

Communication

Bluetooth is not a feasible option due to water interference. FM has worked the best so far. We are looking into ordering a higher powered Transmitter.

Potential users

We think this device will be very useful to more than just the vision impaired.

Thank you for watching!

Questions?