IPRO 310 :

Designing & Building

Prototypes for

Assisting Blind Swimmers

Team Members:

Research Subteam	Passive Device Subteam	Active Device Subteam
Elizabeth Bauer	*Axita Patel*	*Miguel Dela Cruz*
Ivan Tovalin	*Garrett Ezell*	*Svetlana Mokhnach*
Mohammad Mahmoud	*Abin Koshy*	*Jeffrey Stanford*
		Palika Goldstein

The Problem

- **In the U.S.**
  - **10 million blind and visually impaired**
  - **1.3 million are legally blind**

- **Challenges in swimming**
  - **Access to swimming facilities**
  - **Orientation in the water**
  - **Location of the wall**

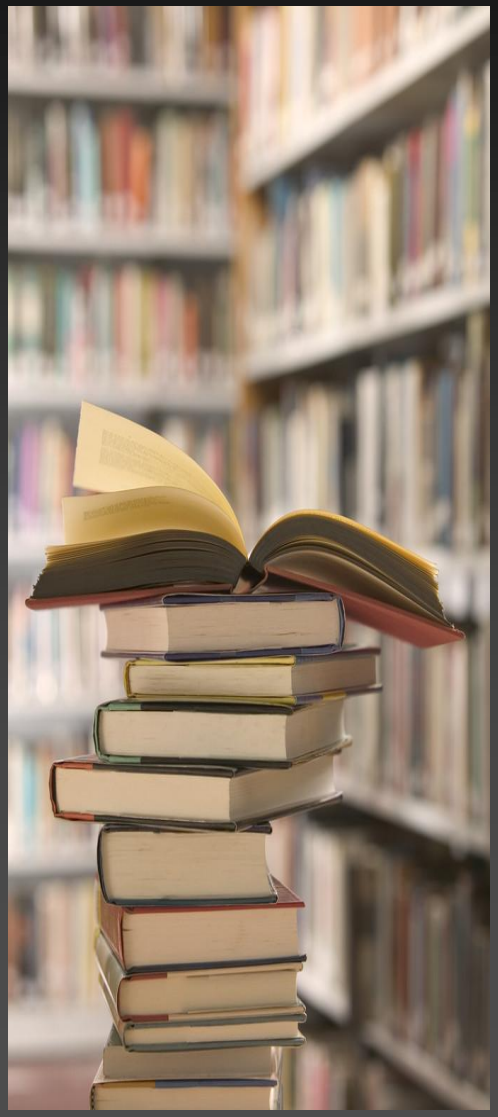
The current method used in swim competitions uses tappers who use a foam device to inform swimmers of when to turn

Semester Goals

- Design, Build and Test an Active Sonar Device
- Redesign, Build and Test a Passive Device: Swimming Lane Tapper
- Write a thorough report that captures:
  - Essence of issues faced by blind swimmers
  - Design Criteria
  - Need and Proposed Acceptance of Devices

Background Research Results

- Review of Spring ’07 Data
- Patent Search
- Research on Notre Dame’s Passive Device Designs
- Patented Lane Bubbler
- Research on Institutions for the Blind
- Research on Health Risks



Research Subteam Objectives

- Gather information on the design criteria for future prototypes
  - Market Demand
  - Prototype Interface
  - Location of prototype on swimmer
  - Multiple vs. Single Devices
- Produce an inclusive report of all the data collected

Accomplishments

- Interview with 2 S11 Swimmer
- Interview with 2 S12 Athlete/Swimmer
- Interviews with 2 Swimming Coaches of the Blind
- Interview with Ophthalmologist who specializes in low vision rehabilitation
- Prototype Ideas and suggestions
  - Vibration
  - Inconspicuous Device
  - Location on the body

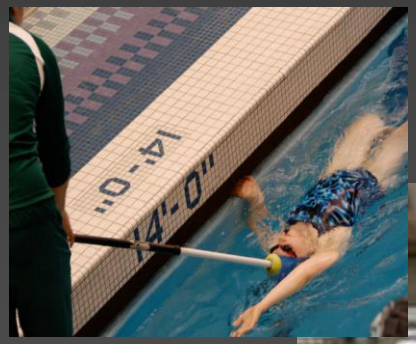
Recommendations for Next Semester

- Analyze results from surveys given to the family and friends of the blind or visually impaired swimmers
- Conduct Market feasibility search
  - Pricing Range
  - Possible Government Funding
- Identify other uses for the devices
- Compare satisfaction/ease of use of both prototypes by test volunteers

Passive Device Subteam

Design Requirements

- Based on Notre Dame's 'Lane Tapper'
- Easy to Set-up & Use
- Effective tool for straight swimming
- Effective tool indicating end of lane



Testing

- **First Test**
  - **Sighted swimmer w/blacked-out goggles**
  - **Materials**
  - **Spacing of tappers**
  - **Body contouring of each stroke**

Testing (Continued)

- **Second Test…First Prototype**
  - **Sighted swimmer w/blacked-out goggles**
  - **Effectiveness**
  - **Interference**
  - **Speed**
  - **Swimmer's reactions**

Testing (Continued)

- **Third Test…Modified Prototype**
  - **Sighted swimmer w/blacked-out goggles**
  - **Visually impaired swimmer**
  - **Effectiveness**
  - **Interference**
  - **Speed**
  - **Swimmer's reactions**

Notre Dame Testing

- 3 visually impaired swimmers
- 2 sighted swimmers w/ blacked-out goggles
- Side-by-side comparison test
  - 2 blind swimmers
  - 2 lane (one w/ lane tappers, one w/o)
- Very positive feedback from blind swimmers
- Suggested modification

Results

- Effective tool
  - Straight swimming
  - End of lane indication
- Swimmer's felt SAFE
  - Tactile indication of space
  - Effective for all types of strokes
  - Back stroke
  - Breast stroke
- Lane Tapper Sturdiness
  - Tappers pulled off by strong strokes

Recommendations for Next Semester

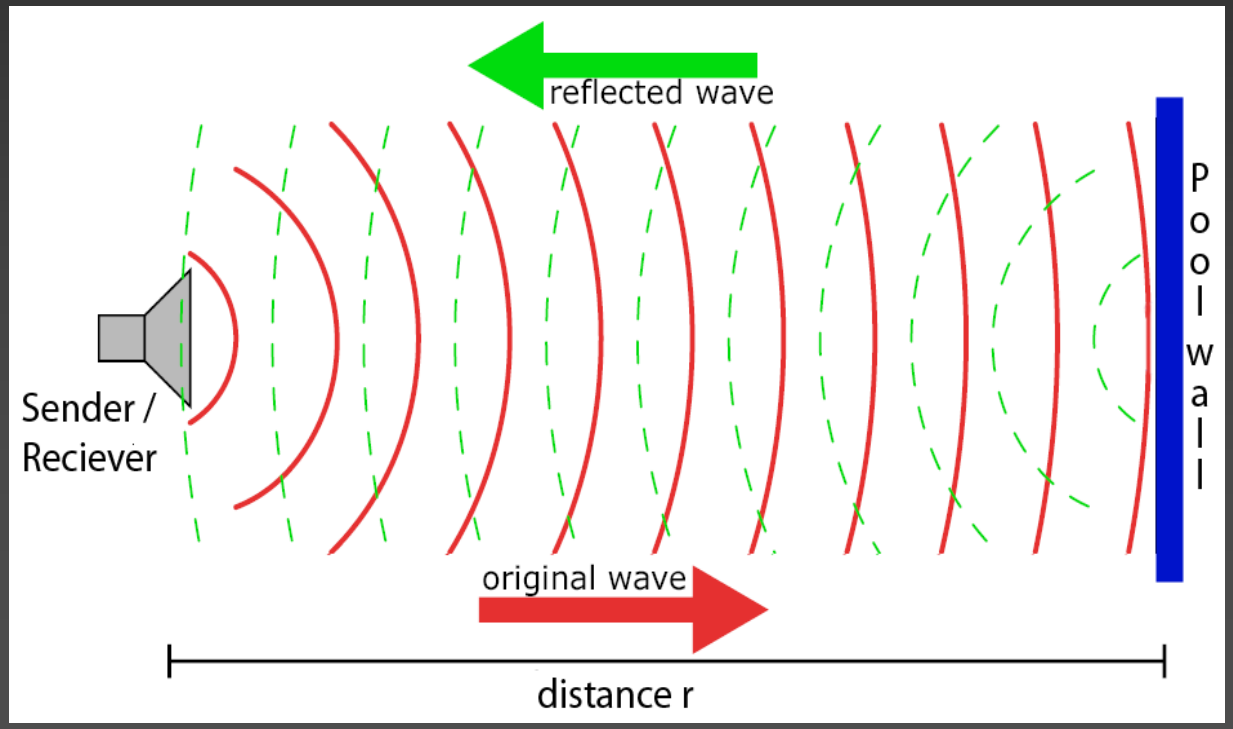
- Testing
  - With more visually impaired swimmers
- Design Modifications
  - Length of tappers
  - Thickness of end of lane tappers
  - Bracketing tappers to prevent flipping
- Documentation
  - Of Everything
  - Engineering Notebook

Active Sonar Device Subteam

Sonar

Etymology: SOund Navigation And Ranging

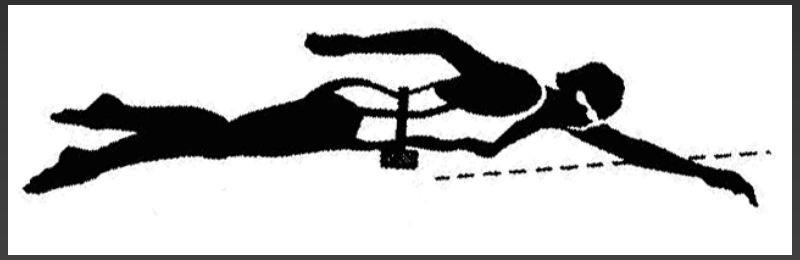
Definition: a technique that uses sound propagation (sound waves sent out to be reflected by other objects) especially under water to navigate, communicate or to detect other vessels.



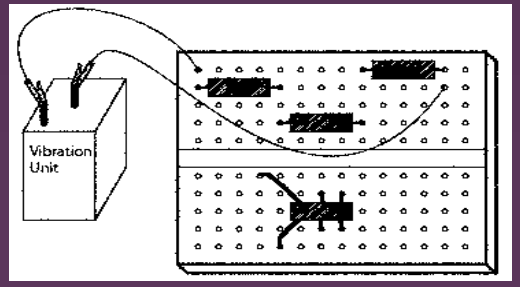
Research/Design of SUPAD

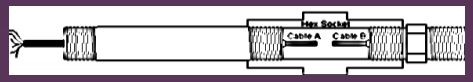
Sonar Underwater Personal Anti-Collision Device

3 Design Teams



- **Transducer:**
  - **Send and receive signal**
  - **Connected to a driving circuit**
- **Microcontroller:**
  - **Compute distance of swimmer to the wall**
  - **Provide voltage output**
- **Vibration:**
  - **Orient swimmer**





Results to Date

Transducer:

- Driving circuit in development

Microcontroller:

- PSoC seminar (Cypress)
- Rough draft of program

Vibration:

- First test:
  - Motor connected to a battery with a switch
  - Vibration too weak
  - Casing absorbed most of the vibration
- Second test:
  - Motor with an unbalanced weight
  - Can sense the vibration
  - Need to create a more effective casing

Next Semester Recommendations

Transducer

- **Obtain a driving circuit**
- **Possibly use two transducers**
  - **At end of the pool and with the swimmer**

Microcontroller

- **Determine constants from the driving circuit**

Vibration

- **Build and finalize casing**

Goals Achieved

- Completed patent research
- Developed a progressive sonar device
- Built and tested passive device
- Conducted 8 Interviews
- Edited videos for testing
- Created & maintained engineering notebooks

Special Thanks To:

- Chicago Lighthouse for the Blind
- Irish Aquatics Paralympics Program
- Wisconsin School for the Blind and Visually Impaired
- Cypress Semiconductor Corporation
- Mr. Tim Spencer
- Mr. Jeffrey Larson
- Mr. Ray DeBoth
- Our faculty advisor Prof. Daniel Ferguson
- Mr. John Komer

[Insert I feel Safe Video]

Thank you

Questions?