Lane Tappers – Helping the Visually Impaired with Spatial Orientation in the Pool

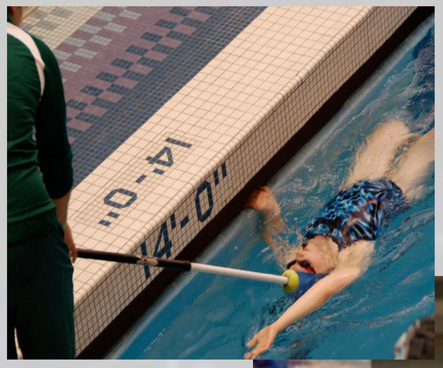
Design Requirements

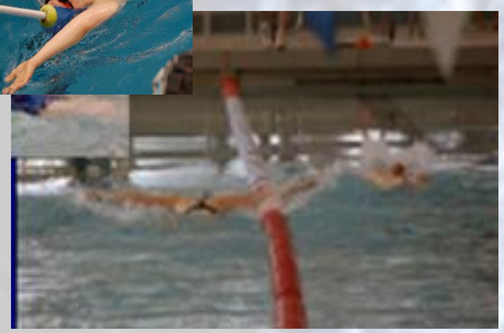
•Based on Notre Dame's 'Lane Tapper'

•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 Test

First Prototype Test

- Sighted swimmer w/blacked-out goggles
- Effectiveness
- Interference
- Speed
- Swimmer's reactions

Third Test…Modified Prototype

- Vinyl feelers added to tappers
- Sighted swimmer w/blacked-out goggles
- Visually impaired swimmer
- Effectiveness, Interference, Speed, Swimmer's reactions

Fourth Test…Notre Dame Prototype

- Doubled the frequency of tappers
- Increased overall strength of design
- 3 V.I.S.'s, 2 sighted swimmers
- Effectiveness, Interference, Reactions + Suggestions

Results

Effective tool

- Straight swimming
- End of lane indication

Swimmer's felt SAFE

- Tactile indication of space

Not 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

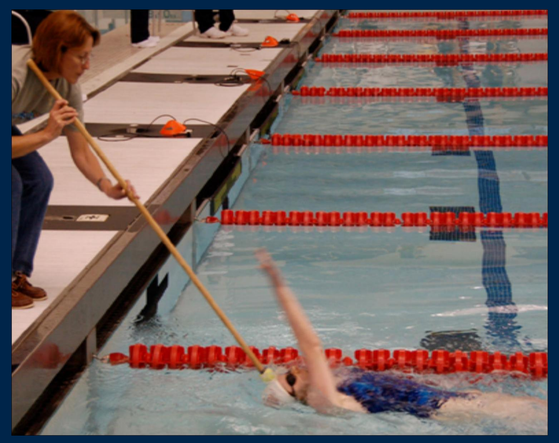
- Of Everything
- Engineering Notebook

IPRO 310
Designing & Building Prototypes for Assisting Blind Swimmers

Background

-10 Million blind or visually impaired in the U.S. alone

-1.3 Million are legally blind



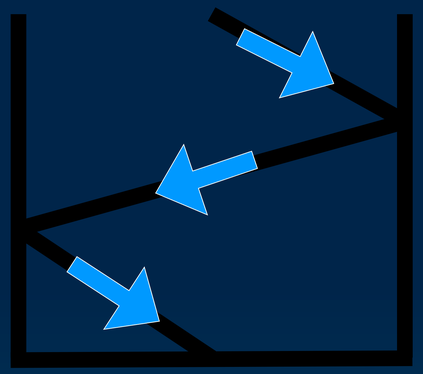
With **TAPPERS**

This method is **inconvenient** because it is **expensive** and it requires a lot of **man power**.

Problem

Blind / visually impaired swimmers have difficulty with spatial orientation and edge detection while swimming.

Spatial Orientation



Edge Detection

Objective

To better understand challenges of blind / visually impaired swimmers while swimming.

This information was gathered by conducting:
- Interviews

with blind / visually impaired swimmers and their coaches.

Results

Additional design criteria gathered for the sonar device included:

- Size- **Deck of Cards**
- Preferred Body Location- **Lower Back/Waist Area**
- Tactile Interface- **Vibration**
- Preliminary Pricing- **$50-$500**

Sonar Underwater Personal Anti-collision Device

SUPAD

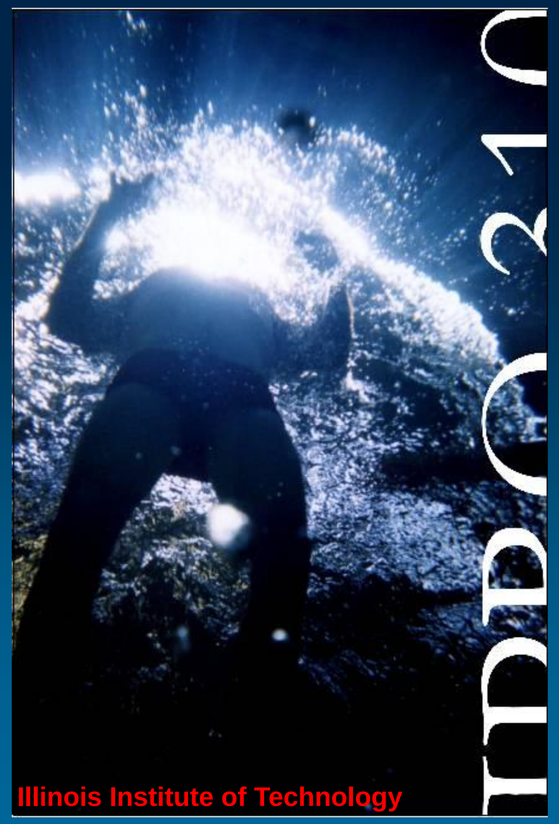
Problem

How to help the visually impaired with spatial orientation in the pool.

Sonar

Etymology: SOund Navigation And Ranging

Definition: a method or device for detecting and locating objects especially underwater by means of sound waves sent out to be reflected by the objects.



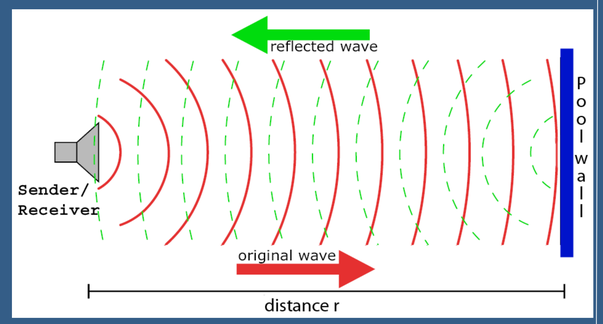
Illinois Institute of Technology

How it works:

Key: *first signal sent by the transducer*
Echo: *bounced signal off the pool wall*
t: *difference between the time key is sent and echo is received.*
r: distance of the swimmer from the pool wall
C_{water} *: speed of sound in water*

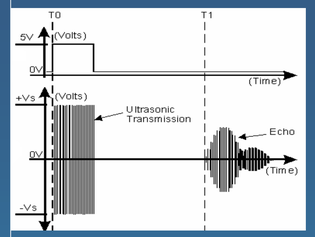
1. SUPAD strapped on the swimmers waist

2. Transducer sends a signal

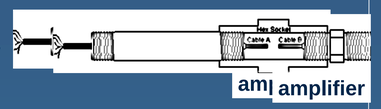


3. Signal bounces off the pool wall and then back the transducer

4. Transducer sends echo to the amplifier

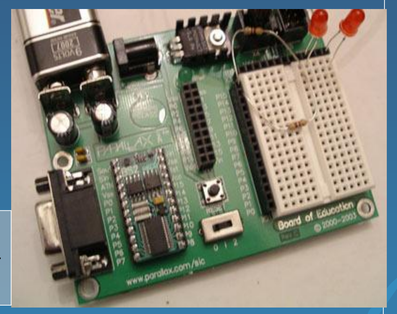


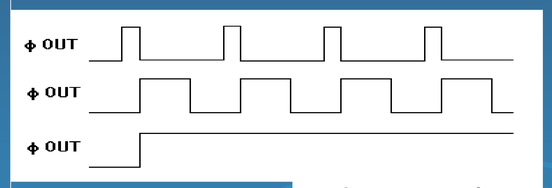
5. Echo is digitalized, amplified, then goes to the microcontroller



6. Microcontroller computes the distance by taking the time difference of key and echo, multiply by the speed of sound in water, then divide by two

$$r = \frac{t \times c_{water}}{2}$$

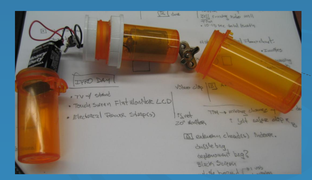




Varying output voltages

7. Microcontroller outputs voltage depending on the value of r

8. Vibration unit vibrates accordingly



Functionalities of SUPAD

- **Determine the distance from the wall to the swimmer**
- **Differentiate between objects in the pool and the wall**
- **Waterproof**
- **Adjustable by the swimmer**
- **Varying output vibration**
- **Differentiate between multiple devices**
- **Hydrodynamic design**
- **Easy to use**
- **Battery test**
- **Rechargeable**