# 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

<table>
<thead>
<tr>
<th>First Test</th>
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<tbody>
<tr>
<td>Sighted swimmer w/blacked-out goggles &amp; Materials Test</td>
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<table>
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<tr>
<th>First Prototype Test</th>
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<tr>
<td>Sighted swimmer w/blacked-out goggles</td>
</tr>
<tr>
<td>Effectiveness</td>
</tr>
<tr>
<td>Interference</td>
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<tr>
<td>Speed</td>
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<tr>
<td>Swimmer’s reactions</td>
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<table>
<thead>
<tr>
<th>Third Test...Modified Prototype</th>
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<tbody>
<tr>
<td>Vinyl feelers added to tappers</td>
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<tr>
<td>Sighted swimmer w/blacked-out goggles</td>
</tr>
<tr>
<td>Visually impaired swimmer</td>
</tr>
<tr>
<td>Effectiveness, Interference, Speed, Swimmer’s reactions</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Fourth Test...Notre Dame Prototype</th>
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<tbody>
<tr>
<td>Doubled the frequency of tappers</td>
</tr>
<tr>
<td>Increased overall strength of design</td>
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<tr>
<td>3 V.I.S.’s, 2 sighted swimmers</td>
</tr>
<tr>
<td>Effectiveness, Interference, Reactions + Suggestions</td>
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</tbody>
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## Results

<table>
<thead>
<tr>
<th>Effective tool</th>
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<tbody>
<tr>
<td>Straight swimming</td>
</tr>
<tr>
<td>End of lane indication</td>
</tr>
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<table>
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<tr>
<th>Swimmer’s felt SAFE</th>
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<td>Tactile indication of space</td>
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</table>

**Not effective for all types of strokes**
- Back stroke
- Breast stroke

<table>
<thead>
<tr>
<th>Lane Tapper Sturdiness</th>
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<tbody>
<tr>
<td>Tappers pulled off by strong strokes</td>
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</tbody>
</table>

## 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 manpower.

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

Spatial Orientation

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

Edge Detection
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.

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

How it works:

1. SUPAD strapped on the swimmer’s waist

2. Transducer sends a signal

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

7. Microcontroller outputs voltage depending on the value of r

8. Vibration unit vibrates accordingly

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

Etymology:

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