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BUOY

IPRO 310

Assistive Devices for
Blind and Visually Impaired
Swimmers

I Swim, You Swim, We All Swim

Outline

- Problem
- History
- Mission
- Team Organization and Development
- Technologies Utilized
- Outreach to Community
- Ethical Issues
- Accomplishments
- Future Recommendations

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Statistics

Problem

- Safety
- Independence
- Concealment of device
- Detect obstructions

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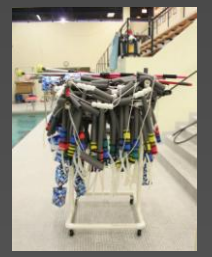
Project History

Fall 2006:
- Start of IPRO
- Market Research
- General Research
- Notre Dame modifications

Spring 2007:
- Research
- Passive redesign
- Passive Testing

Spring 2008:
- Vibrator Belt concept
- Modified Passive device



Fall 2008:
- New Storage Device
- Selected 2 active technologies
- New Management

Summer 2007:
- SONAR research
- Passive redesign
- Passive Testing

Fall 2007:
- SONAR applications
- Passive device modifications

Summer 2008:
- Modified Passive device
- Created Storage Device
- Snorkel Device Concept

Spring 2009

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BUOY Mission Statement

" To develop, test, and implement assistive technology with the community to promote safety and improve independence of blind and visually impaired (BVI) swimmers. "

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Team Organization

Active Team 1: Invisible Fence Tech.
Coleman Baar (ME): LEAD
Kevin Kruse (BME)
Li Li (EE)
Maggie Ng (BA)
Zhi Ma (EE)
Ryan Freund (CE)

Active Team 2: Sonar Tech.
Meghan Murdock (ME): LEAD
Lorne Turrentine (ME)
Hsuen Yew (BME)
Bingjian Zhang (EE)
Jeff Reilly (Physics)
Mohammed Rehman (ECE)

Documentation
Jeff Reilly (Active 2): LEAD
Coleman Baar (Active 1)
Lorne Turrentine (Active 2)
Ryan Freund (Active 1)

Media
Li Li (Active 1): TEAM LEAD
Bingjian Zhang (Active 2)
Mohammed Rehman (Active 2)
Zhi Ma (Active 1)

Survey
Maggie Ng (Active 1): TEAM LEAD
Meghan Murdock Active 2)
Hsuen Yew (Active 2)
Kevin Kruse (Active 1)

Faculty and Advisors
Frank Lane (Rehab Psych), David Gatchell (BME), Ken Schug (Chem)

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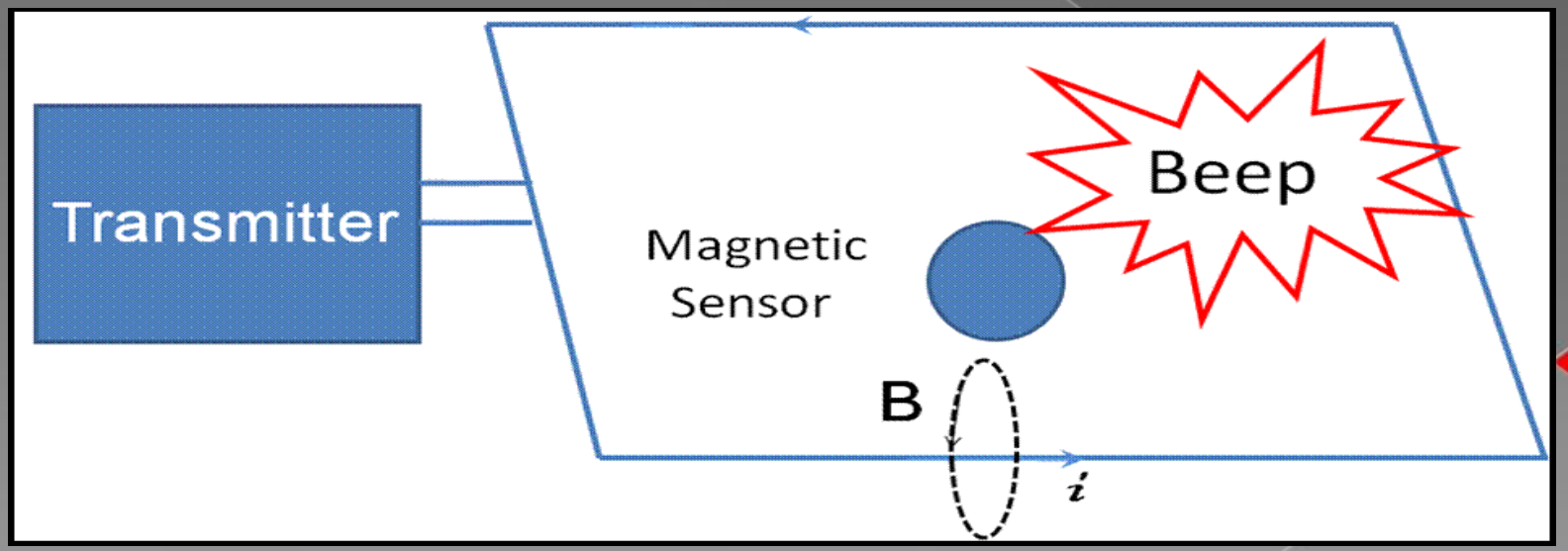
Sonar Technology

Laser Beam Technology

TECHNOLOGY

Invisible Fence Technology



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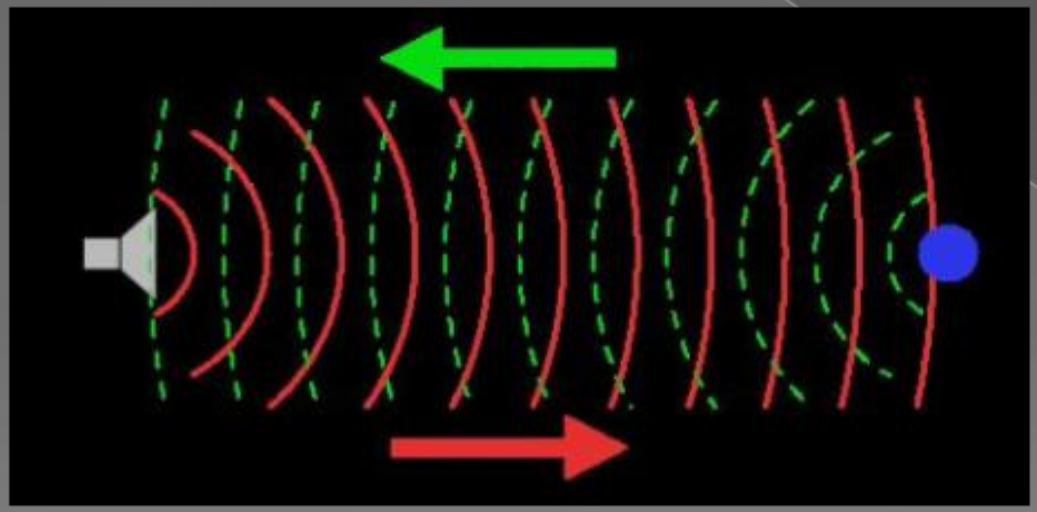
SONAR

RESEARCH

- Circuit design and modification
- Power consumption, underwater signal, cost analysis
- Miniaturization, wave propagation in air and water interface



TESTS

- Ultrasound parking sensors
- Air interface test
- Air – Water interface test
- Water interface test
- Detection zone test

RESULTS / ANALYSIS

- Signal insufficient to penetrate water
- Max distance 4.5 ft
- Max angle of detection 10 degrees
- Fourier analysis identified wave properties

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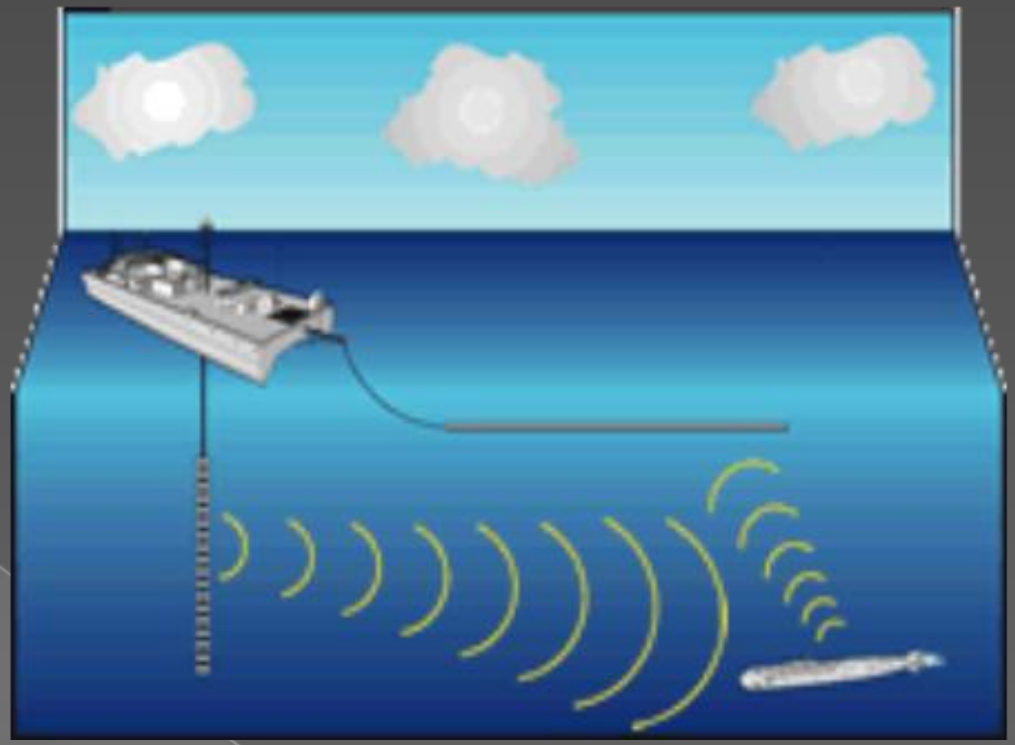
SONAR

CHALLENGES

- Underwater function
  - Underwater transducer
  - Water proofing
- Further research
  - Circuit and amplifier
  - Optimal power and frequency output
- Access to expertise and sources
- Budget & time constraint



POSSIBLE NEXT STEPS

- Involve expert on SONAR
- Research underwater SONAR
- Construct a circuit or modify device
- Documentation to prevent back-tracking

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Invisible Fence

RESEARCH

- Operations of the device
- Functionality in air and water
- Specifications of device
- Circuit design
- Properties of magnetic fields

Pool test for application and reliability in water

TESTS

Lab testing for device specifications

Faraday Effect

Pool test for boundary detection

RESULTS / ANALYSIS

- This technology works reliably in air and water
- Unmodified design identifies boundaries
- This technology does not communicate position
- Steel and copper pipes have negligible effects on magnetic fields
- Maximum distance of 55in (Single Loop)

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Invisible Fence

CHALLENGES

- Location of wire (Pool floor, Lane lines, etc.)
- Position feedback
- Interference with magnetic field
- Integrating alert system into receiver
- Integrating receiver into swim-wear

POSSIBLE NEXT STEPS

- Modify receiver's alert type
- Integrate receiver into swim-wear
- Design position identification
- Develop working prototype

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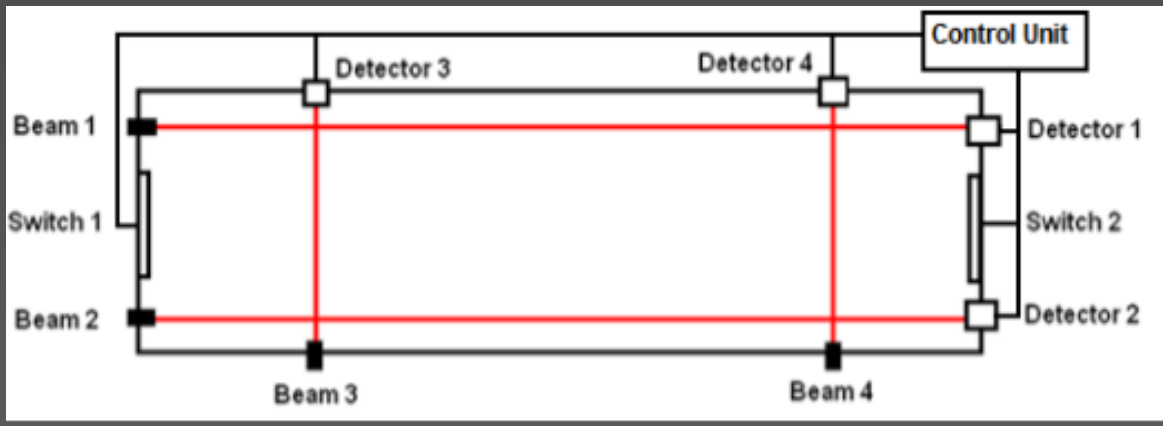
Laser

RESEARCH:

- Applications of lasers underwater
- Examine different circuit designs



Pool layout and design for laser system.

Prototype laser detector with lid off.

TESTING:

- Tested to make sure circuit worked
- Tested to see if prototype was waterproof
- Tested through tank of water

RESULTS / ANALYSIS

- Circuit functions properly, length of signal depends on the size of the capacitor
- Housing unit waterproof
- Device functions properly through water tank

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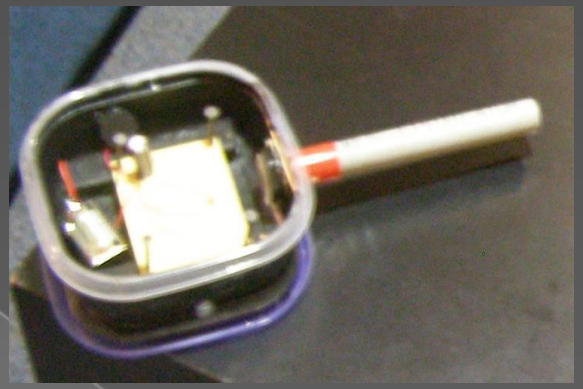
Laser

CHALLENGES

- Alerting User
- Laser beam interference
- Differentiating position
- Power Source



POSSIBLE NEXT STEPS

- Design a control system for detectors and end switches
- Create supports for lasers and end switches
- Examine various circuits with time delays
- Further testing including
  - Under water testing
  - Housing material oxidation

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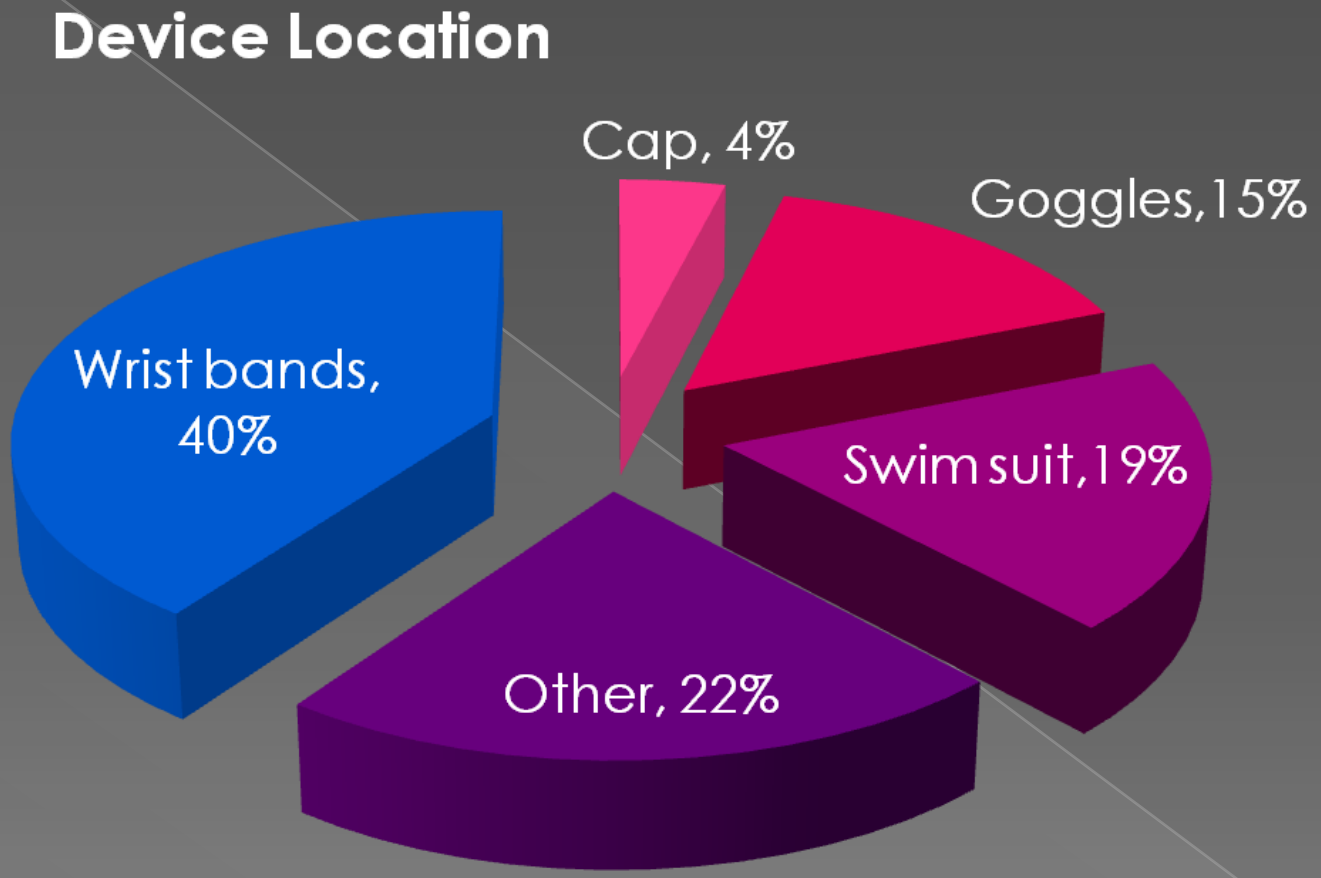
OUTREACH

The Chicago Lighthouse
for People Who are Blind or Visually Impaired

CHICAGO LIGHTHOUSE VISIT
Technology Presentation

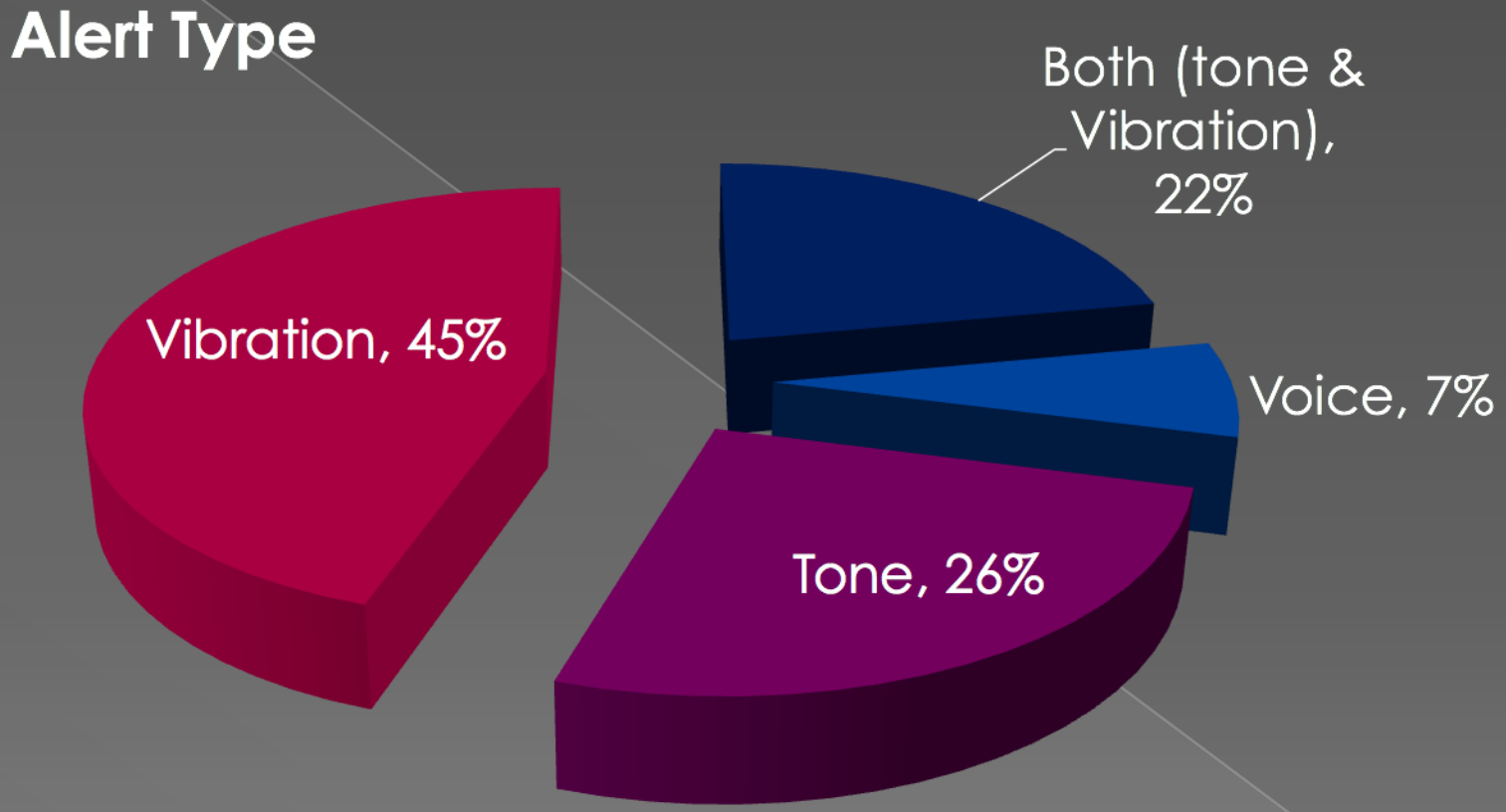
Survey Administration
- 27 surveys collected

Survey Result



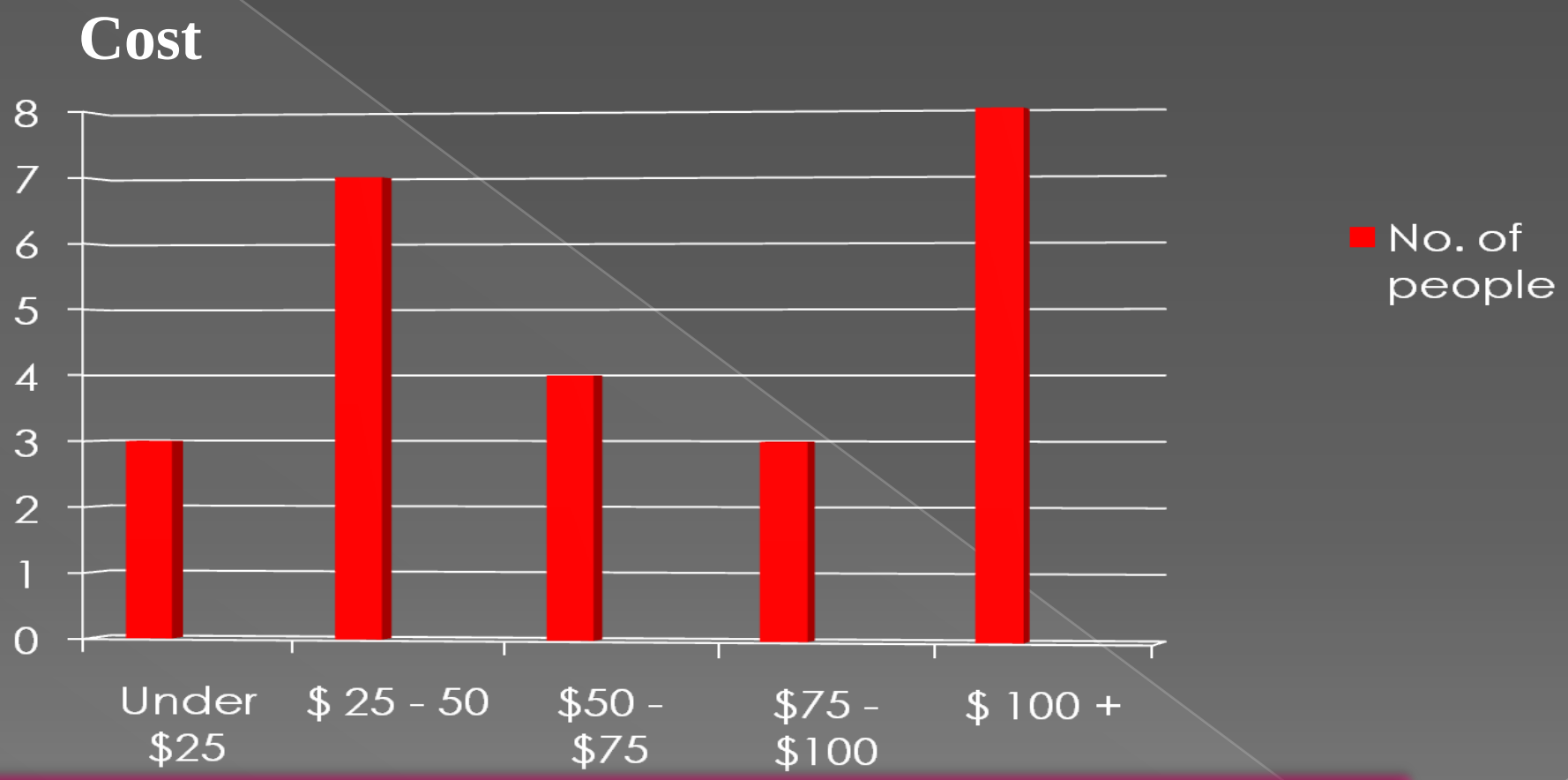
- The majority of BVI individuals surveyed preferred a low-profile wristband device

Survey Result



- Almost half of the responses received indicated a preference for a vibration alert over any audio signal

Survey Result



- The most popular price range was $100+, reasons for the high price choice may include the opportunity for financial assistance

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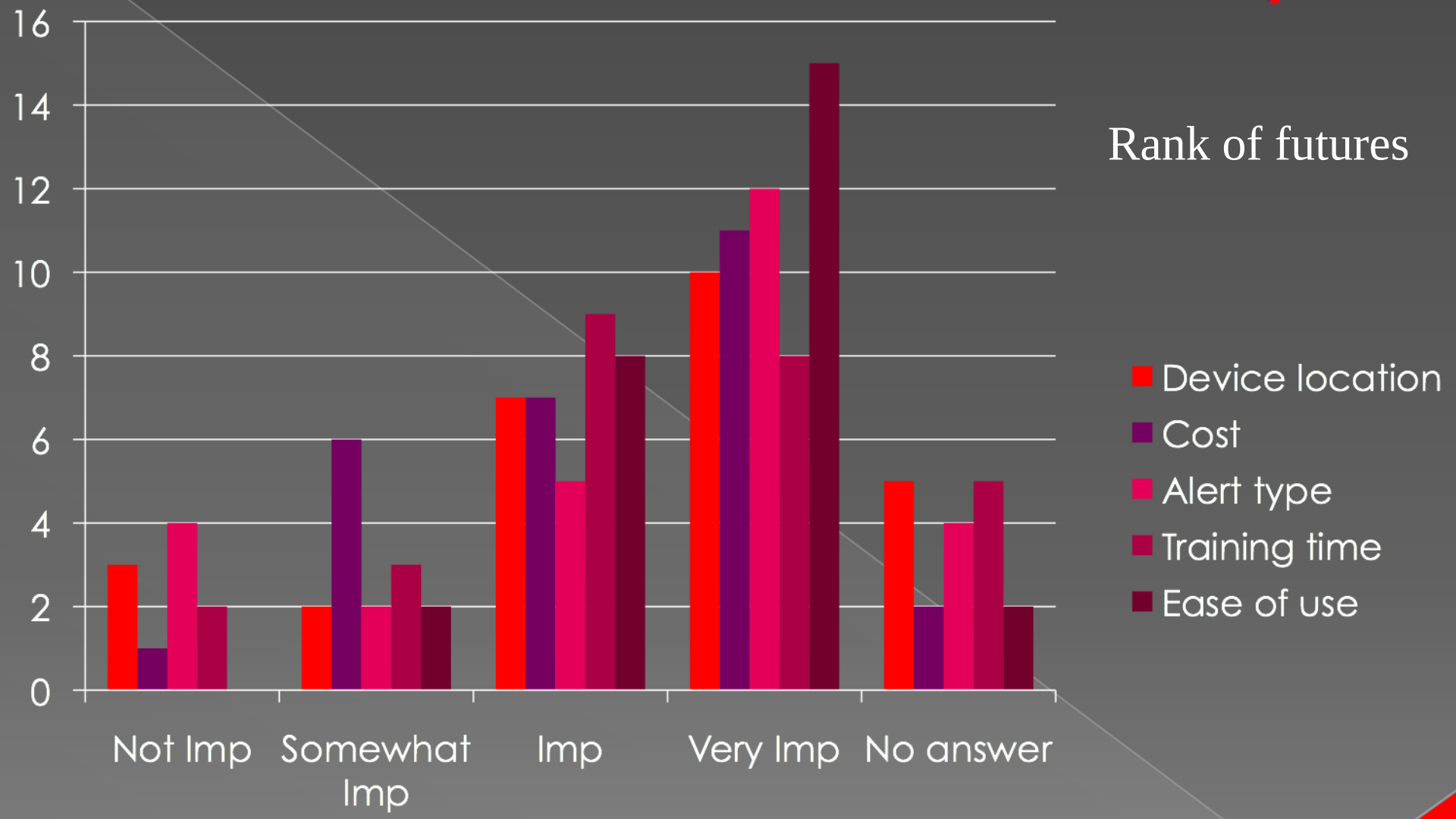
Survey Result



- All device features were ranked very important, but ease of use and alert type were ranked the most important

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Wisconsin Center BVI

Passive Device Testing

- Long term testing of the eyeSwim device
  - Long term user & staff feedback
  - Durability
  - Failure mode identification
- Created new Surveys & Consent forms
  - 2 surveys: (1) Swimmer, (1) Staff
  - Awaiting IRB Approval
  - Wisconsin Center will administer

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Wisconsin Center

Passive Device Testing

WCBVI

CHALLENGES

- Potential drop off date: week of 5/11
- Agreement between WCBVI and IIT
  - Liability of WCBVI if the device is damaged while in their control
  - Potential for injury during a device malfunction
  - IIT Legal has been contacted
- Copy of release forms\parental consent forms
- Descriptions of previous testing of the device
- Approval by Wisconsin Dept of Public Instruction Legal and Wisconsin Dept of Administration

WISCONSIN DEPARTMENT OF PUBLIC INSTRUCTION

State of Wisconsin - Department of ADMINISTRATION

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WEBSITE

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IPRO 310 | **Devices that Assist Blind & Visually-Impaired individuals in Swimming and Other Exercise Activities**

- INTRODUCTION
- PRODUCT
- SURVEY
- PARTNERS
- GALLERY
- ABOUT US

.: Contact Us

I swim, you swim, we all swim

.: Introduction

The problem posed with blind and visually impaired (BVI) swimmers is one of safety and independence. BVI individuals need to be able to orientate themselves in a swimming pool and avoid obstructions like lane-lines, pool walls and other swimmers for a safe experience. Additionally, it is important to BVI swimmers to maintain their independence and maintain a low profile during this experience. The Buoy team will focus on the design, testing and implementation of assistive technology focused on a pool environment with continuous input and feedback from the BVI community. A current passive device created in previous IPROs will be field-tested in a BVI pool for the semester in order to identify failure-modes of the device and collect real-world BVI user feedback to discover areas for improvement. Additionally, two groups have been organized to assess the use of invisible-fence and

ETHICAL ISSUES

- Beneficence:
  - Maximizing benefits for BVI community while minimizing risks
- Non-malfeasance:
  - Quality and safety of the prototypes
- Autonomy:
  - BVI community able to participate
  - Respecting their willingness to participate
- Justice:
  - Price and patent
- Fidelity:
  - The safety of testing environments

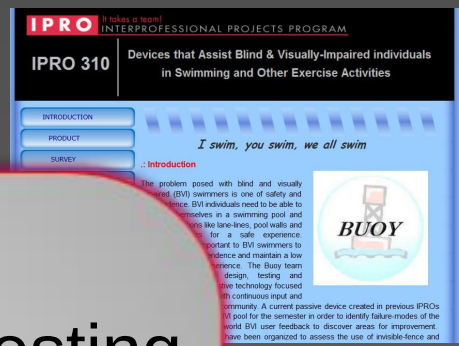
ACCOMPLISHMENTS

- Verified applications of technology in a pool environment
- Documented research, testing, results, & conclusions of each technology in a technical report
  - Help future IPROs understand our process
- Modified, obtained IRB approval, & administered user-needs survey
- Created user and staff passive device surveys and submitted for IRB approval
  - Set up testing and survey administration with WCBVI
  - Working with IIT Legal to comply with WCBVI requirements
- Developed BUOY Website

RECOMMENDATIONS: TECHNOLOGY

- Sonar
  - Question further development due to cost and complexity of the circuitry
- Invisible Fence
  - Modify receiver's alert type
  - Integrate receiver into swim-wear
  - Design position identification
  - Develop working prototype
- Laser
  - Alert user when a beam is interrupted
  - Design position alerts
  - Develop a working prototype

RECOMMENDATIONS: OUTREACH



- Early Chicago Lighthouse visit
- Work with the WCBVI on passive device testing
- Ensure website is accessible to the BVI community
- Post both passive device surveys and the user needs survey on the team website
- Research current assistive technology training
- Continue documentation to ensure continuity of IPRO semesters

Questions?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