IPRO 310 Final Report

Spring 2009

Devices that Assist Blind & Visually-Impaired Individuals in Swimming and Other Exercise Activities

Advisors: Frank Lane, David Gatchell & Ken Schug

1. Abstract

A. 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 low-profile during this experience. The Buoy team focused on the testing of technology to prove or disprove their applications for assistive technology in a pool environment with continuous input and feedback from the BVI community. The team also sought to find a partner to long-term field test a current passive device created in previous IPROs in order to identify failure-modes of the device and collect real-world BVI user feedback to discover areas for improvement. Two major groups were organized to assess the use of invisible-fence and ultrasound technology in the creation of new assistive technology. Surveys and interviews were also conducted with the BVI community to ensure the Buoy team is meeting the needs of the market.

2. Background

A. Sponsors
   I. Chicago Lighthouse for the Blind & Visually-Impaired was found in 1960, its main mission is to serve people who are blind or visually impaired with a broad array of innovative programs designed to assist them in leading richer, more independent lives.
   II. Wisconsin Center for the Blind and Visually Impaired
   III. In collaboration with the electrical engineering design teams at the Rose-Hulman Institute of Technology.

B. Customer: The blind and visually impaired community
   I. According to the U.S. Census Bureau News published in December 2008, there are nearly 7.8 million people age 15 and older who had difficulty seeing words or letters in ordinary newspaper print, including 1.8 million being completely unable to see.
   II. 609,000 children in the United States live with some degree of visual impairment and over 50,000 of them are legally blind.

C. BVI persons unable to exercise on their own safely and independently
   I. Lack of facilities for BVI swimmers
   II. In the past, most of the IPRO groups focused on technology before obtaining feedback from the BVI community. As a result, the devices that had been created were not very

autonomous for the users. The prototypes were often bulky and caused impediments in the swimmers performance.

D. Similar Solutions
    I. EyeSwim passive device modified by previous IPRO semesters from the original device created by Notre Dame University
    II. Some underwater swimming devices that are used by the swimmers: Life Buoyancy Device, Swimming Aid, Sonar Lifeguard and Easy Float.
    III. Devices that can be used underwater but not for swimming purposes; these devices may be adapted to our design: Underwater phone, Underwater iPod and Underwater headphone.
    IV. Devices using either sonar or ultrasound to guide the blind but they cannot be used underwater: Tongue Sensor and Electrode.
    V. Several of the devices stated above are already being sold while the few others are only in the patent phase.

E. Technology
    a. It was determined that assistive technology techniques must be employed in the development of the devices involved in this project. Consumers must be kept in mind or involved in the creation of an assistive device.
    b. Two technologies were suggested from the previous IPRO as potential solutions to the problem of location in pool environments. These technologies are ultrasonic sensors and an invisible fence concept. Ultrasonic sensors are essentially a type of SONAR. It uses a beacon that sends out a pinging source to calculate distance from an object by timing how long it takes the signal to return to the sensor. The invisible fence concept works by creating a boundary with a wire and sending a radio signal through it that can be picked up when a receiver, worn by someone, nears the boundary.

F. History
    a. Passive device showed signs of success by helping swimmers correct their direction if they were off track; however it did so at the cost of requiring a large, bulky device that stands out from conventional methods of swimming.
    b. A vibration belt was attempted. This device was also large and stood out. It did not eliminate the need for an assistant to be outside the pool warning the swimmer when they were nearing walls or lane lines.

c. A snorkel device was created. This stood out in the pool because most swimmers do not use snorkels when swimming laps and the mouthpiece was rather large. Additionally, it required an assistant to be outside the pool giving directions.
d. SONAR was used before as well, however in previous attempts the groups tried to mount the sonar source on the wall instead of on the swimmer. Mounting it on the wall lead to a lot of noise and false signals getting picked up and misleading the swimmer.

G. Ethical Issues
   a. Beneficence
      i. Different BVI swimmers would need different assistance while swimming according to their age and swimming experience.
   b. Non malfeasance (Do not harm)
      i. Quality and safety of the prototypes
   c. Autonomy
      i. The appearance of device
      ii. Self image of the users
   d. Justice
      i. Price
      ii. Patent and copyright
   e. Fidelity
      i. The safety of testing environments

II. Business/Societal Costs
   a. BVI persons unable to exercise on their own safely and independently
   b. Lack of facilities for BVI swimmers

3. Objectives

A. Our mission is to develop, test, and implement assistive technology with the community to promote safety and improve independence of blind and visually impaired (BVI) swimmers.
B. Team Objectives
   I. Test the current passive device created by previous IPRO 310 teams: full semester field-testing to obtain user feedback and identify failure modes.
      a. Partner with the Wisconsin Center for the Blind and Visually Impaired to test the EyeSwim device. Installation has been scheduled for the week of May 17th.
   II. Facilitate active projects for the purpose of creating new assistive technology using current ultrasound, invisible fence and laser technology.

a. Compact: incorporate into swim wear (goggles, suit, cap, MP3).
b. Minimize Price
c. Meet market user-needs

III. Include the BVI community in the design process using surveys, interviews, BVI facility visits, and BVI feedback. Research user markets to maximize consumer benefit and marketability of the devices.
   a. Partner with the Chicago Lighthouse for the Blind and Visually impaired to administer user-needs survey, conduct interviews and research current available assistive technology

IV. Create a cooperative, motivational and innovative team environment using team-building techniques.

4. **Methodology**

A. According to survey data from previous semesters, existing assistive technology does not allow BVI swimmers to swim as independently as they would prefer.
B. The Buoy team researched what devices have already been developed by this IPRO and other organizations and determined a market exists for such devices.
C. The team members were divided into three major development teams geared towards utilizing specific technology in the testing of the applications of these devices in a pool environment.
   I. SONAR technology team
   II. Invisible Fence technology team
   III. Laser beam technology tea,
D. Team members were further broken down into sub teams that focused on IPRO deliverables.
   I. Media team
   II. Research and survey team
   III. Documentation team
E. The team initiated the involvement of the market BVI community through surveys and interviews.
F. The team was diligent about documenting their research and results that will be easy to follow by future IPRO's.
G. The research and survey team was responsible for creating the surveys and respective consent forms for the semester. Additionally, they were responsible for reporting on the results of any surveys administered during the semester. The entire class needed to approve all documents created by the research and survey team and the IRB has final approval authority prior to administration.
H. The Documentation sub-team was responsible for the written deliverables due during the semester. Their rough drafts of the

deliverables were presented to the entire group and a final draft was developed through class feedback.

I. The Media sub-team was responsible for the presentation deliverables due during the semester as well as creating a Buoy website and maintaining the iGroups site. All deliverables were approved by the entire team prior to submission.

	1/19 - 1/25	1/26 - 2/1	2/2 - 2/8	2/9 - 2/15	2/16 - 2/22	2/23 - 4/1	3/2 - 3/8	3/9 - 3/15	3/16 - 3/22	3/23 - 3/29	3/30 - 4/5	4/6 - 4/12	4/13 - 4/19	4/20 - 4/26	4/27 - 5/3	5/4 - 5/11
Defining the problem																
Gathering Research/Surveys/Feedback																
Identifying Possible solutions																
Project plan (Due 2/6)																
Analyzing and selecting																
Designing																
Midterm Presentation (3/2-3/12)																
Testing																
Modifying																
Preparing for IPRO day																
Abstract/Brochure (Due 4/27)																
Poster (Due 4/27)																
Final presentation (Due 4/29)																
IPRO Day (5/1)																
Final report (Due 5/8)																
Deliverables CD (Due 5/11)																

2009 Assistive Device User Needs Survey

IPRO 310 *is an InterProfessional project at the Illinois Institute of Technology aimed at enabling blind and visually impaired individuals to swim safely and independently. The team aims to fill the void in assistive technologies present for blind and visually impaired swimmers by designing, documenting, testing and marketing a prototype.*

General description: *The purpose of this survey is to solicit the needs of blind and visually impaired individuals relative to swimming. A multidisciplinary design team will use the results of this survey in the development of assistive technology*

Skill Level

1. *Do you currently swim?*

   - *If answer YES, how would you describe your skill level out of the following options?*
     a. *Needs assistance*
     b. *needs supervision*
     c. *no supervision required*

   - *Do you mainly swim for exercise (laps) or recreational (fun) purposes?*

- *How often do you swim (per week / per month)?*
- *Where do you normally swim (public or private facility)?*

- *If answer NO:*
  - *Have you ever tried swimming?*
    - *If YES, reason for decline:*
      a. *Other: _____*
      b. *Safety*
      c. *Time*
      d. *No assistance*
      e. *Lost interest*
      f. *Pool availability*
  - *If a device was built to improve the BVI swimming experience by aiding in the navigation of the pool would you be interested?*

Device Characteristics:
If a device was built to improve the BVI swimming experience by aiding in the navigation of the pool…

2. *Device Location:*
   a. *Cap*
   b. *Goggles*
   c. *Swimsuit*
   d. *Wrist bands (both wrists)*
   e. *Other:_____*

3. *Alert Type:*
   a. *Tone*
   b. *Vibration*

4. *Cost: What is the MOST amount of money you would be willing to spend on this type of device?*
   a. *$100+, Max Amount: _____*
   b. *$75-$100*
   c. *$50-$75*
   d. *$25-$50*
   e. *Under $25*

5. *Rank each of the following based on the scale: (not imp, somewhat imp, important, very imp)*
   a. *Device location (not imp, somewhat imp, important, very imp)*
   b. *Cost (not imp, somewhat imp, important, very imp)*
   c. *Alert type: tone/vib (not imp, somewhat imp, important, very imp)*
   d. *Training time (not imp, somewhat imp, important, very imp)*
   e. *Ease of use (not imp, somewhat imp, important, very imp)*

6. *Would you prefer a device that provides you with constant information if you are headed on the right course or a device that only alerts you if you veer off course (approaching a wall or lane line)?*

7. *Can you give me an example of an assistive device you found very helpful? What features did you find most helpful?*

8. *Can you give me an example of an assistive device that you did not find useful? What features made the device unappealing?*

9. *Would you be willing to participate in a test of an assistive swimming device? If so, include contact information*
   a. *Name: _____*
   b. *Phone #: _____*
   c. *Email: _____*
   d. *Would you need transportation?*

Demographic Questions

10. *Age: _____*
    - *(5-11, 12-21, 22-35, 36-64, 65+)*

11. *Gender (Male / Female)*

12. *Level of blindness*

13. *Do you know of any organizations, institutions or individuals that would fund this type of assistive technology?*

2009 Passive Device User Survey

IPRO 310 *is an InterProfessional project at the Illinois Institute of Technology aimed at enabling blind and visually impaired individuals to swim safely and independently. The team aims to fill the void in assistive technologies present for blind and visually impaired swimmers by designing, documenting, testing and marketing a prototype.*

General description: *The purpose of this survey is to solicit feedback regarding a current passive assistive device. A multidisciplinary design team will use the results of this survey in the modification of the current device and the design of potential new devices.*

Demographic questions/ info here

Device Feedback

1. *Did you feel the device helped to keep you centered (Yes/No)?*

2. *Could you feel the difference between the side and the end tappers (Yes/No)?*

3. *Did you feel the end tappers well enough to slow down before reaching the wall (Yes/No)?*

4. *Did you feel the icicles hanging from the side tappers (Yes/No)? If YES, did they inhibit your stroke at all (Yes/No)?*

5. *Would you like the end tappers to be closer or further from the end of the pool?*

5. *If you were redesigning the device, what would you change:*

a. *Side tappers*
b. *End tappers*
c. *Icicles*
d. *Material*
e. *Layout:*
    A. *distance between tappers*
    B. *length of tappers*
    C. *distance across the lane*
    D. *distance from end tapper to end of pool*
f. *Anything else you would change?*

6. *Did any part of the device malfunction?*

7. *What device/techniques do you currently use to help you swim and how does this device compare to those devices/techniques?*

8. *Would you encourage your local pool facility to purchase this device?*

9. *What was your overall impression of the device (1- Impedes swimming, 2 – Does not help but does not impede, 3 - Somewhat helpful, 4 – Fairly helpful, 5 – Very Helpful)?*

Demographic Questions

10. *Age: _____*
    - *(5-11, 12-21, 22-35, 36-64, 65+)*

11. *Gender (Male / Female)*

12. *Level of blindness*

13. *Do you know of any organizations, institutions or individuals that would fund this type of assistive technology?*

2009 Passive Device Staff Survey

IPRO 310 *is an InterProfessional project at the Illinois Institute of Technology aimed at enabling blind and visually impaired individuals to swim safely and independently. The team aims to fill the void in assistive technologies present for blind and visually impaired swimmers by designing, documenting, testing and marketing a prototype.*

General description: *The purpose of this survey is to solicit feedback regarding the current passive assistive device from the staff who regularly maintains the device. A multidisciplinary design team will use the results of this survey in the modification of the current device and the design of potential new devices.*

Device Feedback

4. *What was the average time it took to install the device in the pool?*

5. *What was the average time it took to remove and store the device?*

6. *How would you rate the ease of installation (1- Very difficult, 2 – Fairly difficult, 3 – Moderate, 4 – Fairly easy, 5 – Very easy)?*

7. *How would you rate the ease of removal and storage (1- Very difficult, 2 – Fairly difficult, 3 – Moderate, 4 – Fairly easy, 5 – Very easy)?*

8. *Did the device fail or break? If so, how?*

    a. *During what activity did the device fail:*
        i. *General pool/swim use*
        ii. *Installation*
        iii. *Removal*
        iv. *Storage*

    b. *Approximately how many times per week did the device fail/break?*

10. *Did the storage unit fail or break? If so, how?*

    a. *How many times per week did the device fail/break?*

11. *How would you rate the storage unit (1 - Very poor, 2 – Poor, 3 – Moderate, 4 – good, 5 – Very good)?*

12. *How would you rate the instruction manual provided with the device (1 - Very poor, 2 – Poor, 3 – Moderate, 4 – Good, 5 – Very good)?*

13. *How would you rate the repair manual provided with the device (1 - Very poor, 2 – Poor, 3 – Moderate, 4 – Good, 5 – Very good)?*

14. *How would you rate the difficulty of repairing the device/storage unit (1- Very difficult, 2 – Fairly difficult, 3 – Moderate, 4 – Fairly easy, 5 – Very easy)?*

15. *How would you rate the ease of finding replacement parts (1- Very difficult, 2 – Fairly difficult, 3 – Moderate, 4 – Fairly easy, 5 – Very easy)?*

16. *Would you be interested in purchasing a device like this for your facility (Yes/No)?*
    a. *If yes, what would you be willing to pay for such a device (Under $100, $100 - $200, $300+)?*

17. *Did you receive any positive or negative feedback from the users (Yes/No)?*
    a. *If yes, what was the feedback?*

18. *What was your overall satisfaction with the device (1 - Not satisfied, 2 - Somewhat satisfied, 3 - Moderately satisfied, 4 - Fairly satisfied, 5 – Very satisfied)?*

19. *Please list any additional comments you think may help:*

5. Team Structure and Assignments

A. Faculty Roster

Faculty	Email	Specialization
Frank Lane	lane@iit.edu	Rehabilitation Psychology
David Gatchell	dgatchel@iit.edu	Biomedical Engineering
Dr. Ken Schug	kschug@msn.com	Biology, Chemistry, Physics

B. Team Member Roster

Team Member	Email	Major, Year	Skills/Strengths
Coleman Baar	cbaar@iit.edu	ME, 3rd Year	Experience with the physically and mentally disabled Computer Proficiency (Word, Excel, Basic C++, and Basic AutoCAD, Basic MATlab) Political Background
Ryan Freund	rfreund@iit.edu	CE, 4th Year	Proficient in Mathcad, Sap2000, Excel, Autocad. Experience with elderly disabled.

Kevin Kruse	kkruse1@iit.edu	BME, 3rd Year	Extensive use of Microsoft Word, Excel, and PowerPoint Programming in C++, HTML, PHP, MYSQL, Actionscript 3, XML Some Spanish speaking and writing skills
Li Li	lli43@iit.edu	EE, 4th Year	Spectrum Analyzer (including device programming), HP Power meter (including device programming), USRP (GNU Radio Interface), C6713 DSK DSP chip (Including CCK interface). FPGA (Including VHDL coding) Operating Systems: Windows, Linux; Programming: C/C++, Python, GNU Octave, MATLAB coding; Applications: MATLAB Simulink, Maple, AutoCAD, Microsoft Office, PSpice, Power World, Omnipeek
Zhi Ma	zma10@iit.edu	EE, 4th Year	Word, Excel, PowerPoint, programming(JAVA,C),Signal Analyse,MATLAB,PSpice
Meghan Murdock-Barriball	mmurdock@iit.edu	ME, 4th Year	Nine years of professional administrative experience Lean Six Sigma Yellow Belt certified, Green Belt classroom training completed, currently working on Green Belt certification project Proficient in Microsoft Office applications
Man Ng	mng6@iit.edu	BA, 3rd Year	MS Word, Excel, PowerPoint, Outlook, Quicken, Fluent Mandarin and Chinese
Mohammed Rehman	rehmmoh@iit.edu	ECE, 3rd Year	Programming Skills: Java, C, Linux, Visual Basic, Assembly Language, VHDL, HTML Web Skills: Internet Explorer Software: MS Word, Spreadsheet, Power point, Windows XP. Hardware: Can troubleshoot, install, upgrade, and maintain PC hardware PSPICE, MATLAB, Power World Software, SUE, Circuit

			design and implementation. Languages: English, Urdu and Punjabi
Jeffrey Reilly	jreilly2@iit.edu	PHYS, 4th Year	Excellent leadership and communications skills. Ability to identify and solve problems. Computer competency with proficiency in Microsoft Office Suite and Computer Programming (Language C++). Certifications in CPR and First Aid.
Lorne Turrentine	turrlor@iit.edu	ME, 4th Year	Unigraphics, Solid Works, Basic MATlab, AutoCAD, C++, Maple, MS Office (Word, Excel, Microsoft PowerPoint)
Hsuen Yew	hyew@iit.edu	BME, 4th Year	Molecular Bio lab, Programming, Medical research Instrumentation, product design & prototyping, personal finance, marketing, multi language communication.
Bingjian Zhang	bzhang15@iit.edu	EE, 4th Year	Simulation tools: P-SPICE, Matlab Operating Systems: Windows XP, Linux Programming Languages: C, JAVA Applications: Commview for WiFi, OmniPeek, Spectrum Analyzer, USRP, Oscilloscope.

C. Major teams
   I Active Team 1: Invisible fence technology
      a. Coleman Baar (ME) TEAM LEAD
      b. Kevin Kruse (BME)
      c. Li Li (EE)
      d. Maggie Ng (BA)
      e. Zhi Ma (EE)
      f. Ryan Freund (CE)
   II Active Team 1 Contributions
      a. Performed multiple pool tests to determine invisible fence functionality inside and out of water.

b. Proved invisible fence technology is capable of creating boundaries and alerting a receiver when approaching boundaries.

III Active Team 2: Ultrasound technology
a. Meghan Murdock (ME) TEAM LEAD
b. Lorne Turrentine (ME)
c. Hsuen Yew (BME)
d. Bingjian Zhang (EE)
e. Jeff Reilly (Physics)
f. Mohammed Rehman (ECE)

IV Active Team 2 Contributions
a. Performed mutiple pool tests to determine sonar functionality inside and out of water.
b. Determined the parking sonar purchased was not functional under water as the frequency of it's signal was not strong enough to penetrate the water instead the water was detected as an object.
c. Researched circuitry for a new device built from scratch.
d. Recommended that further investment into sonar technology be suspended due to the complexity of the circuitry and the price of the underwater transducer unless more subject matter experts could be recruited or more funding supplied.

F. Minor Teams
I Media Team
a. Li Li (Active 1) TEAM LEAD
b. Bingjian Zhang (Active 2)
c. Mohammed Rehman (Active 2)
d. Zhi Ma (Active 1)

II Media Team Contributions
a. Website
b. Brochure/Abstract
c. Poster
d. PPT Presentations
e. Deliverables CD
f. iGroups
g. Informal group pictures

III Research/Survey Team
F. Maggie Ng (Active 1) TEAM LEAD
G. Meghan Murdock (Active 2)
H. Maggie Ng (Active 1)
I. Hsuen Yew (Active 2)
J. Kevin Kruse (Active 1)

IV Research/Survey Team Contributions

a. A user-needs survey was modified from a previous semester and a consent form for the survey was created and both were approved by the IRB.
b. The survey was administered at the Chicago Lighthouse for the Blind and the results were tabulated and reported.
c. The Buoy team partnered with the Wisconsin Center for the Blind and Visually Impaired (WCBVI) to field test the passive device and a drop off date for the passive device at the school is scheduled for the week of May 17th.
d. Two surveys were created for the passive device field testing: one for the device user and one for the device maintenance staff. The surveys as well as their respective consent forms are awaiting IRB approval.
e. The WCBVI has agreed to administer the surveys.

V Documentation Team
a. Jeff Reilly (Active 2) TEAM LEAD
b. Coleman Baar (Active 1)
c. Lorne Turrentine (Active 2)
d. Ryan Freund (Active 1)

VI Documentation Team Contributions
a. Midterm/Final report
b. Agendas
c. Meeting minutes
d. Budget Management
e. Timesheets
f. Device pictures
g. Weekly status reports

VII The major teams were organized based on member skills and field of expertise to ensure equal distribution of talent. The minor teams were organized to include two members from each major team to ensure that both major teams have equal influence over the minor team's respective responsibilities and deliverables.

G. Designation of Roles
G. BUOY Overall Team Leader: Lorne Turrentine
H. Master Schedule Maker: Lorne Turrentine
I. Weekly Timesheet Collector/Summarizer: Documentation Team
J. Minute Taker: Documentation Team
K. iGroups Facilitator: Media Team
L. Website Creator and Facilitator: Media Team
M. Agenda Maker: Documentation Team
N. Timekeeper: Coleman Baar

H. An additional major team was create mid-way through the semester to account for a new technology. Jeff Reilly and Kevin Krause led the Laser Team to test the applications of laser beam technology to set boundaries in a pool environment. Multiple other team members

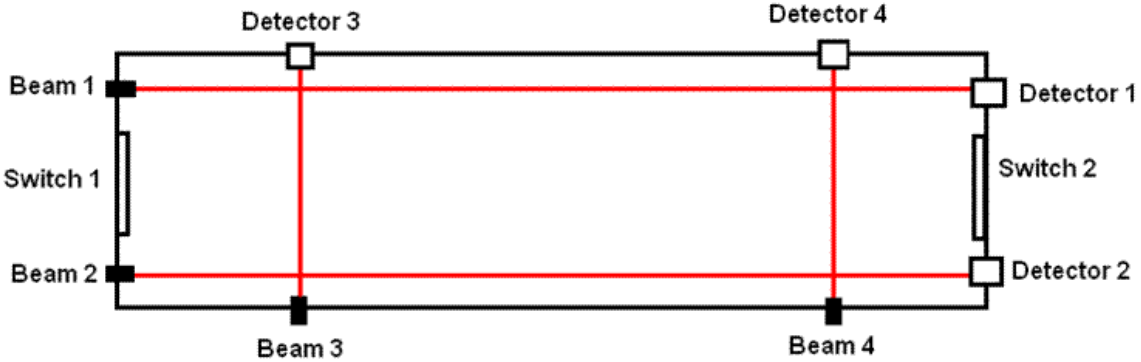
volunteered during the semester to help with the laser research and testing. The contributions of the Laser Team included the testing and determination that laser beam technology is successful at creating boundaries in a water environment.

6. Budget

Category	Requested	Approved	Explanation	Status
Supplies	$50 2/6/09	Awaiting	Wires, building materials, solder, and other miscellaneous items for modifying equipment	Pending
Equipment	$280 2/6/09	Awaiting	$130 Ultrasound Parking sensors from Autosonar. $150 Invisible Fence Technology.	Pending
Services	$25 2/6/09	Awaiting	Printing etc.	Pending
Travel	$100 2/6/09	Awaiting	Trips to stores for equipment and facilities to administer surveys and interviews. Potential coverage for trip to drop off passive device for field testing.	Pending
Participant Support	$25 2/6/09	Awaiting	Used for pool test participants if needed.	Pending
Team Building	$100 2/6/09	Awaiting	Used for team building exercises to be determined	Pending
TOTAL	**$580**	**$0**		

7. Results

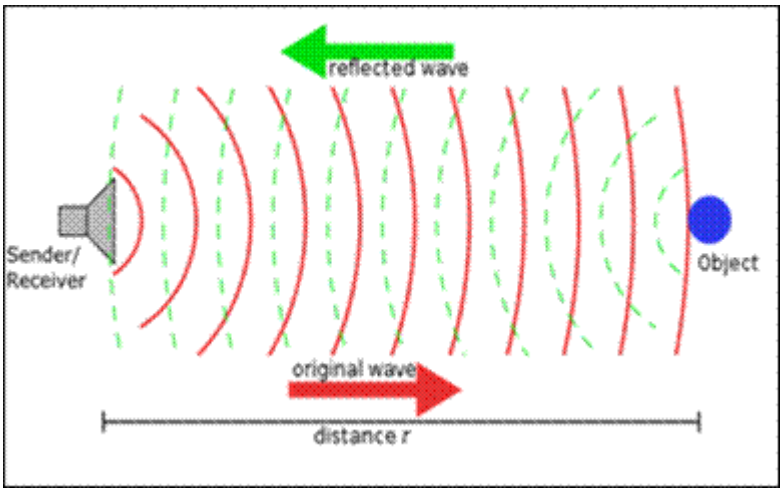
A. Laser beam Technology Description: Create a boundary using laser alarms to alert the user when they are out of the specified boundary.



I. Testing: Determine the feasibility of using a laser system through waterproofing and pool testing.

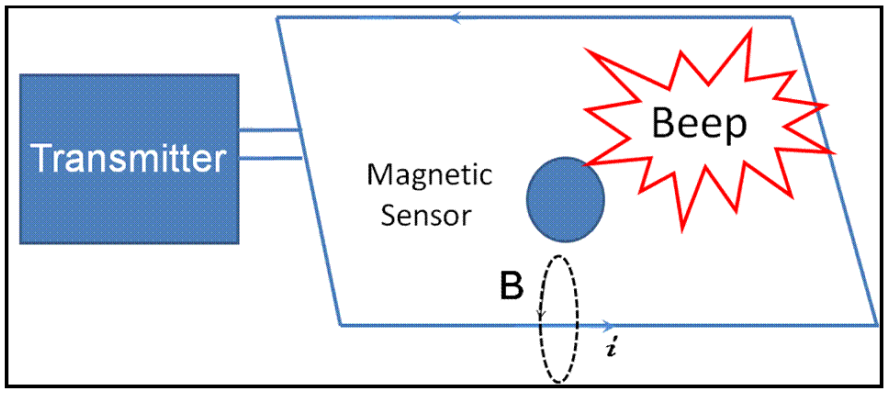
II. Results: The system setup is operational Waterproofing was proved out through a submergence test

B. SONAR Technology Description: Sonar reflects sound waves off obstacles to determine the distance between the device and the obstacle.



I. Testing: Determine the detection zone; consisting of the angle of detection and the distance of detection.
II. Results: Each transmitter/receiver's detection zone had a distance of 4.5 feet and an angle of detection of 10 degrees. Testing underwater showed the water itself reflected the device's propagated waves and was interpreted as an obstacle by the device.

C. Invisible Fence Technology Description: Use electric fence technology to create a perimeter for a BVI swimmer to detect a boundary in a pool. When the magnetic sensor approaches a certain distance from the wire, it gives off an alarm.

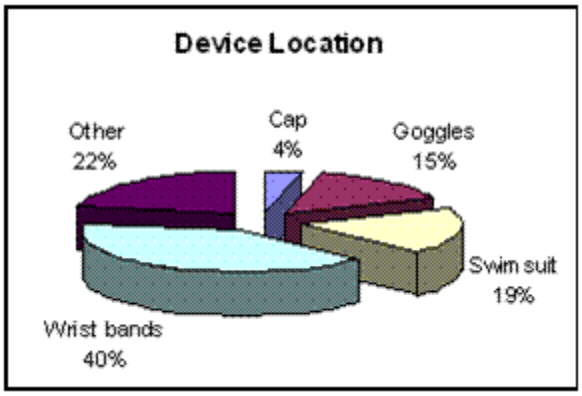


I. Testing: Determine the functionality of invisible fence technology in pool applications Examine the air to water interactions of the transmitter and receiver Test the technology in various potential device setups
   a. Above lane lines
   b. Below lane lines
   c. Through flag lines
   d. General perimeter

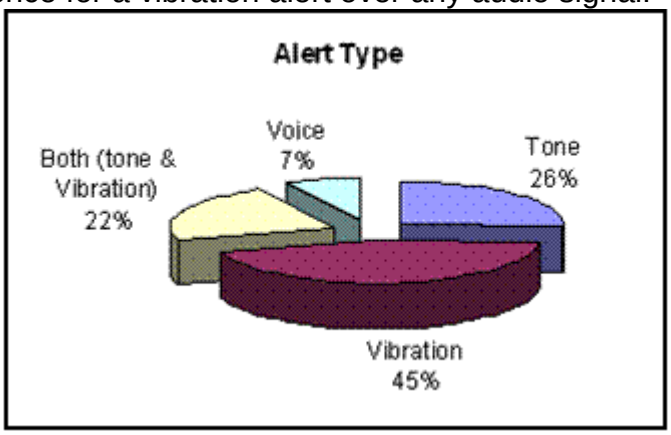
II. Results: Pool tests showed that the detection distance between the receiver did not change when the receiver, the wire, or both were underwater or in air. Looping the wire in the same direction with the current significantly increased detection distance. Looping the wire in the opposite direction with the current canceled out the signal.

D. Survey/Research Results: Long term testing of the passive device is scheduled with the Wisconsin Center For the Blind and Visually Impaired. User surveys for the passive device for both swimmers and staff members have been written and approved by the IRB and will be administered by the Wisconsin Center during testing in the Summer 2009 term.

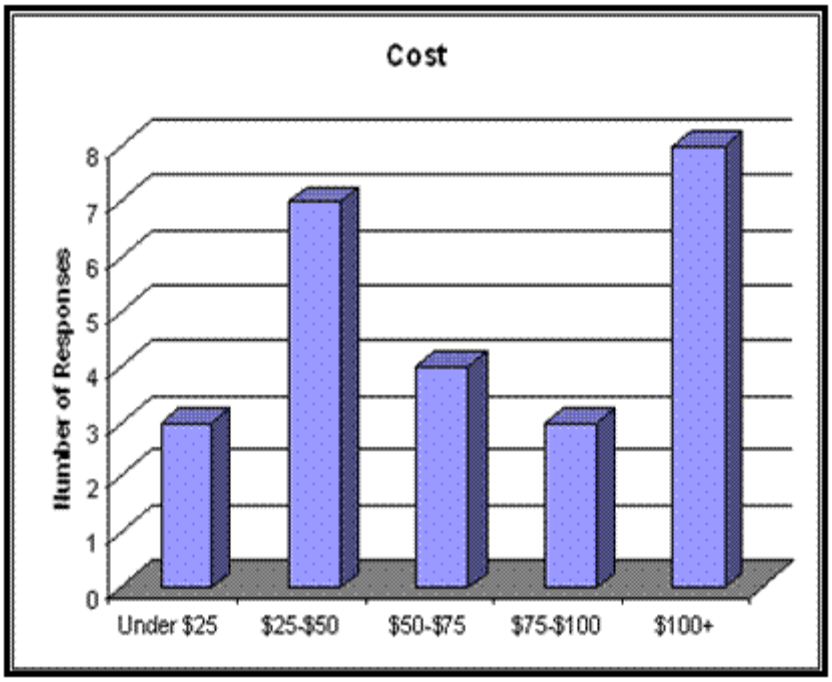
I. The majority of BVI individuals surveyed preferred a low-profile wristband device.



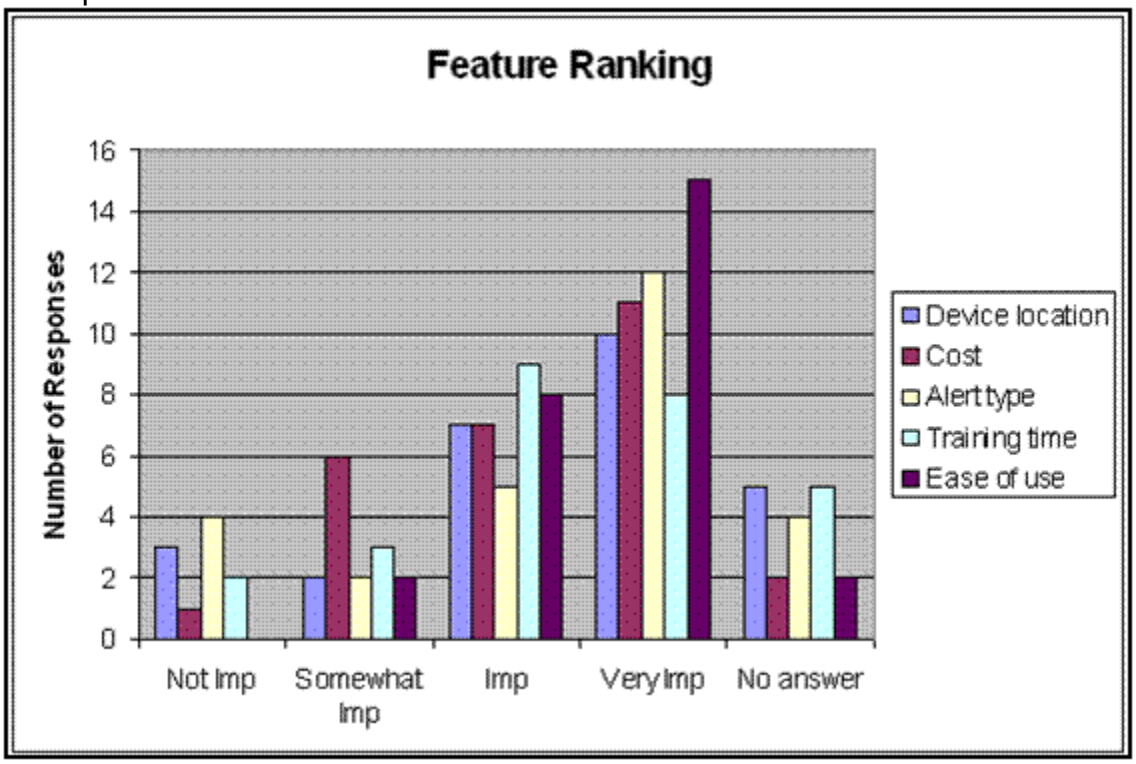
II. Almost one half of the responses received indicated a preference for a vibration alert over any audio signal.



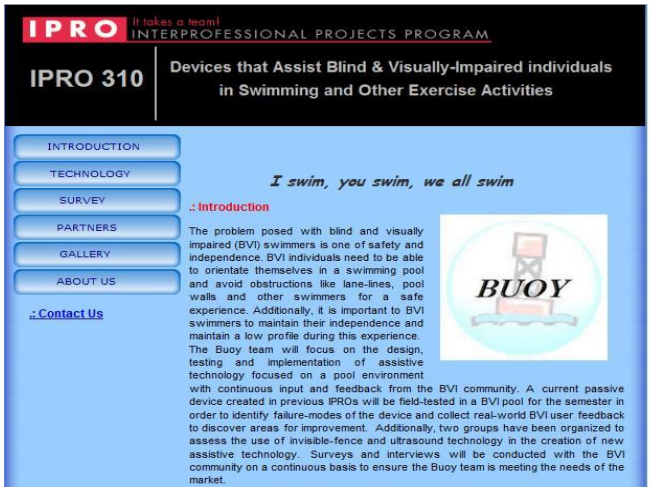
III. The two most popular price ranges were $25-$50 and $100+, reasons for the high price choice may include the opportunity for financial assistance.

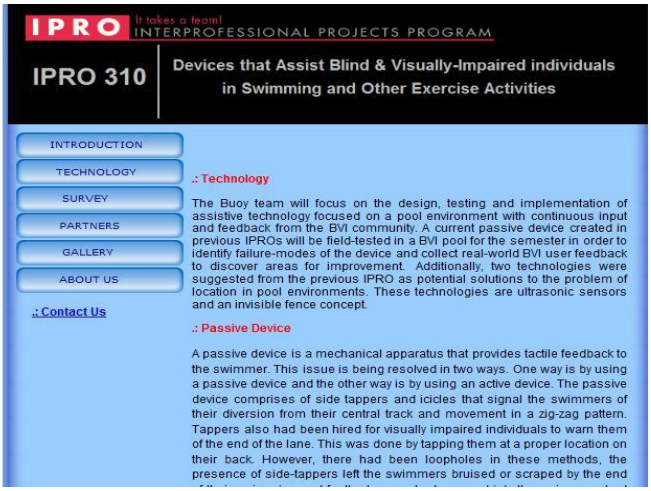


IV. All device features were ranked as very important in the design, but ease of use and alert type were ranked as the most important of all the features



E. Buoy Web Page
   I. http://www.iit.edu/~ipro310s09
   II. The website is intended to network with the BVI community; allowing for the outreach and receipt of ideas and progress. The user needs survey as well as the passive device surveys will be more assessable to a larger community, increasing their amount of influence and feedback.
   III. Topics involved in the web page:
      a. Introduction: Description of the overall background of this project. Team construction history detail mission.
      b. Technology: Introduction to the existing product, exploring potential technologies can be applied to our products.
      c. Survey: Results of surveys taken by the previous and current IPRO team, online survey is also provided in this section.
      d. Partners: Collaborator of the team.
      e. About us: Group personnel introduction.





9. Obstacles

A. Challenges with the Passive Device testing at the WCBVI:
   I. Agreement needed between the school and IIT regarding:
      a. Liability of WCBVI if the device is damaged while in their control
      b. Potential for injury during a device malfunction
      c. IIT Legal has been contacted
   II. Requests from WCBVI
      a. Copy of release forms\parental consent forms
      b. Descriptions of previous testing of the device

c. Approval by Wisconsin Dept of Public Instruction Legal and Wisconsin Dept of Administration

10. Future Applications and Recommendations

A. Laser Future Application:
   I. Create a system for alerting the user when a beam is interrupted
   II. Design end switches to change left and right lane alert signals
   III. Build supports to hold the laser beams and detectors

B. SONAR Future Applications:
   I. Need a transducer made for underwater use, so that propagated waves penetrate the water.
   II. Question further development due to cost and complexity

C. Invisible Fence Future Applications:
   I. Design a method of alerting user to the difference between left lane, right lane, and end of the pool.
   II. Incorporate the receiver into swim wear to maintain a low profile.
   III. Waterproof the receiver and the transmitter.
   IV. Develop a working prototype.
   V. Test cue conflict theory and it's effect on disorientation.
   VI. Involve faculty experts in the testing of communication and application

D. Overall Technology Conclusions: Because of the price and difficulty in modifying the sonar device, our team decided to focus more heavily on the invisible fence and laser alarm system which both show promising applications. By studying and documenting the applications of each of these technologies, we are providing a path for future IPROs to develop the technologies further. Through continued research and development, we hope to incorporate one or more of these technologies into a safe and reliable prototype.

E. Sub-team Conclusions: The major accomplishments of our semester was our outreach to the BVI community through visits to the Chicago Lighthouse, the creation, modification and IRB approval of multiple surveys and consent forms, and the design and production of a functional website. Additionally, the documentation of our progress for future IPRO's has dramatically improved over previous semesters.

F. Sub-teams Next Steps:
   I. Maintain involvement with the BVI community
   II. Ensure website is accessible to entire BVI community
   III. Load both passive device surveys and user needs survey on website
   IV. Promote documentation for future IPRO teams to ensure continuity

11. References

A. All links are uploaded to the bookmarks section of iGroups.

12. Acknowledgements

A. Contact List

I. The Chicago Lighthouse for the Blind and Visually Impaired
1850 West Roosevelt Road
Chicago, Il 60608-1298
Tel: (312) 666-1331
Fax: (312) 243-8539
www.thechicagolighthouse.org

II. Wisconsin Center For Blind and Visually Impaired
Dan Wenzel, Center director
1700 W. State St. JanesVille, WI 53546
Tel: 608-758-6100
www.wcbvi.k12.us

III. Illinois School for the Visually Impaired
658 East State St.
Jacksonville IL 62650
Tel: 1-800-919-5617
Fax: 217-479-4479
www.isvi.net

IV. Indiana School for the Blind and Visually Impaired
7725 North College Ave.
Indianapolis Indiana 46240
Tel: 317-253-1481
Fax: 317-251-6511
http://intra.isbrockets.org/public/

V. Rose-Hulman Institute of Technology ECE department
Tel: 812-877-8228
http://ece-1.rose-hulman.edu/ece/