IPRO 310 Project Plan

Spring 2009

BUOY

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

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 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 ultrasound technology in the creation of new assistive technology. Surveys and interviews will be conducted with the BVI community on a continuous basis to ensure the Buoy team is meeting the needs of the market.

2. Team Information

A. Faculty Roster

LeadFaculty	Email	Specialization
Frank Lane	lane@iit.edu	Rehabilitation Psychology
Co-Instructors	**Email**	**Specialization**
David Gatchell	dgatchel@iit.edu	Biomedical Engineering
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, 3rd 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. Team Identity

   I. Name: Buoy

   II. Logo:

   III. Motto: "I swim, you swim, we all swim"

3. Team Purpose and 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.

   II. Facilitate two active projects for the purpose of creating new assistive technology using current ultrasound and invisible fence technology.

     a. Incorporate into swim wear (goggles, suit, cap, MP3).

   III. Include the BVI community in the design process using surveys, interviews, BVI facility visits, and BVI feedback.

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

V. Research user markets to maximize consumer benefit and marketability of the assistive devices.

4. Background

A. Collaborators

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 School for the Blind

III. In collaboration with the electrical engineering design teams at the Rose-Hulman Institute of Technology.

B. Customer: The blind and visually impaired community

The size of the market for this type of assistive technology in America can be estimated by looking at the breakdown of the number of BVI Americans. This is shown below.

I. 1.1 million: Estimated number of legally blind Americans

II. 54,000: Younger than 19 and blind

III. 370,000: Older than 85 and blind

IV. 121,000: People who are completely blind

V. 110,000: Blind people able to distinguish only between light and dark 609,000 children in the United States live with some degree of visual impairment and over 50,000 of them are legally blind.

C. User Problem

I. 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 did not facilitate autonomy of the user. The prototypes were often bulky and created an impediment to the swimmers performance.

D. Technology

I. The independent living philosophy 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.

II. 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. A signal generator sends a radio signal through the wire that can be picked up when a receiver, worn by someone, nears the boundary.

E. History

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I. The 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.

II. 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.

III. 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.

IV. 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.

V. Devices I, II, and III failed to achieve independence of the swimmer due to the need of an assistant. IV failed by not correctly "mapping" the environment.

F. Ethical Issues

I. Beneficence: the action that is done for the benefit of others. Beneficent actions can be taken to help prevent or remove harms or to simply improve the situation of others.

a. The main purpose of Team Buoy is to benefit the BVI community.

II. Non-malfeasance: to "do no harm." Refrain from providing ineffective treatments or acting with malice toward subjects. The pertinent ethical issue is whether the benefits outweigh the risks.

a. Quality, safety, and independence of the prototypes

III. Autonomy: the "personal rule of the self that is free from both controlling interferences by others and from personal limitations that prevent meaningful choice." Autonomy is used to help individuals act intentionally, with understanding, and without controlling influences.

a. The appearance of device

b. Self image of the users

c. Providing the swimmer with a choice

d. Increasing independence, while decreasing dependence on other people

IV. Justice: the quality of being fair and reasonable

a. Price

b. Patent and copyright

c. Overall availability of the device to the BVI community

V. Fidelity: faithfulness to a person, cause, or belief, demonstrated by continuing loyalty and faith.

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      a. The safety of testing environments

      b. Staying involved with the BVI community

G. Business/Societal Costs

    I. BVI persons unable to exercise on their own safely and independently

    II. Lack of accessible pools for BVI swimmers

H. Practical Solutions

    I. The passive device will be finalized and sent to one of our sponsor for research and survey purposes.

    II. Our team will arrange to visit The Chicago Light House and conduct surveys and interviews with BVI individuals.

    III. Two active device teams created: Invisible Fence and Ultrasound device.

I. Similar Solutions

    I. Some underwater swimming devices that are used by the swimmers: Life Buoyancy Device, Swimming Aid, Sonar Lifeguard and Easy Float.

    II. 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.

    III. Devices using either sonar or ultrasound to guide the blind but they cannot be used underwater: Tongue Sensor and Electrode.

    IV. Several of the devices stated above are already being sold while the few others are only in the patent phase.

5. Team Values Statement

Behavior	How to address?
Punctuality and absences	Publish attendance chart for peer reviews.
Conflict resolution	Team leader encourages antagonists to discuss the problem face to face.
	If the problem is related to the direction of the IPRO and the F2F method fails, the issue will be brought up during a class session and open for discussion. A vote (majority rule) is then taken for a final decision. The vote ensures that the issue is closed and the teams can move forward with their work. We want to ensure that conflict/issues to not impede the progress of the IPRO.
	If the problem is of a personal nature and the F2F method fails, the class advisors will be consulted.
Communication	Break the ice by conducting team building activities and encourage team members to express ideas and suggestions.
	Host regular meetings to promote open dialogue and team members to share their findings or problems directly.
	Team members can share documents on iGroups and iGroups contains members contact information.
Motivation	Team building to improve team spirit.
Fair Distribution of work	Two active teams and three sub-teams.
	Leaders of each active and sub-team ensure members have fair workload.
	Volunteers for non-categorized work.
Documentation	One member of Documentation Team in charge of meeting minutes in each class and upload to iGroup.
	Agendas are discussed with professor before class to ensure our work is on track.
	Documentation team ensures group in on-track with deliverables.
	Timesheets record each member's time contribution in this project.
	iGroup houses all documentation ensuring organization and visibility to entire team.

6. Methodology

A. Existing assistive technology does not allow BVI swimmers to swim as independently as they would like according to survey data from previous semesters.

B. Our team will:

   I. Conduct long-term testing of the passive device by this IPRO and other organizations, to address this issue and determine whether a market exists for such devices. We then intend to work with the Blind and Visually Impaired community to develop prototype devices for further testing.

   II. Team members will be divided into two development teams geared towards utilizing specific technology in the development of a prototype device. Team members will be further broken down into sub teams that will focus on such tasks as: media, research/surveys, and documentation.

   III. It is reasonable to expect that by the end of the semester we will have researched and tested existing devices. We will have made contact with the BVI community. We will have a design and testing results for a prototype. We will also have detailed documentation that will be easy to follow by future IPRO's.

C. Potential solutions will be tested by the sub teams and the volunteering participants

   I. There will be three phases of testing:

      a. Phase one will consist of only Buoy members

      b. Phase two will consist of Buoy members and BVI swimmers

      c. Phase three will consist primarily of BVI swimmers and a few control tests with Sighted swimmers

   II. Tasks include: acquisition of facilities and participants, user-feedback and ensuring complete safety of all involved. Subtasks will include acquiring external testing locations and identifying all legal and financial issues with testing locations and participants.

D. Results of research and testing will be documented as follows:

   I. The Research/Survey sub-team will work to develop an appropriate sample of testing methods, surveys and interviewing processes. Upon approval of the entire team, the Research/Survey Team will administer the testing methods and the surveys.

   II. They will also be responsible for creating reports summarizing the findings.

   III. Prior to the Research/Survey Team presentation of results, the results will be provided first by the Active Team responsible for the creation of the device. This is to give the opportunity to the active team to brainstorm solutions to identify issues and to prepare the active team for future questions posed by the entire class.

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IV. The reports will then be presented to the class as a whole by the Research/Survey team. The Documentation Team will be responsible for recording minutes during these presentations and posting all relevant documents to the team website and iGroups.

V. The primary purpose of analysis is measuring and recording the results. These results will then be broken down for the entire team. Possible criterion include: comfort, ease of use, potential price and appearance.

E. The Documentation sub-team will be responsible for the written deliverables due during the semester. Their rough drafts of the deliverables will be presented to the entire group and a final draft will be developed through class feedback.

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

G. Contact List

   I. The Chicago Lighthouse
      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/

7. Expected Results

    A. We plan on interacting with the BVI community at the Chicago Lighthouse.

    B. Research and testing of the previous passive device will be conducted at a local facility that will allow testing.

    C. Team Building exercises will be conducted throughout the semester.

    D. We expect to gather data on functionality, ease of use, comfort and discreteness.

    E. We intend to explore two active devices, utilizing ultrasound technology and an invisible fence system; as well as, prolonged testing of a modified lane line system.

    F. Our potential outputs are developing competent assistive devices meant to aid BVI swimmers, furthering research on such devices and increased awareness in this field.

        I. Multiple working prototypes

        II. Survey compiled data

        III. Establish working relationships with BVI organizations for future semesters

    G. We will need to focus on creating devices that appeal to and increase independence for the BVI community while maintaining a safe testing environment and keeping technology affordable. Additionally, it will be important to filter out false positive feedback.

    H. Buoy will document and incorporate all results into a final proposal, with all results being based on extensive research and testing in coalition with the BVI community.

8. Project Budget

Category	Requested	Approved	Explanation	Status
Supplies	$100 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**		

9. Schedule of Tasks and Milestone Events

A. Tasks and events calendar

	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)																█

B. Master team schedule

    I. See iGroups for original file.

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10. **Individual Team Member Assignments**

   A. BUOY Overall Team Leader: Lorne Turrentine

   B. 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 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)

   C. Minor Teams

      I. Media Team

         a. Li Li (EE) TEAM LEAD

         b. Bingjian Zhang (EE)

         c. Mohammed Rehman (ECE)

         d. Zhi Ma (EE)

      II. Media Team Responsibilities

         a. Website

         b. Brochure/Abstract

         c. Poster

         d. PPT Presentations

         e. Deliverables CD

         f. iGroups

         g. Informal group pictures

III. Research/Survey Team

   a. Maggie Ng (BA) TEAM LEAD

   b. Meghan Murdock (ME)

   c. Maggie Ng (BA)

   d. Hsuen Yew (BME)

   e. Kevin Kruse (BME)

IV. Research/Survey Team Responsibilities

   a. Survey creation, administration, and results reporting (including graphics)

   b. All passive device field-testing responsibilities including maintenance of the device, failure-mode, survey and user-feedback reporting

   c. Community coordination

   d. Passive device testing pictures

V. Documentation Team

   a. Jeff Reilly (Physics) TEAM LEAD

   b. Coleman Baar (ME)

   c. Lorne Turrentine (ME)

   d. Ryan Freund (CE)

VI. Documentation Team Responsibilities

   a. Midterm/Final report

   b. Agendas

   c. Meeting minutes

   d. Budget Management

   e. Timesheets

   f. Engineering notebook

   g. Device pictures

   h. Weekly status reports

D. The major teams are organized based on member skills and field of expertise to ensure equal distribution of talent. The minor teams are 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.

11. Designation of Roles

     I.   Master Schedule Maker: Lorne Turrentine

    II.   Weekly Timesheet Collector/Summarizer: Documentation Team

  III.   Minute Taker: Documentation Team

  IV.   iGroups Facilitator: Media Team

   V.   Website Creator and Facilitator: Media Team

  VI.   Agenda Maker: Documentation Team

 VII.   Timekeeper: Coleman Baar

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