

I PRO 310: Swimming Aid for Visually Impaired Swimmers

Research Subteam Final Report

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Background Info

There are at least 10 million blind and visually impaired people in the U.S. alone. Of those 10 million, there are at least 1.3 million who are legally blind. Individuals that do swim are faced with many challenges in addition to those that come with learning a sport. One major problem that the blind and visually impaired face is the danger of hitting the edge-wall of the pool while they are swimming, which could cause serious injury or even death. Another problem they face is the inability to swim in a straight line. This could force the swimmer to lose valuable time during competitions or impede in their workout when swimming recreationally.

To solve the issue of wall collision, the blind and visually impaired swimmers are 'tapped' by tappers. The tappers hold a long stick, with the end covered in a soft, spongy material. The tappers tap the swimmers on their shoulder or head to inform them that they are approaching the wall. This solution is effective, but it does have its drawbacks. Two tappers are needed for every blind and visually impaired swimmer, making it a challenge to secure the necessary number of tappers for when they are needed. Another concern of the solution is its cost; it is expensive to have tappers there the entire time the swimmers are swimming. Not to mention that it takes time to train people how to tap in the proper location, which differs based on the swimmer.

The biggest constraint that the research sub-team came in contact with was access to blind or visually impaired swimmers. It was difficult finding blind and/or visually impaired individuals, who currently swim or used to swim, so that we could interview them. The same can be said for the swimming coaches. As it is the summer semester many of these individuals of interest had prior engagements.

Purpose

Our sub-team was given the task of gathering information so that we could better understand the issues that blind and visually impaired swimmers face as well as gathering design criteria for the prototypes. We did this by interviewing blind and visually impaired swimmers, as well as their coaches. We wanted to understand the necessary functionality of a device that would eliminate the need for tappers. Using interviews, we aimed to better identify the swimming aid design parameters that would impact a swimmer's usage and experience; such as device dimensions, preferred location of the device on the body and device interface. We seek to identify a price point that the customers would be willing to pay.

Additionally, we will try to better understand how blind and visually impaired swimmers were introduced to swimming in the first place. This understanding may help identify a temporal opportunity for introducing our planned swimming aid. Understanding the challenges our swimmers face when they first entered the sport may influence our swimming aid design so as to facilitate entry in to the sport.

Methodology

At the start of the semester we were instructed by our advisor Dr. Ferguson to review all of the data collected from the Spring '07 IPRO 358, the predecessor to our IPRO. There were a couple interviews on igroups with: Ray Campbell, Tim Spencer, Walter "Wally" and Jennifer and Kristal. A couple of these interviews had some useful information but many of them were transcribed in a strange format with very little useful information to be gathered from. There was no information about these interview subjects, except for a brief description in the project plan. The problem with the description in the project plan is that no name was listed so we had to match their description to their interviews as best we could to get a better understanding of who the interviewee was.

We wanted to make sure this did not happen again so we recorded each interview and had a complete transcription of the whole interview.

Our sub-team principally focused on primary research, specifically interviews, to gather our data. We have conducted 8 interviews. Each interview was conducted with two or more interviewers and, for the most part, one interview subject at any one session. The questions that were asked in the interview were carefully designed by our sub-team to gather answers related to what we needed to learn from the individual being interviewed. Each interview was audio recorded, and then transcribed later in the week for a more careful final analysis. The signed consent of each interview subject was obtained before the beginning of each interview. In those interviews that were conducted with a blind or visually impaired individual, the consent form was read aloud to the interview subject and the consent form was counter-signed by a witness to the reading. These interview transcripts and consent forms can be found in the *Summer Interviews* section of our engineering notebook.

Thank you cards were sent out to everyone that helped us this semester. For Lori and James who are completely blind some thank you cards in Braille were purchased from tactile vision and will be sent to them once received. The tactile vision website where the card is purchased can be found in Appendix IV of this report.

Engineering Notebook

An engineering notebook was also created as a resource for the Fall '07, who will continue on our project. This folder contains any and all information that we used and/or gathered throughout the semester such as information on the institutions for the blind, interview questions and interview transcriptions etc.

John Komer and his Swimming Pool Lane Marker

Along with a review of the spring semester data we also conducted some research on the different blind institutions and any information we could find on the challenges that blind swimmers face. In this data search we came across a post on the American Foundation for the Blind website, from an engineer in Ohio who had created and patented a lane marker prototype using bubbles. We decided not to follow the pathway of making a prototype using bubbles but we did keep in touch with the engineer, John Komer. All of

the email correspondence between him and us can be found in our subteam's engineering notebook, in the *Contact Info* section, along with his internet post and prototype patent. The patent is very detailed but I will list a brief description of his prototype. The prototype consists of a thin tube located around 3 feet below the surface of the water that releases a stream of bubbles. At the flag lane markers there is a "waterfall", which is a tube with perforations that drops water onto the swimmer to signal the location of the backstroke marker.

He has been working on his project for a couple years now and has conducted tests in Columbus, Ohio to which he received good feedback. He mentioned that he was trying to make it less cumbersome to install into a pool.

Some of the things he mentioned that he was having a problem with are: trying to get the tube small enough so that it would sink lower in the water, but the problem with having a small tube is that there is a lot of resistance with the bubbles. Because of this he was having a problem with overheating, which he was working on fixing. Even though we were not able to work with him this semester, Dr. Ferguson said we might be able to work with him next semester. He is very excited about possibly working with us in the fall and is going to try to come to our IPRO day presentation to see what we have done so far in our project.

Chicago Lighthouse for the Blind

The second week of class we had a class trip to the Chicago Lighthouse for the Blind. In this visit the class talked with Dr. Kara Hagerman, Ray Campbell and Kelsey Thompson. Notes from these interviews can be found in the engineering notebook, section *Summer Interviews*. Dominic Calabrese, public relations for the Lighthouse, first met us and then handed us over to Joe Wright for the rest of the tour. Joe has been our contact person and extremely helpful with everything. If he is not available his coworker, Deborah (Debbie) whose contact information I do not have, knows about our project and is very helpful as well.

We have conducted two more interviews, in addition to the ones mentioned previously. The first interview was with Tim Spencer. Even though Tim was interviewed last semester it was a short interview and did not address all of the issues that we were looking into. A brief description of every interview that we conducted can be found in the results section of this report along with a full transcription of each interview found in engineering notebook. Kelsey Thompson was the other interview conducted at the Lighthouse. Kelsey is a rehabilitation counselor at the Lighthouse who does swimming for exercise and recreation. We also needed some consent forms translated into Braille and she was the contact person for that. Both Tim and Kelsey would like to stay involved in the project and are interested in seeing how the prototypes turn out.

Institutions for the Blind

➤ Wisconsin School for the Blind and Visually Impaired (WSBVI)

The contact information for the Wisconsin school was found on their website. I first contacted Diana Brower the physical education teacher. I left a message on her machine but the call was never returned. I then tried Stacy Grandt, the Outreach Director, for more information on who was the right person to contact. She was very helpful and gave me the names and numbers of Amy Snow and Kelly Bailey, the two swimming coaches. She also said that if I could not get a hold of them to give her a call back and she would see what she could do.

I first contacted Amy Snow, the swim coach, who was really interested in our project and willing to help in any way possible. We were able to set up an interview date for July 10th at the Wisconsin school with Coach Snow, Coach Bailey and one of the students on the swim team. Both Coach Snow and Coach Bailey are visually impaired but they still have enough eyesight to be able to coach effectively. Mohammad and I traveled to Janesville, Wisconsin which took less than two hours of traveling time. Coach Bailey had a family emergency and was not able to meet with us but we did get to talk with Coach Snow and the swimmer. Again the data from the interview can be found in the results sections of this report and in the *Summer Interview* section of our engineering notebook along with their contact information.

➤ Indiana School for the Blind

Originally we were thinking of also traveling to the Indiana School for the blind to conduct interviews. I tried contacting the swim coach, Rob Strauss (I'm not sure if that is how it is spelt as I was transferred by the secretary to his voicemail), but was told that he was on vacation in the summer and very rarely came into his office. I left him one voice mail, which was never returned. We decided not to pursue this path further because of budgeting issues. Coach Snow from WSBVI said that Rob Strauss was a very dedicated and good coach. She said he would probably be a good person to interview as he had a lot of passion for what he did. This would be a good path to pursue in the fall semester if budgeting allows.

➤ Illinois School for the Blind and Visually Impaired (ISVI)

We gathered a lot of information on this school but we decided not to contact anyone as we did not have the finances to travel to the school for the interview. The school staff directory and sports information can be found in the engineering notebook. We heard that ISVI has a good swimming program and would also be a good direction to take for interviews. If more than one or two interviews were setup at once it would make a trip to the school a lot more feasible.

Irish Aquatics Paralympics Program (Notre Dame University)

Annie Sawicki was a contact of Daniel Ferguson from previously. The passive device is actually based off of one of their preliminary prototypes. Dr. Ferguson invited her and one of her swimmers, Lori, to participate in one of our swim experiments. They arrived early and Mohammad and I were able to interview both Annie and Lori. They had a lot of good feedback as Annie has been coaching for 12 years and Lori has been swimming for a long time and is currently training to swim in the Paralympics. Two weeks after they visited us at IIT we went to Notre Dame and tested our prototype there. Lori was able to test it as was another S11 swimmer, James. Due to the lack of time we were not able to interview James but he would be a good person to interview as he is also training for the Paralympics and is very outgoing. He reminds me of Tim Spencer in his personality style as he was very extroverted and likes to talk and joke around. When he tested the passive device he had a lot of ideas on changes or adjustments, leading me to believe he would be a good person to interview.

Mobility Specialist

Katherine Sheldon is the mobility specialist at the Lighthouse for the Blind. We thought it would be informative to interview her since she has a lot of experience working with the blind and visually impaired. We were going to ask her questions about the issues and challenges that the blind and visually impaired face as well as questions about how they learn new techniques best and how open they are to new things. The list of questions we wanted to ask her are listed in the *Summer Interview* section of our engineering notebook. I did get in contact with her a couple times but due to her busy schedule we were unable to set an interview date. She might be a good person to interview and ask questions about the tentative user manual that would have to be made for the release of any prototype.

Jennifer

Last semester they did an interview labeled as “Interview with Jennifer and Kristal” but it did not have a lot of useful information in it. Also because the interview was done with two people at once the answers of each person probably influenced the other person’s answers. We’re not sure who Kristal is but Jennifer is a swimming coach for the visually impaired here in Chicago. We were able to get her information from the Lighthouse but she never returned our voicemails. Joe Wright had told us that she had been injured from some accident and probably would not be available. She works at the Hilton health club on Michigan Ave. I verified with her job that she was out on injury.

Obstacles

One obstacle that we came in contact with was that of human subject testing. We learned that we needed to get IRB approval before conducting interviews with blind or visually impaired swimmers. This obstacle was solved by submitting an application to the institutional review board (IRB). We found that we had to have the interviewees sign a consent form stating that they understood what they were participating in and agreed to be interviewed.

One of the biggest problems that the entire team had to deal with was the issue of time. With the summer semester being only eight weeks long it puts a lot of pressure on students to produce results. As explained previously, the issue of time is what made us decide not to conduct the surveys as we did not have enough time to issue them and analyze the answers.

The issue of limited finances resulted in the decision not to contact the Illinois School for the Blind or pursue the Indiana School for the Blind and Visually Impaired for additional interviews. Both schools were located 235 miles and 176 miles, respectively.

As stated previously, many of the individuals of interest had prior engagements in the summer semester. A couple messages were left for interview candidates, which were never returned. As a result we were not able to conduct a greater amount of interviews. Even though the 8 interviews that were conducted did surpass our project plan goal of 3-5 interviews, it is still a small sample size. More interviews and surveys must be conducted in order to verify that the results we found are representative of all blind and visually impaired individuals.

Lastly, another obstacle that we came across was that of conducting the surveys. Last semester an online survey was created for the family, friends or coaches of blind and visually impaired swimmers. This survey was never conducted last semester for lack of time. We decided to take up the challenge this semester and issue the survey. We ran into a similar problem as before, access to the family members. We had the idea of giving the survey to the individuals that we interviewed for them to give to their family and friends to fill out and send back to us. The problem with this is that many of the interviews we conducted were in the later weeks of the semester and the semester will be completed before the results are sent to us leaving no one to analyze the results. We are still contemplating this option and holding the completed surveys to be analyzed by the fall '07 team.

The fall IPRO may face many of the same barriers that we did but they will have more people and more time to complete their planned tasks. Another issue that they should not have as great of a problem with in the fall semester is school sessions. Because of the summer semester, many of the schools were out of session as we found out with the Indiana swimming coach. I would recommend that the fall semester try to contact the surrounding schools for the blind, such as Indiana and Illinois, and interview the coaches and some of the students on the swim team. If we get a good submission of completed surveys the fall IPRO will have a head start on data collection as they will already have data to analyze and compare to ours. Lastly, IRB approval should be taken care of early in the semester so that can get started on their research right away.

Results

The results that are listed here were gathered from the interviews conducted. As stated before only 8 interviews were conducted, which leaves a very small sample size. The results that are described here are not representative of all blind and visually impaired individuals as a whole but this is the start of the investigation process. Listed below are some of the results obtained from our interviews:

Access

One of the main issues or challenges facing blind and visually impaired swimmers is access to facilities. This is something that was outside the scope of this project but it came up in every interview when asked about the challenges that one faces while swimming.

Early Development of Blindness

One casual observation that we found is that every blind or visually impaired individual that we interviewed had been blind or legally blind from birth or a very young age. From the interview with Dr. Hagerman at the Chicago Lighthouse for the Blind, we could see that was a difference in the adaptation styles of individuals who had gradual vision loss compared to sudden vision loss. She said that individuals that are born with a visual impairment adapt a lot better than someone who lose their vision when they are older. She also said that if they get assistance in the early stages they adapt a lot better in the long run.

Physically Active

Another interesting finding that we discovered was that each individual that was involved or is currently involved in swimming was also involved in other physical activities. Each individual was involved with at least one other sport or physical activity aside from swimming. As an example, when we asked Tim Spencer what other physical activities he was involved in or has been involved in he said, "You name it I've played it". I'm not sure what this result might mean but it is interesting to know. A big obstacle to someone being active is access to facilities. Perhaps this is why individuals who are involved in one sport are usually involved in others as well because they have better access to services.

Motivational Factors

In most of the interviews we asked the individuals if they had a strong family and/or group support. Of those that were asked each one said yes. From birth these individuals were probably raised with the mindset that they could do whatever they set their mind to, with strong family and friend support. With a high sense of self-esteem they probably were more willing to try new sports and get involved with new activities than other kids might be. This may be a good targeting area. There is probably a strong correlation of high self-esteem and strong emotional support from family in friends with involvement in sports and physical activities.

Difficulties and/or Challenges in Swimming

The main difficulties that the blind and visually impaired face have already been discussed earlier in this report and throughout each IPRO report: edge detection and location of the sides of the pool. For this reason the prototypes that are being created are trying to resolve these issues. One thing that we discovered is that the difficulty level of swimming depends on the level of eyesight. Lori, Tim and James (another S11 swimmer from Notre Dame) have really bad eyesight and had difficulties swimming straight and detecting the edge of the pool. On the other hand, Kelsey, Joe and Amy even though they are classified as “legally blind” had a better level of eyesight, enough to see the black line at the bottom of the pool. Because of this they were able to swim in a straight line but still had a level of difficulty in detecting the edge of the pool.

We also found that the level of swimming instruction is different with blind and visually impaired individuals. A sighted individual learns how to swim through both visual and tactile aids but an unsighted swimmer cannot see well enough to learn swimming strokes with visuals. A more one-on-one instruction is necessary to teach a visually impaired person how to swim. Coach Snow mentioned that she has to get into the swimming pool, at times, and physically show the swimmer how to do the stroke and what they are doing wrong. Kelsey, who is legally blind but has more vision than some of the others depending on the time of day and lighting, learned how to swim at a public pool with a bunch of other sighted kids and an instructor. She mentioned that she needed a lot more one-on-one instruction, compared to her peers, because she could not see what the instructor was demonstrating like they could.

Design Criteria

The gathering of design criteria for both the active and passive prototypes was one of the main reasons why we conducted interviews. Some design criteria that we found were: location on the body, interface, dimensions and device visibility. When asked what they were looking for in a device the answer was: something that would allow them to detect the edge of the pool and tell them when to turn. Helping them swim in a straight line was also a point of interest but did not seem to come up as much as the other two.

➤ Locations

Two locations on the body were listed as possible ideas for the active prototype. The majority of the interviewees listed the lower back or waist area as being a good spot for any device. Swimmers, such as Lori, Annie and Amy, were adamant in saying that anywhere else on the body would not work as it would impede on the swimming stroke. Joe at first said the wrist or ankle but when we asked him if he thought it would impede on the stroke he then said that the waist would probably be “more logical”. Kelsey really liked the idea of something on the wrist, like a stop watch. She said that because she has never swum competitively she would not know “if [it] would be a problem for some people”. She mainly liked the idea of it being really

inconspicuous and easy to use. Overall it can be said that the most preferred location is the lower back or waist area.

➤ Interface

In the beginning of the semester we were looking into the different types of interfaces for the active device. There were looking into audio vs. tactile interfaces and which one would be more effective while swimming. This question was asked in each of the interviews and was answered unanimously with tactile. Many of them said that an audio signal might be hard to hear over the regular noise of a swimming pool, especially in a swimming competition. Everyone seemed to like the idea of vibrations and thought that it would work well with swimming, especially since visually impaired people have a more refined tactile sense than sighted people do.

➤ Size/Dimensions

The question about size gave a range of answers. Everyone said that the device would have to be small, as not to impede on the swimmer's stroke and body movement. Amy Snow said that size of a razor phone would probably be a good size, Joe Scheunemann similarly said a deck of cards. Kelsey liked the idea of a wrist watch or arm band for the wrist or no bigger than a cell phone for the back/waist. Annie Sawicki and Lori Miller both said it should be as small as possible. Lori mentioned that she did not like the idea of having anything on her when she swims and said that it should not matter on the size per se but the intensity of vibrations. She said she would like something to be really small, like a square inch in size. Of course it should be pointed out that Lori Miller is really small in size and was afraid that anything too big would throw off her swim stroke.

➤ Device Visibility

In each interview we asked the interviewee if they would mind a device that could be seen easily by other people. We got a mixed response, which is most likely a result of the level of sight that each participant had. Kelsey and Tim who can both see to a certain degree both mentioned that they wanted something very inconspicuous. Kelsey told us a story from when she was in high school: one of her high school teacher's gave her this helmet type device that would allow her to see the white board better. She said that she did not use it because it was huge and made her stand out from everyone else. She mentioned that the goal of technology should be to simplify things.

Lori and Joe said just the opposite. They mentioned that they did not mind using devices for general mobility and athletic performance. Lori said "I'm not going to try to pass as not being blind. That doesn't affect me. I'm not even opposed to wearing a ski vest as a blind skier or a running belt as a blind runner." Joe also said that it did not matter if others could see the device was an aid. As I mentioned before, I think the mixed answers is a result of the level of sight that the individual has. If a person is completely blind from birth they would be used to using mobility aids and cannot see if others are using something else. On the other hand if you can see people's faces

and do notice that you stand out from the crowd, I'm sure it would make using a conspicuous device a lot harder to use.

➤ Pricing

Unfortunately, questions about pricing were not added to the interview questions until the 4th interview. We were able to ask 5 of the 8 interviewees what they would consider a good price for the active sonar device, if one were to be created. The pricing ranged from \$50-\$1000 depending on the individual asked. The two interviews that were conducted at the Wisconsin School for the Blind left us with a really high price range when asked about pricing. Coach Amy Snow said that she would pay up to \$500 for a device such as the one we were describing but also stated that it would depend on the “bells and whistles” of the device. The swimmer, Joe Scheunemann, said he would pay even over \$1000 for a device. When we asked him about the high price he stated that devices for the blind were really expensive as blind people “are in the minority”. He compared it to a computer-like electronic that he had recently bought for \$6500.

Those interviews were at the high end of the price range. The three last interviews with Annie Sawicki, Lori Miller and Kelsey Thompson gave a much lower price range. They each had the same opinion that it should not be too expensive and stated that they would not want to pay more than \$100 for a device such as the one we might be offering in the very near future. We believe that the difference in pricing is due to the individuals themselves. Amy and Joe were from a school for the blind and were most likely accustomed to the high pricing of normal electronics for the blind. Also Coach Snow stated that she would buy one device and see if it worked and then make the decision to buy more devices if necessary. The rest of the interviews were with people that worked and supported themselves individually and wanted something more in the price range that they could afford. I am not certain but I believe that if more interviews were conducted the second price range of \$50-\$100 would be the more feasible price range than anything over \$100.

Discussion & Conclusion

Our interview subjects are mostly individuals who have experienced very early development of blindness in their childhoods (or were born blind). The early onset of degradation of visual acuity stimulates efforts of mobility adaptation. This early beginning of mobility adaptation, coupled with a supportive family, lead our interviewees to undertake physical activities, such as swimming.

This long term development may be indicative of a long term market with the potential of an upgrade path. In the active sonar approach; the comfortable size, fitting and vibration strength of a sonar unit (SUPAD) would be different depending on the age and physical dimensions of the swimmer. In the passive approach, there may not be as much potential for a long term market. Further testing of the passive device across a range of ages with blind or visually impaired swimmers may help determine if there is or isn't a one-size-fits-all solution.

The interviews with swimming coaches have shed light on the effort-intensive process of teaching a stroke to a blind or visually impaired swimmer. This process usually consists of one-on-one training involving frequent physical contact. This limits the time and opportunity of a coach to train swimmers en masse. The number of blind or visually impaired individuals who wish to learn how to swim may be limited by the non-scaling training approach that coaches employ today. Both the passive and active approaches have the potential of aiding the swimming coach in teaching more individuals on how to swim. This may, in turn, expand the size of the market that would be interested in purchasing such devices.

Some of our interviewees have expressed concerns about the potential form of the device. Specifically, the concern is regarding the visibility of the potential sonar device that would be located around the waist/lower back region. One potential way of addressing this concern is to camouflage the device so that it appears to be part of the swimming attire (in terms of color/pattern and fabric appearance).

From our pool of interviewees, anyone short of complete blindness did not have major problems in swimming straight along the pool lane. Detecting the edge of the pool (without frequent stopping and distance estimation) was a concern amongst many of our interviewees.

The approach ultimately implemented will depend on a number of factors. The passive approach would be best if there are indications that the market is limited in size and there is a strong desire for a very low cost solution. The sonar approach could be implemented if the sale price was reasonable. The current information regarding pricing preferences covers a large range. Further data gathering is needed to better understand market pricing reactions, i.e. what would our customers (swimmers or pool managers) be willing to pay for a device that allows autonomous swimming of blind and visually impaired swimmers?

Finding further uses for the devices (e.g. sonar device as a safety device for elderly individuals in swimming pools) may help in expanding the market and tap into the economies of scale for the perspective of manufacturing.

Recommendations

- Analyze results from surveys given to the family and friends of the Blind or Visually Impaired swimmers. Compare data collected from these surveys with the data that we collected from our interviews thus increasing the sample size of participants.
- Conduct interviews at the surrounding schools for the blind, primarily Indiana School for the Blind and Visually Impaired and Illinois School for the Blind, both of which have good swimming programs. From experience, interviews with coaches give a different perspective on swimming and are extremely informative

and should be pursued to the same extent as interviews with blind swimmers. A coach has a lot of experience with the different issues and challenges that blind swimmers face and the techniques that they use when swimming.

- Conduct a market feasibility search that will look into the tentative market for both devices. Information into what the pricing range for each device should be and whether there is a possibility of government funding if used in public institutions.
- Identify other uses for the devices, a larger market. Some suggestions of other uses of the device might be, using it as a safety device for older persons or individuals who use corrective lenses. It could also be used as an educational tool for teaching a sighted or non-sighted swimmer on when to make the turn at the edge of the pool or how to swim in a straight line.
- Lastly, compare the satisfaction and/or ease of use of both prototypes. Volunteers would be needed to test both devices and give their honest opinion of each device and how it worked for them individually. Volunteers from all different acuities can be used so as to have a representative sample size from the visually impaired and sighted population.

References

Article → Swimming as a Totally Blind Athlete: What You Need to Know
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The Chicago Lighthouse for People Who Are Blind or Visually Impaired
<http://www.thechicagolighthouse.org/default.asp>

Wisconsin School for the Blind and Visually Impaired
<http://www.wcbvi.k12.wi.us/>

Indiana School for the Blind and Visually Impaired
<http://intra.isbrockets.org/public/>

Illinois School for the Visually Impaired
<http://www.isvi.net/>

United States Association of Blind Athletes
<http://www.usaba.org/>

International Blind Sport Federation
<http://www.ibsa.es/eng/>

American Foundation for the Blind
<http://www.afb.org/default.asp>

Swimming Pool Lane Marker → John Komer's Patent
<http://www.afb.org/default.asp>

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Research Sub-Group

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- Joe Wright – Assistant Manager of Public Relations of the Lighthouse. Our contact within the lighthouse. He set up all the interviews and was extremely helpful with everything.
- Tim Spencer – Has been swimming recreationally his whole life. Interviewed with us and also helped us test the passive device.
- Ray Campbell – Used to competitively swim in high school. Interviewed with us.
- Dr. Kara Hagerman – Director of Clinical Services. Ophthalmologist who specializes in low vision rehabilitation. Interviewed with us
- Kelsey Thompson

Wisconsin School for the Blind and Visually Impaired (WSBVI)

- Amy Snow – Swimming coach for WSBVI. Interviewed with us.
- Joe Scheunemann – Past swimmer on the WSBVI team. Interviewed with us.

Irish Aquatic Paralympics Program (IAP)

- Annie Sawicki – Swimming coach for IAP. Interviewed with us and helped in passive device testing.
- Lori Miller – Swimmer for IAP. Interviewed with us and helped in passive device testing.
- Paul Down – Professor of Industrial Design at Notre Dame University. Part of team that came up with original lane tapper idea. Assisted in passive device testing.

John Komer – Engineer in Ohio with a patented lane marker of his own design. There is a slight possibility that he might be working with us in the fall semester.

Appendix

- I. Interview Questions for a Blind Swimmer
- II. Interview Questions for Coach Amy Snow (visually impaired)
- III. Interview Questions for Coach Annie Sawicki (not visually impaired)
- IV. Tactile Vision: Braille Thank You Cards

Appendix I: Interview Questions for a Blind Swimmer

1. What is your age and occupation?
2. Could you please detail the nature and history of your visual impairment?
3. How well can you see?
4. Tell us about yourself so that we can better understand your experience of life
5. What physical activities are you currently involved with?
6. When did you become involved with swimming?
7. Was there anything you found difficult at first?
8. Did someone in particular encourage you in your physical activities or was it more of a network of people?
9. What are some of the challenges that you face when swimming?
10. Can you describe your swimming strategy? How do you orient yourself in the lanes? How do you know when to start your turns when doing laps?
11. Are you comfortable using a device for general mobility?
12. Would you be comfortable using a device for athletic performance?
13. Do you swim recreationally outside of practice? If so, do you need a tapper?
14. What would you be looking for in a device that would allow you to swim more autonomously?
15. How do you feel having something attached to you while you swim?
16. Do you have any suggestions on what locations would be most appropriate to put the device?
17. How easy is it to differentiate between different interfaces (ie. Tactile vs. audio)?
18. If we were to create a device that signaled the location of the wall with a vibration, where, on your body would that vibration be most detectable to you?
19. Would you prefer have a single source of input or separate locations across the body?
20. How much would you be willing to pay for a device that can enable you to swim autonomously?
21. How much would you wish it to be priced at?
22. Would you mind wearing a device that others would easily notice if it allowed you to swim more autonomously?
23. What are the maximum dimensions you would deem for such a device?
 - Credit Card
 - Modern Cell Phone
 - Poptarts
 - Wallet, etc.
24. Are there any other thoughts you would like to share with us?

Appendix II: Interview Questions for Coach Amy Snow (visually impaired)

1. What is your name, age and occupation?
2. Could you please detail the nature and history of your visual impairment?
3. When did you first get interested in swimming?
4. Did someone in particular encourage you in your physical activities or was it more of a network of people?
5. How long have you been a swimming coach?
6. Have you ever coached sighted individuals? If so, what are some of the biggest differences in teaching strategies between sighted and low vision swimmers?
7. How many hours a week do your swimmers practice in a regular semester?
Summer semester?
8. What do you think is the most difficult thing about coaching the blind or visually impaired?
9. How do your swimmers rely on their other senses while swimming?
10. How do you coach your swimmers to swim in a straight line?
11. How difficult is it to teach them to swim in a straight line?
12. How do they know when to turn?
13. How easy is it to differentiate between different interfaces (ie. Tactile vs. audio)?
Which do you think would be more effective while swimming?

We are attempting to create a passive and active prototype that will allow swimmers to swim more autonomously...explain prototypes:

14. Do you think these devices will allow blind or visually impaired individuals swim more autonomously?
15. How much would you be willing to pay for a device such as the ones we are creating?
16. How much would you wish it to be priced at?
17. What are the maximum dimensions you would deem for such a device?
18. As a coach what are those factors that motivate or inhibit blind or visually impaired individuals to take up swimming?
19. Are there any other thoughts you would like to share with us?

Appendix III: Interview Questions for Coach Annie Sawicki (not visually impaired)

20. What is your name, age and occupation?
21. When did you first get interested in swimming?
22. How long have you been a swimming coach?
23. Have you ever coached sighted individuals? If so, what are some of the biggest differences in teaching strategies between sighted and low vision swimmers?
24. What is the average level of proficiency found in your program?
25. What is the distribution of visual acuity of your swimmers over your years of coaching (ie. S11-S13)?
26. Are you primarily funded by the University or by other government or non-government grants?
27. How many hours a week do your swimmers practice in a regular semester?
28. What are often the obstacles that swimmers face when they first start swimming in the program?
29. What do you think is the most difficult thing about coaching the blind or visually impaired?
30. How do you address these difficulties?
31. How do your swimmers rely on their other senses while swimming?
32. How do you coach your swimmers to swim in a straight line?
33. How difficult is it to teach them to swim in a straight line?
34. How do they know when to turn?
35. How easy is it to differentiate between different interfaces (ie. Tactile vs. audio)? Which do you think would be more effective while swimming?

We are attempting to create a passive and active prototype that will allow swimmers to swim more autonomously...explain prototypes:

36. We have two potential devices...how would you be able to use these when coaching?
37. Do you think these devices will allow blind or visually impaired individuals swim more autonomously?
38. How much would you be willing to pay for a device such as the ones we are creating?
39. How much would you wish it to be priced at?
40. What are the maximum dimensions you would deem for such a device?
41. As a coach what are those factors that motivate or inhibit blind or visually impaired individuals to take up swimming?
42. Are there any other thoughts you would like to share with us?