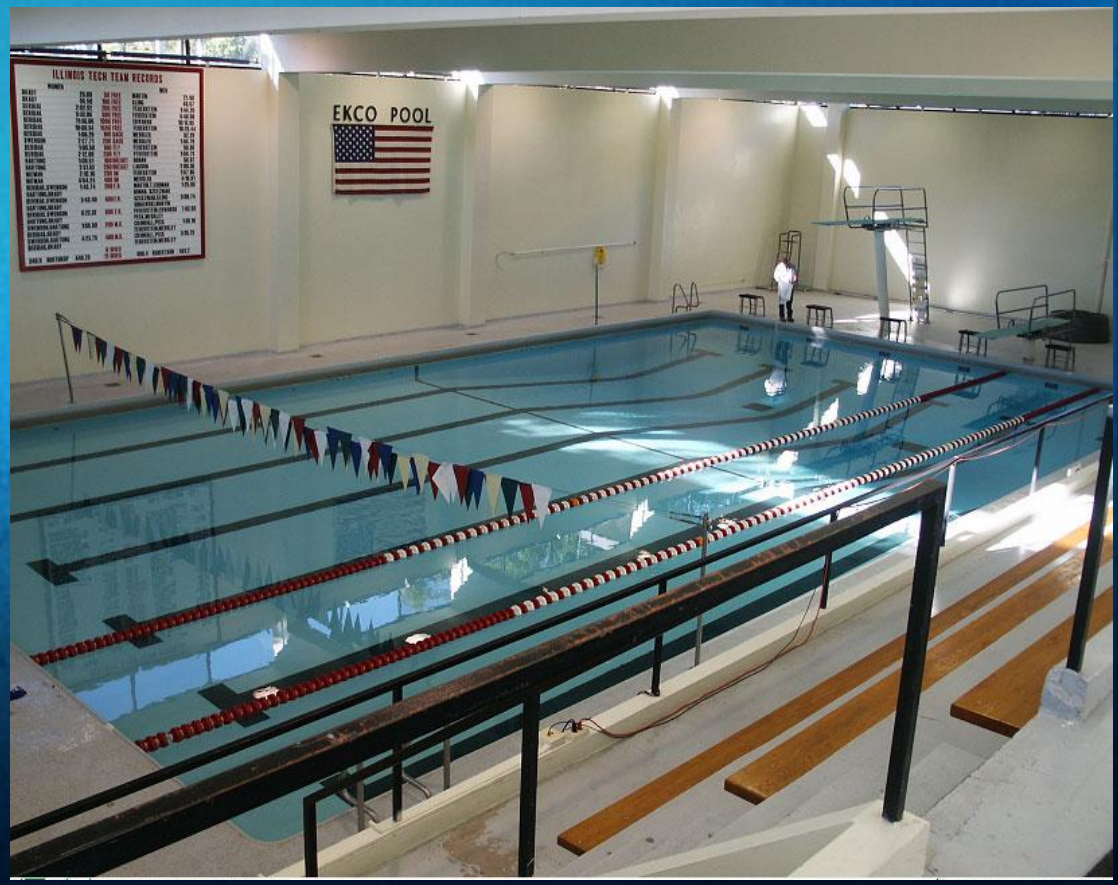
IPRO 310:
Assistive Devices for Blind and Visually Impaired Swimmers

Agenda

- Intro to IPRO 310
- Team Concept
- Team Development
- Sub-team Reports
  - Passive
  - Active
- Results
- Challenges
- Conclusions and Recommendations



"There are 10 million adult Americans that are blind and visually impaired."

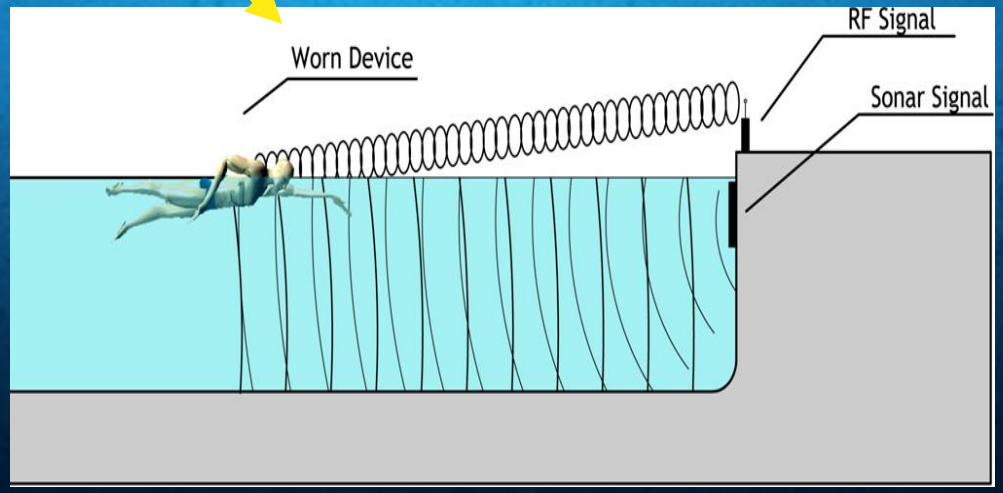
-American Foundation for the Blind

IPRO 310: Mission Statement

"Provide a safe, effective, and reliable assistive device for visually impaired swimmers"

Concept

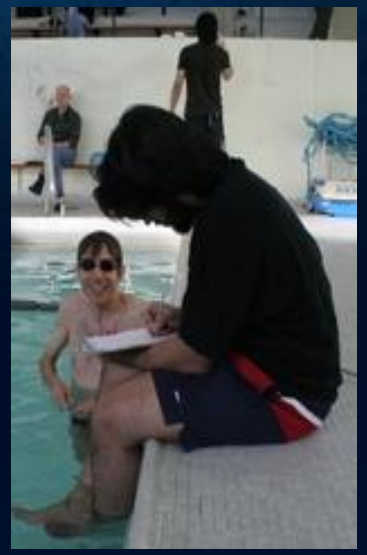
- Students from various majors all aimed to solve the same problem of designing devices for BVI swimmers.
- Passive and Active Sub-teams.
  - Stationary vs. Mobile devices



Data was collected through:

- various pool tests
- surveys for direct feedback

from the BVI community

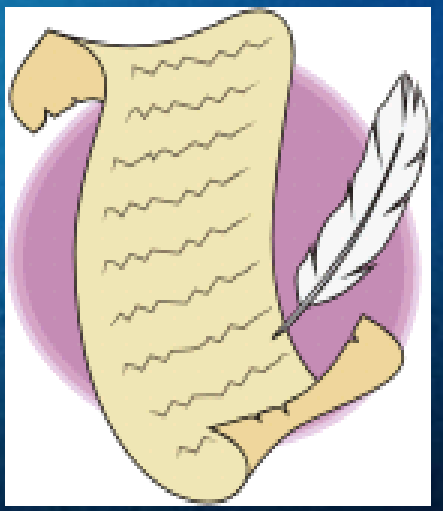


Team Development & Performance

- Exercises
  - Blindfold exercise
  - Trip to Chicago Lighthouse
- Team Charter
- Team Organization
  - Passive
  - Active

Team Charter:

1. To be **accountable for our actions** and to each other in an effort to conduct a successful IPRO
2. To maintain **enthusiasm** and concern for each other and this IPRO, prioritizing our needs effectively
3. To **distribute work fairly**, acknowledge each other's achievements, and share in our rewards collectively
4. To be **respectful** while bringing constructive criticism, avoiding judgment on the basis of race, gender, beliefs, etc.
5. To **record and document** our work, so that future teams can get the maximum benefit from our work



IPRO 310 FALL 2008 Team Division

Active Team

- Lorne Turrentine
- Jan Teves
- Hsuen Yew
- Vaibhav Gupta
- Sikander Soleja
- Daniel Chiu

Passive Team

- Arun Sood
- Jodi Warns
- Lisa Reed
- Neha Padwal
- Sunny Sajjad

Faculty & Advisors

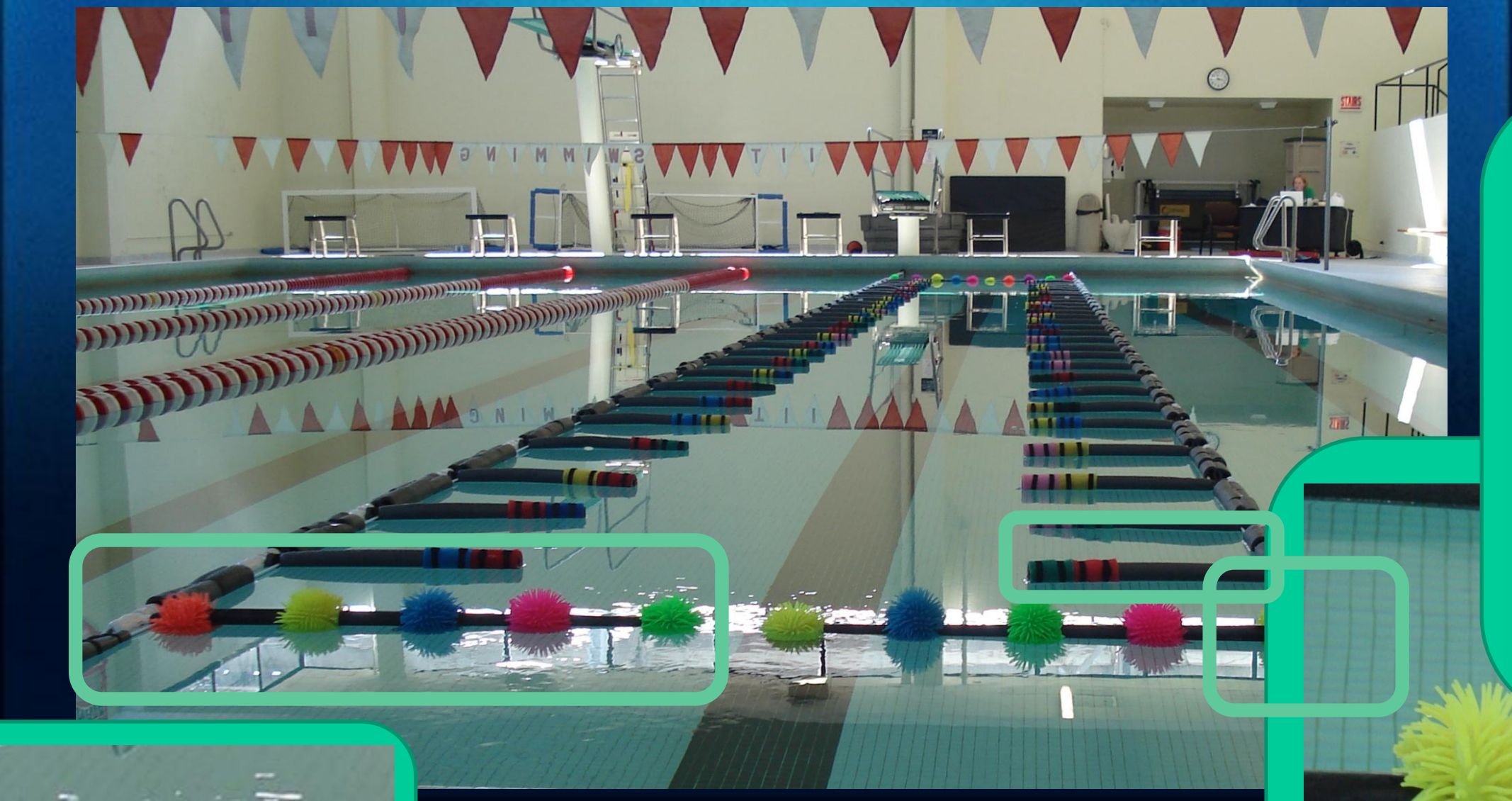
- Dr. Ken Schug, Dr. Frank Lane, Dr. David Gatchell, Shital Patel, Fiona Daay

Current Methods

- Swim along lane line
- Hire manual tappers or guides

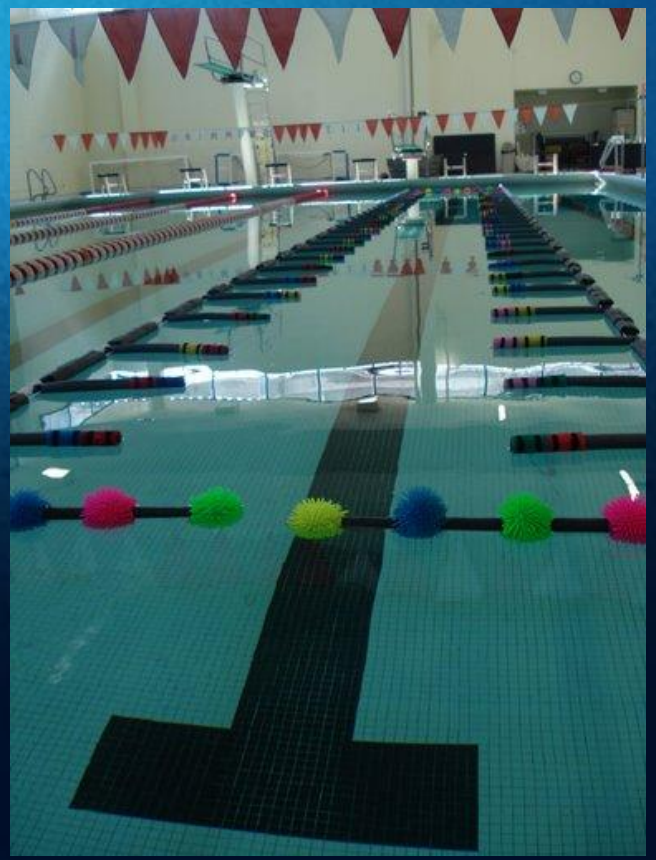
Passive Device

Key Components



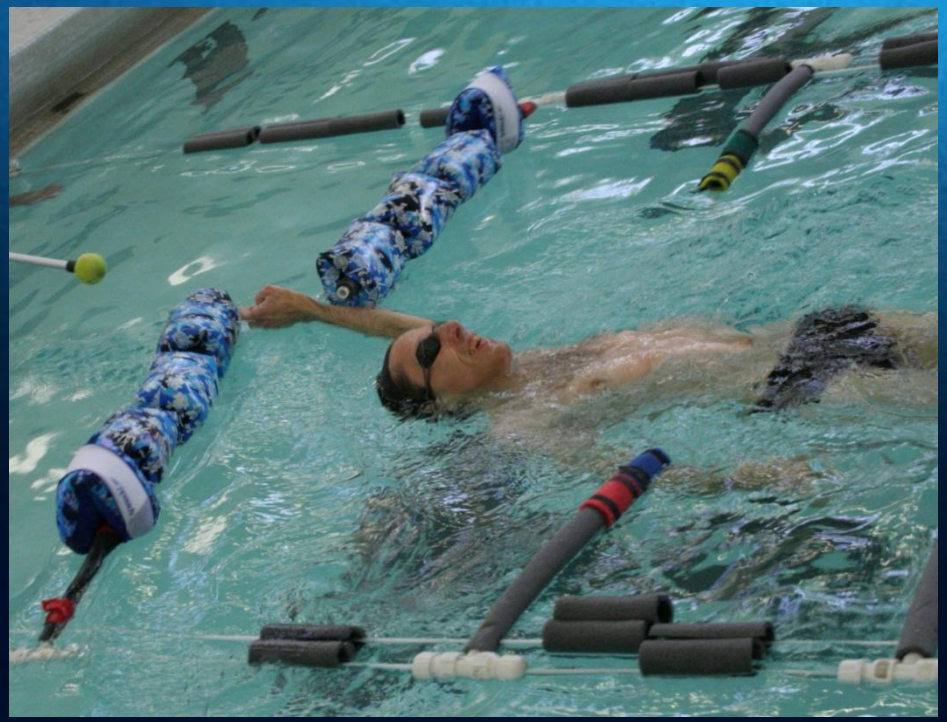
Past Ipro: Passive Team

- Since Spring 2006
- Pool Device
  - Degrading of materials
- Storage Device
  - Damaging to pool device
- End tappers not distinguishable



Passive Team: Upgrades

- Rebuild Overall Device
- Redesigned Storage Device
- Tested New End Tappers



Storage Device

Version 1 (Spring 2008)

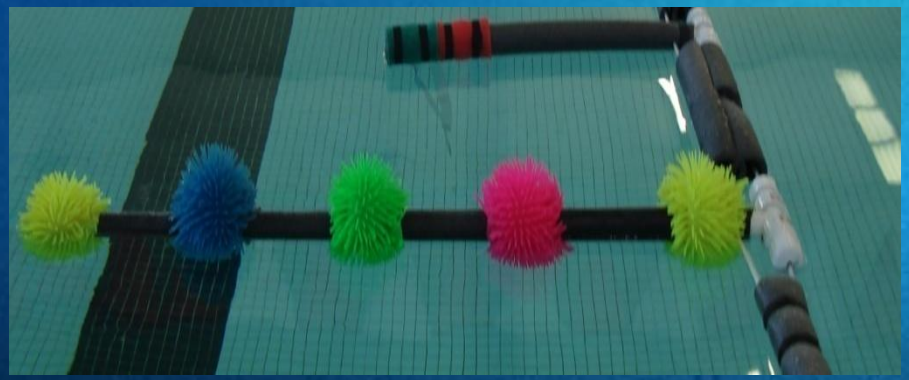
- Horizontal
  - Damaged Side Tappers

Version 2 (Fall 2008)

- Vertical
  - Tappers Hanging
  - Increased Portability

End Tappers

Spring 2008



Puffer Balls

- Degraded

Fall 2008

Floaties

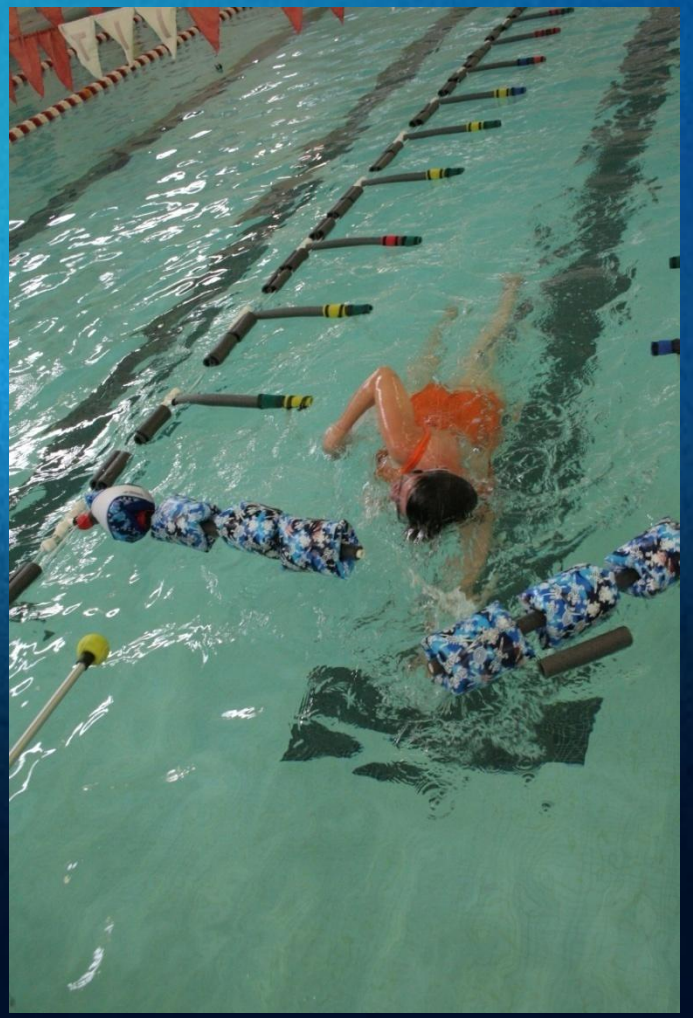
- Used as pool device
- Very noticeable

Bells

- Integrate different sense

Pool Test

- Institutional Review Board certification
  - Consent forms
- Variety of Blind Swimmers
- Variety of strokes
- User feedback



Pool Test Feedback

“If you lessen the distance between tappers, it would make a great device.” – Kelly, blind swimmer

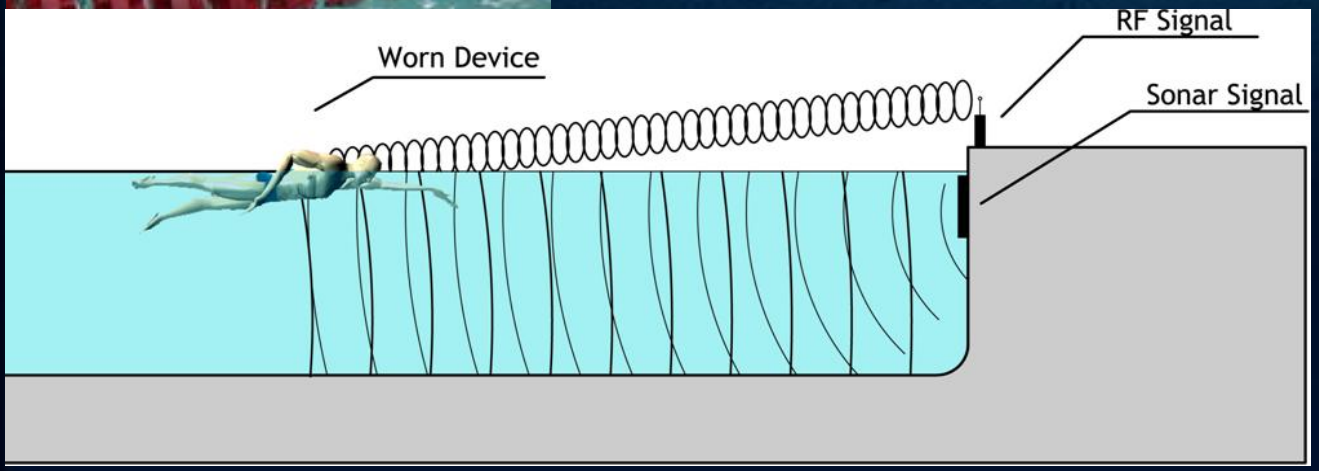
“Confident in the pool setup. Need to narrow end tappers.”
- Beth, blind swimmer

“I loved the device and had lots of fun.”
- Alex, partially blind swimmer

Past IPRO's: Active Team

1. Vibration Belt
2. Snorkel
3. Mounted Sonar

All had a primary focus on Technology and NOT the User

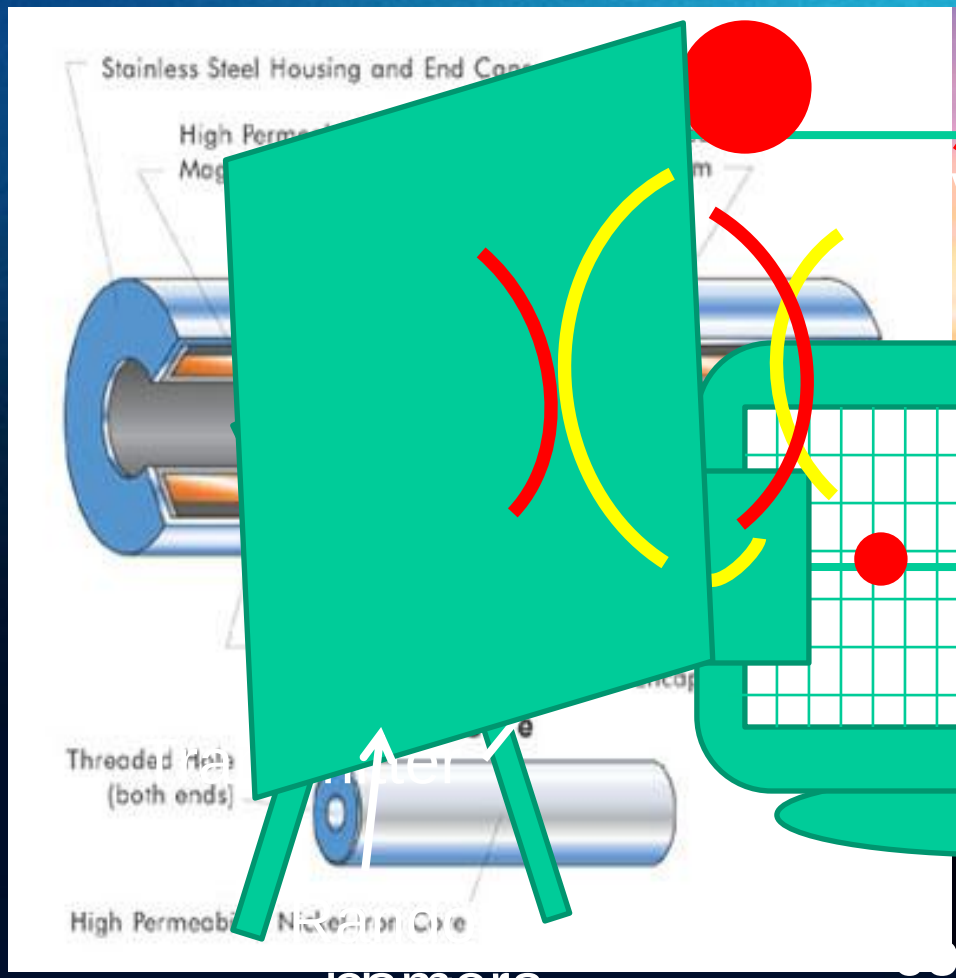


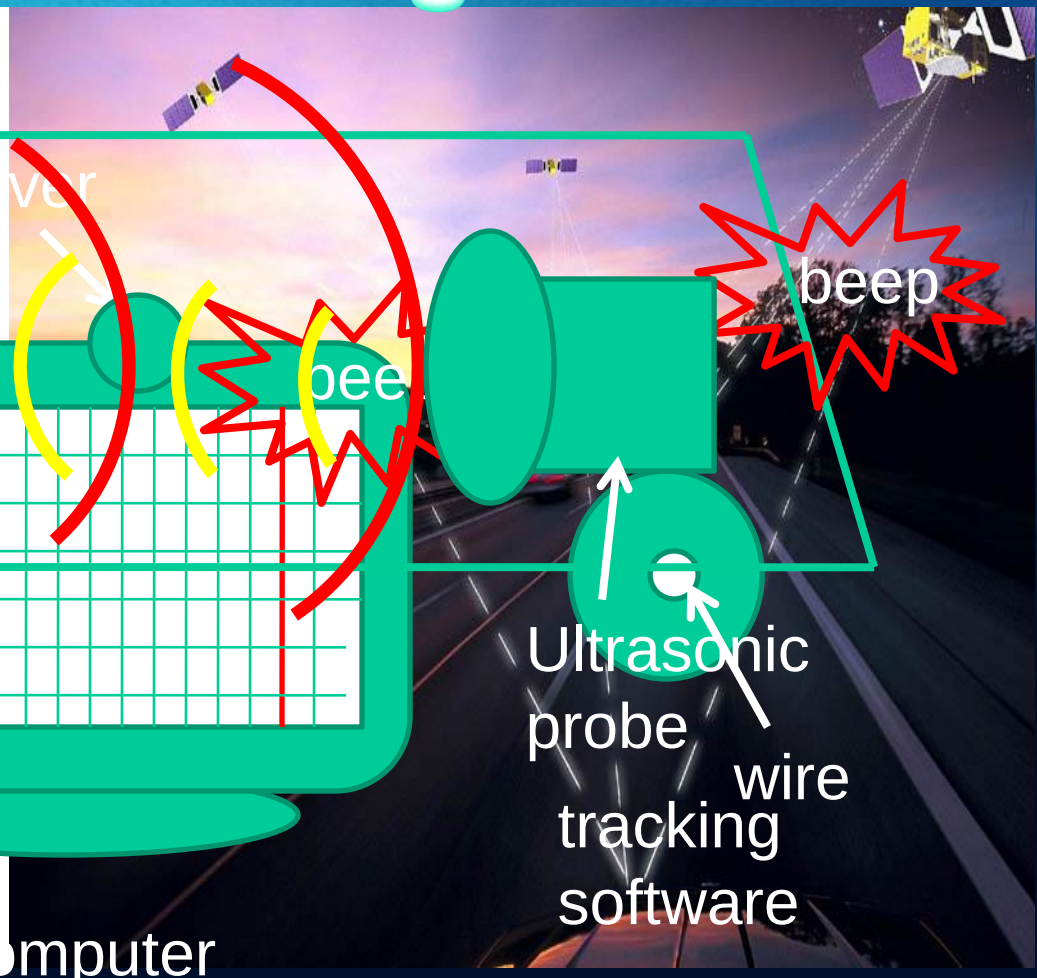
New Research: Active

- Invisible fence
- Radio Frequency
  - Perceived Sound Guidance (PSG)
- LVDT
- Camera tracking
- GPS
- Ultrasound sensor
  - Simplified version
    = Hydrophone

New Research

- LVDT
- Ultrasonic sensors
- Perceived sound guidance





camera

object

mputer

Decisions, Decisions, Decisions

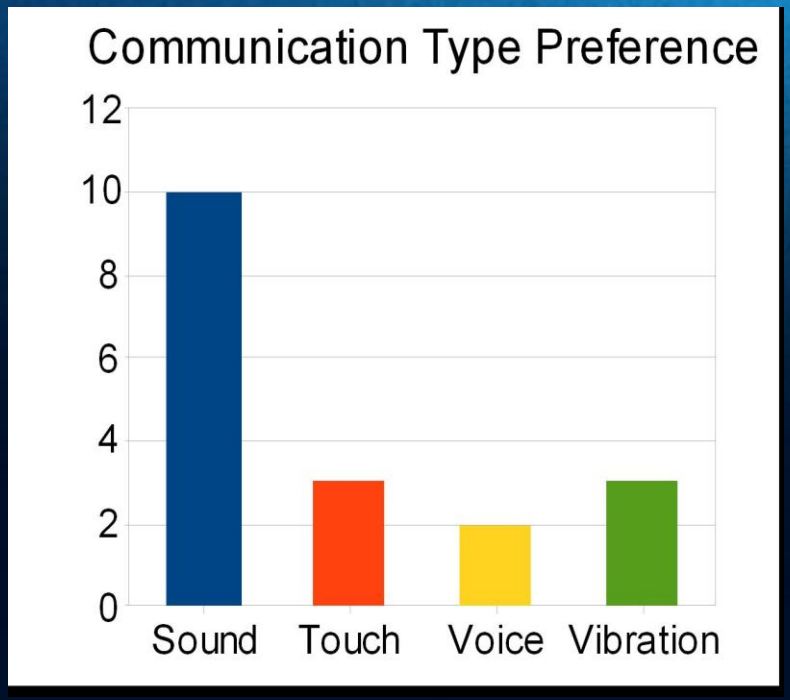
	Rank 1-7	(-1,0,1)	(-1,0,1)	(-1,0,1)	(-1,0,1)	(-1,0,1)	(-1,0,1)	
	Importance Factor	Invisible Fence	PSG	LVDT	Camera Tracking	GPS	Parking Sensors	Current Device
Cost	3	1	0	0	-1	-1	1	0
Compact/Potability	5	-1	1	1	0	-1	1	0
Reliability	7	1	0	0	0	0	1	0
Independence	4	1	1	1	0	1	1	0
Power Req/Battery Life	2	0	0	-1	1	0	0	0
Easily Made	1	1	-1	-1	1	0	1	0
User Friendly	6	1	1	1	1	1	1	0
	Total	16	14	12	6	2	26	0

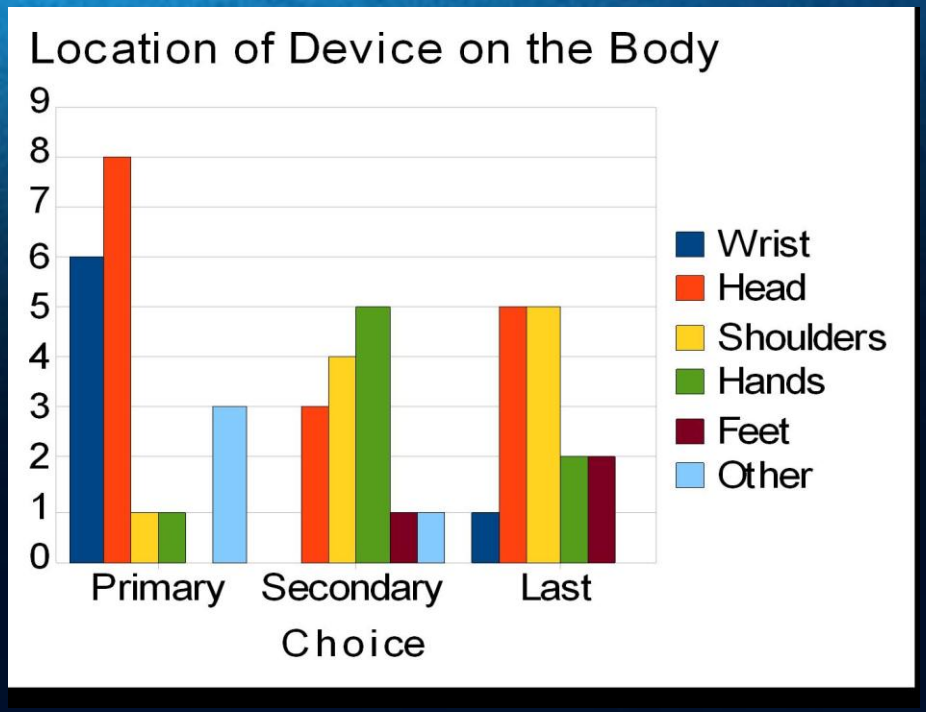
Decision Matrix

- Select which technologies to develop further using informed decision
- Helped to select appropriate technology

Community Connections: Active Team

- First semester for this IPRO to include user involvement in developing device
- Team created and administered survey at the Chicago Lighthouse for the Blind
  - Qualitative feedback from B/VI individuals was obtained
  - Result:





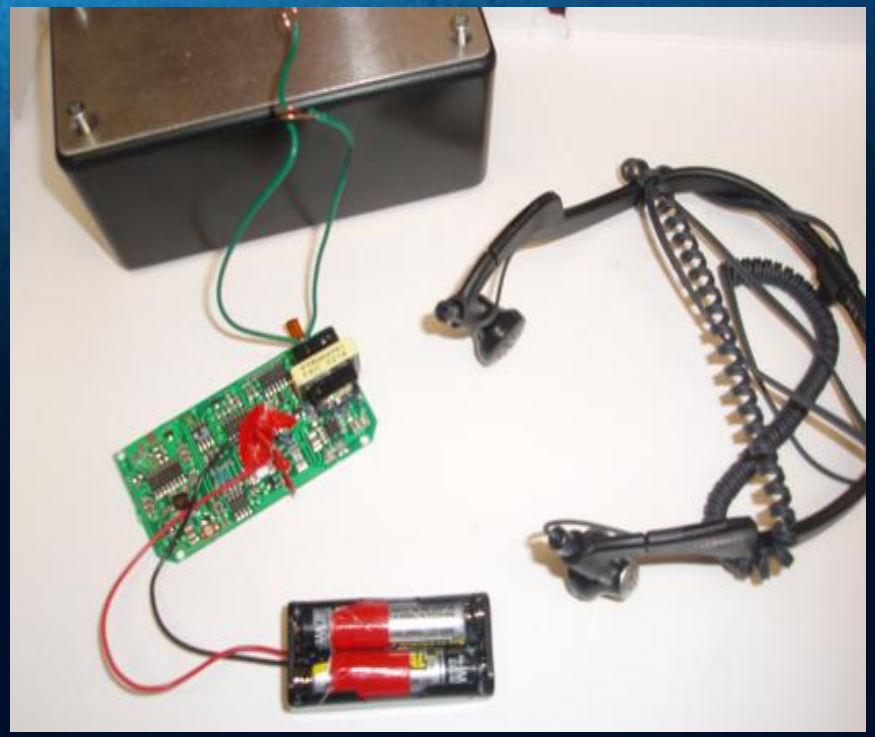
Active Team:
Survey at Chicago Light House

Significance of survey:

- Increased depth of community involvement
- Enhanced connection with:
  - Chicago Lighthouse for the Blind
    - Fully involved in testing & surveys
- IPRO 310 is an ongoing project
- Results guide design direction for the future
  - How the device is to communicate with users
  - Feedback type
  - Ergonomics of the design

Active: Tested Devices

- Established contact with:
  - Yale University-Intelligent Sensors Laboratory
    - Dr. Roman Kuc - Research in dolphin echolocation
      - Hydrophone before ultrasound



- Modified "snorkel" device into headphone version
  - More compact
  - Less noticeable
  - Swimmer gear

Successes

Active Team:

- Create and administered survey to the BVI community. ✓
- Build prototype of snorkel using headphones. ✓
- Select three specific technologies (Ultrasonic sensors, Invisible Fence, Hydrophone) ✓
- Build hydrophone ✓
- Document Research ✓

Passive Team:

- Redesign end tappers ✓
- Redesign storage device ✓
- Manufacture Storage Device ✓
- Rebuild entire passive device ✓
- Document Research ✓

Challenges

- Budget
  - Money was spent only with entire team's approval
  - Only 38% of budget was spent
- Team performance
  - Agenda
  - Weekly status report
  - Critiqued by expert (Dan Apple)
- Uneven distribution of disciplines
  - Cross subteam communication
- Faculty changeover for a continuing IPRO
  - Made adjustments to new teaching style
  - Ensure proper communication between students and faculty

Conclusions

- Team organization is essential
- Back tracking lead to wasted time
- Different swimmers have different preferences
- More feedback the better

Recommendations

- Divide subteams according to major
- Appropriate documentation
- Increase adaptability
- Conduct pool tests often
  - Endurance testing
  - User testing
  - Keep the BVI community involved

Questions?

Special Thanks to: