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# V Sports: An Even Ground for Deaf Athletes

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AN EVEN GROUND FOR DEAF ATHLETES

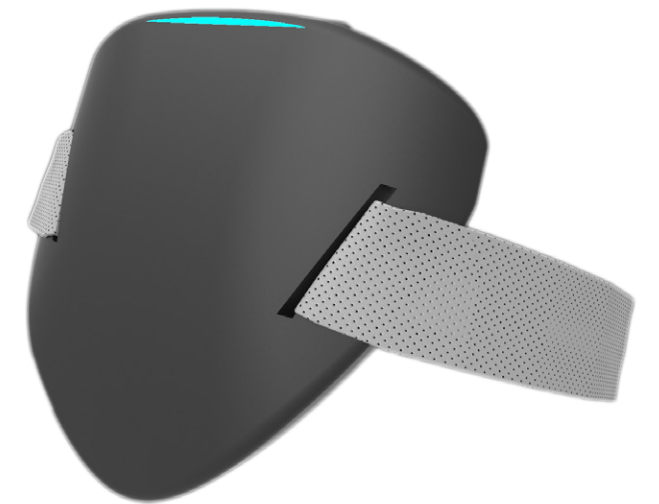




## OVERVIEW

In a society in which sports entertainment is highly praised globally, not a lot of people are aware of the existence of hearing impaired athletic leagues. Yet, for almost every sports league that exists, there is also an equivalent league for hearing impaired athletes. The inability to hear does not stop hearing impaired athletes from being competitive and playing the sports that they are passionate about. Although, it does not prevent them from playing, deaf athletes may still face communication problems with their teammates, coaches, as well as referee officials.

This project explores the communication problems that hearing impaired athletes may face during a game. It will also identify an area of opportunity and propose a product solution to address these communication problems.





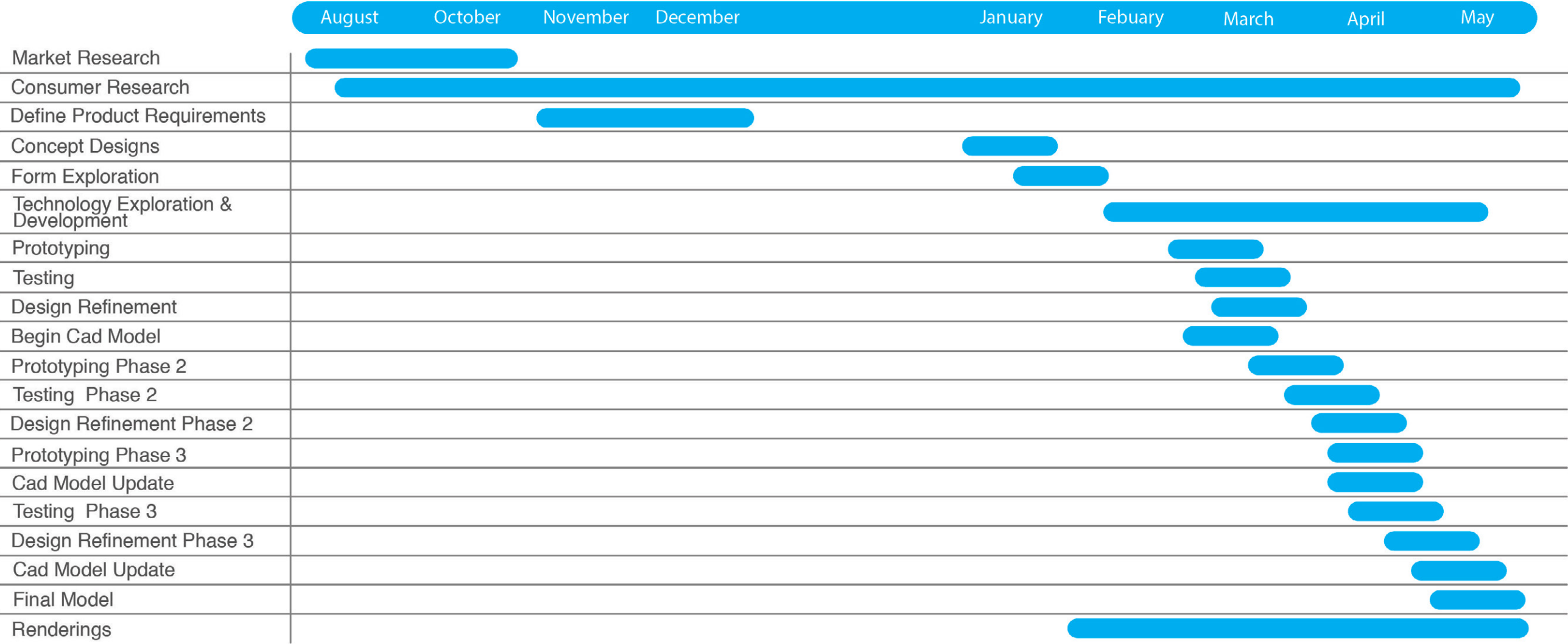
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# Project Timeline



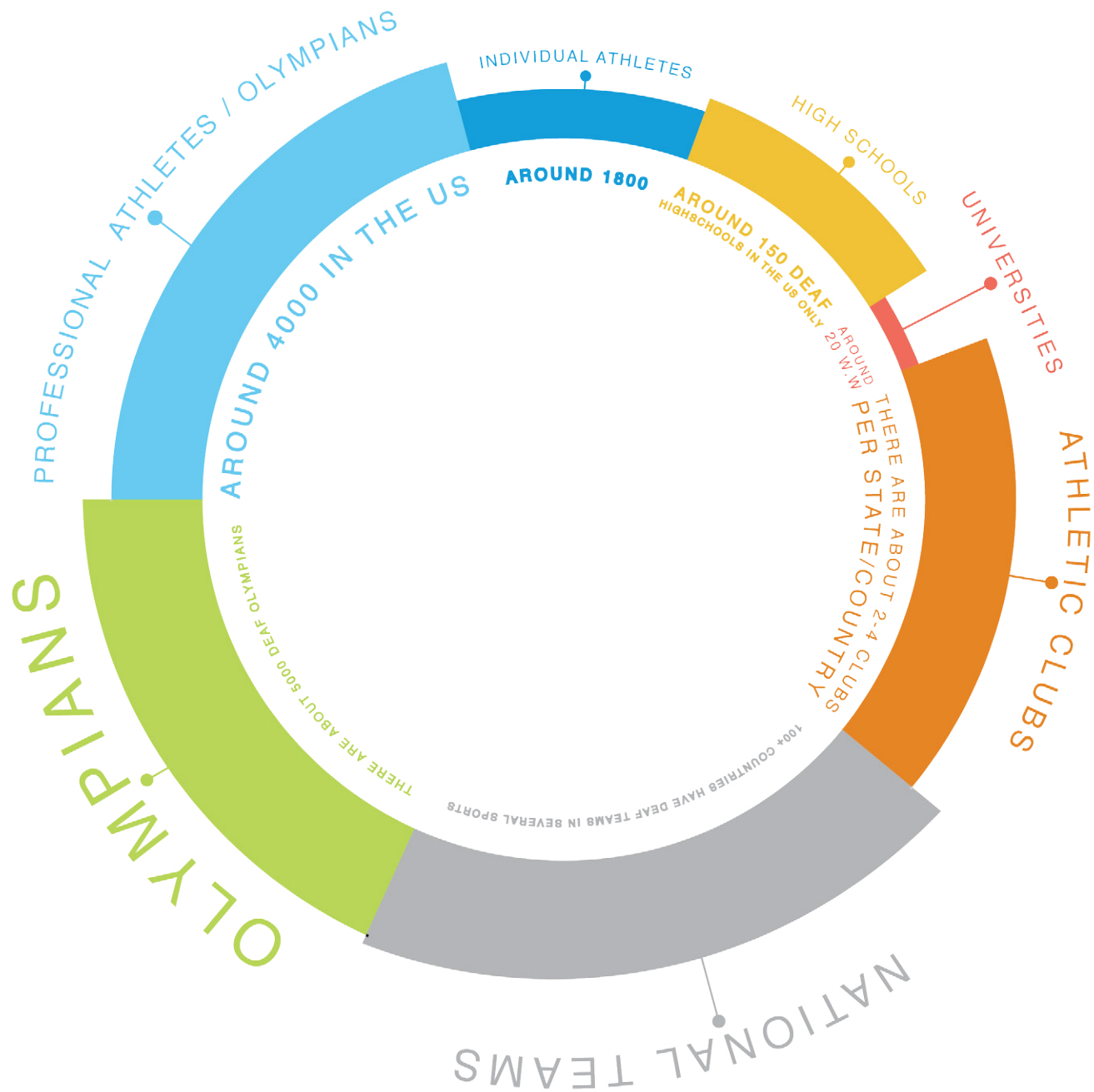
# The Research

## *Brief History*

The deaf athletic community has been around for nearly a century. The first international deaf olympics (known at the time as the international silent games), were held in Paris in 1924.

Although only nine countries participated in the first silent games, the deaf athletic community has grown significantly over the past 92 years, there were a total number of 108 participants at the last deaf olympic games.





## Market Size

The size of the deaf athletic community does not just limit itself to the Deaflympics. Just in America alone 48 million people suffer from hearing loss, and amongst them are people who enjoy playing sports with their freinds, in athletic clubs, on school teams, and even professionally on national teams.

Taking in account that this is the case in other countries all around the world, my target market will consist of unsigned individual athletes, deaf schools (highschool universities), deaf athletic clubs, national deaf teams as well as international deaf associations such as the Deflympics, FIBA and more.

*What Does It Mean  
To Be a Deaf Athlete*

Some may automatically come to the conclusion that hearing impaired athletic games are either played differently or have completely different rules than hearing games. In actuality the only real difference is their inability to hear.

Hearing impaired athletes partake in every sorts of sports, with little to no modifications, but rather, with several obstacles to overcome.

According to *Deaf and the sports community*, some of the obstacles that deaf athletes may face are:



Communication barriers with  
their teammates.



Communication barriers with  
their coaches.



Communication barriers with  
the referee.



## *Communication With Teammates*

Communication is a very important part of sports. Players need to be social and support each other, that is the essence of every competitive sports team.

When playing in a team with other hard of hearing athletes, nonverbal communication is the means through which they express themselves. Though it may sound like an effortless task, it actually requires twice as much focus during a game.

An article from the Washington Post that talks about a recent victory of Gallaudet University's basketball team, provides a good description of what it is like to rely on nonverbal communication during games. They state, "The players are constantly looking at their coaches and looking at each other... They rely on facial expressions, eye contact, body language and hand signals. To have to do this and focus on the ball and the adversary team is not an easy task."

On the other hand, there is also the case of individual hard of hearing athletes who have to overcome the challenge of playing at their best while being able to communicate on a hearing team.

Sometimes their teammates make the effort of learning some basic hand signs, other times the player has to split his/her attention and focus on the game and an interpreter who follows him/her from the sideline.



## *Communication With Coaches*

Interactions with coaches tend to be more simple when the coach is also hard of hearing. When this is not the case, an interpreter helps with their interaction.

## *Communication With Referees*

The role of a referee is to judge a game from a non-bias stand point, and call for fouls when needed. In order to do so, the referee should be able to get the attention of the players instantly at any given point of the game.

In hard & hearing athletic games, referees use their whistles but they mainly rely on visual cues such as flags, and lights to get the players' attention.



From a hard of hearing athlete's point of view, when in the middle of a fast pace game, it tends to be difficult to always see these visual cues. Some problems that tend to arise from this are false starts, athletes not stopping when there is a foul, continuing to play when the end of the game is pronounced.



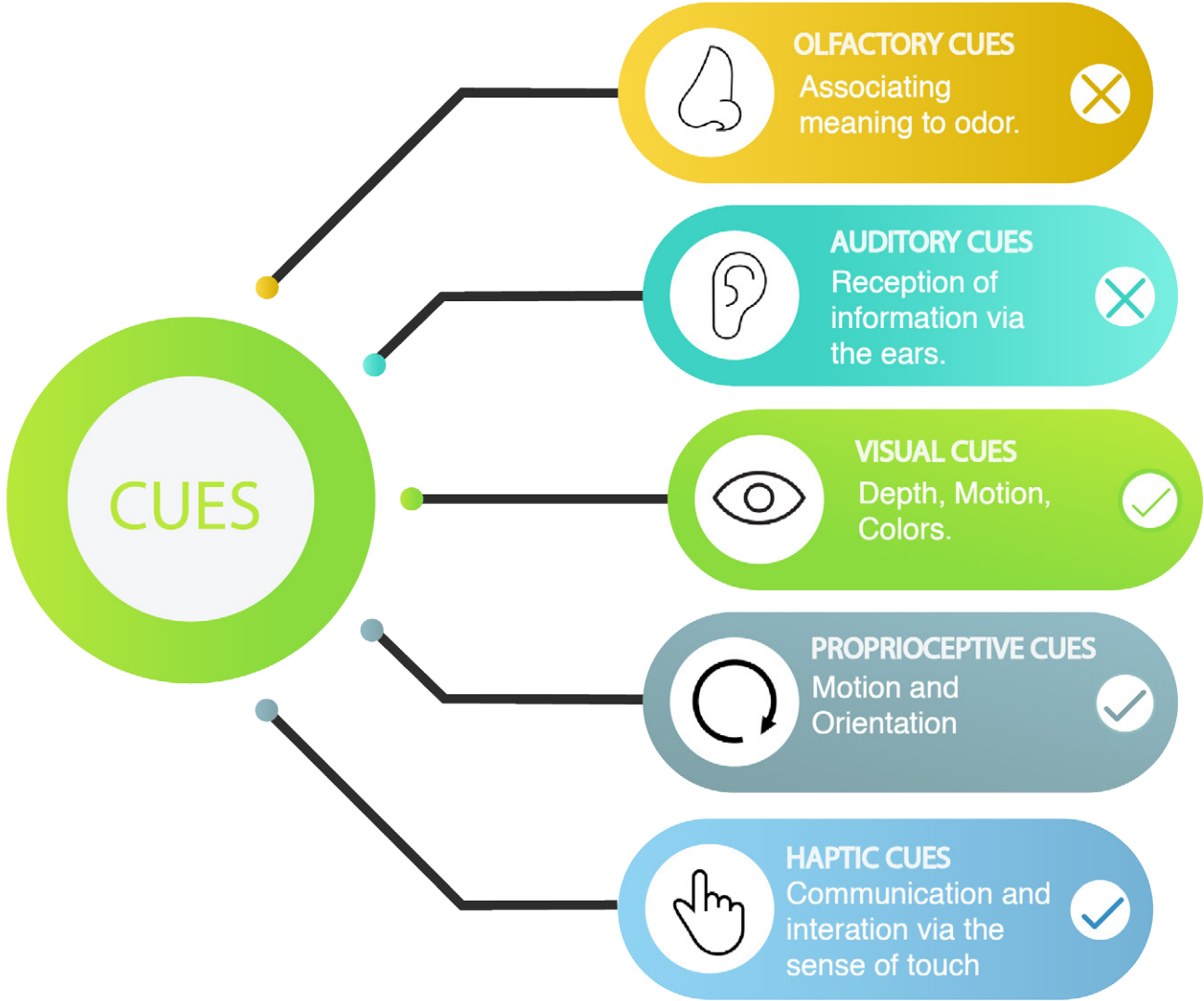
There have been several cases where athletes misinterpreted or completely missed the referee's signal.

In the 2012 London Paralympics, Olivia Breen came 5th overall in the 100m - T38. She did not perceive a false start being called in the first round, while the rest of the field stopped, she continued running.

There is an opportunity here to design an alerting system that will give referees the ability to get athletes attention in a faster and more effective way.

Sensory  
Cues

I started to look at the different senses and sensory cues that athletes who are hard of hearing could possibly recept to. Amongst those are the following.



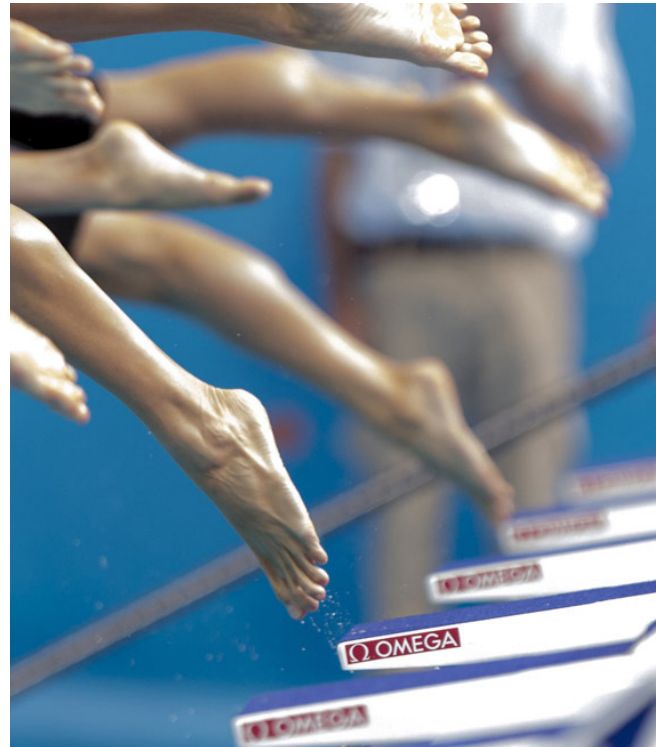
Out of these different sensory cues, visual and haptic cues are more appropriate when it comes to designing an alerting system for hard and hearing athletes.



## *Visual-based Alerting*

When considering ways to alert hard of hearing people using visual sensory cues, lights are a good way of getting people's attention. However in order for it to be effective, the light must be in the athlete's range of vision at all times.

Light-based alerting systems prove to be more effective in athletic games in which athletes are facing one direction.



Swimming is a good example



In Basketball it is a little different, depending on the type of court



## *Haptic-based Alerting*

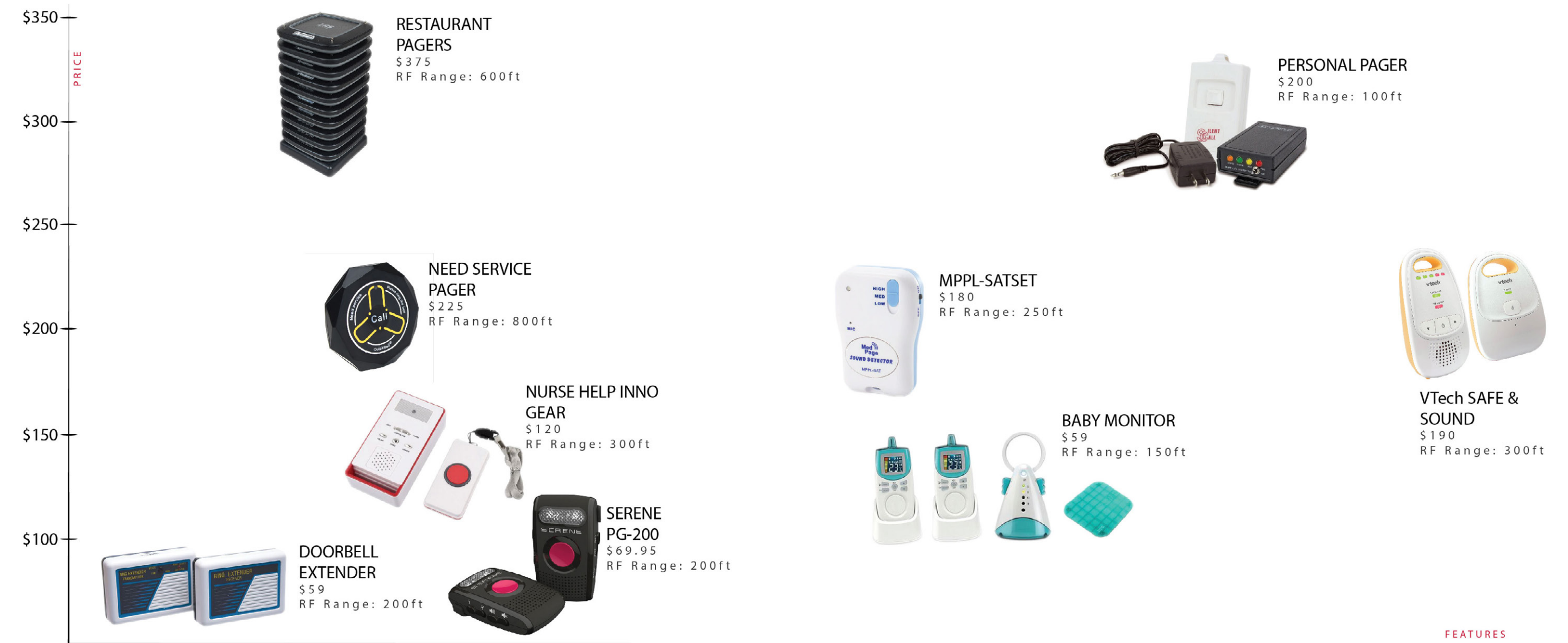
Another way to alert hard of hearing is through haptic feedback. Communication done through a vibration response.

After doing more research I found out there was already an existing market for haptic-based alerting systems that are designed for the hard of hearing.

Some of these products include door bell extenders, pagers intended to allow users to call for help, as well as baby monitors.



Market Research



## First Interview

### *Interview with Matthew Bujak*



Athletic Director of PSD

In an effort to acquire more information on communication problems that hard of hearing athletes have with referees, I had to conduct interviews.

I visited the Pennsylvania School for the Deaf and interviewed the athletic director, Matthew Bujak. Matt was an assistant soccer coach at Gallaudet University. He then coached soccer and basketball for 5 years at the Pennsylvania School for the deaf before becoming athletic director.



Basketball Team



The interview with Matthew lasted for about 40 minutes and it was very insightful. I started by asking him a few questions about his background, and dove straight to the issue. These were some of the questions and answers that stood out.

**Q:** “How do deaf players communicate with their coaches?”

**A:** *“Sometimes the coach is deaf as well and he communicates with the players using sign language, or sometimes it is a hearing coach and they would have an interpreter with them... or other times they would finger spell.”*

**Q:** “What are some of the problems that frequently happen on the field that you observed throughout your coaching years?”

**A:** *“Something common that would happen if there was a foul, in basketball, or soccer I guess, if there was a foul and the referee blows the whistle, or if they are trying to explain, the students don’t understand why they go the foul. Sometimes being the coach I could ask the referee why, and if I can get an explanation, I am able to explain it to the student athletes and then they would understand...”*

**Q:** “How does the referee usually signal the start of the game.”

**A:** *“Usually the referee would raise their hand and blow the whistle and we know that it is time to go, time to start... or if there is a foul they would waive their hands... sometimes you don’t see it, and then they keep playing, or another player, someone on the other team, we also help support each other to let each other know that time has been stopped... maybe they would have like a towel or something, and they will waive it, that does not happen often though.”*

## Preliminary Testing

### *First Attempts*

In order to start identifying which part of the body a vibration signal would be best felt during intense movements, I had to start testing.

First, I bought a few RC cars and tuned them to the same frequency so that they could all be responsive to a single remote control.

As much of a pain as it was, I dismantled these cars and tried to repackaged them into small wearable boxes. Unfortunately, they were too bulky and very uncomfortable to test with.

I then thought of gathering 6 or more friends, taking their phones and adding them all on a group chat. I would then make them play amongst themselves with loud music playing in their to distract their auditory reception as they play. Then send a group message to see if the vibration would catch their attention mid-play.

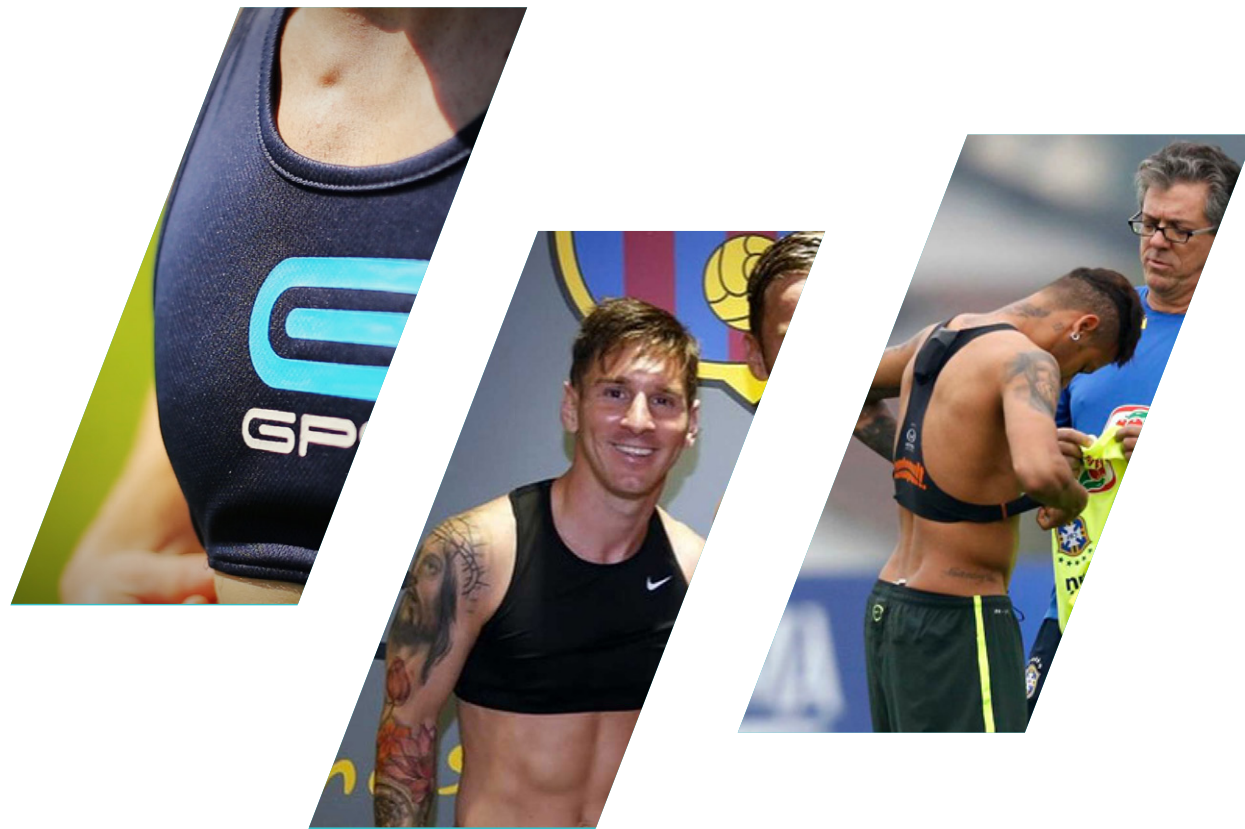
This seemed like a good test idea, but the vibration intensity of most phones from a single message can not be felt during intense movement.



## *Inspiring Trend*

While I was doing research, I fell on an interesting trend. Recently, the implementation of technology in sports has increased.

In Soccer, American football and other sports, athletes now wear performance trackers that allow coaches to keep track of players' fallbacks, and improvements.



To hold these performance trackers in place, the athletes wear what some mock to be the "man bra".

A Comfortable chest sports wear with a pocket on the back to house the trackers. Professional athletes all across different sports discipline use it during games.





## *Testing With a Pager*

Instead, I purchased a few sets of Serene pg-200 pagers along with several other accessories that allowed me to place the pagers on different parts of the body.



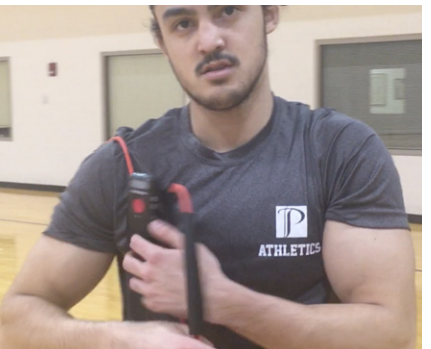
Some of these extra accessories included the following.



Knee Straps, Arm Straps, Posture Correction Straps, Contraction bands and more.



With these tools, I gathered some athletes from Philadelphia University and had them play different sports while wearing the pager on their upper arm, lower arm, chest, and on their back as well.



I tested for comfortability and for vibration intensity.



### *Basketball*

“it is a cool idea, make sure the material is soft so that that people do not hurt each other during play...”



### *Soccer*

“I feel the vibration on my chest. but it is restricting my airflow. However the arm works better.”

### *Basketball*

“I feel the vibration better on my arm..”



### *Baseball*

“I feel the vibration better on the arm because there is more skin contact. I can still feel it on the back, but it is not as intense.”





### *Basketball*

“I would rather have the device on my back, when shooting, both my arms feel free.



### *Baseball*

“I did not really feel it that well on the back.”

### *Basketball*

“I think the product is better on the arm, its much easier to feel...”



### *Basketball*

I would prefer it on the back, just because my arms are movng so much I may not always feel the vibration”







### Soccer

"I think that the arm is better, for sure!"



### Soccer

"I prefer it on my arm, It was a better visual for me, I could see it in the corner of my eyes."

### Soccer

"I think I feel it better on the arm"



### Volleyball

"I rather wear the device on my back."





### Soccer

"I feel it better on my arm "



### Soccer

"I feel the vibration much better on the arm."

### Soccer

"It is more effective on my arm, I feel it much better.



### Basketball

"it is a cool idea, make sure the material is soft so that that people do not hurt each other during play..."



## *Design Criterias*

1

### **WATERPROOF**

To protect circuitry from sweat & liquid damage.

2

### **FRAGILITY**

Must be strong enough to protect the circuitry from damage.

4

### **SOFTNESS**

Must be soft enough not to hurt athletes when they come in contact with one another.

3

### **RF RANGE**

Radio Frequency Range must be strong enough to cover 360 feet.

5

### **BATTERY LIFE**

Power must be able to last 2 hours and a half.

6

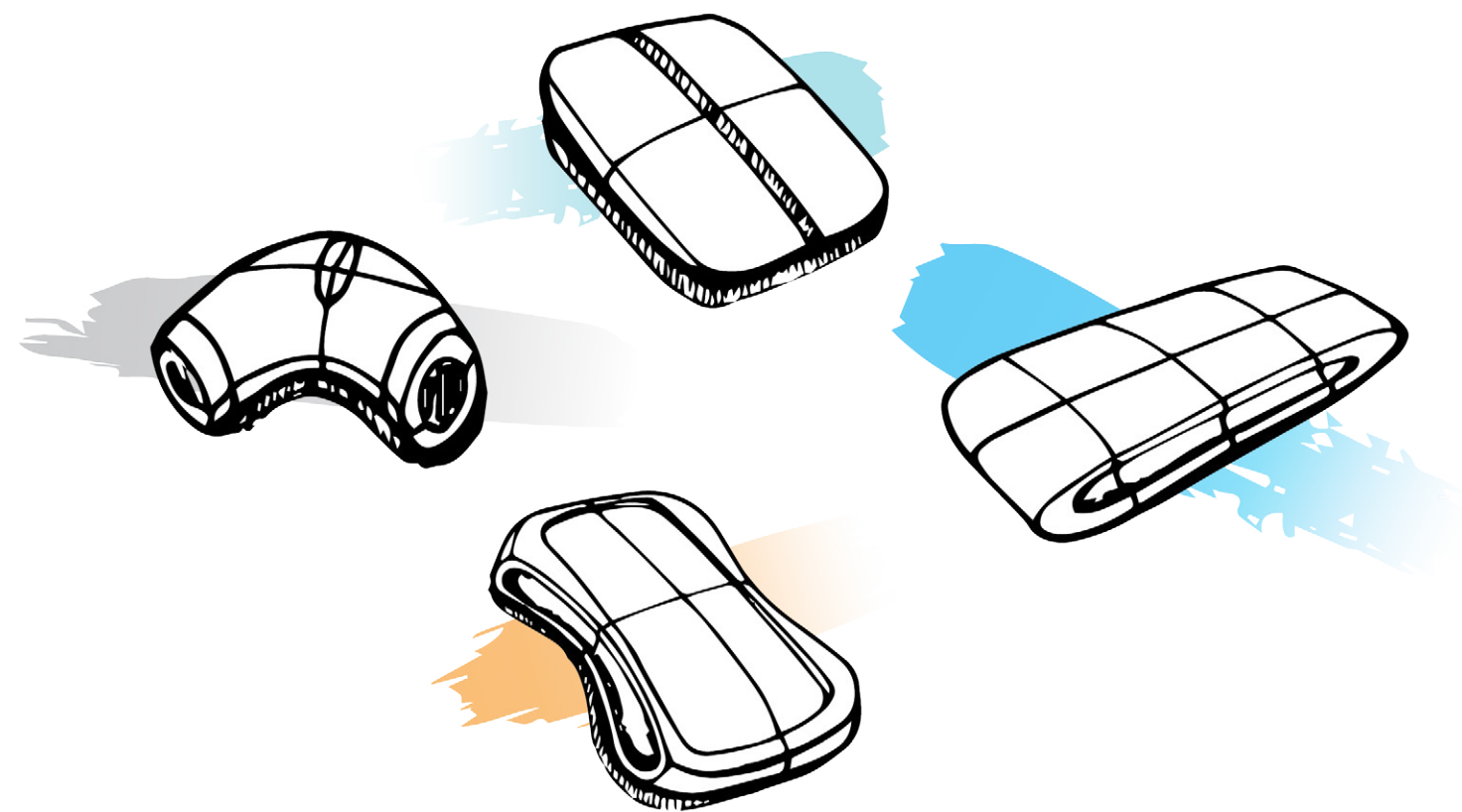
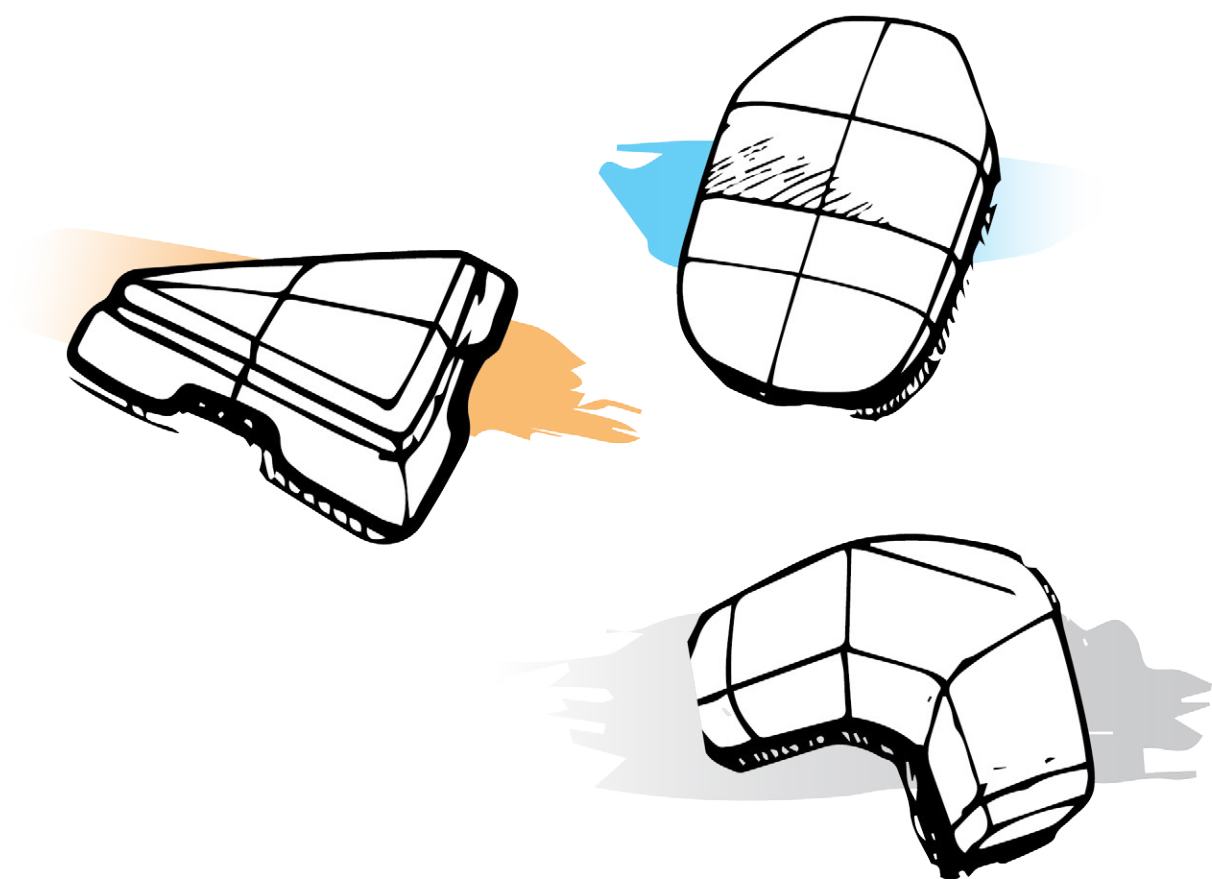
### **OLFACTORY CUES**

Product must be as seamless as can be.

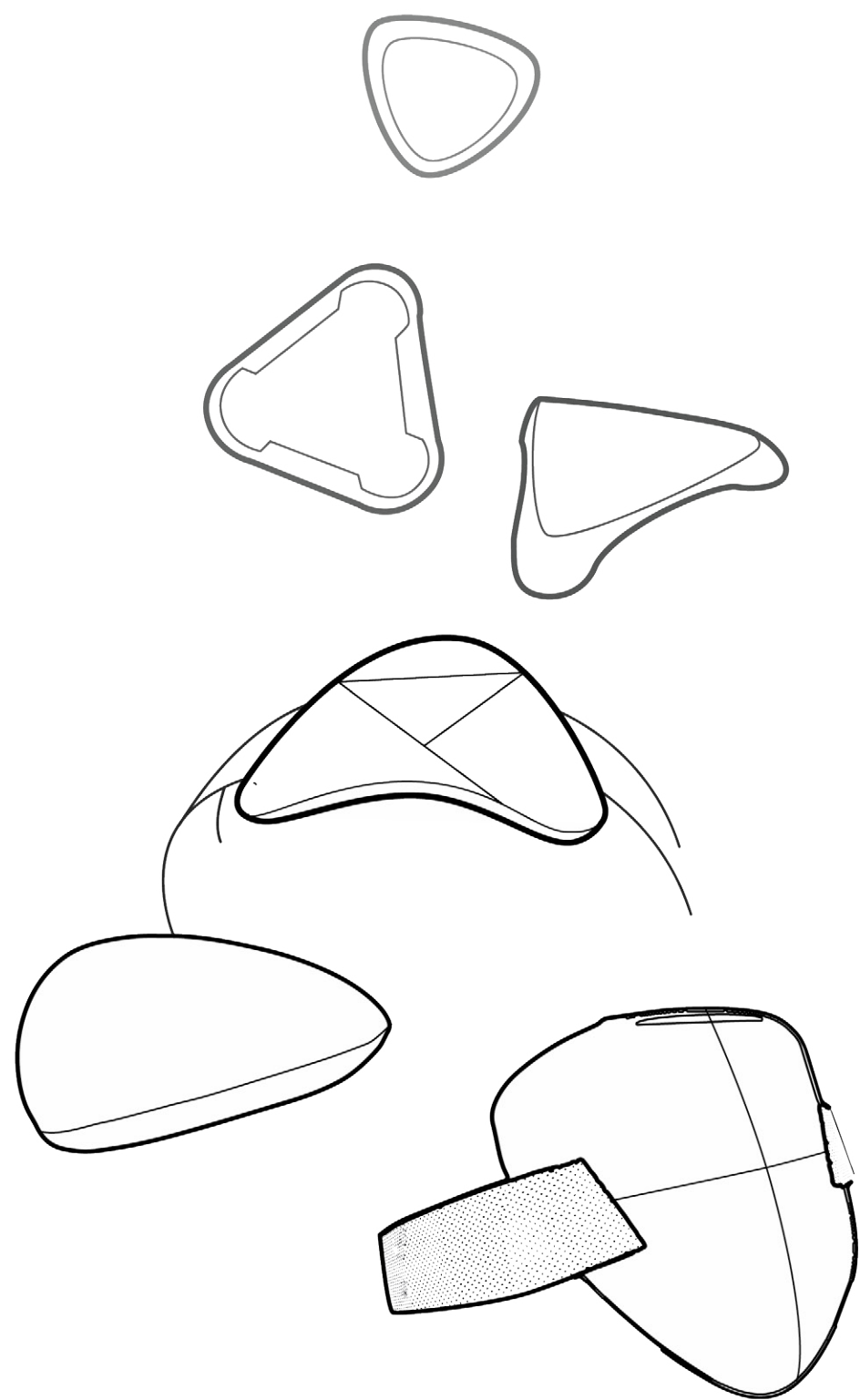


# Design Concepts/

## Form Exploration









## Technology Exploration and Development

One of the most convenient technology required to make the system work is Radio Frequency. With a simple Transmitter and a receiver tuned to the transmitter's frequency, one should be able to send a signal from one end to the other.

RF (Radio Frequency) Technology can be explained simply with the example of radios. The transmitter being the radio station antenna, and the receiver being a car radio, when you tune your car radio to a particular station your radio receives the signal from the radio antenna.

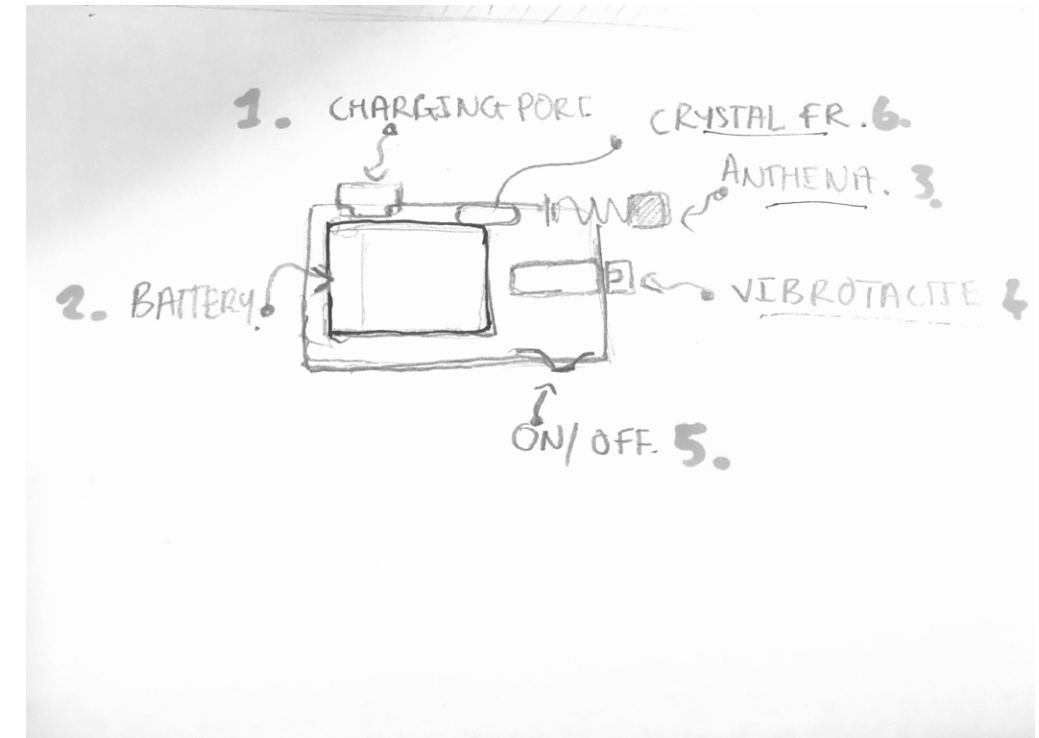
The best way for me to understand the technology was to buy a product on the market that already uses it.



The Serene PG-200 two-way pager was designed to allow deaf people to call for help with the press of a button. Upon realizing that this product did exactly what I was attempting to achieve but for a different purpose, I bought a few of these and unassembled it to figure out which components I needed to make my system work.



Taking apart the PG-200. Identifying the internal components that are necessary for the system to work.

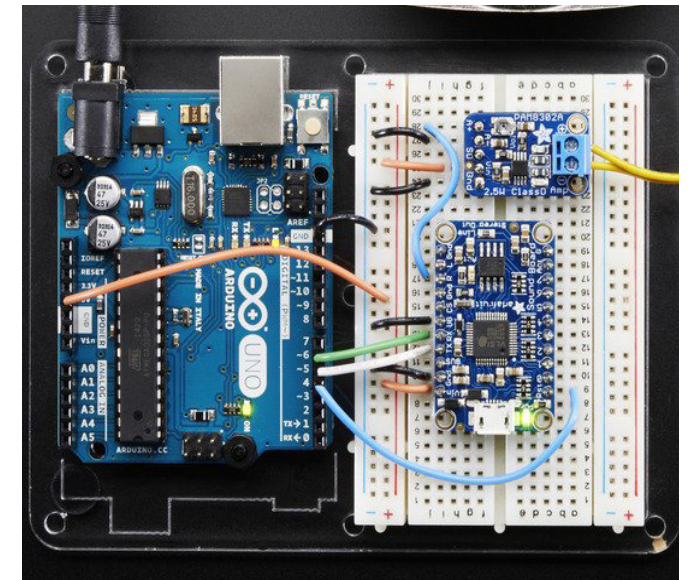
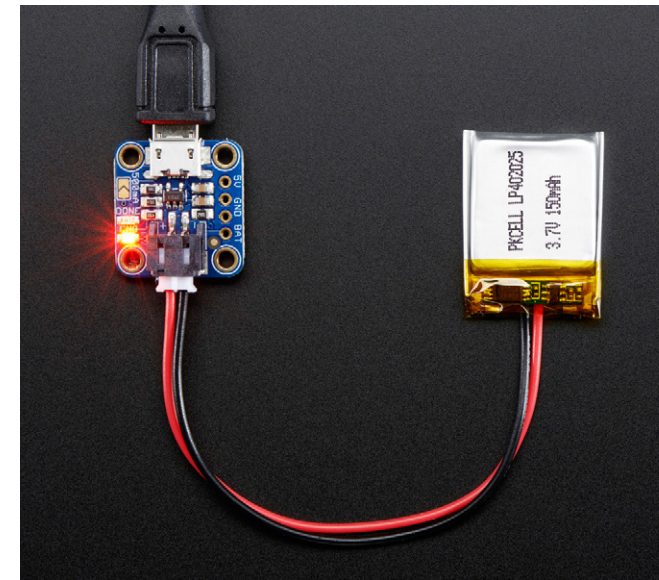
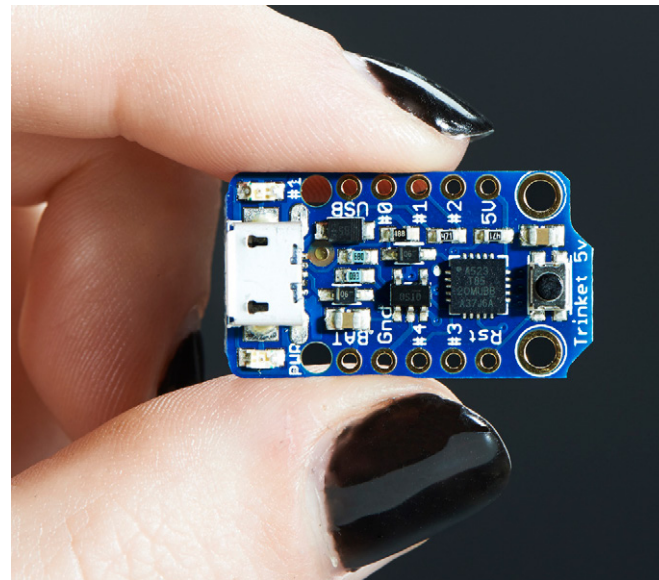


The next step was to buy scaled down versions of the essential components in order to have a small circuit board to work with.



Having a little to no knowledge in electronics, I began to seek for help. I started to watch tutorials and read through articles with the aim of gaining knowledge on how to build a simple RF system.

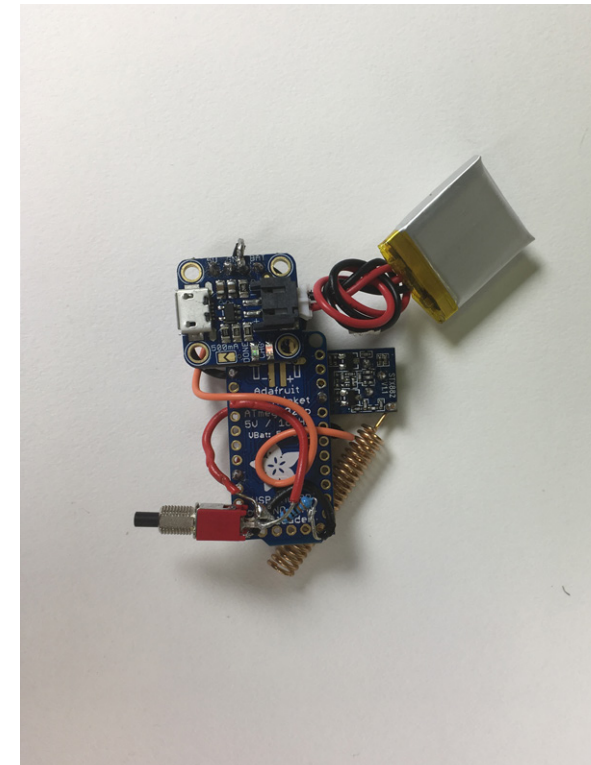
Throughout my research, I fell on Adafruit products, a company that focuses on producing small circuit boards for projects like this. With a little arduino programming, the system could be put in place. Their circuit boards are user-friendly. They make circuit assembly feel like playing with Legos.



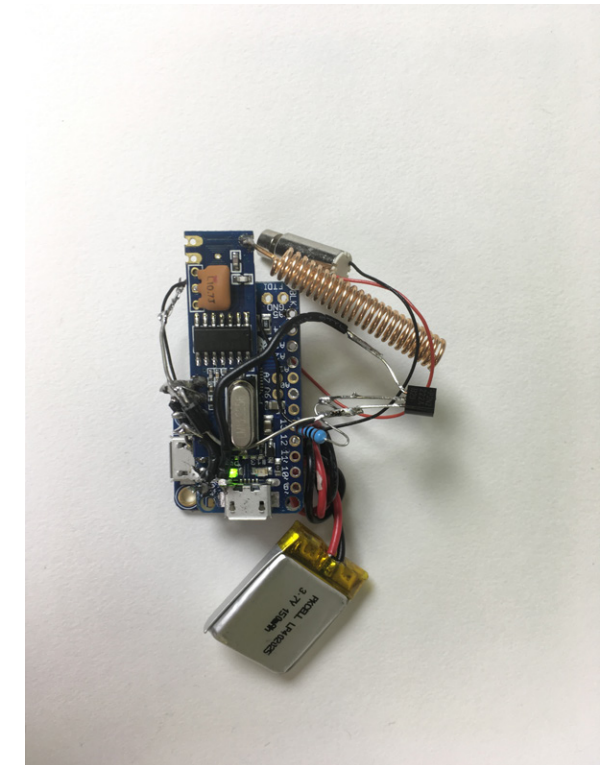


I was fortunate enough to make an encounter with an exceptional engineer who spent his free time building products to help people. Keliomer got very interested in the project, and spent a considerable amount of his time helping me learn the technology. Together we built about 4 working prototypes and I what I learnt, I was able to build two other on my own.

Keliomer works for a Laser company in Philadelphia. Having worked on similar projects in the past, it took us less tries than expected to be able to achieve the goal of building a small scaled working prototype. The triangular for of the design initially came to because that was the smallest shape in which we were able to compact the circuit board assemblies.

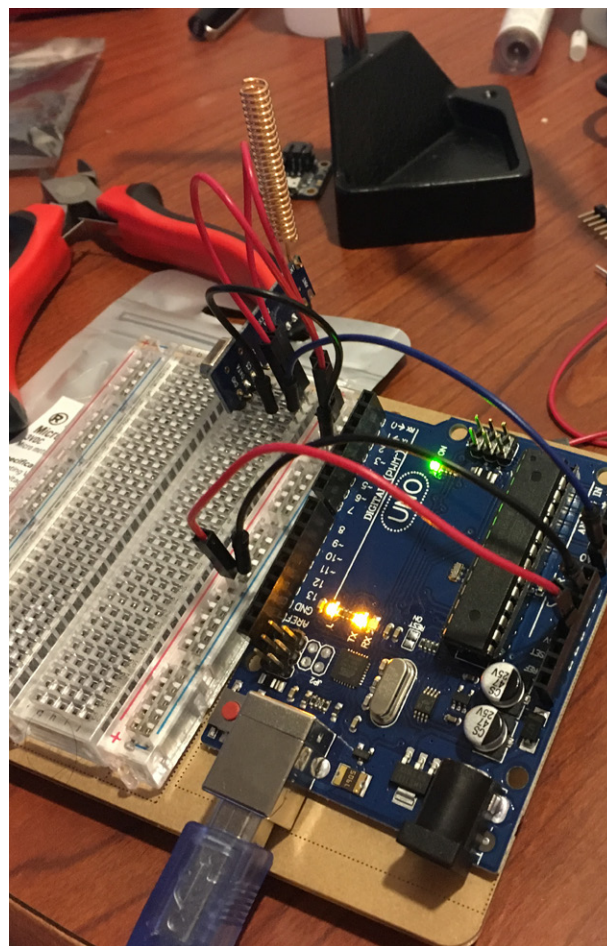


Transmitter

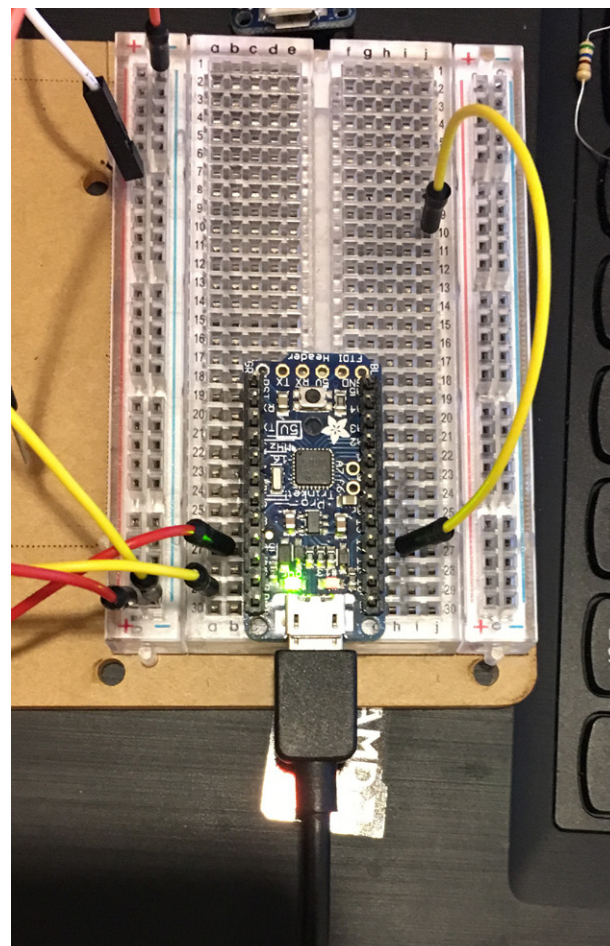


Receiver





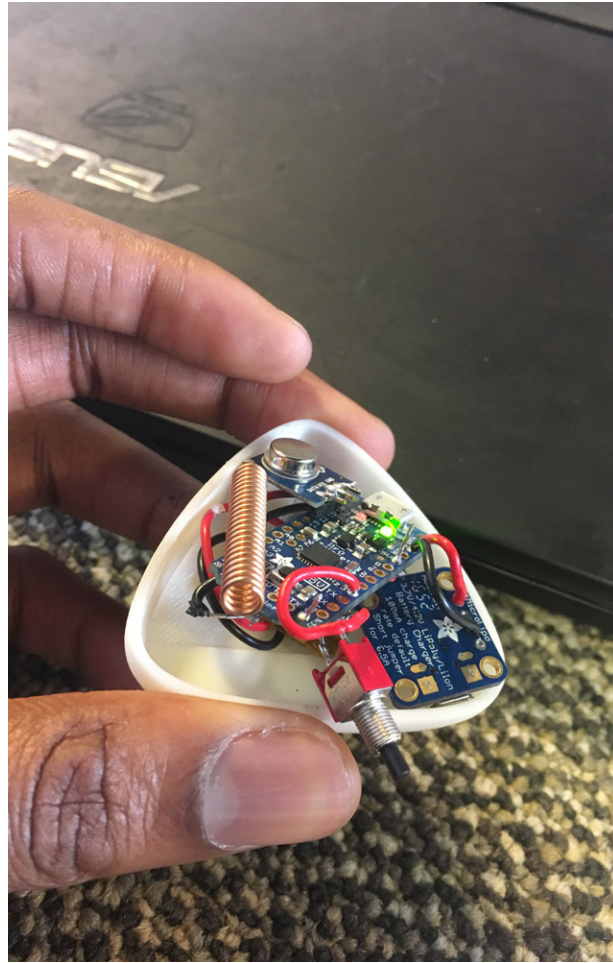
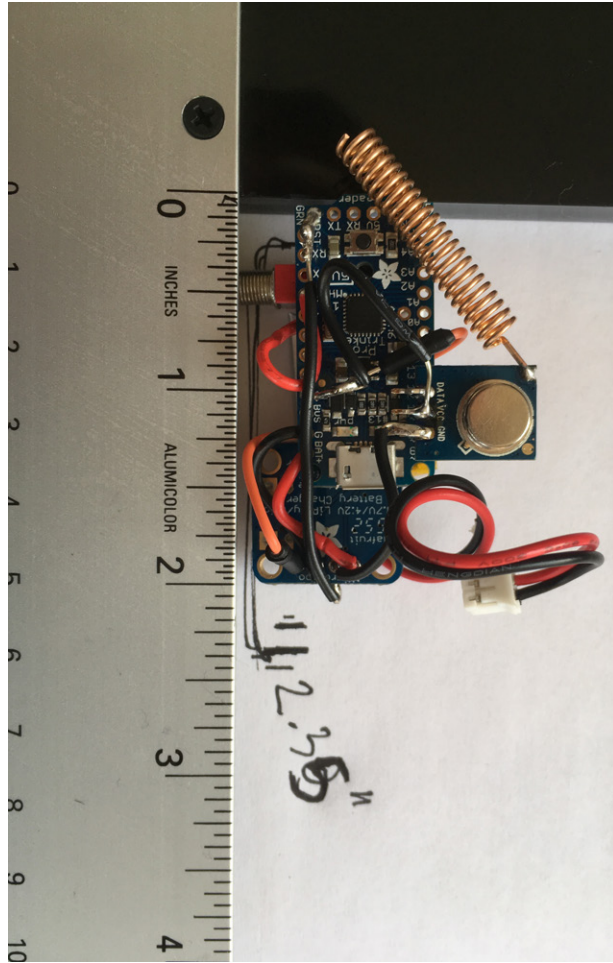
Testing the code with a breadboard



After running a few breadboard tests we know knew where everything needed to be connected. We then proceeded to soldering the wires to the right pins on the adafruit circuit board.









## Further Testing



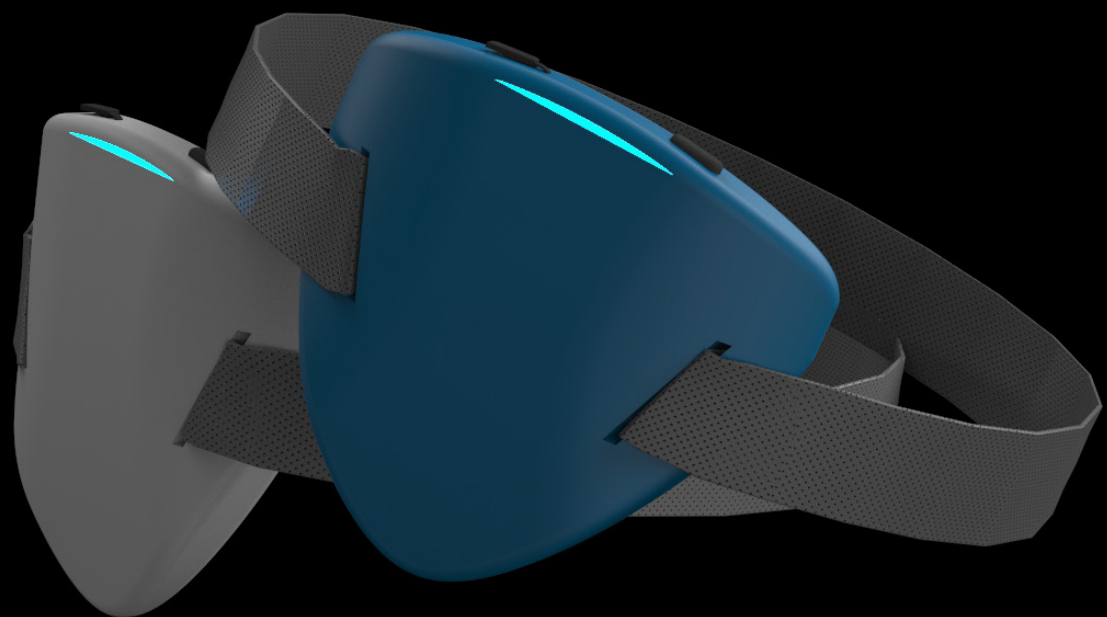
Nasir Ford & Jacob Cross

On my second visit to the Pennsylvania School for the deaf, Matt Bujak (Athletic Director) gave me the opportunity to test the first working prototypes with two amazing hard of hearing athletes Nasir Ford and Jacob Cross.

Unlike my previous visit, there was no interpreters available. In order to communicate Matt and I texted back and forth which worked perfectly fine.

I allowed them to play between themselves, and prompted them to stop and raise their hand if they felt a vibration while playing. I did this several times, and the prototype was effective Nasir and Jacob really like the idea they thought it could certainly make a difference in the interaction between teams and referees.



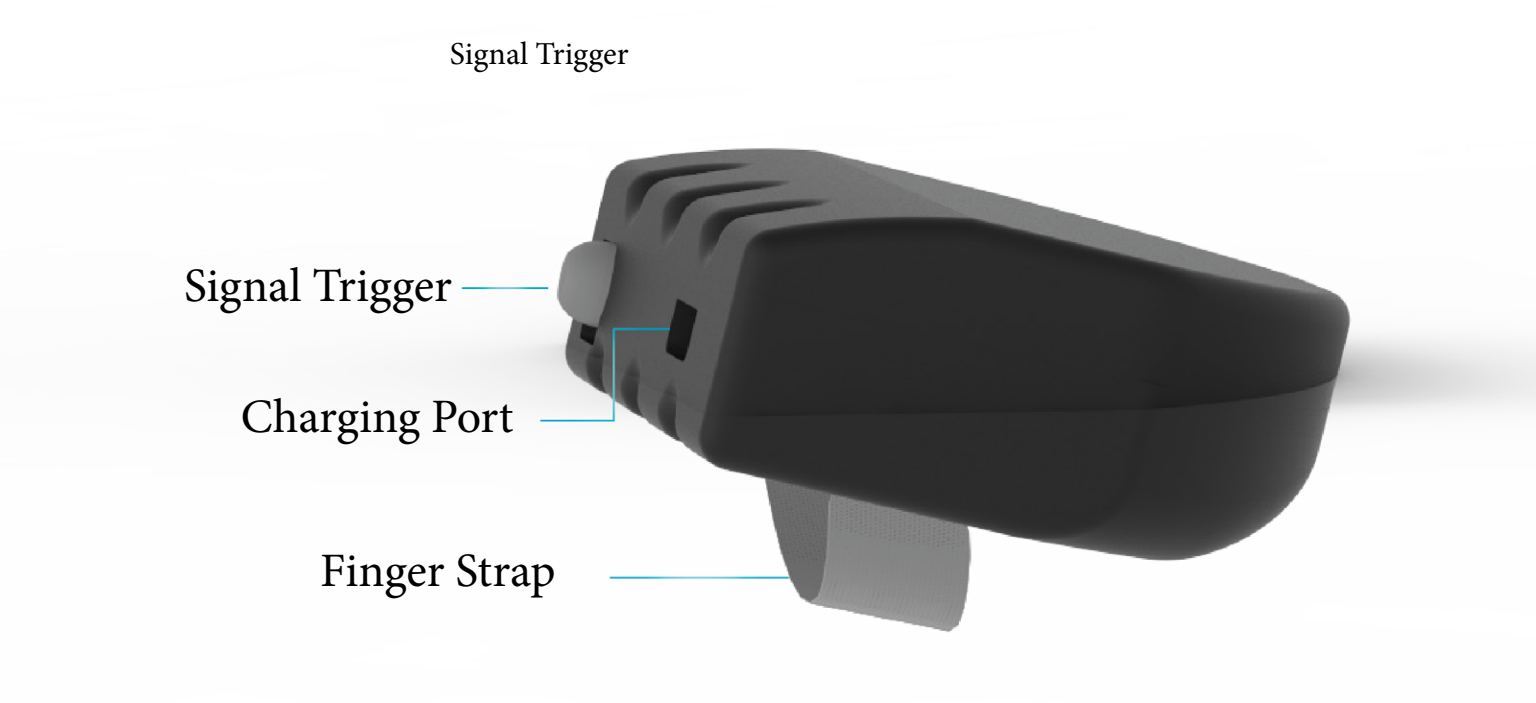
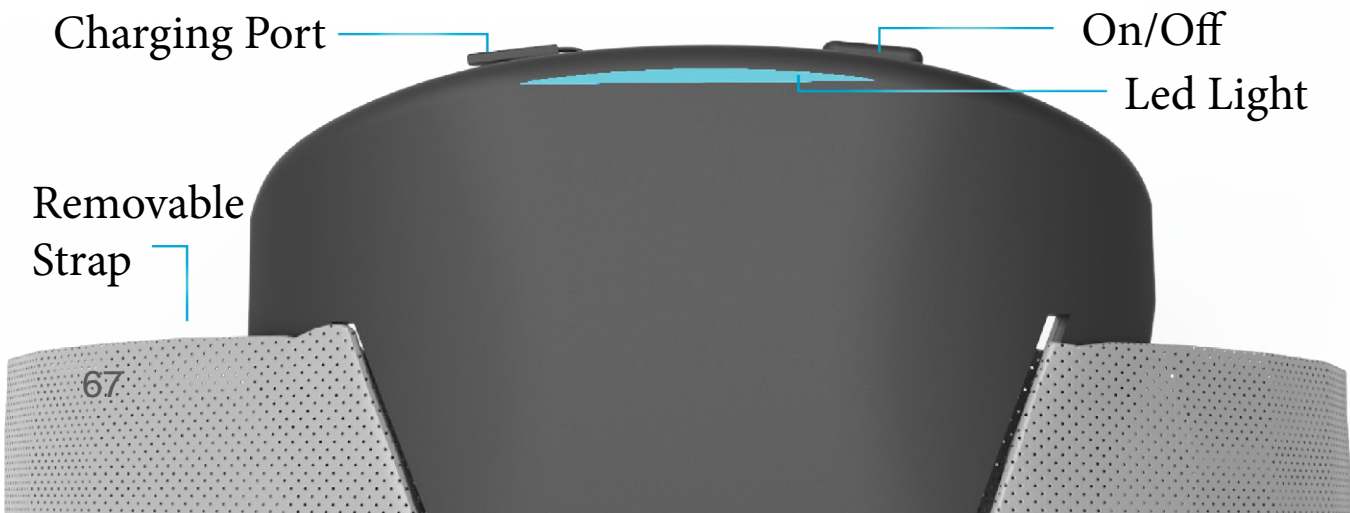




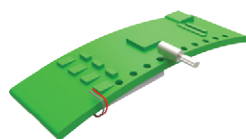
# Product Details

## Features/Tech Spec

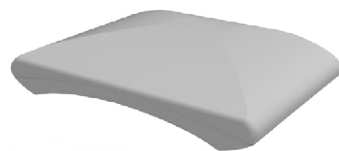
- Frequency Range: 360 ft
- Transmit Frequency: 868MHz
- Battery: 3.7V 300mAh
- Rechargeable/ Micro USB Port
- Batteries Last up to 2 hours 1/2



Manufacturing



Flexible Circuit Board



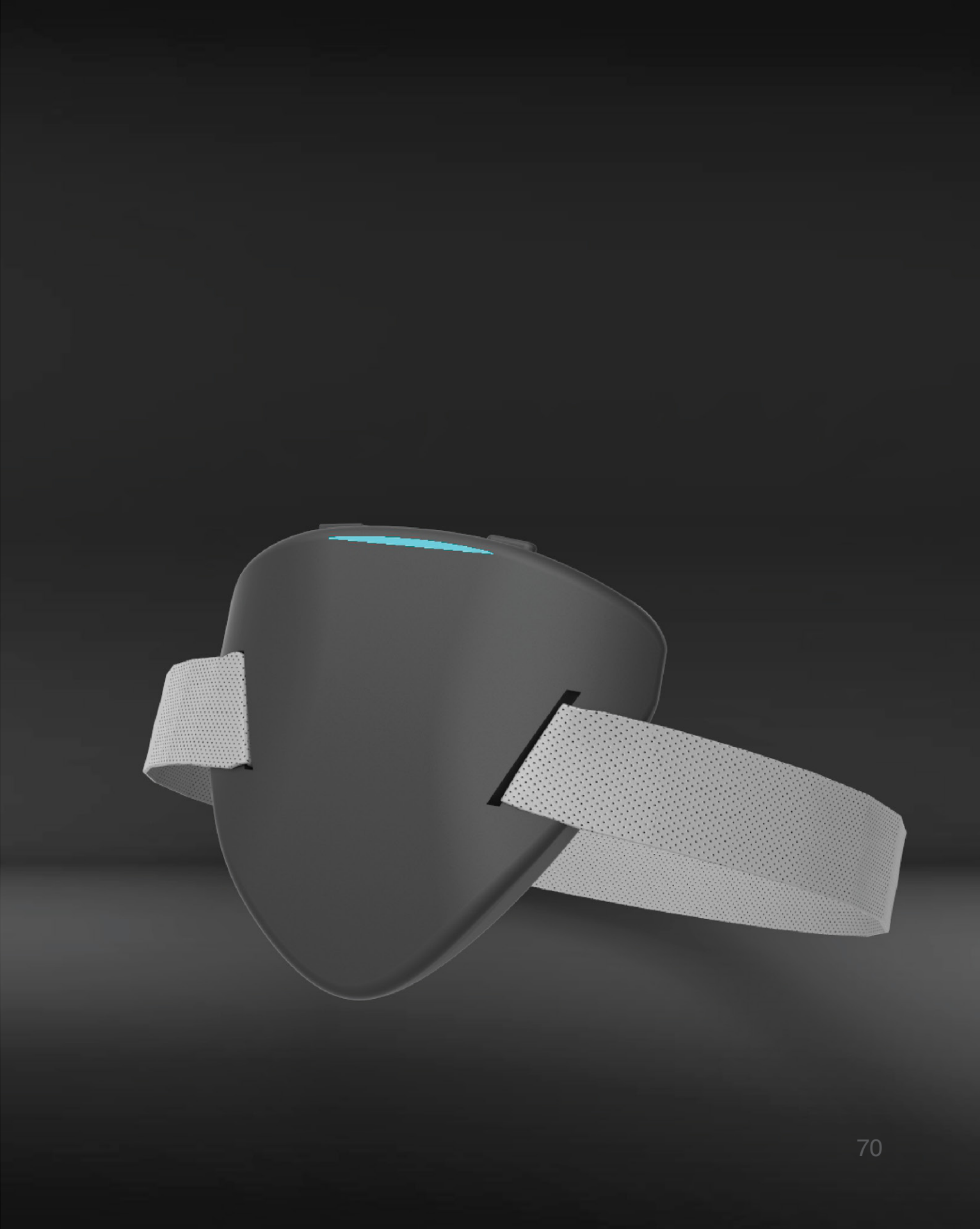
Hypersonically bonded  
in rigid polyethylene  
core shell



Overmolded in soft  
silicone rubber sleeve

Pricing

Single Unit :     \$38  
Set of 12 With  
Referee Trigger: \$399













# Network



**Matthew Bujak**  
*Athletic Director At The Pennsylvania School For The Deaf*



**Joshua Pagan**  
*Student At Philadelphia University  
Junior Referee*



**Keliomer Castillo**  
*Engineer/ Programmer*



**Nasir Ford**  
*Student Athlete At The Pennsylvania School For The Deaf*



**Jacob Cross**  
*Student Athlete At The Pennsylvania School For The Deaf*



Justin Sieble

*Industrial Design Professor.*



Todd Kramer

*Industrial Design Professor.*



Jonathan Spindle

*Engineer Professor.*



Mark Havens

*Industrial Design Professor.*



Michael Leonard

*Industrial Design Professor.*



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This project explores the communication problems that hearing impaired athletes may face during a game. It will also identify an area of opportunity and propose a product solution to address these communication problems.