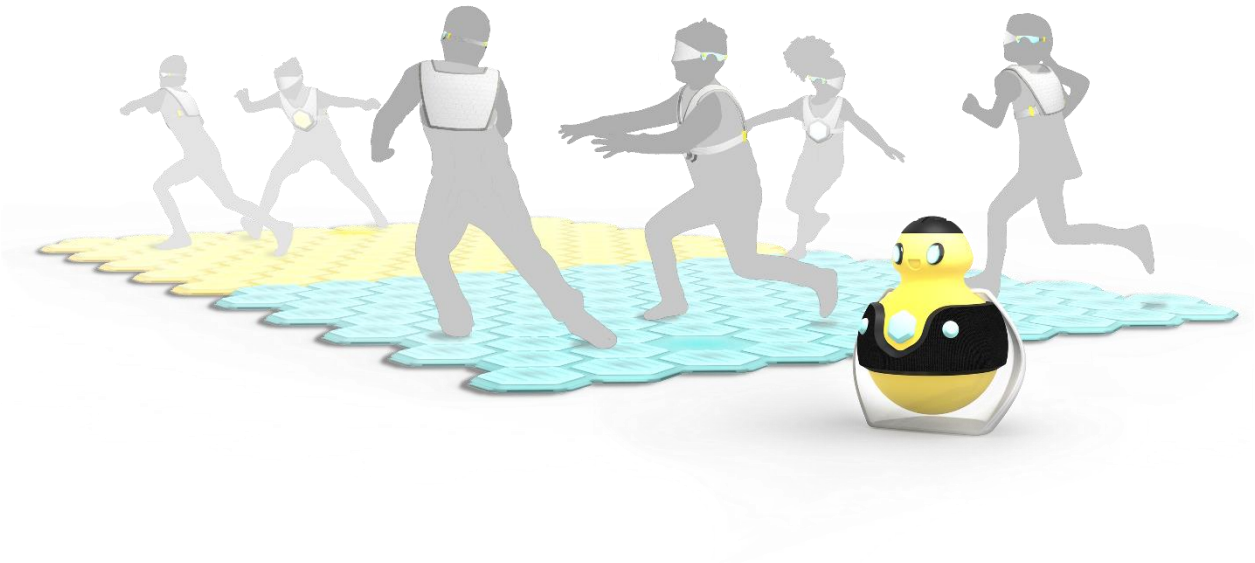
AVI

Activities for the Visually Impaired



CHARLOTTE WATKINS

INDUSTRIAL DESIGN THESIS REPORT

ACTIVITIES FOR CHILDREN WITH IMPAIRED VISION

by

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Submitted in partial fulfillment of the requirements for the degree of

Bachelor of Industrial Design

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ABSTRACT

Physical activity in an average child's development and daily routine is important for their physical and mental growth. It is no less so for children with impaired vision. This demographic isn't getting enough active play due to the lack of resources and tools to encourage them to stay active. Currently, there are little to no easy, affordable, and group integrated solutions for active play which cater towards children ages 8-12 with impaired vision. Often sitting these activities out, visually impaired children eventually lose their confidence and develop anxiety participating in active games. With new emerging technologies, how could current concepts be improved and catered towards physical activity and physical education to encourage children with impaired vision to be active with their sighted and non-sighted peers? This thesis proposes in-depth studies of current problems and solutions visually impaired children face when participating in active play by using methods such as interviews, surveys, and observational studies. Scaled modeling and exploring ergonomics will solidify proper human factors and full-bodied interaction designs as this thesis is directed to children. The solution to be developed for visually impaired children will encourage more active play and physical activity to enhance their physical, emotional, and social development and well-being.

Keywords: Physical activity, visual impairment, children, confidence

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CHAPTER 1 INTRODUCTION

Figure 1- Kid sitting out in gym class

1.1 PROBLEM DEFINITION

The problem being addressed is the lack of games catered towards children with impaired vision. With this absence, it could affect their developmental and social growth they depend upon to have what is known as a successful and fulfilling life. Without catered games and activities, these children develop a lack in self confidence which deters them from participating in future sports (DeBoer, 2022). When visually impaired children are integrated into mainstream schools with limited visually impaired resources, they are often left out in crucial physical education opportunities such as gym class or don't participate in active recess play (Chodosh, 2016). Oftentimes not participating in physical education is often caused by an inflexible curriculum or being unaware of alternative solutions.

This thesis report will explore the current and future opportunities within the visually impaired community between ages 8-11 to support design decisions made to establish this thesis.

1.2 RATIONAL & SIGNIFICANCE

To grasp a better understanding of the type of users and their relationship with physical activity, research about the following topics and questions needs to be established:

- What are the current solutions to physical activity for the visually impaired?
- Adaptive tools for the visually impaired
- What does visually impaired physical education look like?
- Do children want to play active games in their free time?
- What would ergonomics for children 8-11 look like?
- Games & sports popular for sighted children

Tools that will help establish these research findings are the following

- Scholarly articles
- Product benchmarking
- Parental blogs
- Surveys
- Interviews
- User Observations
- Ergonomic studies
- User activity mapping

These research tools and findings will provide understanding of the user and give context that supports this thesis.

1.3 BACKGROUND/HISTORY/SOCIAL CONTEXT

On average children should be receiving at least 60 minutes of moderate to vigorous intensity physical activity each day. However, visually impaired children aren't given the same opportunity as their sighted peers to stay active especially in schools, discouraging children to do so in their free time. Without physical education or activities, this takes a toll on children as it delays development such as motor skills and motor development (Stuart, Lieberman, Hand, 2006.

About 2.6% of children ages 6-14 in Canada have a visual impairment that can't be corrected (Statistics Canada, 2020 and 55% of those who are visually impaired are women and girls (VLEG, GBD, 2020. For these children, there are few adaptive active games and sports they can easily participate in. These sports include Goalball; a sport only for those who are legally blind (International Paralympic Committee, 2022, Beep Baseball; an adaptive version of baseball for the visually impaired (National Beep Baseball Association, 2022 and individual sports such as swimming, running (with a guide runner, and gymnastics to name a few.

For visually impaired children in Canada in particular, there are resources and teacher aids that can be implemented into mainstream school however there is only one school in Canada that caters specifically for the visually impaired. The W. Ross MacDonald school for the blind, located in Brantford, ON, Canada is the only school in Canada that adapts everything such as academic classes, practical classes, and of course physical education for children from kindergarten to grade 12 for them to be successful.

CHAPTER 2 RESEARCH

2.1 USER RESEARCH

To ensure the targeted user's needs, it's important to understand their likes, dislikes, behaviors, and lifestyle.

2.1.1 USER PROFILE-PERSONA

2.1.1.1 PRIMARY- VISUALLY IMPAIRED CHILDREN AGES 8-11

The primary users are children with visual impairments ages 8-11. These are the primary users as this product is catered specifically for those who are visually impaired. They are often in school and socializing with friends, however they may not be playing physically demanding games with their sighted peers. When they do get active, they often participate or compete in individual sports that accommodate their needs.

2.1.1.2 SECONDARY- SIGHTED CHILDREN AGES 8-11

The secondary users are sighted children ages 8-11. These children are secondary users as they also play and socialize with children in their school that are visually impaired. They are in school and often enjoy classes such as gym and like to play games such as dodgeball and going outside for recess to play on the play

structure. Outside of school they like to play with friends in the backyard and play team sports such as soccer or basketball.

2.1.1.3 TERTIARY- PHYSICAL EDUCATION TEACHERS, PARENTS, AND GUARDIANS

The tertiary users are adults such as physical education teachers, parents, coaches, and other guardians. These users are interacting with children of a variety of ages with a variety of skill sets and abilities. They encourage children to do their best when it comes to staying active, however they aren't educated in ways to adapt sports and games to kids with disabilities such as impaired vision.

2.1.1.4 PERSONA

Name: Sally Smith

Age: 10

Education: Grade 5

Location: Ottawa, ON

Main hobby: Dancing

Figure 2- Girl with glasses

Frequency: Most weekends and after school

Duration: 1 ½ hours

Social: Mostly with her friends, sometimes solo

Other Activities: Somewhat active lifestyle. Swimming in the summer and can participate in gymnastics at school.

2.1.1.5 PROFILE

Sally Smith is 8 years old and in the fifth grade. She loves spending time with her friends and going to dance class.

Sally loves dancing and other rhythmic sports like swimming and gymnastics. She started dancing because her parents always saw her dancing whenever the music was on, so they signed her up for classes every weekend.

Sally has been in dance classes since she was 5 and would like to continue her passion and maybe even go competitive.

2.1.1.6 USER BEHAVIOR

Sally dances on weekends with her club during fall, winter, and spring. During the summer she takes swimming lessons and does other dance camps with some of her friends. When Sally dances she typically needs another guide besides the dance instructor to help her get the moves right. Her friends can get the hang of the moves faster than Sally can because they are able to see the dance teacher, but her friends will help her practice outside of class. After dance class Sally and her friends go back home or play for a bit while their parents continue chatting.

2.1.1.6.1 SALLY'S RELATIONSHIP WITH DANCING

Sally really loves dancing but can get frustrated when she compares herself and the pace she learns compared to her friends and the rest of the class. She often feels singled out because of her guide and would like to fit in like the rest of the class. However, when she has the moves down pat, she thrives in her creative bubble and loves the music she can dance to.

2.1.2 CURRENT USER PRACTICE

Overall, daily tasks that visually impaired children do compared to sighted children are relatively similar. They go to school, learn, eat, play, socialize just like all children with the occasional adaptation here and there. The main difference is navigation and the use of tools. Often children with impaired vision use tools to navigate around their schools, homes, and outdoor/indoor environments such as white canes, guide dogs, or human guides (Barlow, Carter, 2009).

2.1.3 USER OBSERVATION- ACTIVITY MAPPING

2.1.3.1 INTRODUCTION

A user observation was conducted at the W. Ross MacDonald school for the blind in Brantford, ON Canada. The observation goal was to identify what children with

impaired vision enjoyed doing during their free time such as recess, as well a tour of the school and the tools they provide the students. The user observation was ended by a lesson provided by Heather DeBoer, an orientation and mobility teacher at the W. Ross MacDonald school to simulate being visually impaired and how to navigate using human guides and other navigation tools.

2.1.3.2 USER OBSERVATION- FIELD NOTES

The following are field notes and takeaways from the user observation.

Indoor Recess

- 5 students in grades 2-3.
- Children rock themselves when standing.
- Limited active play, most children play sitting or standing.
- Identifying toys by touching.
- Lots of large toys like yoga balls, gymnastic blocks.
- Toys are bright and often primary colors.
- Toys include kitchen set, metal teeter totter, plasma cars, small trampolines, yoga balls, wooden trains and blocks.

Outdoor Recess

- 10-12 students, grade 5-6.
- 1:1 staff to student ratio.
- Kids love the swings.
- Touching bird houses, trees, and leaves.

- Partially sighted kids played freeze tag.
- Kids holding each others' hands and guiding peer to where and what object they are feeling.
- Students leave white canes at gate.
- Play structure was average but bright and colourful.
- Regular swing sets and wheelchair accessible swing sets.

Features in the School

- Transitions of floors- regular hallways had bright rubber floors with white stripe for contrast, intersections of hallways were wooden to identify different sounds & texture.
- Walls have 18-20" wooden panel railings to navigate, at intersection there is Velcro on panels.
- Gym has upper level with circular track with wall rails.
- School has every sport accessible to students.
- School has different lights in hallways to help differentiate different hallways, some students see better in different lighting.
- They offer classes that teach how to cook, do laundry, navigate around the city.

Orientation & Mobility Lesson Takeaways

- Kids follow sound cues over touch cues.
- Most kids often have very blurry vision or black hole in part of sight.
- The bigger the object, the easier it is to identify what the object is.
- Group integration with visually impaired and sighted kids is better.
- Kids love the Bop-It.
- These kids often lack the confidence to play sports because 1: they've never played or 2: they don't want to get potentially hit.
- Besides W. Ross MacDonald School or blind camps, visually impaired children aren't often in situations where they are in large groups of visually impaired kids.

- Kids only understand objects and concepts based on description, sounds, and touch.

2.1.3.3 USER OBSERVATION- ACTIVITY MAP

	Finishing Class	Getting to cubby	Waiting to go outside	Playing on Swing set	Going back inside
User Goals	Leaving class in time	Getting on outdoor clothes	Going outside	Playing on the swing with friends	Gathering all belongings to go back inside
User Actions	Packing up pencil case and clearing desk	Putting on outdoor shoes and coats	Getting in line with class and guide	Putting white cane down, grabbing friends and swing together	Getting white cane with help of their guide
User Thoughts	"I can't wait to go and play"	"Is it raining outside?"	"How much longer?"	"Can I swing higher?"	"I can't wait for next recess" "I'm hungry"
User Feelings	Excited	Frustrated	Impatient	Happy	Content
User Experience					
Problems/ Challenges	Not knowing who they will play with or what they will play	Tying up shoelaces, doing up coat zipper	Getting impatient waiting to go outside	Not many game options besides swinging	Sad to go back inside, not enough physical activity
Ideas/ Takeaways	Kids love to get out and play	Kids take a long time to get ready	Kids are impatient	Kids only enjoy swinging	Kids love recess so they should maximize their physical activity

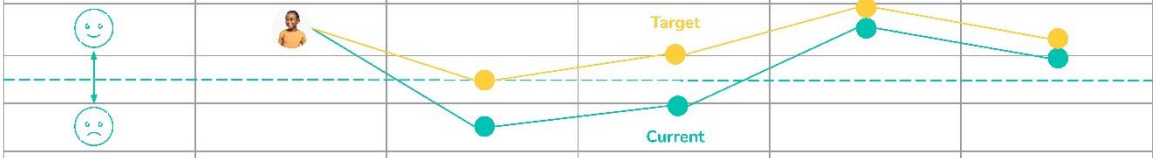


Table 1- Activity Map

The table above demonstrates the process the user might have and feel in the process on getting ready for recess, going out for recess, and coming back inside.

2.1.4 USER OBSERVATION- HUMAN FACTORS OF EXISTING PRODUCTS

During the user observation at W. Ross Macdonald, many of the existing physical activities remained the same compared to a mainstream school. Tools that the school for the blind offered were railing when running, goalball, balls with bells, and partnered running/skiing. The way they adapted sports such as soccer or basketball included running with kids' arms placed in front of them while yelling so other children around can hear who is near them. However, when discussing with one of the teachers at W. Ross Macdonald, it's not

the most ideal way to play sports. During recess it was clear that children with impaired vision most enjoyed going on the swings since the children enjoy the swaying motion as well as playing on the play structure since the kids can enjoy a more physical and sensorial interaction.

2.1.5 USER OBSERVATION- SAFETY AND HEALTH OF EXISTING PRODUCTS

With deteriorating vision, objects around the home, or at school can become hazardous as visually impaired children are still learning to adapt to navigation. Therefore, AVI should be able to consider safety aspects such as

- Using bright coloured lights
- Using non-slip textures on the ground
- Incorporate larger sized features for better grip and understanding
- Have contrasting colours
- Incorporate the use of sound for navigation

2.2 PRODUCT RESEARCH

While some existing products that visually impaired are not necessarily designed for the visually impaired, they are still useable by this demographic. The following section shows the research on products related to this thesis.

2.2.1 BENCHMARKING- BENEFITS AND FEATURES OF EXISTING PRODUCTS

A categorization of features and benefits of visually impaired friendly products was needed to help determine the key terms to better analyze which terms should be used when designing for the users. The promotional material and description were gathered from each benchmarked product, gathered in a spreadsheet, and sorted by the word frequency. The results of this categorization are shown in tables 2 and 3.

Key Benefits of Comparable Products	
Keyword	***Frequency***
Comfort	9
Style	17
Ease	15
Safety	20

Table 2 – Key Benefits of Comparable Products

Key Features of Comparable Products	
Keyword	***Frequency***
Measurements	16
Components	16
Finish	7
Materials	5

Table 3- Key Features of Comparable Products

2.2.2 BENCHMARKING- FUNCTIONALITY OF EXISTING PRODUCTS

The following table (see table 4) includes existing products and how they range in comparison to each other based on functionality. The table displays the products on an XY axis of functionality, the Y axis being products that incorporate more intricate and smaller compared to the X axis being products that are more simple and larger in size.

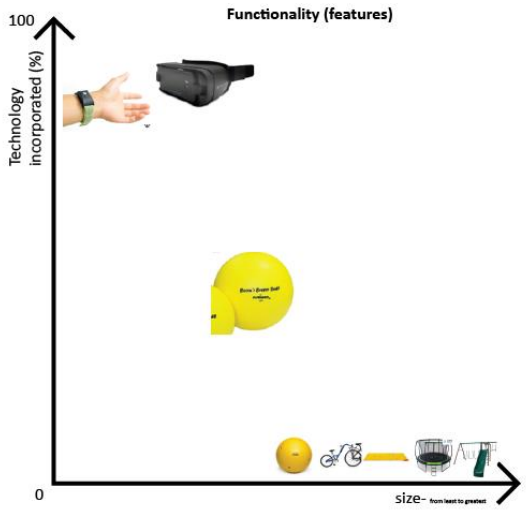


Table 4- Functionality

2.2.3 BENCHMARKING- AESTHETICS AND SEMANTIC PROFILE OF EXISTING PRODUCTS

Many products that are designed for children and especially those with visual impairments are often bright in colour and large as these features are easier to identify for someone with low vision. Larger scaled objects allow for larger details which can be identified by touch and through the limited vision that these children have. This is justified by the examples listed in the table above as these auditory sport balls are both bright yellow and larger in size.

Table …. Organizes benchmarked products based on forms using an XY table. To the left of the X-axis represents rectilinear forms, and the right represents cylindrical forms. The top of the Y axis represents cylindrical forms, and the bottom is triangular.

Tables 5 and 6 organize benchmarked products based on types of interactions using an XY table. On the left of the X-axis are products using push buttons, and to the right are products using sensory indications. The top of the Y-axis are products using dials, and the bottom are those using sound indications.

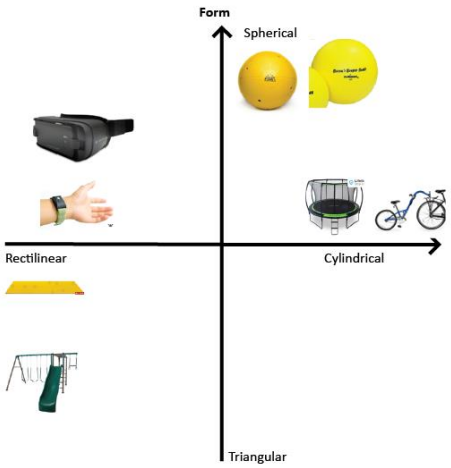


Table 5- Form

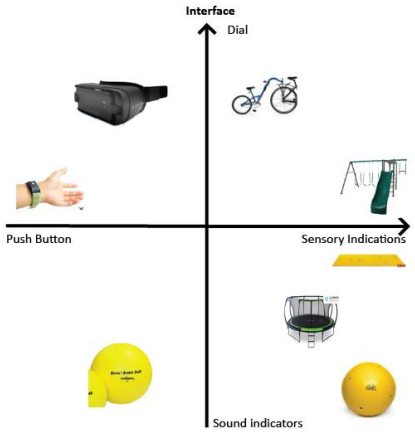


Table 6- Interface

2.2.4 BENCHMARKING- MATERIALS AND MANUFACTURING OF EXISTING PRODUCTS

								
	1	2	3	4	5	6	7	8
	Iris Vision live	LIFETIME Swing Sets	ISA Goalball with bells	Kazoo Tandem bike	BOOM'R Beeper Ball	Rousettus VIYM Yoga Mat	JumpFlex Trampoline	Wayband

Benefits								
	-Technically superior -Highly sophisticated -Accessible	-Easy to maintain -Designed for safety -Comfortable	-Comfortable -Easy to grip -Bright	-Secure -Lightweight -Adjustable	-Loud -Soft -Lightweight	-Easily transportable -Intuitive tactile -Comfortable	-Safe -Spacious -Durable -Stable -Bouncy	-Durable -Stretchy -Comfortable
Features								
Ages	15+	3-12	12+	4-10	4+	8+	100-300	16+
Special Features	-12x magnification -High contrast colour modes -Wireless charging built in	- UV resistant - Free standing - All-weather resistant	- Textured outer surface - Internal metal balls - 8 holes in outer shell to help transmit sound	- Adjustable handle bar & seat post - Moose rack - Hitching system - Single speed	- slip-in/slip-out module - provides auditory clues	- carrying strap - raised and depressed features	- 360 degree seal - 200% more clearance dramatically softens any pole contact	- 360 magnetic charging port - sweat resistant - water resistant - Isolated haptic feedback
% of technology incorporated	85%	0%	0%	0%	40%	0%	0%	80%
Lifetime (years)	4-5 hours use on single charge	5- year warranty	Not shown	Not shown (estimated 30+)	Not shown (estimated 10 years)	10 years	Lifetime warranty	Not shown
Weight (lb)	1.1	100	2.75	18	4	5	Not listed	Not listed
Material	PC	Wood, PE	Heavyweight rubber	Aluminum	Polyurethane foam	PVC	Steel tubing, tension springs, PP	Polymer (hi impact)
Manufacturing	Injection Molded	Injection Molded	Injection Molded	Aluminum Drawn	Foam molding	Die cut	Steel drawn & bent	Injection Molded
Dimensions (in.) (W) x (H) x (D)	4” x 8.14” x 4.75”	33.5ft x 18ft x 14.5ft (L x W x H)	9.5” Diameter	20” wheel diameter	8 ¼”	68" x 24" x 1/4" (L x W x H)	13” Diameter, 6ft H	Not listed

Table 7- Benchmarked Product Features/Functionality/Materials/Manufacturing

2.2.5 BENCHMARKING- SUSTAINABILITY OF EXISTING PRODUCTS

The repetitive use of plastics in the toy industry not only affects our environment but also human health, especially children. Research shows that children who teeth or chew on PVC toys ingest and absorbs harsh chemicals (Niebelschuetz, 2023). So why not implement healthy and sustainable materials into children’s products?

Implementing and encouraging sustainable choices in early childhood can help improve a healthier lifestyle, lasting changes to better our future, and improve the environment (Morrison, 2022. Since children easily absorb and adopt new information lifestyles, why not implement sustainable choices starting with toys that they form emotional attachments to, that way they can associate objects they love and connect it to sustainability.

2.3 SUMMARY OF CHAPTER TWO

Overall, this chapter clarifies the few products available for children with impaired vision that require no adaptation. Current products on the market in this field are mainly large, bright, and colourful to locate easier. Navigation is an important feature for visually impaired products as the visually impaired don't always rely on the sight that they do have, therefore, using other senses such as sound and touch or even emphasizing physical features and colours. Oftentimes, children with impaired vision don't carry the confidence to participate in physical activities with their sighted peers as they aren't able to play the same way or need tools to help them which can make them feel out of place. In order to encourage visually impaired children, exposure to adapted games will provide more practice in participating in active games thus building their confidence to play with their peers.

CHAPTER 3 ANALYSIS

3.1 NEEDS

With the limited physical education products in the market for the visually impaired, educators and parents often adapt or create “do it yourself” solutions which aren’t ideal and time consuming. Creating more products that would encourage children both sighted and visually impaired would allow for more exposure in this market and allow the users to feel more confident to participate in activities.

3.1.1 NEEDS/BENEFITS NOT MET BY CURRENT PRODUCTS

There is a need to improve the current solutions because the current solutions are not catered towards younger children’s need for active play and those that do are mostly individual play that require a sighted guide. For children ages 8-11, current solutions are often individual sports rather than games and are typically seen in backyards, parks, athletic centers, and schools. Other equipment for team sports such as Goal ball and Beep Baseball, can be used outside of the sport however children would just be limited to ball sports.

3.1.2 LATENT NEEDS

3.1.2.1 LINKING BENEFITS WITH NEEDS- ADAPTIVE BALLS

The following images (Figure 3 and 4) and tables (Table 7) illustrate the comparison of similar auditory sports balls used in sports such as goal ball and to compare the benefits of them with the user's needs.

Figure 3- ISA Goalball

Figure 4- Boom'r Beeper Ball by FlagHouse

Benefits	Features
Easy to Use	Easy to grip Easy to identify location through sound Bright colours are easy to identify
Safety	Large Soft to touch
Multi-functional	Can be used for variety of games

Table 8- Benefits and Features from Promotional Literature

3.1.3 CATEGORIZATION OF NEEDS

A categorization of needs helps differentiate the user's immediate needs, latent needs, wants, and wishes. Children with impaired vision experience similar needs to sighted children in environments such as school, however, there are added stress and peer pressure in social situations being in middle childhood to be "normal". This can be a challenge for visually impaired children as they don't want their disability to stand out amongst their peers. Figure 5 lists and categorizes these needs, wants, and wishes.

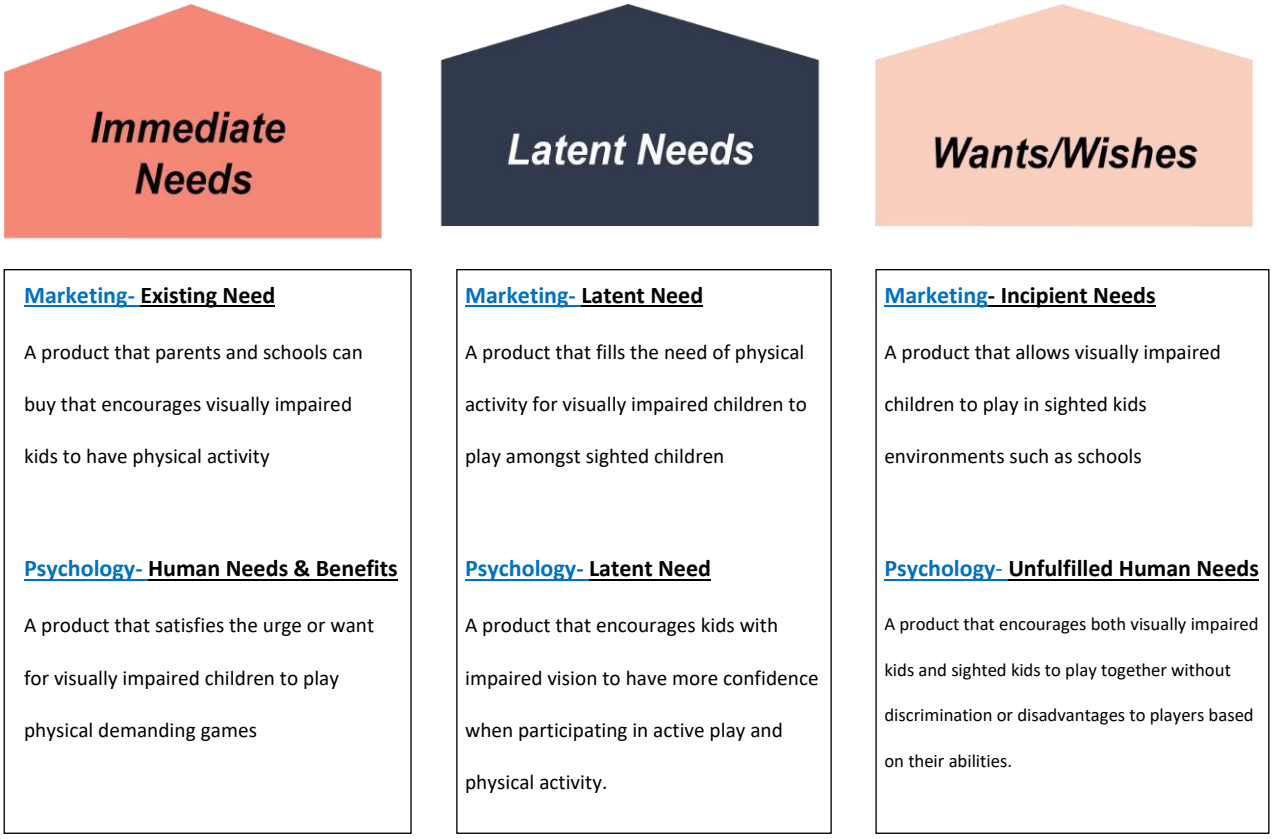


Figure 5- Categorization of Needs-1

Figure 5- Categorization of Needs-2

Figure 5- Categorization of Needs-3

3.2 ANALYSIS-USABILITY

3.2.1 JOURNEY MAP

The following table (table 8) identifies and analyzes current feelings and thoughts that a user may have in schools or at home. Mainly children with impaired vision in “mainstream” schools often feel left out in classes such as physical education or out on the playground at recess and would want to participate

Journey Map

DO?
- Attend school
- Plays less physically active games
- Has troubles participating in games with sighted children
- Often need their peer guides or canes to navigate

6-8 YEAR OLD CHILD WITH SEVERE VISUAL IMPAIRMENT
- In grade 1-2
- In school for mainly sighted children

NEED TO DO?
- Hit developmental milestones
- Having more independence from family
- Develop confidence
- Having one or more hours of physical activity per day

SAY?
- “I can’t wait to go and play”
- “Let’s go play!”
- “Do you want to go on the swing with me?”

SEE?
- Limited distance in front of them
- Often very blurry
- Might have black spot in middle of sight

PAIN
- Being left out of gym class because their teacher can’t adapt the curriculum activities
- Being left out of recess games
- Being left out of social groups because of disability

GAIN
- Participating in fulfilling activities they enjoy
- Getting the physical activity they need for the day
- Being able to play sports
- Making friends when playing

HEAR?
- “I think you need to sit this game out”
- “Do you want to play with me?”
- “Can you see how many fingers I’m holding up?”
- “Can I try your cane?”

THINK & FEEL
- I wish I could go play the game my class is playing
- I wonder what my friends and I will do at recess
- How will I adapt to play like the other kids?

Table 8- Journey Map

3.2.2 USER EXPERIENCE

This user experience map below (table 9) is an example of the user doing activities like going out for recess. Recess gives kids the opportunity to have unorganized play. During the user observation at W. Ross MacDonald, recess was the primary observation to determine whether children with impaired vision would willingly participate in active games and if not, what would be solutions to encourage them to want to play active games.

User Experience Map- Recess

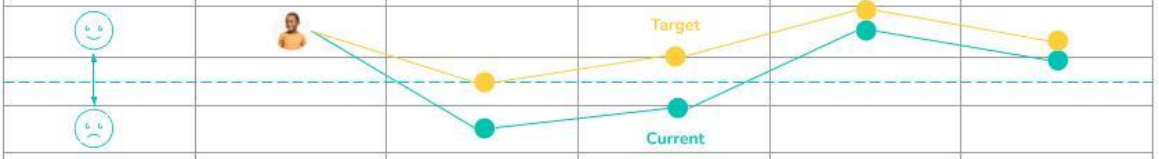
	Finishing Class	Getting to cubby	Waiting to go outside	Playing on Swing set	Going back inside
User Goals	Leaving class in time	Getting on outdoor clothes	Going outside	Playing on the swing with friends	Gathering all belongings to go back inside
User Actions	Packing up pencil case and clearing desk	Putting on outdoor shoes and coats	Getting in line with class and guide	Putting white cane down, grabbing friends and swing together	Getting white cane with help of their guide
User Thoughts	"I can't wait to go and play"	"Is it raining outside?"	"How much longer?"	"Can I swing higher?"	"I can't wait for next recess" "I'm hungry"
User Feelings	Excited	Frustrated	Impatient	Happy	Content
User Experience					
					
Problems/ Challenges	Not knowing who they will play with or what they will play	Tying up shoelaces, doing up coat zipper	Getting impatient waiting to go outside	Not many game options besides swinging	Sad to go back inside, not enough physical activity
Ideas/ Takeaways	Kids love to get out and play	Kids take a long time to get ready	Kids are impatient	Kids only enjoy swinging	Kids love recess so they should maximize their physical activity

Table 9- User Experience Map: Recess

3.3 ANALYSIS- HUMAN FACTORS

These ergonomic observations help determine how the product can successfully accommodate children of ages 8-11 and make them feel comfortable in the gear to make them feel more confident and inclined to play. A mock-up model of each component of the game was created to establish a proper scale for both a 5th percentile 8-year-old and a 95th percentile 11-year-old. Both smallest and largest percentiles of users were fitted to the same adjustable game pinnie, adjustable headset, tile, and game hub. Scaling these mock-ups to both extremes of percentiles was a crucial step for the user to feel more confident and motivated to participate in the active game.

3.3.1 PRODUCT SCHEMATIC- CONFIGURATION DIAGRAM

Below are schematics (figure 6 and 7) that includes the initial configuration diagram on this thesis product scaled to both a 5th percentile 8-year-old and a 95th percentile 11-year-old.

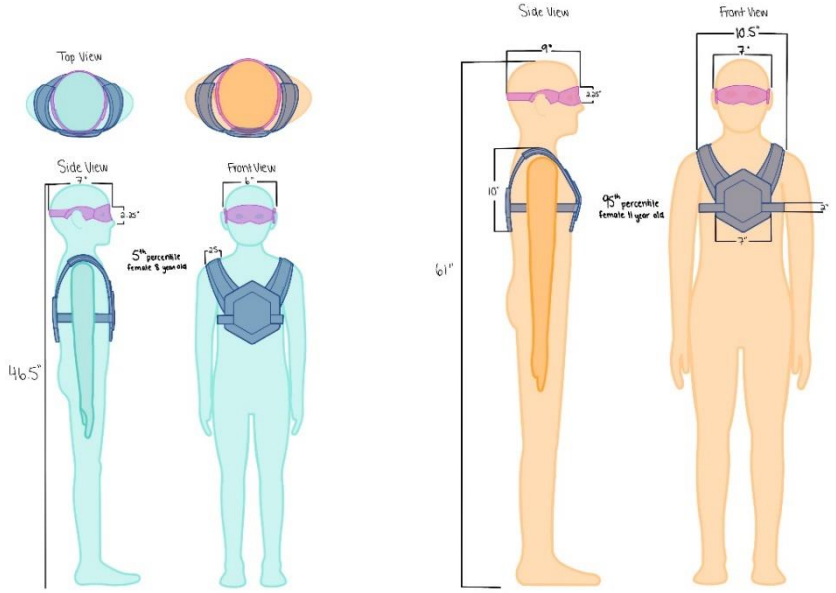


Figure 6- Product Schematic-1

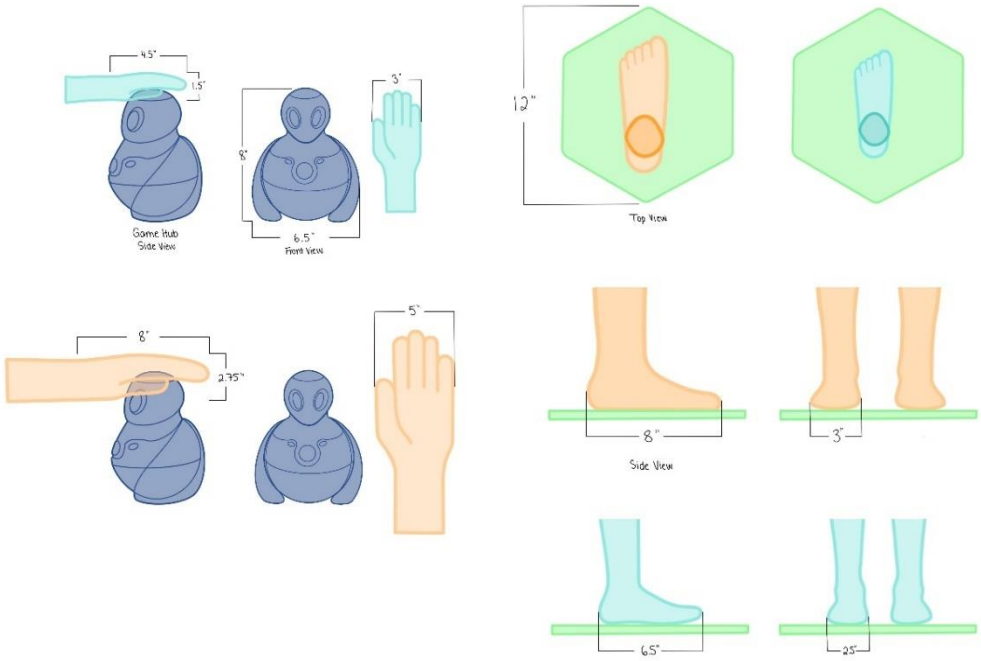


Figure 7- Product Schematic-2

3.3.2 ERGONOMIC- 1:1 HUMAN SCALE STUDY

Developing an ergonomic study before finalizing the concept was an awakening stage in the design process as it allowed for larger changes to be made. The study (figure 8) was measured with human models that fit the 5th percentile of a female 8-year-old, and the 95th percentile of a female 11-year-old as females at this stage or growth are the tallest. Changes to the design include significantly increasing the size of AVI to better identify its features, as well as decreasing the size of the smart blind fold earpiece to eliminate unnecessary bulk.

Figure 8- Ergonomic 1:1 Human Scale Study-1

Figure 8- Ergonomic 1:1 Human Scale Study-2

Figure 8- Ergonomic 1:1 Human Scale Study-3

Figure 8- Ergonomic 1:1 Human Scale Study-4

Figure 8- Ergonomic 1:1 Human Scale Study-5

Figure 8- Ergonomic 1:1 Human Scale Study-6

3.4 ANALYSIS- AESTHETICS & SEMANTIC PROFILE

This design utilizes current trends such as larger and slightly bulkier objects while still maintaining some slimming aesthetics to prevent the product from looking cheap. Below (figure 9 are some other inspirations to the form such as the bee. The tiles were hexagon shaped as they fit together seamlessly which led to the bee/beehive inspired game hub as it is the game home. Below is a mood board that inspired the form of the design.

Figure 9- Moodboard and Inspirations

3.5 ANALYSIS- SUSTAINABILITY: SAFETY, HEALTH & ENVIRONMENT

A health and safety consideration that were included in AVIs design is the bone conduction technology used for the headset which doesn't rely on emitting sound directly to the eardrum this creating no strain to the ear canals which is crucial especially for children (SoundGuys, 2022). Other safety features include the use of sound in the players vest to alert if other children are near to avoid injuries especially for players who aren't used to being blindfolded in active games. Textured tiles also partially force children to slow down and feel where on the board they are.

3.6 ANALYSIS- INNOVATION OPPORTUNITY

3.6.1 NEEDS ANALYSIS DIAGRAM

Table 10 analyzes the users basic, security, social belonging, esteem, and self-actualization needs. Based on these needs, visually impaired children need adaptive physical activity equipment to encourage them to build confidence to play with others to ensure a healthy lifestyle. Further needs include ease of use (adaptive), physical activity, encouragement, confidence, and playing amongst their peers.

Product- Adaptive Ball				
Needs	**Benefits and Underlying Needs**	**Level of importance**		
Basic Needs *Physical Health*				
Physical Activity	Achieving the minimum required of physical activity recommended.			*High*
Proper Growth Development	Hitting proper growth milestones (physically & mentally)			*High*
Security *Safety, securing resources*				
Safety	Protection of child/players			*High*
State, Group, Individual				
Securing resources *Optimization of limited resources (cost effectiveness)* • *Value* • *Accumulation of resources (wealth)*	Price is important to families with disadvantaged kids as most adaptive equipment can be expensive		*Moderate*	
	Reliability of product (longevity)		*Moderate*	
Control over environment (tasks)	*Product (tool) that amplifies human abilities*			
Convenience *Ease of Use*	Size of Ball (is it easy to hold in one or two hands?)		*Moderate*	
	Material (is it easy to grip)			*High*
	Weight (is it light enough to throw and heavy enough to get speed?)		*Moderate*	
Social Belonging *Effort / resources to belong to a 'tribe'*				
Social Engagement	Interacting with other children and learning teamwork skills when playing with others. Creating meaningful friendships.			High
Motivation	Feeling the need to be competitive when playing		Moderate	
Tribal Identity	Feeling they belong to a group (the sport or the team)		Moderate	
Behavior cues for survival *(copying behaviors…* *Proper technique, learned skills)*	Teachers/coaches/relatives recommendations. (ensuring the right technique to not get injured)			High
Behavior cues for social interaction of group *(copying behaviors… Interaction cues, play, have fun)*	Team mates/opposing team/coaches/teachers recommendations		Moderate	
Peer Pressure	Being encouraged by team members to do well or better		Moderate	

Esteem ***Personal influence in 'tribe'***				
Social Status 'I want to be like them'	How good other players are, being on the best team		Moderate	
Personal Status	Am I good enough? Do my teammates like me?		Moderate	
Self-Actualization 'Higher order' Functions/Needs ***Needs that are pre-dominantly 'outer cortex'***				
Intrinsic pleasure	Enjoying the sport		Moderate	
Creative endeavors	Ways of improving their skills	Slight		
Motivations (extrinsic)	Playing & making up new games	Slight		
Motivations (intrinsic)	Playing more organized games	Slight		
Emotional	*Empathy- What can I do to make the experience better for my teammates, how can I help them?*	Slight		

Table 10- Needs Analysis Diagram

3.6.2 DESIRABILITY, FEASIBILITY & VIABILITY

A feasibility chart (Figure 10) was made to organize users, existing products, environments, and needs. The chart is organized from least feasible and important to most feasible and important, as well as three categories of eliminate, consider, and prioritize.

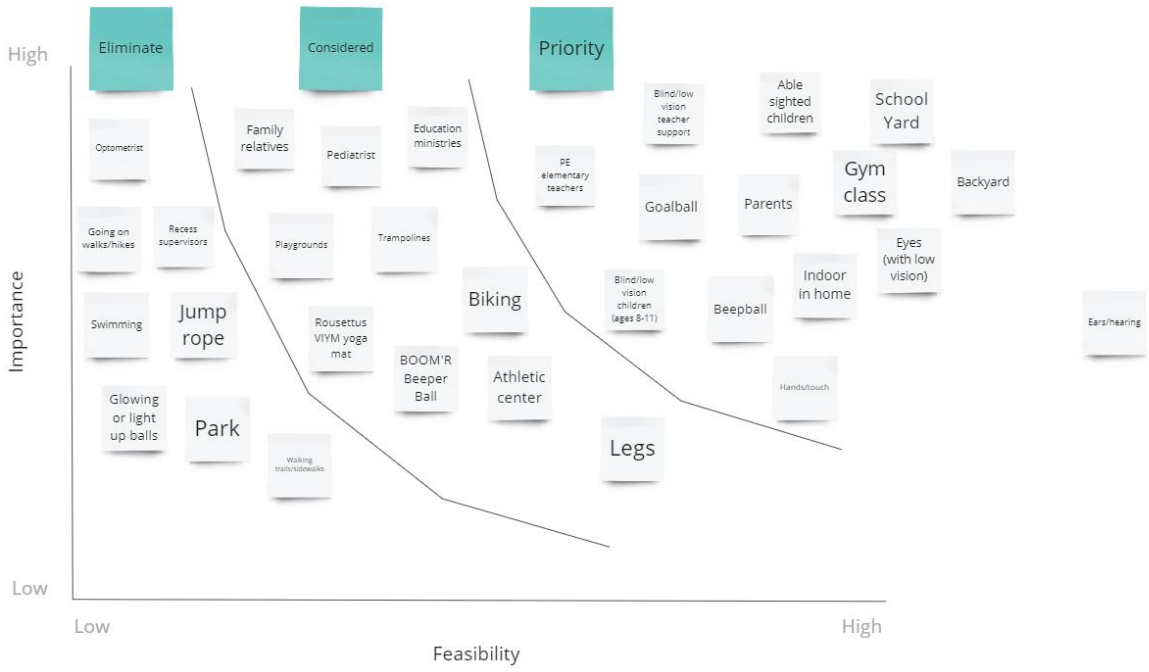


Figure 10- Feasibility and Importance Chart

3.7 SUMMARY OF CHAPTER 3- DEFINING DESIGN BRIEF

Overall, the focus of this thesis is to allow for more inclusive in physical activity for children with impaired vision. Through this inclusion, it will allow “mainstream” schools to adopt this product and behavior to ensure children with impaired vision among other children with disabilities to be included for children to develop better confidence and hit their developmental milestones. This design brief with help to support design decisions throughout initial and concept development to ensure a successful product that meets those requirements.

CHAPTER 4- DESIGN DEVELOPMENT

4.1 INITIAL IDEA GENERATION

4.1.1 AESTHETIC APPROACH AND SEMANTIC PROFILE

Figure 9- Moodboard and Inspirations

Many of the initial inspirations that were chosen include the other senses besides sight such as touch and hearing. Since many visually impaired people can still perceive lights and shapes, bright glowing lights and bright colours were also an influence on the initial designs.

4.1.2 MIND MAPPING

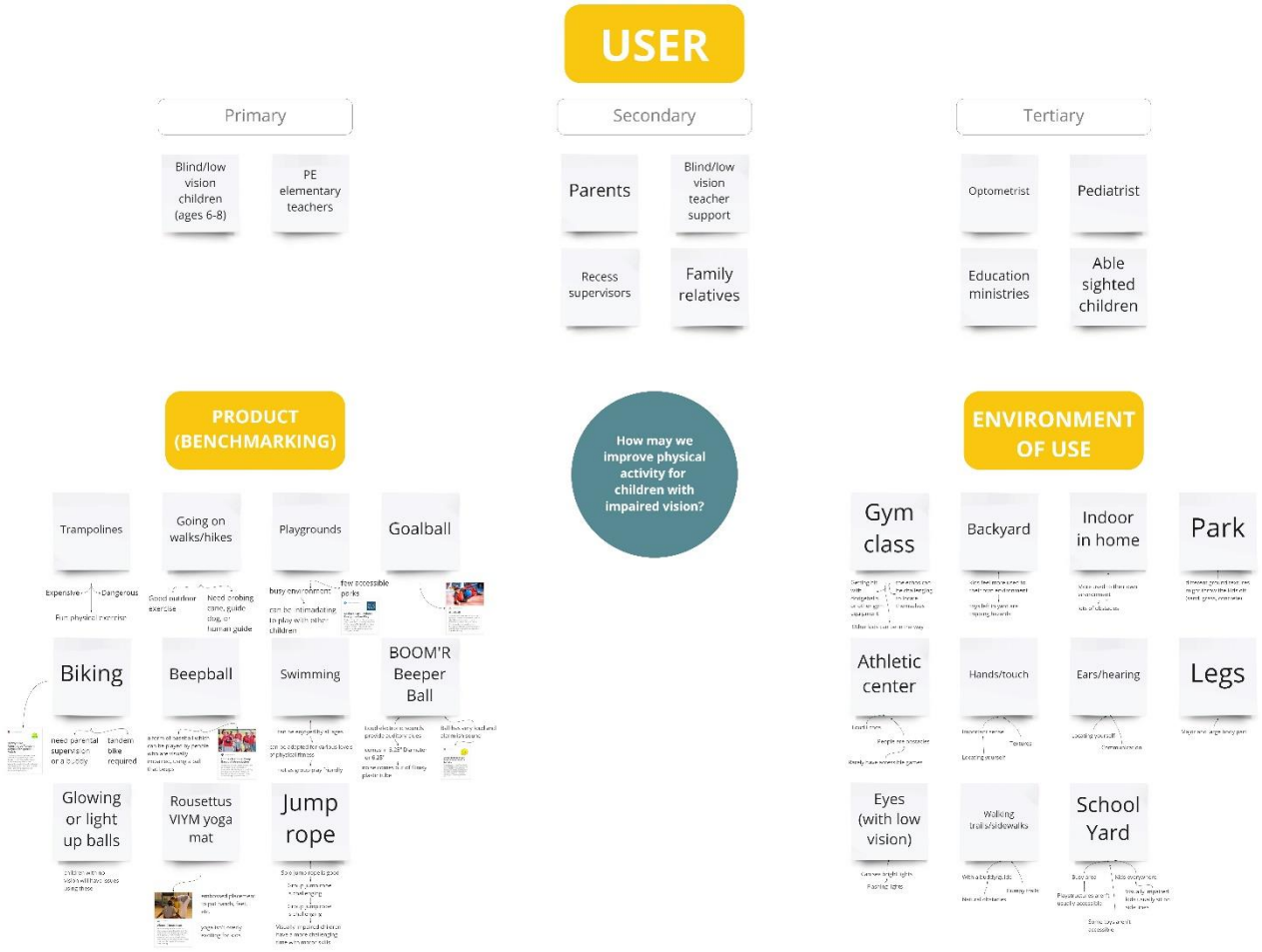


Figure 11- Mind Mapping

Mind mapping allowed for words and ideas to form what will eventually be initial ideas. The mind mapping was divided into potential users, benchmarking, and the environments that these products and users are often found. At this stage, the discovery of the current holes in the market for activities catered directly towards children with impaired vision.

4.1.3 IDEATION SKETCHES

Six ideas were generated, each one focusing on the senses such as auditory and touch. The ideas ranged from adaptations to existing childhood games often played during mainstream elementary school recess', others were new tools or equipment that could be used in current sports. Figures 12 are the developed sketches.

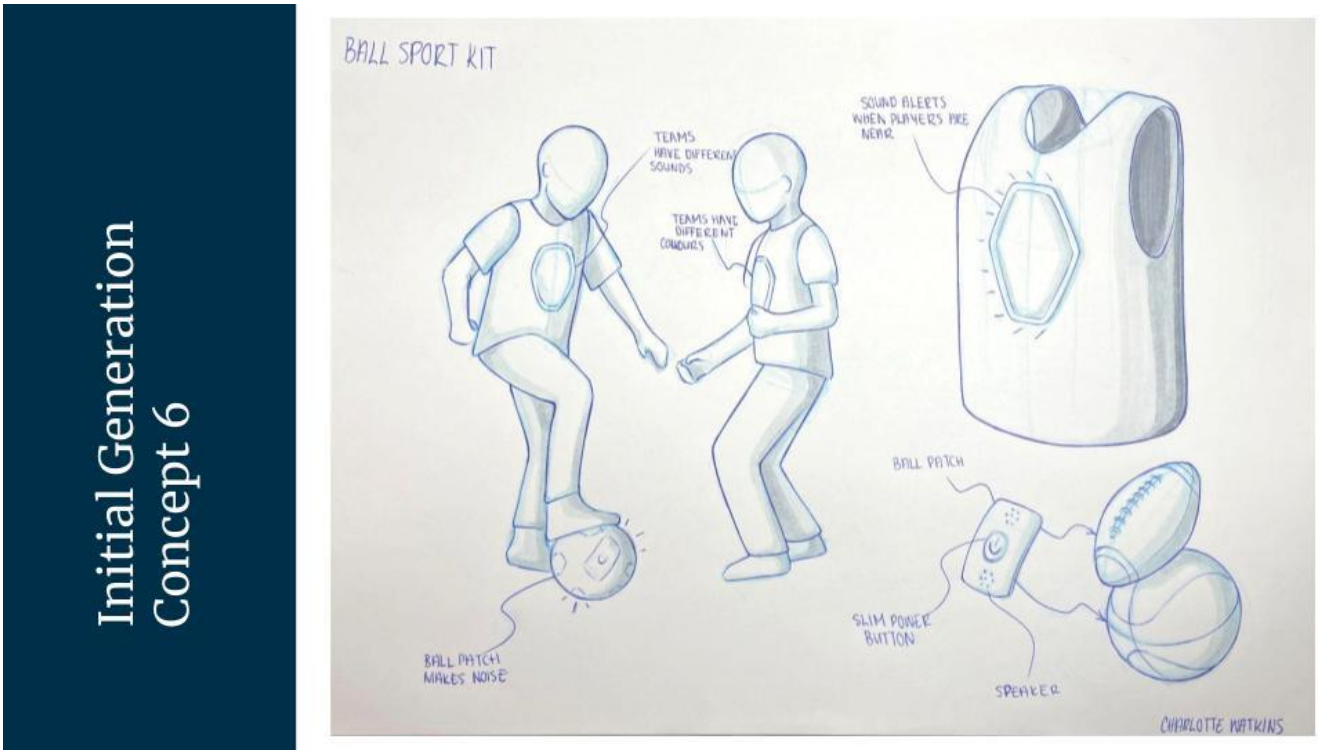


Figure 12- Initial Concepts-1

Initial Generation Concept 5

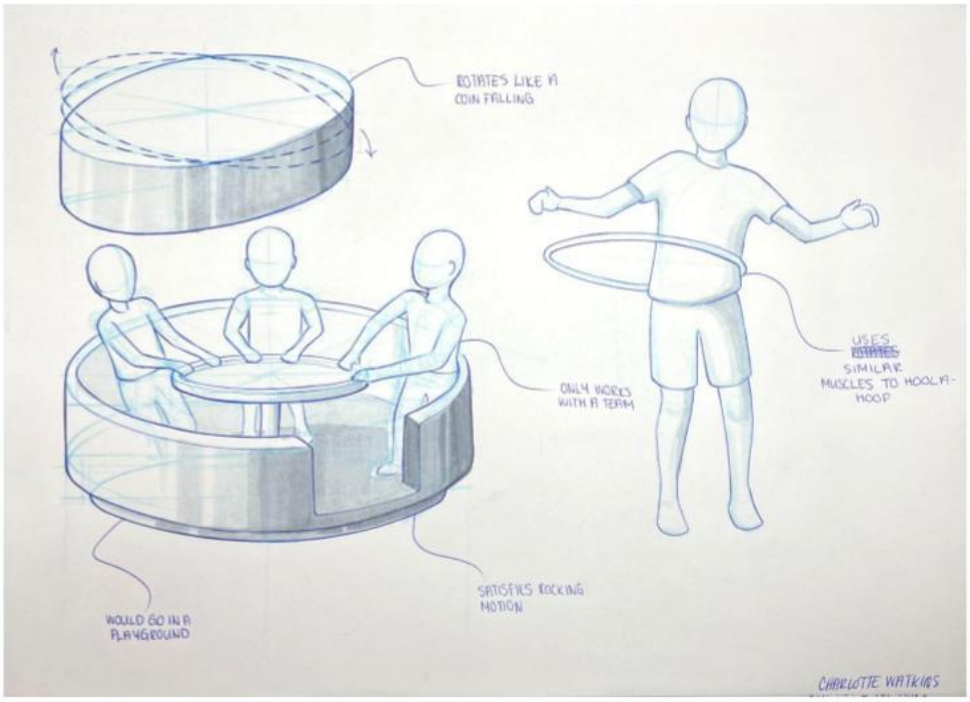


Figure 12- Initial Concepts-2

Initial Generation Concept 4

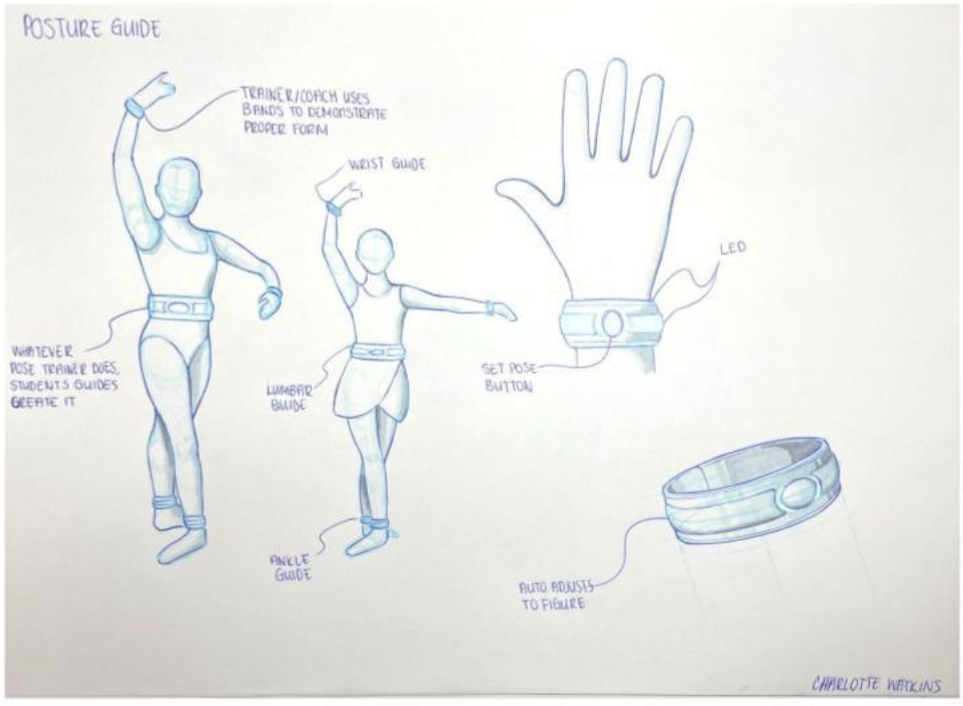


Figure 12- Initial Concepts-3

Initial Generation Concept 3

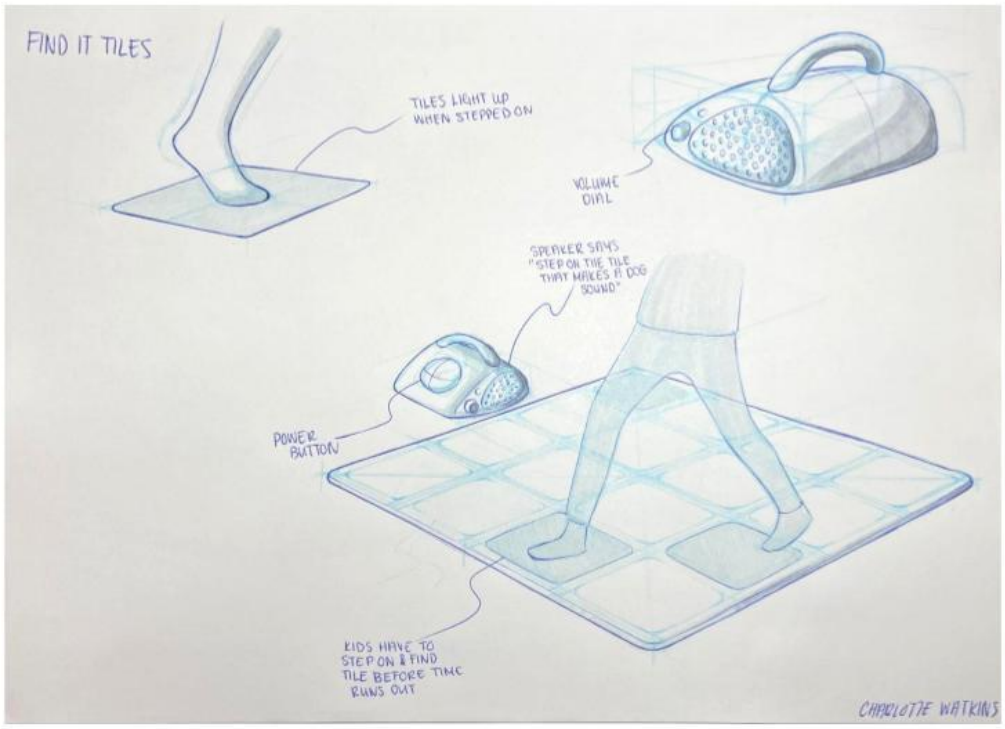


Figure 12- Initial Concepts-4

Initial Generation Concept 1

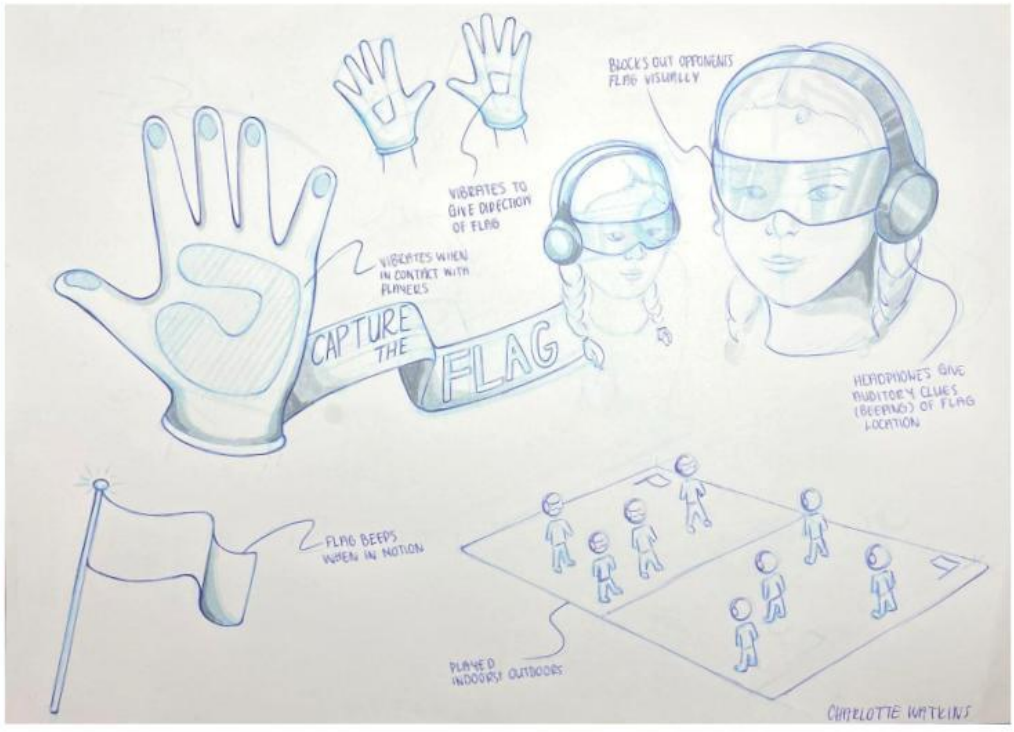


Figure 12- Initial Concepts-5

Initial Generation Concept 2

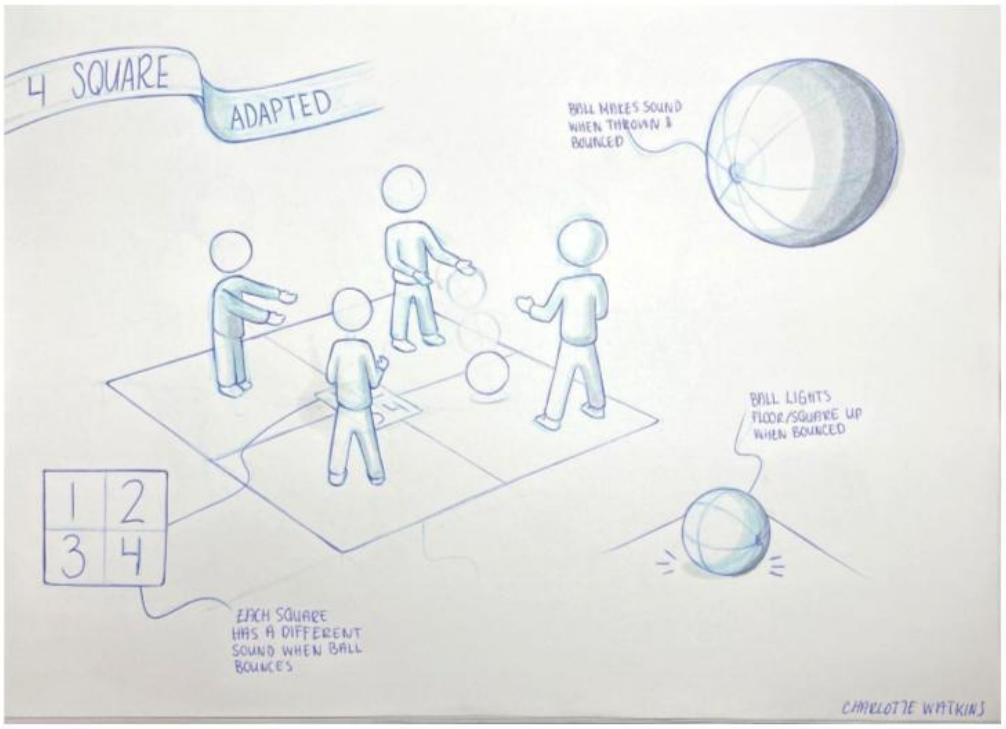


Figure 12- Initial Concepts-6

4.2 CONCEPT EXPLORATION

4.2.1 CONCEPT 1

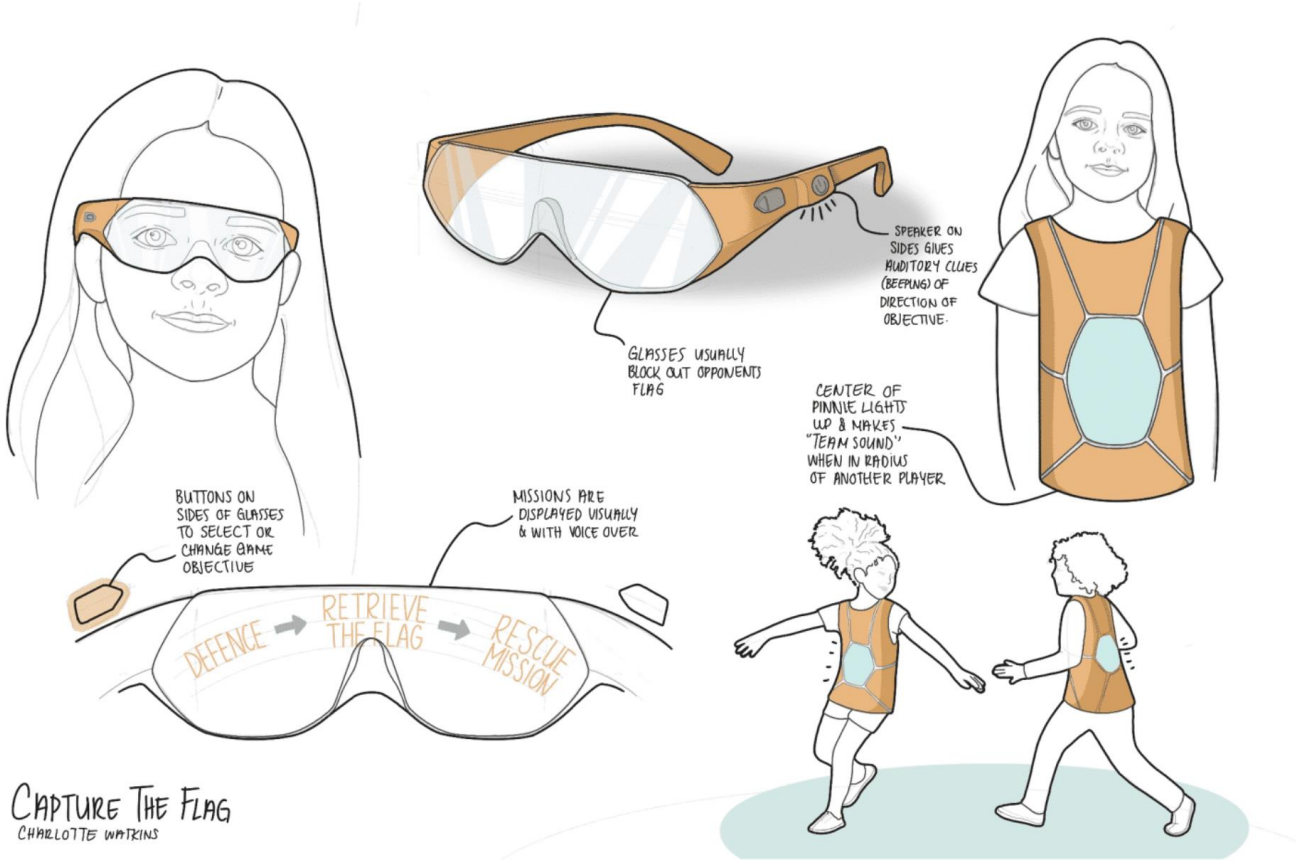


Figure 13- Concept 1-1

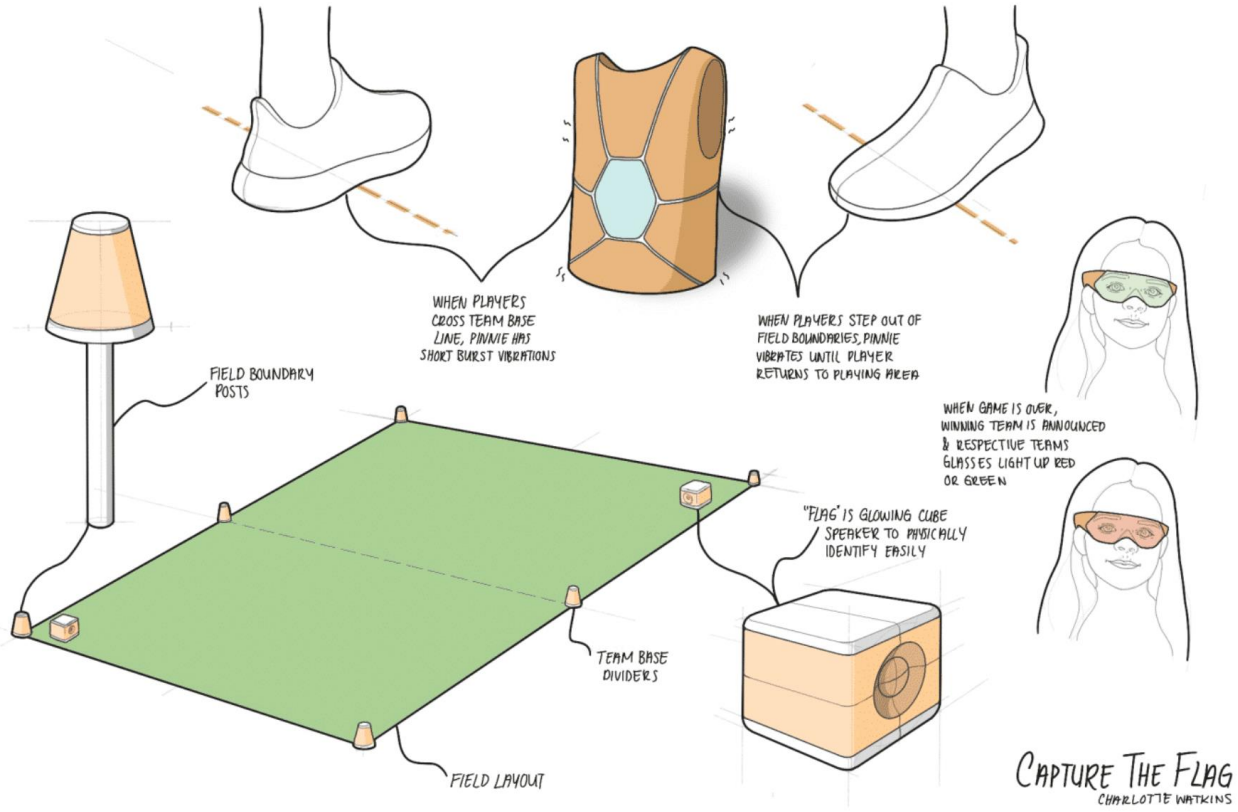


Figure 13- Concept 1-2

This concept was an adaptation of the game known as Capture the Flag. The goal of the concept was to allow both visually impaired children and sighted children to play together in a game that was familiar to them using new technology. The goal of this version of capture the flag is to find the opponents “flag” in this case a block that provides haptic feedback for the children to find it and bring it back to their team’s side. The goggles ensured a fairer way of playing by blocking out the opponent’s flag so players must rely on other senses to find it. Included in this version of capture the flag are team jerseys which vibrate to alert players if they are out of bounds as well as a team sound to let other players know who is near them and what team they are from.

4.2.2 CONCEPT 2

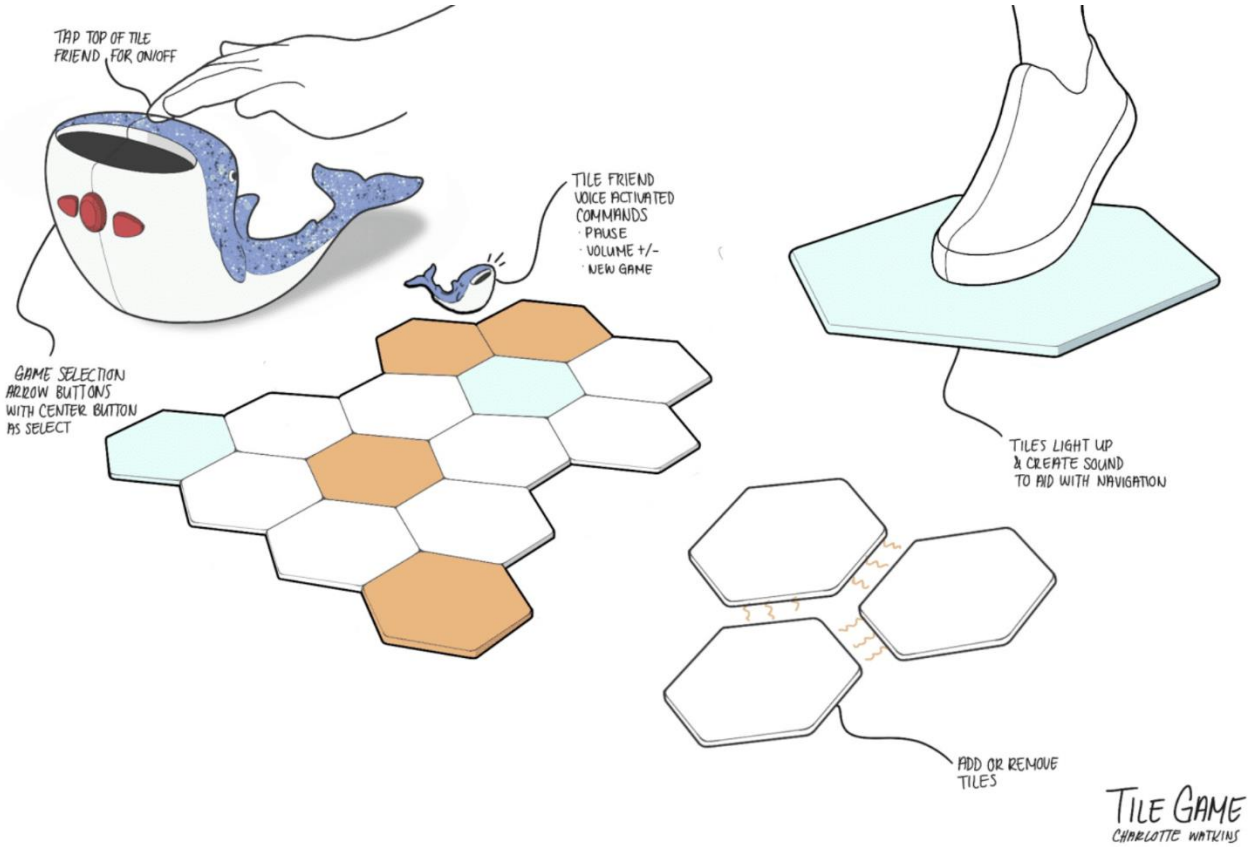


Figure 14- Concept 2-1

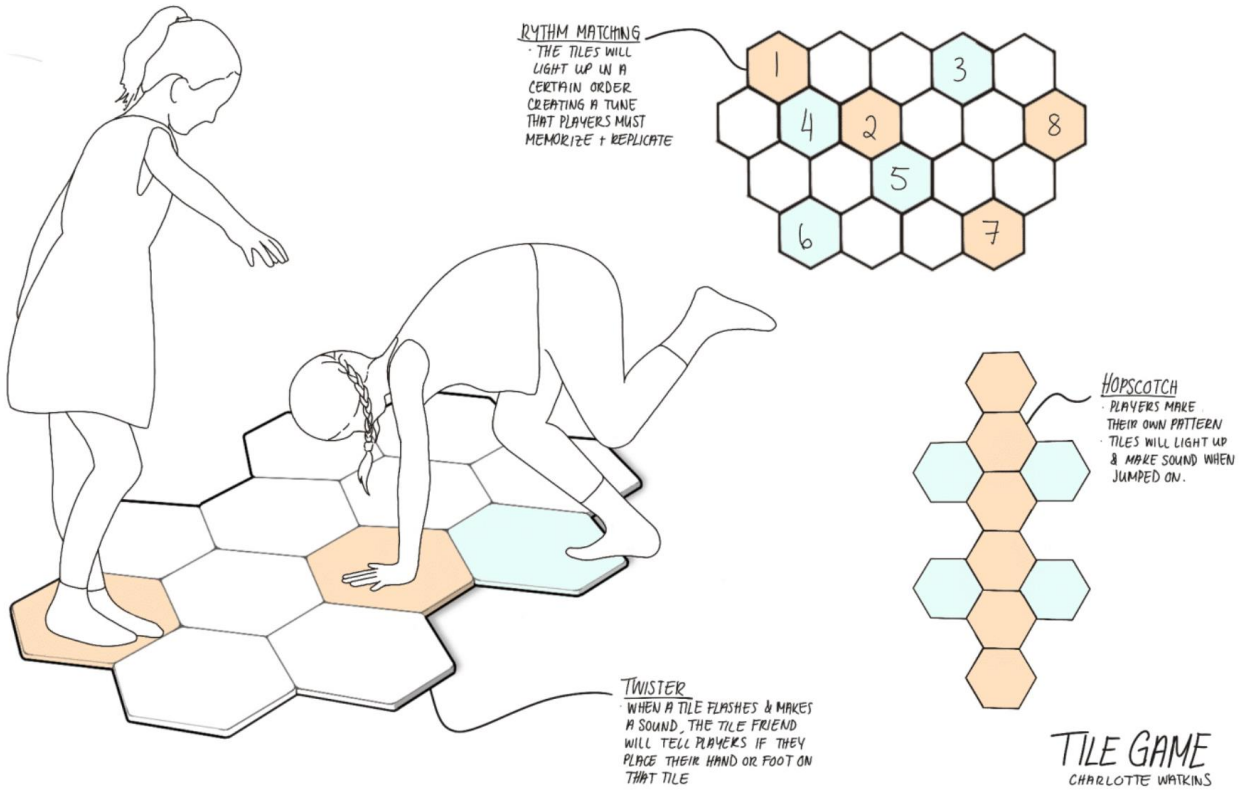


Figure 14- Concept 2-2

This concept, the Tile Game provided multiple visually impaired friendly games in one system that could be played among a large or small number of players as well as both sighted and non-sighted children. Adapted existing games were included such as Twister and Hopscotch as well as other games like matching music/rhythms with interactive light up tiles.

4.2.3 CONCEPT 3

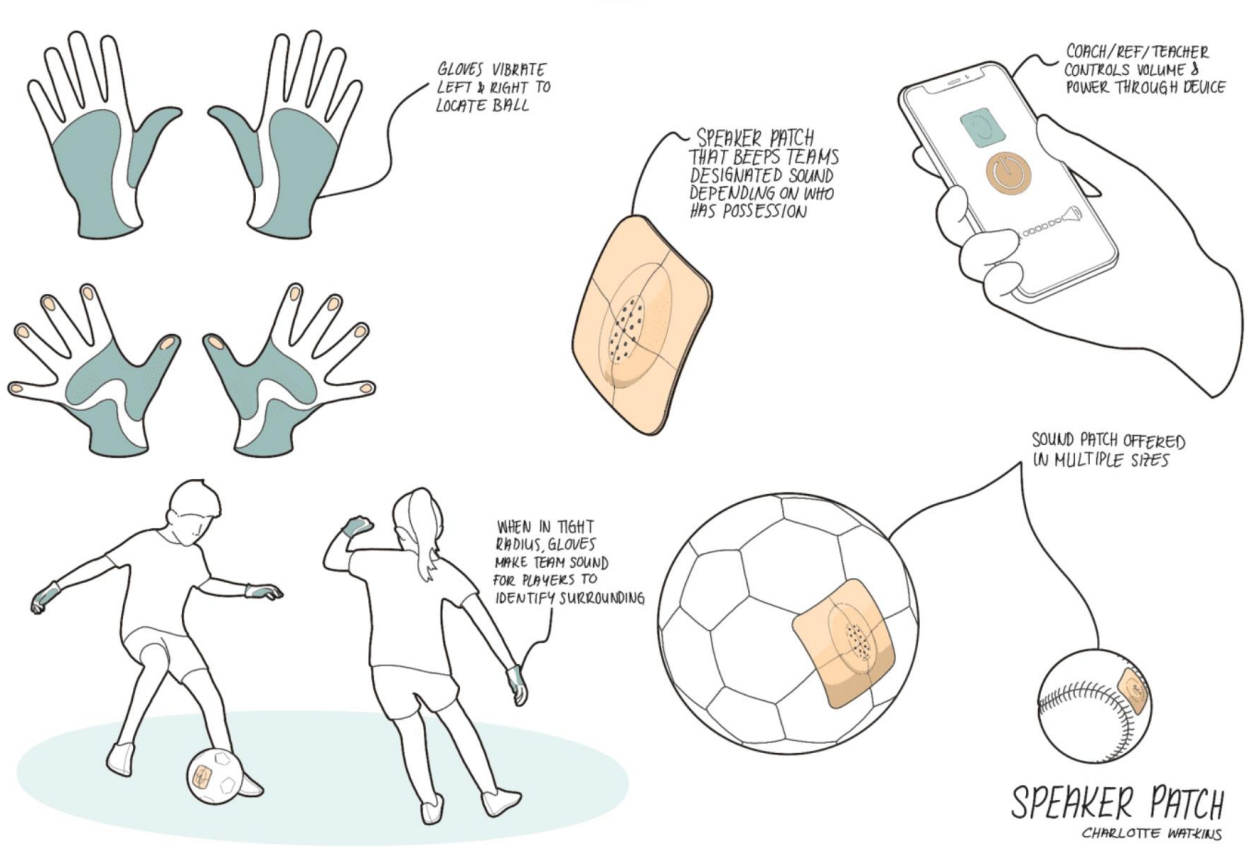


Figure 15- Concept 3

This final concept provided a tool that could be used by parents or coaches to include visually impaired children in sports such as soccer, basketball, or other ball games. It would include gloves that game direction cues through vibrations as well as a sound patch to put on the game ball which amplifies sound. This device would also include an app interface for the parents or coaches to control the sound levels, type of game, etc.

4.3 CONCEPT STRATEGY

4.3.1 CONCEPT DIRECTION AND PRODUCT SCHEMATIC ONE

This chosen concept combined two previous initial concepts from the previous week of a game system which included a variety of visually impaired friendly games that includes player goggle blindfolds, player jerseys, tiles that make up the playing area, and a game hub. The player blindfolds include speakers on either side which provide auditory cues to help the players locate the opponent team's flag. Vests vibrate and project sound to let players know who is near them and when they are out of bounds. The game hub includes buttons and voice commands to choose the desired games, pause, resume, start, and stop the game.

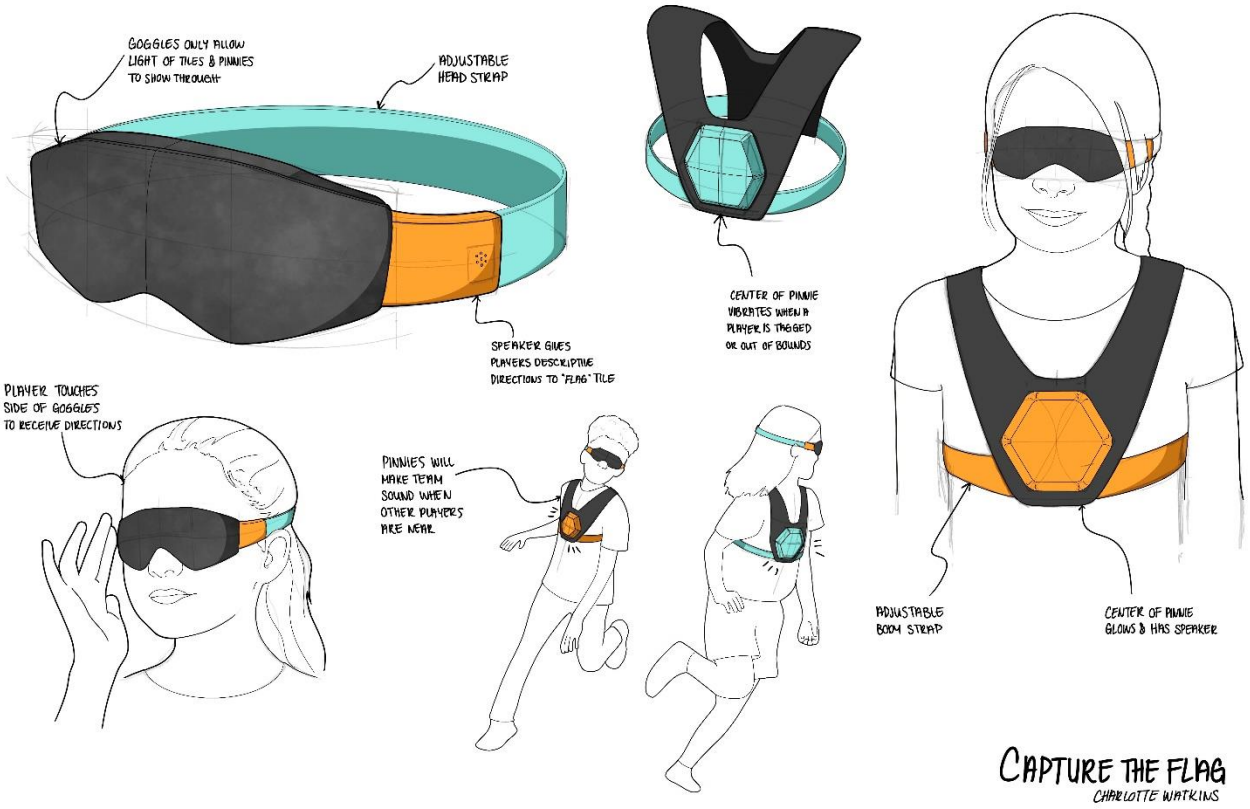


Figure 16- Concept Direction 1-1

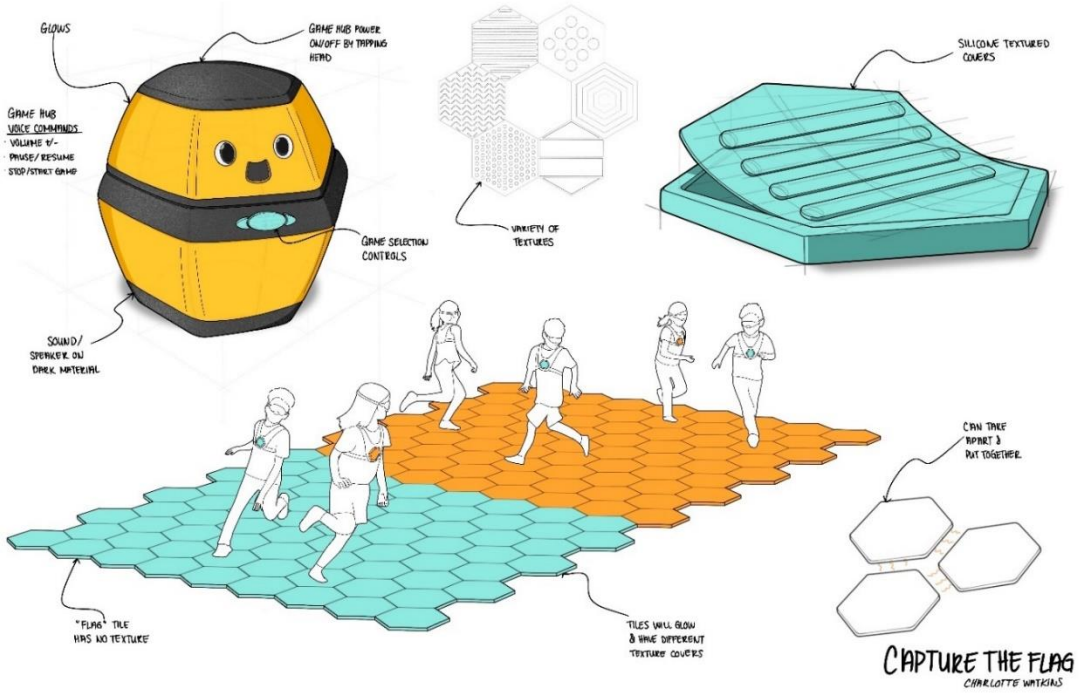


Figure 16- Concept Direction 1-2

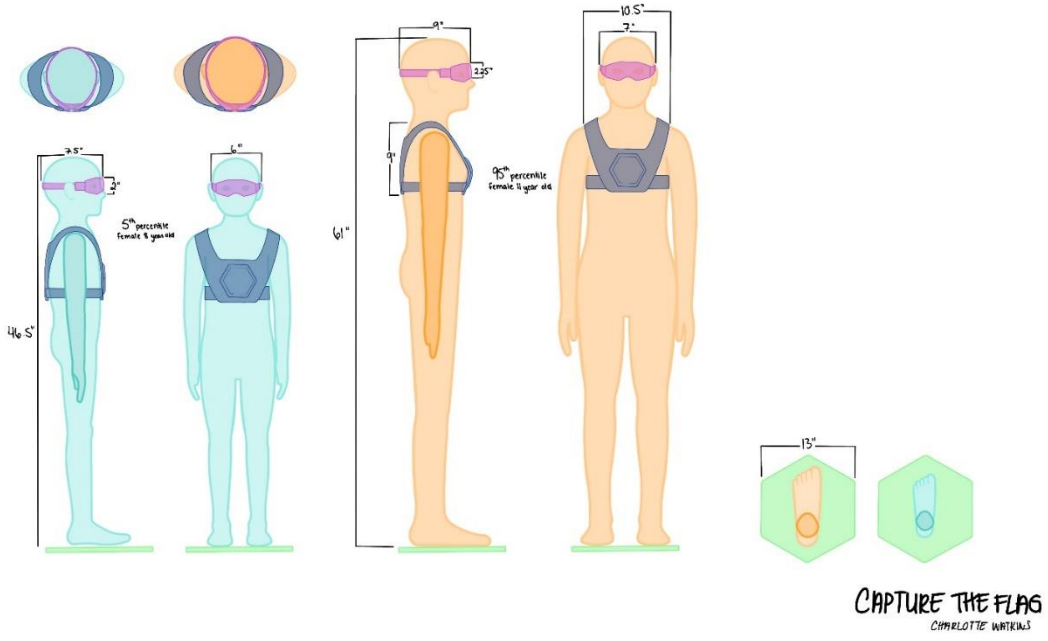


Figure 16- Concept Direction 1-3

4.3.2 CONCEPT DIRECTION AND PRODUCT SCHEMATIC TWO

This second chosen concept was a more realized version of the previous week's ball sport tool. Instead of the patch, a series of auditory and light up balls were created with designated charging/storage station. Game gloves allow for the players to better locate the auditory and light up balls as well as alert players when others are nearby. An app for parents or coaches provides information of battery usage for each ball and volume control.

Figure 17- Concept Direction 2-1

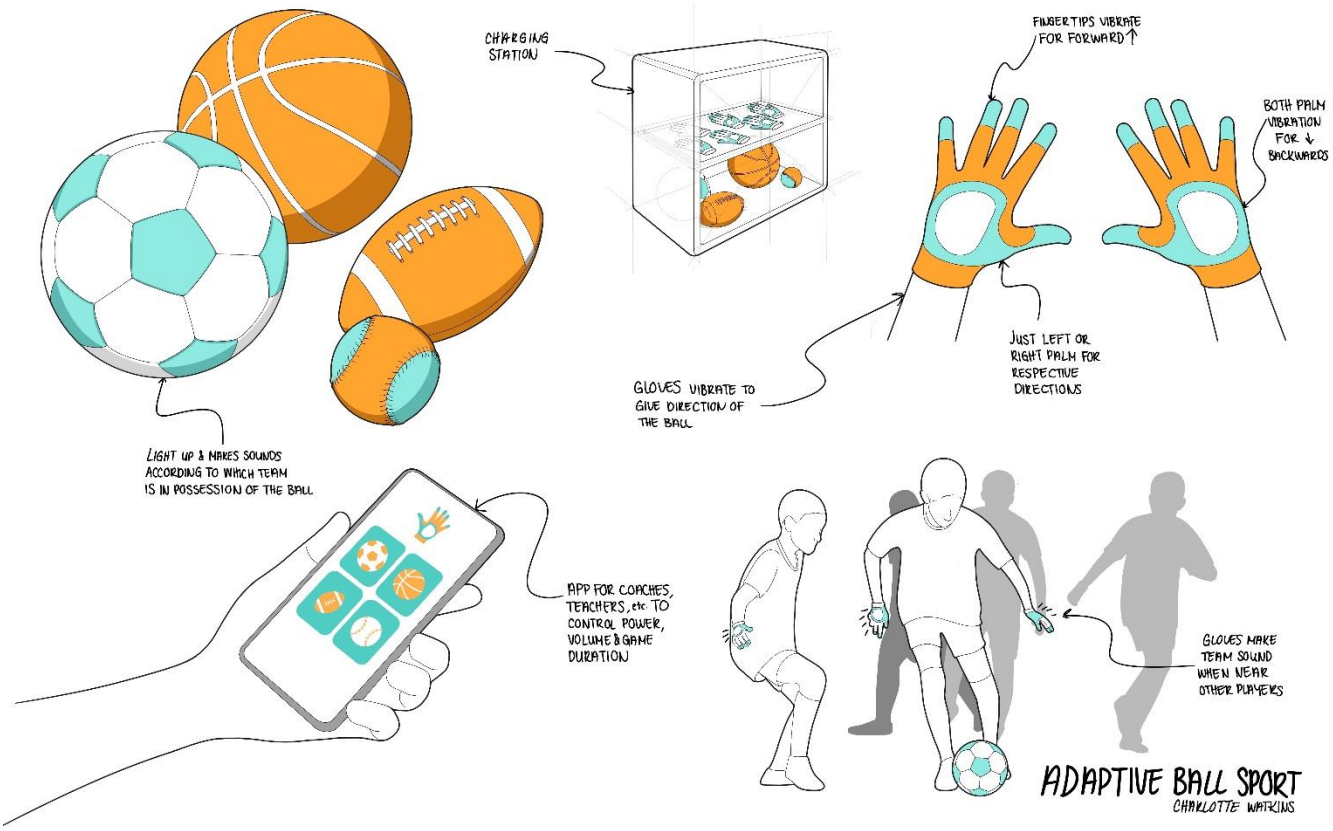


Figure 17- Concept Direction 2-1

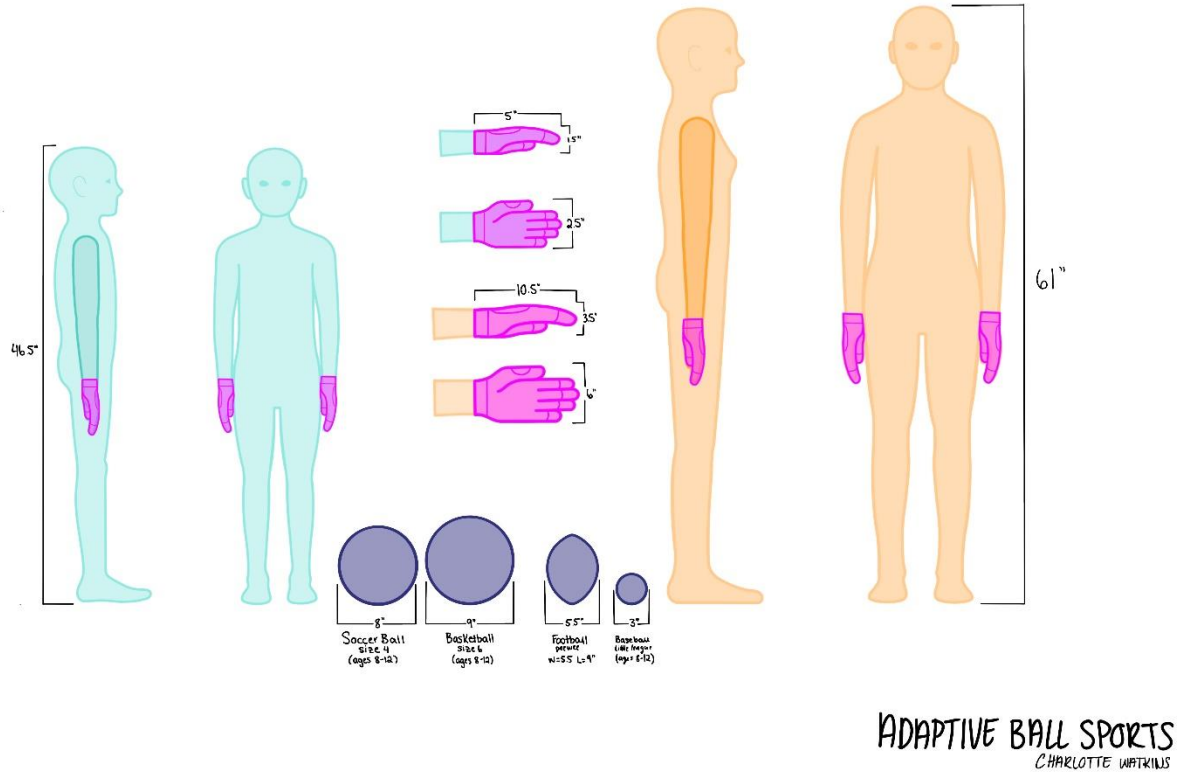


Figure 17- Concept Direction 2-2

4.4 CONCEPT REFINEMENT AND VALIDATION

4.4.1 DESIGN REFINEMENT

This concept was the pursued concept as it provided a variety of play for children with impaired vision as well as allowed both sighted and non-sighted children to play together fairly.

4.4.2 DETAIL DEVELOPMENT

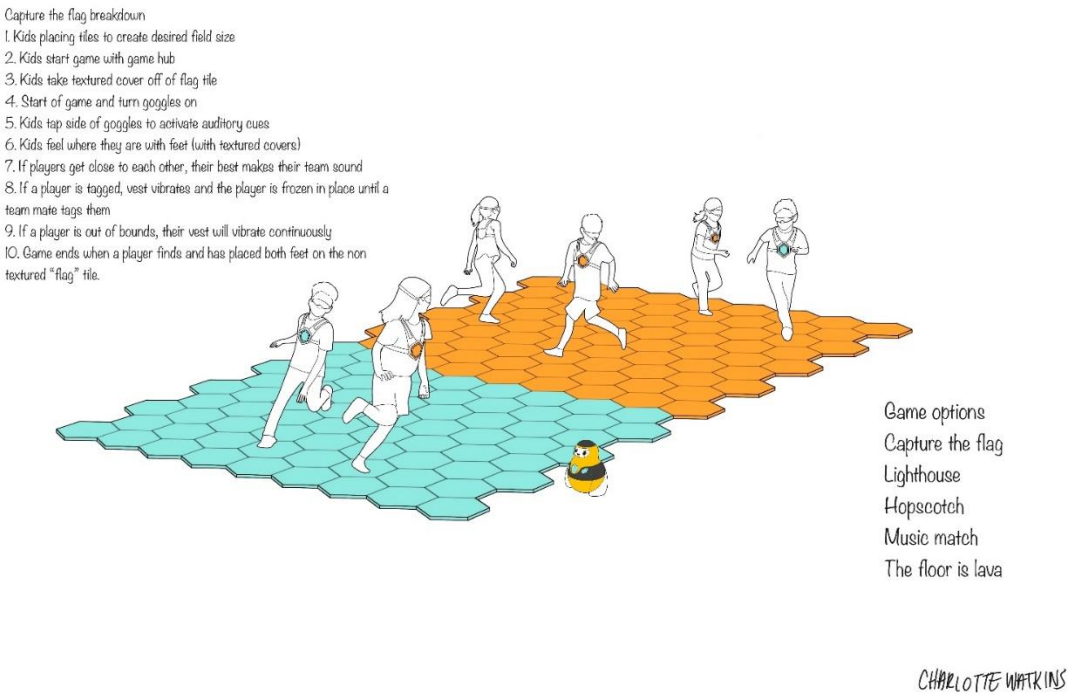


Figure 18- Detail Development-1

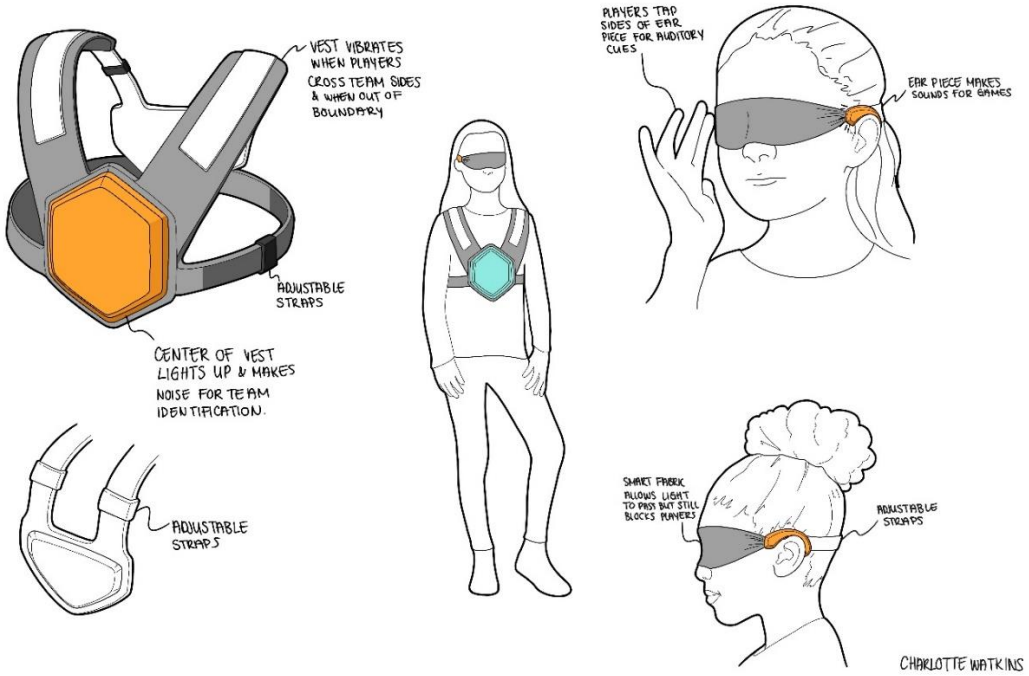


Figure 18- Detail Development-2

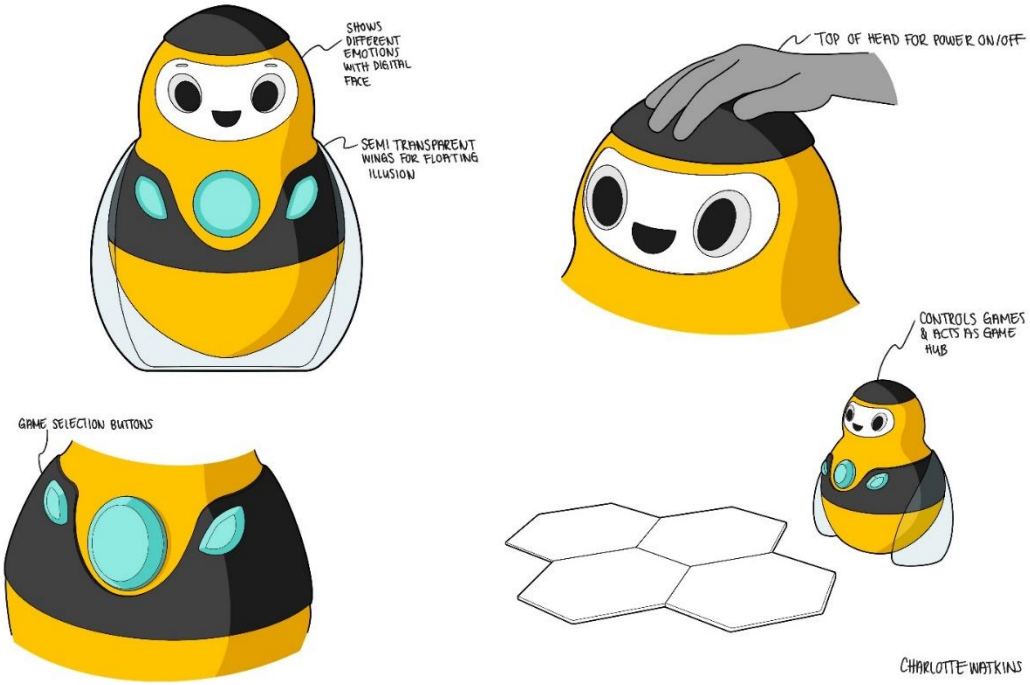


Figure 18- Detail Development-3

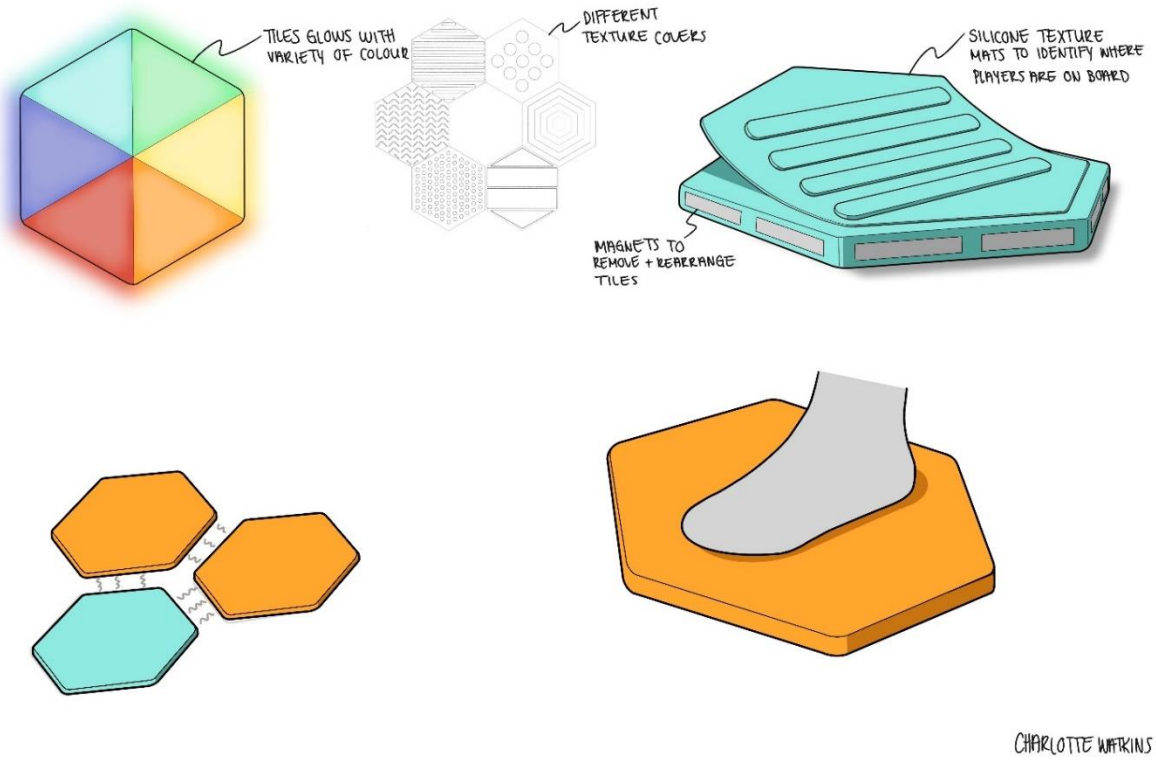


Figure 18- Detail Development-4

4.4.3 REFINED PRODUCT SCHEMATIC & KEY ERGONOMICS

The product schematics (figure 19) were further developed to ensure the child ergonomics were still applicable for easy transferable measurements and proportions from sketches to CAD.

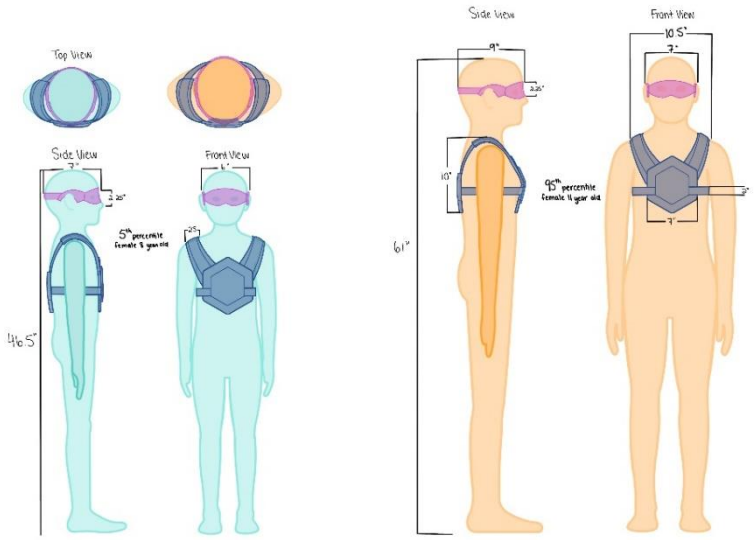


Figure 19- Product Schematic 2-1

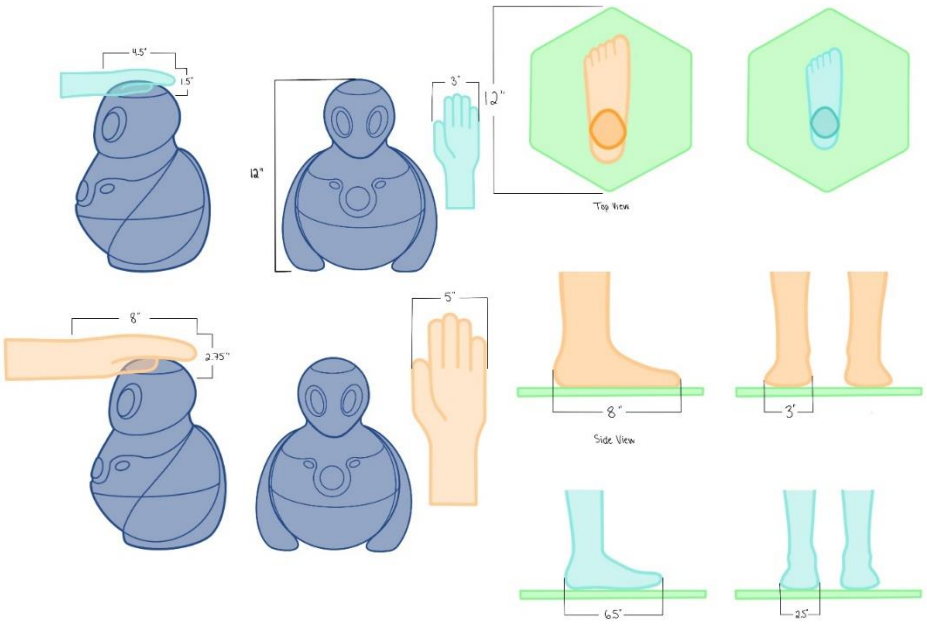


Figure 19- Product Schematic 2-2

4.5 CONCEPT REALIZATION

4.5.1 DESIGN FINALIZATION

The design resolved in some aesthetic changes such as increasing the size of AVI and changing the vest style to a softer look and feel. The smart blindfold includes a power switch and uses bone conduction technology allowing the users to hear/feel the auditory cue vibrations on the sides of their temples while also being able to listen to their surroundings. The AVI game hub includes large, easy to locate game selection buttons as well as a power button. AVIs eyes provide bright digital and verbal feedback along with voice activated commands. Player vests have adjustable straps and a center light & speaker for team identification. The light up game tiles define the game boundaries and include textured covers for players to feel with their feet where on the board they are or which team side they are on. When done playing for the day, game equipment is stored into charging units for wireless charging.

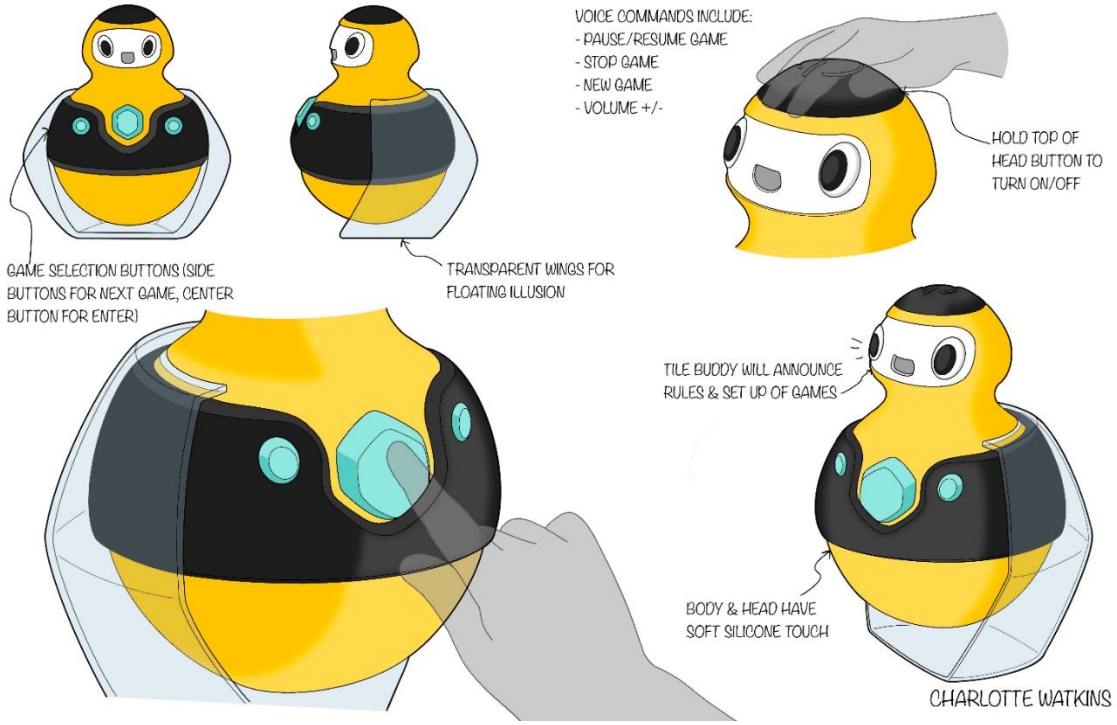


Figure 20- Design Finalization-1

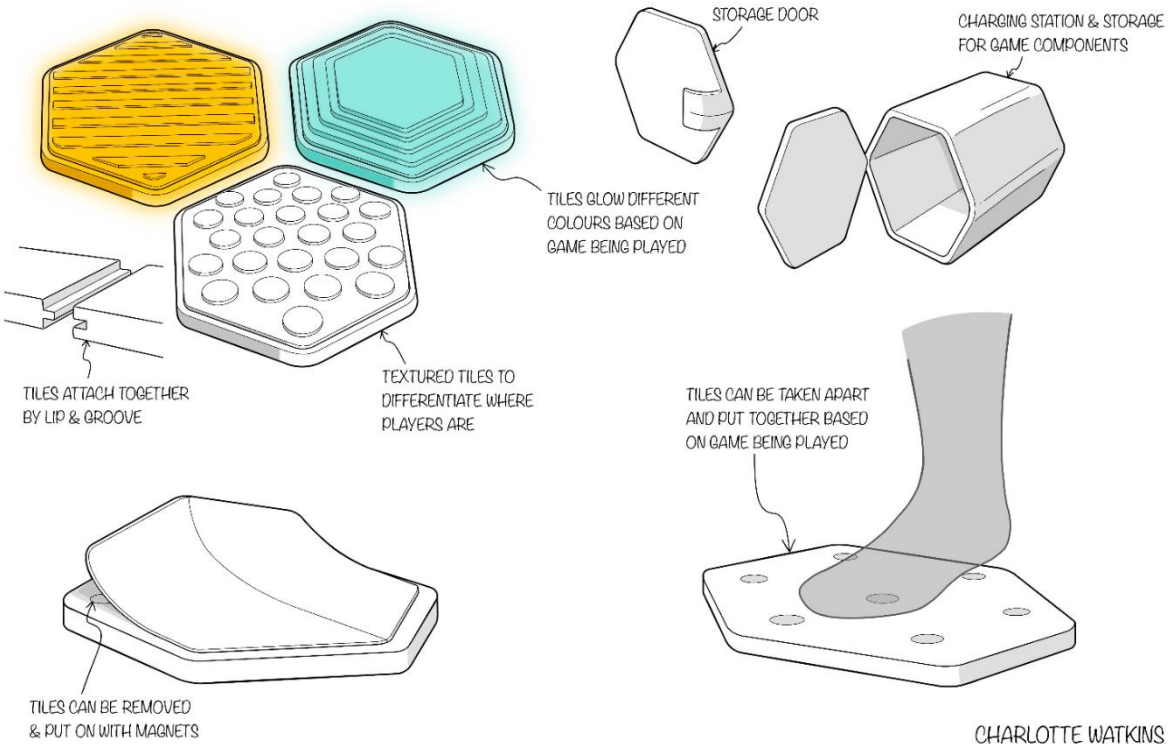


Figure 20- Design Finalization-2

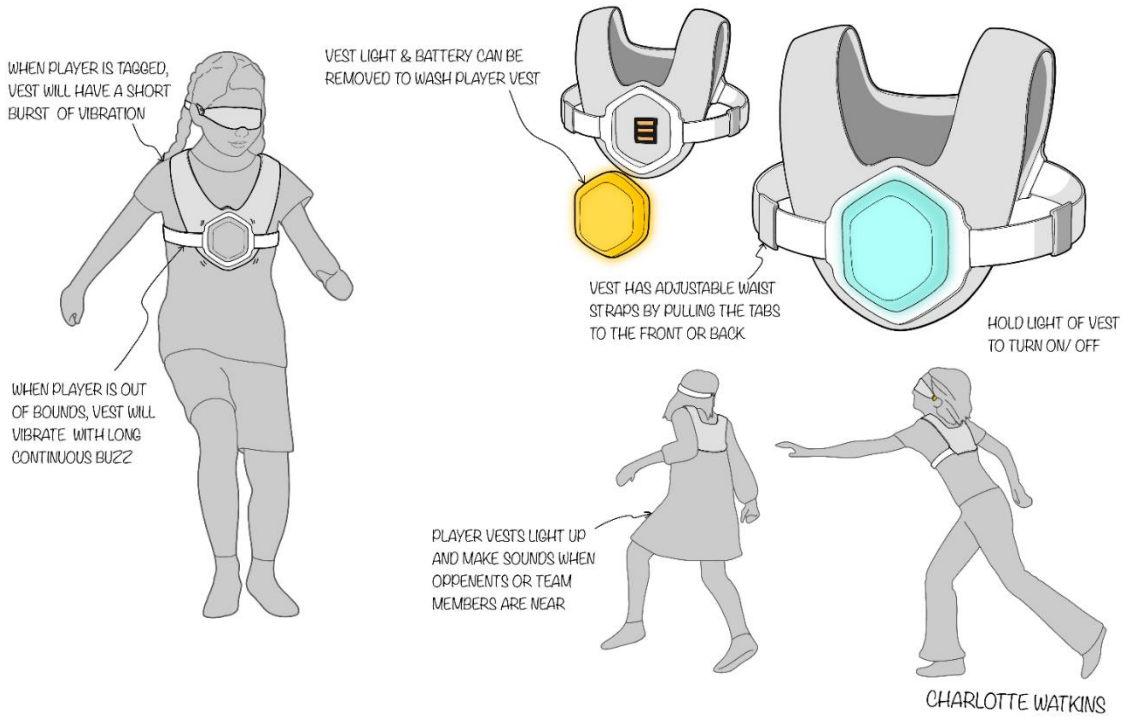


Figure 20- Design Finalization-3

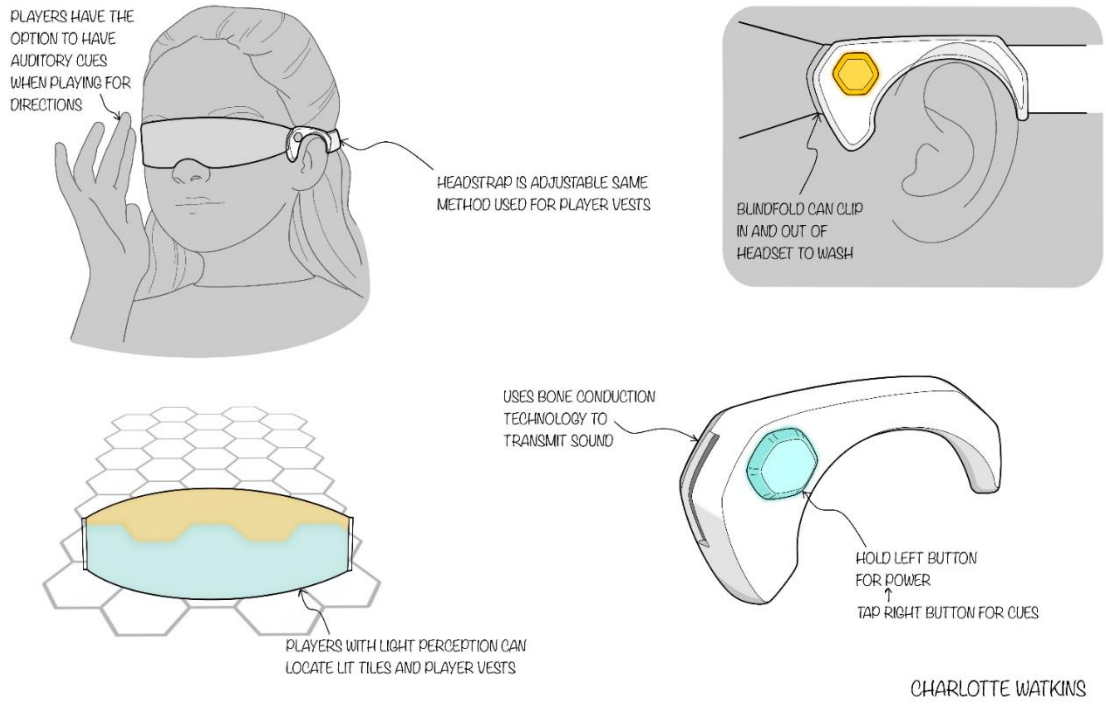


Figure 20- Design Finalization-4

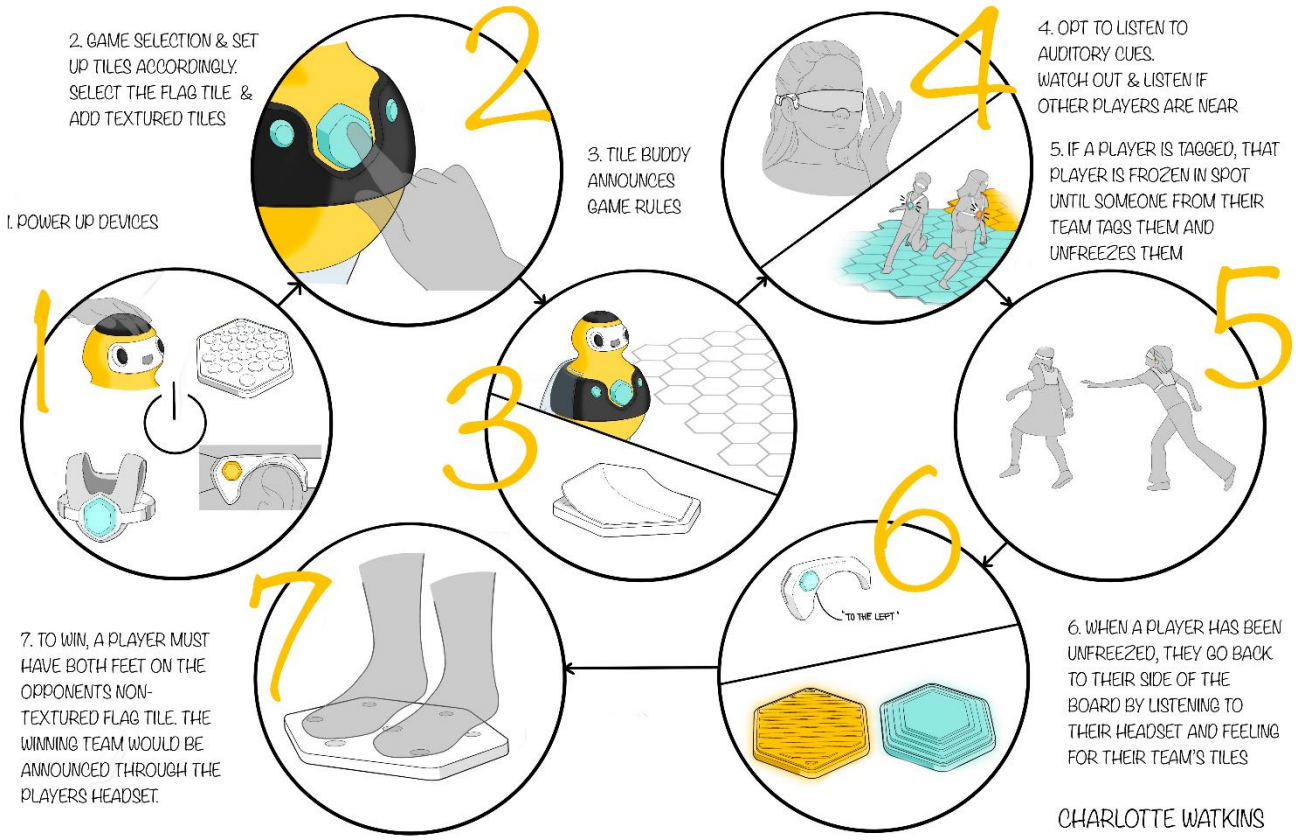


Figure 20- Design Finalization-5

4.5.2 PHYSICAL STUDY MODELS

A quarter scale physical study model was developed to ensure dimensions were accurate and to get a clearer perspective on proportions. Many dimensions remained the same from this until the final product other than increasing AVI by an inch (or 4 inches at a real scale). The physical model allowed for a more realistic view on how to divide the fabric of the player vest as it was an introduction to manipulating fabric. Physical model study shown in figure 21.

Figure 21- Physical Study Model-1

Figure 21- Physical Study Model-2

Figure 21- Physical Study Model-3

4.6 DESIGN RESOLUTION

Final detail development that was included into AVIs game equipment were small aesthetic considerations such as materials. It was important to integrate more textures in the vest to allow children with impaired vision to interact with the details of the product so that they have a more memorable experience wearing it. Hexagon patterned fabric that incorporated different textures was found and was chosen to integrate the hexagon motif. Other material details such as grey trim around the vest as well as a colour palette were finalized.

4.7 CAD DEVELOPMENT

During the CAD modeling stage of the design, minor details were changed and added. Some of these details include removing the inset on AVIs face as it was an unnecessary feature to include and disrupted the aesthetics, adding manufacturing details such as electrical connectors to the male parts of the tiles, adding chamfers to the tiles and texture covers, and altering the shape of the blindfold earpiece. CAD modelling progress is shown in figures 22.

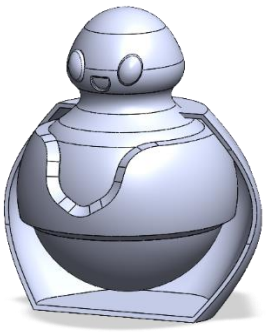


Figure 22- CAD Development-AVI

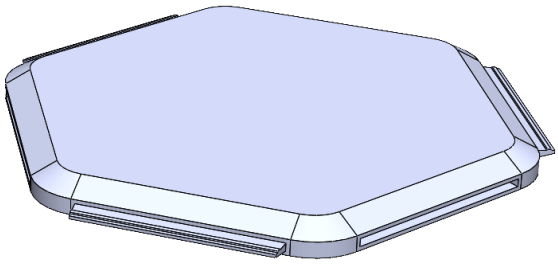


Figure 22- CAD Development-Tiles

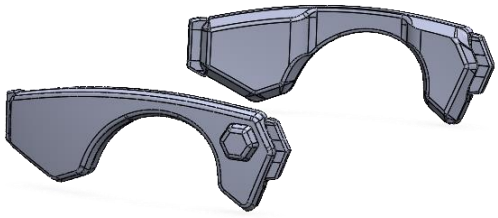


Figure 22- CAD Development-Smart Blindfold

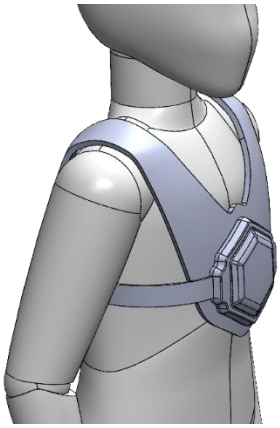


Figure 22- CAD Development-Player Vest

4.8 PHYSICAL MODEL FABRICATION

Through trial and error, the model fabrication was developed through many test 3D prints which were printed and adjusted based on tolerances, and printer errors. Sourced materials that were used were PLA and SLA plastic, Ripstop by the Roll hexagon fabric, grey and white cotton shirts, black cloth, and spray paints. All game tile pieces were printed at Agile Manufacturing Inc., and the remainder prints were at home prints using an Ender 3 Pro printer. Figures 23 demonstrate a part of the model making progress.

Figure 23- Physical Model Fabrication-1

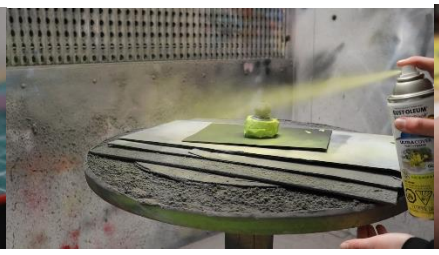


Figure 23- Physical Model Fabrication-2

Figure 23- Physical Model Fabrication-3

Figure 23- Physical Model Fabrication-4

Figure 23- Physical Model Fabrication-5

CHAPTER 5- FINAL DESIGN

5.1 DESIGN SUMMARY

AVI encourages children with impaired vision to practice their navigation skills through active play thus increasing their confidence participating with sighted children during visually impaired friendly games equipped by AVI.

5.1.2 HOW DOES AVI WORK?

Power On

Power on AVI, smart blindfold, and player vests

Game Selection

Browse between games using the side & center selection buttons or through AVIs voice activation.

Game Rules & Set up

AVI addresses rules & set up

Players may select their team using their headset or have AVI divide them.

Players place textured tile covers to identify through touch which team side they are on.

Navigation

Opt-in to listen to auditory cues to help find the flag tile by pressing the smart blindfold button.

When players approach each other, vests will play their “team sound” to let each player know if the approaching player is one’s teammate or a player from the opposition.

Being Tagged

If a player is tagged, that player is frozen in place until someone from their team tags them to free them.

Being freed

When a player has been freed, they return to their side of the board by listening to their smart blindfold and feeling for their team's floor tiles.

Game End

The game ends when a player has found and placed both feet on the opponent's team's flag tile and the results are announced on smart blindfold.

5.1.3 BENEFITS

AVI encourages children to use and rely on their other senses for navigation. This will benefit children with impaired vision greatly as it allows them to practice using their navigation skills in an active way thus increasing their confidence over time in other active settings.

5.2 DESIGN CRITERIA MET

5.2.1 FULL BODIED INTERACTION DESIGN

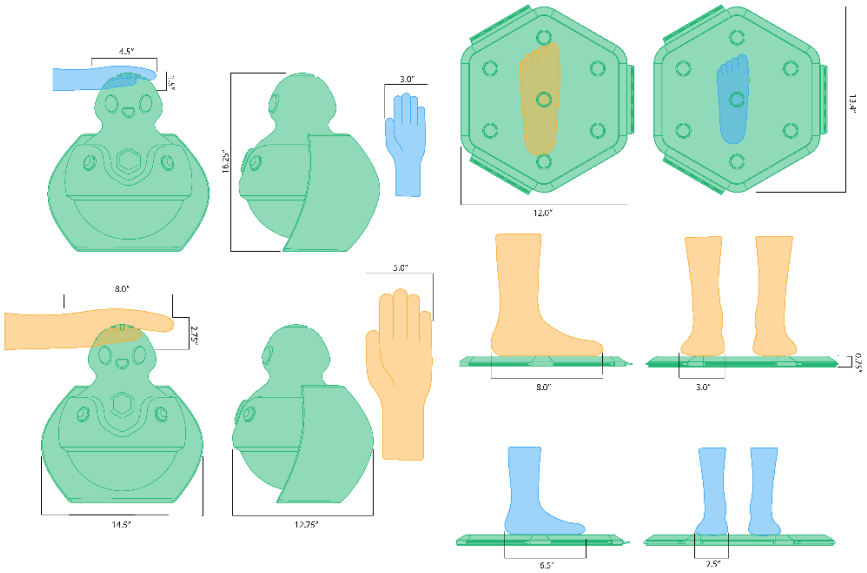


Figure 24- Full Bodied Interaction Design-1

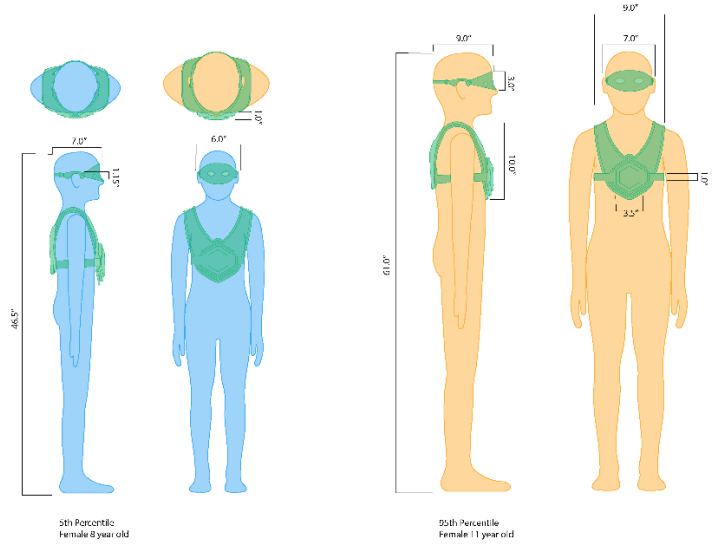


Figure 24- Full Bodied Interaction Design-2

5.2.2 MATERIALS, PROCESSES, AND TECHNOLOGY

This section will be divided between the main game components of AVI: the game tiles, smart blindfolds, player vests, and AVI. Each component will consist of information regarding manufacturing, materials, and other elements.

Game Tiles

For safety reasons, it's important to ensure the game tiles are made from a grippy material so that as children are running the tiles don't slide. Therefore, materials such as TPE are an ideal solution since it's a thermoplastic which is highly recyclable, nontoxic, and latex free. TPE also consumes less energy during manufacturing compared to its non-sustainable relatives and is cost effective. This is a great alternative to silicone as silicone cannot be reused (Kyledriscoll, 2014). However, TPE has a very similar soft yet grippy touch as well as translucent.

Smart Blindfolds

The players' blindfolds and head strap would be made from a polyester alternative such as Bananatex. Typical polyesters are manufactured by extruding crude oils from the ground and treating the material with harsh chemicals resulting in land, water, and air pollution. Few polyesters are recyclable however it isn't biodegradable and has a lifespan of up to 200 years. Bananatex is the better solution to fabrics as it can come in a variety of fabric weights and colours as well as being PFC free. Its lifecycle consists of cutting the stalks of Abaca banana plants, fiber extraction, paper making, yarn spinning, weaving, beeswax coating, assembling, manufacturing, releasing to retail, and finally being biodegradable at the end of its life cycle (Axminenko, 2023). The smart blindfold ear pieces use bone conduction technology which amplify sound waves through a players skull around their temples to be able to listen to auditory instructional cues while being able to clearly hear their

surroundings during game play. The earpiece casing would consist of an ABS shell with a TPE over mold for a soft touch. TPE as previously mentioned, and ABS are both thermoplastics meaning they can be recycled through melting without changing their physical properties and are non-toxic materials often used in children's products (CDN, 2006). Injection molded ABS would also be the material of choice for the earpiece buttons for durability.

Player Vests

Similar to the blindfold, the player vests, trim, waist band, and stitching would also use Bananatex because of the reasons previously mentioned as well as for its water-repellent properties (Quirino,2022). The vest button and adjusters would use TPE for its translucent and sustainable properties, and the center plug for the main button would use ABS for its durability and shine.

AVI

AVI's body skeleton, speaker skeleton, and selection buttons are injection molded ABS for it's durable and sustainable properties and other reasons mentioned in the smart blindfold section. Since AVI's eyes include digital screens, the shell of the eyes is manufactured from Acrylic/PMMA as a hard plastic alternative since it is a light transmissible plastic. Acrylic/PMMA allows 92% of light to pass through being more than any other glass or plastic, it's lightweight, non-toxic when manufactured, fully recyclable, a thermoplastic, and can reduce energy consumption by 55% compared to similar materials (PMMA, 2021).

5.2.3 DESIGN IMPLEMENTATION

The following is the bill of materials per game equipment. Each figure (game equipment) has a corresponding table (bill of materials.)

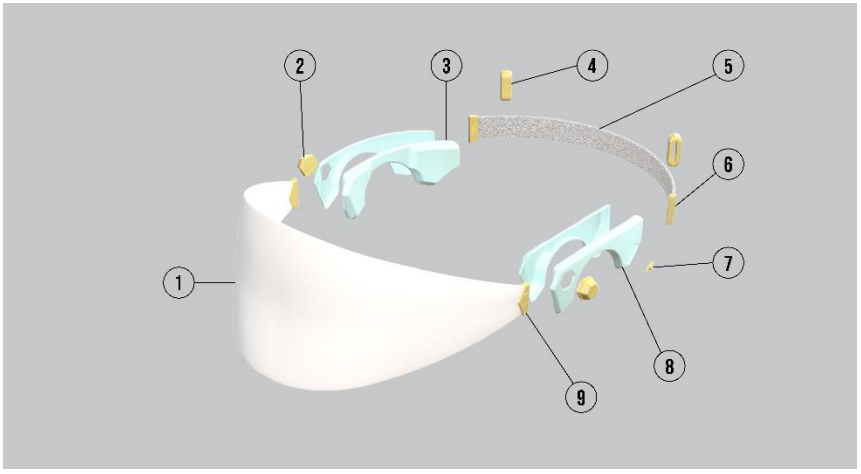


Figure 25- Design Implementation-Smart Blindfold

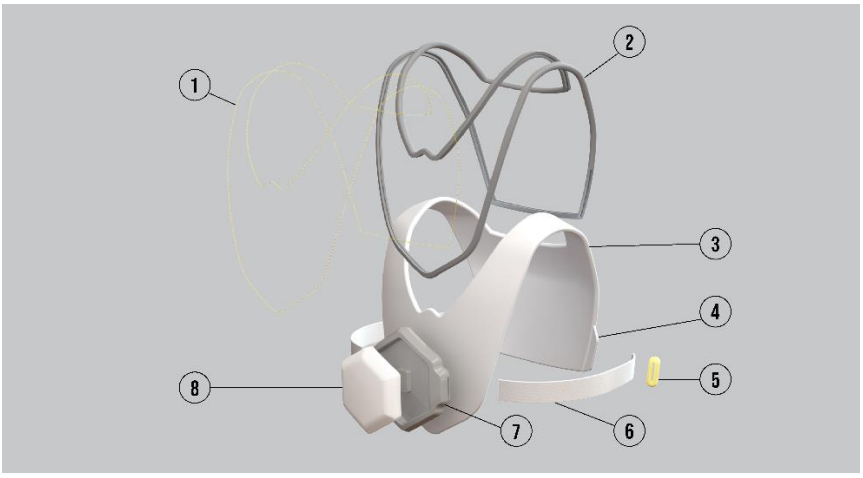


Figure 25- Design Implementation-Player Vest

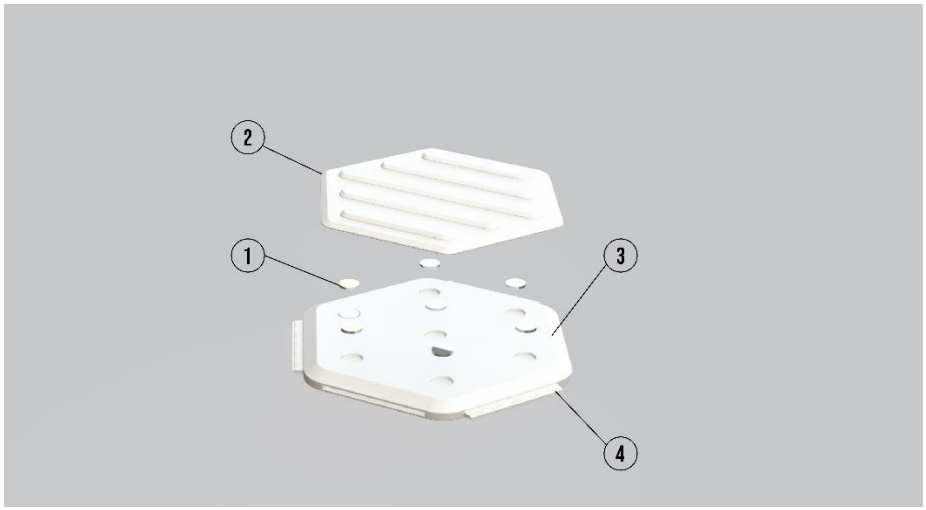


Figure 25- Design Implementation- Tile

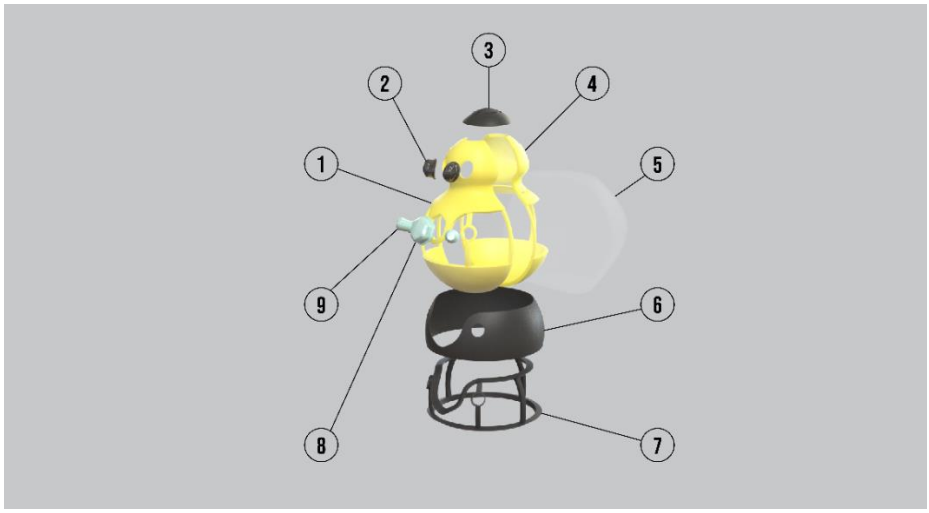


Figure 25- Design Implementation-AVI

Smart Blindfold

Part #	Description	Quantity	Material	Manufacturing Method
1	Blindfold	1	Bananatex	Woven
2	Auditory Cue Button	2	ABS	Injection Molded
3	Inner Earpiece Shell	2	Thermoplastic Elastomer & ABS	Injection Molded
4	Head strap Adjuster	2	Thermoplastic Elastomer	Injection Molded
5	Head strap	1	Bananatex	Woven
6	Back Earpiece Clasp	2	ABS	Injection Molded
7	Power Switch	1	ABS	Injection Molded
8	Outer Earpiece Shell	2	Thermoplastic Elastomer & ABS	Injection Molded
9	Blindfold Earpiece Clasp	2	ABS	Injection Molded

Table 11- BOM Smart Blindfold

Player Vest

Part #	Description	Quantity	Material	Manufacturing Method
1	Stitching	2	Bananatex	Woven
2	Outside & Inside Trim	1	Bananatex	Woven
3	Main Vest Body	1	Bananatex	Woven
4	Vest to Waistband Connectors	2	ABS	Injection Molded
5	Waistband Adjusters	2	ABS	Injection Molded
6	Waistband	2	Bananatex & Rubber	Woven
7	Light Button Base	1	ABS	Injection Molded
8	Light Button	1	Thermoplastic Elastomer	Injection Molded

Table 12- BOM Player Vest

Game Tiles

Part #	Description	Quantity	Material	Manufacturing Method
1	Tile Magnets	7 (per tile)	Iron	Powder Metallurgy
2	Tile Cover	2 (per tile)	Thermoplastic Elastomer	Injection Molding
3	Tile Base	1 (per tile)	Thermoplastic Elastomer & ABS	Injection Molding
4	Copper Connectors	30 (per tile)	Copper	Stamped Metal

Table 13- BOM Tiles

AVI

Part #	Description	Quantity	Material	Manufacturing Method
1	Main Front Shell	1	Thermoplastic Elastomer & ABS	Injection Molded
2	Eye	2	PMMA	Injection Molded
3	Power Button	1	Thermoplastic Elastomer	Injection Molded
4	Main Back Shell	1	Thermoplastic Elastomer & ABS	Injection Molded
5	Wings	1	Frosted ABS	Injection Molded
6	Speaker Fabric	1	Organic Linen	Woven
7	Speaker Shell	1	ABS	Injection Molded
8	Enter Button	1	ABS	Injection Molded
9	Selection Buttons	2	ABS	Injection Molded

Table 14- BOM AVI

5.3 FINAL CAD RENDERING

Figure 26- Final CAD Rendering-Insitu

Figure 26- Final CAD Rendering-Player Vest

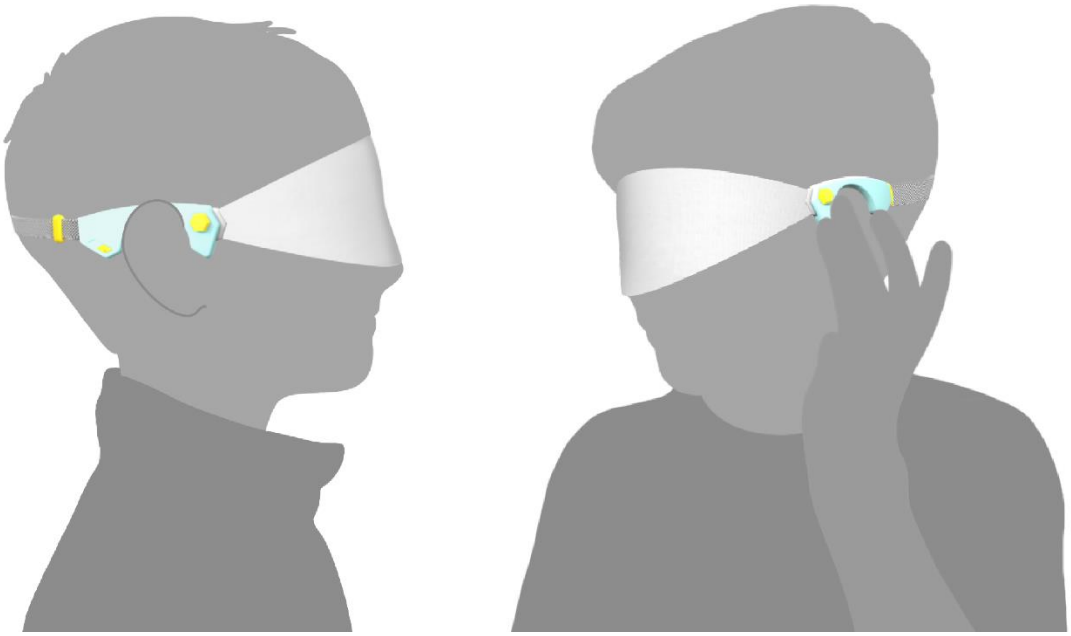


Figure 26- Final CAD Rendering-Smart Blindfold

Figure 26- Final CAD Rendering-AVI

5.4 PHYSICAL MODEL

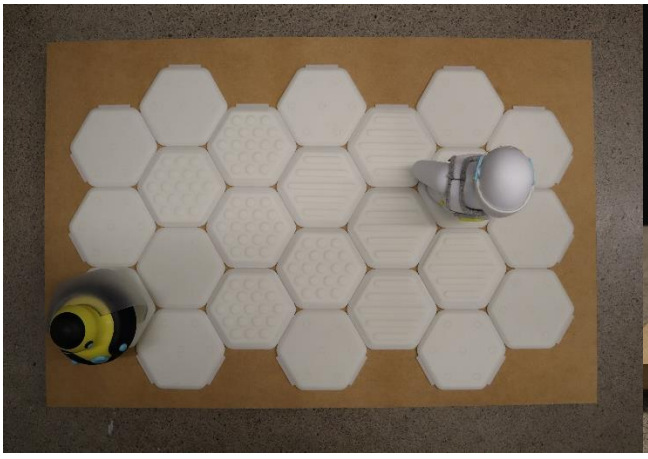


Figure 27- Final Physical Model-1

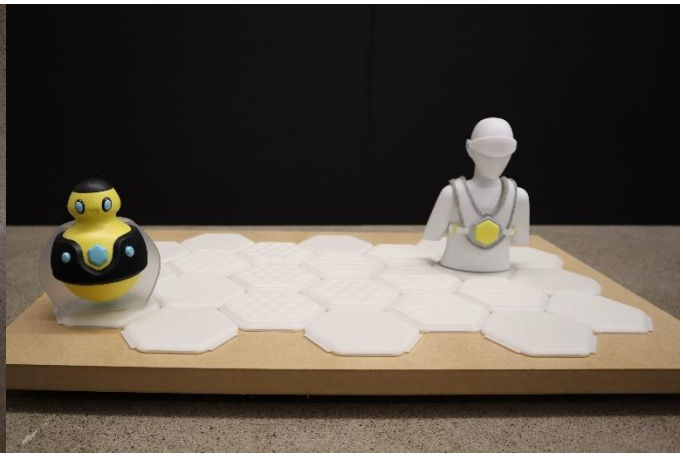


Figure 27- Final Physical Model-2

Figure 27- Final Physical Model-3

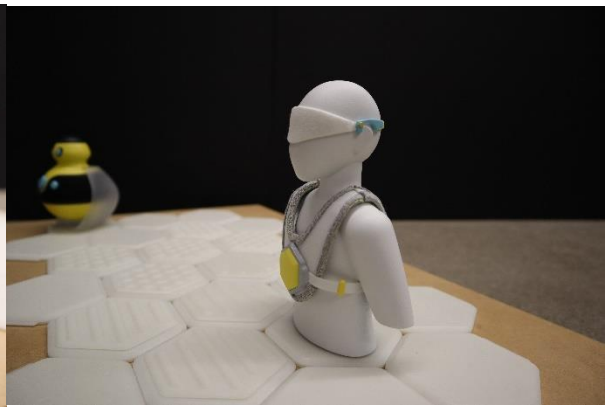


Figure 27- Final Physical Model-4

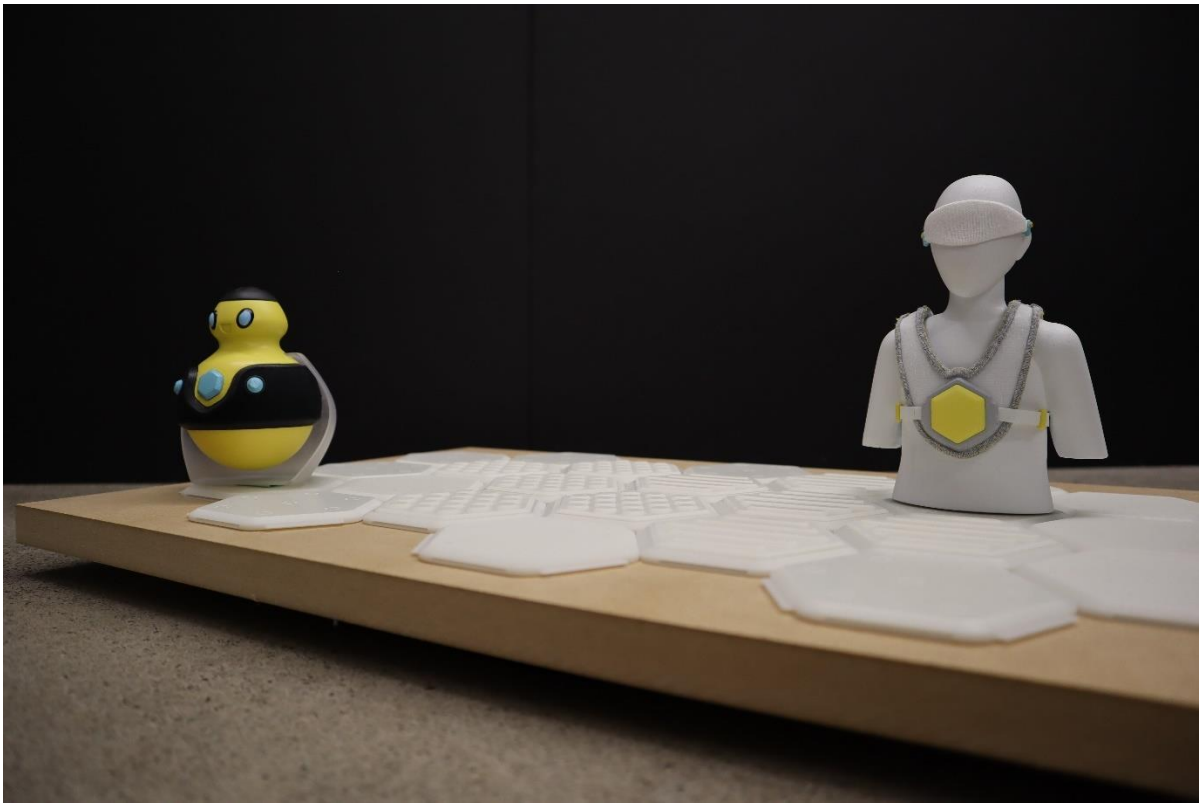


Figure 27- Final Physical Model-5

5.5 TECHNICAL DRAWINGS

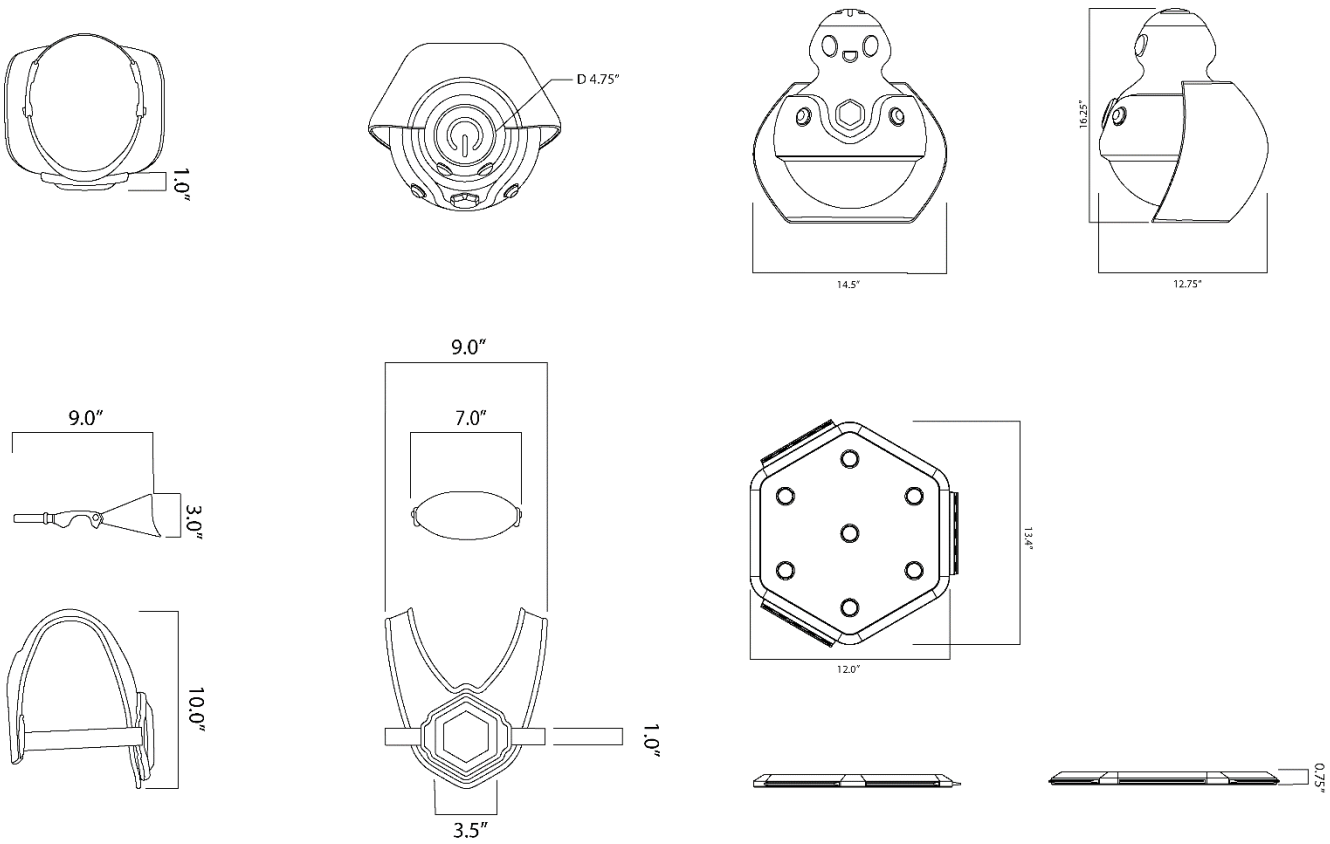


Figure 28- Technical Drawing

5.6 SUSTAINABILITY

Taking multiple aspects such as health, sustainable education, materials, and manufacturing into consideration when developing a product has influenced the business aspect as well as the look and feel of the product significantly. By doing so it can influence the users to reflect and compare their current products to this thesis project and potentially have them consider changing their habits for themselves and their children. By incorporating sustainability into products such as AVI in early to mid-childhood, we can implement sustainable living as a regular habit thus creating a healthier future and environment.

CHAPTER 6- CONCLUSION

Figure 26- Final CAD Rendering-Insitu

AVI is also able to implement more inclusive active play in “mainstream” school curriculums and at home to encourage visually impaired children to feel more confident in participating with their peers.

REFERENCES

ABS A Brilliant Solution for a "Greener Planet". In cooperation with - cdn.ymaws.com. (2006). Retrieved from https://cdn.ymaws.com/www.ppfahome.org/resource/resmgr/pdf/abs_green_brochure.pdf

Amazon.com : Vgeby Children vest kids breathable waistcoat for hunting ... (n.d.). Retrieved from https://www.amazon.com/VGEBY-Children-Breathable-Waistcoat-Hunting/dp/B08HQ2PN1Y

Axminenko, A. (2023). *Bananatex®Natural white LW poplin Dwr*. BANANATEX®. Retrieved from https://www.bananatex.info/products_EN.html#medium

Centers for Disease Control and Prevention. (2001, August 23). *Growth charts - data table of stature-for-age charts*. Centers for Disease Control and Prevention. Retrieved from https://www.cdc.gov/growthcharts/html_charts/statage.htm#females

Centers for Disease Control and Prevention. (2001, August 23). *Growth charts - data table of stature-for-age charts*. Centers for Disease Control and Prevention. Retrieved from https://www.cdc.gov/growthcharts/html_charts/statage.htm#males

Chong, C., & Kappen, D. (2022). *Week 11-IDSN4002_Human-Factors-Ergonomic_F22*. Lecture.

DeBoer, H. (2022, October 14). User Observation at W. Ross MacDonald. personal.

Deines, T. (2016, May 4). *Blank training vests sports Pinnies for football / soccer team Adult & Youth & X Large*. opentip.com. Retrieved from https://www.opentip.com/Blank-Training-Vests-Sports-Pinnies-for-Football-Soccer-Team-Adult-Youth-X-Large-p-5599779_7GAB-DKGAB01_BLACK-ADULT.html?ats=gs&srsltid=Ad5pg_FLjKrdO6LvLnQ9L-ZYnm7qZ5z4CxFERozs3wRnvqD-KrRMTXIWE40

Ducharme, J. (2018, June 28). *Only 23% of Americans get enough exercise, a CDC report says*. Time. Retrieved from https://time.com/5324940/americans-exercise-physical-activity-guidelines/

Eilik. Energize Lab. (n.d.). Retrieved from https://store.energizelab.com/products/eilik

Elastomer, K. (2022, May 17). *Advantages of thermoplastic elastomer*. Kent Elastomer Products. Retrieved from https://www.kentelastomer.com/advantages-of-using-thermoplastic-elastomer-as-an-alternative/#:~:text=Thermoplastic%20elastomers%20are%20an%20excellent,recycled%20by%20molding%20or%20extruding.

Gender. The International Agency for the Prevention of Blindness. (2022, May 31). Retrieved from https://www.iapb.org/learn/vision-atlas/inequality-in-vision-loss/gender/

Gilobaby Kids Robot Toy, interactive smart talking robot with voice controlled touch sensor speech recognition, singing, dancing, repeating, recording, birthday gifts for children boys girls age 4-7, remote- & app-controlled toys - Amazon Canada. , Remote- & App-Controlled Toys - Amazon Canada. (n.d.). Retrieved from https://www.amazon.ca/dp/B09ZLHZQLW/ref=sspa_dk_detail_0?pd_rd_i=B09ZLHZQLW&pd_rd_w=v0N54&content-id=amzn1.sym.c7dca932-da6a-44fc-af09-cc68d2449b34&pf_rd_p=c7dca932-da6a-44fc-af09-cc68d2449b34&pf_rd_r=RM0H9QT9CSPKZ3M03NGP&pd_rd_wg=2B40S&pd_rd_r=0d5c77df-ef7b-494f-bb91-76206c7b66f2&s=toys&sp_csd=d2lkZ2V0TmFtZT1zcF9kZXRhaWw&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUEzU1JNWDlaTDdHOEImZ

W5jcnlwdGVkSWQ9QTA4NjM0NzQxOUFPTTE5TzJYMjFNJmVuY3J5cHRlZEFkSWQ9QTA4NTIzMTcyUk4wT1ZOSjRVNDAxJndpZGdldE5hbWU9c3BfZGV0YWlsJmFjdGlvbj1jbGlja1JlZGlyZWN0JmRvTm90TG9nQ2xpY2s9dHJ1ZQ&th=1

Haylou Purfree BC01 bone conduction headphones - worldwide delivery. Bone Conduction Headphones - Worldwide delivery. (n.d.). Retrieved from https://haylou.info/purfree-bc01.html

Hexlights Hexagon Wall Lights, premium set of touch & remote controlled RGB wall panels - led hexagon lights, sensory lights - great for living room, bedroom & gaming room decor - 13 colors, 7 pack. Amazon.ca: Tools & Home Improvement. (n.d.). Retrieved from https://www.amazon.ca/HEXlights-Remote-Controlled-Wall-Lights/dp/B08WTYL8WD

Kyledriscoll. (2014, August 8). *Silicone Sustainability*. Design For Sustainability. Retrieved from https://kyledriscoll.wordpress.com/2014/08/08/silicone-sustainability/

Life cycle of clothing. Let's Talk Science. (n.d.). Retrieved from https://letstalkscience.ca/c4c/resource/life-cycle-clothing#:~:text=After%20Use%3A%20Polyester%20is%20not,Some%20polyester%20is%20recycled.

Moka SFX MK-LD02 led dance floor wedding for bars, parties and nightclubs, shows. MOKA SFX. (n.d.). Retrieved from https://www.mokalighting.com/products/moka-sfx-mk-ld02-led-dance-floor-wedding-for-bars-parties-and-nightclubs-shows-and-more?_pos=10&_sid=8c5eb6d59&_ss=r

Morrison, R. (2022, November 2). *The lasting impact of teaching sustainability to your kids*. Biofriendly Planet | For a Cooler Environment. Retrieved from https://biofriendlyplanet.com/eco-awareness/the-lasting-impact-of-teaching-sustainability-to-your-kids/?utm_source=rss&utm_medium=rss&utm_campaign=the-lasting-impact-of-teaching-sustainability-to-your-kids

Niebelschuetz, M. (2023). *The importance of sustainability in play*. The Genius of Play. Retrieved from https://thegeniusofplay.org/genius/expert-advice/articles/the-importance-of-sustainability-in-play.aspx#.Y-E0oHbMJhE

OpenRun pro. Shokz Canada. (n.d.). Retrieved from https://ca.shokz.com/products/openrunpro?_pos=1&_sid=6aca31ff6&_ss=r

Palacios-Mateo, C., van der Meer, Y., & Seide, G. (2021, January 6). *Analysis of the polyester clothing value chain to identify key intervention points for sustainability - Environmental Sciences Europe*. SpringerOpen. Retrieved from https://enveurope.springeropen.com/articles/10.1186/s12302-020-00447-x

Polycarbonate Roofing Pros and Cons. A&C Plastics. (n.d.). Retrieved from https://www.acplasticsinc.com/informationcenter/r/polycarbonate-roofing-pros-cons

Properties and benefits. PMMA. (2021, September 29). Retrieved from https://www.pmma-online.eu/pmma-science/properties-and-benefits/

Rogers, T. (2015, July 13). *Everything you need to know about ABS plastic*. Everything You Need to Know About ABS Plastic. Retrieved from https://www.creativemechanisms.com/blog/everything-you-need-to-know-about-abs-plastic

Silicone. Life Without Plastic. (n.d.). Retrieved from https://lifewithoutplastic.com/silicone/

SoundGuys. (2022, December 4). *Bone conduction headphones: Gimmick or godsend?* SoundGuys. Retrieved from https://www.soundguys.com/bone-conduction-headphones-20580/

The global life cycle of Stainless Steels. (n.d.). Retrieved from https://www.worldstainless.org/files/issf/non-image-files/PDF/Team_Stainless/The_Global_Life_Cycle_of_Stainless_Steels.pdf

The World Counts. (2023). *Environmental Impact of Toys*. The world counts. Retrieved from https://www.theworldcounts.com/challenges/consumption/other-products/environmental-impact-of-toys

TILLEY, A. R., & DREYFUSS, H. (2002). In *The measure of man and woman: Human factors in design* (pp. 13–17). essay, John Wiley and Sons.

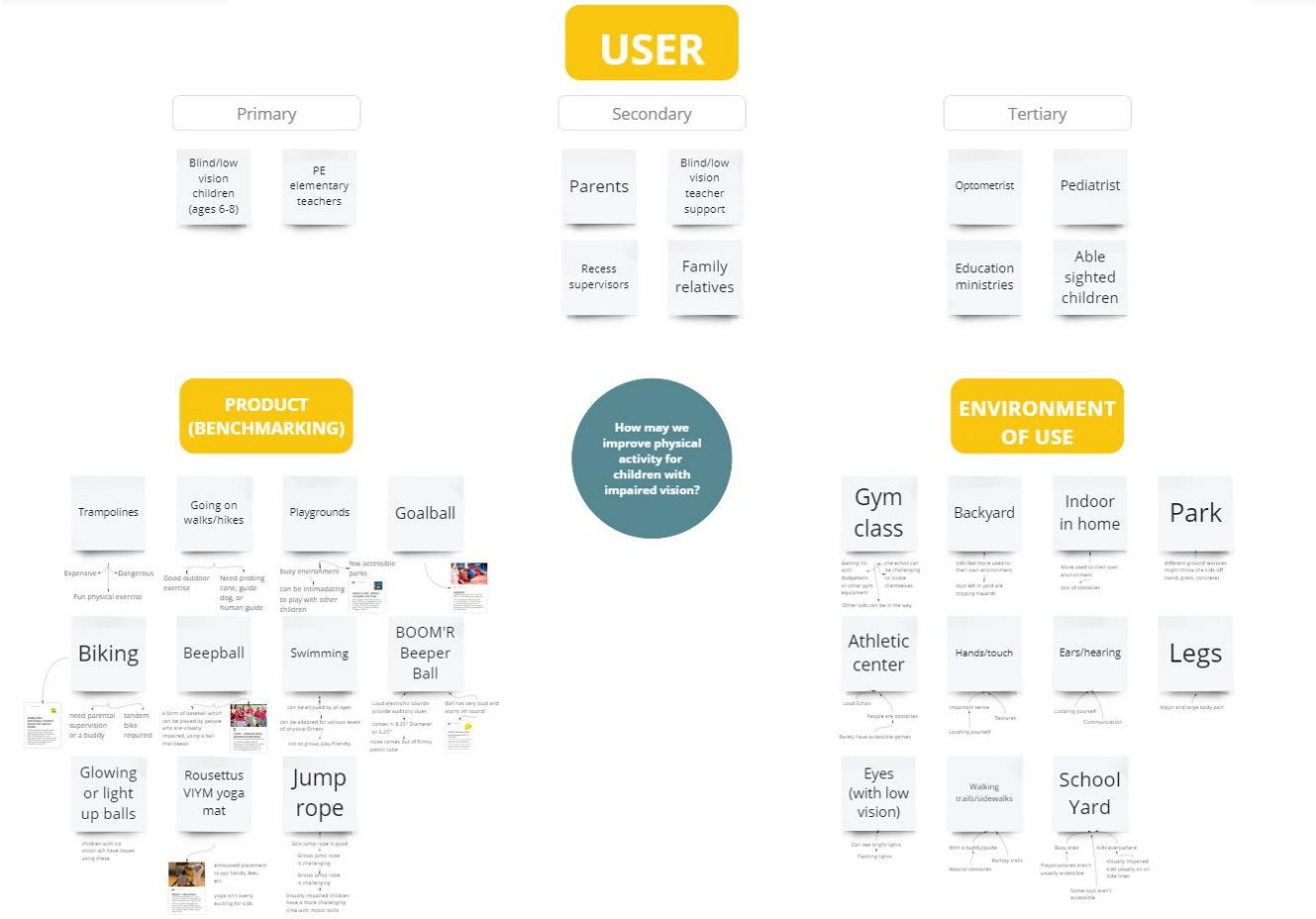
Valdez, F. (2021, August 13). *Is tempered glass environmentally friendly? (explained)*. UpHomely. Retrieved from https://uphomely.com/tempered-glass-environmentally-friendly

Water treatment solutions. Lenntech Water treatment & purification. (2023). Retrieved from https://www.lenntech.com/periodic/elements/ti.htm#:~:text=carcinogenicity%20to%20humans.)-,Environmental%20effects%20of%20titanium,environmental%20effects%20have%20been%20reported.

What is ABS plastic and is it recyclable? Plastic Collectors. (2020, April 23). Retrieved from https://www.plasticcollectors.com/blog/what-is-abs-plastic/

APPENDIX A – DISCOVERY

Triangulation

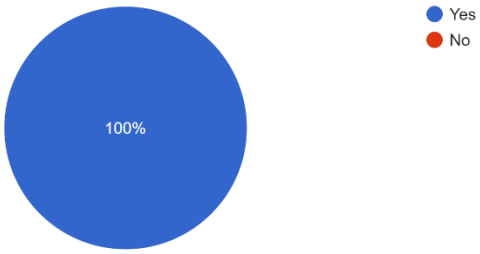


APPENDIX B – CONTEXTUAL RESEARCH (USER)

Physical Activity for Children with Impaired Vision Survey

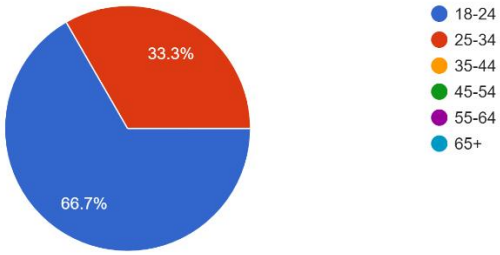
Your participation in this survey is completely voluntary and you may end the surve at any time without giving a reason or fear of being penalized. If ..., of my own free will, to participate in this survey

3 responses



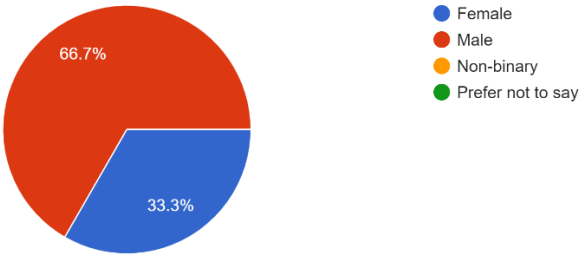
In what age range do you belong?

3 responses



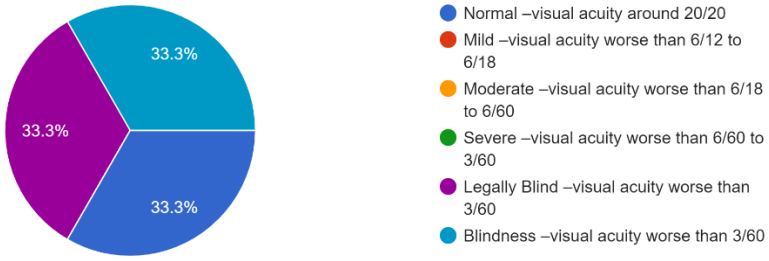
How do you identify?

3 responses



What is your level of vision?

3 responses



What do you believe are the top 3 challenges or major issues children with impaired vision are facing?

3 responses

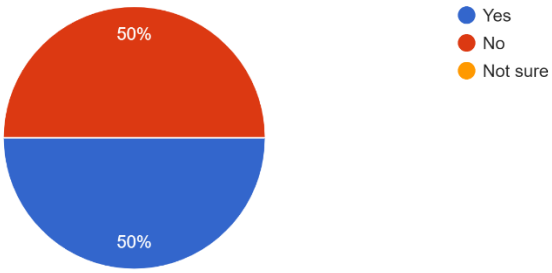
Participating in team sports, finding activities that would suit everyone, and finding equivalent activities.

Lack of opportunity lack of understanding of blind sport, no / little integration with sighted peers from a young age leading to isolation later in life

I'm not entirely sure. My sister's school has generally been great about accommodating her. She doesn't get bullied for her nystagmus or albinism. People who don't look in her eyes are generally surprised to learn that she has nystagmus or albinism (she has blonde hair and blue eyes).
One issue is that during P. E. she sometimes goes to the library to read on her kindle. Sometimes they are able to adapt things to her, but her depth perception isn't great and she can't really see after a certain distance so many sports are out of the question. Other times she is allowed to run laps around the playground outside, and kids who don't want to participate in the activities are allowed to run alongside her.

In elementary school, did you (or your school) have access to accessible activities for those with impaired vision?

2 responses



Have there been trends you've noticed in physical activity for younger children with impaired vision over the last 5 years? (Any changes, similarities)

2 responses

Less and less chance to take part in competitive sports

I don't know about trends, but my sister does running.
I think in first grade she was in the regular gym class but she broke her glasses when she couldn't catch a ball that someone threw, so they changed the IEP.

What kind of technology would be beneficial within physical activity/education?

3 responses

Some way to track steps, accessible balls and other equipment like basketball hoops and volleyball net and such. But easily enough for sighted children to play as well.

Not much. Just appropriate for the sports (e.g bell tennis balls)

I think something in track where the lines were differently colored to stand out more

What would you consider the top 3 current solutions within physical activity in this demographic?

3 responses

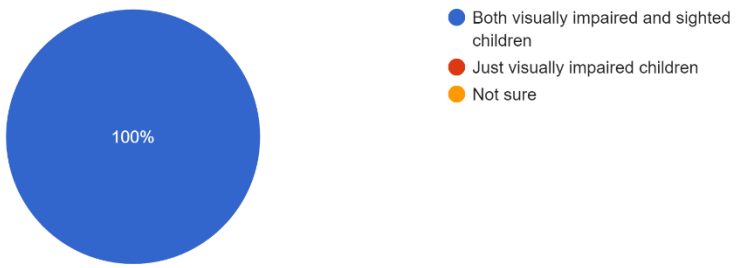
Not sure but balls with bells inside is good. Pedometers are good. And maybe some use of an appple watch?

More chance to play with sighted peers, nurturing a love for sport in younger children, exposing children to less dumb down versions of sport

One of the lines at the track at the local kids rec center is thicker than the others so m y sister usually runs in the lane that track is in. Sometimes her best friend (an amputee!) runs alongside her as a guide of where she's supposed to be.

Would games including visually impaired children be better for both visually impaired and sighted children or just visually impaired children?

3 responses



What current technology do you find/think is beneficial for active play/physical activity?

2 responses

Balls with bells in it

Anything that the child like playing with.

Were there particular games/sports that were more challenging to play with others, both sighted and non sighted kids than other games, and why were they more challenging?

2 responses

I haven't found an easy one besides swimming al other team sports isn't easy. I would say maybe football or basketball especially the faster ones with a lot of running. All team sports is really difficult though.

Badminton and tennis because of the nature of having to hit the ball / shuttlecock

APPENDIX C – FIELD RESEARCH (PRODUCT)

Related products to AVIs game equipment

Current Products

Current related products to this thesis include interactive tiles, toy robots, bone conduction headphones and tactical vests. The following are some examples of these products and their use of materials.

Interactive Tiles

HEXlights Hexagon Lights (Figure…)

- Primary materials used are **Acrylonitrile Butadiene Styrene (ABS)** & LEDs.

MOKA SFX MK-LD02 Led Dance Floor (Figure…)

- Primary materials used are **ABS** and **tempered glass**.

Toy Robots

GILOBABY Kids Robot Toy (Figure…)

- *Battery powered.*
- *Primary materials are **ABS** (and is BPA free).*

Eilik (Figure…)

- *Battery powered.*
- *Primary material is **high strength polycarbonate (PC).***

Bone Conduction Headphones

OpenRun Pro (Figure…)

- IP55 Water- Resistant.
- Magnetic charging.
- Primary materials are **silicone** (battery compartment & ear hook), **polycarbonate** (speaker & charging port), and **stainless steel** (speaker & charging port).

Haylou PurFree BC01 (Figure…)

- Waterproof.
- Magnetic charging.
- Primary materials are **silicone** (headband and ear hook) and **titanium alloy** (frame).

Tactile Vests

VGEBY Children Vest for Hunting Battle Game (Figure…)

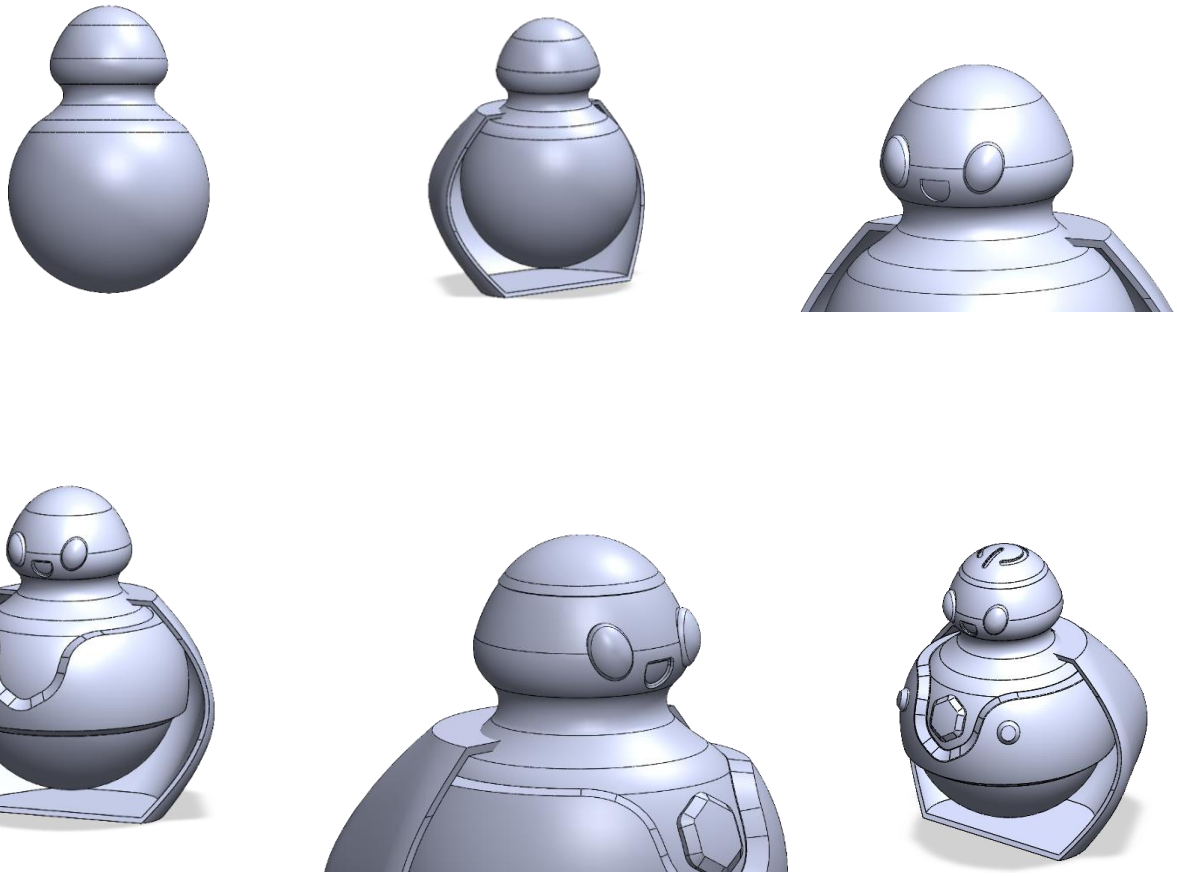
- Wear & tear resistant.
- Durable.
- Primary material is 600D **polyester.**

Blank Training Vests (Figure…)

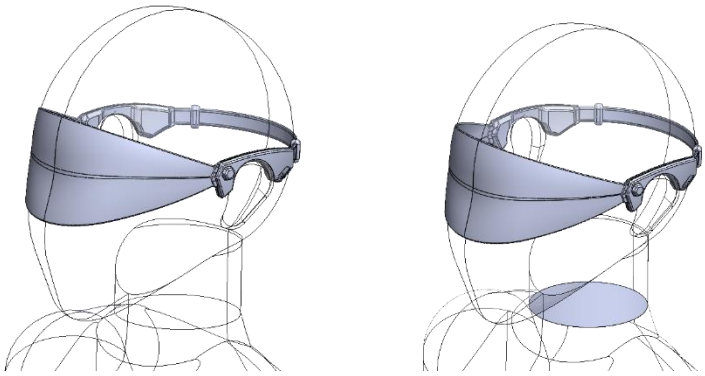
- Elastic waistband.
- Primary material is polyester.

APPENDIX D – CAD DEVELOPMENT

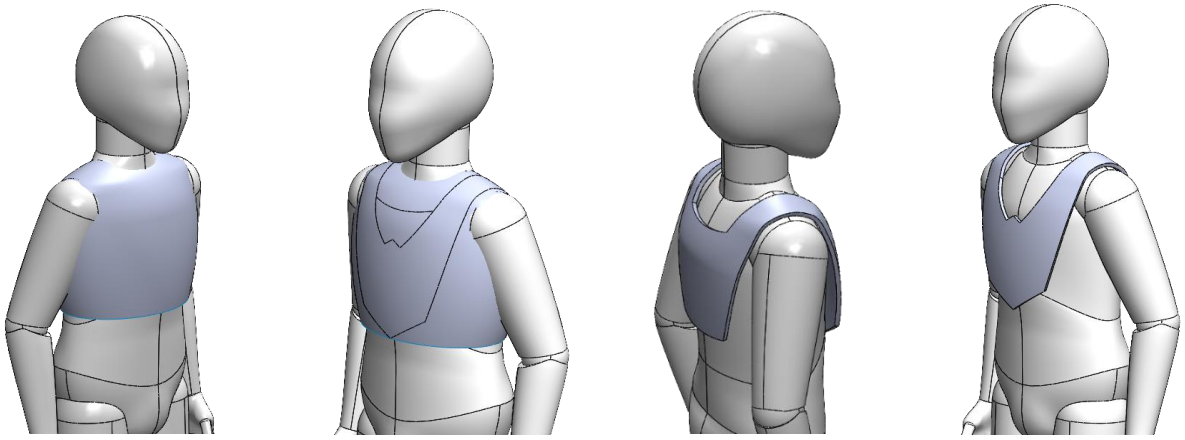
AVI CAD Progress

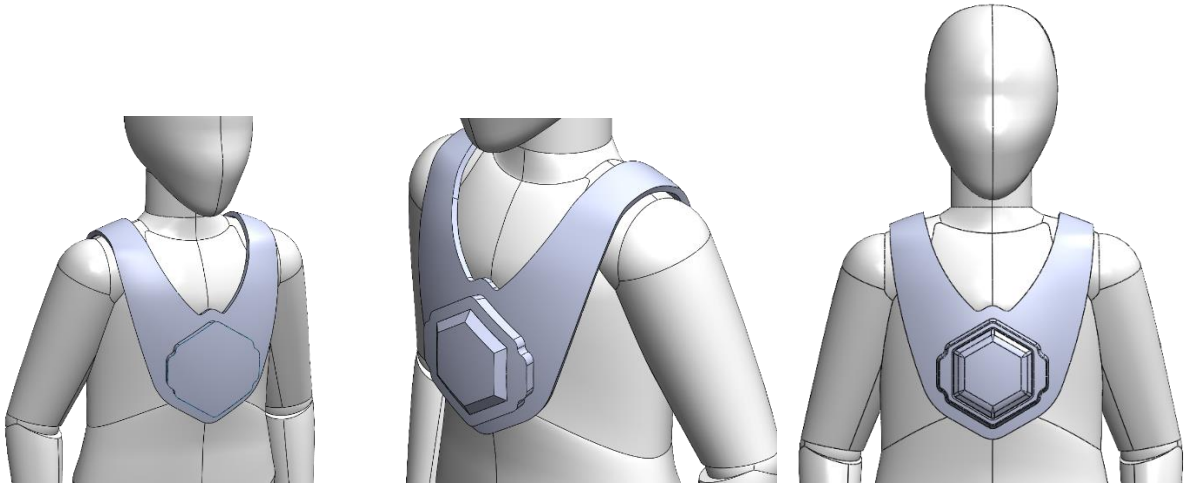


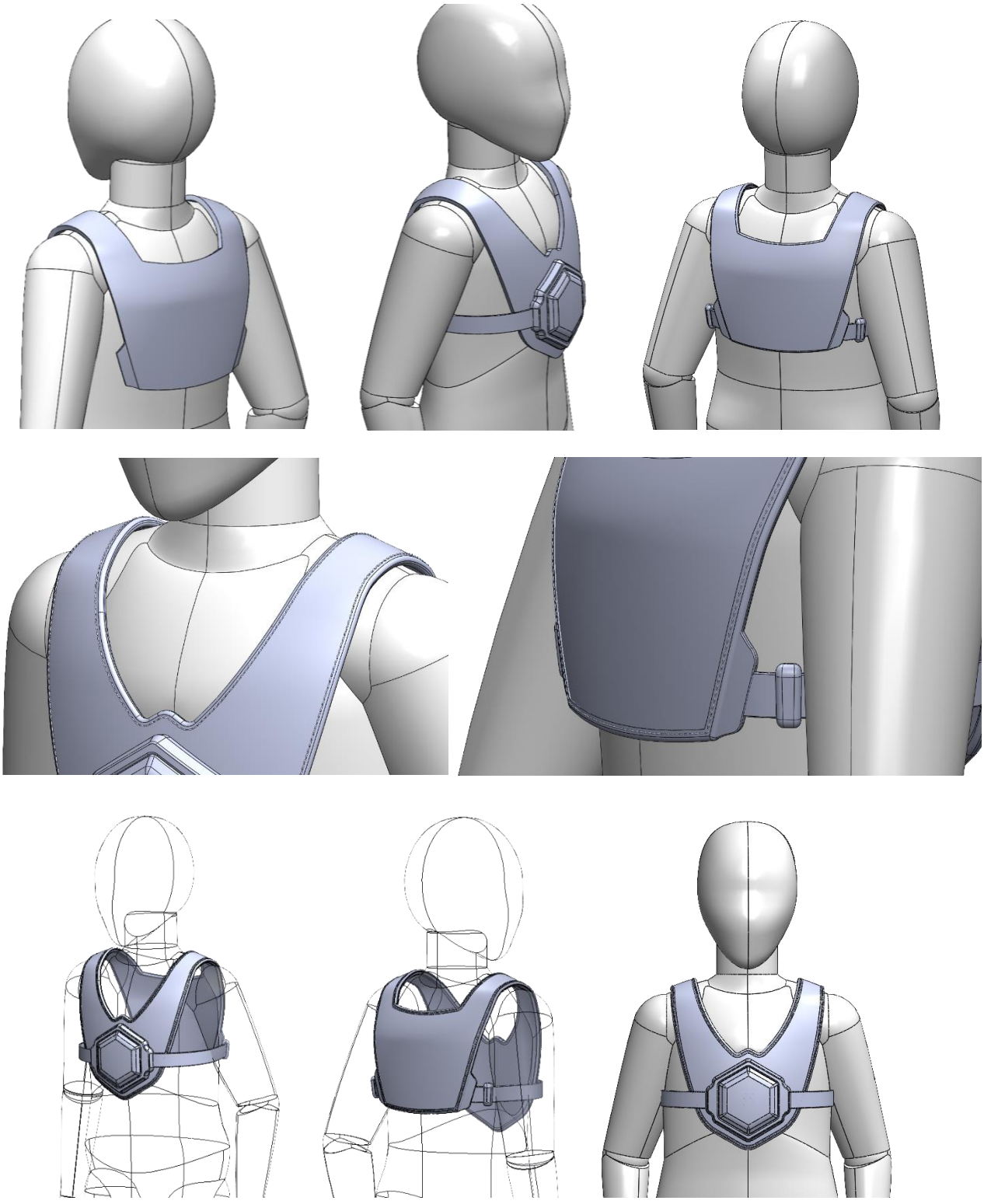
Smart Blindfold CAD Progress



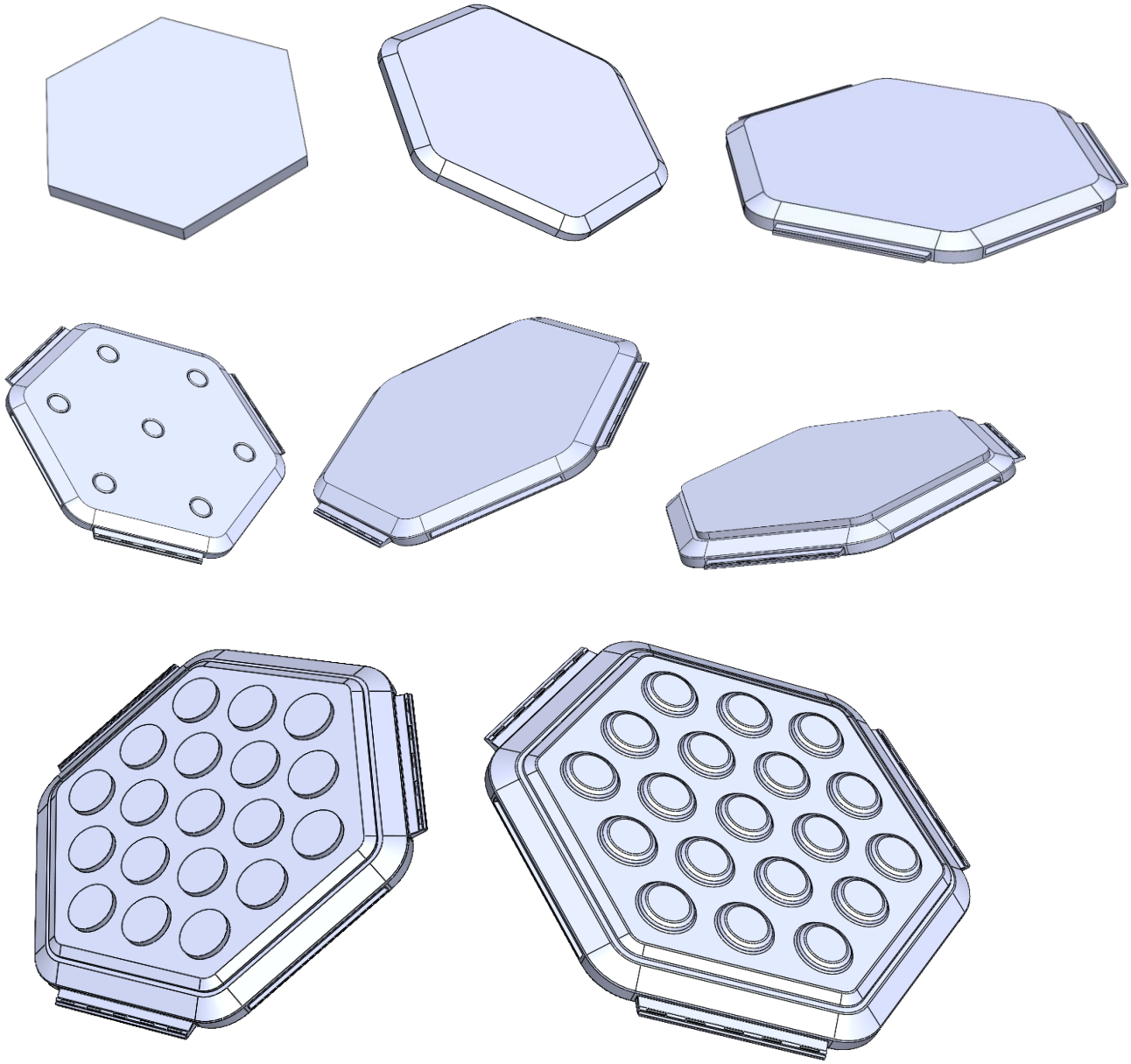
Player Vest CAD Progress

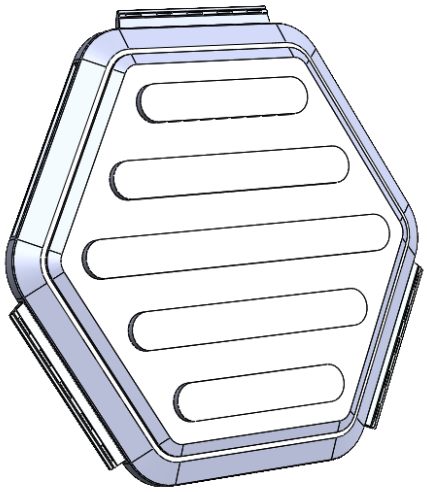


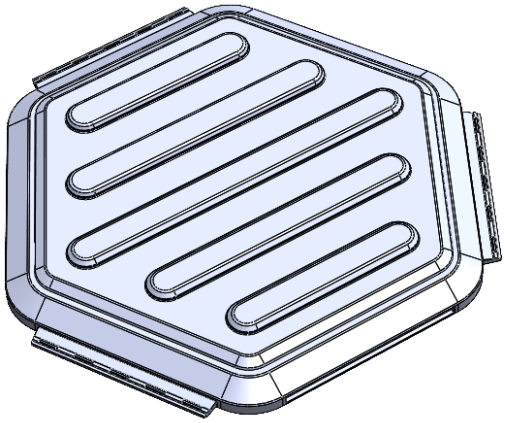




Tile CAD Progress

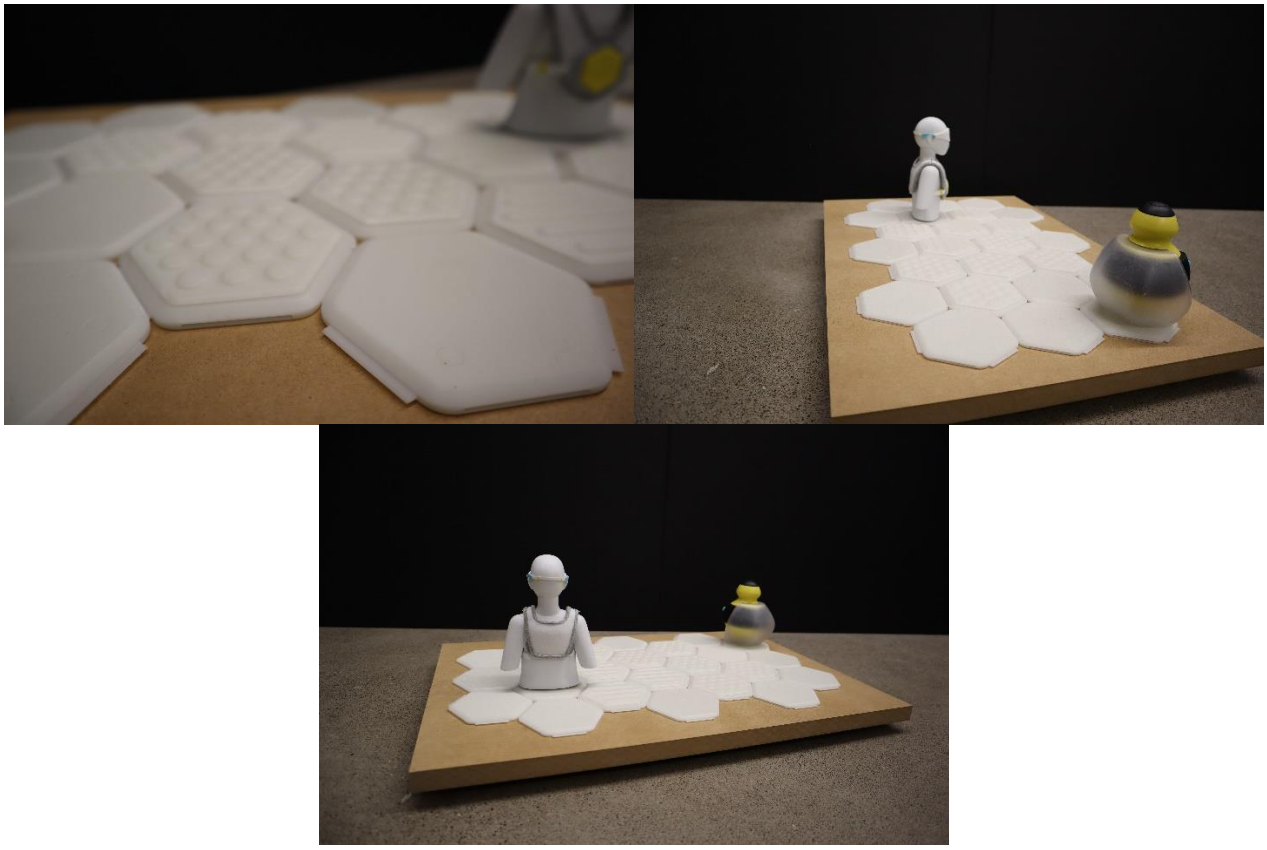




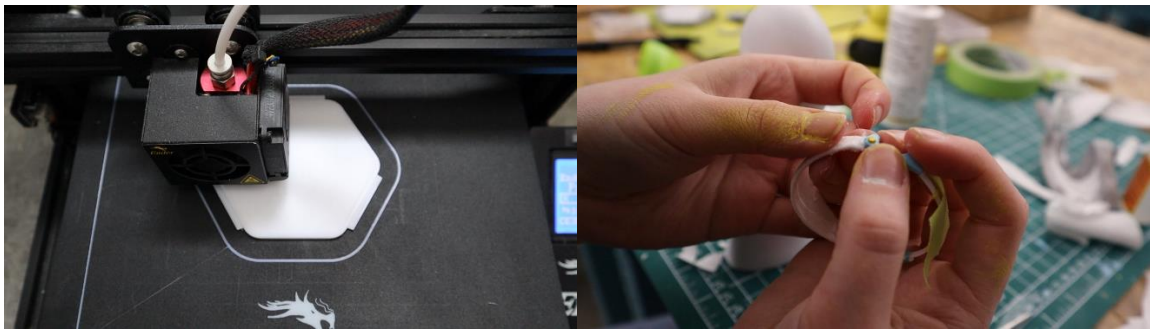


APPENDIX E – PHYSICAL MODEL PHOTOGRAPHS

Final Physical Model



Physical Model Progress



APPENDIX F – APPROVAL FORMS & PLANS

IDSN 4002
SENIOR LEVEL THESIS ONE

Humber ITAL / Faculty of Applied Sciences & Technology
Bachelor of Industrial Design / FALL 2022
Catherine Chong / Frederic Matovu

THESIS TOPIC APPROVAL:

Student Name:	Charlotte/Watkins
Topic Title:	How May We Improve Physical Activity for Children with Impaired Vision?

TOPIC DESCRIPTIVE SUMMARY (PRELIMINARY ABSTRACT)

Physical activity in a child's development and daily routine is important physically and mentally for their growth as it is for children with visual impairments. This demographic especially aren't getting enough active play due to the lack of resources and tools to encourage them to stay active.Currently, there are little to no easy, affordable, and group solutions for active play catering towards early elementary aged children with impaired vision. Oftentimes these kids are being told they cannot participate in gym activities due to the physical educators lack of resources and knowledge surrounding this demographic. With emerging technology, how could current or future technology be improved and catered towards physical activity and physical education in order to get children with impaired vision active with their sighted and non sighted peers? This thesis proposes in-depth studies of current problems and solutions visually impaired children face when participating in active play by using methods such as interviews, surveys, and observational studies. Scaled modeling and exploring ergonomics will solidify proper human factors and full-bodied interaction designs as this thesis is directed to children. The solution to be developed for visually impaired children will encourage more active play and physical activity as often as daily in order to enhance their physical, emotional, and social development.

Student Signature(s): C. Watkins	**Instructor Signature(s):** Catherine Chong
Date: 27 / 09 / 2022	**Date:** 29 September 2022

17

Chong, Kappen, Thomson, Zaccolo

IDSN 4502
SENIOR LEVEL THESIS TWO

Humber ITAL / Faculty of Applied Sciences & Technology
Bachelor of Industrial Design / WINTER 2023
Catherine Chong / Fredric Matovu

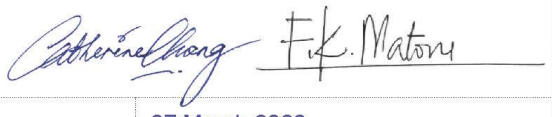
CRITICAL MILESTONES: APPROVAL FOR CAD DEVELOPMENT & MODEL FABRICATION

Student Name:	Charlotte Watkins
Approved Thesis Title:	Physical Activity for Visually Impaired Children

THESIS PROJECT – DESIGN APPROVAL FORM

Design is reviewed and approved to proceed for the following:	[X] **CAD Design and Development Phase**
Comment:	Continue design refinement in CAD development, need to iron out detailing and product's features, pay attention to surfacing, components, and assembly methods for design feasibility. Viable holistic design thinking in conjunction with considerations into sustainability aspects. CAD development must be at least 75% complete for review before approval for fabrication.

Design is reviewed and approved to proceed for the following:	[X] **Model Fabrication Including Rapid Prototyping / 3D Printing and Model Building Phase**
Comment:	Waiting for CAD development review (as of Feb-21). Good progress with CAD, design completed, continue detail refinement, once refined, fabrication of model can begin.

Instructor Signature(s):	
Date:	07 March 2023

1

Chong, Kappen

PANEL ON RESEARCH ETHICS
Navigating the ethics of human research

TCPS 2: CORE 2022

Certificate of Completion

This document certifies that

Charlotte Watkins

successfully completed the Course on Research Ethics based on the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2: CORE 2022)

Certificate # 0000848658 **15 September, 2022**

IDSN 4002 / 4502
SENIOR LEVEL THESIS ONE & THESIS TWO

HUMBER
Faculty of Applied Sciences & Technology
Bachelor of Industrial Design / FALL 2022 & WINTER 2023

INFORMATION LETTER

Research Study Topic:	Physical activity for children with impaired vision
Investigator:	Charlotte Watkins, (613) 716-7112, charlotte.watkins2001@gmail.com
Sponsor:	Humber ITAL, Faculty of Applied Sciences & Technology (IDSN 4002 & IDSN 4502)

Introduction

My name is Charlotte Watkins, I am an industrial design student at Humber ITAL, and I am inviting your participation in a research study on various problems that children with impaired vision face when participating in physical activity. These problems include being left out in physical education in schools, lack of adaptability in current games, and limited integration in active games with both sighted and non-sighted children in schools and other social environments. The results will be contributed to my Senior Level Thesis project.

Purpose of the Study

This study is being conducted as an aid in designing a product capable of improving and integrating active play activities for children both sighted and visually impaired ages 6-8. The product to be designed is inspired by current solutions that help develop other senses such as hearing and touch. With your help, I plan to address problems that visually impaired children face in schools and other active social interactions. This study is primarily based on understanding ergonomics, human interaction design activities, and user experience aspects of the research area.

Procedures

If you volunteer to participate in this study, active play and other social interactions with other visually impaired children will be observed and documented. Your activities will be documented by means of a digital camera, and written notes. You might also be asked questions pertaining to your thoughts, concerns, likes, and dislikes of your current relationship with physical activity and physical education.

Confidentiality

Every effort will be made to ensure confidentiality of any identifying information that is obtained during the study. In the case of being recorded visually, your face will be masked /blurred or hidden. The information and documentations (photographs) gathered are all subject to being used in the final presentation of the study.

Participation and Withdrawal

Your participation in this study is completely voluntary and you may interrupt or end the study and the session at any time without giving a reason or fear of being penalized.

If at any point during the session, you feel uncomfortable and wish to end your participation, please let the moderator know and they will end your participation immediately.

Humber Research Ethics Board

This research project /course has been approved by the Humber Research Ethics Board. If you have any questions about your rights as a research participant, please contact Dr. Lydia Boyko, REB Chair, 416-675-6622 ext. 79322, **Lydia.Boyko@humber.ca**

IDSN 4002 / 4502
SENIOR LEVEL THESIS ONE & THESIS TWO

HUMBER
Faculty of Applied Sciences & Technology
Bachelor of Industrial Design / FALL 2022 & WINTER 2023

INFORMATION LETTER

Conditions of Participation

- ✓ I understand that I am free to withdraw from the study at any time without any consequences.
- ✓ I understand that my participation in this study is confidential. (i.e. the researcher will know but will not disclose my identity)
- ✓ My identity will be masked.
- ✓ I understand that the data from this study may be published.

☐ **I have read the information presented above and I understand this agreement. I voluntarily agree to take part in this study.**

Participant's Name	Participant's Signature	Date

Project Information

Thank you very much for your time and help in making this study possible. If you have any queries or wish to know more about this Senior Level Thesis project, please contact me at the followings:

Phone: (613) 716-7112

Email: charlotte.watkins2001@gmail.com

My supervisor is:

Prof. Catherine Chong, **catherine.chong@humber.ca**

IDSN 4002 / 4502
SENIOR LEVEL THESIS ONE & THESIS TWO

HUMBER
Faculty of Applied Sciences & Technology
Bachelor of Industrial Design / FALL 2022 & WINTER 2023

PARTICIPANT INFORMED CONSENT FORM

Research Study Topic: Physical activity for children with impaired vision
Investigator: Charlotte Watkins, (613) 716-7112, charlotte.watkins2001@gmail.com
Courses: IDSN 4002 & IDSN 4502 Senior Level Thesis One & Two

I, _____*(First Name/Last Name)*, have carefully read the Information Letter for the project of physical activity for children with impaired vision, led by Charlotte Watkins. A member of the research team has explained the project to me and has answered all of my questions about it. I understand that if I have additional questions about the project, I can contact « insert student Name » at any time during the project.

I understand that my participation is voluntary and give my consent freely in voice recording, photography and/or videotaping; with the proviso that my identity will be blurred in reports and publications.

Consent for Publication: Add a (X) mark in one of the columns for each activity

ACTIVITY		YES	NO
Publication	I give consent for publication in the Humber Library Digital Repository which is an open access portal available to the public	☐	☐
Review	I give consent for review by the Professor	☐	☐

Privacy
All data gathered is stored anonymously and kept confidential. Only the principle investigator /researcher, Charlotte Watkins and Prof. Catherine Chong or Prof. Frederick Matovu may access and analyze the data. All published data will be coded, so that visual data is not identifiable. Pseudonyms will be used to quote a participant (subject) and data would be aggregated.

I also understand that I may decline or withdraw from participation at any time, without negative consequences.

I understand that I can verify the ethical approval of this study, or raise any concerns I may have by contacting the Humber Research Ethics Board, Dr. Lydia Boyko, REB Chair, 416-675-6622 ext. 79322, **Lydia.Boyko@humber.ca** or Charlotte Watkins, (613) 716-7112, charlotte.watkins2001@gmail.com.

Verification of having read the Informed Consent Form:

☐ I have read the Informed Consent Form.

My signature below verifies that I have read this document and give consent to the use of the data from questionnaires and interviews in research report, publications (if any) and presentations with the proviso that my identity will not be disclosed. I have received a copy of the Information Letter, and that I agree to participate in the research project as it has been described in the Information Letter.

Participant's Name	Participant's Signature	Date

3

APPENDIX G – ADVISOR MEETINGS & AGREEMENT FORMS

HUMBER
Faculty of Applied Sciences & Technology
Bachelor of Industrial Design / FALL 2022 & WINTER 2023

IDSN 4002 / 4502
SENIOR LEVEL THESIS ONE & THESIS TWO

INFORMATION LETTER

Conditions of Participation

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- ✓ My identity will be masked.
- ✓ I understand that the data from this study may be published.

☑ **I have read the information presented above and I understand this agreement. I voluntarily agree to take part in this study.**

Laurie Moore	LMoore	Oct 14'22
Participant's Name	Participant's Signature	Date

Project Information

Thank you very much for your time and help in making this study possible. If you have any queries or wish to know more about this Senior Level Thesis project, please contact me at the followings:

Phone: (613) 716-7112

Email: charlotte.watkins2001@gmail.com

My supervisor is:

Prof. Catherine Chong, **catherine.chong@humber.ca**

2

HUMBER
Faculty of Applied Sciences & Technology
Bachelor of Industrial Design / FALL 2022 & WINTER 2023

IDSN 4002 / 4502
SENIOR LEVEL THESIS ONE & THESIS TWO

PARTICIPANT INFORMED CONSENT FORM

Research Study Topic: Physical activity for children with impaired vision
Investigator: Charlotte Watkins, (613) 716-7112, charlotte.watkins2001@gmail.com
Courses: IDSN 4002 & IDSN 4502 Senior Level Thesis One & Two

I, _____*(First Name/Last Name)*, have carefully read the Information Letter for the project of physical activity for children with impaired vision, led by Charlotte Watkins. A member of the research team has explained the project to me and has answered all of my questions about it. I understand that if I have additional questions about the project, I can contact « insert student Name » at any time during the project.

I understand that my participation is voluntary and give my consent freely in voice recording, photography and/or videotaping; with the proviso that my identity will be blurred in reports and publications.

Consent for Publication: Add a (X) mark in one of the columns for each activity

ACTIVITY		YES	NO
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Review	I give consent for review by the Professor	☐	☐

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I also understand that I may decline or withdraw from participation at any time, without negative consequences.

I understand that I can verify the ethical approval of this study, or raise any concerns I may have by contacting the Humber Research Ethics Board, Dr. Lydia Boyko, REB Chair, 416-675-6622 ext. 79322, **Lydia.Boyko@humber.ca** or Charlotte Watkins, (613) 716-7112, charlotte.watkins2001@gmail.com.

Verification of having read the Informed Consent Form:

☑ I have read the Informed Consent Form.

My signature below verifies that I have read this document and give consent to the use of the data from questionnaires and interviews in research report, publications (if any) and presentations with the proviso that my identity will not be disclosed. I have received a copy of the Information Letter, and that I agree to participate in the research project as it has been described in the Information Letter.

Laurie Moore	LMoore	October 14'22
Participant's Name	Participant's Signature	Date

3

HUMBER
Faculty of Applied Sciences & Technology
Bachelor of Industrial Design / FALL 2022 & WINTER 2023

IDSN 4002 / 4502
SENIOR LEVEL THESIS ONE & THESIS TWO

INFORMATION LETTER

Conditions of Participation

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- ✓ I understand that my participation in this study is confidential. (i.e. the researcher will know but will not disclose my identity)
- ✓ My identity will be masked.
- ✓ I understand that the data from this study may be published.

☑ **I have read the information presented above and I understand this agreement. I voluntarily agree to take part in this study.**

Heather Deeser — Participant's Name
[signature] — Participant's Signature
Oct 21/22 — Date

Project Information

Thank you very much for your time and help in making this study possible. If you have any queries or wish to know more about this Senior Level Thesis project, please contact me at the followings:

Phone: (613) 716-7112

Email: charlotte.watkins2001@gmail.com

My supervisor is:

Prof. Catherine Chong, catherine.chong@humber.ca

2

HUMBER
Faculty of Applied Sciences & Technology
Bachelor of Industrial Design / FALL 2022 & WINTER 2023

IDSN 4002 / 4502
SENIOR LEVEL THESIS ONE & THESIS TWO

PARTICIPANT INFORMED CONSENT FORM

Research Study Topic: Physical activity for children with impaired vision
Investigator: Charlotte Watkins, (613) 716-7112, charlotte.watkins2001@gmail.com
Courses: IDSN 4002 & IDSN 4502 Senior Level Thesis One & Two

I, Heather Deeser *(First Name/Last Name)*, have carefully read the Information Letter for the project of physical activity for children with impaired vision, led by Charlotte Watkins. A member of the research team has explained the project to me and has answered all of my questions about it. I understand that if I have additional questions about the project, I can contact « insert student Name » at any time during the project.

Prior to the

I understand that my participation is voluntary and give my consent freely in voice recording, photography and/or videotaping; with the proviso that my identity will be blurred in reports and publications.

Consent for Publication: Add a (X) mark in one of the columns for each activity

ACTIVITY		YES	NO
Publication	I give consent for publication in the Humber Library Digital Repository which is an open access portal available to the public	☒	☐
Review	I give consent for review by the Professor	☑	☐

Privacy

All data gathered is stored anonymously and kept confidential. Only the principle investigator /researcher, Charlotte Watkins and Prof. Catherine Chong or Prof. Frederick Matovu may access and analyze the data. All published data will be coded, so that visual data is not identifiable. Pseudonyms will be used to quote a participant (subject) and data would be aggregated.

I also understand that I may decline or withdraw from participation at any time, without negative consequences.

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Verification of having read the Informed Consent Form:

☑ I have read the Informed Consent Form.

My signature below verifies that I have read this document and give consent to the use of the data from questionnaires and interviews in research report, publications (if any) and presentations with the proviso that my identity will not be disclosed. I have received a copy of the Information Letter, and that I agree to participate in the research project as it has been described in the Information Letter.

Heather Deeser — Participant's Name
[signature] — Participant's Signature
Oct 21/22 — Date

3

me Oct 4, 2022
to Traci, Dan, Lynne, Laurie

Good afternoon Traci,

My apologies for the delayed response, I have prepared a consent form for parents explaining the purpose of the study and my thesis project.

That's amazing you've created such great opportunities for these children! I would love to set up an in-person interview during the user observation or phone interview whenever that would be convenient for you to explore potential solutions for my product.

My goal for the observation would be to observe and document (written notes and visual documentation) preferably during a recess or gym class and observe how the students play, what kind of games they play, and how they spend their free activity time.

As far as a timeline, it would be great to do a Thursday or Friday of next week, would that work for you?

I've attached the consent form (word and pdf) and my Ethical Conduct for Research Involving Humans certificate. Let me know if this is the kind of consent form you would need or if you'd like to change or add anything.

Looking forward to hearing from you.

Thanks,
Charlotte Watkins

4002_F22_FTA-3_TCPS-2-CORE_Wat... PDF
IDSN4002-4502_Thesis-Info-Letter-In-... Doc
IDSN4002-4502_Thesis-Info-Letter-In-... PDF

Moore, Laurie (EDU) Oct 6, 2022
to me, Traci, Dan, Lynne

Hi Charlotte,

Could we connect tomorrow morning and see what might work? It is quite the process to get consents because many of our students stay in lodging throughout the week. If we can connect and determine which activity/students you would like to observe, we can send those consents out hopefully tomorrow before the students go home at 11:30. Let me know what time we could connect?

Chat soon,

Laurie

Laurie Moore
Vice Principal

Moore, Laurie (EDU) Oct 6, 2022
to me

Hi Charlotte,
So nice to meet you! Dan said he was fine with you just coming to observe and not have to formalise it with consents so that makes it easy. You are welcome to come on Thursday morning if that works for you? Recess is just after 10:00 if you want to come around then? I will see what I can do in terms of an O&M lesson as well and arrange for you to observe some gym classes.
Let me know if that works for you and what time you figure you can stay until?
Laurie

Get Outlook for Android

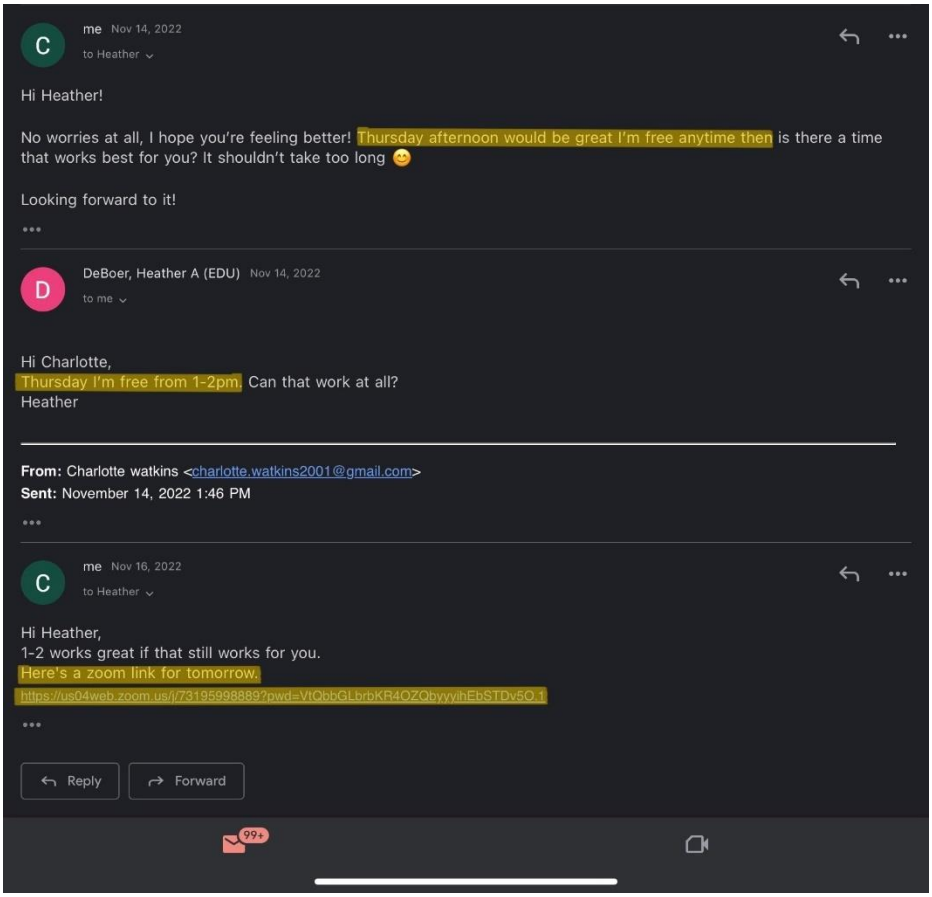
From: Charlotte watkins <charlotte.watkins2001@gmail.com>
Sent: Thursday, October 6, 2022 8:52:58 PM

me Oct 7, 2022
to Laurie

Hi Laurie!

It was such a pleasure to meet you too! And that's great news. An O&M lesson and gym class would be great if that works out and is convenient for you. Thursday morning at 10 sounds great, I can stay until 2:30-3. Let me know if that's too late for you guys.

Looking forward to it!



me Nov 14, 2022
to Heather

Hi Heather!

No worries at all, I hope you're feeling better! Thursday afternoon would be great I'm free anytime then is there a time that works best for you? It shouldn't take too long 😊

Looking forward to it!

DeBoer, Heather A (EDU) Nov 14, 2022
to me

Hi Charlotte,
Thursday I'm free from 1-2pm. Can that work at all?
Heather

From: Charlotte watkins <charlotte.watkins2001@gmail.com>
Sent: November 14, 2022 1:46 PM

me Nov 16, 2022
to Heather

Hi Heather,
1-2 works great if that still works for you.
Here's a zoom link for tomorrow.
https://us04web.zoom.us/j/73195998889?pwd=VtQbbGLbrbKR4OZQbyyyihEbSTDv5Q.1

Reply Forward