IKANOS

Magnetic Mobility Device

Erin Rice | Senior BFA Thesis | Spring 2017

I K A N O S

ikanos • [Greek] • *adj* • "able, strong, sufficient"

PROBLEM STATEMENT

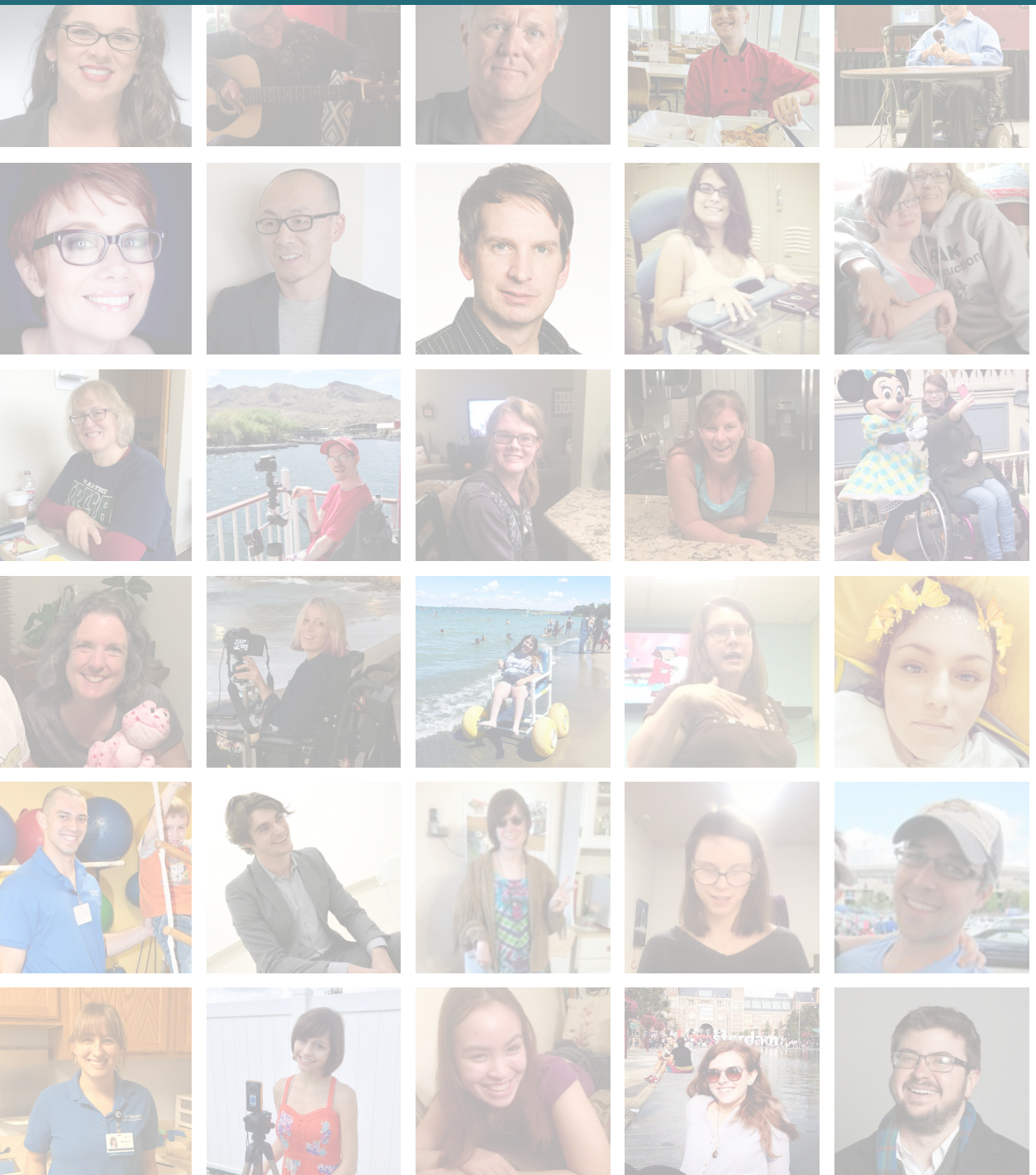
Smart phones have become an integral part of daily life as nearly 70% of the world's population own one. For many, communication and daily interactions rely on the use of cell phones, yet due to the nature of manual dexterity impairments, people with disorders such as Cerebral Palsy may have difficulty independently controlling and using their phone without risk of dropping it.

Cerebral Palsy, the most common childhood disability affecting 17 million people world wide, is a group of physical disorders that affects muscle coordination and control due to disturbances that occur in early fetal or infant brain development. One of the most common symptoms is **manual dexterity impairments**, which include shaky hands, tightened muscles, restricted arm extension, fatigue and impaired mobility. **Small hand movements** needed to regularly control a small device, such as a cell phone, can become **strenuous to people with Cerebral Palsy** who have limited hand function.

The general public seems to think that all cases of Cerebral Palsy are the same, often associating it with the most severe cases in which the ability to walk, talk and live independently is greatly impaired. While these types of cases definitely exist, the majority of people with cerebral palsy can walk, talk and live independently, but are **limited in their motor skills** forcing them to **adapt to everyday objects designed for able bodied people.**

People often wrongly assume that cerebral palsy is a cognitive disability, but in actuality it is a **physical disability** that affects movement and posture. 30-40 percent of people with cerebral palsy experience cognitive impairments, but this is considered an accompanying issue and is independent from CP.

CEREBRAL PALSY | RESEARCH PEOPLE



RESEARCH | *Interview*

THERAPISTS
Miriam Tribbett
Kristine Kalber
Victoria
Hunter Smith

PARENTS
Delores
Denise Zimmerman
Sherri
Julie Synder
Sheron's Mom

LOCAL PEOPLE
Chris Freeby
Lindsey Zimmerman
Sherone
Delana
Janice

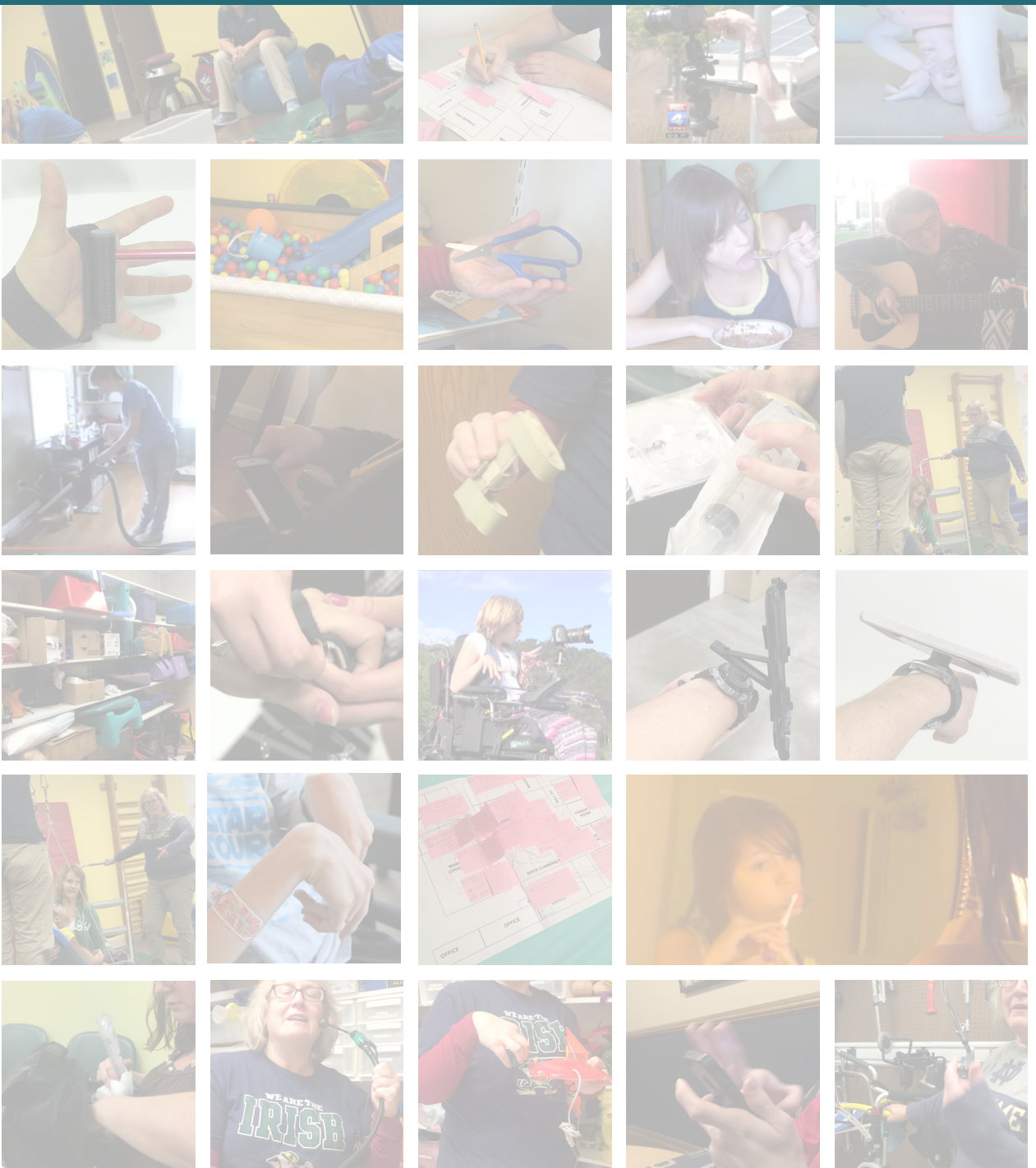
PROFESSIONALS
Kyle Akin
Dan Spelt
Chad Madson
Jess Irwin
RJ Mitte

BLOGGERS
Chloe Tear
Tawny Leonard
Mindy Leonard
Charisse Hogan
Logan Alexander

FACULTY
*Scott Shim
Michael Elwell
Ann Marie Conrado
Sarah Martin
Brian Edlefson
George Tisten
Richard Gray
Lynette McCarthy
Jeff Spoonhower
Nicole Woods
Andre Murniks

* Thesis advisor, want to give special thanks for the guidance throughout the year.

Throughout the course of the semester, I spoke with a range of people from therapists, professors and people with cerebral palsy from all over the world. This research was vital to better understand cerebral palsy from the perspective of people familiar with it.



RESEARCH | *Observe*

COLLECTION OF RESEARCH THROUGH

- Prototype testing
- Observations
- Shadowing therapists
- In-home visits
- Teen interviews
- Parent interviews
- Online contacts

REACHING OUT THROUGH

- Hesburgh Library
- Local hospitals
- High School Special Ed programs
- Cerebral Palsy National Center
- Logan Center
- YouTube
- Tumblr
- Twitter
- Instagram
- Facebook

CEREBRAL PALSY | BACKGROUND RESEARCH

MOST COMMON CAUSES

Only 30% of people with cerebral palsy have some severity of a cognitive disability. Cerebral palsyalso cannot be developed later in adulthood.

Premature birth

Lack of oxygen during birth

Bleeding in brain

Infection during pregnancy

WHAT IS CEREBRAL PALSY?

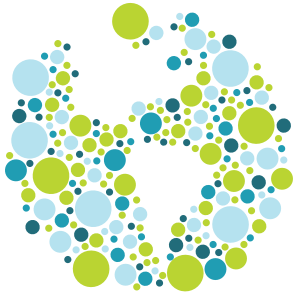
Cerebral palsy is a non-progressive disorder that occurs in the developing fetal of infant brain and varies based on the area of the brain affected. As a result, someone with cerebral palsy's muscle control, muscle coordination, muscle tone, reflex, posture and balance can be permanently affected.

WHAT ARE MANUAL DEXTERITY IMPAIRMENTS?

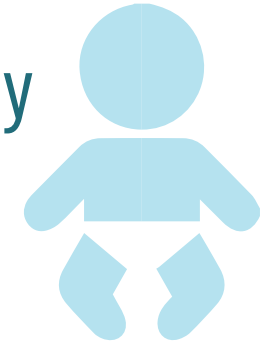
When the coordination of small muscles in movements involving the synchnolization of hands and fingers is limited, this is considered manual dexterity impairments. This occurs in disorders such as cerebral palsy and muscular distrophy and affects the ability to normally control and interact withall everyday objects.

17 million

people have Cerebral Palsy worldwide

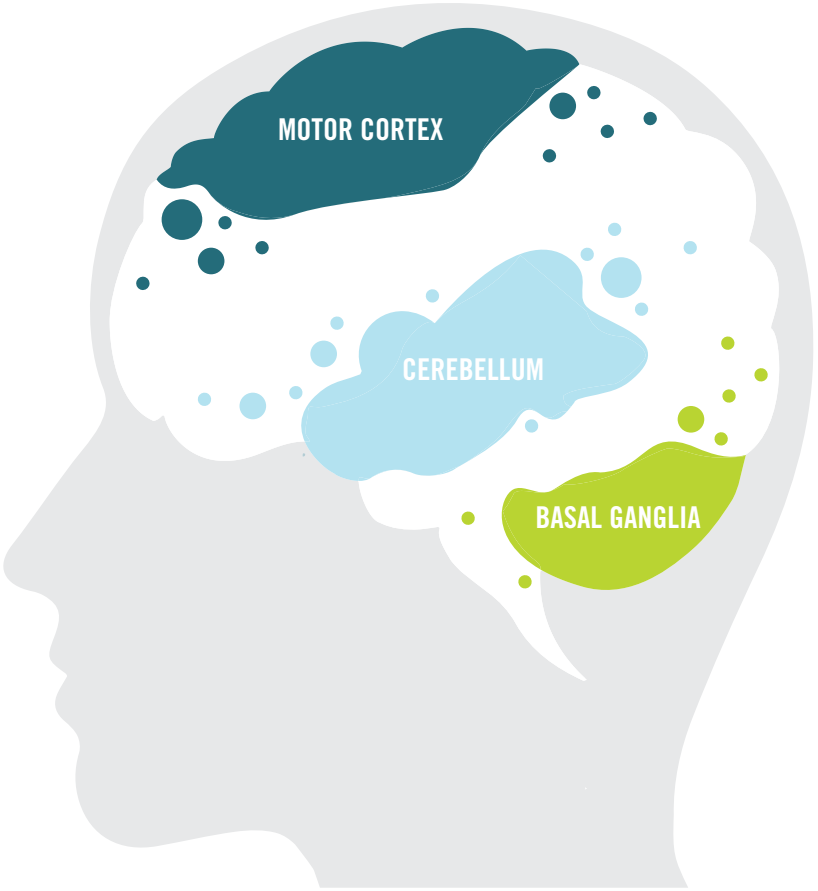


1 in every **323**



babies are diagnosed with Cerebral Palsy

This first page describes a little background on cerebral palsy. Throughout the course of the semester, I met with occupational and physical therapists from St. Joseph's Hospital in Mishawaka to gain a better understanding of cerebral palsy and how exercises and therapy can help someone over time.



SPASTIC // 70 - 80%

Motor cortex damage

- Tight, stiff, limited movement

DYSKINETIC // 20%

Cerebellum damage

- Difficulty with balance, depth perception and walking
- Shaky movements

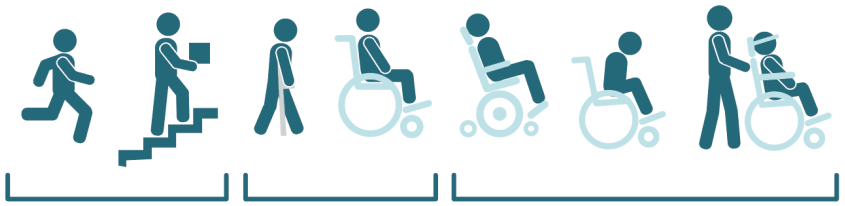
ATAXIC // 5 - 10%

Basal ganglia damage

- Difficulty in controlling and coordinating movement
- Invountary movements

CEREBRAL PALSY | BACKGROUND RESEARCH

RANGE OF MOTION AFFECTED

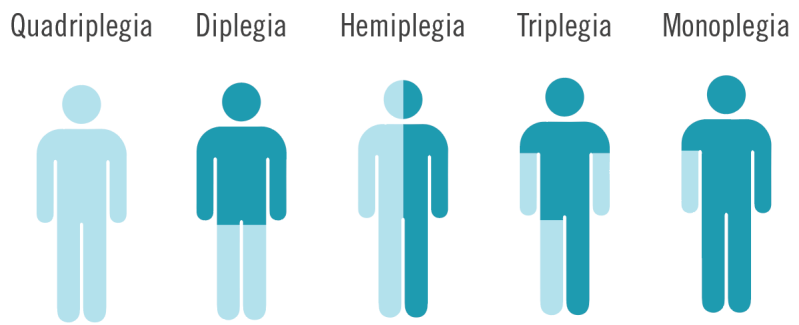


60
percent can walk without the use of an aid

10
percent can walk with an aid

30
percent will use a wheelchair

PARTS OF THE BODY AFFECTED



4 limb
all limbs are affected

2 limbs
both legs are more severely affected

1 side
the arm is usually more involved

3 limbs
usually both arms and a leg

1 limb
usually the arm

To better understand cerebral palsy, I used the Hersburgh Library and online resources to fully understand the medical and scientific terms behind the disorder. I learned that cerebral palsy really is an umbrella term in that there are so many different classifications, symptoms and severity levels making each case truly unique from the next.

Cerebral Palsy is an **umbrella term** used to describe a group of motor control disabilities

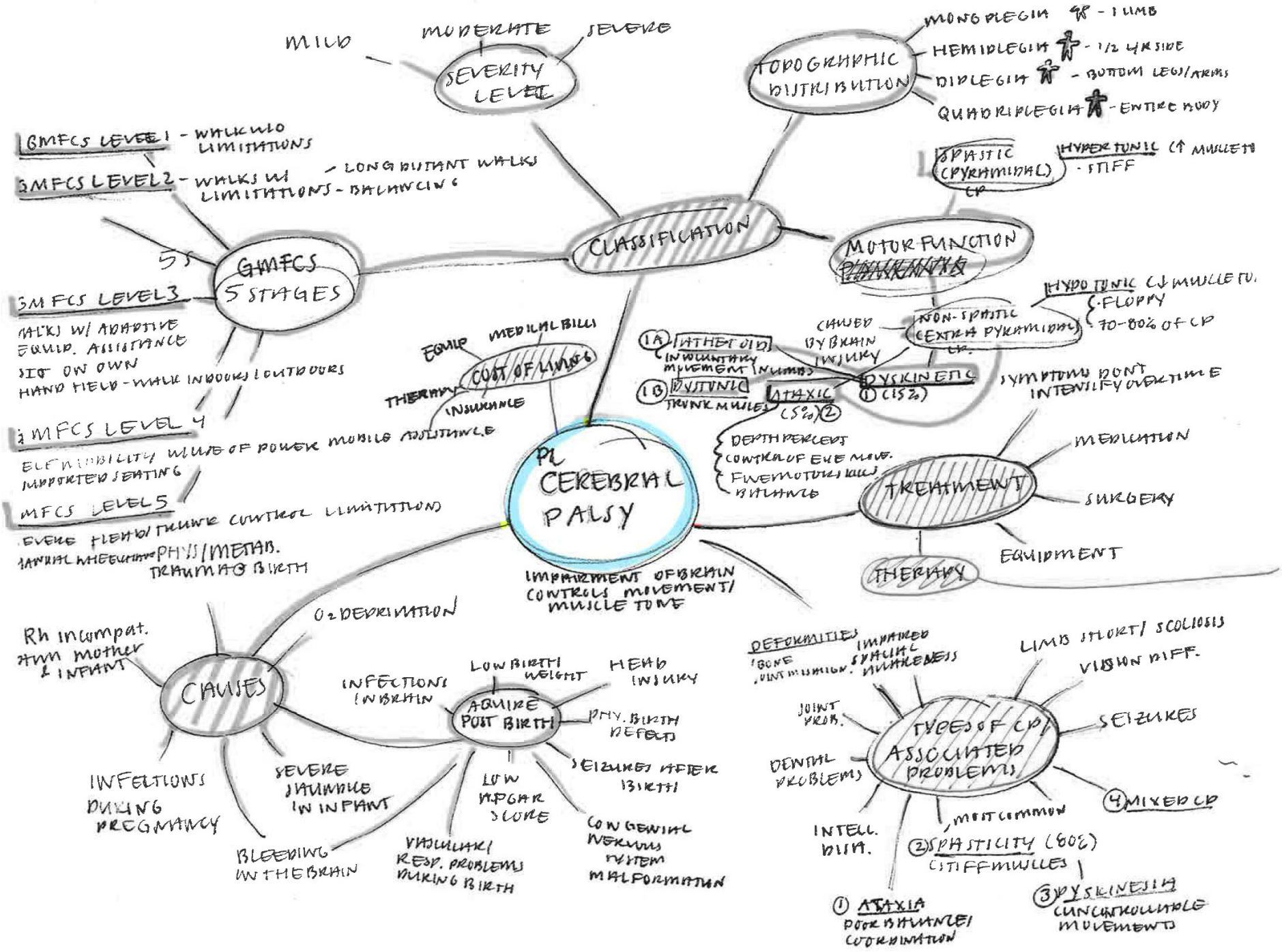
caused by a brain disorder or **brain injury to specific parts of the brain**, appearing in infancy or early childhood.

It is the most common form of **childhood disability**

and permanently affects **muscle coordination** and **body movement.**

Cerebral palsy is **not a disease**. It **does not progress** or get worse and it is **not communicable.**

CEREBRAL PALSY | MEDICAL RESEARCH



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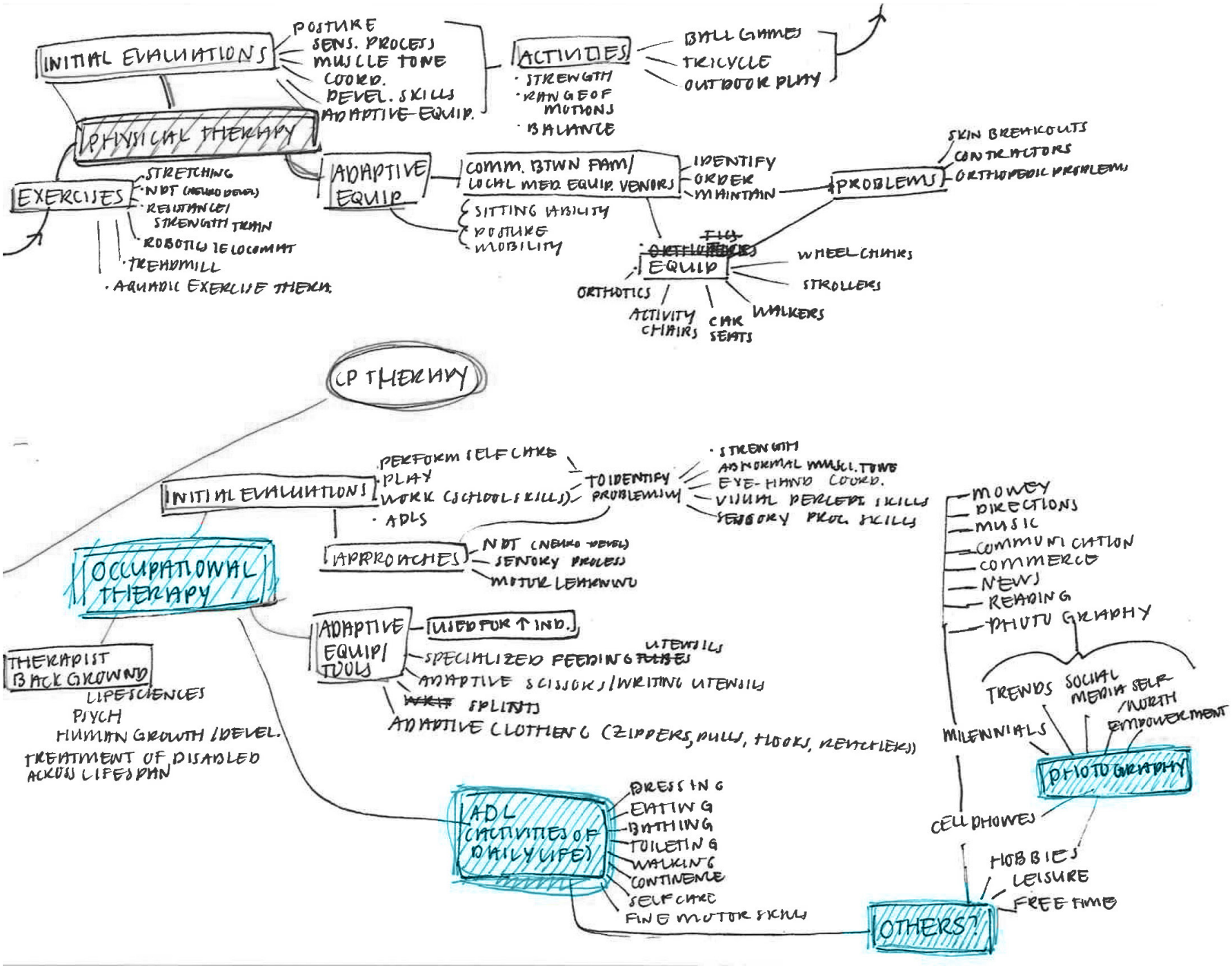
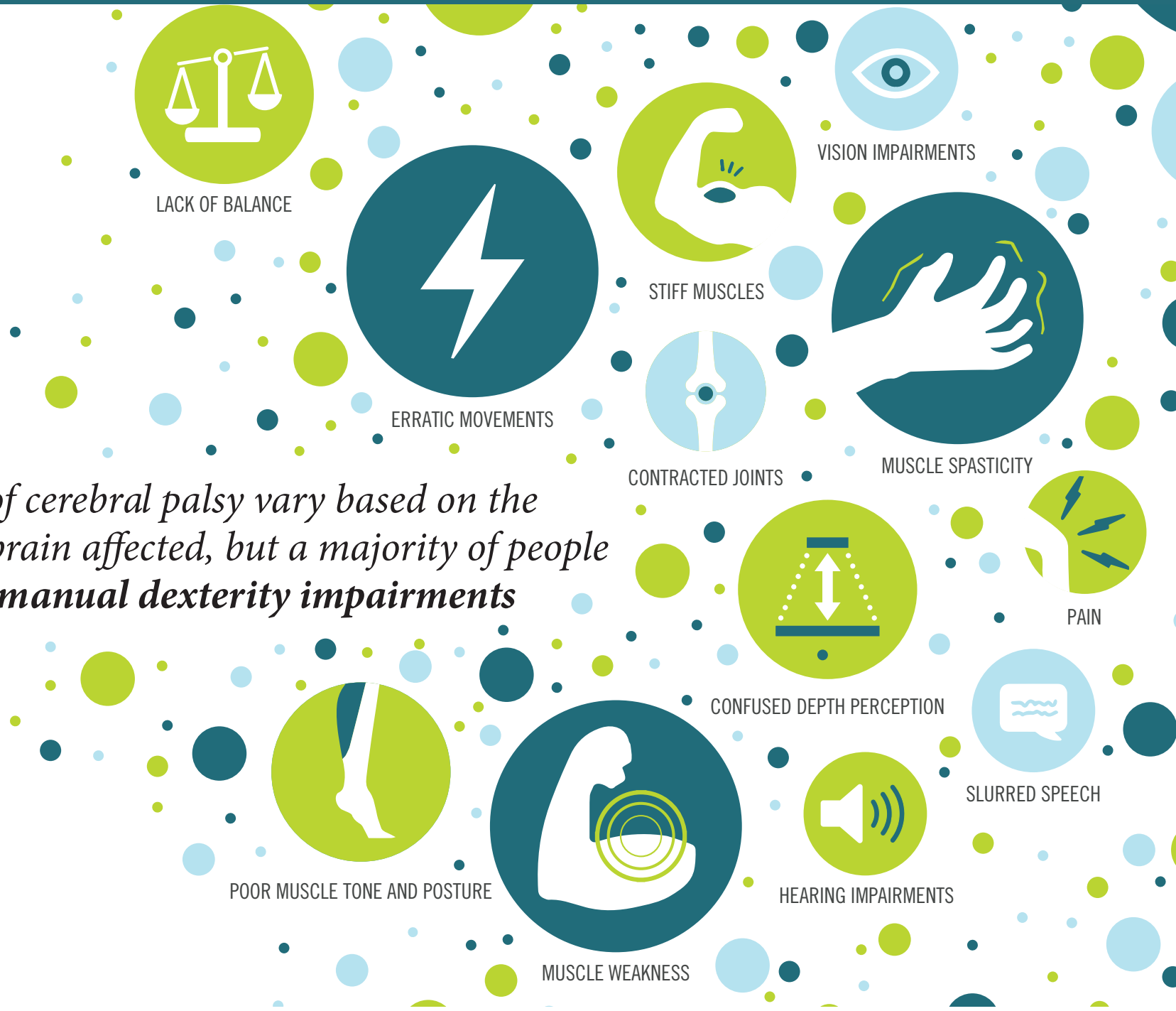


CEREBRAL PALSY | SYMPTOMS



Symptoms of cerebral palsy vary based on the part of the brain affected, but a majority of people ***experience manual dexterity impairments***

Although all cases and people with cerebral palsy experience a range of symptoms, a majority of cases experience manual dexterity impairments.

MANUAL DEXTERITY IMPAIRMENTS

Manual dexterity impairments, one of the most common symptoms of Cerebral Palsy, include symptoms such as shaky hands, tightened and weak muscles, involuntary movement restricted arm extension, lack of fine motor skills, fatigue and impaired mobility. This affects the ability to easily interact with everyday objects that are typically controlled with hands. This occurs not because the muscles do not work, but because the brain is unable to send the proper signals to the muscles to communicate when to contract and relax. People often use physical and occupational therapy as a way to strength muscles and learn adaptive techniques to work around this.

- Fatigue in hand muscles and joints
- Difficulty control precise movements
- Shaky hands
- Tightened muscles
- Difficulty gripping objects
- Lack of control of wrist muscles
- Muscle weakness

CEREBRAL PALSY | USE OF SMART PHONES

70%

OF THE WORLD
will have smart phones

80%

of pictures will be taken on
SMART PHONES

88%

of people will use their phone camera as the second most frequently used function behind texting.

PEOPLE WITH MANUAL DEXTERITY IMPAIRMENTS HAVE SOME **DIFFICULTY CONTROLLING SMALL DEVICES**

Manual dexerity impairments affect 1 in 146 people in the US under the age of 18. Small hand movements needed to regularly control a small device, such as a cell phone, can become strenuous to these people with limited hand function. Smart phones have become an integral part of daily life as nearly 70% of the world's population own one. For many people, communication and daily interactions rely on the use of cell phones.

Yet, due to the nature of manual dexterity impairments, people with these conditions have difficulty controlling and using the phone due to the nature of touch screens. Many of the teens I spoke with expressed that they don't feel any different than anyone else other than just having to do things a little bit differently, but they grew frustrated because of the lack of products that help them interact and socialize with their friends and peers on a smartphone independently.

OBSERVATIONAL RESEARCH

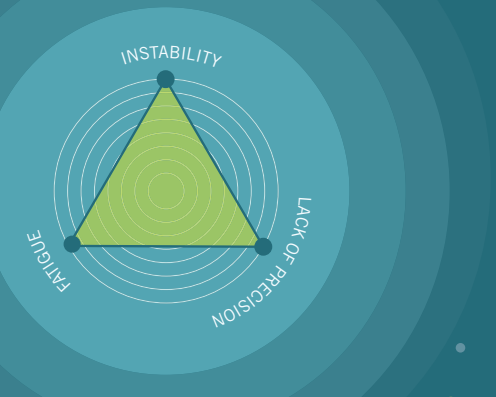
The following observations and notes are made through conversations, interviews and observations from talking to people with a variety of cerebral palsy symptoms. These results and observations do not define cerebral palsy as a whole.

PAIN POINTS
of using phones with manual dexterity impairments

DIVING INTO THE PROBLEM

By comparing the top three pain points for people with manual dexterity impairments based on everyday activities with cell phones, it became evident that **using the smart phone to take pictures is one of the most difficult tasks.**

TAKING PICTURES



TEXTING

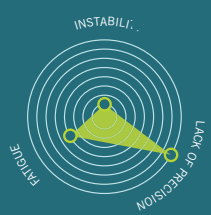
PHONE CALLS

SCROLLING ON INTERNET

LIFTING PHONE

HOLDING PHONE

SWIPE SCREEN



PROBLEM 1 INSTABILITY

Often dropping the phone and Difficulty picking it up

PROBLEM

Due to tremors and shaky hands, holding the phone is not always secure. Also, Because the phone is small and flat, when it falls on the ground it is very hard to pick up with low dexterity, sometimes taking minutes.

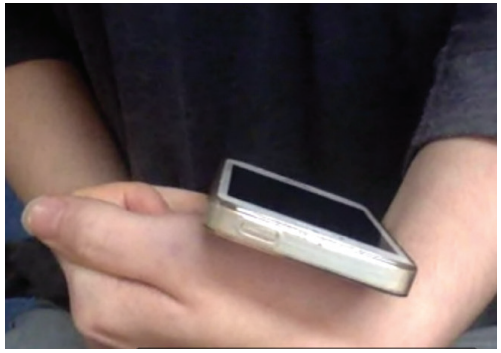
OBSERVATIONS

People adapt to the best of their ability to the phones. To pick up the dropped phone, bending down, pushing the phone against the wall or foot and getting it at an angle to grab it

Shaky, weak and stiff hands

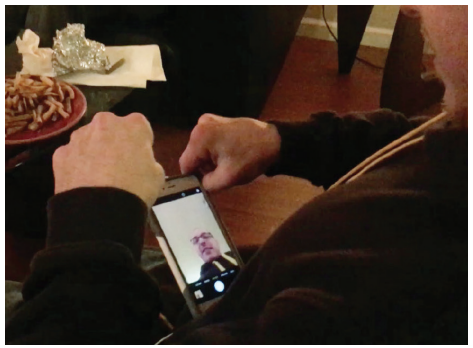
Due to shaky hands, Chloe uses her mouth to balance her phone and her thumb to take the picture, even though she can't see the screen.

Make shift phone stand



Tawny props her phone on the wrist of her weaker hand for support, but it often slips off and falls to the ground.

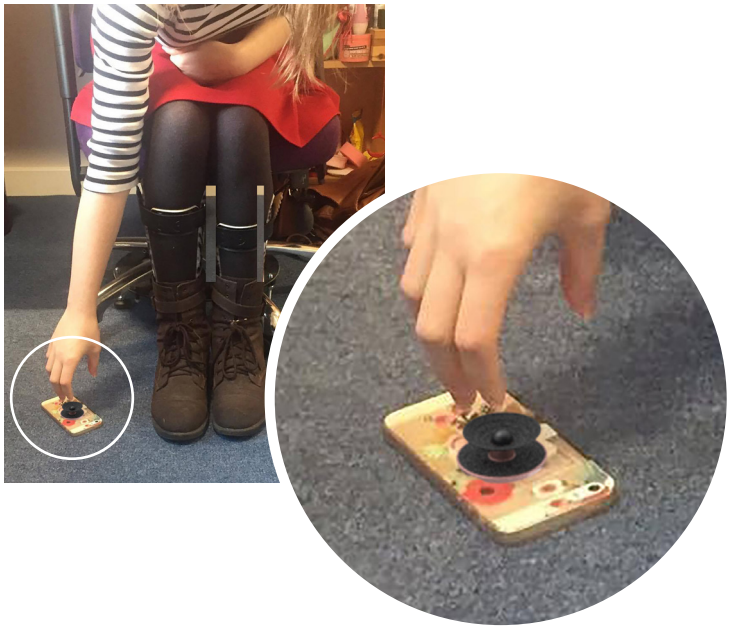
Needs to hold phone with two hands



Kyle uses his body as a 3rd contact point to balance his phone and to takes selfies, but this technique is at a weird angle and limits what he can photograph.

Accidentally throws or drops phone

When Kyle drops his phone, he scoots until he can reach and pick it up from the ground by pushing it against his foot.



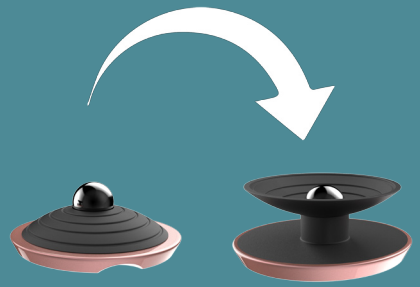
EASY GRIP

IKANOS The back of the phone attachment that holds the metal ball also has a rubber shell that reacts to the amount of force that is exerted onto the phone when dropped, releases and flips inside out. This creates a ledge for people to **lift the phone** off the ground more easily.

Ikanos **stabilizes the phone** on the wrist and allows precise motion of controlling the fingers to be concentrated on one action – touching the screen.

Secures phone on wrist, strong enough to **withstand spasms, involuntary movement and shakiness.**

Easy to pick up



Pop up when hits ground

Sticky adhesive, rewet to reuse

PROBLEM 2 LIMITED FINGER CONTROL

Pressing small buttons on the phone can be difficult

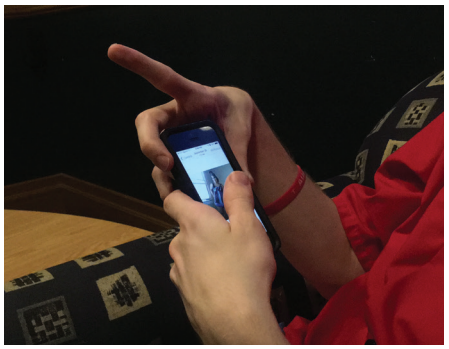
PROBLEM

Manual dexterity impairments make it **difficult to control precise finger movements**, making holding, using and navigating the phone difficult

OBSERVATIONS

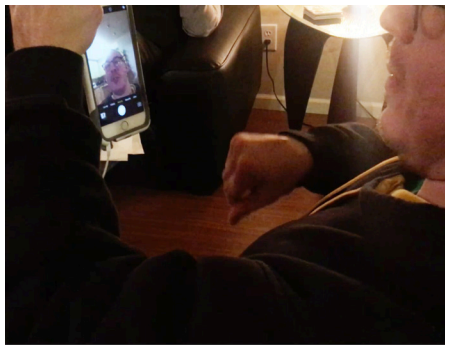
Often times people focus more on holding the phone and preventing themselves from dropping it than using the phone itself. Because of this, I noticed that there are a lot of methods and adaptations created to help deal with this.

Small buttons on phone



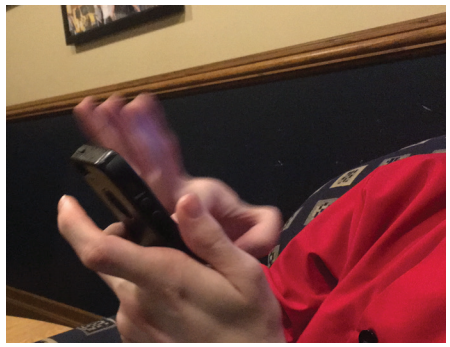
Small buttons and precise movements needed to focus, zoom and take the picture are difficult to control.

Spastic hand movements



Cerebral palsy often causes spastic hand movements and a lack of balance, this makes it hard to push specific buttons on the phone, such as the call button, a name in a contact list or the capture photo button.

Shaky finger control



Difficulty using both hands to hold phone and do precise motions such as **swipe, press, pinch and zoom** in but wants to be able to do this independently.

REQUIRES LESS DEXTERITY

IKANOS By **balancing the phone on the wrist**, it takes away the dexterity and concentration typically needed to hold the phone allowing more concentration and focus on controlling the functions of the phone rather than holding the phone.

The Bracelet is **symmetrial** so the direction the bracelet is put on doesn't matter. This takes away unnecceary hand movements used to figure out the orientation of the device.

PROBLEM 3 MUSCLE FATIGUE

When doing small, repetitive tasks, it **becomes tiring** and makes it harder to do everyday things.

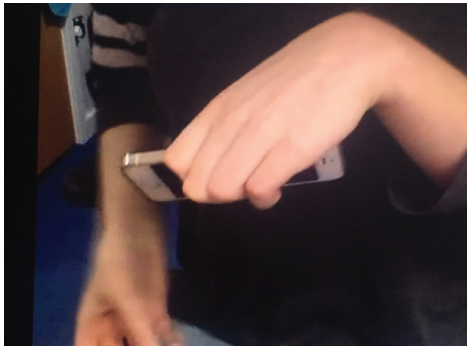
PROBLEM

Using rings, putting on gloves, adjusting buckles, looping strings through small holes are all relatively annoying and difficult for people to do with manual dexterity impairments. Also lifting and holding the arm causes fatigue.

OBSERVATIONS

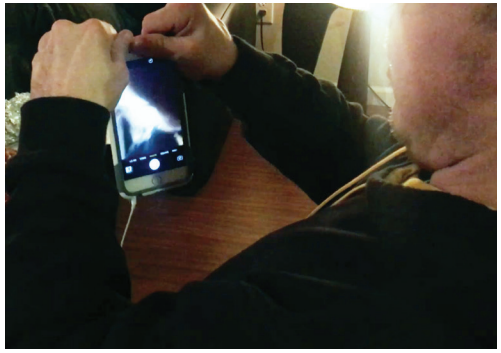
Grabbing, pushing and pulling and pressing down are all functions that require less small exact movements. Even when assistive devices are available, often choose to be independent.

Weak grip / difficulty rotating wrist



Can grip objects but not firmly, weaker hand often has difficulty doing tasks such as pointing, swiping and gripping due to weak and stiff muscles.

Covers camera when holding phone



Holds phone by corner bumpers to operate, but often covers camera with hands while trying to take a picture and struggles to get the correct angle.

Difficulty with sustained arm extension

Shakiness when extending arm and holding camera at same time in situations such as talking on the phone or taking a picture, but still prefers to do it this way instead of using an assistive device.

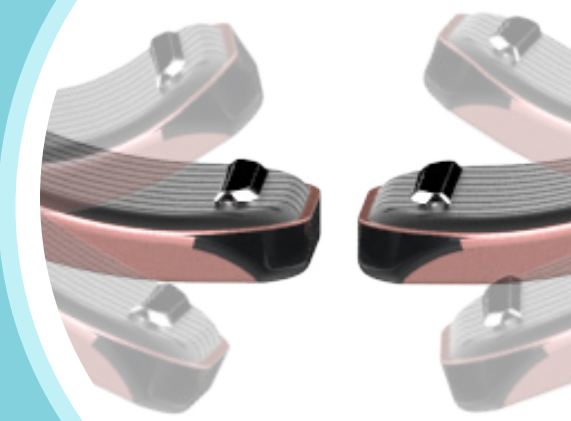
Assistive devices are ugly

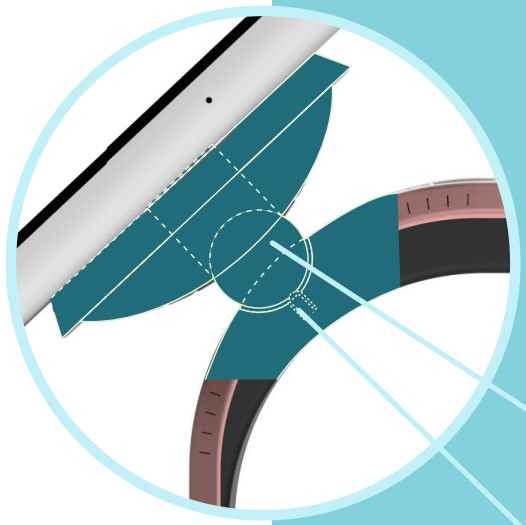
Assistive devices are clunky, large and medical looking.

SECURE, FLEXIBLE MAGNETIC HOLD, EASY TO ADJUST

IKANOS Ikanos takes advantage of **gross motor functions** by creating a slip on and off system that, while sturdy, requires less small movements which make it hard.

IKANOS also uses **rare earth magnets** to provide a strong hold on the phone but still allows for flexibility to adjust the angle and height of the phone along the sockets.



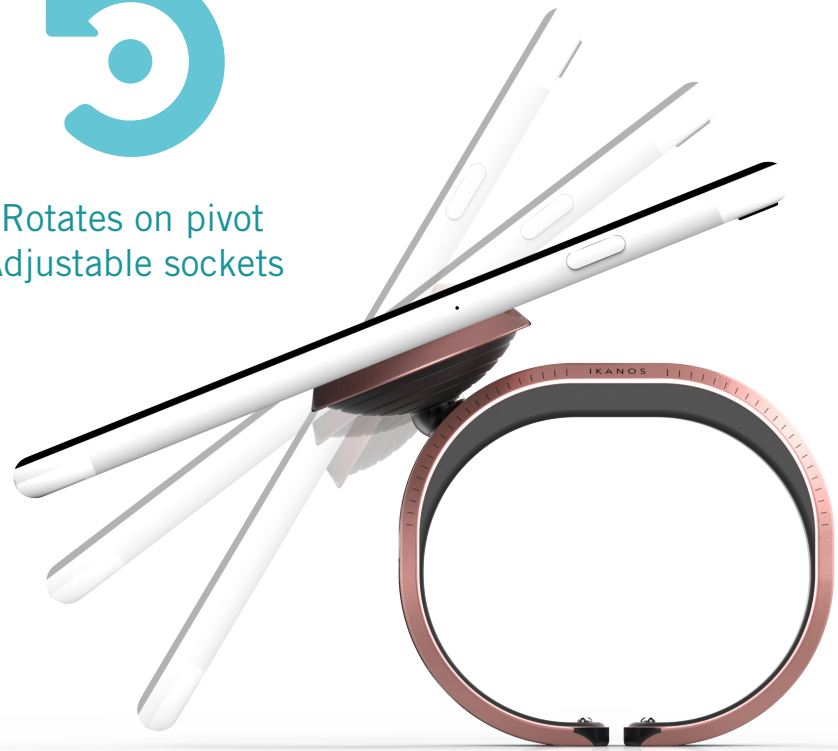


Easy slip on bend

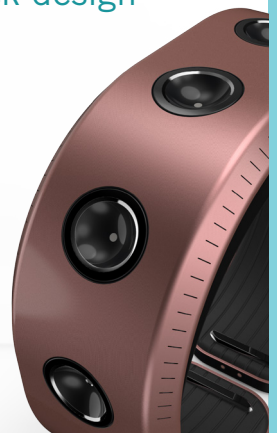
Rotates on pivot
magnetic ball and
joint sockets

Rare earth magnet
at bottom of sockets

Rotates on pivot
Adjustable sockets



Sleek design

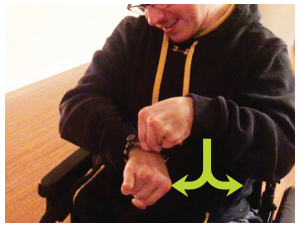


IKANOS | PROTOTYPING AND TESTING PROTOTYPES

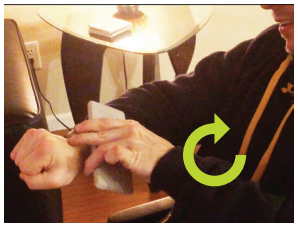
I made a series of prototypes using magnets, velcro, tape, buttons to create gloves, rings, bracelets and attachments. I tested my prototypes on Kyle who has cerebral palsy. Based on my observations and his feed back, I refined my ideas and moved onto the final stages.

SUCCESSFUL PROTOTYPES

Connects to wrist for hands free



Easy slip on bracelet



Rotational pivot

Pick up loop

Magnetic ball joint rotation

Concentrated precision

Easy to navigate

Hands free for speaker phone

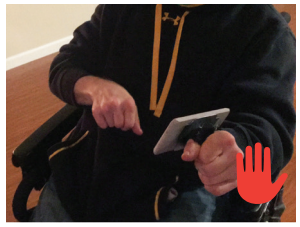
- Magnetic ball joint for pivotal rotation
- Easy slip bracelet grip
- Back of the phone loop for easy grab

UNSUCCESSFUL PROTOTYPES

Rings difficult to put on

Finger loops are hard to wear

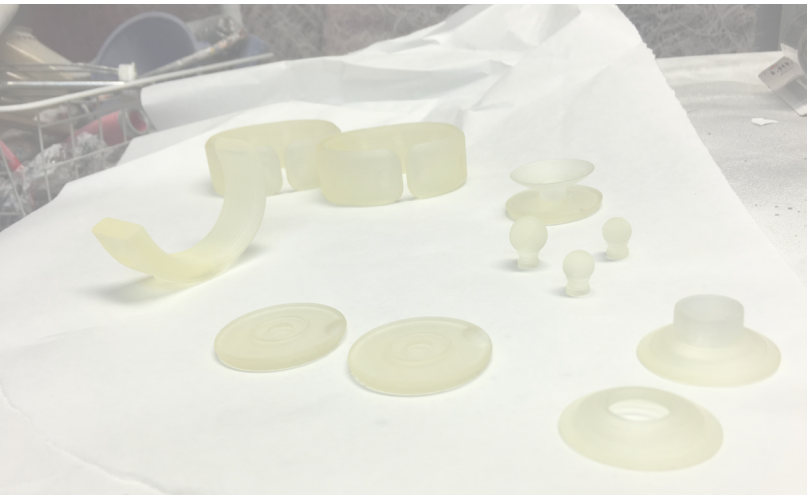
Phone bumper hard to steady

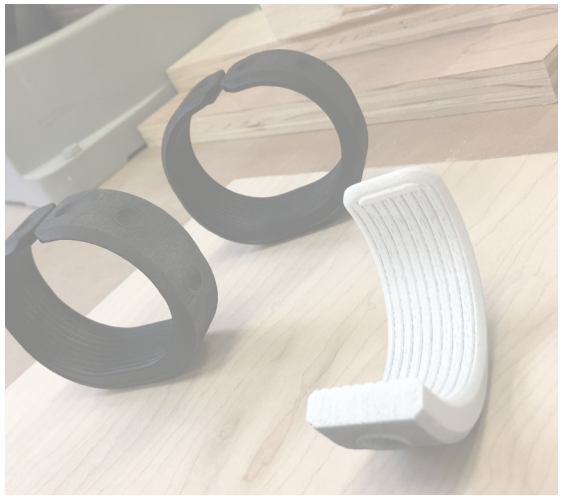


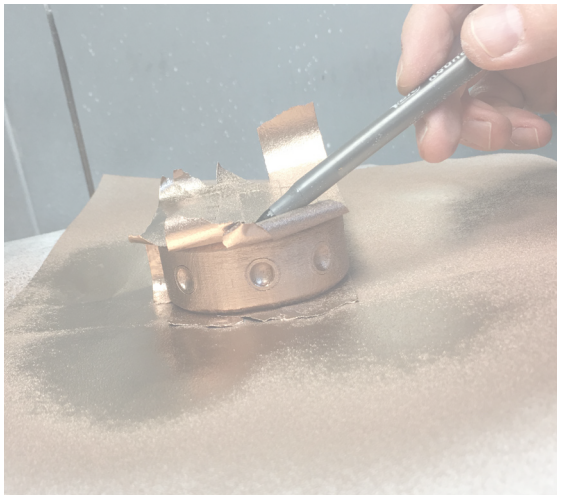
Gloves difficult to put on & steady

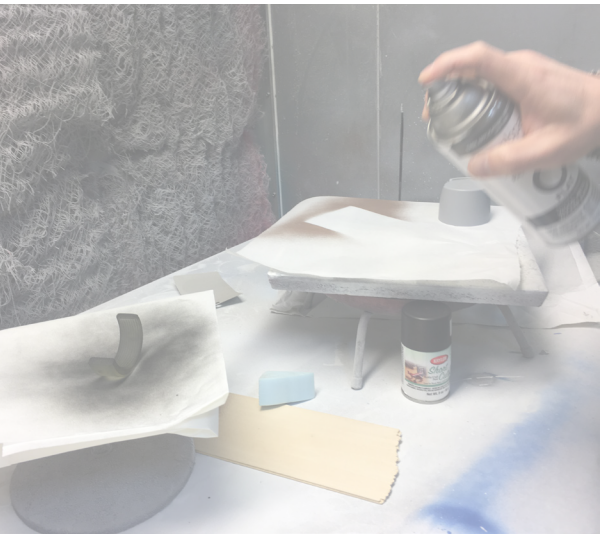
- Gloves and rings are difficult to put on independently
- Awkward or non-adjustable angles are hard to adjust
- The need of two hands to control the smartphone

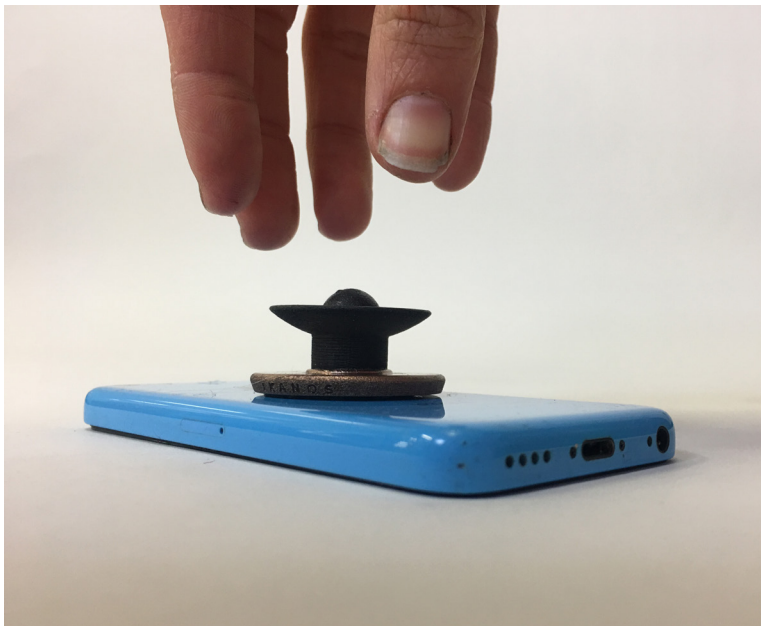
IKANOS | REFINED PROTOTYPING



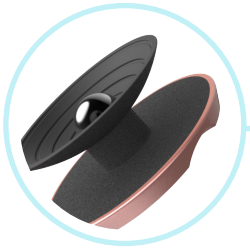








RUBBER GRIP AID
Rubber backing flips inside out on ground impact creating a ledge to grip more easily to pick up off the ground

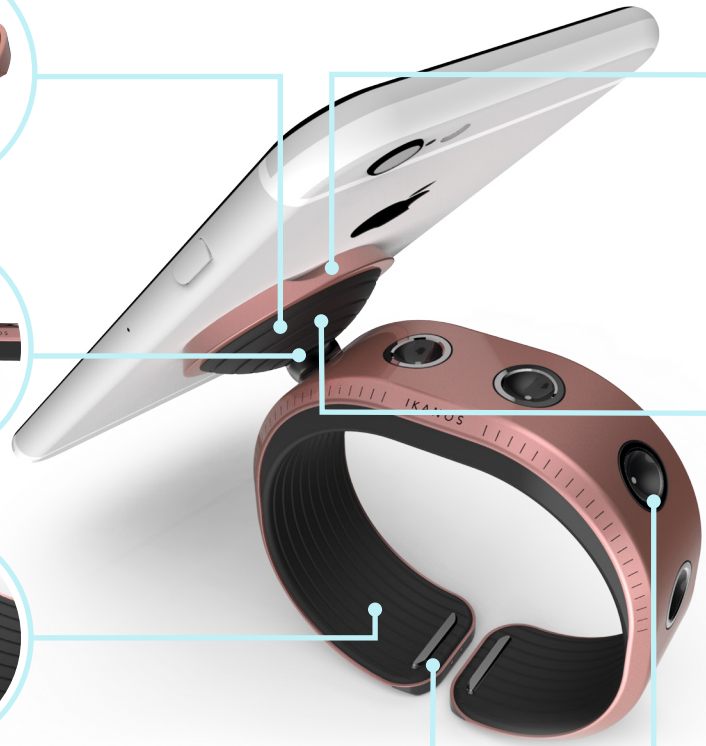


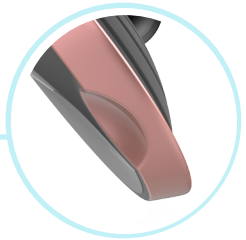
MAGNETIC BALL JOINT
Chrome-plated neodymium magnetic provides powerful contact yet allows for the flexibility of rotation within the socket

*safe for use with electronic devices

SOFT TOUCH INNER GROOVES
Provides maximum tactile experience in comfort, security and support

EASY ON AND OFF
With a flexible band, slipping Ikanos off and on is as simple as a push and a pull, making it preferable for people with low functioning dexterity



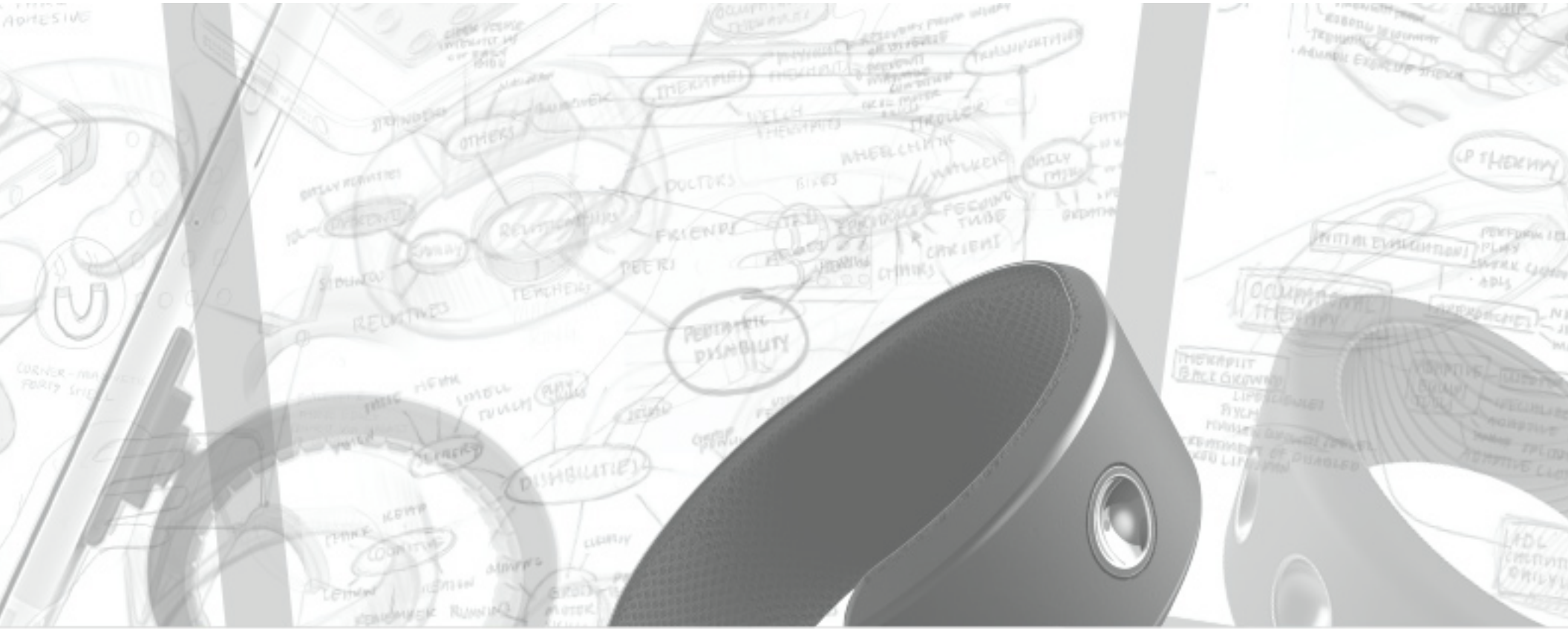


GROOVE FOR EASY REMOVAL
Indent groove under magnetic mount provides easy removal for rewet/ reuse or disposal

REUSABLE ADHESIVE STRIP
Gel adhesive can be rewet and reapplied to various devices over multiple uses.

ADJUSTABLE MAGNETIC SOCKETS
The height of the mount can be adjusted up and down the bracelet. Personalized sizes are provided as well

IKANOS | REFINEMENT



CUSTOMIZABLE | SLIM & SLEEK | SIMPLE

I used solidworks and keyshot to explore color, pattern, size and function. I ultimately decided to go with a rose gold, anodized black and pearl to follow the trends of set by the iphone. IKANOS also has a customizable option, offering a series of wood, leather and fabric.


iPhone
5
IKANOS

I K A N O S


IKANOS


IKANOS

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www.campixphoto.com/

Chloe Tear - UK
cpstudentblog.blogspot.com/
cpteensuk.org/chloe-tear
twitter.com/chloeltear?lang=en
facebook.com/lifeasacerebralpalsystudent/

Tawny Leonard - Minnesota
youtube.com/user/tawnyrae2222

Charisse Hogan - Colorado
youtube.com/user/jazzygirl585 - charisse living with cerebral palsy
worldcpday.org/our-campaign/public-awareness/charisse-living-with-cerebral-palsy/
instagram.com/charisselwcp/?hl=en

Mindy Tucker - Canada
livingmycplife.wordpress.com/tag/mindy-tucker/
livingmycplife.com/index.php/tag/mindy-tucker/
youtube.com/channel/UCLB9I5gGtAxlgfOdaww7tog
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*Senior thesis advisor

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Many of the people I got to work with over the past school year are doing amazing things that should gain attention. Please check out the following links to learn more about the faces behind IKANOS.

Questions or comments? Contact me at emrice75@gmail.com, thank you.
ErinRiceDesign.com