Anna Bibikova

Design Brief

Problem statement and background

Fine motor disability is when a person does not have full control of their hands and they have difficulty or are unable to complete tasks that require hand or finger dexterity. These people may be unable to make purposeful and precise movements with their hands which could make it difficult to impossible to do things such as tying shoelaces, typing, writing with a pen, and more. These impairments impact their overall quality of life in a negative way. People that have incomplete use of their hands struggle with leading the highest quality life just because of the many tasks that they fail to complete on their own. Occupational therapy for the development of fine motor skills is an extremely tedious and long process. It is especially difficult to keep children focused during these long rewardless sessions of practicing the same movements repeatedly. The specific problem that I am choosing to tackle is that Occupational Therapy is tedious and boring, and most activities are geared towards small children without attempting to create anything interesting and engaging for older kids. This leads to slow progress and lack of daily practice at home. There's currently nothing on the market for motor skills that's geared towards older kids.

My goals and objectives for this project were to create a product for kids to be able to train their fine motor skills in a way that is fun and rewarding and could keep them engaged for hours, multiple times per week.

In order to design the best product for people to buy, it is important to research existing solutions on the market.The two main areas that I did my market research in were products for hand therapy and fine motor skills training , and also video game controllers or setups designed for disabled users. After doing extensive research on online stores, and OT sites, I can conclude that by far the majority of games or products that are designed for younger children. I'd estimate anywhere from four to nine years old. A lot of the games that are being sold on Amazon or on therapy websites are puzzles that involve sticking shapes into the correct slot, or using plastic tweezers to pick up and sort objects. There are also arts and crafts sets that use precise motions to weave string together to create fuzzy art and some pretend cooking games where a wrist twisting motion is used to turn over a spatula.

The main problems that I noticed with these games and tools are that they are geared towards either small children or adults that are able to self motivate. There are practically no solutions for anyone in between, such as middle schoolers or early highschoolers, who are too old to be interested in sorting games but still too immature to self motivate through months or years of tedious exercise. Another thing that I noticed is that every activity would train only one motor skill at a time. The grip strength exerciser would only train grip strength, and the tweezer sorting games would train two point pinch. The gap in the market lies in those two areas. Creating a product for older kids, and creating a product that can train more than one skill at a time.

I interviewed Laurie Reddy, a hand therapist at Baylor Scott and White hospital, in order to figure out how she keeps kids motivated for longer periods of time and over months. She usually uses the same games that I found being sold online, however a point of interest for me was that she mentioned occasionally using VR games to interest kids further. This led me to the

idea of mixing videogames with hand therapy. Videogame controllers increase hand dexterity and quickness, so it would make sense to create a controller for people that don't have full use of their hands for the same purpose.
I did discover that Microsoft had come out with an adaptive videogame controller with plugins for people with varying disabilities to be able to play, but it does nothing to improve their conditions or train them, so this is where I decided to concentrate. After conducting market research I think that the best possible solution that I could offer would be a plugin to an existing gaming system , like the xbox adaptive controller, instead of a whole separate accessory.
I concluded that the best way to keep older kids engaged and interested in therapy was by creating a videogame controller that would also train their hands. I ran this idea by Laurie Reddy and she confirmed that such a product would most likely be capable of achieving this.
I also spoke with another Certified Hand therapist, Rajeshree Jaiswal, from Texas Children's Hospital in Houston. My main aim in speaking to her was to determine what the most important fine motor skills are to learn, from most to least difficult, and what are the ways that I can incorporate all of those movements into a singular videogame controller.
She helped me narrow down the essential fine motor skills from least difficult to most difficult to master: overall grip strength, lateral pinch (which is like pinching a key), two point pinch (which is using the index finger and thumb to pinch), opposition (which is being able to bring the thumb up to each of the rest of the fingers and across the palm) and lastly overall finger dexterity and full motion of the wrist.

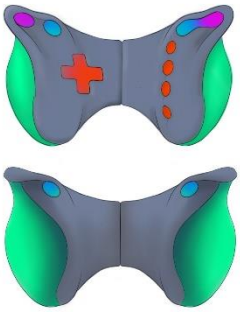
Solutions Considered

I worked back and forth with a Neuroscience Robotics and Rehabilitation PhD at UT Austin, James Sulzer, throughout my ideation process, receiving constant feedback on each new iteration of my product.
My main concerns in the beginning of the development of the controller was how to incorporate all of the necessary movements to practice the essential fine motor skills into one shape. I started out by molding the shape by doing all of the movements with a piece of play dough in my hand. This was the shape that resulted; an oblong organic shape with indents for every finger wrapped around it and a flat area on top where it was pinched.

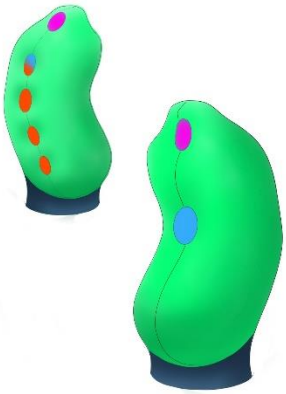
I decided to use this shape as a base for all of my ideation.

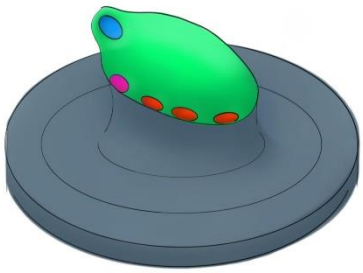
Anna Bibikova

My first concepts were concentrated on creating something that is very similar looking to Xbox controllers because it would be more intuitive to use. I included some of my ideation below.



While this approach may look aesthetically pleasing, Dr.Sulzer pointed out that people that have limited use of their hands may have a more difficult time holding up a heavy controller. This led me to begin ideating more in the direction of a stable controller that can sit on a desk, more like a joystick with a very stable base.





I refined the shape of the controllers according to my playdough shape, and came up with a very organic final shape of a controller that would be able to train all of the movements.

However, it was brought to my attention that not everyone that may want to use the product might have five fingers that would fit perfectly into the grooves, which prompted me to develop

multiple interchangeable controllers that could be used by more than one hand type, with varying abilities.

I also took into consideration that the base that the controllers plug into should also be designed with the user in mind. I experimented with bases with suction cups to stabilize them but decided that it would be inconvenient since not every surface is able to be suctioned to. So I settled with designing a base that is large enough to be stable, and also offers wrist support.

Description of final approach and design

The final idea that I came up with was to create a base along with three interchangeable joystick heads for three levels of difficulty. The first joystick head is for the most severe hand disabilities. It is a simple oval shape with a pinch portion on top.

There are no indentations for individual fingers, so the user can grip it however they are able to. The top portion can be used either for lateral pinch or two point pinch.
The second controller is for people that have more use of their hands or have progressed from using the first controller. It is also an oval shape but with an indentation for the thumb as guidance as well as two buttons at the front for the fingers to be able to locate and press them with ease, as well as a pinch portion on top.

The third controller concept is for those that need the most minimal help with the development of their hand strength or fine motor skills. It is closest to my original singular joystick concept in that it has indentations for each finger and is as ergonomic to fit the hand as

possible. It also has two buttons on the front, like the second level controller, because Dr.James Sulzer pointed out that individual fingers get tired easily regardless of how healthy the hand is.

All three of the controllers are tilted forward to ease wrist strain.

This set of controllers also comes with a base. The base is triangular and it is 10” x 12”x 2” and it features a raised rest area for the wrist. Some people are not able to stabilize their hand well, or may have muscle spasms that make it hard to keep the hand still. This area is slightly dipped allowing the arm to rest into it.

Outcome

I casted silicone into the shapes of my controllers and gave them to Rajeshree Jaiswal to give to children with hand disabilities to test , and she reported that children are able to practice the correct hand exercises on all three of the shapes.

Cost

The controllers themselves would be injection molded TPU, with silicone overmolding. The base would be Injection molded ABS. The cost would be similar to the videogame controllers that are out on the market.

Significance

The significance of my project is that occupational therapy doesn’t have to be a boring and tedious process. There are many opportunities to make therapy fun, since there aren’t many solutions out on the market currently, such as incorporating hand training into videogame controllers.
Encouraging people to continue their therapy at home would result in much faster progress and recovery times with hand disabilities or injuries.

Acknowledgements and references

Anna Bibikova

I would like to thank my Professor Jeff Feng for guiding me through the process of developing this project.
I would also like to thank the following professionals for taking the time to give feedback and contribute to my work:
Laurie Reddy, Certified Occupational Hand Therapist at Baylor Scott and White
James Sulzer, Neuroscience Robotics and Rehabilitation PhD at UT Austin
Rajeshree Jaiswal, Advanced Hand Therapist at Texas Children's Hospital