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Versita Assistive Drawing Device: Helping People Living with Motion Disorders Learn to Write and Draw

1) Problem Statement/Research Question and Background

Around the world, many CP users suffer from physical impairments include visual, learning, hearing, speech, epilepsy and intellectual disabilities. According to Centerd for Disease Control and Prevention(CDC), estimates of CP ranging from 1 to nearly 4 per 1,000 live births or per 1,000 children. Specific symptoms of CP vary from person to person. Cerebral Palsy (CP) is the abnormal development of the brain or damage to the developing brain that affects body movement, muscle control, muscle coordination, muscle tone, reflex, posture and balance.

Research of this project is divided into two sections, primary and secondary research.

Primary research is based on a user interview participated by Cerebral Palsy user Sylvia Drzewiecki, a 78-year-old freelance artist that attends weekly rehabilitation programs at United Cerebral Palsy of Los Angeles(UCPLA).The CP daily life routines and hand-using experience regarding disability is used as a foundation and learning of Cerebral Palsy artists' needs. Hand and arm's moving range is very limited, with difficulty in moving and maintaining body balance or posture. Her reflection includes requirements of being more independent, needing some type of tools to make daily hand usage less tired, and enables her to grip tight and stable enough while drawing. Higher adaptive user experience, drawing tool diversity and comfort level is considered important for the design.

Secondary research of this project helps build a solid foundation on Cerebral Palsy user hand behaviors, symptoms and details about the physical disabilities. Cerebral Palsy artists encounters difficulty in drawing independently without the help of assistants, and imposes burden on hands and bodies. While physical treatments and rehabilitation such as occupational therapy is used, the need of developing a functional drawing aid to help users better grab and draw with limited hand control, is significant.

2) Methods/Approach/Solutions Considered

Initial design methods including an adaptive grip tool for enhancing drawing experience, or a wearable product with stabilizing functions. The first concept of wearable assisting art tool is considered to use bionic functions with ergonomic study of forms, but is not taken as the final direction for lacking functionality and feasibility of being inclusive for various users.

The second concept of an adaptive drawing hand-aid, is considered more applicable to accomplish higher indolence in user experience, and is developed into fitting diverse drawing tools, pens and brushes to satisfy user needs. This need-based approach help stabilize art-tool gripping, smoother drawing experience and use firm mechanic knowledge to fix the parts.

3) Description of Final Approach and Design

The final design approach of the product is a set of assistive drawing tools for Cerebral Palsy users to enhance adaptability and diversity, and named as "Versita". In consider of CP artists' limited hand movement, body control and balance, the design is refined with snap-fit mechanisms. While the user grab onto the main hand grip part, a separate pen-pen holder tip is assembled onto the grip to help grab the pens or art drawing tools. To satisfy diversity of switching from different art tools, the whole set of "Versita" drawing aid come with four sizes sets.

Mechanisms and engineering knowledge that supported this disability design, is based on a Cantilever Snaps-fits Mechanisms and Joinery application are supportive mechanism applied to 3D printing of the product model.

The design is also finalized in consider of product's Color, Material and Finishing(CMF). The CMF of Versita assistive drawing tools use material with optimum malleability, cohesiveness, and strength. Under such consideration, thermoplastics and splinting material are listed as potential CMF choices that enable manufacturing with precision and used in biomedical applications. Graphene, nylon, TPE filament and TPU are also considered to be potential materials used for manufacturing the product, with the need of 3D Nylon Prints to be malleable and break resistant, while preventing grease or abrasion at the same time for stability.

4) Outcome (Results of any outcomes testing and/or user feedback)

After earlier design models is sent out, feedback including thickening the supporter holder legs is taken into consideration. Users also suggest the necessity of tightening the too safely and firmly so it could hold art tools well.

Therefore, after adding supportive backbones and reinforcing triangular structures, the 3D printed model of user testing phase 3 provided user feedback for the final design outcomes. Volunteer CP users, Lucy and Ronald from UCPLA, reflected that maintaining the design interchangeable is more feasible, which means keeping two separate parts assembled together instead of printing out into one whole body. This is in consideration of Cerebral Palsy users' limited hand movement and hand control, so replacing pen-holder tips would be easier in case users accidentally drop the tool and breaks it.

According to the user testing video, the product is also acknowledged by both users to be working comfortably and fluently. Users provided feedback that it is easy to use in multiple ways of grabbing it. The fitness of art tools, and diversity of being capable to switch between different-size art tools is another successful deliverable for the Versita product.

5) Cost (Cost to produce and expected pricing)

For the product's user testing stage, the three stages of test models cost approximately 100 USD, after modeled in Solidworks and sent to UCPLA Curatorial and Adaptive Design Manager, Aragna Ker's design office for 3D Printing. The models are printed with PLA printing for stability and firm structure. The product considered of 4 sizes, each with a main hand grip and a pen holder assembled together.

For the final pack that come with 4 sets of hand-grips and art-tool holders, the cost is expected to be around 150-200 dollars, if mass-production is applicable with 3D printing. The time cost of printing each hand-grip set is about 2 hours, according to the user test.

6) Significance

Cerebral Palsy artists encounters difficulty in drawing independently without the help of assistants, and imposes burden on hands and bodies. The product set "Versita" is a drawing aid that brings a solution to enhance flexible moving of hand and arms with functionality and ergonomic form. Empathetically designed for Cerebral Palsy artists with hand disability, this product is targeted as offering them the capability to better control and create by only moving the arms.

This assistive drawing aid tool could help Cerebral Palsy users fulfill the needs of better hand control, and offer effectiveness in terms of hand-drawing experience. With this supportive tool, CP artists could grab art tools and make art creation in a way **stress-free** and enables **flexible movement** during painting.

7) Acknowledgements and References

Acknowledgement:

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