Adaptive Assistive Device

Colton Kuchta, Ryan Norfleet, and Samuel Ryan
Advisors: Roberta Gagnon
Trine University
One University Avenue, Angola, Indiana 46703

ABSTRACT

In collaboration with J.C. Innovations Helping Hands, a non-profit organization dedicated to aiding those with limb differences, and Timerson Downing the team aimed to develop an improved assistive device for a 4-year-old girl and a bike riding aid. The client' outgrew the previous device (pictured below). The team's goal was to create a low-cost, easy-to-maintain device using additive manufacturing while prioritizing her safety and comfort.

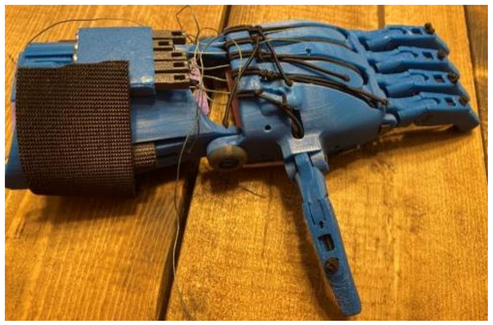

Figure 1: Current Assistive Device

After conducting research and consulting with the client, the team decided to use a Whipple mechanism design for the primary assistive device, which allowed for an adaptive grip without the need for a more complex or costly mechanism. Additionally, the team developed a ball-mounted cup for the bike to stabilize her while riding. The team is excited about the opportunity to improve the client's quality of life with these assistive devices.

CUSTOMER NEEDS/SPECS

Outlined below are the clients needs for both the primary assistive device and the bike mounted device. This was created from interviews directly with the client with additional requirements proposed by the team.

Finalized Customer/Sponsor Design Needs

- Device needs to be comfortable
- Device needs to grab/hold objects
- Device needs to be durable
- Client needs to be able to ride a bike safely
- Device needs to be low cost
- Device need to be lightweight
- Device needs to be aesthetically pleasing

Figure 2: Customer Needs

DESIGN CONCEPTS

The team created three main concepts for the primary assistive device, one using nitinol wire, one that was just an optimization of the original model, and one that utilized the Whipple mechanism. After meeting with the client and referring to the customer needs, the team selected the new design utilizing a Whipple mechanism for adaptable grip, and an easy to adjust tension system.

Figure 3: Initial Primary Assistive Device Design

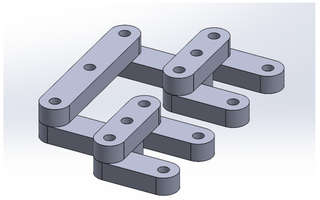

Figure 4: Whipple-Mechanism Design

TEST RESULTS

Testing of the bike mounted assistive device consisted of various strength and durability tests which it passed, including a drop test and stress test while attached to handlebars. A test with the client produced satisfactory results in the categories of control, safety, and design.

Figure 5: Client Testing Bike Mount Assistive Device

Testing of the primary device consisted of various grip tests and durability tests, including precision grasping of a pencil and lifting a 3 lb weight. The device was also worn by the client to ensure a comfortable fit.

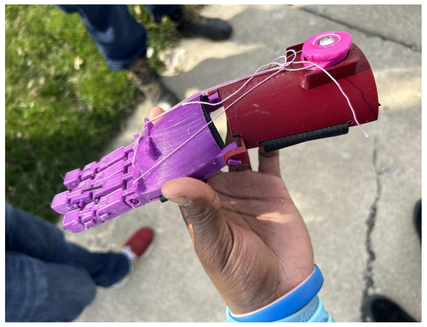

Figure 6: Primary Assistive Device Client Tested

FINAL DESIGN

The primary assistive device's final design was modified to have tighter tolerances and a rework of the wire system for easy maintenance, as well as various reinforcements. The final device was also printed in pink and purple to reach the aesthetic requirements for the device.

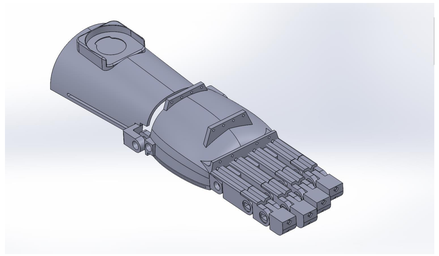

Figure 7: Primary Assistive Device Final Design

The team created multiple iterations of the bike mount assistive device ranging from mounting method to overall length. The final iteration of the assistive device was designed to be durable and comfortable for the client to wear while also allowing quick engagement/disengagement.

Figure 8: Bike Mount Assistive Device Prototype & Final Design

Certain challenges were encountered during the printing process, such as clogging of some machines which resulted in the hot pink color being printed as black. To resolve this issue, the team switched printers from Ultimaker to Ender, which proved to be successful. As evident in the image, the piece was printed impeccably using the new printer.

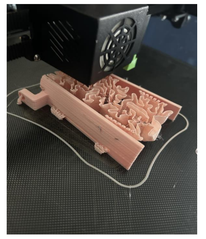

Figure 9: Forearm Printing Process

CONCLUSION

The engineering team has utilized the engineering design process to develop a device that assists a young girl with her daily activities and cycling. The primary assistive device has been designed with a more robust grip force, a streamlined and visually appealing appearance. The bike-mounted assistive device has also been engineered to operate to the client's satisfaction, allowing her hand to feel at ease while using it and enabling effortless insertion and removal of her hand from the device.

LESSONS LEARNED

The team has learned a few things throughout the process of this project:

- Problem solving skills
- Organizational skills
- Communication of design process and goals
- Improved documentation and design skills
- Ensure the safety of the client when testing
- How to communicate with non-engineers
- Importance of IRB process and approval

ACKNOWLEDGEMENTS

The following individuals are thanked by the team for their assistance in finishing this project:

Jody Claypool, JC Innovations
Kosciusco County Community Foundation
Timerson Downing, Innovation One