Electromyographic Prosthetic Hand (OLSN)

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ROBOTICS TEAM & LEADERSHIP EXPERIENCE

Intro & Problem Definition

Kaeden Olson, a local boy, was born without a major portion of his right hand due to the prenatal defect Amniotic Band Syndrome (ABS). TURTLE has taken up the task of providing a prosthetic hand for Kaeden to help him with his day to day tasks.

Figure 1: *Group photo of Kaeden with some of our amazing team after a great day of connections and measurements.*

Approach & Methods

Our team followed a flexible and iterative design methodology focused on achieving both functionality and form. The goal was to create two custom, affordable prosthetic hands that balance technical innovation with human-centered design. Every design decision was made with Kaeden's comfort, usability, and confidence in mind. Keaden and his mom were consulted throughout the entire project, making sure all of his needs were met, including any aesthetic design decision to make the process more comfortable.

Design Requirements

- One prosthetic hand featuring a mechanical ratchet control system
- One prosthetic hand driven by electromyography
- Cable-driven thumb mechanism for both hands
- Customizable electronics and software housed in a waterproof casing

Hardware

Socket

- Both variations feature the protective carbon outer shell seen in ***Figure 7*** bound against rolled silicone chosen for its pliability. Chicago screws combine the layers for minimal protrusions while maintaining tight contact.
- A slightly modified ratchet was built into the socket to pull on a braided steel cord to adjust the tightness of the socket against the patient's arm.

Mechanical Palm

- Implemented a similar ratchet mechanism to optimize control of finger actuation as opposed to the motors in the electrical design.
- Rescaled palm to fit Kaeden's hand better and made modifications to account for hand growth while trying to maintain a more rounded/realistic design.

Thumb

- With the updated dimensions provided by Kaeden's measurements, the thumb was able to be resized to properly match his other hand. Using the scan of Kaeden's arm, the thumb attachment was iterated to now provide a comfortable fit to Kaeden's hand.

Fingers

- Metal tabs now replace the plastic joints to add the necessary strength
- Silicone rubber has now been custom molded to each finger to add tactility in place of TPU

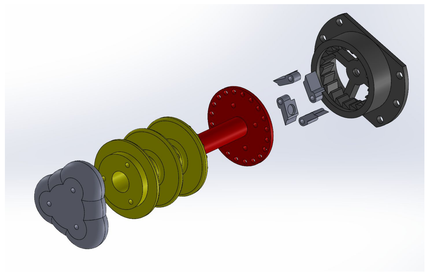

Figure 2: *Palm Ratcheting Assembly, Exploded View*

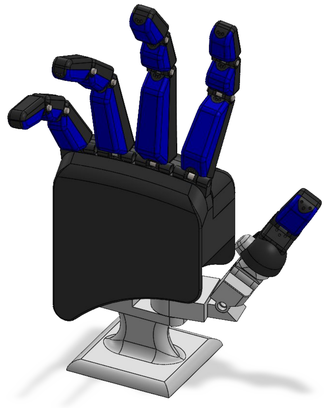

Figure 3: *Spring 2025 Hand Assembly*

Electrical & Control

Each finger of the robotic hand is actuated by a 6V motor with an encoder, managed via a PID control system through an H-Bridge for precise positional accuracy. Gestures are inputted via the Sparkfun Myoware 2 sensors and transmitted through UART from a laptop. Additionally the encoder allows for variation in positioning of each finger. Currently the system is reactive and grip force is strong enough to handle small objects.

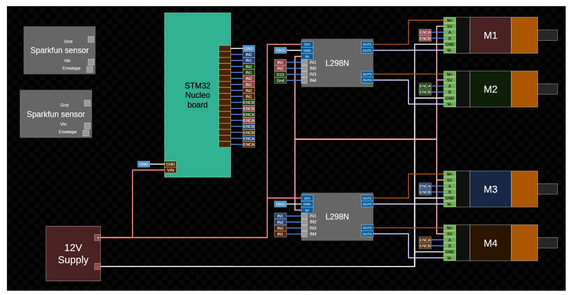

Figure 4: *Testbed Electrical Diagram*

Future systems will incorporate the usage of an inhouse myoelectric system with a smaller microcontroller board governing the control logic and machine learning. This decision was made to increase operational efficiency, decrease thermal throttling, and increase overall battery life of the device with power management systems.

Photos

Figure 5: *Kaeden test fitting the silicone developed by 14th Element*

Figure 6: *Measuring Kaeden's full sized fingers*

Figure 7: *Will showing Kaeden how the forearm socket will fit on his arm*