Electromyographic Prosthetic Hand (OLSN)

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TEXAS A&M UNIVERSITY Engineering

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ROBOTICS TEAM & LEADERSHIP EXPERIENCE

Intro & Problem Definition

Kaeden Olson, a local boy in Bryan, TX, was born without a major portion of his right hand due to the prenatal defect Amniotic Band Syndrome (ABS). Due to this disability, Kaeden has faced serious hardship among his peers, resulting in mental health and behavioral issues. TURTLE has taken up the task of providing an affordable and custom prosthetic hand for Kaeden.

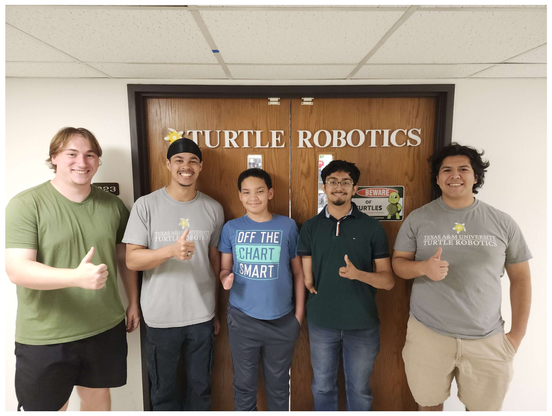
Approach & Methods

The design methodology that the team adopted was one of flexibility and form—with the intent of being able to reproduce and create custom prosthetics for individuals. OLSN has become the sublab within TURTLE specializing in this design and production.

Design Requirements

- Four motorized fingers & one cable-driven thumb.
- Customizable electronics and software with a waterproof casing.
- Prioritizing accessible and affordable components with McMaster and electronics.

Measurements



This semester, we got much needed physical measurements from Kaedon! Hand progress is only forwards from here. Yes, he is holding up a “gig em” in this photo!

Hardware

Sleeve

- The sleeve was designed to house the PCBs and the Myo Band. This protects all components from damage and other external factors.

Palm

- Both variations feature the protective carbon outer shell seen in *Figure 1* bound against rolled silicone chosen for its pliability. Chicago screws combine the layers for minimal protrusions while maintaining tight contact.
- **Mechanical Palm - Basic Function**
  - Implemented a ratchet mechanism to optimize control of finger actuation as opposed to the motors in the electrical design.

Thumb

- The thumb subteam used a weighted decision matrix to balance the primary design concerns of maintenance, simplicity, and cost, resulting in a **cable-driven design** that is simple in structure and implementation.

Fingers

- The finger subteam worked on parameterized modeling, making each finger piece entirely parametrically driven by an excel spreadsheet. This allows for modification easily for Kaeden’s growth.
- TPU provides additional grip compliance to all finger and thumb surface contact joints.

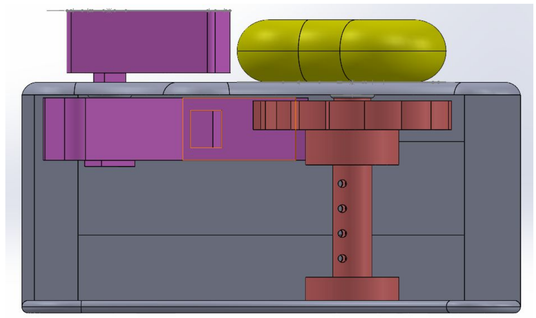


Figure 1. Inner Hand Assembly

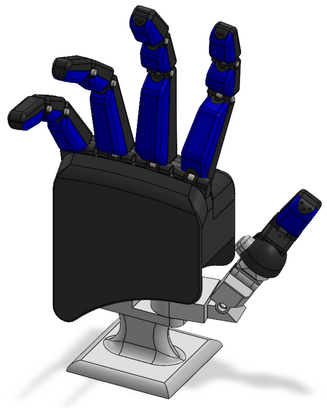


Figure 2. Full Mechanical Assembly

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 Myo band and transmitted through UART from a laptop. Additionally the potentiometer allows for dynamic positioning of each finger. The reset button recalibrates the default position. Currently the system is reactive and grip force is strong enough to handle small objects.

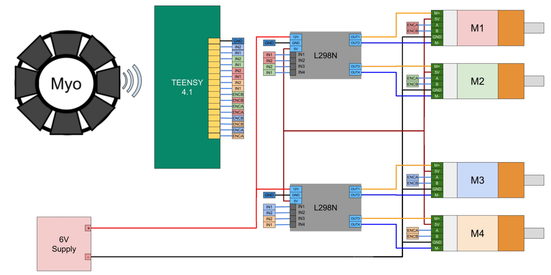


Figure 3. Mobile System

Future systems will incorporate the usage of an inhouse myoelectric system with an STM32 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

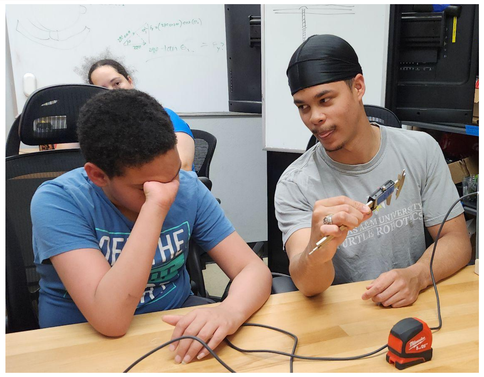


Figure 4. Zachary Explaining Measurement Uncertainty to a bored Kaedon

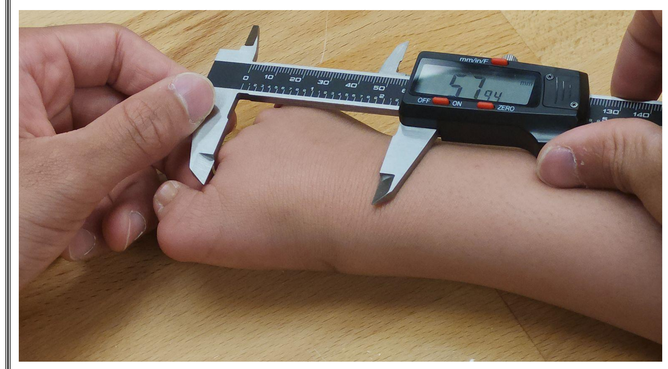


Figure 5. Measuring Kaedons palm length

Figure 6. Testing the TURTLE Scanner V1 on Kaedon