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Forearm design for a myoelectric prosthetic hand

Ryan C. Yoder

Nicholas F. Ports

TJ Quintillian

Brittney D. Fouse

Keller Martin

See next page for additional authors

Authors

Ryan C. Yoder, Nicholas F. Ports, TJ Quintillian, Brittney D. Fouse, Keller Martin, Jaymie R. Monday, Meghan L. Sampson, and Samuel F. Whittle

Forearm Design for a Myoelectric Prosthetic Hand

Jaymie Monday and Samuel Whittle

School of Science, Engineering, and Health, Messiah College, Mechanicsburg, PA

Problem Statement

Our client, eleven-year-old Lily Inzey, was born without a left forearm or hand. Lily's options for prosthetic assistive devices are limited by the high cost and lack of insurance coverage of pediatric prostheses.

Figure 1: Our client, Lily Inzey

Goals

- To create a custom fitted myoelectric prosthetic device for Lily that is able to control the hand based on muscle contractions in her residual limb.
- To share the love of Christ with our client and her family by gifting her with the hand and praying for her.

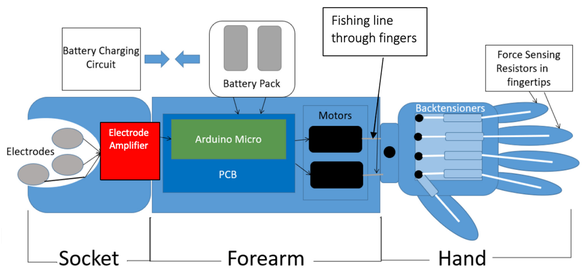

Figure 2: Block diagram illustrating the components needed for prosthesis

Specifications

Criteria	Goal
Weight	< 500g
Grasps	Power/Cylindrical (Fig 3)
Grip force	10 lbs
Grasp Speed	Close in 1.2 s
Feedback	Safety Switch
Cost	< $1000
Life of Daily Use	1-2 hours continuous use
Lifetime	1 year

Figure 3: Depiction of power/cylindrical grip pattern

Electrical Design:

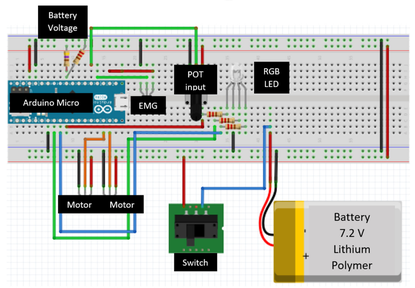

Figure 4: Diagram of the main circuitry for the hand.

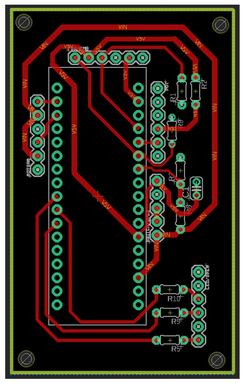

Figure 5: Layout of the PCB

- MagneSnap Electrode System- reads and amplifies muscle impulses from arm. Connected to socket liner via magnets.
- Printed Circuit Board (PCB) – Customized to connect electrical components including the microprocessor, the Arduino Micro.
- Batteries – One 7.2V Lithium Polymer.
- Motors – Two motors power the hand: one for thumb, index, and middle fingers and the other for the ring and pinky fingers.

Back Tension System:

- A back tension design is needed to return the hand to a neutral open state (Figure 6).
- Design consists of elastic string on the back of each finger tied to individual sliding blocks on the back of the palm.
- Each sliding block is adjustable via screws threaded into each block to allow the back tension to be adjustable (Figure 7).

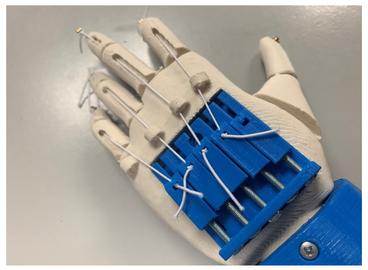

Figure 6: Fully assembled back tension system

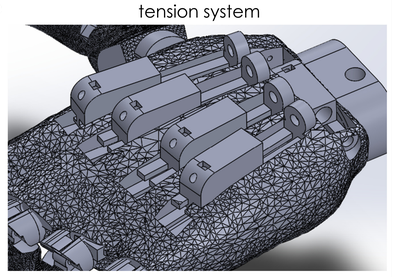

Figure 7: SolidWorks Model of Current Back Tension System

Mechanical Design of Current Prototype:

- Custom fitted socket for our client (Figure 8).
- Embedded into the forearm are a power switch, charging port, RGB LED to display battery level, and a potentiometer that controls sensitivity of muscle input (Figure 9).
- The forearm and hand are 3D printed using traditional PLA

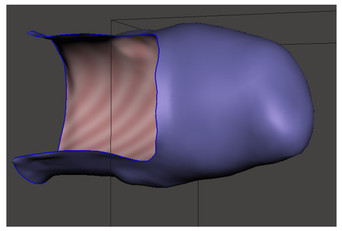

Figure 8: 3D scan of client's residual limb for socket design

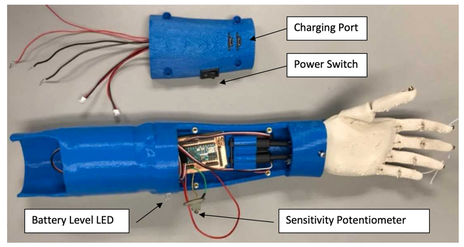

Figure 9: Completed Prototype

Modular Goal for Future Design:

- Our arm is tailor for our client, Lily (Figure 10) but it is required for the arm to be applicable to many different clients
- New modular designs will use simple inputs, such as hand width and forearm length, to create a custom arm scaled to the client's measurements.
- Has to the possibility to help anyone around the world once uploaded to an open source platform

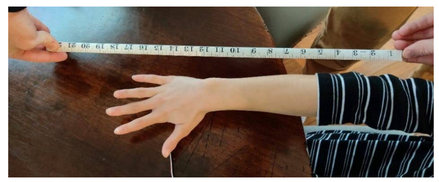

Figure 10: Tailored Measurements used to scale arm to match Lily's other arm

Conclusion

We currently have a functioning device that reads muscle signals to open and close the hand. We have made plans to give Lily a prosthesis to test in the fall of 2020 and move forward on making the arm modular for open source use.

Team Members

- Brittney Fouse
- Nicholas Ports
- Jaymie Monday
- Ryan Yoder
- Sam Whittle
- Meghan Sampson
- TJ Quintillian
- Keller Martin

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Department of Engineering
Messiah College