Adapt-a-Grip Terminal Devices

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Types of Terminal Devices

1. ***Passive:*** Assist in balance and stabilization of objects. Often chosen for appearance as they resemble a natural limb but lack active movement.

2. ***Body-powered:*** Utilize a cable system operated by motion of shoulder blade and upper arm. Common due to affordability, durability, and good performance with physical labor tasks.

3. ***Externally Powered:*** Provide active hand and joint movement through sensors and EMG signals, without body motion. Offers greatest grasp force.

4. ***Activity Specific:*** Designed for specific activities to prevent damage to everyday prosthesis. Specifically tailored to activities and hobbies.

5. ***Hybrid:*** Combination of two other types of prostheses.

Activity Specific

Activity Specific prostheses are tailored to specific physical tasks, enabling individuals to excel in sports and recreational activities beyond what traditional prosthetics offer.

- Enhanced Performance: Specifically designed for the task
- Interchangeable: Easily swapped out from a potentially endless variety of activity specific terminal devices

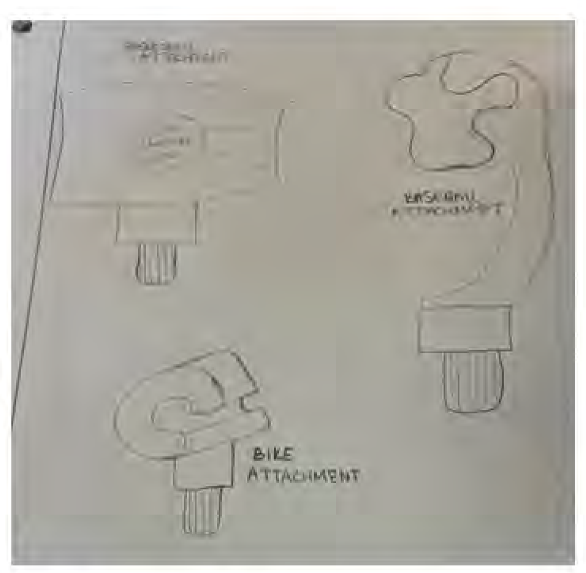


Figure 1: Sketches

Figure 2: Baseball and Basketball Terminal Devices

Figure 3: Cycling and Crocheting Terminal Devices

A terminal device could be made for any activity by adding the quick disconnect wrist connector to the 3D model and finally 3D printing the device.

Body-Powered Terminal Device

Two hybrid prostheses were made, a combination of electrically powered and body powered terminal devices. The body powered device

The initial design of the body-powered terminal device featured separate wires for flexion and extension, leading to an unrealistic hand design. Powered by the adaptable socket and early version of the quick disconnect wrist, its functionality and appearance were limited.

Figure 5: First Iteration Hand Sketch

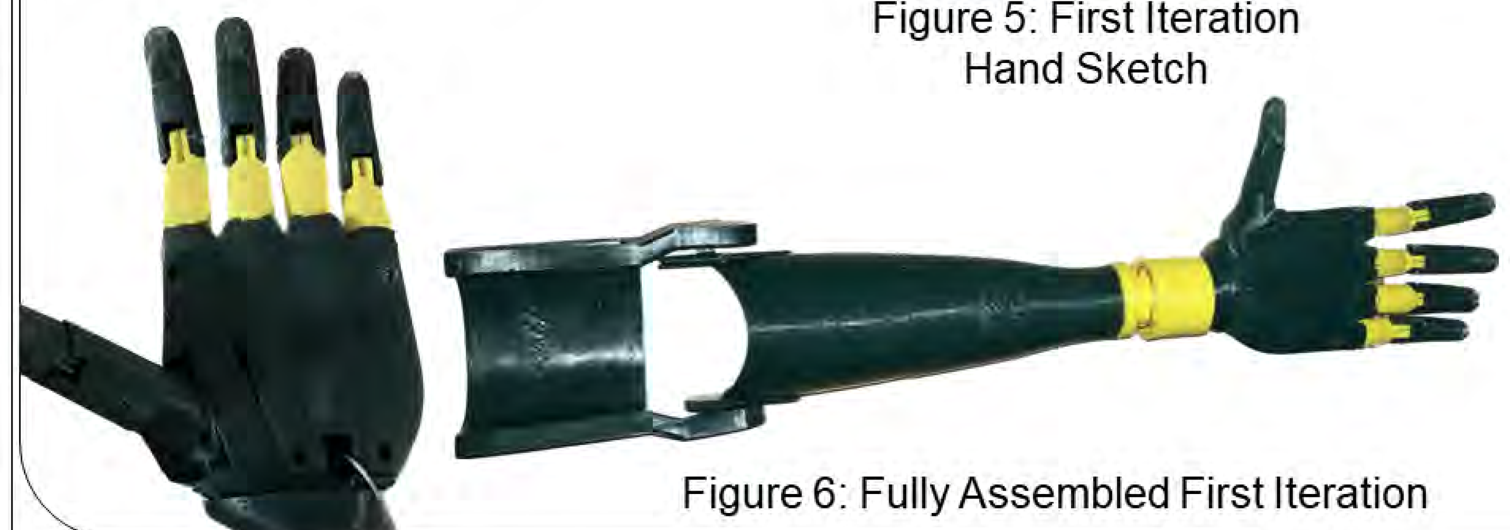


Figure 6: Fully Assembled First Iteration

However, advancements led to an updated version with flexible joints that replaced the need for extension wiring. The updated palm and finger shape resulted in a more realistic hand design.

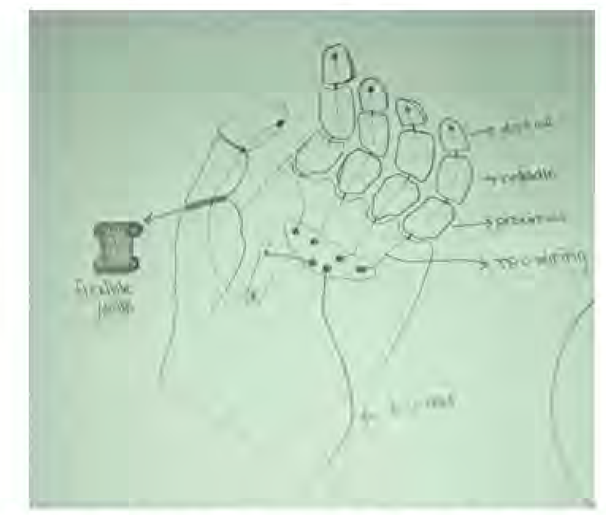


Figure 7: Updated Hand Sketch

The flexible joints could be made from TPU filament, or a mold mixture made from silicone caulking and cornstarch. Both methods were tested and found to be sufficient in creating strong but flexible joints.

Figure 8: Fully Assembled Updated Body-Powered Prosthesis

Connected to the adaptable socket and updated quick disconnect wrist, this iteration could grasp a variety of objects including water bottles and phones, enhancing its practicality and usability.

Voice Control Prosthesis

Voice control terminal device is capable of a wide range of customizable commands, meticulously designed for versatility and accessibility. Uses a voice recognition module to orchestrate precise finger movements. As shown below the electrically powered hand was able to mimic the hand gestures programmed.

The circuit diagram is shown to the right, describing the various connections made to the Arduino Nano that was used to execute the commands.

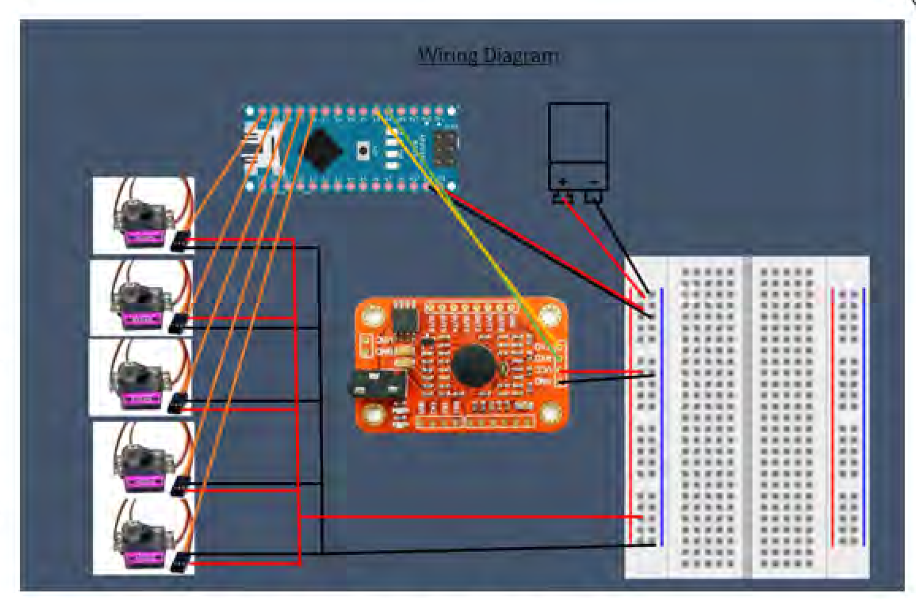
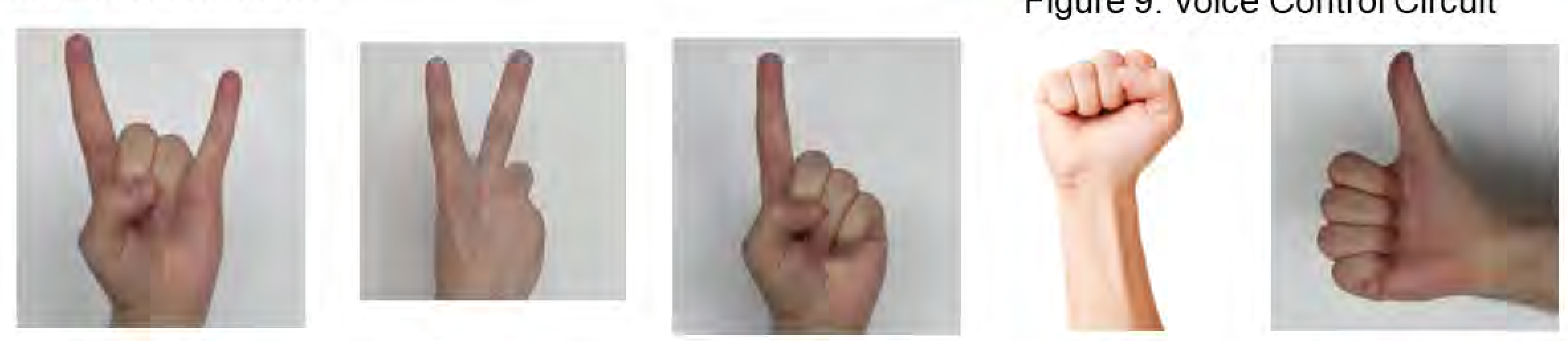


Figure 9: Voice Control Circuit



Rock On | Peace | Point | Fist | Thumbs Up

Pressure Sensing Prosthesis

The first iteration of the pressure sensing hand had large flexible pressure sensors that were attached to the outside of each finger. The electronics were all placed discreetly inside the hand.

The updated pressure sensing hand consisted of flexible finger joints that limited the number of wires going through the fingers. Consisted of smaller FSR sensors that could be protected and placed inside the updated finger design. The final major difference was the improved palm design that allowed more room for electronics.

When closing around an object to grasp it, the sensors register the pressure and convert it into a change in resistance. That change in value gets mapped onto the servos to move them the correct degree.

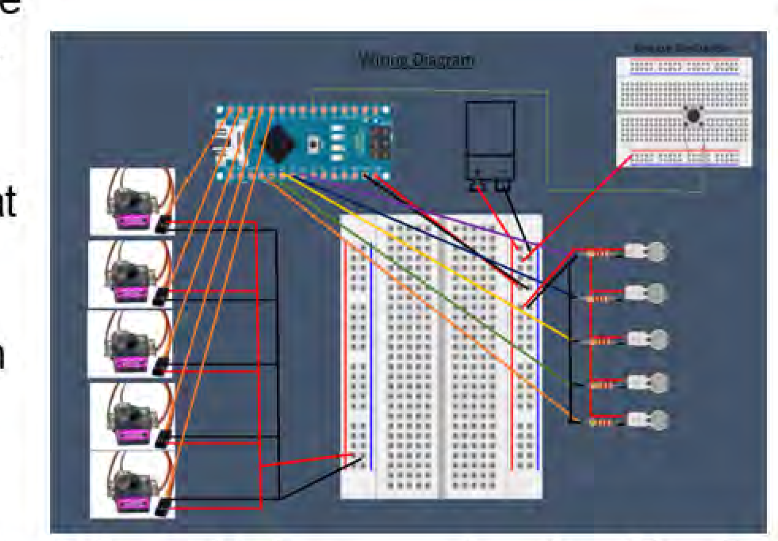


Figure 10: Pressure Sensing Circuit

Figure 11: First Iteration

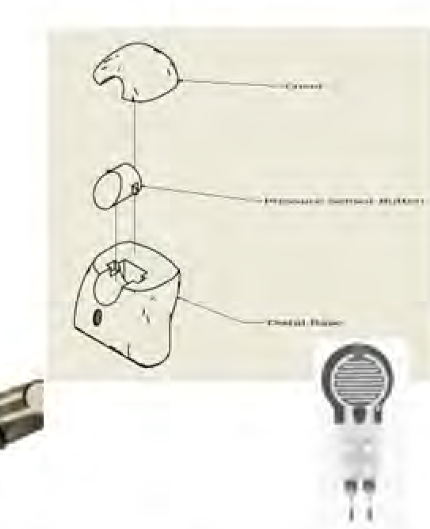


Figure 12: Updated Finger Design and FSR Sensor

Figure 13: Updated Pressure Sensing Hand