Goal

- Design and build an affordable prosthetic hand without sacrificing quality and usability.
- Will be controlled using EMG technology and have haptic feedback.
  - Electromyography (EMG): The recording of the electrical activity of muscle tissue via electrodes.
  - Haptic feedback to notify the user how much force they're applying when gripping object; allows for ability to adjust strength of grip.

Motivation and Objective

- There is no real middle ground when it comes to prosthetics; the affordable options (Figs. 1-a and 1-b) have very limited functionality and are cumbersome to use, while the advanced options (Fig. 1-c) have better features but are exorbitantly expensive.

- Our objective is to make a better middle ground by making a prosthetic hand that has features commonly found in top tier prosthetics, while offering it at a price that the average consumer can afford.

Challenges

- The servos we utilized drew too much current which rendered a battery pack inefficient. We plan to order less power-hungry servos to resolve this issue. Presently, we have made an adapter so the prosthetic can be powered off the wall for demonstration purposes.

References

[5] https://lab4online.com/about_us/what_is_new/cherokee__van_gorden_students_create_3_d_prosthetic/

Methodology

- Build EMG circuit to acquire signal from the users muscle. Signal acquired via electrode patches.
- 3D print hand using open source design, assemble with servos and high tensile lines (used as tendons).
- Programmed PIC microcontroller in assembly to process signal from EMG and actuate hand correspondingly.
- Add force sensors to finger tips and implement biofeedback using vibrational motors and PIC microcontroller.
- Implement pre-programmed movements and “hold” feature for further usability.

Current Results and On-Going Work

- Successfully implemented control of the prosthetic hand (Figs. 5-6) using signals from muscles via our EMG circuit (Fig. 4.1) and PIC microcontroller (Fig. 4.2). A calibration circuit (Fig. 4.4) was added in order for the prosthetic to be easily adjusted for different users. The bio-feedback system (Fig. 4.3 and Fig. 11) and a third degree of freedom (wrist rotation) were implemented. Additionally, several selectable preprogrammed movements were added for further functionality (Figs. 7-10).
- We plan to place all our components on a PCB (Fig. 12) and also make a consolidated portable battery pack.