Regained Mobility: A Low-Cost 3D Printed Myoelectric Prosthetic Hand

Background

- 10,500 people in the US are registered as having a wrist/hand amputation\(^1\)
- Target user has inability to perform daily tasks independently\(^2\)
- Insufficient funds for myoelectric solution

Technical Objectives

Our design goal is to develop a method to assist hand amputees in performing simple tasks independently with natural muscle control.

Target Values:
- Weight: 0.65lbs - 1.35lbs\(^3\)
- Cost: Less than $500

Functionality Goals:
- Grab and hold objects without slip
- Operation between -20 °C and 40 °C
- Functions under 10 lbs. of force
- No slip within 20 lbs. of force
- Water resistance of +5 ingress

Related Work and State of Practice

- Current market devices and technologies are unaffordable
- Can be upwards of $10,000\(^4\)
- Prosthetic hands are not currently being developed at Wayne State University

Future Development and Testing

Immediate:
- Design and development of EMG processing software
- Testing accuracy of myoelectric motor movement
- Verification of design input checkpoints

Long Term:
- Developing methods for mass manufacturing:
  - Stereo Lithography Apparatus (SLA)
  - Laminated Object Manufacturing (LOM)
- Patient functionality validation
- Higher degrees of movement in programming

Commercialization Plan

- Currently only at prototype stage
- Need to validate functionality of timing belt
- Need to develop EMG signal processing aspect of device
- Need to streamline assembly

References

- Yang, Zhou. Personal Interview. 5 October 2016.

Acknowledgements to the Biomedical Engineering Department, Yang Zhou with Dr. Chaoyang Chen’s Robotic Rehabilitation Lab, and Professor Brian M undo

Design Output Overview

Shoulder Cuff
- Lithium ion battery with USB power output
- Arduino Uno Microcontroller
- Variable Grip Strength Dial
- Sleeve
- Gel liner and adjustable buckle strap
- EMG pads

Hand
- Three finger with thumb design
- Cable system for movement
- Finger Grips
- Analog Feedback Micro Servo Metal Gear Motors

Miscellaneous
- 3D manufactural materials: Ninjaflex Plastic
- Training manual and initial training for patient

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