Electronic Controlled Exoskeletal Hand (ECEH)

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Market Research

Looking into the markets of end of arm tools (EOAT) and prosthetic hand markets, the two markets most similar to ECEH, the team was able to determine many places for improvements in these products on the market. There exists no robotic hands within the current market that possess the following characteristics:

❖ Cost Effectiveness While Maintaining Quality Assurance
❖ Real-Time Remote Control Mimicking Capability

Electrical Components

Through extensive research and testing with different electrical components, the electrical components we selected were:

- 5x 10K Resistance Potentiometers (per system)
- 5x LX-224 Digital Bus Servo Motors (per system)
- 1x Arduino Mega 2560 (per system)
- 1x LX-224 Servo Motor Driver Board (per system)

Force Capabilities

ECEH used LX-224 TowerPro Servo Motors to achieve the desired amount of torque for each finger. We calculated the necessary torque for each finger on the human hand to ensure we were meeting our goal of achieving human-like capabilities. Using the equations for $F_{A1}$ and $F_{A2}$ with arrays in matlab, we came across these graphs:

\[
F_{A1} = 2l(t_{10} + 4r_{20})\cos\left(\frac{\theta_{A1}}{2}\right) \\
F_{A2} = 2(t_{10})\cos\left(\frac{\theta_{A2}}{2}\right)
\]

Results

Throughout the development of our proof of concept, we were able to successfully actuate the fingers on the robotic hand with the controller. Additionally, we were able to create a preliminary haptic feedback system.

Future Outlook

We believe we have fulfilled our initial goal of designing a system that can mimic the motion of a human hand and provide a user with haptic feedback all while being wirelessly controlled. Potential future improvements should include:

- Creating a more compact system
- Implementing reliable wireless communication
- Adding a wrist feature

Silicone Molding

To ensure the robotic hand’s fingers returned to their original position, we molded the robotic hand in silicone using a 3D silicone mold.

Cable System

We created a system of cables and pulleys using 100 lbs Kevlar braided line. We also used constant force springs taken from badge reels. This system was installed in both the controller and the robotic hand.

Arduino

Potentiometer

Driver Board

LX-224 Servo