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Smart Exoskeleton Hand with Soft Electronics

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MULTI-DEPARTMENTAL

Smart Exoskeleton Hand with Soft Electronics

CAPSTONE DESIGN EXPO 2017

MULT 602 | **Team members:** Andrew Choi[1], Han Ha[1], Gabrielle Jones[2], Gregory Zobel[2] | **Faculty adviser:** Dr. Woon-Hong Yeo[2,3], Dr. Weijun Xiao[1]
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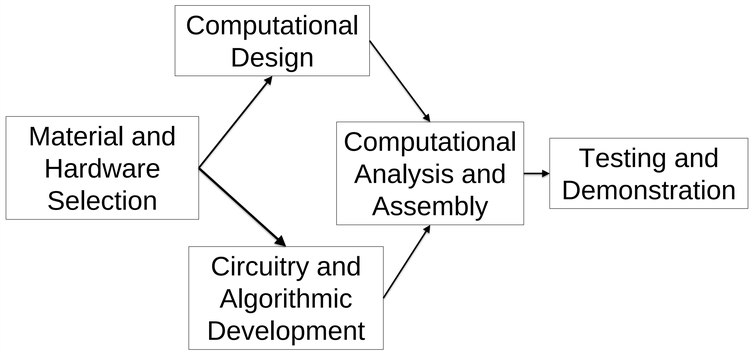
Background

- Millions of people are affected by hand and wrist related injuries annually
- During rehabilitation, these patients are unable to perform basic activities outside of the supervision of their physician
- There is currently no known device aimed purely at performing basic movements without aiding in rehabilitation

Objectives

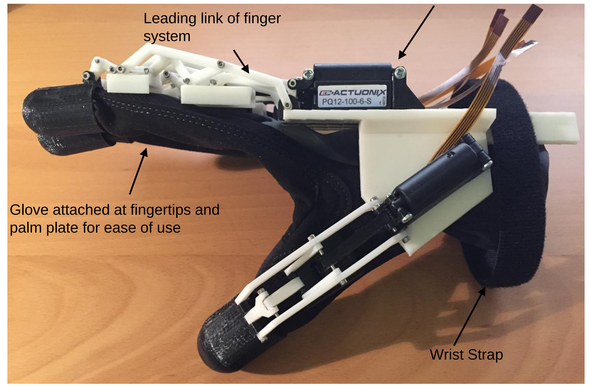
- We aim to develop an electromechanical system paired with EMGs to provide extra strength and mobility where it lacks
- We aim to track and display the EMG signals read by the electrodes and display them for ease of the patient

Project Overview

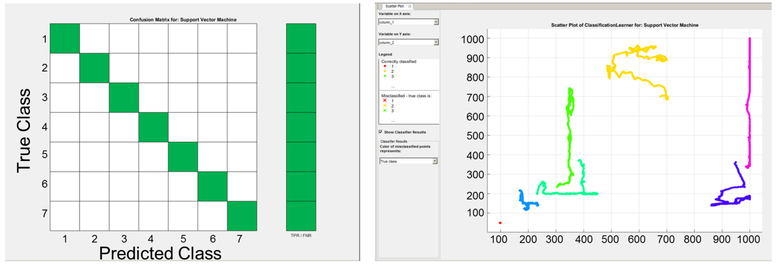


Design and Prototyping

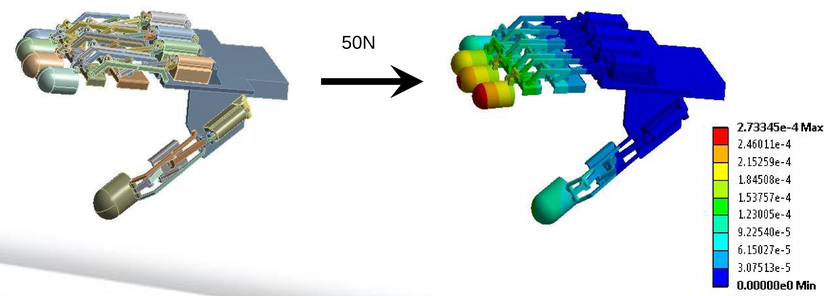
- **Prototype Development**



- Confusion Matrix for Characterization

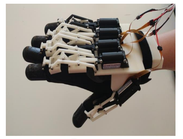


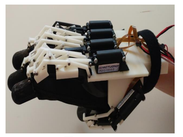
- Computational Analysis (Deformation)

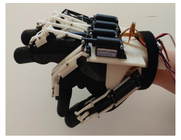


Software and Classification

- Program to train and perform real-time classification of the EMG signals written in C and Python
- Applies software filters and algorithms to process signals
- EMG training uses statistical analysis.


Open


Thumb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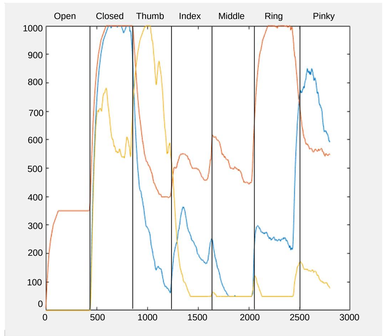

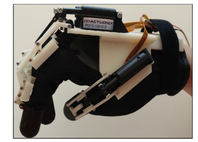
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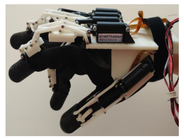
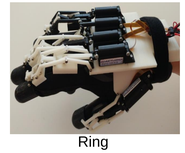
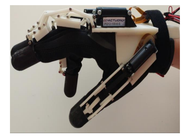
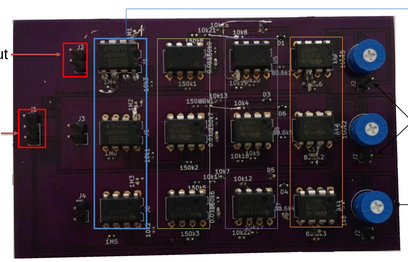

Middle


Ring


Pinky

Circuit Design



- **Differential Op Amps (Stage 1)** Takes in two signals and calculates the difference and outputs one signal
- **Op Amps (Stage 2)** Amplifies signals obtained from stage 1
- **Op Amps (Stage 3)** Amplifies signals and rectifies them using diodes
- **Op Amp (Stage 4)** Amplifies signals and smooths it to one signal threshold to output to Raspberry Pi

Conclusions

- We successfully fabricated an exoskeleton glove via computational analysis and 3D printing.
- In vivo test demonstrates real-time, multi-motion classifications via finger movements.

Future Plans

- Design the ExoHand using the Eden by Stratasys for further structural stability.

VCU School of Engineering