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EMG Based Trajectory Control of Hand Exoskeleton

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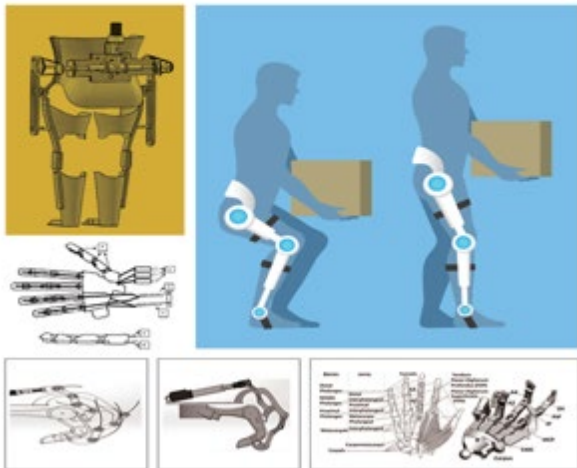
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EMG Based Trajectory Control of Hand Exoskeleton

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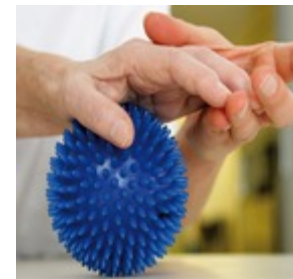
Enass Mohammed

Mallory Anderson



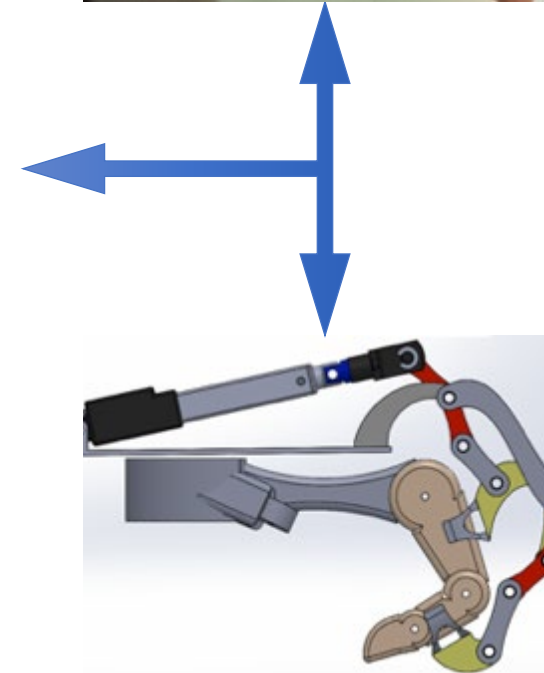
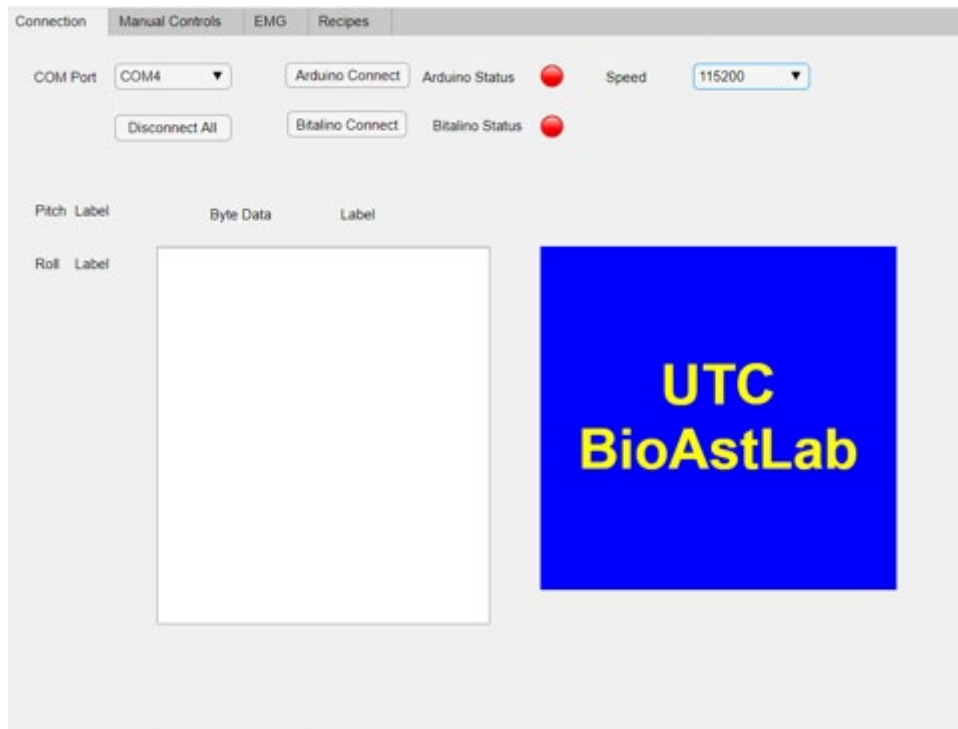
Robotics Rehabilitation

- Rehabilitation based on robotics provides an accurate implementation of therapy techniques and enhances the repetitiveness of exercises.
- The workload of therapists performing the therapy paradigms can be shared by the robots. Besides, robotics integration with the virtual situation and the acquisition of quantitative data can help to simplify hand rehabilitation by enhancing therapy procedures and evaluating the response of patients.



Hand Exoskeleton

- In this project, we have designed and controlled the hand rehabilitation exoskeleton robot with smart algorithm for active and passive rehabilitation processes.

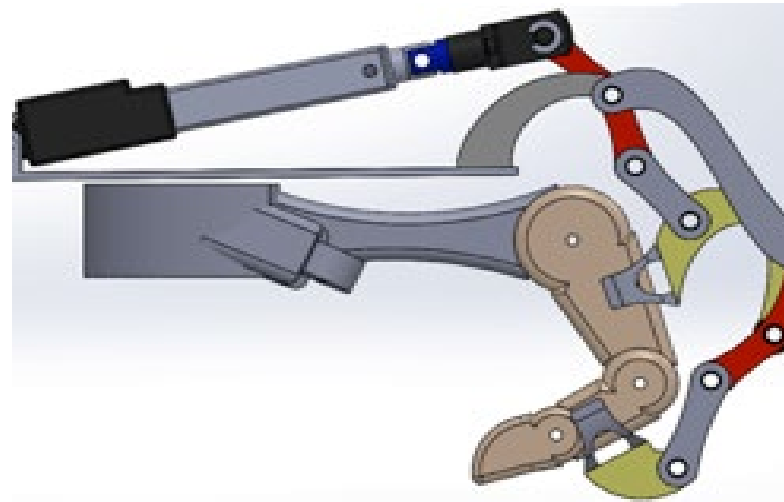


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Hand Exoskeleton

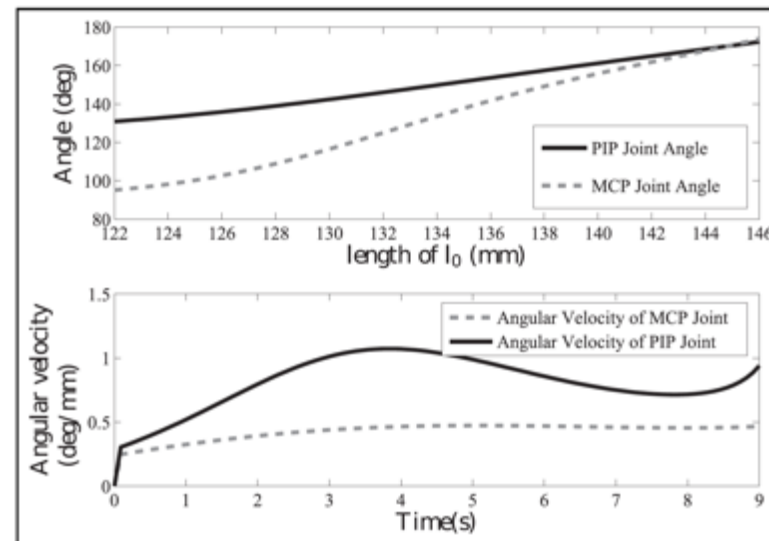
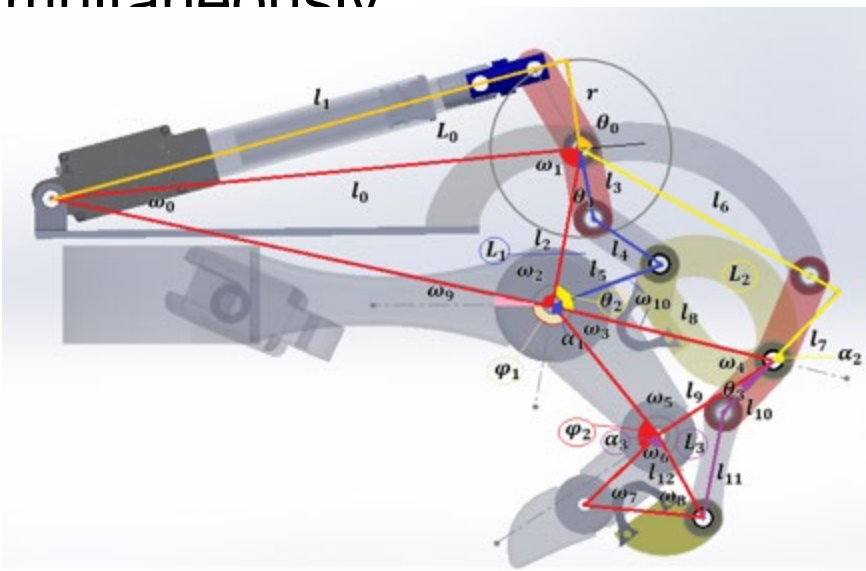
- The mechanism for realization of flexion and extension movements is designed using a single actuator for each finger.



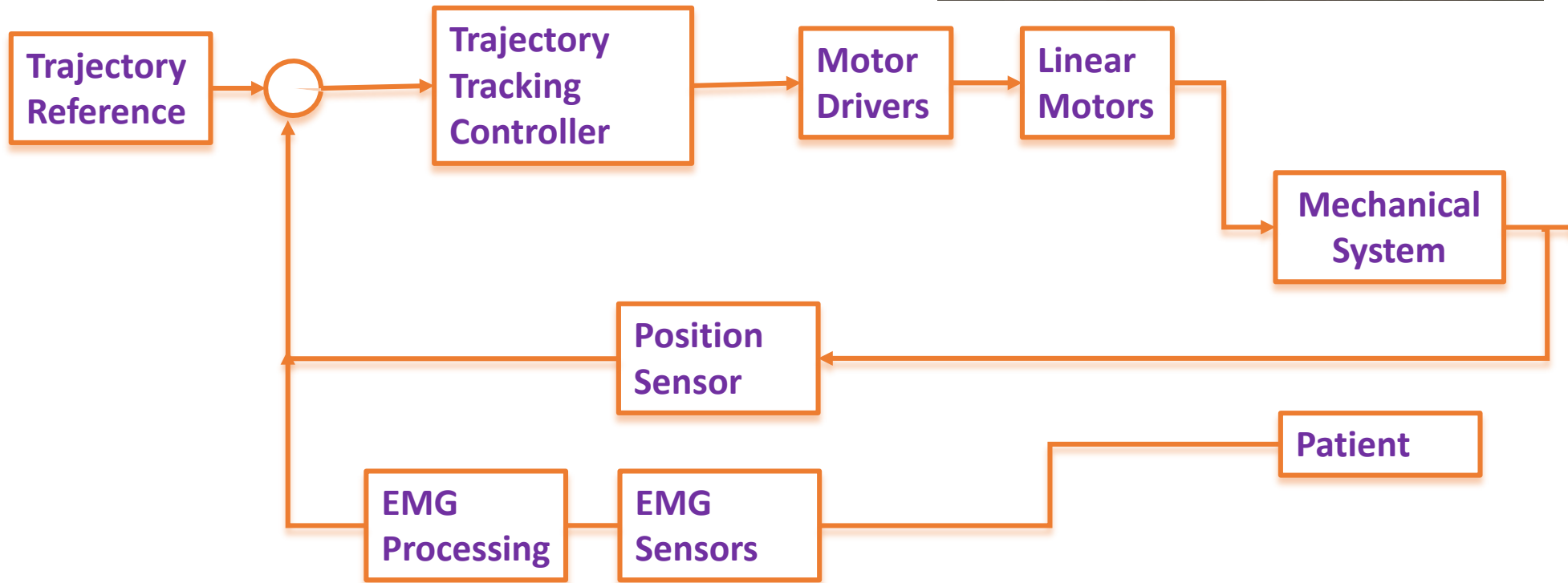
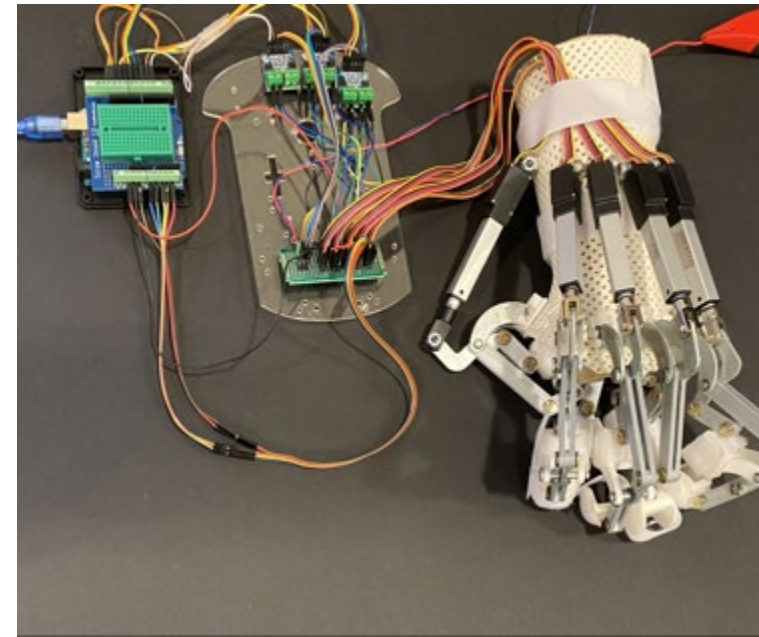
- The system has an interface for the rehabilitation which follows the user's movements, calculates success and generates a report. All units communicate with each other wirelessly.

Hand Exoskeleton

- The mechanical structure of the exoskeleton is extremely simple. The middle and the proximal phalanxes are used as a link of consecutively connected two 4-bar mechanisms, respectively.
- The PIP (proximal interphalangeal) and MCP (metacarpophalangeal) joints are actuated by a single electromechanical cylinder to produce complex flexion and extension movements. Hence, both joints are actuated simultaneously.



Control Structure



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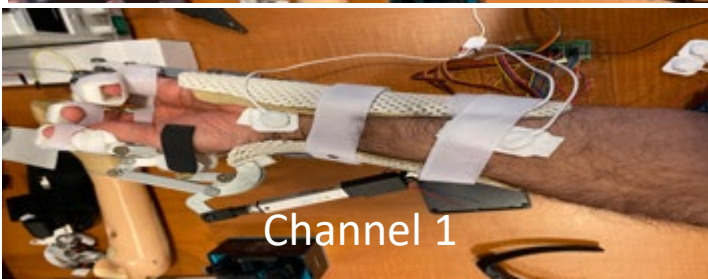


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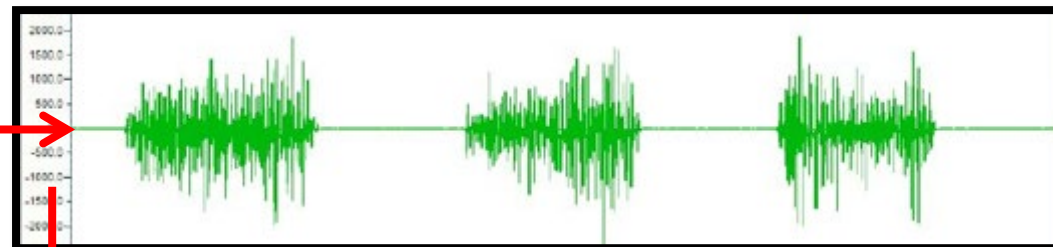
EMG

- Single EMG input consisting of two Bipolar Ag/AgCl Snap Electrodes
- Channel 1: Forearm Flexors (flexor carpi radialis, flexor digitorum superficialis)
- Channel 2: Forearm Extensors (extensor carpi radialis, extensor digitorum)
- Flexor contraction = Hand Closing, Extensor contraction = Hand opening
- Extent of contraction dictates hand velocity.

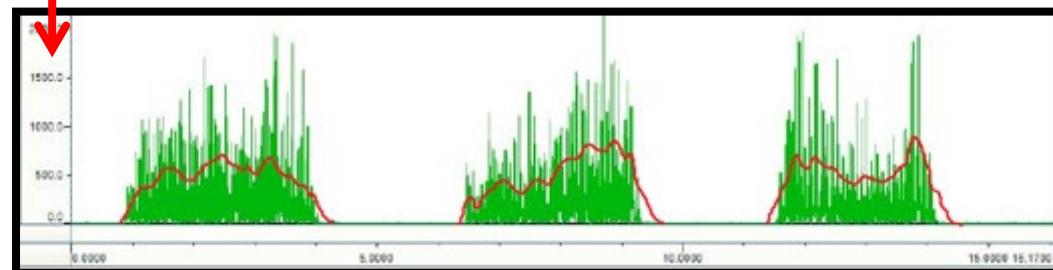
Interface and Preamp/filter



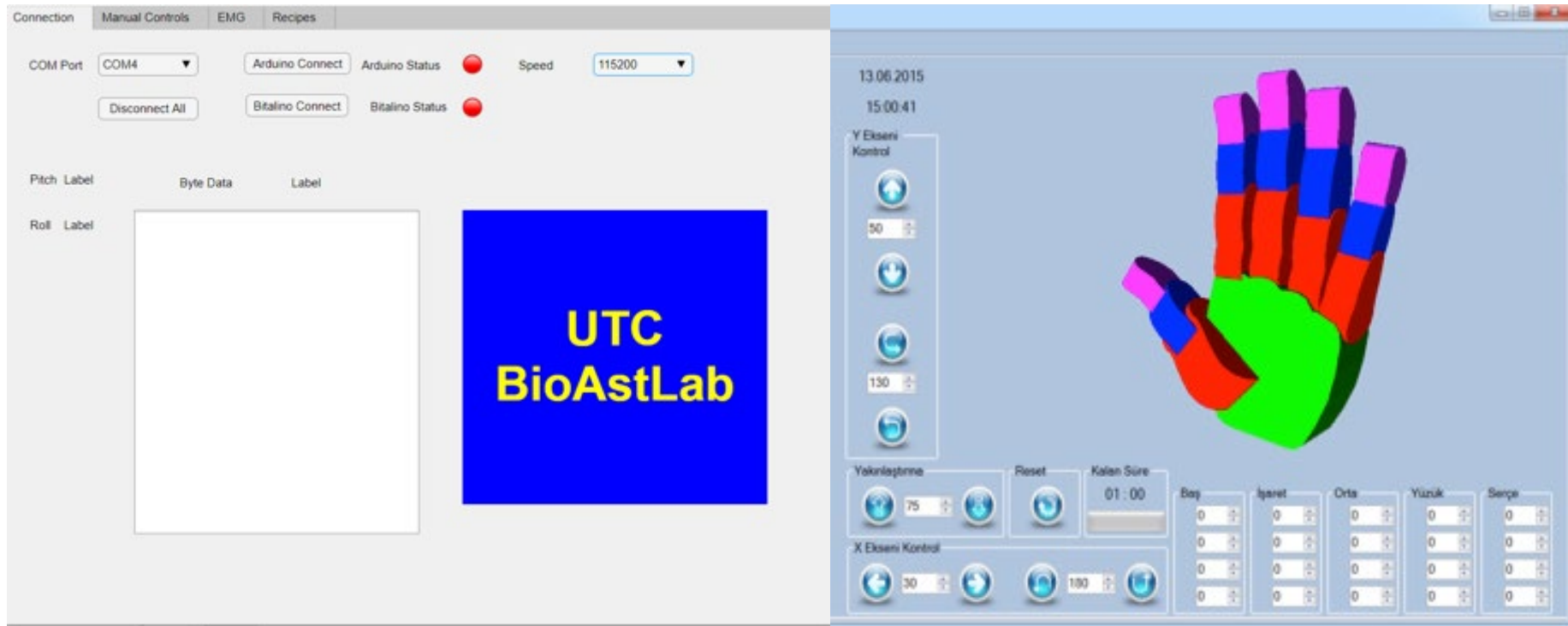
“Raw” EMG (Single Channel)



Rectified (Green) & Smoothed EMG (Red)



Rehabilitation Interface



- A GUI was created using MATLAB from which the system is controlled.
- System can be controlled manually or by using preprogrammed recipes

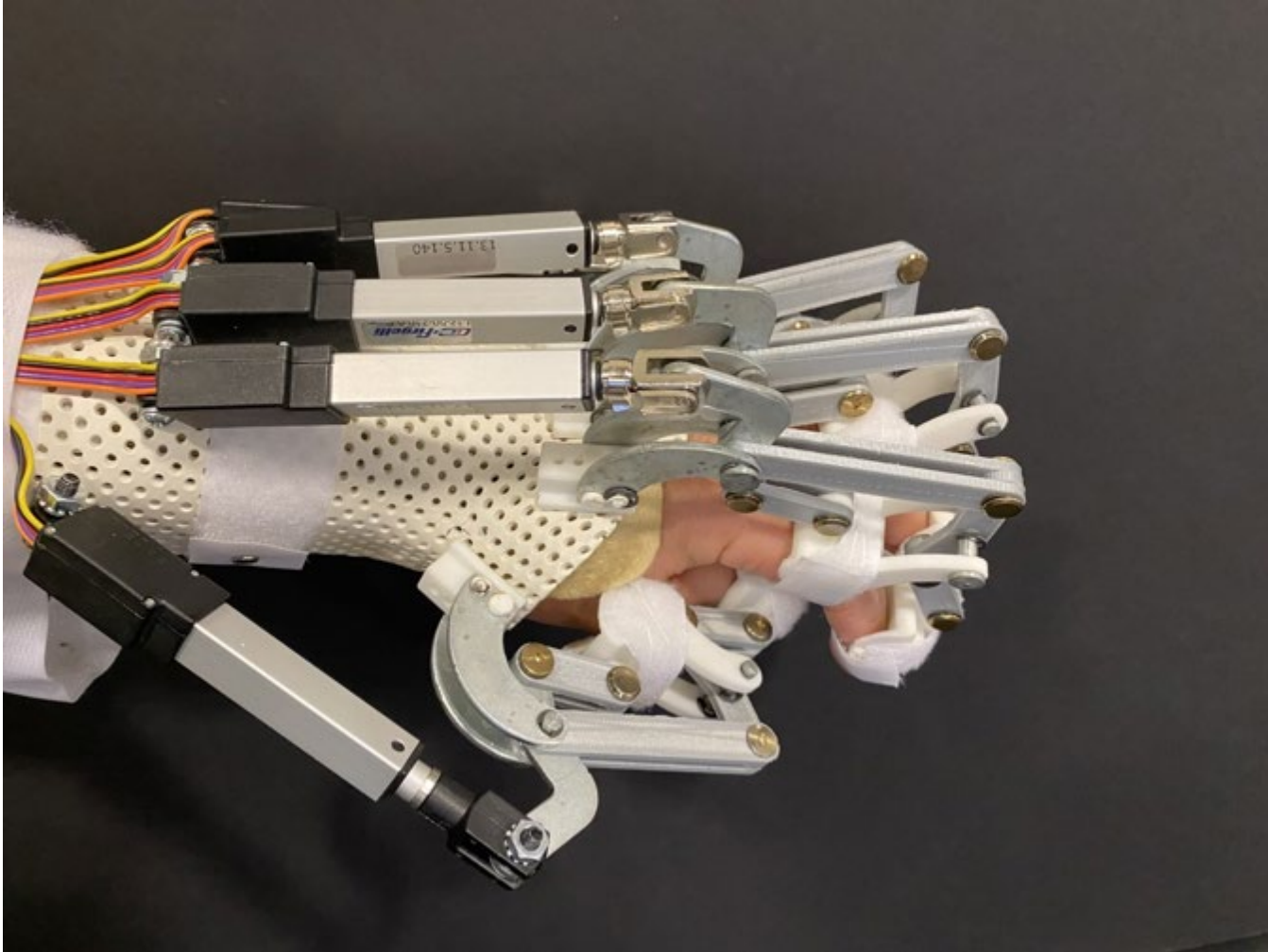
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