TheraArm: Orthosis Therapy for Arm Rehabilitation and Movement Assistance

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Over 25 million Americans are affected by stroke or peripheral neuropathy, a disease that degrades motor and sensory nerve control. Affected individuals often find it very difficult to perform simple activities of daily life, such as talking on the phone or getting dressed. Implementing an inexpensive, portable system that can provide arm movement assistance and support rehabilitation would be highly beneficial. This project investigates the feasibility of designing a low-cost, 3D-printed orthosis that augments patient movements and tracks rehabilitation progress. The TheraArm prototype system developed for the experimental evaluation consists of an exoskeleton and 3 actuators: a 48mm stroke linear actuator and two 360-degree rotational servo motors. The exoskeleton was modeled in SolidWorks and 3D-printed using ABS resin. A separate 3D-printed arm model simulates a wearer’s arm. Assistive arm operation relies on a control system driven by signals from EMG sensors placed on users' muscles. The controller translates electrical signals into specific actuator movements. It supports three degrees of freedom (DOF) corresponding to movements associated with elbow and shoulder extension/flexion and shoulder adduction/abduction. Experimental results confirm the feasibility of creating an assistive device that provides 3-DOF for the wearer’s arm. TheraArm's shoulder joint actuation increases arm range of motion compared to other existing exoskeleton models. Results demonstrate the system's ability to rapidly adjust actuation based on live input from EMG sensors. TheraArm's control system can detect user’s intended movements and provide appropriate assistance with excellent repeatability. Further optimizing shoulder actuator placement is considered for future study.

Awards Won:

Second Award of $1,500