The Recovery Glove System- A Sensor Driven Glove with interactive games for Fine Motor Skill Disabilities

Oscar Ledezma, Jonathan Rey, Brian Lee, Nicholas Alvarado, Deborah Won
California State University, Los Angeles.

Introduction: Currently, stroke is the fifth cause of death and disability among adults, affecting approximately 795,000 people every year in the United States [1], [2]. Hand mobility is commonly impaired in stroke victims. Treatment for hand impairment range from therapist-guided physical exercises to robotically controlled exoskeletons. Devices that act as a substitute, such as the exoskeletons and neuromuscular electrical stimulation, do not typically rehabilitate hand movements but merely assist movements when the device is donned. A more effective treatment which actually restores hand mobility is by encouraging patients to carry out hand movements themselves [3]. Therefore, our aim was to develop a low cost therapeutic device which better motivated patients to practice their hand exercises themselves without having to wait for their next physical therapy appointment.

Materials and Methods: An Arduino-based hand therapy device was developed to motivate stroke patients to practice movements which aid in rehabilitating range of motion and hand strength. A glove was embedded with a force sensing resistor (FSR) at each of the fingertips except for the thumb. The FSRs were connected to a voltage divider circuit which fed into an analog input of the ATMega 328P microcontroller. Individual finger presses are detected and the force magnitude of these finger presses are determined in the microcontroller code, and then fed to a computer game engine, developed in Scratch. Each finger is associated to a color; the user is required to press by doing a functional pinch grip of the appropriate finger with sufficient strength to play each game. There are 7 interactive games: Simon Says, Crazy Drums, The Color Game, Jetpack Joyride, Don’t Touch the Spikes and Grid Guardian. In the games the user does an action by pressing the correct sensor associated to the color of the character, object or action.

Results and Discussion: A small clinical study was conducted to determine whether our glove and games were useable and playable by people who suffer from hand weakness and limited range of motion, if the use of the game-based device improves motivation, grip strength and subject ability to carry out a standard block & box test. Coming into the study participants, 83.3% strongly agree and 16.7% agree that traditional hand rehabilitation exercise is unmotivational and boring, 83.3% of participants never played and had no interest in video games, and were unlikely to complete their therapist recommended exercises. Towards the end of the study 83.3% found hand rehabilitation with games to be more motivating than traditional therapy, At the end of the study and 66.6% of subjects that weren’t interested in video games at the start of the study changed their opinion. Furthermore, they were willing to buy a device similar to the Recovery Glove if it was under $100.

Conclusions: In this study, we were able to test our recovery glove, a description of the games and game interface structure that we developed as well as the lessons learned about how to ensure that our games can be understood and used by patients who suffer from hand impairments. Even though, participant’s changes in grip strength and box & block test scores vary, the Recovery Glove was shown to be a motivating device that assisted with repetitive functional hand motion.

References: