Tactile Instructions for Wearable Physical Rehabilitation

Justin Blevins (blevi2ja@dukes.jmu.edu) Megan Caulfield (caulfimk@dukes.jmu.edu)
Dr. Jason Forsyth (forsy2jb@jmu.edu)
Department of Engineering
James Madison University

Abstract

Research has found as low as 35% of patients actively do at home exercises for physical therapy. When patient adherence is low, recovery is less effective, complications increase, the duration of their treatment extends, and the probability of long term chronic conditions increases.

The proposed research seeks to explore wearable computing systems to enable physical therapy patients to receive feedback on their movements while at home and apply corrections as though a therapist was working hands-on with them.

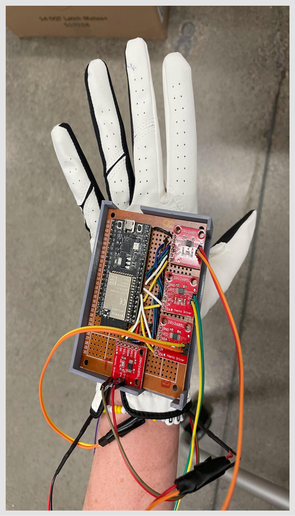
Background

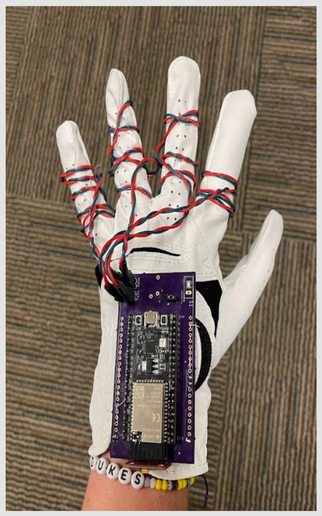
Physical therapists encounter obstacles of patient's not participating in their full recovery plan by failing to do at home exercises. Self-efficacy is a leading reason patients say they do not do at home exercises, simply a belief in their ability to effectively carry out an exercise on their own.

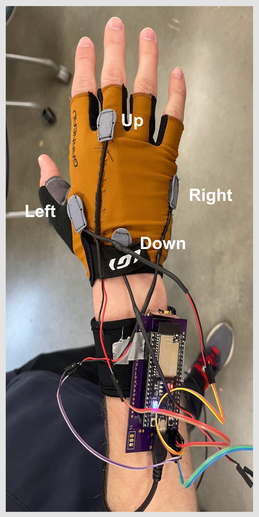
Our research explores the use haptic feedback to encourage patients to participate in their exercises and how to communicate motions to the user. The work is being expanded as research is in progress examining tactile motor instructors on upper arm mobility.

Design Evolution

The glove design has evolved based upon internal trials. The motors have been moved externally to create more space in the glove, and the large circuit board has been reduced to a custom printed circuit board. To aid wearability, the board was removed from the hand to the wrist to address weight challenges. Various tractor placements have been trialed.

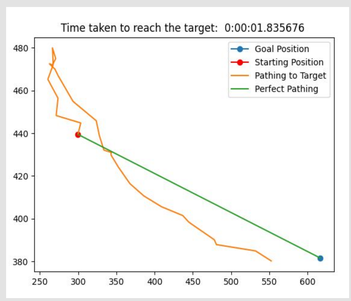


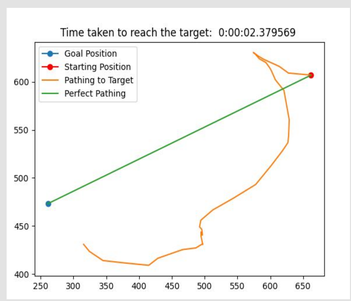


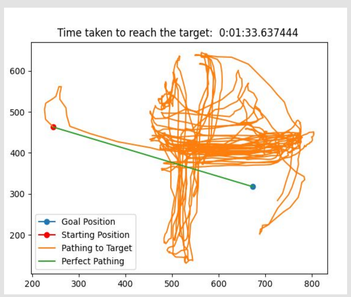


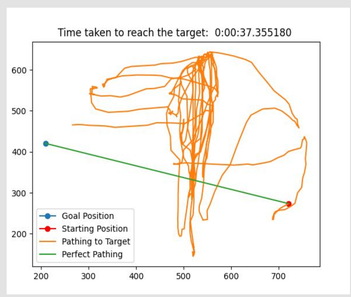
Experimental Method and Data Analysis

A user study was conducted with ten healthy individuals where ten random targets were generated and the haptic glove guided the individual towards a target. Each of the users was allowed two trials with a short break in between. Data was collected to evaluate the pathing and the time taken to reach each of the targets.

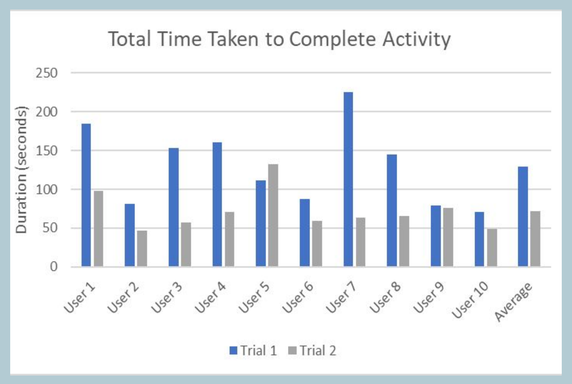


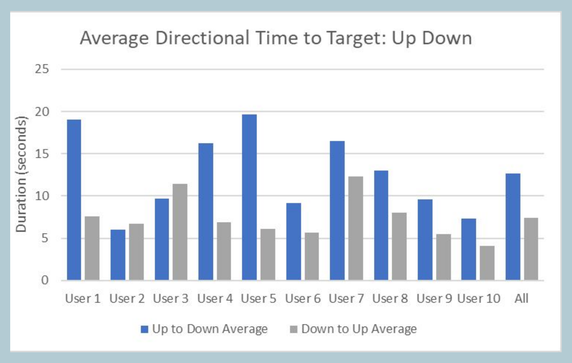


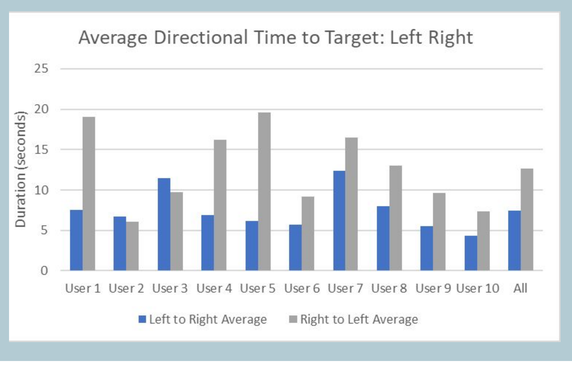




User Study Results







Conclusions

Users generally improved time to target on the second trial. Right and Up tactors were easier to perceive and follow compared to Left and Down. Overall, the study was successful by showing that haptic feedback can effectively convey motion information to the user. We hope to expand this feedback to more complex activities and full arm motion.

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