Wearable rehabilitation glove powered by twisted and coiled artificial muscles (TCAMs)

Thilina H. Weerakkody¹, Carlo Greco², Venanzio Cichella¹, Leonardo Pagnotta², Caterina Lamuta¹

¹ Department of Mechanical Engineering, University of Iowa, Iowa City, 52242, IA, USA.
² Department of Mechanical, Energy and Management Engineering, DIMEG, University of Calabria, Arcavacata di Rende, Italy

Email: thilina-Weerakkody@uiowa.edu
Introduction

- Strokes (cerebrovascular accident)
- Trauma
- Occupational injuries
- Spinal-cord injuries
- Sports injuries

**Causes for**

**Upper-limb impairments**

**Rehabilitation over a period**
- Activities of daily living
- Domestic life
- Social life
- Economy of the country

**Impact on**

**Existing issues**
- Patients need of travel for a longer distances
- Medical expenses.
- Daily exercises have high impact on speedy recovery

**Recover by**

**Daily exercises have high impact on speedy recovery**
Research Problem

A CF/PDMS muscle with a radius of 400 μm lifting a half gallon of water more than 1 inch with an applied voltage of 0.172 V cm−1.
Muscles mainly involved in the wrist rotations (Adapted from Kenhub)
Design and Development

Design of the glove

Design of the hand for testing

Prototype of the hand used for testing
Tests and Results

Motion

Prototype Validation result
Simulations of rehabilitation exercise
a) rehabilitation exercise performed with the glove; b) a rehabilitation exercise without the glove to emulate the weak hand; c) a rehabilitation exercise of a weak hand together with the glove; d) velocity for the flexion and extension; e) velocity for the ulnar and radial deviation; f) ulnar-radial deviation cycle performed at high frequency.
a) worn glove, with EMG placed below the sleeve

b) Measuring panel for the voltage recorded by the EMGs
Tests and Results

a) Rehabilitation exercise performed when the input is from the EMGs

b) maximum temperature along the tube during the test
Tests and Results

a) Resting position of the hand

b) The exercise results in a rotation of the hand
We proposed a lightweight wearable rehabilitation glove powered by TCAMs for wrist rehabilitation.

This device has 2 degrees of motion that are Flexion/Extension and Ulnar/ Radial deviation.

This device operated by the Electromyographic (EMG) signals of the patient.

The TCAMs are arranged based on the human muscle arrangement of the forearm.

The total weight of the rehabilitation glove is 135g.
Thank you!