
Karina Bjorklund | Wai Kien Goh | Christian Grantz | John Muenz | Bryce Clevenger

FLEX - O - MATIC

BY

FLEX AUTOMATION

PURDUE MECHANICAL ENGINEERING

Problem

The elbow is one of the most commonly used – and commonly injured – joints in the human body

For individuals with elbow/arm conditions, the current elbow device market does not adequately:

- Improve injury recovery time
- Recover mobility and improve quality of life



Target Market

- Hemiparesis-affected stroke survivors
  - Weakness or immobility of one side of the body
- Elbow surgery recovery patients
- Advanced arthritis patients
- Physical therapists
  - Recommend the device to these patient types
  - Calibrate and adjust settings to fit their patients

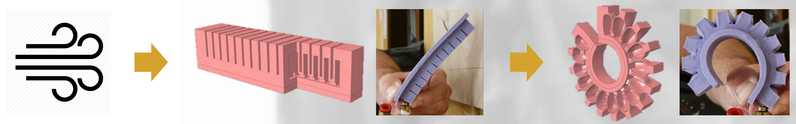
Prototype Cost: $169.73 → Manufacturing Estimate: $156.52 → Assume MSRP $250: $93.48 Profit/Unit 60% Profit Margin → Capture 1% of Stroke Hemiparesis Market: $21.7 Million Profit

Soft Pneumatics

Pneumatic (McKibben) Linear Actuators


Relaxed | Pressurized

Bending Actuators



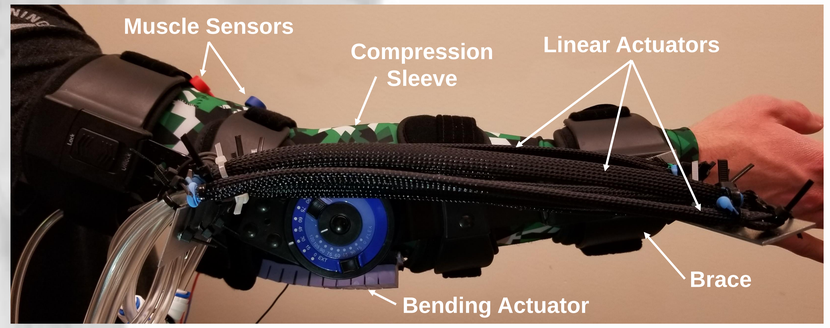
Pressurized Air | Air Cavities in Actuator | Actuator Bends

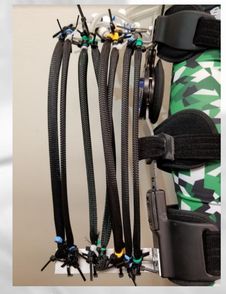
Solution

A assistive motion device that integrates soft pneumatics and muscle-activated controls in a comfortable, wearable prototype

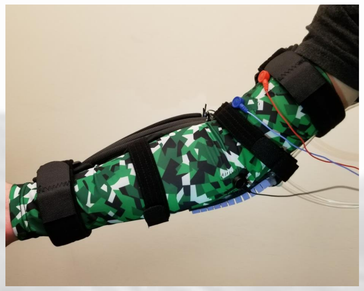
- 120° Range of Motion
- 6lbs assisted force with the arm

See it in Action!

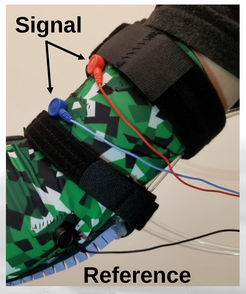




Linear Actuators

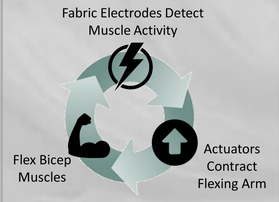


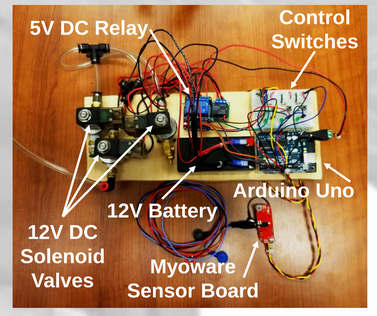
Inside View of the Device

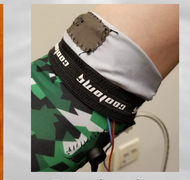


Electrode Locations

Controls

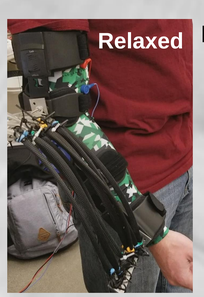




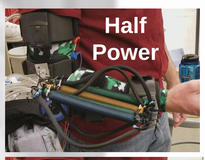


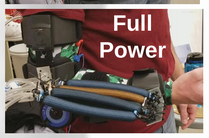
Conductive Fabric Electrodes

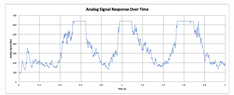
Myoware Sensor Board



Incremental Power Modes





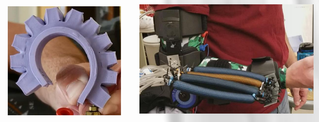


Controllable Signal

Technological Innovations

Fabric Muscle Electrodes

- Reusable, washable, and easy to use, with strong electrical sensitivity
- Fully integrated into the compression sleeve



Soft Pneumatic Actuators

- Lightweight, flexible, comfortable

Future Applications

Reusable Fabric Muscle Sensor Electrodes

- Compression shirt applications for prosthetics
- Sleeve proof of concept extends to other joints

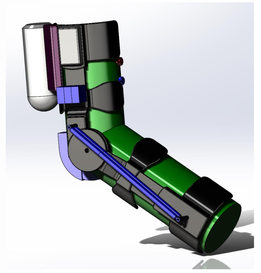
Soft Material Pneumatic Actuators

- "Foot Drop" → Reduce bulk and improve functionality of current designs.
- Other joint injuries (knees, wrists, etc.)
- Other potential muscle groups → Comfortable motion assistance and reduced flexural stress.

Production Model

Changes moving forward:

- Reduce tank size to bring onboard
- Increase tank pressure
- Increase latex tubing durability
- Increase operating pressure
- Reduce number of linear actuators



Testimonials

"The robotics wearable as designed has the potential to influence how future patients perform exercise and activities of daily living (ADLs) following an musculoskeletal and neurologic injury."

Scott Lawrence
Purdue Athletic Training Program
Director

"It is always difficult helping the patient cope with debilitating injuries…
…This technology can help the patients strive for and hopefully achieve independence."

Casey Kohr
Purdue Sports Medicine
Associate Director
Baseball, Soccer, Softball, Tennis