

G.A.I.T.S.



Gear-Assisted Interventional Technology for Standing

By Karena Peterson, Liam Bratane, Donya Darawcheh, Jack Thompson

Problem Statement

Client VR experiences the **occasional** and **temporary paralysis** of their limbs, oftentimes **inhibiting** them from actions such as **standing** or **walking**. These episodes are **exemplified** when the client is **tired** or has **recently exercised**, **furthering** the **limitations** put on the client. Partially-aiding designs such as a **walking cane** or **weak motors** are **not sufficient** for the client as these **rely** on **additional effort** from leg muscles. **Fully-powered** designs would **continue to provide power** even when the client is walking, which would **lead to atrophy**.

Requirements

- Must have emergency stop mechanism
- EMG straps should not constrict circulation
- The device must avoid encapsulation of knee
- The device must weigh less than 10 pounds.
- Device provides appropriate power for 100-150 pounds
- Device is capable of being worn with both loose-fitting and tight-fitting pants.

Methodology

EMG Data & Use:

- EMG was collected by client and analyzed by students.
- Rectus Femoralis during standing/sitting was compared during & not during episode.
- A threshold was found triggering of motor.
- EMG electrodes were built into a strap.

Wiring/Electrical:

- Stepper motors chosen for high torque
 - Connected to drivers then a board
- When the EMG detects a dip motors are triggered
- Programmed in CircuitPython

Mechanical Design & Production:

- Gear system with an 9.1:1 gear ratio, with two motors per side
- All parts designed in CAD (Onshape)
- 3D-printer: Used for most parts, for custom gears and mounts
- CNC: Used for structural plates, supporting weight with metal plates
- Ordered parts: precision bearings, screws, motors.

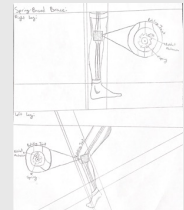
Conclusions

- Applicable for people with conditions partially inhibiting their standing
- Offers a solution that requires very little arm strength
- Automatic alternative

Design 1

Pros: Simple, cost-effective
Cons: Noisy, accumulative replacement costs

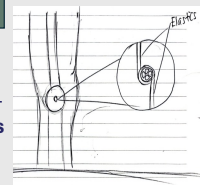
Design was **not chosen** because it **only helps with holding positions, not preforming them.**



Design 2

Pros: Simple, cost-effective, continuous
Cons: High replacement costs

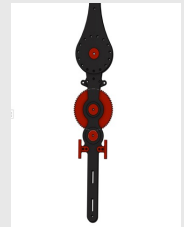
Design was **not chosen** because it **only helps with continuous movement, not the initial movement** or holding positions.



Design 3

Pros: Sufficient force, automated
Cons: Expensive, difficult, constant power

Design was **not chosen** because it is **too inefficient** and **requires difficult machining.**



Design 4 (Final)

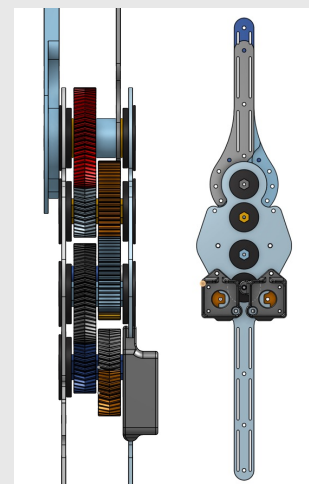
- Modified version of design 3

Changes:

- Gear-only system
- Modified motor positions
- Eliminated worm gear aspect

Pros: More mechanically feasible, more 3D-printable
Cons: More reliant on 3D-print strength, less potential for torque

Design was chosen as an improved version of design 3



Future Work

- Thin the design
 - More modular, can be worn under clothes
- Power by battery
- Control through EMG input
 - Button can be difficult for somebody with less control of their hands