Passive Leg Exerciser

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Passive Leg Exerciser

- Senior Design project, spanning three months
- Worked in a team with two others, Libby Albanese and David Fricke
- Worked closely with our client over this time, and interviewed experts in engineering and physical therapy
- Fabricated a functioning prototype
- Honed research, design and prototyping skills, as well as interview, organizational, and leadership skills on my team

Background

- Our client experienced a spinal cord injury at the T2 level nearly 20 years ago
- Research shows exercising paralyzed limbs is important to maintain blood flow, muscles, ligament elasticity, and prevent spasticity or pressure sores
- People with paraplegia typically rely on physical therapists and motorized cycling equipment to exercise their lower limbs
- Access to these resources can be costly and restrictive, and impossible in the Covid-19 pandemic

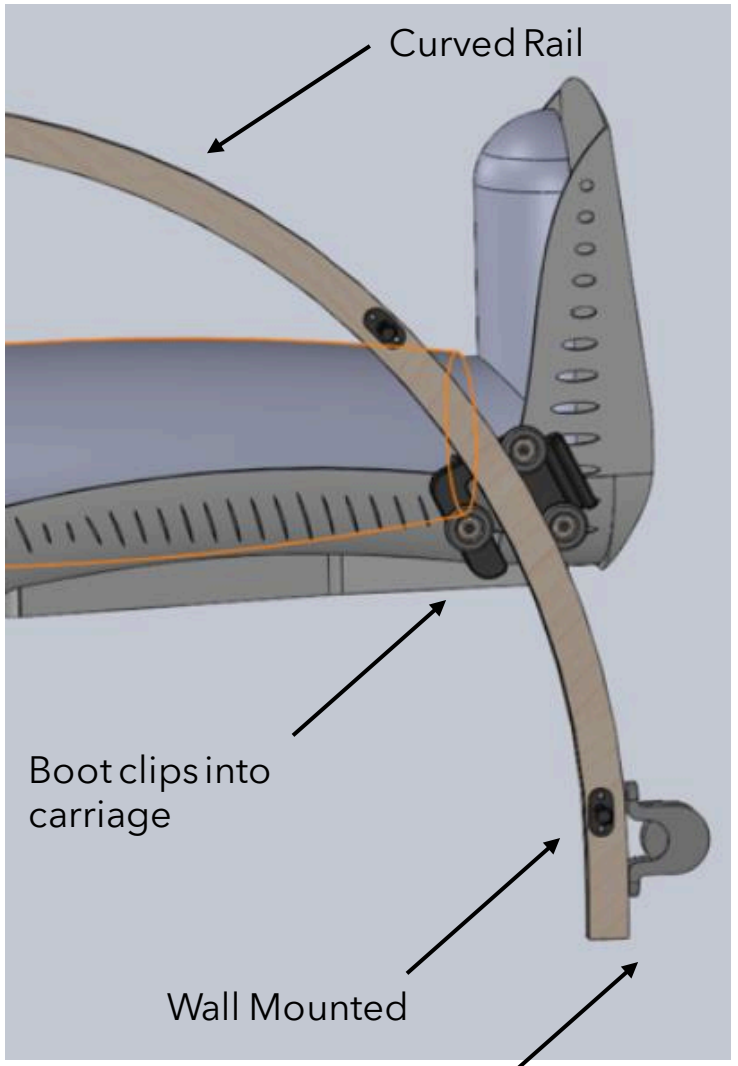
Problem Goal

To create a device that allow user with paraplegia to passively exercise her legs with active force from her arms. This device must be safe, easy to use, and create full flexion and extension of the hip and knee joints.

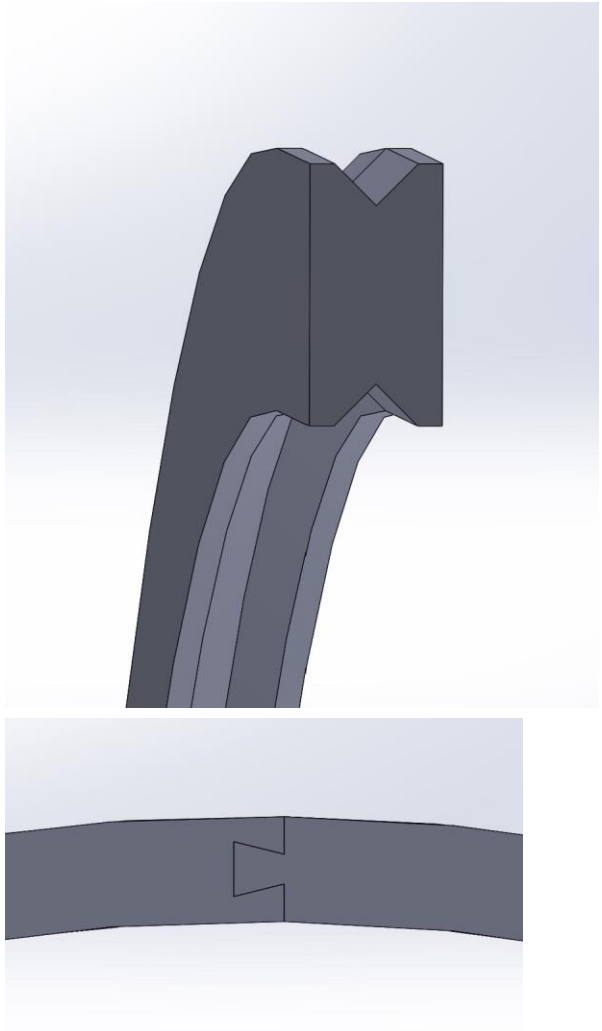
Needs	Requirements
Correct Motion	Structural, Mechanical advantage
Safety	Hardness, support, weight capacity
Ease of setup/use	Complexity, weight, size
Aesthetic	Size (stored and while in use), permanent features

The Final Design

- Semicircular wall-mounted rail
- Pulley driven system
- Foot, ankle, and calf supported, connected at the ankle joint



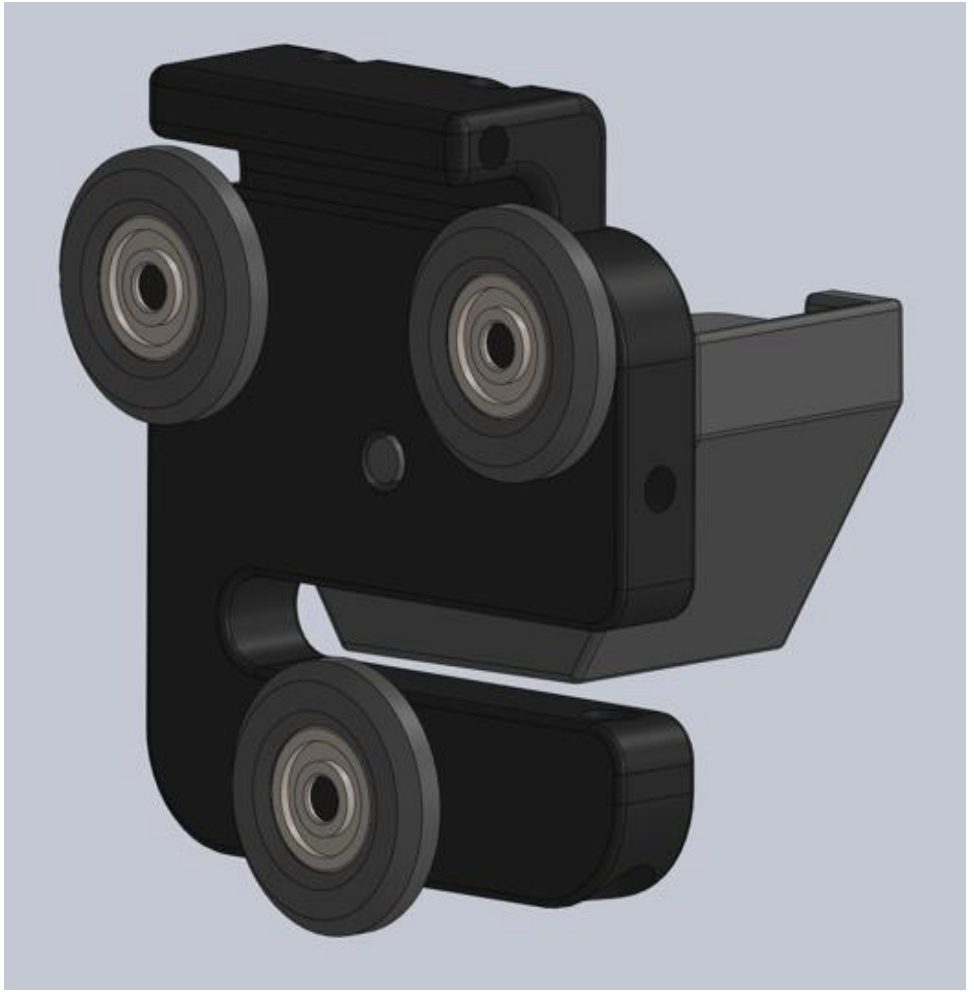
Rail



- Routed inner and outer surfaces provide tracks for the carriage to move along
- Radius of the arc equal to the length of our client's femur
- Laser cut pieces joined by staggered dovetail joints

Carriage

- Roller placement allows carriage to travel along curved rail
- Screw through arm tightens third roller onto the rail
- Seat belt buckle mounted on the opposite side
- Rope passes through attachment over top rollers to travel in the groove of the rail

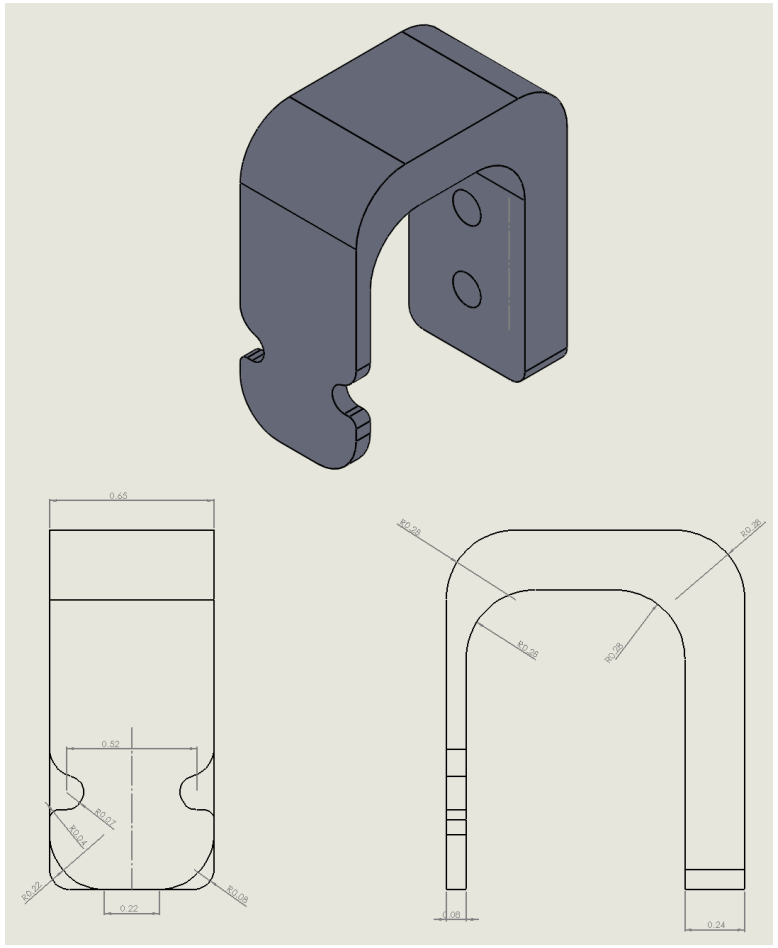


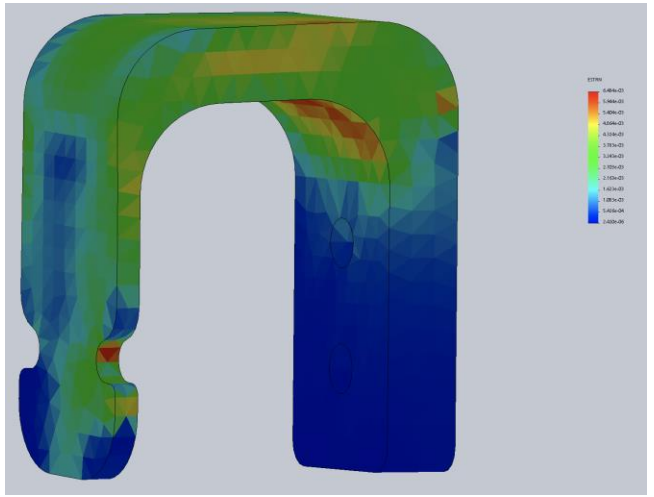
Pulley System

- Third pully offset from rail for user to control the movement
- Rope moves in the groove that the roller travels in to create the exact motion needed

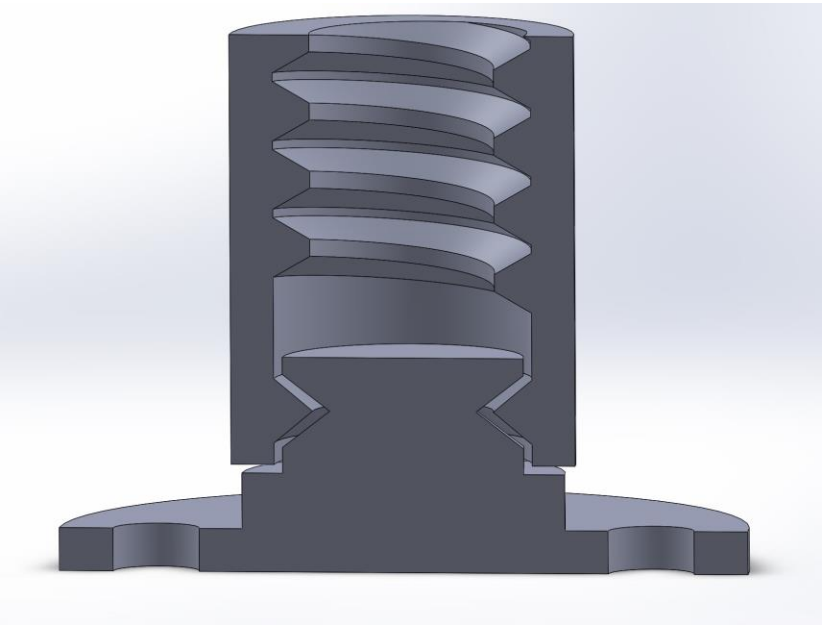
Boot Mounting and Clip

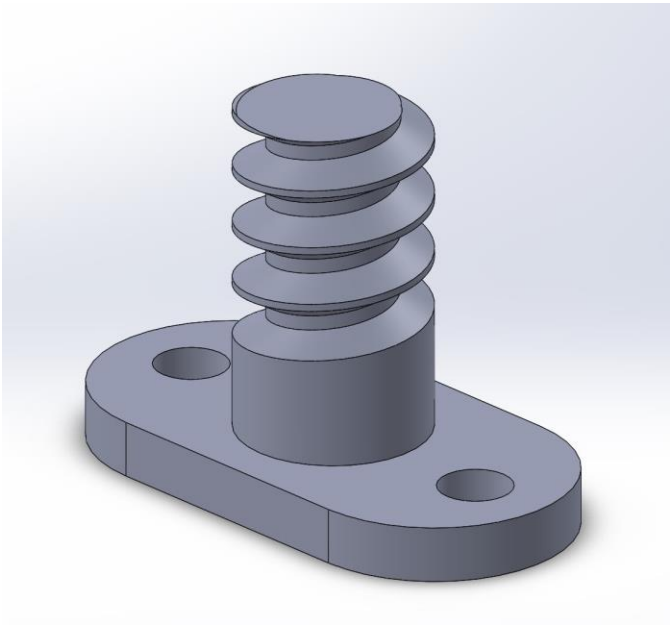
- Boot made from a modified air cast
- Designed a clip to mate with a buckle for easy insertion and release
- Performed FEA to determine possible failure points





Wall Mounts





- To meet strength requirements, given material constraints, chose to mount the rail to a wall at five points
- Designed a three part mount, where the two parts of the wall side are printed together but able to rotate freely
- Two sides are screwed together to tighten/release
- Permanently mounted features are small and unobtrusive

Future Work

- Prototype in aluminum and more extensive testing
- Alter our design to be symmetrically usable, as it is currently only operational for one leg
- Implement more safety features, such as a quick release mechanical stop
- Improve user interface

Thank you