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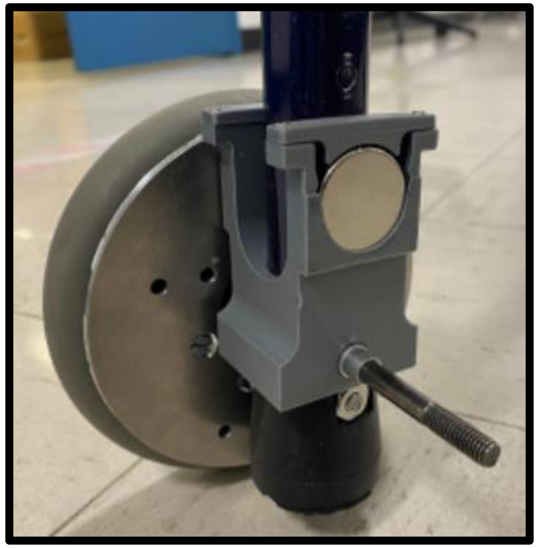
Columbia University SEAS ‘22

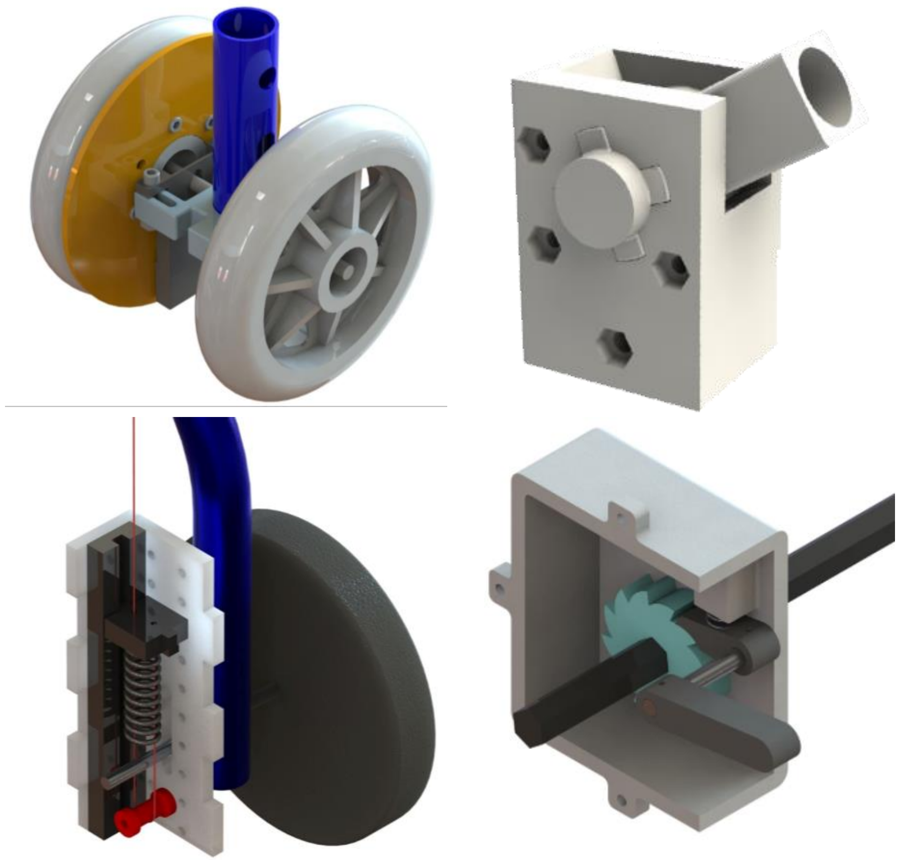
RollControl

Senior Design Project

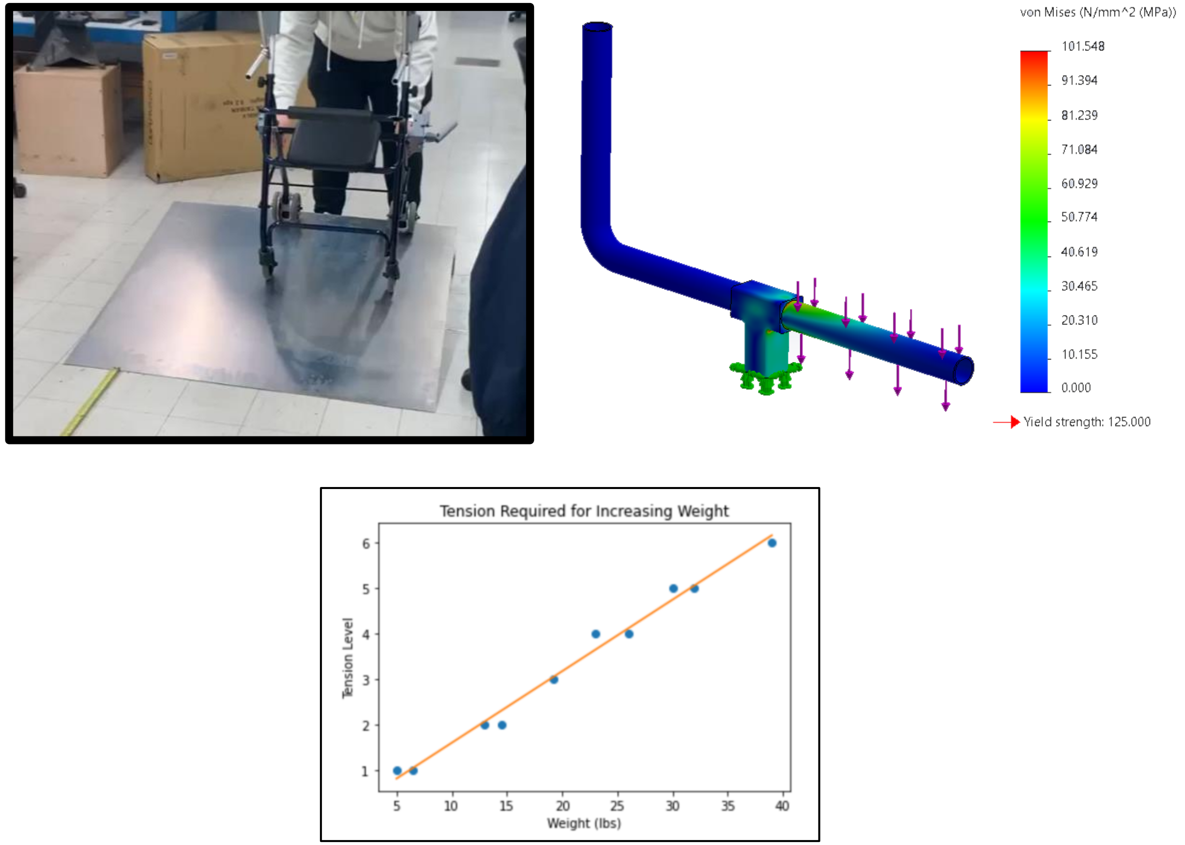
For my senior design project, me and my team created an assistive walking device geared towards independence and adaptability. We used a push-down rollator as a base for our design, which uses springs that actuate as you naturally apply force downwards on the rollator, rather than a pneumatic brake that has levers which can be difficult to squeeze for some people. However, we still found some issues with the stock push-down rollator that limited its target audience. We included additional functionality in the form of a spring tensioning system that changes the length of the spring to take advantage of Hooke's Law, adjustable locking handles, and resistive wheels based on the concept of eddy currents.



Development Process



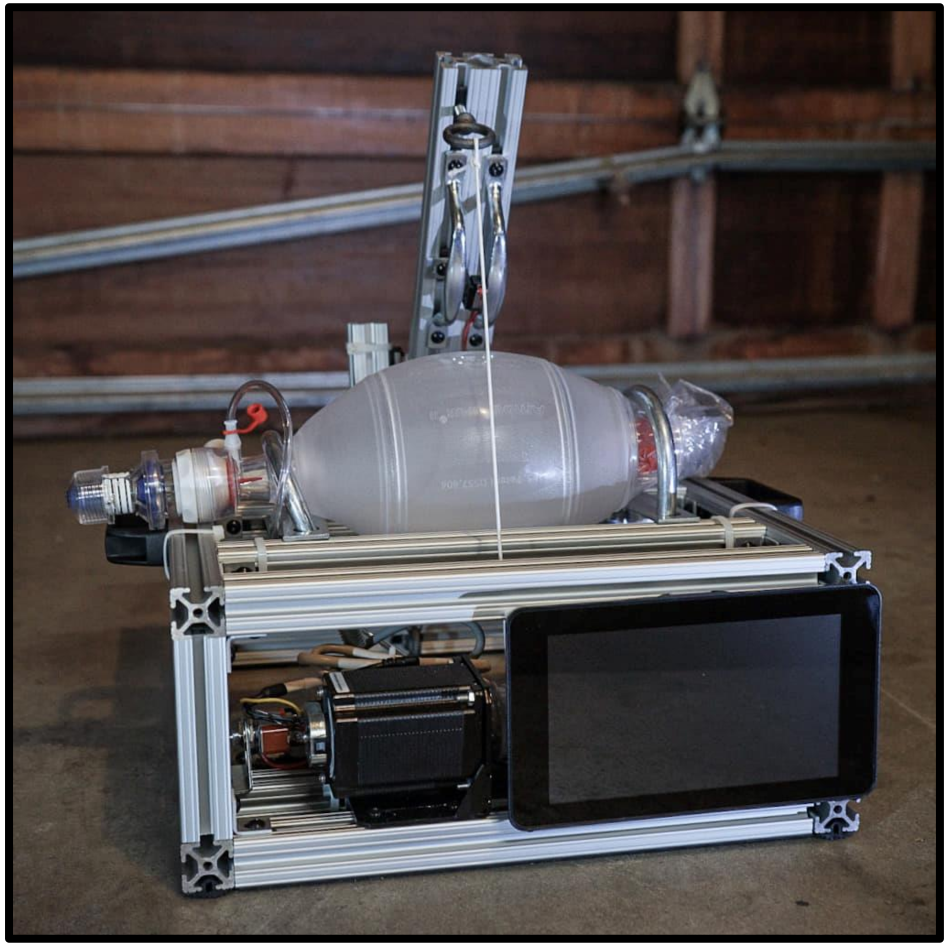
Early models of parts (Starting from top left clockwise): Eddy current wheels, handle locking mechanism, spring tensioning ratchet, and spring tensioning rail



Parts of testing procedures for all three mechanisms: Distance travelled by resistive wheels vs. stock wheels, FEA of handle in different positions with different materials, and added/reduced spring tension from system

VentCU

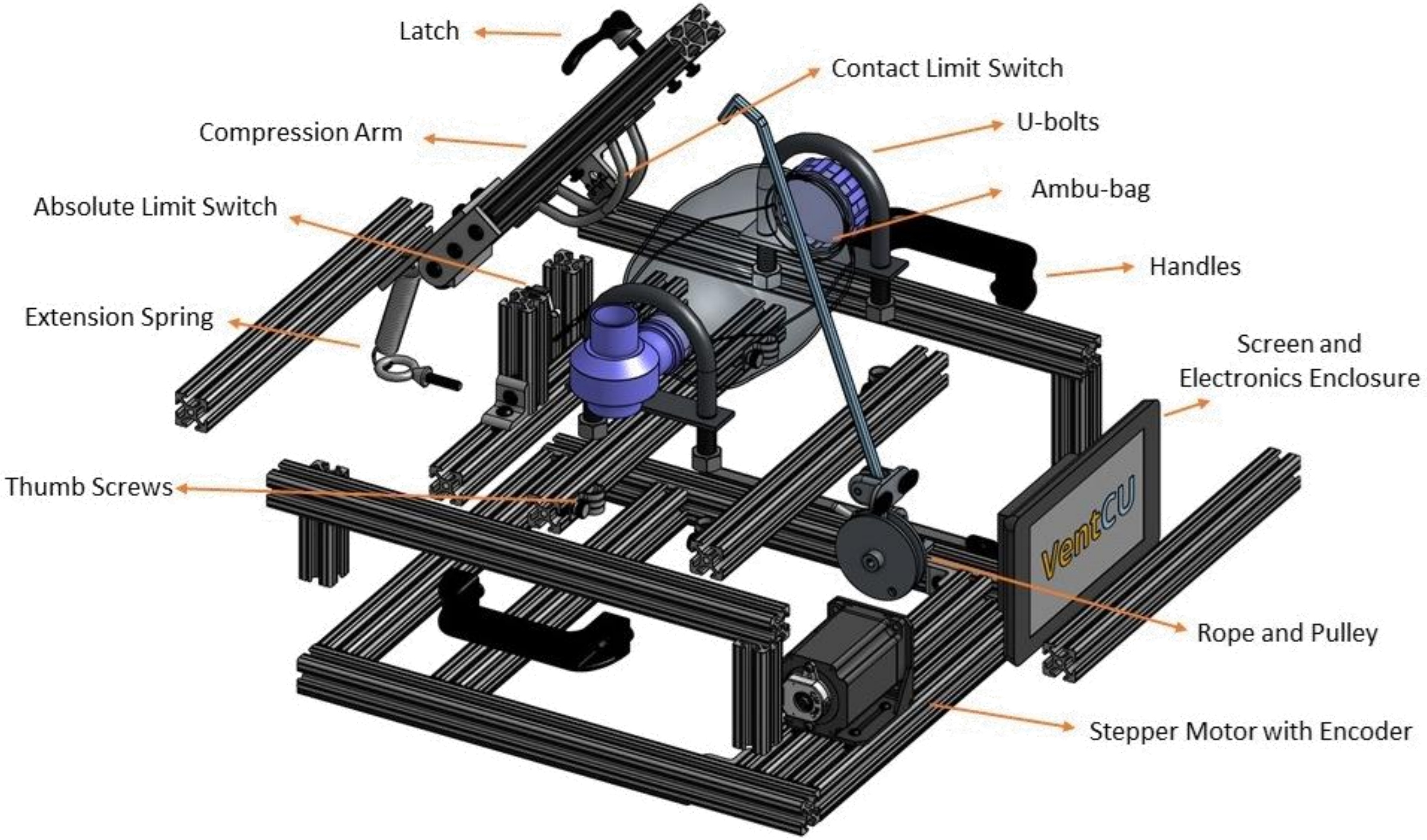
Columbia DIY Challenge

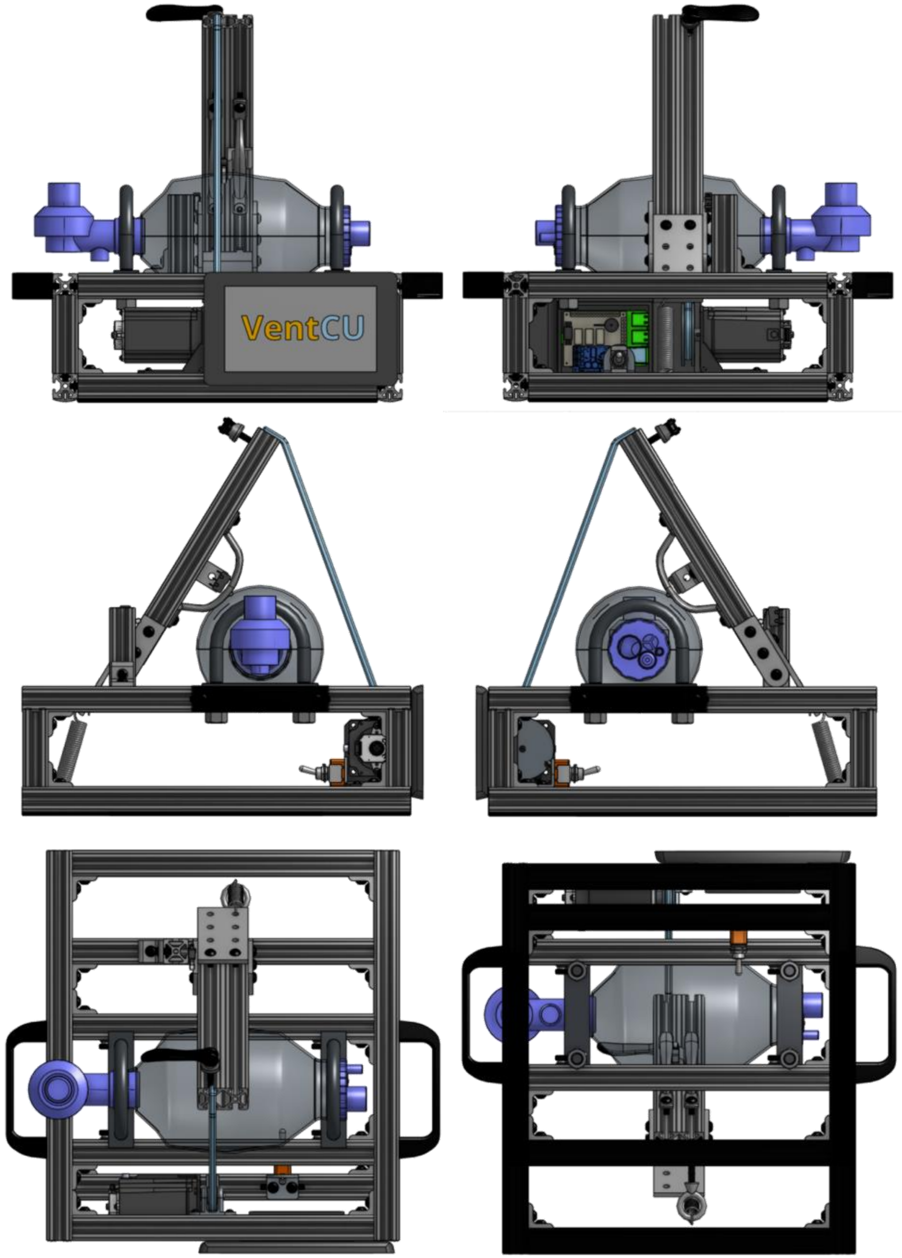


This collaborative project strove to create a ventilator substitute during the global COVID-19 pandemic, when hospitals in New York City were reporting dire shortages. I worked with fellow engineering students from Columbia and UCLA to create an Ambu-bag based ventilator that was easily accessible, easily reproducible, and easily affordable.

The entire ventilator is made of consumer-off-the-shelf parts, meaning that no machining, laser cutting, or 3D printing is required to assemble this device. Having contacted medical professionals and experienced engineers for feedback and support, thorough engineering R&D was conducted to make this goal a reality in only a few months. The entire project is open-sourced and well documented with a Git repository and user manual.

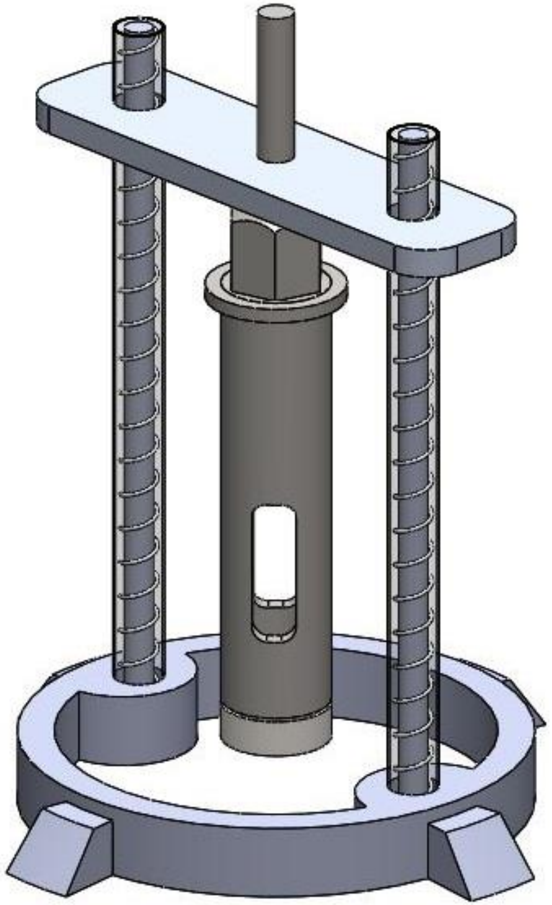
CAD Views


Latch
Contact Limit Switch
Compression Arm
U-bolts
Ambu-bag
Absolute Limit Switch
Handles
Extension Spring
Screen and
Electronics Enclosure
Thumb Screws
VentCU
Rope and Pulley
Stepper Motor with Encoder


VentCU

Lunar Coring Bit

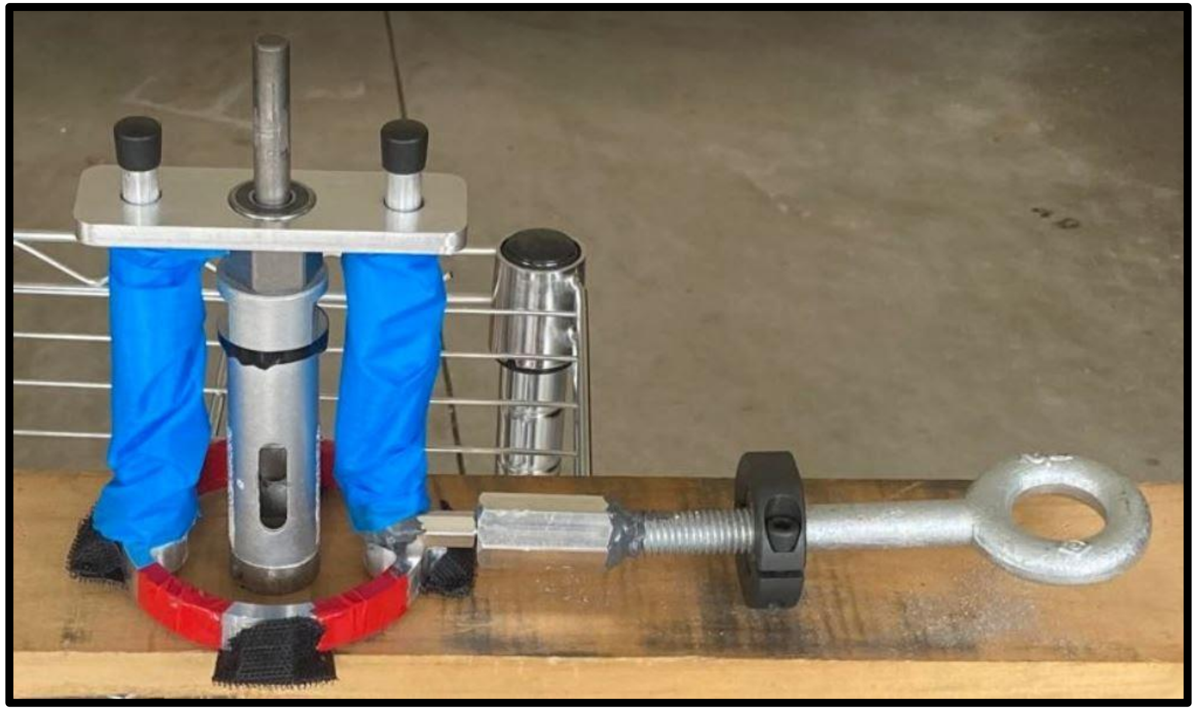
Micro-g NExT



This project is a part of NASA's annual Micro-g NExT competition, which prompts students to create a device that addresses a current space exploration challenge. Conventional coring bits are not made for use in a micro-gravity environment, meaning that special tools must be designed in order to extract a geological sample from a surface on the Moon or Mars. This device aims to solve that issue using a specialized coring bit which is attached to a stabilizing jig, allowing for minimal vibration and maximum cutting power.

The intended coring material is a concrete-like substance, such as the igneous composition found in Martian rock. The base of the stabilization jig is mainly made for flat surfaces, and the shank of the bit fits into any standard power drill.

Final Design and Testing



A modified version of the device, after having taken into account feedback from a NASA review board about safety precautions and extra features

The device being tested underwater at the NASA Johnson Space Center; It successfully drilled through sandstone, creating a core sample that could then be easily removed