EML4501 - Group 10
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B.O.S.S
Bodyweight Off-Set System

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Product Overview

The Bodyweight Off-Set System (B.O.S.S) design allows patients with neuromuscular disorders of the lower extremities to rebuild limb strength and mobility in conjunction with an elliptical. The design applies weight offset by mechanical actuation via springs and a linear actuator, which provides accurate control over the offset at a low cost. The patient is lifted by a movement mechanism consisting of a hydraulic jack and strapped into a harness. The frame combines all the subassemblies along with emergency failure features.

Frame Key Features

The frame utilizes a system of both welded and bolted components, resulting in a stiff frame that is also easy to transport/deploy on site. The side pieces of the frame (8.75' x 4.75') are welded with a diagonal brace, which allows the frame to resist the primary bending moment generated by the weight offset. The center pieces are bolted to the side pieces via 90 degree & triangular brackets. The frame is also very cost efficient, since it consists entirely of commonly available 1020 Alloy Steel stock and some fasteners.

Figure 2. Frame Assembly

Movement Mechanism Key Features

The movement mechanism uses a steel hydraulic jack to lift the patient on a wheelchair. A steel forked platform is mounted to the top of the jack. The patient is wheeled onto the platform and lifted to a level above the elliptical. With the jack on wheels, the patient is slid to the desired location under the harness.

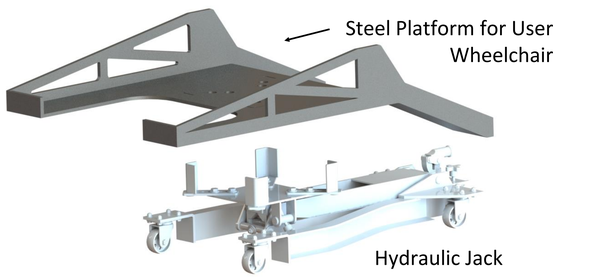

Figure 3. Movement Mechanism

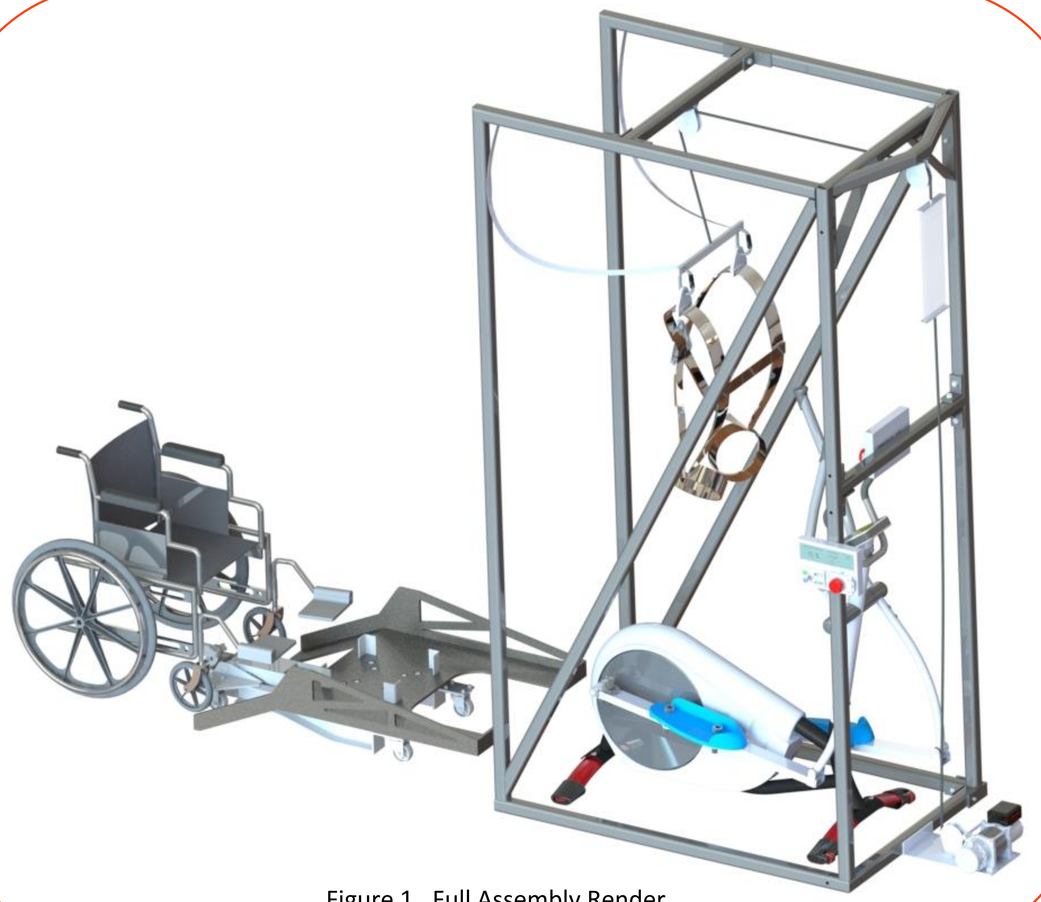

Figure 1. Full Assembly Render

Weight-Offset Key Features

The weight offset system imparts the offsetting force on the user harness via a series of springs and an electric winch. The trainer can accommodate for various patient sizes, removing or adding slack in the suspending rope using the electric winch's control system. Once the user is in position, the winch begins extending the linear springs until the proper weight offset has been reached. With a given winch displacement and known spring constants, the applied force offset is determined via Hooke's Law. As the user translates vertically, the springs change in length to accommodate this movement. The force itself only changes slightly due to the low spring constant of the springs. The use of VeroAcoustic's Torsional Dampening Pulleys allows for the system to be actively damped and reduce harmonic resonance.

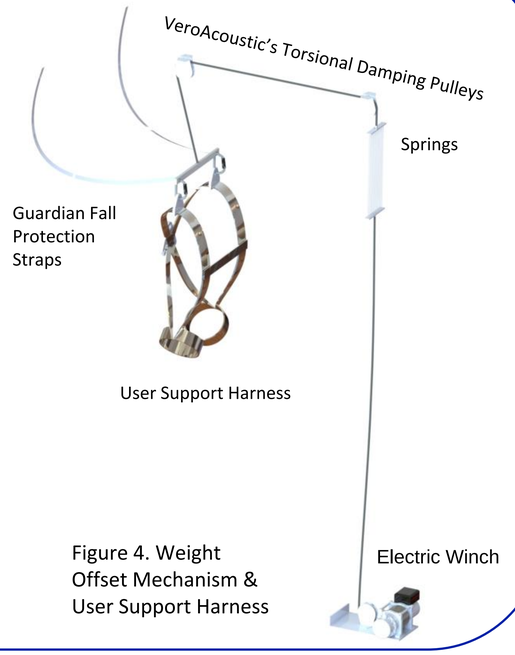

Figure 4. Weight Offset Mechanism & User Support Harness

Cost Analysis

- OTS: $1,644.08
- Raw Material: $943.29
- Manufacturing Operation/Labor Cost: $285
- Energy Consumption: $16.50
- Assembly Labor: $310
- **Total Cost: $3,198.87**

User Panel Key Features

The user panel consists of an easy-to-use interface and display with an indicator for an emergency stop. The panel controls the amount of weight offset in the springs, has weight variation buttons, and offset-percent changes.

Figure 5. User Display

Harness Features

The harness uses multiple straps to overlap the legs and torso to secure the patient during operation. There are sliding buckles that allow for size adjustability. It is lifted at the shoulders to keep the patient up right and has safety straps to prevent a fall.

Acknowledgements

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