

Figure 1. Roof Mounting Lift/Harness System that utilizes an I-beam track system for a vertical and horizontal translation of a patient.

Abstract

The AlliGAIor is a patient support device that controls a user's position on an elliptical through a dynamic offloading system. A motorized winch is used alongside a continuous feedback controller system to lift the patient and provide a desired amount of weight offloading. The winch produces an adverse force to the patient's weight to lessen the relative load on the patient's legs while they train on the elliptical.

Once the patient is securely fastened into their harness, they are lifted into the air by a steel rope connected to a motorized winch. The steel rope runs through a pulley setup that is fixed to a motorized trolley on a rail system. When the patient is at a desired height, the trolley moves horizontally to place the user over the elliptical and the winch lowers them down. After the patient is secured on the machine, the winch initiates offloading and reduces the load on the patient's leg. The controller receives a consistent stream of the user's relative load through a load cell attached to the patient's harness. A mechanical fail-safe setup is constructed to restrict the lower boundary of the patient's height by using polyester ratchet straps attached to a passive trolley.

Function Groups

1. Lifting
2. Harness, Elliptical to Chair
3. Loading
4. Sensors, User Interface
5. Fail Safe

Cost Overview

OTS Parts = \$1,992.97
Raw Materials = \$203.37
MFG Labor = \$69.68
Energy = \$0.04
Assembly Labor = \$39.48

Total = \$2,305.55

Customer Needs Descriptions

Customer Need	Quantified Metric	How?	Customer Need	Quantified Metric	How?
Overall Fit	Volume	Total Volume Used	Mounting	Size	Set Mount Area
Power Supply	Voltage	Measured Supply Voltage	Offset Range	Loading Range	Increment Loading through Winch
Synergy	Volume	Ensured Parts Fit	FES Synergy	Size	Ensured Parts Fit
Full Support	Loading Range	Fully Support User	Cost	Cost	Total Cost
Factor of Safety	Factor of Safety	$\frac{\sigma_y}{\sigma_m} > 1$	Determine Offset	User Interface Access	Set by Trainer Using Interface
Fail Safe	Fail Safe Function	Various Fail Safes	Offset Ease	Loading Range	Anytime Adjust
Comfort	SA Comfort	Spread Weight	Offset Feel	Loading Sensitivity	Small Increments
Security	Response Time	Fail Safe Response	E-Stop	Response Time	Time to Activate
Vertical Movement	Lifting Speed	Winch Lifts Patient	Hardware Program	Volume	Required Parts
Sagittal Fall	Response Time	2 nd Fail Safe Cable	Lifetime	Harness Fatigue	Harness Uses
Transverse Fall	Response Time	Railings and Fail-Safe Response	Visual Indicator	User Interface Access	Interface Displays Key Information
Chair to Air	Chair to Elliptical	Winch Lifts Patient	Force Safety	Reliability Error	Sensor Accuracy
Air to Trainer	Chair to Elliptical	Trolley Moves Horizontally	Intuitive Interface	User Interface Access	Distance from User and Interface
Suspended Support	Loading Range	Hold Max W in Air	Offset Operation	Loading Range	Trainer Controls Applied Loading
Body Size	Loading Range	Max W = 284lbs	Footprint	Size	Limit Footprint

Key Features

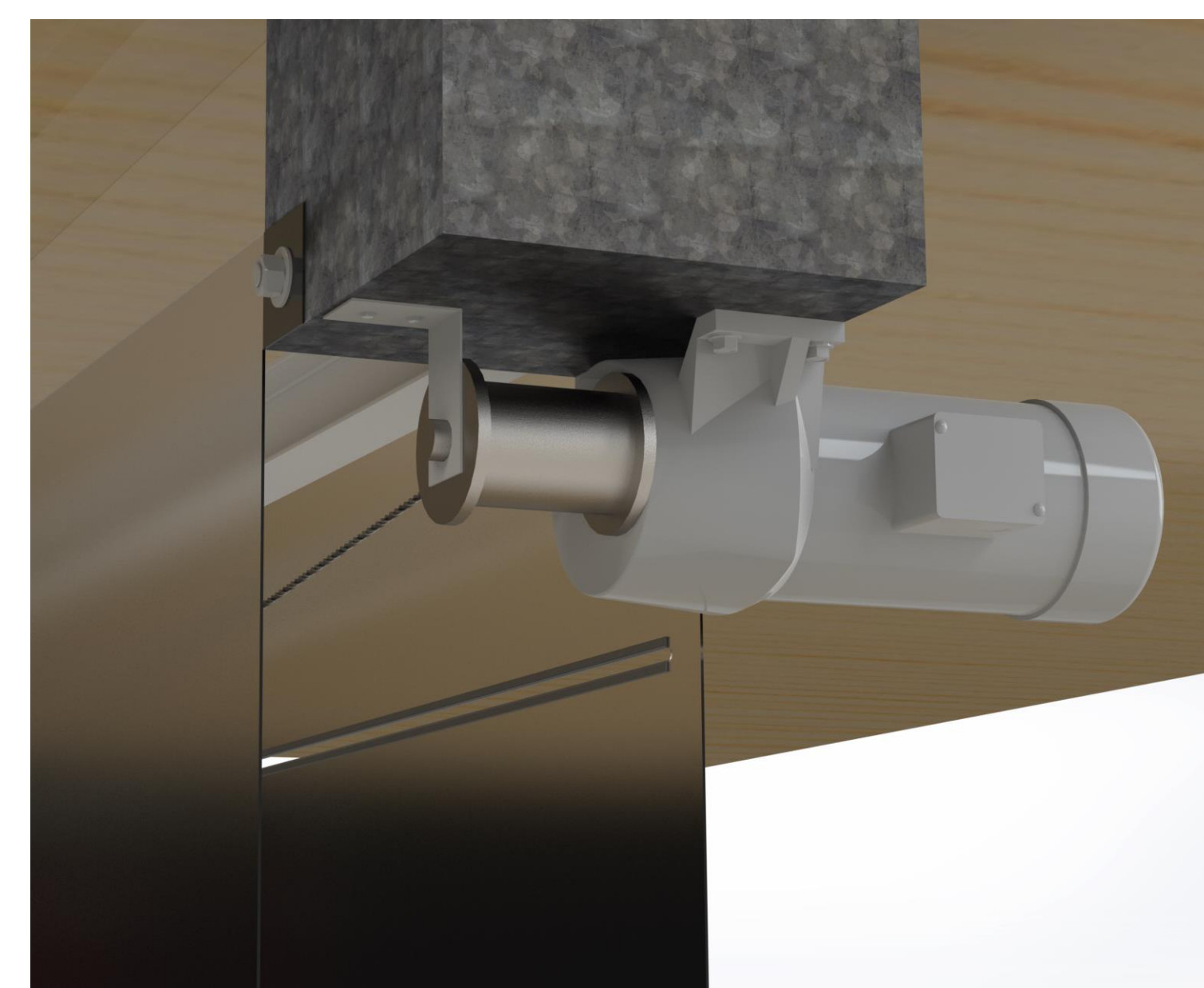


Figure 2. Motorized Winch: A Parallel Shaft DC Gear Motor was selected to operate the winch due to its calculated rate of 8.96 in/s at a continuous torque of 476 in-lbs. at 57 rpm. At this rate, safe operation is guaranteed for accurate offloading while exercising.



Figure 3. Motorized Trolley: A Strongway Electric Trolley with a 2,200 lb. capacity was chosen to transport the patient. This trolley is equipped with a remote toggle switch where a trainer can help guide and prevent swaying.

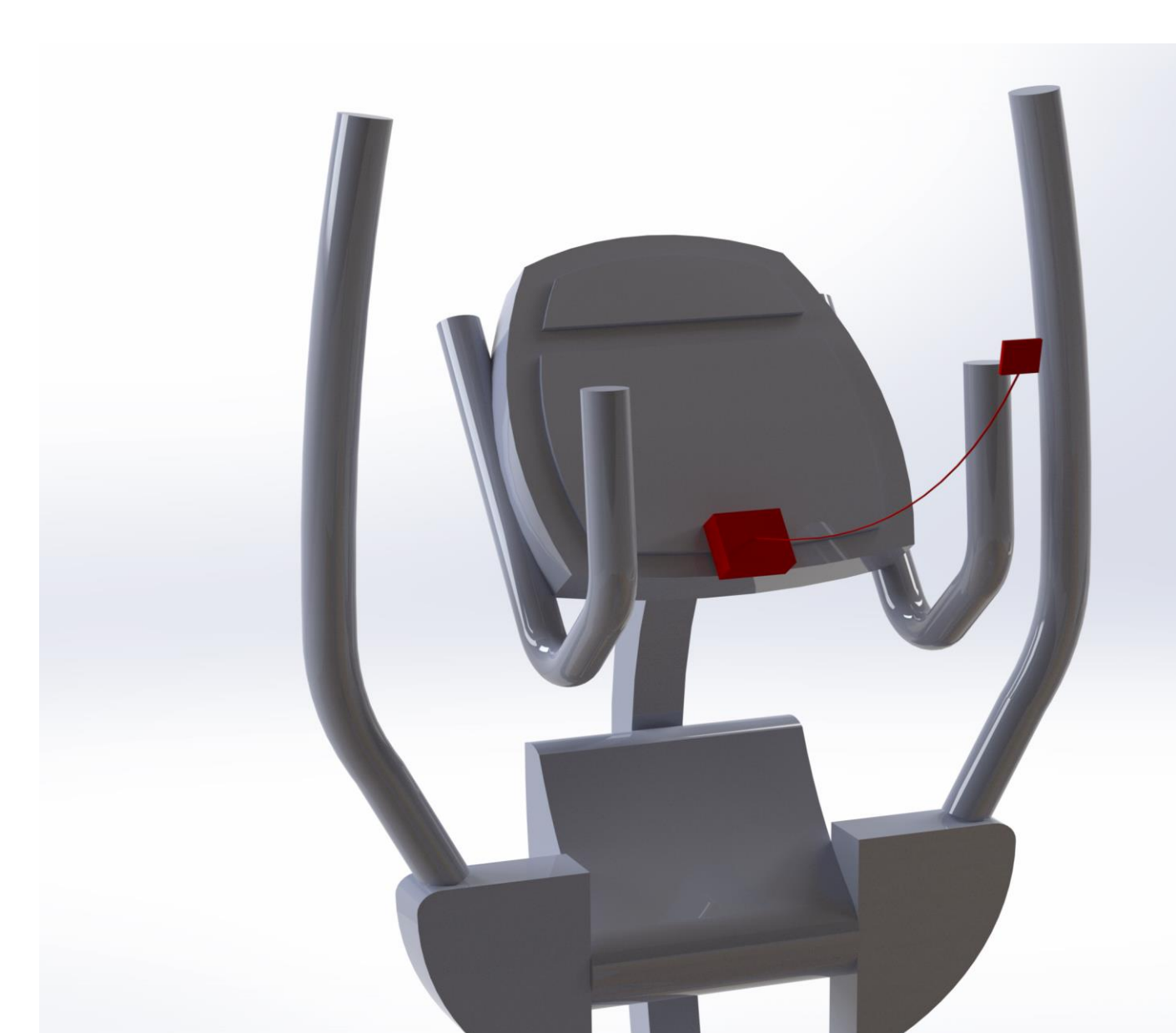


Figure 4. Magnetic Key Switch: If the patient were to fall, lift off the elliptical, or feel unsafe during operation, the magnetic connection can be pulled apart with effortless motion, cutting power from the system

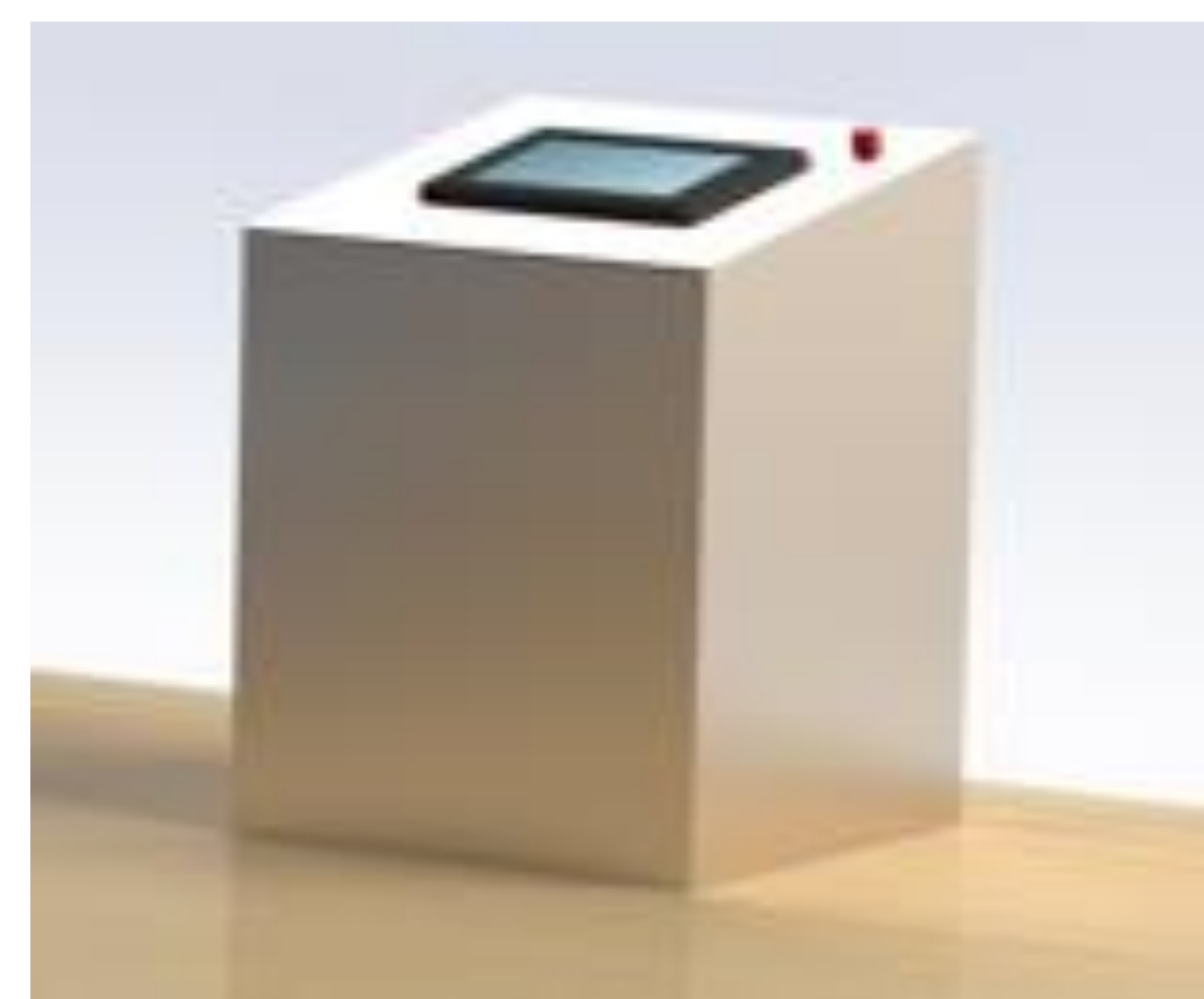


Figure 5. Controller station: Pictured on the left, was implemented to provided a feedback loop that communicates to a digital readout that adjust the patient's height and loading.

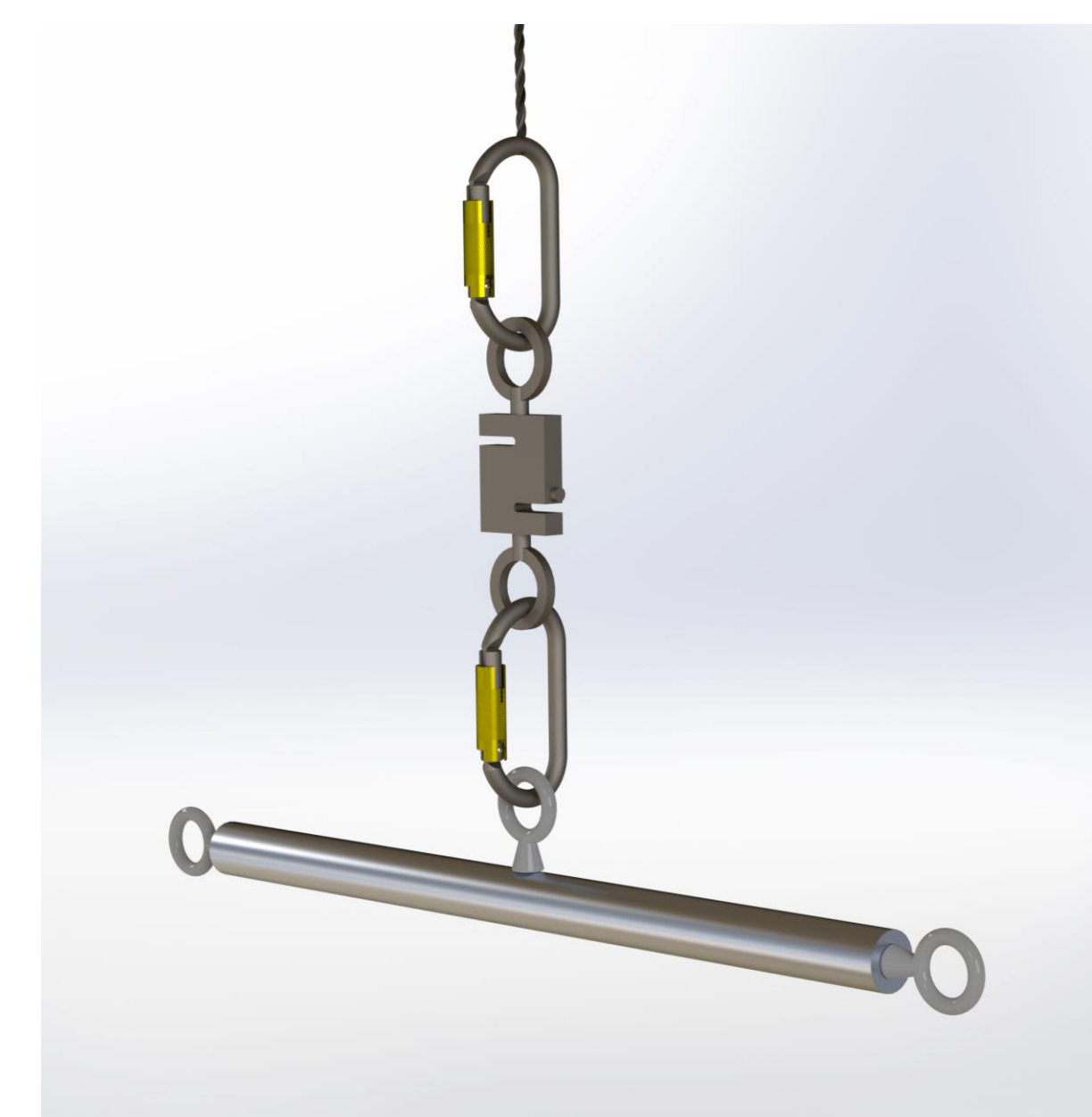


Figure 6. Loadcell and Harness: Pictured on the right, the loadcell's real-time response ensures a dependable digital readout system. The load cell is placed above the harness bar.

Customer Needs Mapping

