

Dual Motor Mobile Elliptical Lift System (DMMELS)

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Abstract

The Dual Motor Mobile Elliptical Lift System (DMMELS) is a human lift system and support harness that provides users with the necessary assistance and stabilization during gait training. The controllable weight offset and lift system is comprised of two independent winches, each powered by electric motors, that allow for precise control of angular position and velocity when transporting and supporting the user. The motors are coupled to encoders that supply position feedback and load cells that convert force into a measurable electrical signal to determine a patient's weight.

Cost

OTS Parts	\$1,938.51
Raw Materials	\$1,187.22
Manufacturing/ Assembly Labor	\$210.27
TOTAL	\$3,336

Customer Needs

See detailed mapping of customer needs on back of poster



Figure 1. Rendered View of the DMMELS Assembly

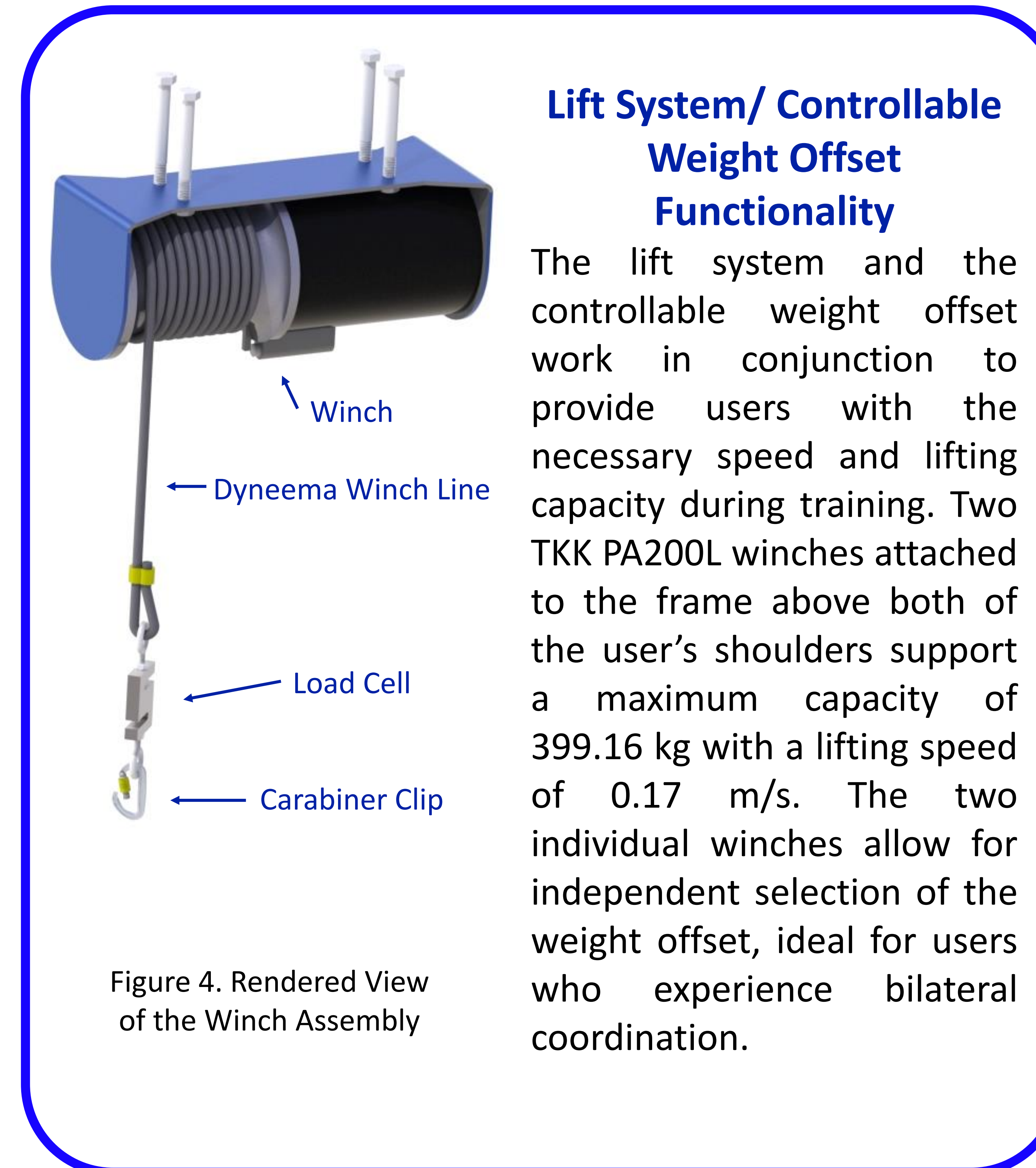


Figure 4. Rendered View of the Winch Assembly

Lift System/ Controllable Weight Offset Functionality

The lift system and the controllable weight offset work in conjunction to provide users with the necessary speed and lifting capacity during training. Two TKK PA200L winches attached to the frame above both of the user's shoulders support a maximum capacity of 399.16 kg with a lifting speed of 0.17 m/s. The two individual winches allow for independent selection of the weight offset, ideal for users who experience bilateral coordination.



Figure 2. Rendered View Highlighting the Mobility of the DMMELS

Frame Functionality/ Mobility

The frame is composed of 6063-T52 aluminum square tubing whose attachment points are secured either through welding or square plates. Two stabilizing rods welded at 45° angles on each of the two frame columns prevent sagittal movement while two adjustable wings attached to either frame column prevent lateral movement. The frame height can be modified manually by inserting pins in the frame's coinciding pin holes.



Figure 3. Rendered View of the Stability Wings

Safety Features/ Control Panel

The touch screen control panel is connected to a Raspberry Pi computer that allows the trainer to customize and input features such as: user's height, weight, user-defined offset weight, start/stop lifting process, start/stop transition to pre-set offset weight, and an on/off visual indicator. A spring-loaded handlebar can be pushed back into place when user is training and pushed back up when not in use for easy transportation. Two emergency shut-off buttons are placed on either side of the system for easy access by the user and trainer.

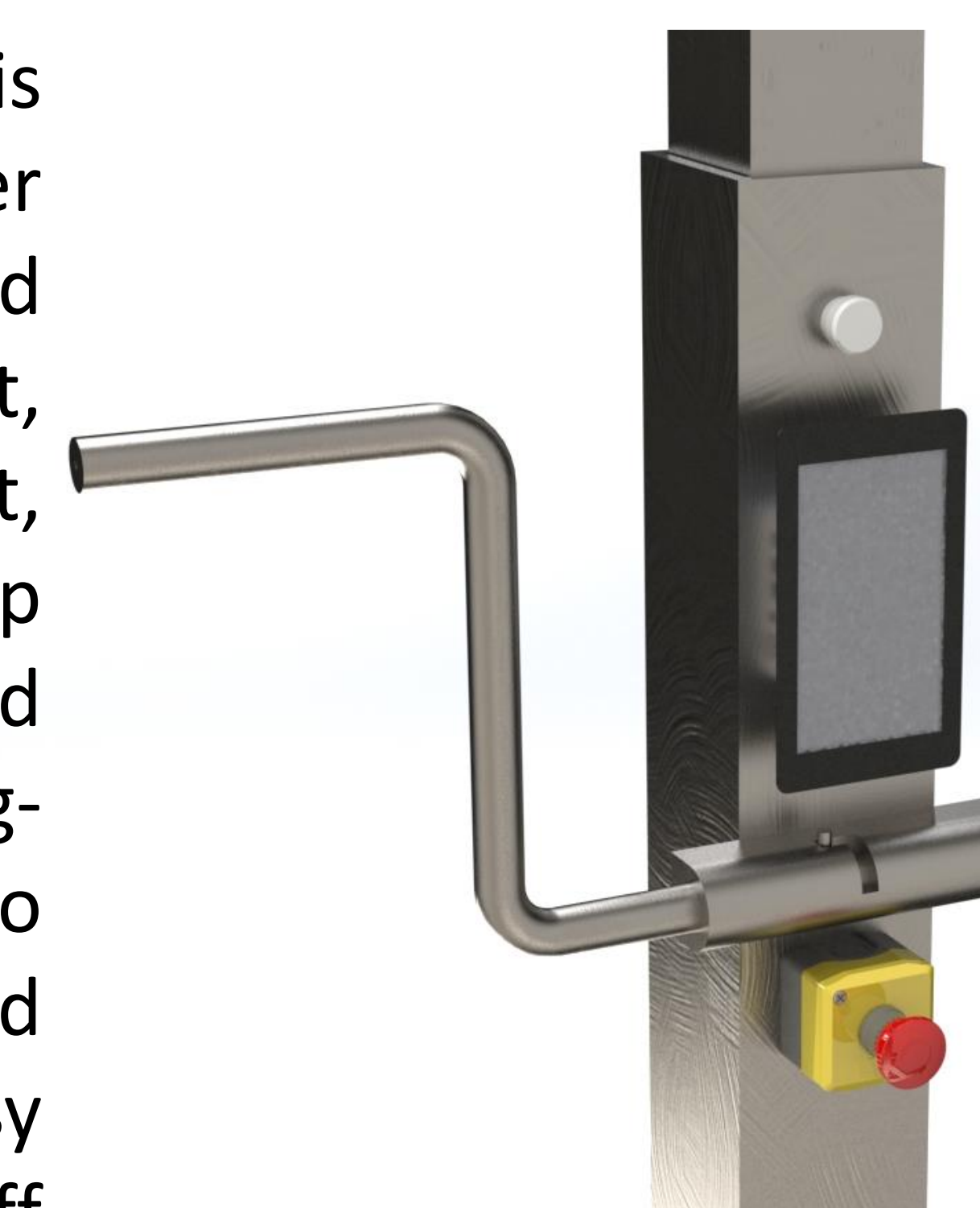


Figure 5. Rendered View of the Control Panel/Safety Features

Dual Motor Mobile Elliptical Lift System (DMMELS)

Customer Need	Quantified Metric(s)	Sub-System	Feature
1	Weight	Lift System	Two TTK PA200L Winches (19.96 kg)
		Frame	Aluminum Frame (201.51 kg)
	Maneuverability	Frame	Two swivel casters, two rigid casters
	Size	Frame	1.98 m x 3.05 m
2	Reliability	Lift System	Two TTK PA200L Winches (Input Power: 480 W, Rated Volt: 110V, Current: 4.36 amps)
3	Comfort	Harness	Two Fasteners (No interference with elliptical)
	Lift Range	Lift System	Two TTK PA200L Winches (Factor of Safety: 3.9)
	Size	Frame	Adjustable Height (2.13 m- 2.74 m) Distance between inner Frame Columns (1.11 m)
4	Lift Range	Lift System	Two TTK PA200L Winches (Maximum Lifting Capacity: 399.16 kg)
	Tensile Strength	Harness to Frame Interaction	Dyneema Polyethylene Fiber (3 GPa)
5	Reliability	Lift System	Two TTK PA200L Winches (Maximum Lifting Capacity: 399.16 kg)
6		Safety Feature	Safety User Handle Bars
7	Speed	Lift System	Two TTK PA200L (Maximum Lifting Speed: 0.17 m/s)
8	Support	Harness	Five Contact Points (user to harness)
	Degrees of Freedom	Harness to Frame Interaction	Carabiner Clips (One Degree of Freedom)
9	Responsiveness	Weight Offset	Two TTK PA200L (Maximum Lifting Speed: 0.17 m/s)
10	Support	Harness	Five Contact Points (user to harness)
11	Support	Harness	Five Contact Points (user to harness)
12	Lift Range	Lift System	Two TTK PA200L Winches (Maximum Lifting Capacity: 399.16 kg)
13	Lift Range	Lift System	Two TTK PA200L Winches (Maximum Lifting Capacity: 399.16 kg)
14	Lift Range	Lift System	Two TTK PA200L Winches (Maximum Lifting Capacity: 399.16 kg)
	Tensile Strength	Harness to Frame Interaction	Dyneema Polyethylene Fiber (3 GPa)
15	Universal Fit	Harness	Adjustable Fasteners
16	Speed	Lift System	Two TTK PA200L (Maximum Lifting Speed: 0.17 m/s)
17	Ease of Adjustment	Weight Offset	Control Panel
18	Stability	Frame	Stabilizing Lateral Wings
19	Ease of Adjustment	Weight Offset	Two TTK PA200L (Maximum Lifting Speed: 0.17 m/s)
20	Responsiveness	Weight Offset	Two TTK PA200L (Maximum Lifting Speed: 0.17 m/s)
21	Responsiveness	Weight Offset	Two TTK PA200L (Maximum Lifting Speed: 0.17 m/s)



Customer Need	Quantified Metric(s)	Sub-System	Feature
22	Ease of Adjustment	Weight Offset	Control Panel
23	Time	Harness	Two Fasteners (~60 sec adjustment time)
	Ease of Connection	Harness to Frame Interaction	Two Carabiner Clips
24	Cost	Harness	\$251.63
		Frame	\$1,310.30
		Lift System	\$141.80
		Weight Offset	\$1,426.91
		Safety Features	\$101.92
25	Time to Implement	Safety Features	Two Emergency Shut-Off Switches
26	Responsiveness	Weight Offset	Load Cell (Control System)
27		Safety Features	Control Panel
28	Ease of Maintenance	Weight Offset	Two Electric Motors (~300 sec to replace)
29	Size	Frame	1.98 m x 3.05 m Distance between inner Frame Columns (1.11 m)
30	Size	Frame	1.98 m x 3.05 m