



# Fall Protection System

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# Project Description

- ◇ Sponsor of project: Zach Lerner, Ph.D.
  - Director of NAU's Biomechanics Laboratory
- ◇ For participants with neuromuscular deficits caused by strokes, spinal cord injuries, cerebral palsy, etc.
- ◇ Intended for fall protection during gait studies
- ◇ Commercial systems may be difficult to integrate and are too expensive

# Background

- ◇ Research of commercial fall protection systems currently on market for gait analysis
- ◇ Track systems
  - Bioness Vector
  - Aretch Zero G
  - SafeGait 360
  - SoloStep
- ◇ Mobile systems
  - LiteGait
  - NxStep



Figure 1: LiteGait [1]



Figure 2: SafeGait 360 [2]



Figure 3: Biodex NxStep [3]

# Design Requirements

- ◇ Rated to support children & adults up to 300lbs (must provide full dynamic analysis, factor of safety, etc)
- ◇ Provide coverage across a 5 meters walkway AND accommodate placement over a treadmill
- ◇ Ability to work up to 2m/s travel speed
- ◇ Maintain visibility of the motion capture cameras (low-profile)
- ◇ Minimal resistance of the tether (no applied force to the user during normal gait)
- ◇ Prioritize portable design

Motion Detection Cameras



Figure 4: Dr. Lerner's Laboratory

Working Space

# Customer Requirements

Top four customer requirements:

- Safety
- Treadmill Compatible
- Must move 5 meters
- Easy to operate

Customer Requirement #	Customer Requirements	Relative Importance (1-5)
1	Cost to Build	3
2	Safety	4
3	Non-Obstructive/Low Profile	3
4	Non-Reflective	2
5	Treadmill Compatible	4
6	Must Move 5 meters	4
7	Unweighted System (Zero Tension)	3
8	Comfortability	3
9	Easy to Operate	4
10	Minimal Maintenance	3
11	Durability	2
12	Reliability	3
13	Adjustability	3

Figure 5: Customer Requirements

# Benchmarking

Ranking of 3 track style systems compared to client's requirements completed

Customer Requirement #	Customer Requirements
1	Cost to Build
2	Safety
3	Non-Obstructive/Low Profile
4	Non-Reflective
5	Treadmill Compatible
6	Must Move 5 meters
7	Un-weighted System (Zero Tensions)
8	Comfortability
9	Easy to Operate
10	Minimal Maintenance
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Figure 6: Customer Requirements

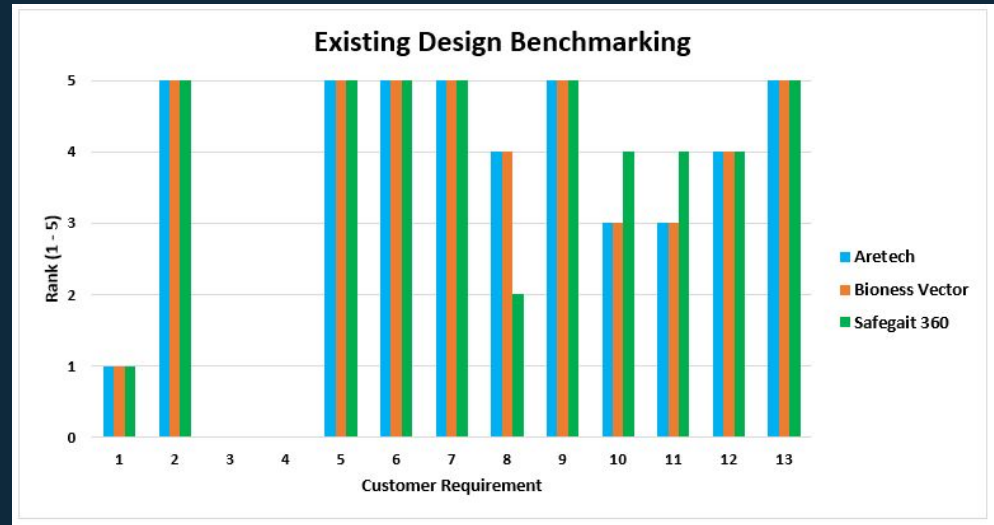


Figure 7: Benchmarking



# Budget

- ◇ Total Budget: \$2,500
- ◇ Expenses to Date: \$0

Table 1: Track Estimate

TRACK ESTIMATE		
<b>Materials</b>		
	Track	\$ 900
	Tether	\$ 100
	Trolley	\$ 400
	Motors	\$ 300
	Wiring	\$ 100
<b>Labor</b>		
	Fabrication	\$ 500
	Assembly	\$ 200
<b>TOTAL ESTIMATE</b>		\$ 2,500
<b>PROJECT BUDGET</b>		\$ 2,500
<b>REMAING BUDGET</b>		\$ -

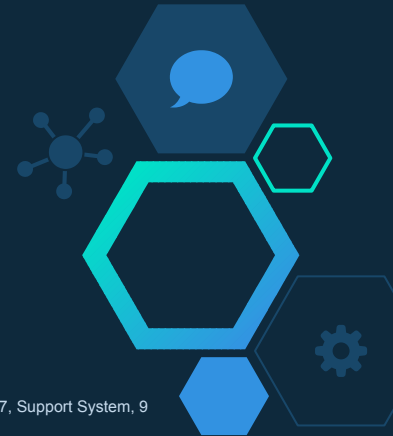
Table 2: Mobile Estimate

MOBILE ESTIMATE		
<b>Materials</b>		
	Tubing	\$ 900
	Tether	\$ 100
	Support Wheels	\$ 400
	Fall Protection	\$ 400
<b>Labor</b>		
	Fabrication	\$ 350
	Assembly	\$ -
<b>TOTAL ESTIMATE</b>		\$ 2,150
<b>PROJECT BUDGET</b>		\$ 2,500
<b>REMAING BUDGET</b>		\$ 350





# Questions?





# References

[1] "Partial-Weight-Bearing Gait Therapy Device," in *LiteGait*, 2015. [Online]. Available: <https://www.litegait.com/products>. Accessed: Feb. 19, 2017.

[2] S. McMannis, "Balance Mobility and Gait Training," in *Safe Gait Solutions: Innovation for Rehabilitation*, SafeGait, 2016. [Online]. Available: <http://safegait.com/>. Accessed: Feb. 17, 2017

[3] Biodex Medical Systems, "Nx Step Unweighing System," in *Senior Rehab Balance and Mobility*. [Online]. Available: <http://www.biodexseniorrehab.com/products/unweighing-system/index.html>. Accessed: Feb. 16, 2017.

[4] "Gym Ab Workout Tower Push Pull Up Chin Up Station Machine Bar Stand Knee Raise," in *Terapeak*, Terapeak, 2017. [Online]. Available: <http://www.terapeak.com/worth/gym-ab-workout-tower-push-pull-up-chin-up-station-machine-bar-stand-knee-raise/262616451980/>. Accessed: Feb. 20, 2017.

[5] Protecta, "Rebel™ Self Retracting Lifeline," in *3M Fall Protection: Self Retracting Lifelines*, 2017. [Online]. Available: <http://www.capitalsafety.com/en-us/Pages/ProductDetails.aspx?prodId=1244>. Accessed: Feb. 17, 2017.

[6] . [Online]. Available: [http://www.bygroup.ca/documents/Image/products/large/98081-6\\_A\\_Deluxe.H.Bag.Stand.jpg](http://www.bygroup.ca/documents/Image/products/large/98081-6_A_Deluxe.H.Bag.Stand.jpg). Accessed: Feb. 20, 2017.

[7] "Electric Hoist/Overhead Crane," in *Grumpy's Performance*, 2016. [Online]. Available: <http://garage.grumpysperformance.com/index.php?threads/electric-hoist-overhead-crane.12188/>. Accessed: Feb. 20, 2017.

# Related Designs



Figure 11: Workout Station [4]

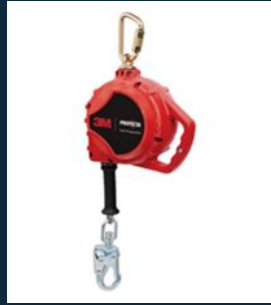


Figure 12: Self Retracting Line [5]



Figure 13: Hanging Punching Bag [6]



Figure 14: I-Beam Trolley [7]

