



# 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 are expensive and can be difficult to integrate



Figure 2: SafeGait 360 [2]

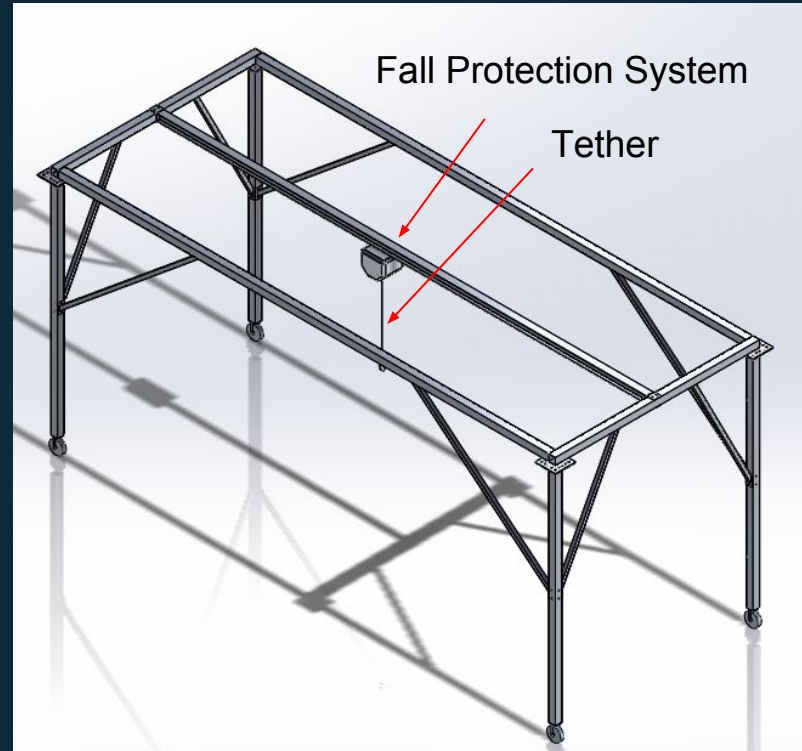


Figure 1: Biodex NxStep [1]

# Final Design



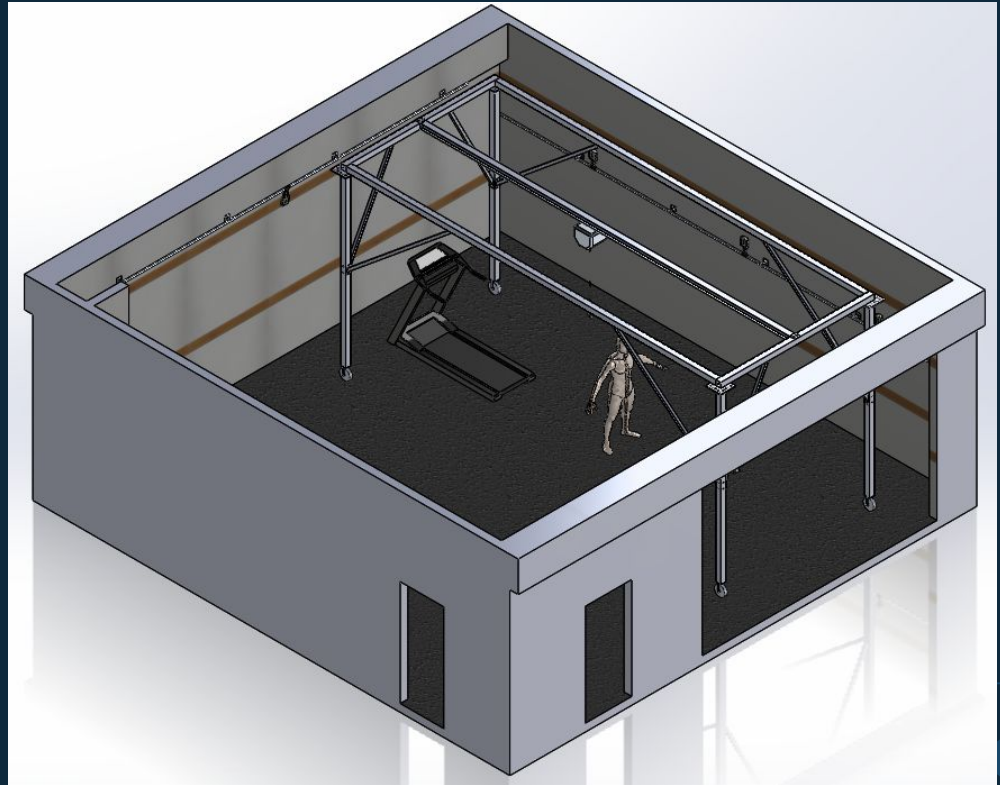
- ◆ Structure Dimension 24'X10'X11'
- ◆ Four columns with wheels
- ◆ Centralized H-Beam as track for trolley attachment
- ◆ Truss support beams fastened to each column for increased structural integrity



# Final Design

## Implementation of System

- Assemble/Disassemble Structure
- Trolley Mechanism
- Tether attaches to Fall Protection System
- Patient attaches harness to carabiners which attach to tether
- Wheels at structure base lock/unlock for mobility
- 30'X30'X12' Room Dimensions



# Design Requirements

Table 1: Customer Requirements

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

- ◇ Safety
  - Structure is composed of high strength steel, heavy duty tether, customized trolley
- ◇ Treadmill Compatible
  - Wheels allow for system to be positioned over treadmill
- ◇ Must move 5 meters (16.4 ft)
  - Structure length dimension is 24 ft
- ◇ Easy to Operate
  - Patient attaches to tether via high strength carabiners
  - Structure assembled/disassembled with bolts and nuts
  - Wheels allow for positioning within lab
  - Can be locked in set location

# Schedule

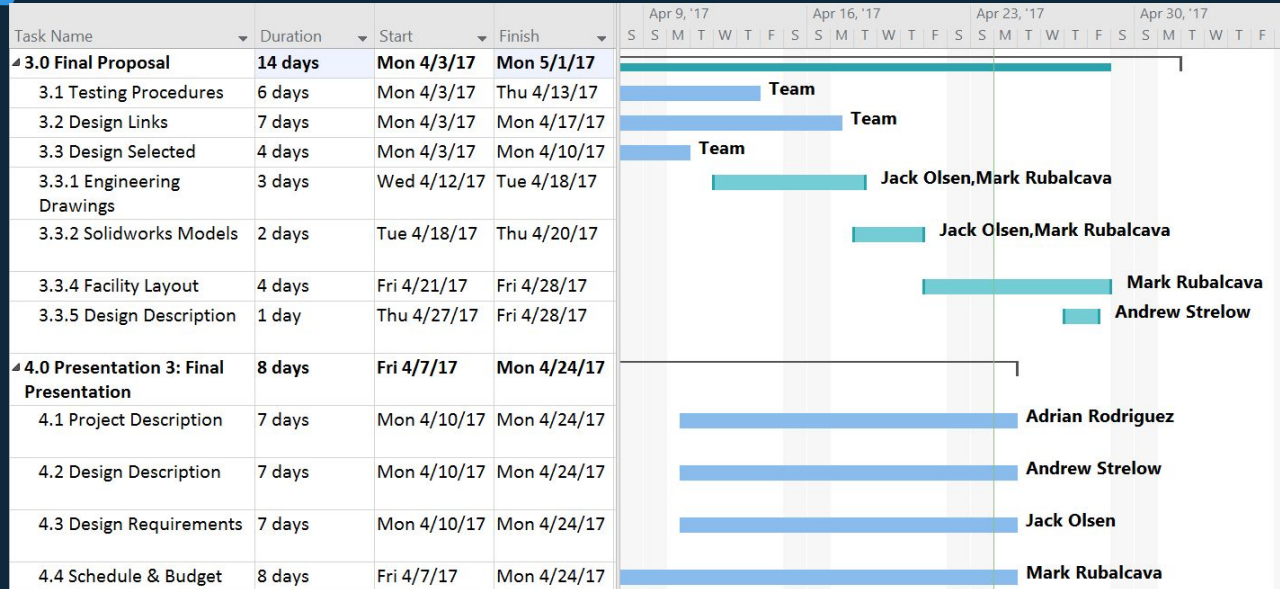


Figure 3: Gantt Chart

- ◇ Slightly behind schedule
  - Working with client on final design

# Budget

Table 2: Bill of Materials [3,4]

Project Name		Fall Protection Support System for Gait Studies					
Team		Team C: Andrew Strelow, Jack Olsen, Mark Rubalcava, Adrian Rodriguez					
Part #	Part Name	Qty	Description	Material	Dimensions	Cost per unit (\$)	Total Cost (\$)
1	Columns	4	Vertical Structural Components	A500 Grade B Square Tubing	4" x 4" x 3/16"	16.78	805.44
2	Beams	4	Horizontal Structure Components	A500 Grade B Square Tubing	4" x 4" x 3/16"	12.08	869.76
3	Track	1	Horizontal Trolley Guide	A992 H Beam W4x13	4.16" x .280" x 4.06"	12.33	308.35
4	Truss Supports	8	Diagonal Framing Supports	A500 Grade B Square Tubing	2" x 2" x 11GA	7.19	402.4
5	Column Fastening Plates	4	Assembly Fastening Mounts	HR A36 Flat Plate	8" x 9" x 1/4"	17.16	68.64
6	Wheel Mounting Plates	8	Assembly Fastening Mounts	HR A36	8" x 8" x 1/4"	15.98	127.84
7	Truss Fastening Plates	16	Assembly Fastening Mounts	HR A36	4" x 6" x 3/16"	10.96	175.36
8	Mounting Brackets	2	Assembly Fastening Mounts	HR A36	8" x 8" x 1/4"	15.98	31.96
9	Bolts	80	Structure Fasteners	A325	3/4"-10 x 1.75"	1.13	90.31
10	Nuts	80	Structure Fasteners	Stainless	3/4"-10	0.64	51.2
11	Washers	160	Structure Fasteners	Stainless	3/4"-10	0.63	100.8
12	Tether	1	Patient Harness Connector	Polyester	5/16" x 100"	25.95	25.95
13	Carabiners	3	Black Diamond Rocklock Screwgate	Aluminum	4.33"x 2.75"	10.95	32.85
14	D-Rings	4	Mounting Dee-Ring	316 Stainless Steel	2-5/16"x6000lb	6.99	27.96
15	Trolley	1	Patient Suspension Mechanism	TBD	TBD	TBD	
16	Wheels	4	Swivel Caster W/ Brake	Phenolic	8" x 2"	25.77	103.08
						<b>System Cost</b>	<b>3221.9</b>

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



Questions?







# References

[1] 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.

[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] "Metals Depot® - Buy Metal Online! Steel, Aluminum, Stainless, Brass", *Metalsdepot.com*, 2017. [Online]. Available: [http://www.metalsdepot.com/?gclid=Cj0KEQjwxPbHBRcDxJLF3qen3dYBEiQAMRyxS5FWIa9tDvertWz1YsVBVeUbX792J-NHQT-\\_DaAjtJwaAoxm8P8HAQ](http://www.metalsdepot.com/?gclid=Cj0KEQjwxPbHBRcDxJLF3qen3dYBEiQAMRyxS5FWIa9tDvertWz1YsVBVeUbX792J-NHQT-_DaAjtJwaAoxm8P8HAQ). [Accessed: 24- Apr- 2017].

[4] "Bolt Depot - Nuts And Bolts, Screws And Fasteners Online". *Boltdepot.com*. N.p., 2017. Web. 24 Apr. 2017.