



# Fall Protection System

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# Project Description

- ◇ Sponsor of project: Zach Lerner, Ph.D.
  - Director of NAU's Biomechatronics 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]

# Designs Considered

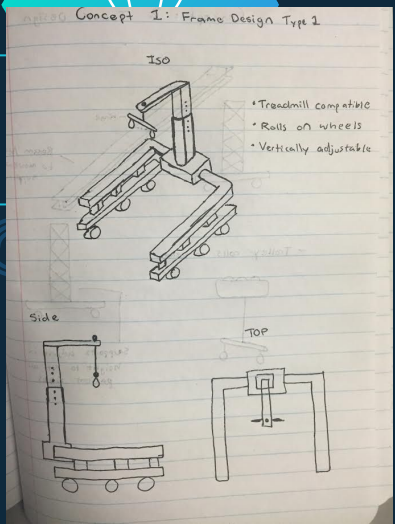


Figure 3: Frame System 1

**Advantages:**

- Rigid Structure
- Vertically Adjustable

**Disadvantages:**

- Obstructive
- Expensive

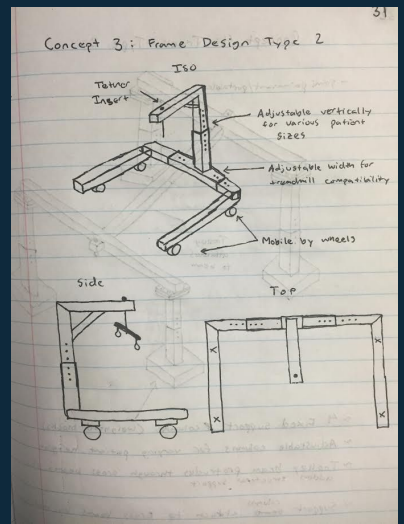


Figure 4: Frame System 2

**Advantages:**

- Vertically and horizontally adjustable
- Portable

**Disadvantages:**

- Unweighted System
- Comfortability

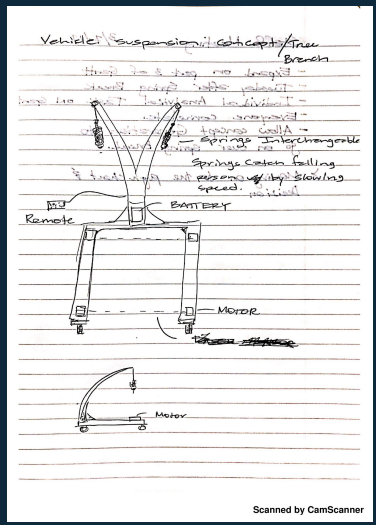


Figure 5: Vehicle Suspension

**Advantages:**

- Moves with patient
- Reduced tension on patient during fall

**Disadvantages:**

- Must interchange components
- Maintenance



# Designs Considered

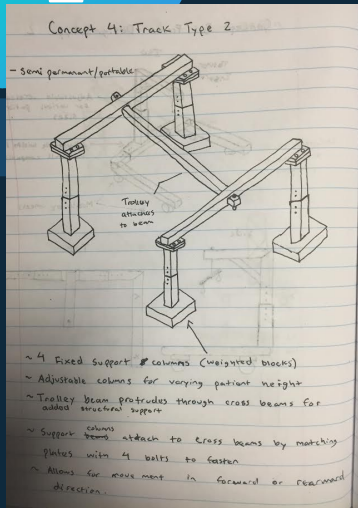


Figure 6: Overhead Track 1

## Advantages:

- Portable
- Minimal maintenance

## Disadvantages:

- Expensive
- Fixed to center of room

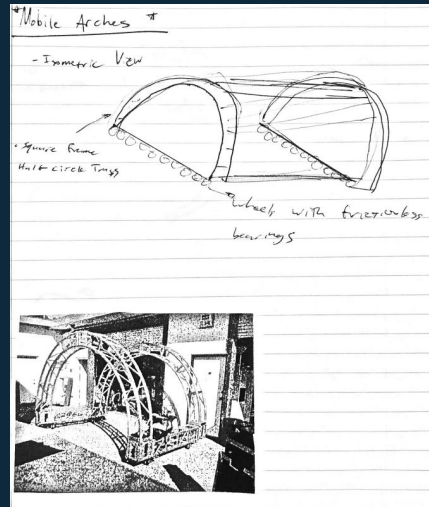


Figure 7: Mobile Overhead Arches

## Advantages:

- Easy to operate
- High safety

## Disadvantages:

- Reliability
- Tension on patient

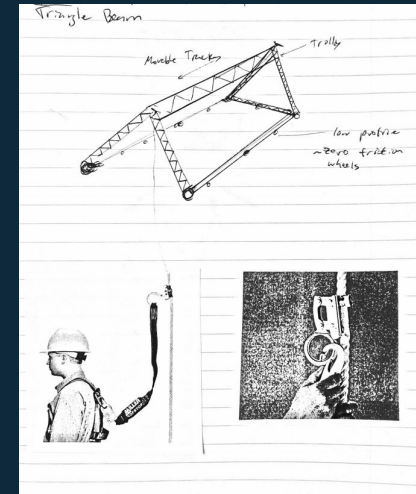


Figure 8: Triangle Beam

## Advantages:

- Low cost to build
- Minimal tension

## Disadvantages:

- Obstructive
- Durability

# Design Selected

Table 1: Decision Matrix for Ground Supported System

Decision Factors		Vehicle Suspension		Frame 2		Frame 1	
		1	2	2	3	3	3
Criteria	Wt.	1	2	2	3	3	3
Safety	0.10	75	7.3	95	9.3	95	9.3
Treadmill Compatible	0.10	100	9.8	100	9.8	100	9.8
Must Move 5 meters	0.10	100	9.8	100	9.8	100	9.8
Easy to Operate	0.10	85	8.3	95	9.3	95	9.3
Cost to Build	0.07	90	8.8	95	9.3	85	8.3
Non-Obstructive/Low Profile	0.07	95	9.3	95	9.3	85	8.3
Un-weighted System (Zero Tensions)	0.07	100	9.8	87	8.5	87	8.5
Comfortability	0.07	80	7.8	87	8.5	80	7.8
Minimal Maintenance	0.07	75	7.3	90	8.8	90	8.8
Reliability	0.07	78	7.6	90	8.8	90	8.8
Adjustability	0.07	70	6.8	100	9.8	90	8.8
Non-Reflective	0.05	100	9.8	100	9.8	100	9.8
Durability	0.05	80	7.8	90	8.8	90	8.8
<b>Weighted Scores</b>			8.5		9.2		8.9

COLOR KEY	
<span style="color: green;">■</span>	HIGH SCORE
<span style="color: yellow;">■</span>	AVERAGE SCORE
<span style="color: red;">■</span>	LOW SCORE

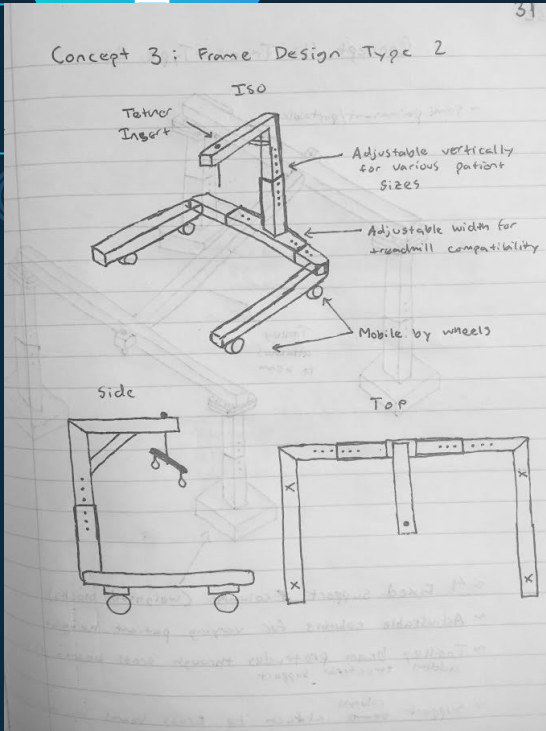


Figure 9: Frame System 2

# Design Selected

Table 2: Decision Matrix for Track Mounted System

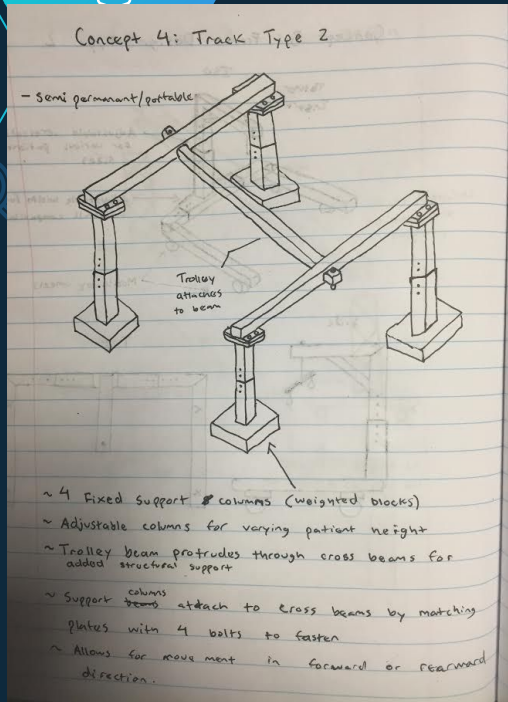


Figure 10: Overhead Track 1

Decision Factors		Triangle Beam		Track 2		Tunnel System	
		Criteria	Wt.	1	2	3	
Safety	0.10	80	7.8	92	9	90	8.8
Treadmill Compatible	0.10	100	9.8	100	9.8	100	9.8
Must Move 5 meters	0.10	100	9.8	100	9.8	100	9.8
Easy to Operate	0.10	90	8.8	95	9.3	95	9.3
Cost to Build	0.07	90	8.8	70	6.8	80	7.8
Non-Obstructive/Low Profile	0.07	85	8.3	100	9.8	89	8.7
Un-weighted System (Zero Tensions)	0.07	90	8.8	85	8.3	85	8.3
Comfortability	0.07	95	9.3	93	9.1	93	9.1
Minimal Maintenance	0.07	95	9.3	95	9.3	95	9.3
Reliability	0.07	80	7.8	90	8.8	83	8.1
Adjustability	0.07	90	8.8	85	8.3	90	8.8
Non-Reflective	0.05	100	9.8	100	9.8	100	9.8
Durability	0.05	85	8.3	95	9.3	90	8.8
<b>Weighted Scores</b>				<b>8.10</b>	<b>8.15</b>		<b>8.10</b>

COLOR KEY	
	HIGH SCORE
	AVERAGE SCORE
	LOW SCORE



# Schedule

- Currently on schedule

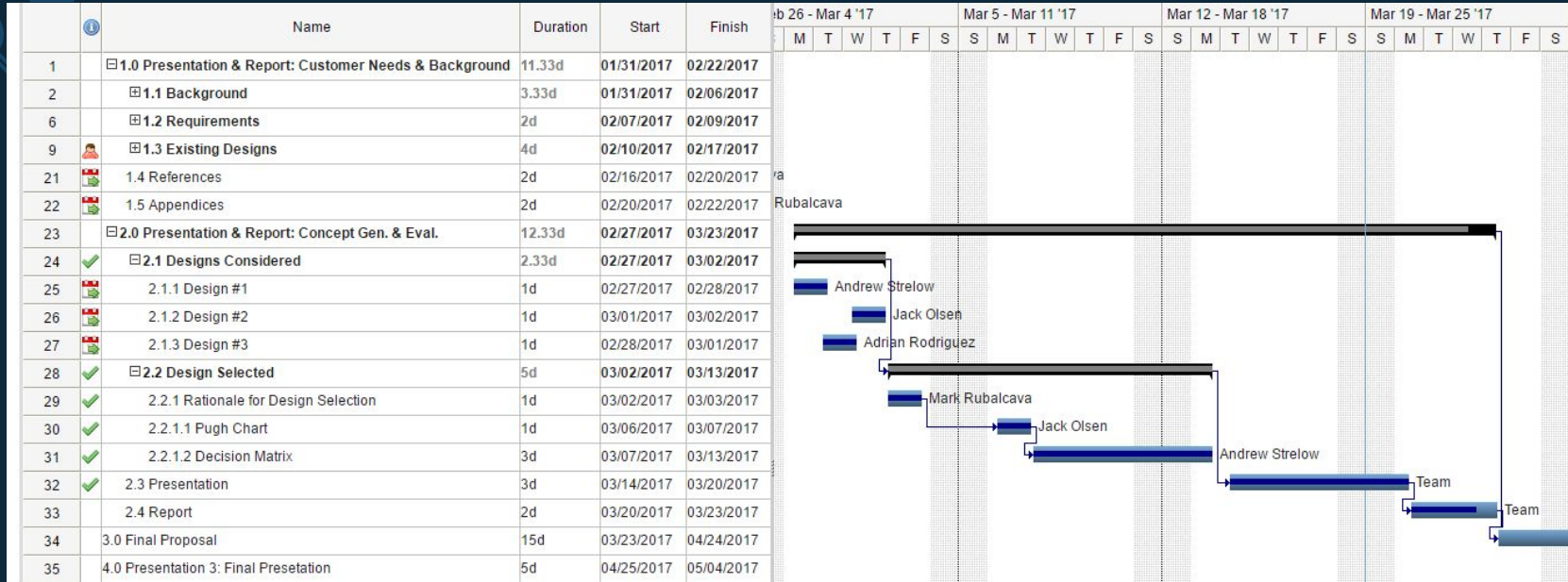


Figure 11: Gantt Chart

# Budget

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

Table 3: Overhead Estimate

OVERHEAD 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>		<b>\$ 2,500</b>
<b>PROJECT BUDGET</b>		<b>\$ 2,500</b>
<b>REMAING BUDGET</b>		<b>\$ -</b>

Table 4: Ground Supported Estimate

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





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