

Fall Protection System

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March 21, 2017



Project Description

- Sponsor of project: Zach Lerner, Ph.D.
 - Director of NAU'sBiomechatronics 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]

Concept I: Frame Design Type 1 · Treadmill compatible · Rolls on wheels · Vertically adjustable

Figure 3: Frame System 1

Advantages:

- Rigid Structure
- Vertically Adjustable

Disadvantages:

- Obstructive
- Expensive

Designs Considered

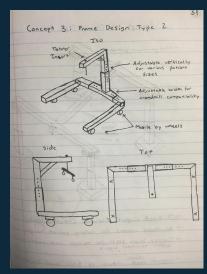


Figure 4: Frame System 2

Advantages:

- Vertically and horizontally adjustable
- Portable

Disadvantages:

- Unweighted System
- Comfortability

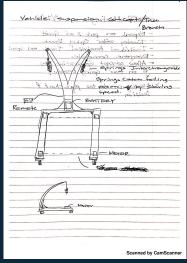


Figure 5: Vehicle Suspension

Advantages:

- Moves with patient
- Reduced tension on patient during fall

Disadvantages:

- Must interchange components
- Maintenance



Concept 4: Track Type 2 ~ 4 Fixed support & columns (weighted blocks) ~ Adjustable columns for varying patient neight ~ Trolley beam protrudes through cross beams for added structural support support stoms attach to cross beans by matching plates with 4 bolts to faster

Figure 6: Overhead Track 1

Advantages:

- Portable
- Minimal maintenance

Disadvantages:

- Expensive
- Fixed to center of room

Designs Considered

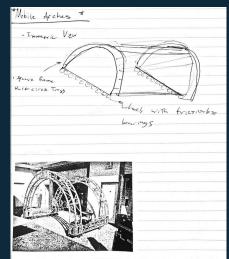


Figure 7: Mobile Overhead Arches

Advantages:

- Easy to operate
- High safety

Disadvantages:

- Reliability
- Tension on patient

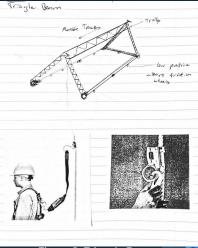


Figure 8: Triangle Beam

Advantages:

- Low cost to build
- Minimal tension

Disadvantages:

- Obstructive
- Durability



Concept 3: Frame Design Type 2 Tetucr Adjustable vertically for various patient Adjustable width for +rundmill compatibility Mobile by wheels Side TOP

Design Selected

Table 1: Decision Matrix for Ground Supported System

Decision Factors	Mobile Communica	vernicie suspension	C	riallie 2	1 cmms	E .								
Criteria	Wt.	1	L	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 Mainenance	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							
Weighted Scores			.5	9.	2	8.	.9							

(OLOR KEY
	HIGH SCORE
	AVERAGE SCORE
	LOW SCORE



Figure 9: Frame System 2

Concept 4: Track Type 2 - Semi garmant/gartable Tracky

attaches

Design Selected

Table 2: Decision Matrix for Track Mounted System

Decision Factors Criteria		Triangle beam	\vdash	I Lack Z	™ Tunnel System				
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 Mainenance	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		
Weighted Scores			10	8.	15	8.10			

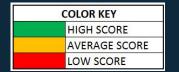




Figure 10: Overhead Track 1

Allows for move ment in forward or rearmord

~ 4 Fixed support & columns (weighted blocks)

~ Adjustable columns for varying patient height

~ Tralley beam protrudes through cross beams for
added structural support

~ Support columns
attach to cross beams by matching

Plates with 4 bolts to faster



Schedule

• Currently on schedule

		Name	Donation	044	Finish	1b 2	26 - Ma	ar 4 '1	7		Mar 5 - Mar 11 '17		r 5 - Mar 11 '17					ar 5 - Mar 11 '17						Mar 12 - Mar 18 '17					Mar 19 - Mar 25 '17					
	•	Name	Duration	Start	Finish		М	W	T	F	S	S	М	T V	V I	F	S	S	М	T	W	Т	F :	S	s I	M 1	W	Т	F	S				
1		□1.0 Presentation & Report: Customer Needs & Background	11.33d	01/31/2017	02/22/2017																													
2		⊞1.1 Background	3.33d	01/31/2017	02/06/2017																													
6		±1.2 Requirements	2d	02/07/2017	02/09/2017																													
9	8	⊞1.3 Existing Designs	4d	02/10/2017	02/17/2017																													
21	-	1.4 References	2d	02/16/2017	02/20/2017	ra																												
22	-	1.5 Appendices	2d	02/20/2017	02/22/2017	Ru	balcav	va																										
23		□ 2.0 Presentation & Report: Concept Gen. & Eval.	12.33d	02/27/2017	03/23/2017						Ħ																							
24	1	□2.1 Designs Considered	2.33d	02/27/2017	03/02/2017				=																									
25	-	2.1.1 Design #1	1d	02/27/2017	02/28/2017			Andr	ew Str	elow																								
26	-	2.1.2 Design #2	1d	03/01/2017	03/02/2017				Ja	ack O	Isen																							
27	-	2.1.3 Design #3	1d	02/28/2017	03/01/2017				Adrian	Rod	rigue	Z																						
28	1	□2.2 Design Selected	5d	03/02/2017	03/13/2017				—		Ħ						-	÷	=															
29	1	2.2.1 Rationale for Design Selection	1d	03/02/2017	03/03/2017					— 1	1ark F	Ruba	lcava	9																N				
30	1	2.2.1.1 Pugh Chart	1d	03/06/2017	03/07/2017							•		Jac	k Ols	en																		
31	1	2.2.1.2 Decision Matrix	3d	03/07/2017	03/13/2017								[_	_		+		Andre	w St	relov	/											
32	1	2.3 Presentation	3d	03/14/2017	03/20/2017	1													L	-	_	_				Tea	m							
33		2.4 Report	2d	03/20/2017	03/23/2017																					-	_	T	eam	1				
34		3.0 Final Proposal	15d	03/23/2017	04/24/2017																							4						
35		4.0 Presentation 3: Final Presetation	5d	04/25/2017	05/04/2017																									N				
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Budget

- Expenses to Date: \$0

Table 3: Overhead Estimate

OVERHEAD ESTIMATE										
Materials										
	Track	\$	900							
	Tether	\$	100							
	\$	400								
	\$	300								
	Wiring	\$	100							
Labor										
	Fabrication	\$	500							
	Assembly	\$	200							
TOTAL ESTIMATE \$ 2,500										
PROJECT	\$	2,500								
REMAING	\$	15								

Table 4: Ground Supported Estimate

GROUND SUPPORT ESTIMATE										
Materials										
	Tubing	\$	900							
	Tether	\$	100							
	Support Wheels	\$	400							
	Fall Protection	\$	400							
Labor	Labor									
	Fabrication	\$	350							
	Assembly	\$	-							
TOTAL ESTIMATE \$ 2,150										
PROJEC	\$	2,500								
REMAI	NG BUDGET	\$	350							





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

