BRAKEThrough Solutions: The Remote Braking System

Group 8

Our Team




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Pediatric Gait Trainer

Presentation Format

- Development Process
  - Construction, Logistics, Testing
- Deliverables Overview
- Product Description
- Live Demonstration
- Team Experience and Lessons

Need Statements

The braking system should be:

- ❖ Safe and reliable
- ❖ Can be activated from a distance
- ❖ Portable
- ❖ Vary braking force

*"The client needs a **safe** and **reliable** remote braking system for his son's pediatric gait trainer. It can be **activated from a distance** to let him practice walking independently."*

Metrics

Metric	Units	Client Statements
Functional Requirements		
Braking Distance	Metres (m)	The braking system is safe and reliable.
Range of Transmission	Metres (m)	The braking system can be activated from a distance.
Speed of Transmission	Seconds (s)	The braking system is safe and reliable.
Activation Method	Remote	The braking system can be activated from a distance.
Function	Versatility of braking system (Rating 1-5)	The system stops the trainer with controlled deceleration. The braking system functions in various common walking environments.
Non-Functional Requirements		
Mass	Kilograms (kg)	The system is adaptable to multiple versions/models of gait trainers and users
Constraints		
Cost	CAD ($)	100
Battery/power life	Hours (h)	The braking system is durable and long-lasting.

Benchmarking and Ranking

Product and company	Importance (weight)	Rollator Brakes	Grillo Gait Trainer Brakes	R8 Crocodile Hand Brake	Rifton Pacer Gait Trainer: Rifton Casters
Activation Method	3	1	2	1	2
Function	2	3	2	2	1
Cost	1	3	2	2	1
Total		12	12	9	9

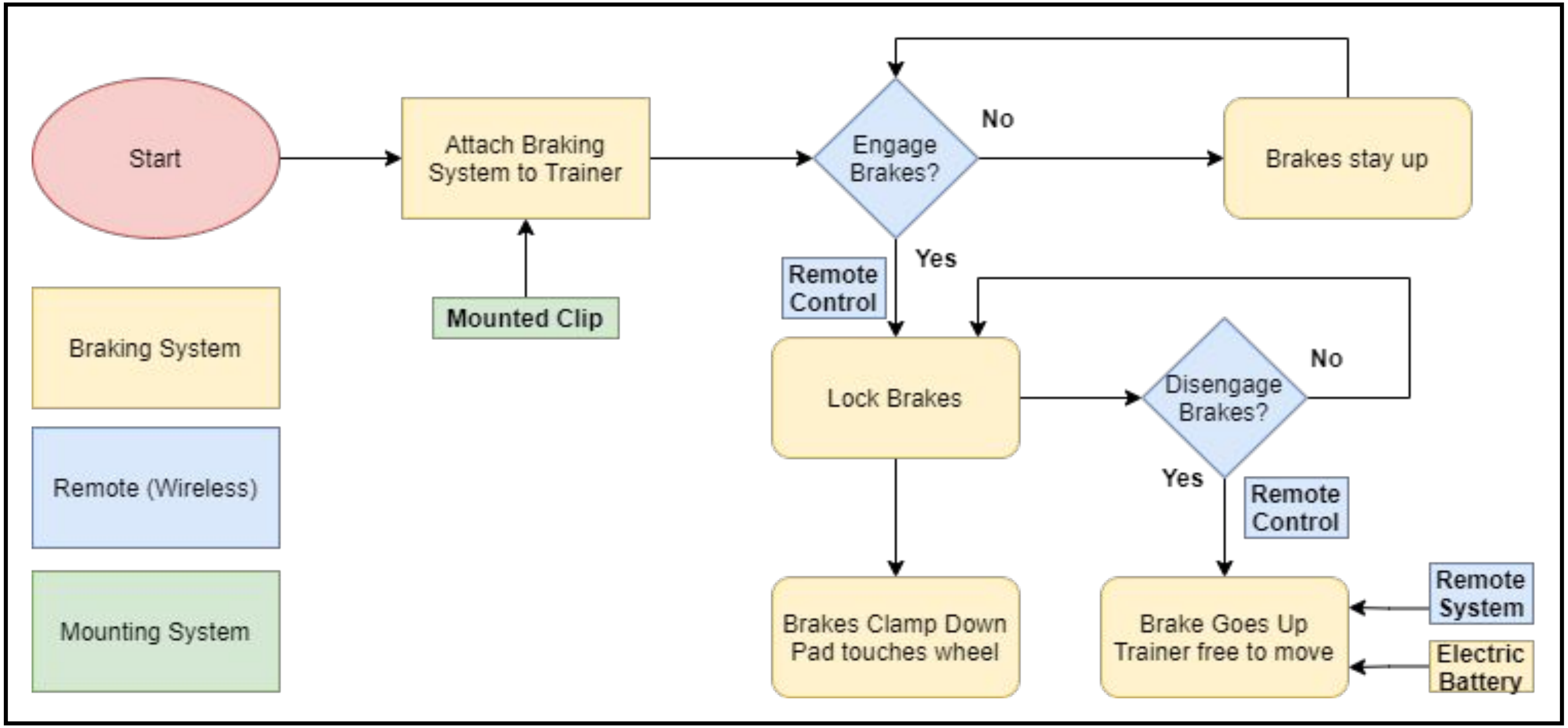
Target Specifications and Constraints

Design Specifications	Relation (=, < or >)	Value	Units	Verification Method
Functional Requirements				
Braking Distance	<	Ideal: 1 Acceptable: 2	m	Testing
Range of Transmission	<=	Ideal: 10 Acceptable: 8	m	Testing
Speed of Transmission	<=	Ideal: 0 Acceptable: 500	ms	Testing
Constraints				
Cost	≤	Ideal: 100 Functional: 150 (with permission)	CAD	BOM Estimation
Battery/power life	>	Ideal: 12 Acceptable: 8	hours	N/A
Non-functional Requirements				
Mass	<	Ideal: 3 Functional: 5	lbs	Measuring

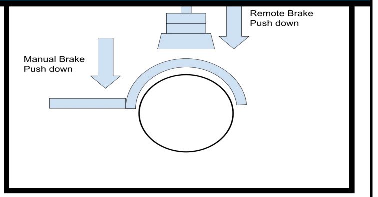
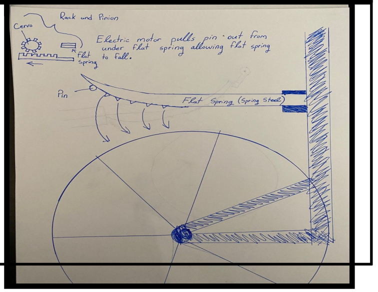
Design Criteria

Client Need Statements	Design Criteria
The braking system is safe and reliable.	**Safety.**
The braking system is durable and long-lasting.	Durability.
The braking system can be activated from a distance.	**Remote braking.**
The braking system is attachable and detachable while maintaining the trainer's state.	Portable.
The braking system functions in various common walking environments.	Environment versatility.
The system stops the trainer with controlled deceleration.	**Gradient braking.**

Functional Decomposition



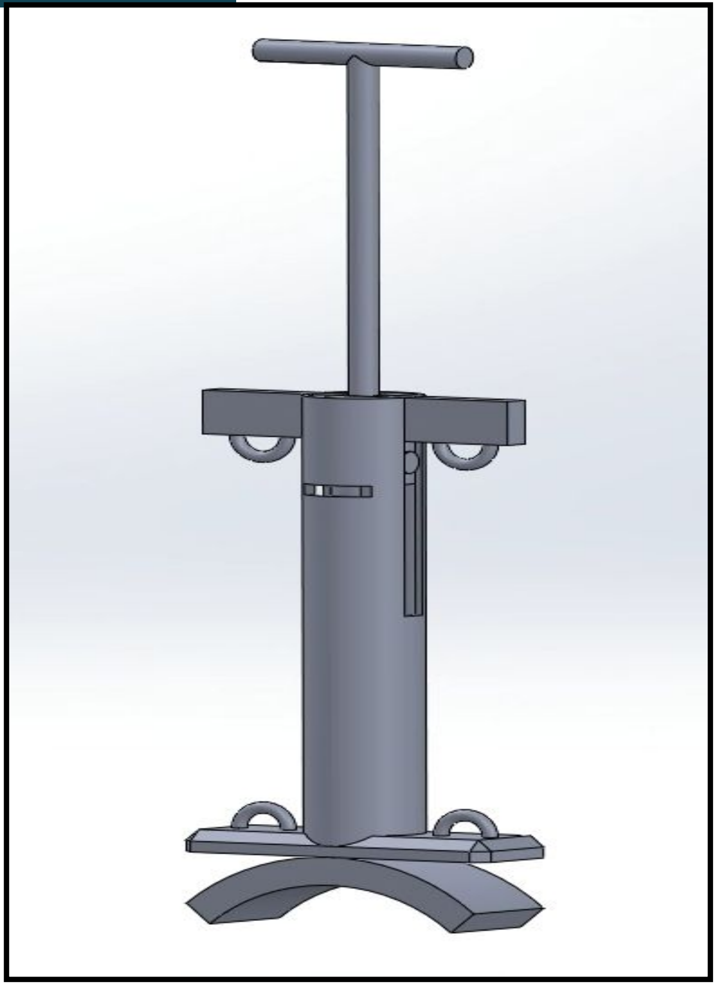
Conceptual Designs

Member	Subsystem	Concept	Sketch
Tahmeed	Braking System	❖ Emergency manual brake ❖ Remote controlled piston	
Matt	Braking Controller	❖ Engage/disengage button ❖ Uses 2-way bluetooth communication	
Brad	Mechanical Braking System	❖ Does not rely on battery power	

Conceptual Designs cont'd.

Member	Subsystem	Safety (4)	Remote Braking (3)	Gradient Braking (2)	Portability (1)
Tahmeed	Braking System	1	1	2	3
	Braking System	3	4	1	3
Matt	Braking Controller	1	1	1	1
	Stopper Attachment	2	1	2	4
Brad	Mechanical Braking System	1	2	2	1
	Mounting	1	2	2	1
Elsa	Global Concept	2	2	2	2
	Global Concept				

Conceptual Designs cont'd.



Client Meeting for First Conceptual Design

Client Cons:

- Lack of Remote Disengagement
- Lack of Braking Speed control – pressure-sensitive button?

Client Pros:

- Interested in wheel surface friction approach
- Not very strict with battery conservation

Deliverable D

Deliverable D Activities:

- New design based on client feedback
- ITP Metrics
- Bill of Materials
- Team Name: **BRAKEthrough Solutions**

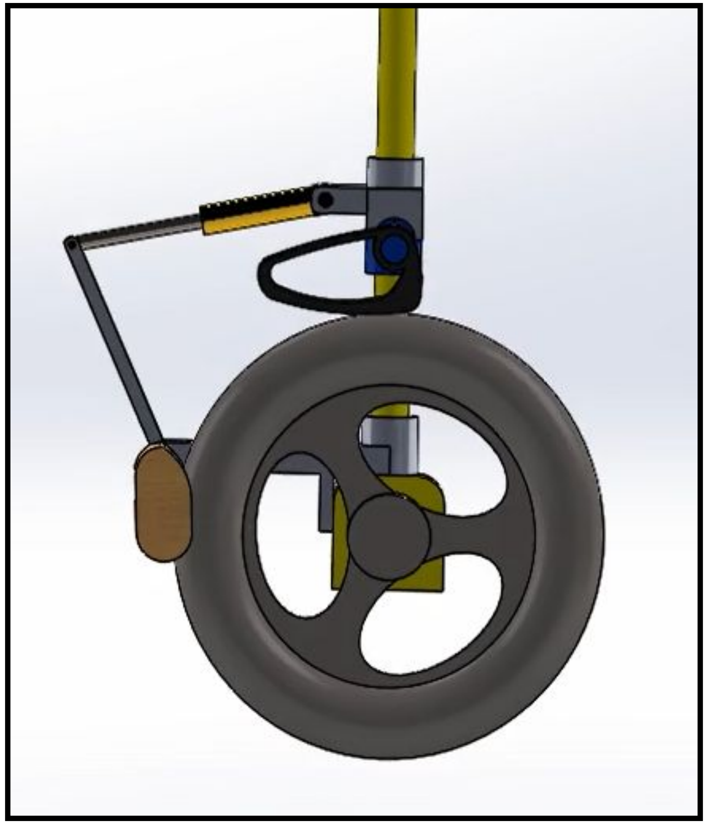
Bill of Materials

Item	**Description**	**Quantity (Approx.)**	**Price**	**Source**
Aluminium Flat Bar	Used to make a mounting system for the brake.	3' ($0.11/ft)	$3.96	Makerstore
Micro Linear Actuator/Push Pull Solenoid	Used to engage and disengage brakes.	1	$25-$30	Makerstore
9V Battery	It's a battery!	1	$1-$4	Makerstore https://makerstore.ca/shop
Bluetooth HC-05	Allows for bluetooth communication using Arduino	1	$12.99	MakerLab
12V Battery	Again, it's a battery.	1	$8.95	Amazon https://www.amazon.ca/Energizer-A23-GP23AE-Alkaline-Batteries
Arduino Nano	Used for logic and communication.	2	$8.00	MakerLab
Pushbutton	Digital Button	2 – 3	Free	Owned by multiple Team Members
Potentiometer/Pressure Sensitive Button	Analog potentiometer dial for force selection.	1	Free	Owned by Tahmeed
RGB LED	LED with ability to change colors for battery indication.	2	Free	Owned by multiple Team Members
Arduino Casing	Protects arduino	1	Free	3D Printed in L'Abbe
Controller Casing	Protects arduino in controller	1	Free	3D Printed in L'Abbe
Total			$68.85 (Approx.)	

New Braking Mechanism

"Angled Arm" Design:

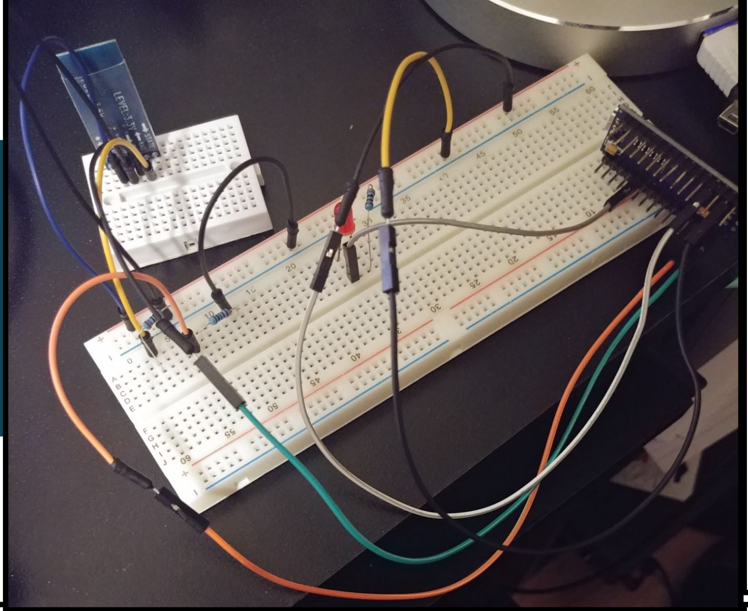
- Uses Mechanical Advantage
- Avoids modifying the Reverse Stops
- Planned to pitch for next Client Meet

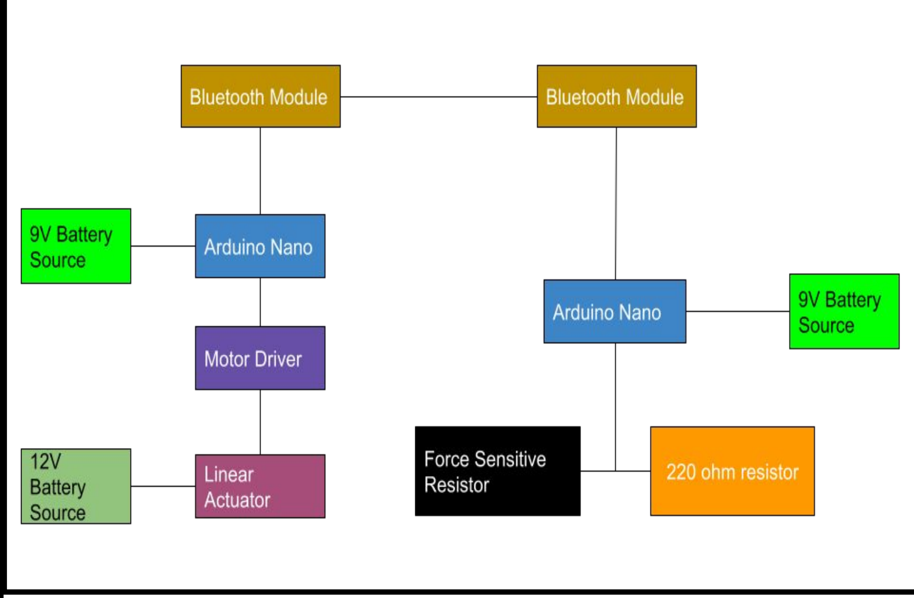


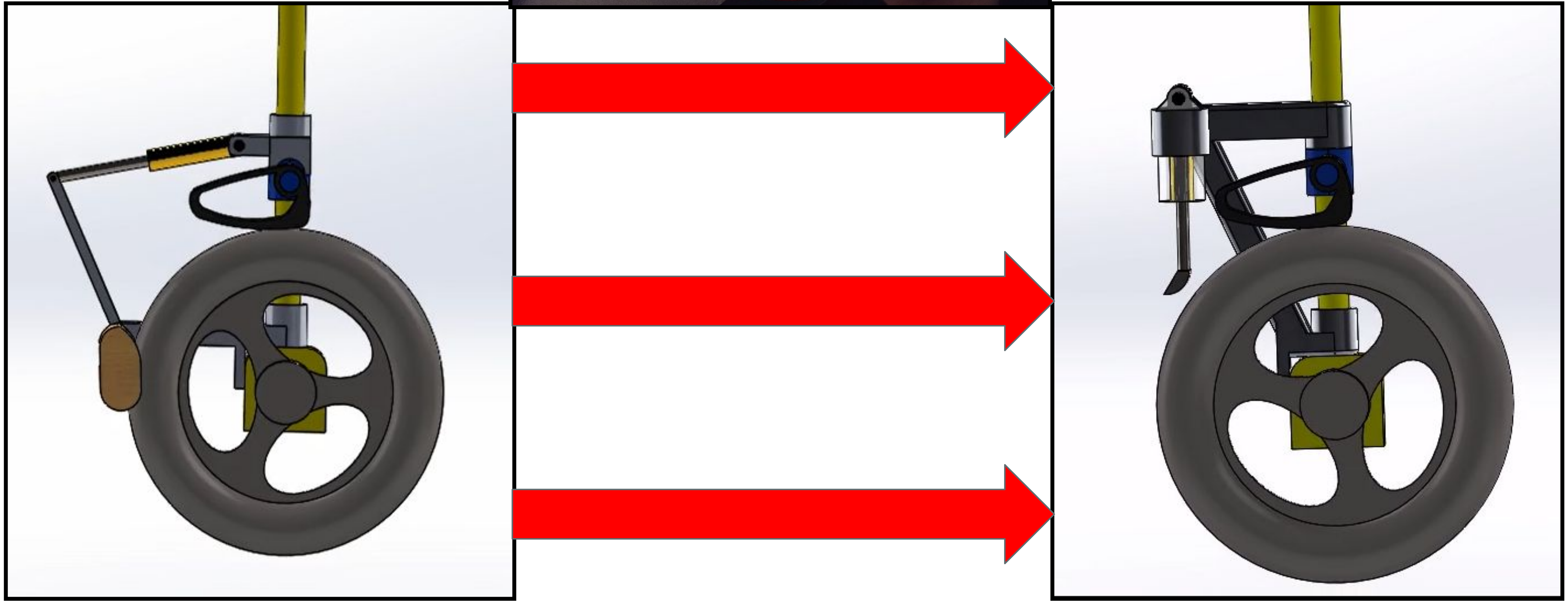
Also, Deliverable E Presentation!

Deliverable F

Prototype 2







Deliverable G - Business Model

Key Partners

Accessibility-related Organizations

Gait Trainer Companies

Key Activities

Manufacturing and selling of remote brakes for gait trainers

Key Resources

Stores (online or physical)

Resource available to gait trainer companies

Value Propositions

Balancing the safety with the independence for disabled people requiring gait trainers.

Reaching the target market

Relationships

Mostly indirect, through trainer companies or reviews

Client feedback response plan

Channels

As accessories on already-existing trainers

Available separately direct-to-consumer through private sales

Customer Segments

Parents of those with disabled children

Caretakers for the disabled requiring gait trainers

Cost Structure

Manufacturing Costs

Marketing and Sales

Development for Adaptability

Revenue Streams

Through gait trainer accessory profits

Through direct-to-consumer purchases

Through investors

Deliverable G - Economics

		Income ($)	Cost ($)	Details
Sales Revenue (3 years)		5,760,000		($400/unit*4800 units)*3 years
Materials			2,880,000	($200/unit*4800 units)*3 years
Cost of Goods Sold			2,880,000	
Gross Profit		2,880,000		
Operating Expenses				
	Overhead		200,000	Fixed initial expenses
	Shipping Costs		300,000	($21*4800 units/year)*3 years
	Electricity		300,000	
	Salaries		1.5 million	(10 Workers *$50,000 annual)*3 years
	Equipment Rental and Rent		112,500	(40ft by 40ft Space at $1.50/ft^2, Also 3 mills at $2900 each)*3 years
	Depreciation Costs		30,000	(3 Years)
	Loans		100,000	(Over all 3 years) (Paid back in first year)
Operating Income		337,500		(No income Tax)
Net Income		337,500		

Quarter	PV Income	PV Expenses	PV Profit (I - E)
1	$480,000	$651,875	-$171,875
2	$960,000	$1,103,750	-$143,750
3	$1,440,000	$1,555,625	-$115,625
4	$1,920,000	$2,007,500	-$87,500
5	$2,400,000	$2,434,375	-$37,375
6	$2,880,000	$2,861,250	$18,750
7	$3,360,000	$3,288,125	$71,875
8	$3,840,000	$3,715,000	$125,000
9	$4,320,000	$4,141,875	$178,125
10	$4,800,000	$4,568,750	$231,250
11	$5,280,000	$4,995,625	$284,375
12	$5,760,000	$5,422,500	$337,500

Income Statement

PV Analysis

Testing Our Design

Aspects Tested	Target	Observed
Activation Range	10 meters	18.3 meters
Braking Force	750 N (Given)	Sufficient
Activation Time Delay	1 Second	0.5-1.0 Seconds
Mount Stability	Firmly (No Budge)	Minute Movement
Braking Distance	1 meter	1-2 meters
Total Mass (1 brake unit)	2-3 lbs	5 lbs
Battery Life	2.5 hours	2-3 hours
Cost (More of a Constraint)	$100	$150

Quantitative	Qualitative

LIVE DEMONSTRATION

Trials and Tribulations

Constraints

- Budget

Tribulations

- Changing client requirements

Lessons Learned and Future Work

Lessons learned

- Communication
- Organization

Future work

- Second brake
- Soldered connections

Conclusion

- Many struggles and obstacles
- Ultimately: **a success!**
- Worthwhile learning experience for client-driven development

Thanks for Listening!