



uOttawa

GNG 2101

A 2.3

One-Handed Walker Steering

By: Defne, Ekin, Jérémie, Jorge, and Saheel

Client Meet 1

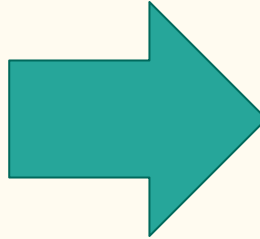
1. What do you think the current walker lacks to accommodate people with limited mobility in the arms?
2. What type of walker should the device be compatible with?
3. For what person is the product intended?
4. Do you have an email we can contact you with?
5. Do you expect the user to be able to install the device themselves or need help?
6. Do you have a preference between an electronic (batteries) or a mechanical device?
7. What has led you to want to fix this problem?
8. Has there been a lot of requests for a product like this?
9. Do you have a preference for the materials that the frame will be made with?
10. Where do you usually use your walker?
11. Are aesthetics a high priority?
12. How do you currently steer your walker (if dislocated)?



Problem analysis

- **Client Statements**

1. I want the device to be long-lasting, be permanent
2. I want to be able to walk over snow banks
3. I want the device to be detachable and versatile
4. I want the device to be stable, balance is key
5. I want the device to be able to fold on itself...

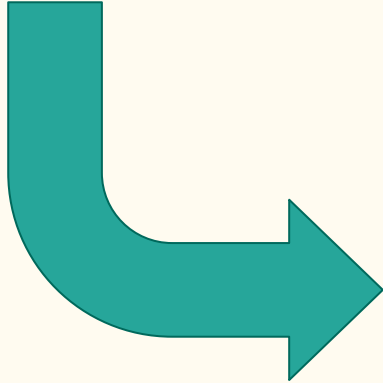


- **Translated customer needs**

#	Need	Imp
1	The device lasts a long time	4
2	The device can endure extreme weather conditions (snow, rain, cold and heat)	3
3	The brackets can be on installed easily on any walker	5
4	The fasteners fit tight	4
5	The device allows an easy installation without making permanent changes to the walker...	3

Metrics

Needs List



Metric #	Needs #	Metric	Unit
1	9	Force required to use device	N
2	9	Manoeuvrability (Turning Radius)	m
3	9	Agility (Rotational speed)	deg/s
4	8	Total weight	kg
5	7	Dimension	m^3
6	2,7,1	Reliability (MTBF)	h
7	1,8	Material	N/A
8	3,5	Detachability (Time to assemble)	min
9	4,9,10	Ease of use	N/A
10	6	Cost	CAD

Benchmarking



No previous
attempts found

Specification	Importance (Weight)	Nitro Euro Style Walker Rollator.	Electric Wheelchair	Manual Wheelchair
Make		Drive Medical	Fold and Travel	Medline
Cost (CAD)	5	400	2900	287
Load Limit (N)	3	1300	1470	1332.8
Material	2	Aluminium	Aluminium	Aluminium
Dimension (cm)	3	70.5 x 58.4 x 92.2 centimetres	72.2 x 62.5 x 95.5 centimetres	80 x 64.8 x 92.7 centimetres
Ease of Installation	4	3	2	2
Force required (N)	5	10	1	130
Manoeuvrability	4	3	2	1
Agility	3	1	3	2
Reliability	4	3	1	2
Total		83	60	67

**Benchmarking done for
components and devices
with similar purpose
(steering)**

Functional decomposition



Decomposition of all needs into logical separable Tasks



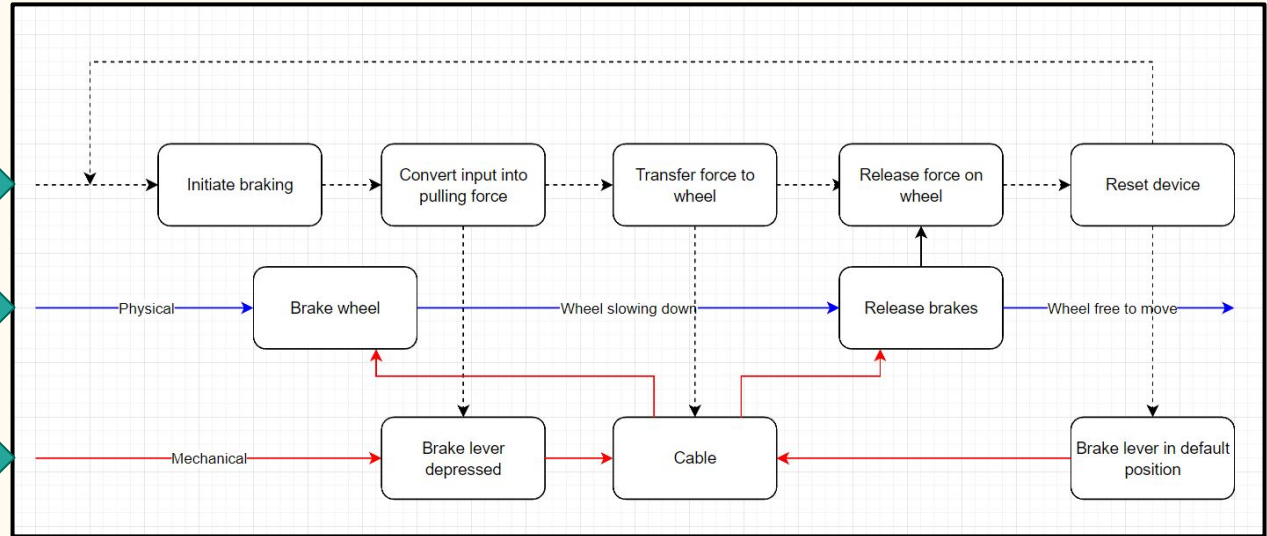
1. Logical



2. Physical



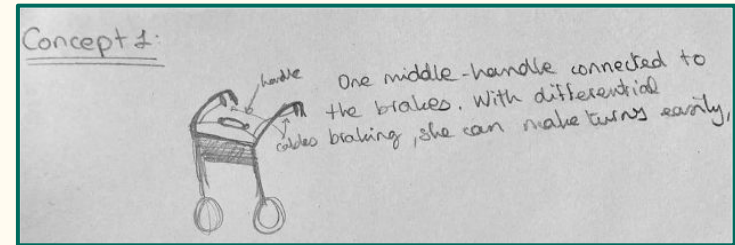
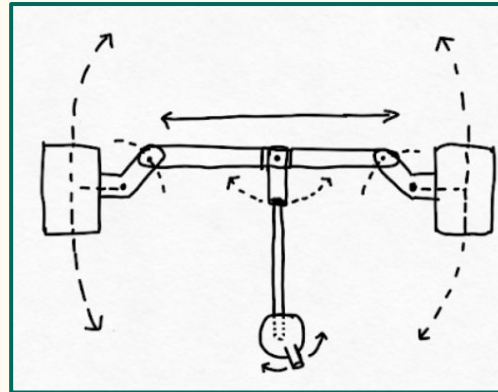
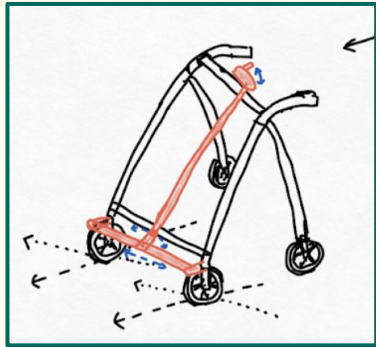
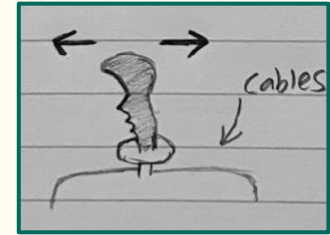
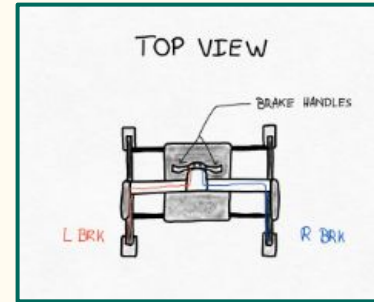
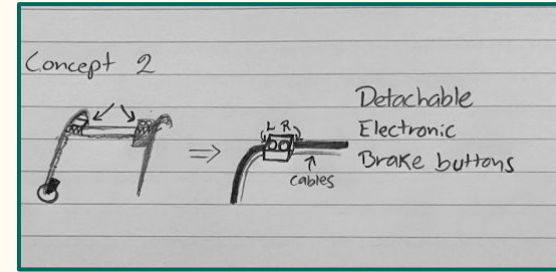
3. Mechanical



Ideation

15

Ideas / Sketches



Target Specifications

Metric #	Functional Requirements	Relation	Value	Unit	Verification Method
1	Force required to use device	<	10	N	Test
2	Manoeuvrability (Turning Radius)	<	2	m	Test
3	Agility (Rotational speed)	>	30	deg.s ⁻¹	Test
#	Non-Functional Requirements	Relation	Value		
4	Total weight	<	8.5	kg	Test
5	Dimension	<	0.55	m ³	Test
6	Reliability (MTBF)	>	2500	h	Estimate
7	Material	-	Aluminium	N/A	Analysis
8	Detachability (Time to assemble)	<	20	min	Test
9	Ease of use	-	-	N/A	Test
#	Constraints	Relation	Value	Unit	
10	Cost	<	100	CAD	Given
11	Time to complete project	<	1/12/2022	Date	Given

Decision Matrix

Concept Options (Part 1 of 3)											
Selection criteria	Weight	Defne Concept 1		Defne Concept 2		Defne Concept 3		Jérémie Concept 1		Jérémie Concept 2	
Force required	0.15	5	0.75	9	1.35	8	1.2	5	0.75	10	1.5
Maneuverability	0.13	5	0.65	7	0.91	8	1.04	4	0.52	8	1.04
Cost	0.13	5	0.65	6	0.78	6	0.78	5	0.65	1	0.13
Total weight	0.15	5	0.75	4	0.6	5	0.60	5	0.75	4	0.60
Dimension	0.11	5	0.55	3	0.33	6	0.66	7	0.77	7	0.77
Reliability	0.11	5	0.55	5	0.55	6	0.66	7	0.77	3	0.33
Material	0.07	5	0.35	4	0.35	5	0.35	5	0.35	3	0.21
Ease of installation	0.15	5	0.75	6	0.9	5	0.75	4	0.6	3	0.21
Total Score		Ref. = 5		5.77		6.04		5.16		4.79	

Concept Options (Part 2 of 3)											
Selection criteria	Weight	Jérémie Concept 3		Jorge Concept 1		Jorge Concept 2		Jorge Concept 3		Saheel Concept 1	
Force required	0.15	10	1.5	4	0.6	10	1.5	5	0.75	10	1.5
Maneuverability	0.13	8	1.04	5	0.65	7	0.91	7	0.91	8	1.04
Cost	0.13	1	0.13	7	0.91	2	0.26	5	0.65	4	0.52
Total weight	0.15	3	0.45	5	0.75	3	0.45	4	0.60	5	0.75
Dimension	0.11	4	0.44	5	0.55	1	0.11	4	0.44	5	0.55
Reliability	0.11	1	0.11	6	0.66	1	0.11	6	0.66	4	0.44
Material	0.07	1	0.07	1	0.07	2	0.14	3	0.21	5	0.35
Ease of installation	0.15	1	0.15	3	0.45	1	0.15	3	0.45	2	0.3
Total Score		3.89		4.64		3.63		4.67		5.45	

Concept Options (Part 3 of 3)											
Selection criteria	Weight	Saheel Concept 2		Saheel Concept 3		Sarp Ekin Concept 1		Sarp Ekin Concept 2		Sarp Ekin Concept 3	
Force required	0.15	10	1.15	4	0.6	4	0.6	5	0.75	10	1.50
Maneuverability	0.13	7	0.91	6	0.78	6	0.78	3	0.39	6	0.78
Cost	0.13	8	1.04	1	0.13	5	0.65	5	0.65	1	0.13
Total weight	0.15	7	1.05	2	0.3	7	1.05	2	0.30	1	0.15
Dimension	0.11	7	0.77	2	0.22	7	0.77	5	0.55	3	0.33
Reliability	0.11	8	0.88	4	0.44	2	0.22	5	0.55	4	0.44
Material	0.07	6	0.42	3	0.21	5	0.35	5	0.35	5	0.35
Ease of installation	0.15	9	1.35	1	0.15	5	0.75	1	0.15	2	0.30
		7.57		2.83		5.17		3.69		3.98	



Winner concept



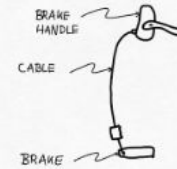
Client Meet 2

- Ask for input
- Ask for any updates on the requirements
- Discuss all possible ideas



Final Decision

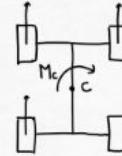
CONCEPT 2: CABLE DIFFERENTIAL BRAKING



Input force
↓
Force conversion
↓
Output force

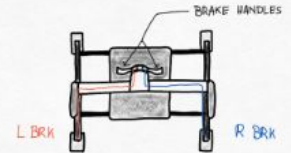
FBD: RIGHT BRK APPLIED

(Differential braking example) (All 4 wheels steerable)



⇒ Walker steers to the right

TOP VIEW



Positives

VS

Negatives

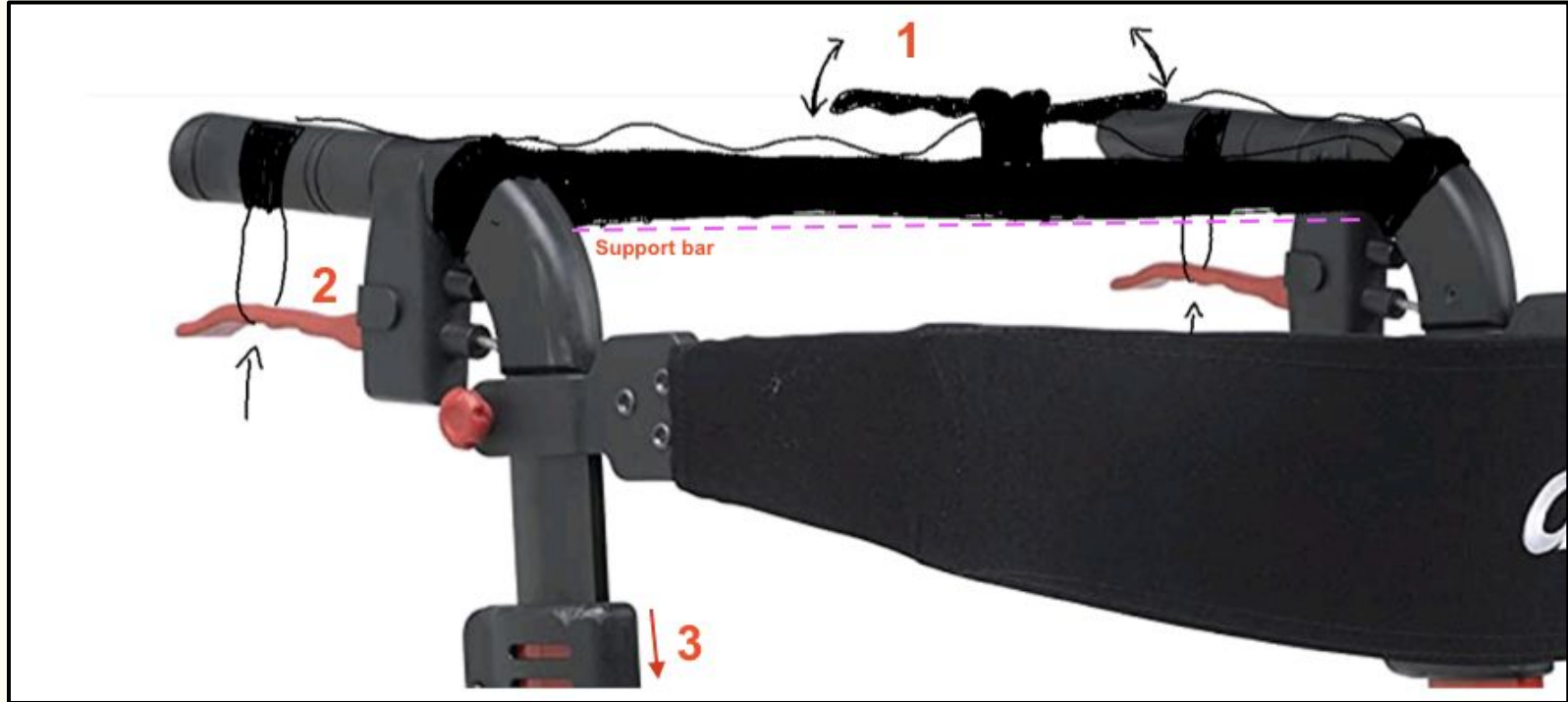
- Low price point
- Ease of installation
- Reliability
- Ease of Use



- Complexity
- Maneuverability



First Prototype -> Low fidelity



Testing -> (focused & analytical)

1. Brake displacement testing

$$\begin{aligned} X_{\text{Lever1}} &= 8.3 \text{ cm} \\ X_{\text{Lever2}} &= 1.8 \text{ cm} \\ X_{\text{Wire1}} &= 2.7 \text{ cm} \\ X_{\text{Wire2}} &= 5.2 \text{ cm} \end{aligned}$$
$$\text{displacement ratio} = \frac{|\Delta X_{\text{Wire}}|}{|\Delta X_{\text{Lever}}|}$$
$$= \frac{|2.7 - 5.2|}{|8.3 - 1.8|}$$
$$= 0.385$$



Figure 1

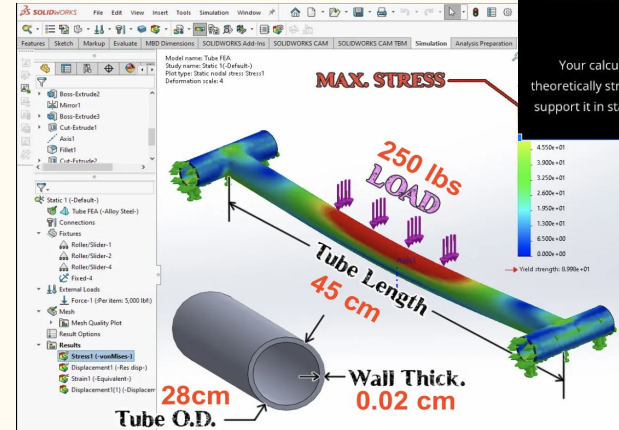
Figure 2



Figure 3

Figure 4

2. Cross Bar Weight Distribution Testing



Material

6063-T6 Aluminum

Choose your material. 1020 and 4130 are the most common choices for cage

Stress Calculation

151 PSI

This is the stress (in PSI) in your material with the load you specified. This does depend on the material chosen.

Safety Factor

139.073

Note: This is a safety factor (they are unitless). See commentary and analysis below.

Comments/Analysis

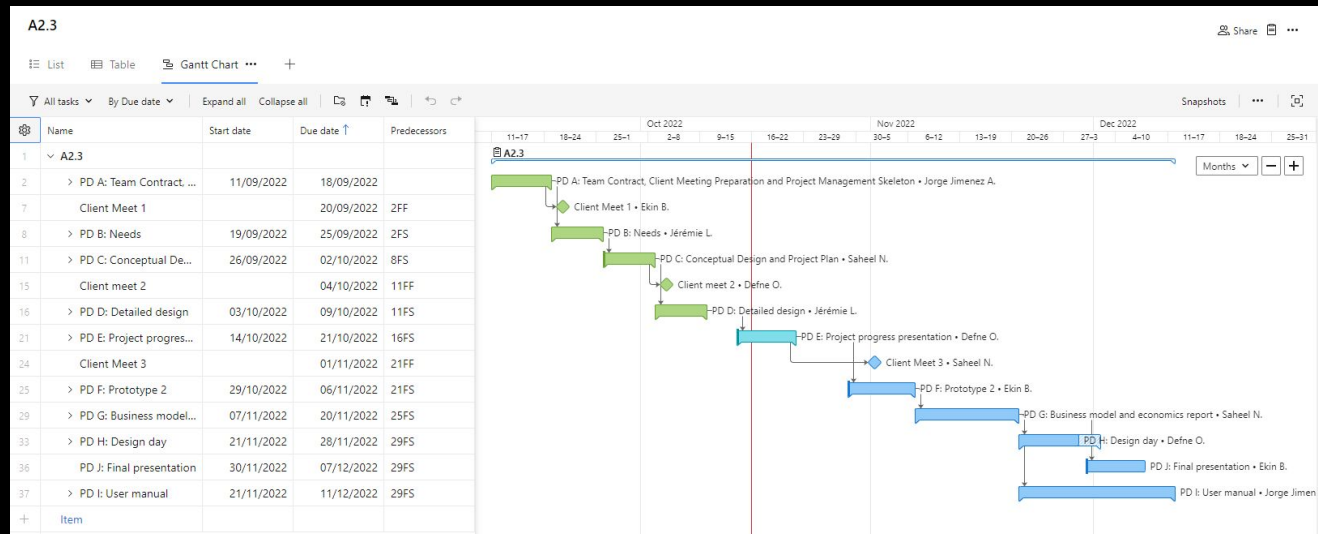
Your calculated safety factor is OVER 1.0. That means your material is theoretically stronger than the load you entered, and is calculated to be able support it in static (not-moving, non-impact) conditions. Get this number even higher for more confidence in your application.

Bill of materials

Bill of Materials			
Material required	Amount	Cost (shipping included)	Link
Brake wire with black tubing	10 pcs	\$12.29	https://amzn.to/3MfO362
Aluminum Brake handle	2 pcs	\$15.99	https://amzn.to/3CKcw0n
Aluminum tube 28x26x500 mm 6063-T6	1 pc	\$32.49	https://amzn.to/3fUZOTu
Sail tie Optiparts	1 pack	\$19.35	https://bit.ly/3T5VChR
Scotch-Mount ½” x 15”	1 pack	\$15.50	https://amzn.to/3fSzGIW
Total Cost =		\$95.62	

- Preliminary
- Under \$100 dollars
- Shipping included
- Additional material considered*

Plan



Our 3 Next Steps

1. Finalize the fasteners' designs
2. Explore options for power to displacement conversion
3. Physical Prototype



Prototype 2

- Physical
- Medium Fidelity
- Reuse Materials For Final product



Client Meet 3 - Questions

1. Are you able to use a bicycle brake?
2. How often do you use the seat on your walker?
3. Do you have a favorite color for us to use for the casing?
4. Would you like to have one handle in the middle of the support bar, or would you rather have one on each side of the mechanism?
5. How do you usually lean onto your walker?



What we will improve on for Client Meet 3

- Share screen with the new prototype
 - Rehearse our presentation
 - Be ready for questions
 - Bring visual support
 - Record the meeting (with consent)
-

Thank you

—