GNG 2101 Deliverable B

Deliverable B: Needs, Problem Statement, Benchmarking, Metrics and Target Specifications

Submitted by

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1. Introduction

Erica is an individual who lives with a disability knows as cerebral palsy. This condition restricts Erica to perform necessary everyday tasks, such as walking, balancing, and other physical activities. Because of this condition, Erica experiences challenges every day. As for transportation, since she has trouble walking, she uses a Nexus rollator. However, this device is known to be quite heavy for her and her husband, and this makes it difficult to transport. Since Erica is suffering from a disability, she isn't capable to move the rollator into her 2016 Kia Sorrento when going on outings with her husband. This is also an issue for her husband since he also suffers from a disability which prevents him from lifting heavy objects. Currently, Erica has a lift for a scooter installed in the back of her vehicle. She and her husband would prefer having a lightweight, foldable and affordable posterior walker which would replace the Nexus Rollator. This new posterior walker would have to be able to be stored in the back seat of their vehicle and light enough to be lifted by her husband.

Many current posterior walkers are expensive, heavy and inconveniently large. However, there aren't many options to choose from that will satisfy all the needs of users. Having a bulky design can interfere with everyday use. It can restrict some individuals from getting where they want to go, and it may cause some individuals to feel uncomfortable when traveling in very crowded areas. An individual with a disability must pay for highly expensive medications and treatment, the cost of a posterior doesn't help save money in any way. Many posterior walkers can be as expensive as $400. Posterior walkers this expensive can be a huge problem for many

individuals, especially if such individuals need a posterior walker for transportation. If an individual has trouble walking, it shouldn't be expected of them to carry and store such a heavy device. The weight of a posterior walker ranges anywhere from 9 to 16 pounds.

The purpose of this project is to design an ideal posterior walker for Erica which would satisfy all her needs. Having this product will simplify Erica's life, allowing her and her husband to travel more efficiently without hassle, as well as allowing them to enjoy desired outings without having to carry around a heavy rollator. This product will be designed as a better alternative than many products offered and surpass the client's expectations.

This document will consist of a list of prioritized needs, benchmarking scores and a list of metrics from comparable products to obtain and design a better solution, a list of targeted specifications, reflections of the client meetings. Most of these details will be taken from various interviews with Erica and will be used to satisfy her needs.

2. Client Statements and Observations

We met with our client Erica and her husband Fahad in a Starbucks on a Sunday morning. We talked with them in detail about their desires for this project, asking several questions about all aspects of her current walker and their idealized walker. We also interacted with their current walker, watching as she used it to move around the Starbucks and the parking lot and trying out walker functions for ourselves (such as braking, lifting, turning, and collapsing). Finally, we watched them load the walker into the car as well as some of the obstacles they faced to do so. We compiled the following list of statements and observations.

Paraphrased Client Statements

Erica needs a walker to help her walk on her own. Some specific things she expressed were the following:

- She wants a walker, not a transport device to move a walker into the car.
- Needs to be a posterior walker to help her stand as tall as she can because her current walker gives her bad posture and back pain.
- She has tried a Crocodile posterior walker meant for children and found that the front wheels didn't turn, but lifting it to turn it threw her off balance.
- She does not care about having a built-in seat or a basket.
- She usually does not put her full weight on it, however when she is unbalanced she relies on it to carry her full 120lbs of weight without tipping. The current walker tips occasionally, especially when a wheel gets caught.
- Her favourite colour is light teal. She pointed at her phone case as inspiration.
- She would like to have some limited height adjustment for days when her posture is different.
- Hand brakes are extremely important. Her current walker has both hand brakes that apply tension downwards on the wheel and slow-down brakes that limit the overall speed, such as when she is going down a slope. Her current walker doesn't always prevent motion when it is locked - the wheels sometimes slide on the surface while locked.
- She uses it mainly indoors, but ideally it could handle the outdoors as well, like sidewalks and parking lots in the winter.
- Their home is mostly hardwood flooring. She mentioned that tiles and ceramic floors are the most unpredictable for traction.
- They have had to replace the handles about 3x already because of how much weight is on them. The front tears apart. We observed the rubber grips slipping off of the handles.

Fahad will be the primary person responsible for lifting the walker into the car when they go out, however his degenerative disability means that he has limited motion. Some specific things he expressed were the following:

- The walker needs to fit between the back seat and the front seat and will not take away room from other passengers.
- He has low grip strength, so he prefers mechanisms that let him use his whole hand.
- He must brace himself against the car to lift the walker into the car, so he must be able to collapse and lift the walker into the car with one hand.
- "The current walker is fine as long as you're always lifting the way it's designed to be lifted." This means that as soon as he leans it against the car floor to push it inside, it uncollapses.

They also expressed some helpful non-functional details such as:

- They own a cat. We observed some cat hair caught in the wheel brake.
- Nexus III Rollators are the most popular brand.

Team Observations

- When they arrived, they let the car idle in front of Starbucks while Erica got out and engaged with her walker. Fahad then drove back to park. They went to the car together when it was time to leave.
- Fahad demonstrated that he was still able to push the walker around when the wheels were locked.
- Erica demonstrated the wheel brake for us by pulling on a triangle-shaped handle under the regular handle. She had no difficulty operating this break.
- A delivery driver stopped in front of the sidewalk when it was time to leave and Erica had to maneuver around it with difficulty. We observed that it was crucially important for her to use a sloped surface to move on and off of sidewalks.
- When Fahad was putting the walker back in the car, the car next to theirs had parked quite close to theirs. This meant that there was less than 1m of space for him to put the walker in the car.
- Their 2016 Kia Sorento back door opened outwards on a hinge.
- Fahad did not sit inside Starbucks. We observed that he did not seem comfortable with a lot of bending motions.
- There were adjustment screw handles on the walker that were about 7cm in diameter, and Fahad suggested that he could use these with little trouble.
- We wrote down the following measurements for her current walker:
    - Hand grips are 32" high
    - Hand grips are 20" apart (could be 15-18" apart, probably)
    - Width is ~11" collapsed

- Wheel diameter: 8”. “Typically you see big wheels in the back, small wheels in the front.” Her current rollator wheels are all the same size.
- ~5” = length of handle part
- 1.75” - width of handle diameter

3. List of Prioritized Needs

From our client meeting, we have created the following list of needs. We have rated them on a scale of 1-5 where:

- 1 means the need is not important or relevant.
- 2 means the need would be nice, but is not important or essential.
- 3 means the need would be nice, but is only mildly important and not essential.
- 4 means the need is important but not essential.
- 5 means the need is important and essential.

ID	Need		Rating
1	The walker	supports at least 120 lbs of weight.	5
2	The walker	stays in upright and locked position in use.	5
3	The walker	turns smoothly in any direction, from motion or rest.	4
4	The walker	collapses to a size that will fit behind the front car seat.	5
5	The walker	allows Erica to stand at full height with her hands on the handles.	4
6	The walker	brakes.	5
7	The walker	has controllable wheel speed (ie roll slower on slopes).	5
8	The walker	is lightweight.	5
9	The walker	has good traction on the ground.	4
10	The walker	is stable when unexpected or uneven forces are put on it.	5
11	The walker	stays collapsed when it is intended to be collapsed.	4
12	The walker	has a limited range of height-adjustability.	4
13	The walker	has wheels that maintain traction with dust, salt, and cat hair.	4
14	The walker	feels sturdy.	4
15	The walker	does not degrade with intense, everyday use.	3
16	The walker	is compact when lifted.	4
17	The walker	can be picked up without a lot of bending over.	3

18	The walker	is a pretty teal colour.	2
19	The walker	feels sturdy and strong.	4
20	The walker	collapses with a smooth and easy one-handed motion.	4
21	The walker	requires little maintenance.	3
22	The walker	has comfortable handles.	3

4. Problem Statement

From these needs, we were able to create the following problem statement that will inform the rest of our design process.

Erica needs a lightweight and sturdy posterior walker that can be collapsed with one hand and fit compactly into the back seat of a car.

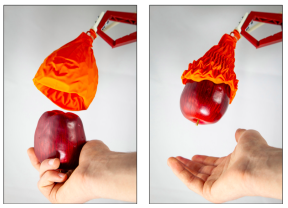
5. Benchmarking Tables

Table 1. Benchmarking Walkers

Feature	Nexus Rollator Walker (current walker)	Deluxe Two Button Folding Walker	Drive Medical Deluxe Two Button Folding Walker	Folding Adjustable Walker Rollator
				
Lightweight	✗	✓	✓	✓
Foldable	✓	✓	✓	✓
Has a seat	✓	✗	✗	✓
Cost	↑	↓	↓	↓

Wheels	✓	✗	✓	✓
Comfortable	✓	✗	✗	✓
Aesthetically pleasing	✓	✗	✗	✗
Adjustable	✓	✓	✓	✓
	https://www.amazon.ca/Nexus-Rollator-Walker-Standard-Handles/dp/B07K4TDD7S/ref=sr_1_4?gclid=Cj0KCQiAjfvwBRCkARIsAIqSWlNBlwMtO2SbU3GId3mKH78v8gqwhTC-xT6ZvcenCUfXDIpxOcqGCDEaArx4EALw_wcB&hvadid=320872438759&hvdev=c&hvlocphy=9000668&hvnetw=g&hvpos=1t1&hvqmt=e&hvrand=6764806849158914279&hvtargid=kwd-309370365252&hydadcr=27653_10600063&keywords=nexus+rollator+walker&qid=1579143020&sr=8-4	https://www.amazon.ca/Deluxe-Two-Button-Folding-Walker/dp/B000MMC6EE/ref=sr_1_18?gclid=Cj0KCQiAjfvwBRCkARIsAIqSWlODa0H3orAtZ8ho0tGIk1AMFCGjeXAbNwqjWsVBw3FX4toIFDsqxwsaAodDEALw_wcB&hvadid=208690734903&hvdev=c&hvlocphy=9000668&hvnetw=g&hvpos=1t1&hvqmt=e&hvrand=5459023756383210565&hvtargid=kwd-296094240922&hydadcr=20846_9881420&keywords=walkers&qid=1579144402&sr=8-18	https://www.amazon.ca/Drive-Medical-Deluxe-Button-Folding/dp/B001HOM4U2/ref=sr_1_8?gclid=Cj0KCQiAjfvwBRCkARIsAIqSWlODa0H3orAtZ8ho0tGIk1AMFCGjeXAbNwqjWsVBw3FX4toIFDsqxwsaAodDEALw_wcB&hvadid=208690734903&hvdev=c&hvlocphy=9000668&hvnetw=g&hvpos=1t1&hvqmt=e&hvrand=5459023756383210565&hvtargid=kwd-296094240922&hydadcr=20846_9881420&keywords=walkers&qid=1579144402&sr=8-8	https://www.amazon.ca/Adjustable-Rollator-Healthcare-Mobility-Lightweight/dp/B07GVC82CQ/ref=sr_1_3_sspa?gclid=Cj0KCQiAjfvwBRCkARIsAIqSWlODa0H3orAtZ8ho0tGIk1AMFCGjeXAbNwqjWsVBw3FX4toIFDsqxwsaAodDEALw_wcB&hvadid=208690734903&hvdev=c&hvlocphy=9000668&hvnetw=g&hvpos=1t1&hvqmt=e&hvrand=5459023756383210565&hvtargid=kwd-296094240922&hydadcr=20846_9881420&keywords=walkers&qid=1579144402&sr=8-3-spons&psc=1&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUEzNUVFVDZOOVI2M0ZRJmVuY3J5cHRlZElkPUEwMDM5NDk3MjFOVk9aQjVJM1EyVSZlbmNyeXB0ZWRBZElkPUEwMDE2Njg1M1NINE9XTlhCUVMwNSZ3aWRnZXROYW1lPXNwX2F0ZiZhY3Rpb249Y2xpY2tSZWRpcmVjdCZkb05vdExvZ0NsaWNrPXRydWU=

Table 2. Benchmarking device that can pick up items

Feature	Deflated Balloon Robot Hand	Lynxmotion Smart Servo Robotic Arm	Manual Chain Hoist
			
Cost	↑	↑	↓
Accessible remotely	✓	✓	✗
Lift heavy items	✓	✗	✓
Move across 3 planes	✓	✓	✗
Complexity	↓	↑	↓
Aesthetically pleasing	✓	✓	✗
Adjustable	✗	✓	✓
Fit into small spaces	✓	✓	✓
	https://techcrunch.com/2019/03/13/mits-deflated-balloon-robot-hand-an-pick-up-objects-100x-its-own-weight/	https://www.robotshop.com/en/lynxmotion-smart-servo-lss-4-dof-robotic-arm-assembled.html	www.harborfreight.com/1-ton-chain-hoist-996.html.

6. Metrics with Associated Units

Metric #	Needs #	Metric	Imp	Units
1	8	Total Weight	5	lbs
2	4,11	Width of Collapsed Walker	5	in
3	3	Wheel Movement	4	deg
4	1,19,14	Load Exerted	5	lbs
5	21	Loading Time	3	s
6	7	Front Wheel Width	3	in
7	5,12	Ideal Walker Height	4	cm
8	7	Maximum Wheel Width	4	in
9	7	Maximum Wheel speed	3	cm/s
10	6	Brake Efficiency	5	%
11	22	Handle weight	5	lbs
12	2,16	Compact Lock Strength	4	N
13	8	Weight of Wheel	5	lbs
14	12	Ideal Walker Width	4	in

15	22	Size of Handle Grip	3	in
16	21	Maintenance Time	3	hrs
17	0	Unit Manufacturing Cost	5	$

7. Set of Target Specs

	Metric	Unit	Marginal Value	Ideal Value
1	Total Weight	lbs	>8	8
2	Width of Collapsed Walker	in	>14	>13
3	Wheel Movement	deg	<180	360
4	Load Exerted	lbs	<120	140
5	Loading Time	s	>40	25
6	Front Wheel Width	in	>8	>7
7	Ideal Walker Height	in	>40	>35
8	Maximum Back Wheel Width	in	>10	>8
9	Maximum Wheel speed	cm/s	>25	>20

10	Brake Efficiency	%	>30	>20
11	Handle weight	lbs	>2	1
12	Compact Lock Strength	N	>10	5
13	Weight of Wheel	lbs	>3	>2
14	Ideal Walker Width	in	>25	23
15	Length of Handle Grip	in	>5	>4
16	Maintenance Time	min	>20	>15
17	Unit Manufacturing Cost	$	<100	100

8. Reflection of Client Meeting

After meeting with Erica and Fahad, we got a lot of insight on what our defined task is for this project. We went into the meeting not knowing exactly what we were going to build for our client. We were not sure if Erica wanted a brand new walker or a device to lift and place her current waker into the car. After talking to our client we decided that a brand new walker would better match Erica and Fahad's needs.

Some of the worries we have after the meeting is if we will be able to meet the criteria of it weighing a maximum of 8lbs so that Fahad will be able to lift it into the car. We are worried that we will not be able to get material for the structure and wheels that will be lighter that 8lbs put

together. We have categorized 4 main criteria that we have to focus on to achieve our goal of creating the best possible lightweight walker. The four main components that we will have to think about, the wheels, the structure, the breaking systems of the walker and the collapsing of the walker, were some of the most important components according to our client and our group after analyzing what was talked about during the meeting. We will need to find wheels that have enough traction in the snow but are also very lightweight. We will also have to ensure that the body of the whole walker is light and are therefore considering using carbon fiber, a common material used for high end bicycles and racecars. The only problem with carbon fiber is that it will be very expensive. We also have to figure out how to make the mechanism lock into place so that it does not open up when it is being lifted just as their current walker does. There are also many ways in which the walker could fold, therefore we have to figure out the best way so that it is compact while still being as light as possible. Since it will be hard for our group to stay within the $100 budget with the carbon fiber for the entirety and the lightweight wheels with a lot of traction, our group will try to reach out to different companies and ask for a discount on the materials or possibly even for the company to fund our entire project. Another way that we can overcome this obstacle is to try and get funding from the university on this project.

After meeting with the client in person it really made our group empathize with the customer and want to put out our best work possible so that the client can actually use the product. It was hard to believe that companies like Nexus, (the brand of Erica's current walker) do no offer lightweight walker options and do not consider that people with will need to lift them into places as Fahad was explaining to us. That is why after this meeting our group wants to do our best in order to help satisfy our client's needs in the best way possible.

9. Conclusion

After meeting with the client and understanding what they need, it was clear that our client needed a brand new posterior walker. The current Nexus III walker wasn't the best design for her and her husband's everyday needs. She and her husband would prefer having a lightweight, collapsible and affordable posterior walker which would replace the Nexus Rollator. This new posterior walker would have to be able to be stored in the back seat of their vehicle and light enough to be lifted by her husband, as well as provide extra support to Erica. With all the information given by our client, we have a much better understanding of what we must create to satisfy their needs. Our next step would have to be testing different materials and looking at different designs to find exactly what would be best for our client. Following the clients feedback, we will be able to start working on our first prototype.

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