uOttawa

Deliverable B: Problem Definition, Concept Development, and Project Plan

Elisha Khandaker, 300308377
David Mclntyre-Garcia, 300241605
Madeleine Forcese, 300287850
Jonathan Birmingham, 300247449
Tyler Yu, 300133533

May 22, 2023

Table of Contents

B.1 Problem Definition

User Statements/Problems:

- Biggest challenge: **Convenient, flexible**
- Everyday tasks: **Everything**, single parent with daughter
- How she deals with it now: **Leaning** a lot, EDS is progressing, dislocating back, shoulder
- Maintenance: don't need much repairs
- Likes/Dislikes of previous attempts: Flexibility for brake, no need to separate to brake, handle on top (helps because she gets weak and shoulders go), needs to be **lightweight, flexible, convenient**
- How is mobility limited?: Has trouble when doing groceries
- No electronic components: No, **big wheels for grass**, **Nitro**
- Crowded areas: Small apartment, barely fits through hallways, difficult. About half an inch on each side. Elevators goes down a lot, needs to use **stairs**
- **Folding is essential**, getting into taxis, going downstairs in case of emergency
- Arm is in a **sling**
- Arm mobility: max height is about arm parallel to ground, no full ROM, wrist can still be used for the most part.
- Other considerations: **CONVENIENCE, FLEXIBILITY, CARRYABLE**. Daughter (11yrs), helps her a lot by going upstairs with a walker.
- Other info?: EDS, connective tissue disorder, can dislocate by reaching for tv remote, can dislocate when making bed, like a rubber band

From the following lists we can conclude the things that we know and do not know.

The things we know include:

- What the walker looks like
- What type of walker it is
- How it must be able to maneuver around the user's living space
- The mobility of the injured arm

The things we don't know include:

- Specifically how the walker folds
- How the walker moves
- How the user specifically leans on the walker

From the above list of user statements and problems we can conclude that the client primarily desires a portable, maneuverable and adaptable design. These factors can be represented by the translated list of needs/problems below.

Translated List of needs/problems

Functional (DO)

- Easy to maneuver (easy to carry around - user friendly, easy to take on and off - easy to fold)
- Easily applicable brake system
- Allows for one handed steering of walker

Non-functional (BE)

- Adaptable (works for either arm)
- Durable (different weather types)
- Installable without permanent changes to the walker

Prioritizing client needs

After determining the translated list of needs/problems into user needs/statements, we can prioritize the client's needs using the following table. The needs are prioritized based on client communication.

Number Priority (most to least importance)	Needs
1	Allows for one handed steering of walker
2	Adaptable (use with either arm)
3	Maneuverable (easy to take on and off and fold)
4	Easily applicable brake system
5	Durable (can be used in different kinds of weather)
6	Installable without permanent changes to the walker

Problem Statement

The client requires a maneuverable, lightweight, easily attachable device that allows them to steer the walker effectively with one arm through narrow spaces and diverse terrain.

Metrics

Characteristic	Unit	Measuring process
Folding/Collapsing	Yes/No	N/A
Total weight	kg	Weigh with scale
Length	cm	Measure tape
Length (Folded)	cm	Measure tape
Adaptable	Yes/No	N/A
Time to assemble	Seconds	Stopwatch
Time to attach to walker	Seconds	Stopwatch
Ease of use	Yes/No	N/A
Cost	CAD	N/A
Dimensions	cm^3	Measuring Tape

Benchmarking

Similar Solutions Link	Satisfaction of User Needs
Carex Folding Hemi Walker: Carex Folding Hemi Walker - One Handed Walker For Seniors - Side Arm Style Walker : Amazon.ca: Health & Personal Care	• This walker can be used by seniors for "side style steering", this means it satisfies the users needs of being **convenient** and **adaptable** because either arm could be used to control the walker. • This walker does not have wheels so it would be difficult for the user to move through grass (as mentioned in the

	meeting). ○ Since our clients shoulders can dislocate at any time, a walker without wheels may apply more unwanted pressure to the shoulders as it would take more effort to maneuver. ● The walker is also height adjustable so it satisfies the users needs of **adaptability**. The height can be adjusted using buttons to slide the tubes up and down, this satisfies the users need of **convenience**. ● The walker is less than 5lbs (specifically 3.5lbs). This satisfies the **lightweight** user need. ● The walker is also able to fold which satisfies the users needs. This means it is **easily maneuverable, convenient, and adaptable.** ● The walker is **carryable** since it is lightweight and has a sturdy handle. ● The walker does not include a seat which is essential for the user in order to take breaks and rest when needed.
Stander Let's Go Indoor Rollator (1 Handed): Stander Let's Go Indoor Rollator (1 handed) – Mountain Medical	● This walker has a **narrow design** overall which satisfies one of the user needs. This aspect will help the user **navigate through narrow hallways and crowds.** ○ The single steering bar includes a brake which satisfies the user's need for **convenience**. ● The walker does not include a seat which is essential in regards to the user statements. ● The walker does include wheels which will help with maneuvering through grass and for "turning in tight spaces". ● This walker satisfies the **adaptability** aspect because the height can be adjusted so it is comfortable for the working arm (and the injured arm). ● The walker does not require any

	assembly so it satisfies the user's need of **assembling with only one arm**.
Crystal Dreams Boutique (single-handed steering component): 	• This single handed steering component for a walker satisfies **convenience** because it can be easily taken on and off. Which also means it should be quite **easy to install with one hand.** • The component is removable so it satisfies the walker still **being able to fold** once the piece is removed. • The component is also **adaptable** because when it is used, any arm can steer the walker. • It is important that this component does not add on too much weight to the existing walker, if it does then it does not satisfy an important user need. • It does not look like this component can fold which is an important user need. Although the component can be removed so the walker itself can fold this satisfies **adaptability** but not so much the user friendly user need.

Target Specifications

Characteristics	**< > =**	**Target Value**
Folding/Collapsing	=	Yes
Total weight	<	5 pounds
Length	=	55 cm
Length (Folded)	<	25 cm
Adaptable	=	Yes
Time to assemble	<	30 seconds
Time to attach to walker	<	30 seconds
Ease of use	=	Yes
Cost	<	100$ CAD

The walker should be able to effectively fold with the design applied to it. This is significant given its priority in client needs. The total weight of the walker with the design attached to it is a hypothesized value according to the need that the walker must be light and easy to carry. The length of the device is another hypothesized value that considers the height and length of the walker (both folded and opened). Adaptability is significant given its priority in client needs. Time to assemble and attach to the walker are measurable values according to the need of the client in which the device must be easily, quickly and efficiently attachable and detachable. The walker must also be easy to use, as indicated by client needs. The cost must be equal to or less than $100, according to the project specifications.

B.2 Concept Development

The basic design of the system will be a bar that connects between both of walkers original handles. From this we will add modules for the different subsystems. The bar is just what everything is going to be attached to.

Subsystem components

Attachment method gadget

Idea 1: Snap clip

Idea 2: Vice Clamps

Idea 3: Velcro

Idea 4: Belt and buckle

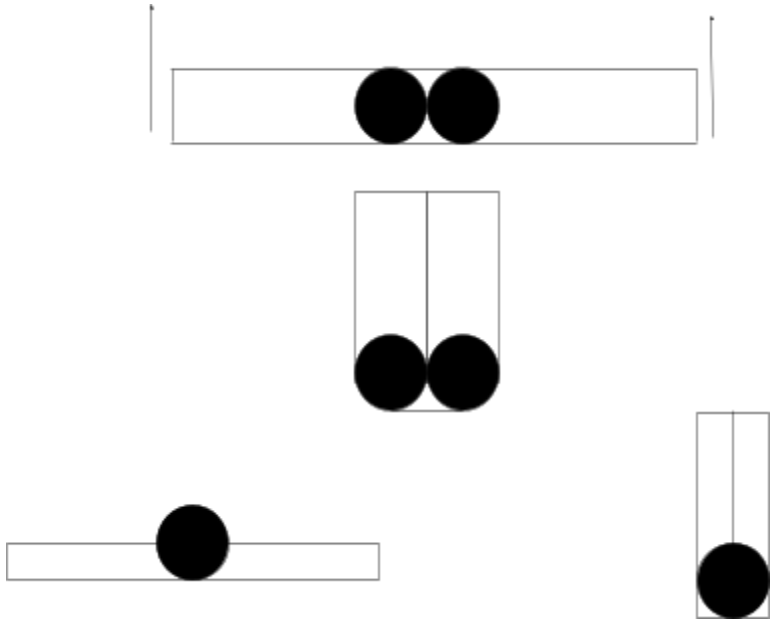
Idea 5: Magnetic

Folding System

Idea 1: Bar aligned with walker's external post

Idea 2: Telescoping inside of itself

Idea 3: Folding method shown in the diagram below.



Steering approach

Idea 1: Wheel attached to bar (in middle) that can be moved from the left side of the walker to the right

Idea 2: Handle that can be grabbed. Handle is roughly 50cm away from the bar going between the two walker handles. Allows for a more accurate and easier way to steer when compared to a bar going from walker handle to handle.

Idea 3: Lever that is placed in between both handles. The lever can be pushed towards both left and right directions to turn the wheels. The lever can also be pulled towards the user to brake.

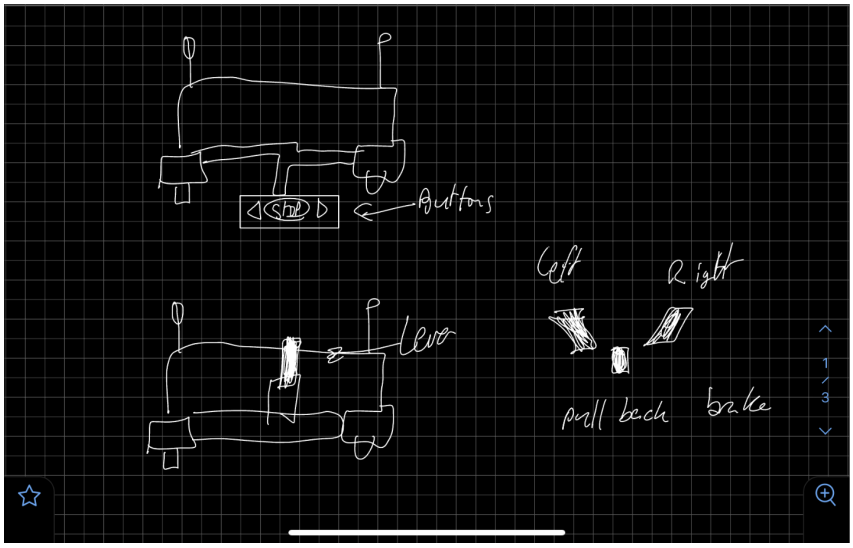
Idea 4: Steering controller that consists of 3 buttons. The controller allows the wheels to turn by pressing either left or right buttons. There is a bigger button in the middle that says, “STOP” allowing the user to activate the brake.

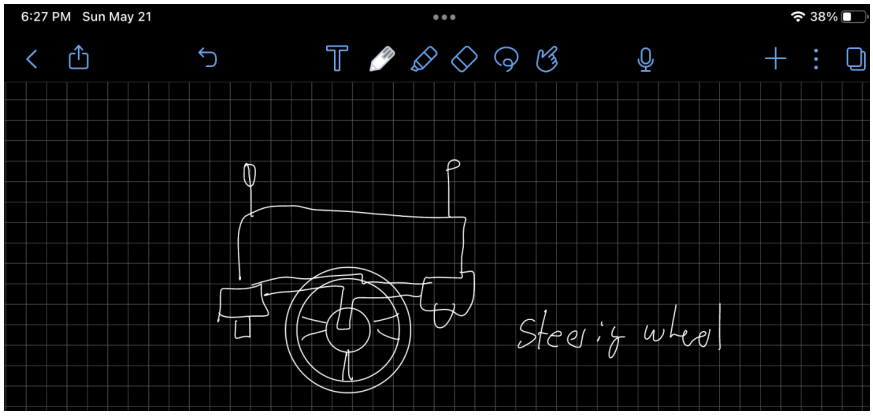
Adapting Mechanism

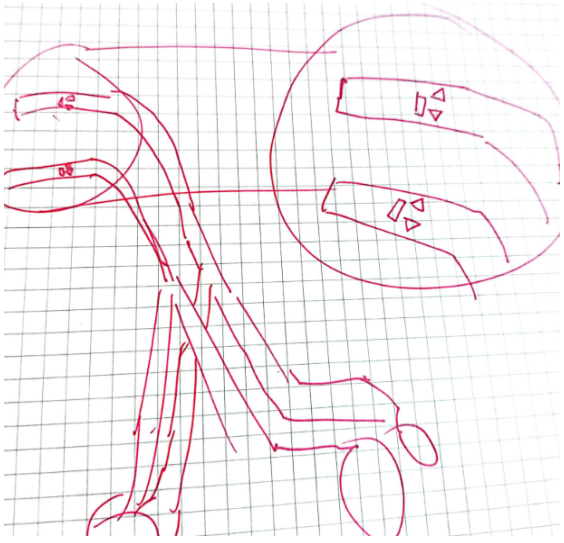
Idea 1: Whatever mechanism that we are going to use for the steering, will be able to move lengthwise across the bar. This will allow the user to move the steering mechanism into whatever position along the bar is the most useful. To do this we will have the mechanism attached on the bar using a circular clamp that can be tightened using a screw that twists to loosen/tighten, in a similar way to the function of a vice clamp.

Idea 2: The mechanism will be able to slide (across the walker) to either side of the walker, allowing it to be used with either hand.

Idea 3: The mechanism will be able to be attached and removed from either handle. Using a clip-on method the mechanism can be attached and moved around depending on the clients comfort and preferences.







Entire system components

After determining specific subsystem components for the prototype, we can now develop final prototype concepts for the entire assembled system. It is important to note that the following selection table is colour coded. Green represents the favored designs from each subsystem, orange represents the second most favored, and red represents the least favored. White represents other concepts.

*Each system idea includes a bar that goes across the width of the walker, going from handle to handle. The subsystems will be added to that bar.

Attachment method (To the walker)	**Folding**	**Steering**	**Adapting** (having system work on both sides)
Snap Clip	Bar aligned with walker's external post	Wheel	Circular clamp that can be tightened using a screw that twists to loosen/tighten, in a similar way to the function of a vice clamp.
Vice Clamp	Telescoping inside of itself	Extended handle	Sliding mount for the steering system.
Magnet	Bar has a pivot point in the middle where the bar can fold in half	Lever system	The mechanism will be able to be attached and removed from either handle. Using a clip-on method the mechanism can be attached and moved around depending on the clients comfort and preferences.
Magnetic weight stack pin		Electronic steering system (Buttons)	

Subsystem components vs Target specifications

Attachment method gadget

When considering how the design will be attached to the walker itself it is important to note that length, time, and ease of use are significant target specifications.

For idea 1 (snap clips), they would be able to easily reduce the time at which it takes to remove and attach the design to the walker. Rather than forcing the design off of the walker, the snap clips would allow the system to be easily removed and would not overly contribute to the weight requirements. For idea 2, the vice clamps allow the system to be easily assembled. For idea 3, the velcro also allows for quick time to assemble and attach to the walker along with ease of use. For idea 4, the belt and buckle apply to ease of use and time to attach to the walker. Finally, the magnetic system applies to the total weight, the time to assemble and the time to attach the system to the walker.

Folding System

When compared to the target specifications, the folding bar alternative (compared to a non folding bar) provides a convenient solution regarding the storage of our product during activities which requires the user to have the walker in the folded position. Our target specifications for this area is to have the bar less than 25 cm when folded and for it to not increase the weight. Both the telescoping bar and the and the bar aligned with the walker's post consider the walker's length given that they must reach either side of the walker.

Steering approach

The target specifications in each case concern the total weight of the system, the ease of use and the time to assemble. The first idea involves the length of the system. Idea 2, also involves length along with the ability of the walker to collapse when not in use. Similarly, the third and fourth ideas involve total weight, folding/collapsing, ease of use and cost in terms of target specs.

Adapting Mechanism:

1. Circular clamp that can be tightened on any part of the main bar
2. Sliding mount for steering system.
3. Steering system can be attached onto either handle using a clip

The target specifications that apply to this subsection of the design, only the Adaptable, Ease of use, and Total weight targets are involved.

For idea 1, the ease of use will be lower than that of the other ideas as it will take more time to use and require more parts to function. This idea will have a high degree of adaptability, allowing it to be moved to any part on the main bar or on either of the handles, but it will also be one of the heaviest solutions.

Idea 2 is a simplified version of idea 1. It consists of a sliding mount for the steering system that can be slide across the main bar to any required position. It will be lower weight than idea 1, but higher than idea 3. It has a high degree of adaptability and is easy to use.

Idea 3 is the most simple and will be the easiest to use. It only allows for a small degree of adaptability, but still has more than the base walker. It will also be the lightest of the three designs.

Promising Solutions

The promising solutions that we have chosen include:

Solution 1: The snap clip as the attachment method, the bar with a pivot point for the folding mechanism, the extended handle for steering, and the sliding mount for the adapting mechanism.

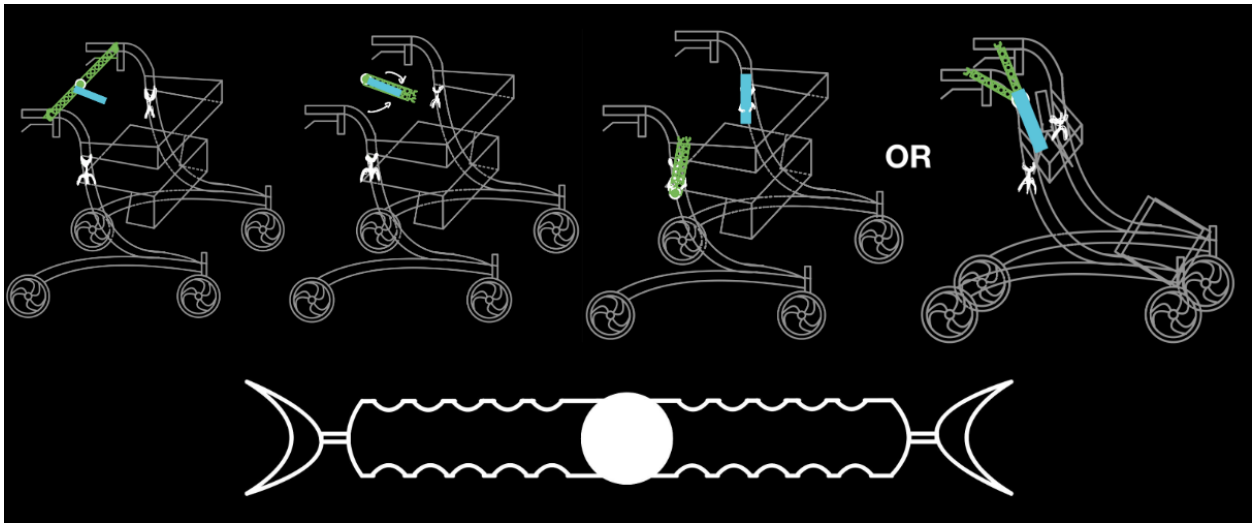
Solution 2: The magnetic weight stack pin as the attachment method, the bar aligned with the external post as the folding mechanism, the electronic steering system for steering, and the circular clamp for the adapting mechanism.

Global Design Concept

Our global design concept integrates each subsystem concept according to its feasibility and comparative functionality. Specifically, the design concept that will be chosen relates to solution 1 involving the snap clip as the attachment method, the bar with a pivot point for the folding mechanism, the extended handle for steering, and the sliding mount for the adapting mechanism. As a group, we have decided that this overall solution would be best given that it appears the most simple and easy to use/control.

As a group we have decided that the snap clip will most efficiently hold the system to the walker, allowing it to be sturdy enough to remain upright and easy enough to attach and remove. There will be multiple snap clips attached to the design, located on either side of the walker. The snap clips are u-shaped, with a small switch on the side that allows the user to lock the system into place by moving it perpendicular to the clip. Next, the bar with a pivot point in its middle allows the walker to be more easily folded and allows the user to more easily remove it to sit on the walker when need be. The bar has attachments on either side to connect to the walker. The extended handle is located parallel to either side of the walker, extended to the center of the walker. The extended handle allows the user to rest their arm and lean onto the walker in order to use bodyweight to control the walker's movement. The extended handle amplifies the force by acting as a lever to help with manipulating the walker (i.e turning, moving forwards, etc). Finally, the sliding mount allows the system to be moved to either side of the walker. By loosening and tightening, the mount is easily moved to either side.

Global Concept Sketches



Concept vs Target Specifications

In terms of folding, the bar with a pivot in the middle allows for efficient and easy folding. The total weight of the system cannot be determined until a physical prototype is built. However, given that materials such as light metals and plastics are being used, we can assume that the concept meets this specification. The length of the design is proportional to the width of the walker itself. Specifically, the length of the pivoting bar and extended handle are important. The sliding mount allows the system to be adaptable for use with either arm. The time to assemble should be reduced given the snap clips that are easily attached and detached from the walker. This also allows the design to be easily used. The cost is dependent on the materials and construction of the design. In this case, the materials should be cheap and easy to use.

The benefits of the design involve its ease of use and speed at which it can be attached. The system is simple and incorporates ease of use. However, some drawbacks involve the steering itself in which the user must use bodyweight. While the components account for this, there may need to be some modifications to further help with steering the walker.