uOttawa

Deliverable C: Detailed Design and BOM

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June 8th 2023

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Introduction

In this deliverable our team will apply the feedback we received from our client, Janice, our updated detailed design concept, skills and resources we have and are missing, the time required to complete the course of this project, and lastly, our Bill of Materials.

Summary of client feedback

After our second client meeting, our client emphasized that the concept of our design is well thought out, although she did express some concerns regarding the materials we are planning to use. Our client specifically stated that plastic snap clips have a tendency of braking and we would need to provide information regarding where to find the snap clip materials in case it needs to be repaired/replaced. Our client mentioned that if we are using metal for the bar components we should consider the factor of rust of materials due to weather constraints. Our client, Janice, justified that she normally steers with her legs so an easier steering component is necessary for the convenience of our design. Lastly, we discussed some ideas for braking systems and she specifically mentioned that the braking components (both sides of the walker) should be usable with only one hand.

Updated and detailed design concept

Final design:

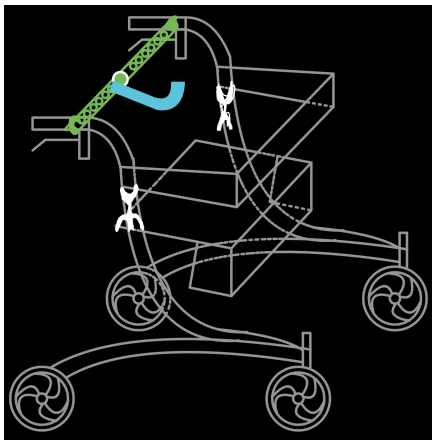


Figure 1.0 Final Design

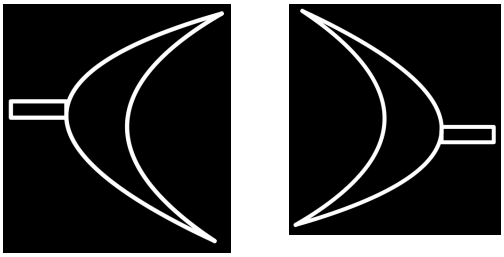
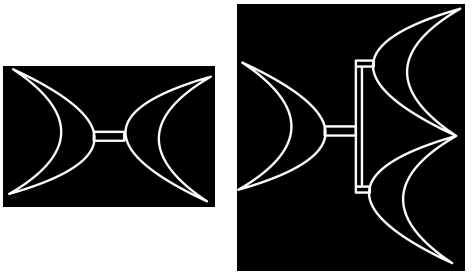
Final design description: Our team's design consists of 3 subsystems to ensure the target user specifications are met. The following three points are organized to explain how each subsystem functions.

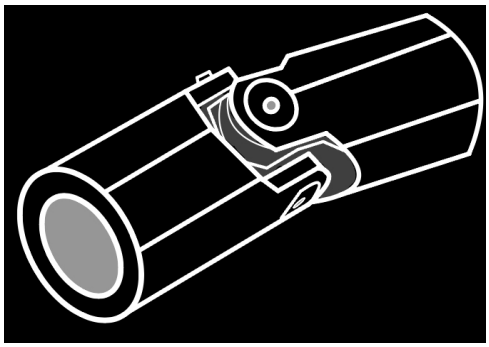
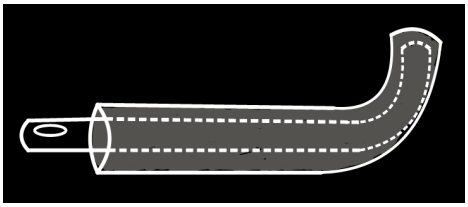
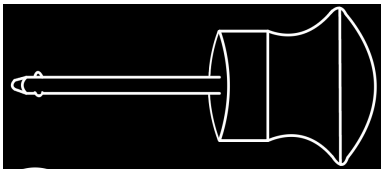
1. The first subsystem is the **main bar** (highlighted in green in Figure 1.0). At the ends of the main, bar snap clips will be attached using **adapters.** Adapters will

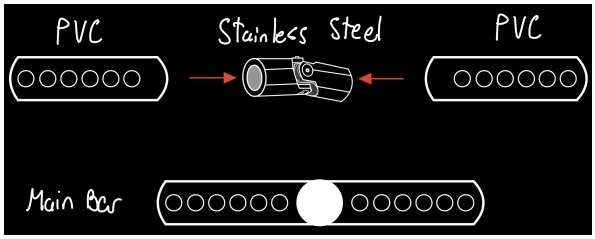
be built by the team. These snap clips allow for the ends of the main bar to snap onto the handles of the walker. The main bar consists of a **hinge** that is made from stainless steel. The hinge allows the main bar to fold in half when needed**.** Two halves of a PVC pipe are connected to the inside of the hinge with a strong **adhesive** or an **adapter** (based on what the team and TA's/PM's see fit). The main bar (two pieces of PVC) have holes of a certain diameter all across the bar. The main bar will be covered with foam, which would be utilized from a **pool noodle.** The softer texture from the foam ensures comfort as the user may need to lean onto this bar for support.

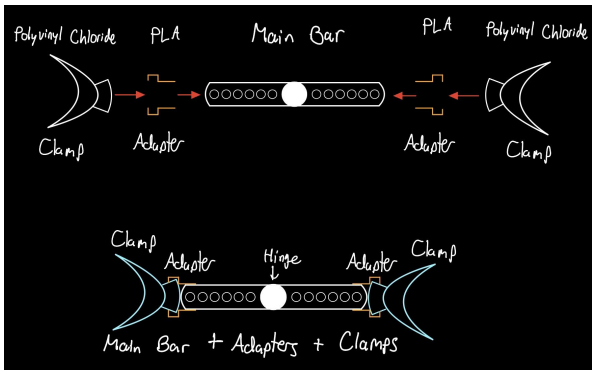
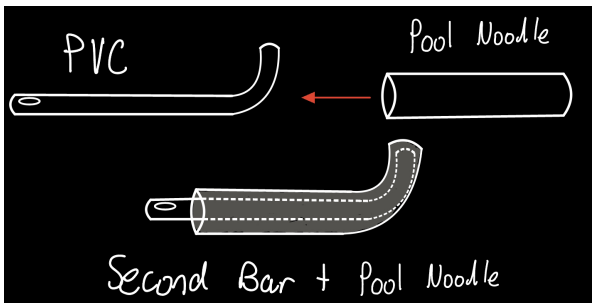
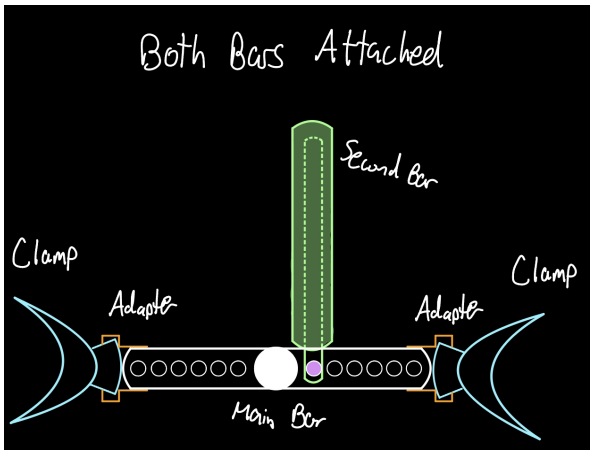
2. The second subsystem of our design is the **secondary bar** (highlighted in blue in Figure 1.0). This bar is meant for easy steering and has a curve to the end of it, similar to an umbrella hook (check Figure I from 'Parts Put Together' table). This bar is going to be made of PVC and will be covered in foam from a pool noodle for easier steering and a sturdy grip, as well as preventing the PVC from rusting from rainy weather. A **stack weight pin** is going to be inserted into the non-curved end of the secondary bar using a strong adhesive or adapter (based on what the team and TA's/PM's see fit). This pin can fit into any of the holes of the main bar so the user can find a comfortable spot for steering with either arm. The diameter of the stack weight pin will have to be slightly less than the diameter of the holes on the main bar to ensure it is easy to remove and not a lot of force is required to steer.

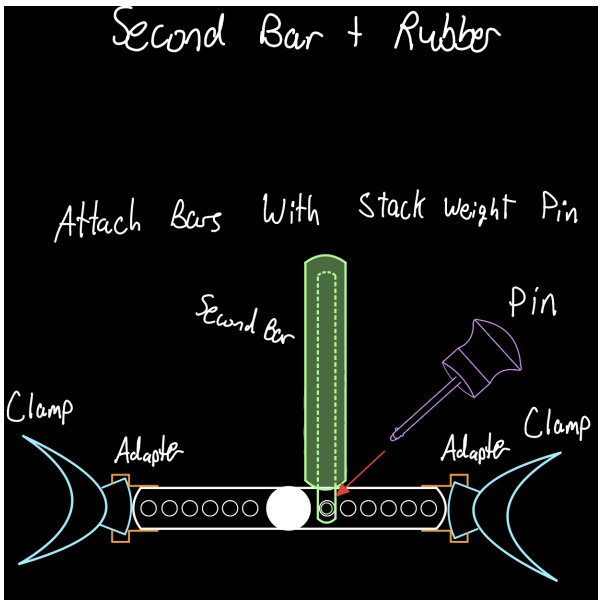
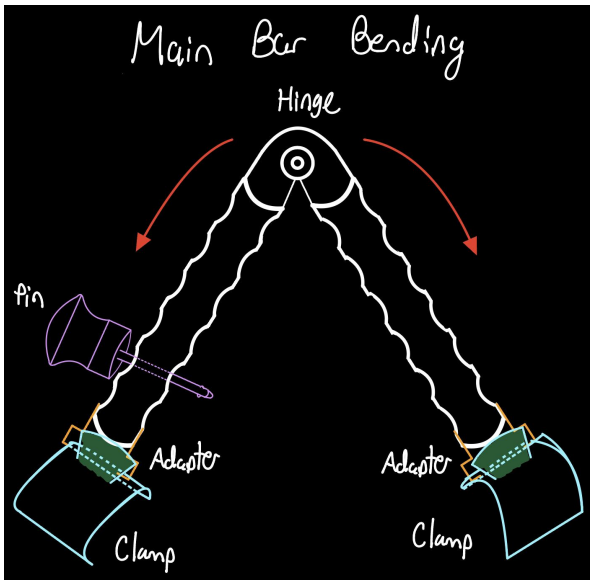
3. The last subsystem of our design are the **snap clips** (highlighted in white in Figure 1.0). There are snap clips attached to either side of the walker. The snap clips will be made of polyvinyl chloride (plastic). The snap clips on one side of the walker are meant to store the main bar once it is removed and folded. The snap clips on the other side of the walker are meant to store the secondary bar once the stack weight pin part is removed from the main bar. The bars simply snap into the snap clip, and the snap clip simply snaps over the sides of the walker.

Individual Parts	
Part	**Visual Representation**
Snap Clips: The snap clips displayed in the images to the right (A), are used to attach the bar to the two handles of the walker. These are made of polyvinyl chloride (plastic) and snap on and off the handles. As well as the snaps that will attach to the side of the walker for storing purposes. These snap clips are also made of polyvinyl chloride (plastic) (B).	 Figure A  Figure B
Main Bar: The complete main bar consists of two halves of a PVC stainless pipe, a hinge in the middle, and two snap clips on either end of the pipes. The main bar is made of PVC stainless steel pipes. The bar has holes (of a certain diameter) all across it. The PVC pipes are attached to the snap clips on either end using an adapter or a strong adhesive. The bar is adjustable and can fold in the middle from the hinge. The pipes are attached to the hinge using an adapter or a strong adhesive. The main bar will be covered in foam using a strong adhesive.	 Figure C

Hinge: The hinge is made of metal. It allows the bar to fold in half. The hinge can lock in place.	 Figure D
Secondary Bar: This bar is attached to the stack weight pin using an adhesive or an adapter. It allows the user to steer the walker more effectively by distributing bodyweight. The secondary bar is covered with foam from a pool noodle to ensure comfort. The foam will be attached using a strong adhesive.	 Figure E
Stack Weight Pin: The stack weight pin is put into the secondary bar with the help of an adapter or strong adhesive. It is connected to one of the various holes on the main bar.	 Figure F

Parts Puts Together	
Parts	**Visual Representation**
Main Bar: The following figure displays how the 2 pipes made of PVC attach to the stainless steel hinge. The two pipes also have holes (of a certain diameter) across the bar. The two PVC pipes are going to be	 Figure G

attached inside the hinge using a strong adhesive or an adapter.	
Main Bar Connected to Snap Clips: Our team will create some sort of adapter in order to attach the snap clips to the end of the bar. We will also consider using a strong adhesive to do this.	 Figure H
Pool Noodle Plus the Secondary Bar: The pool noodle will be slightly larger than the secondary bar but will be the same shape so the secondary bar can fit into the pool noodle's protective layer.	 Figure I
Attaching Secondary Bar to Main Bar: The secondary bar is attached using the stack weight pin to hold it in place. The stack weight pin will be attached to the non-curved end of the second bar using a strong adhesive or an adapter. This way the second bar can be moved along the main bar in different places based on the various holes on the main bar. The stack weight pin is not attached to the secondary bar in the images because our team will have to test if it is easier to have the stack weight pin separate, using it to keep everything in place or part of the secondary bar, like explained in the 'final design' description (work in progress).	 Figure J

	 Figure K
Main Bar Bent: The image displays how the main bar bends from the center using the hinge.	 Figure L

Main Bar Attached to Side Snap Clips (Attached To Walker):

The following figure displays how the snap clips attach to the main bar on one side of the walker.

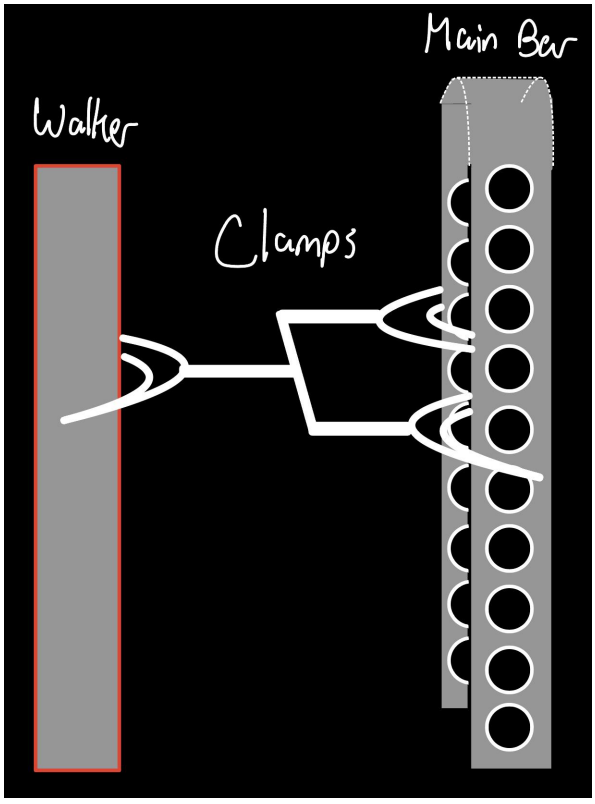
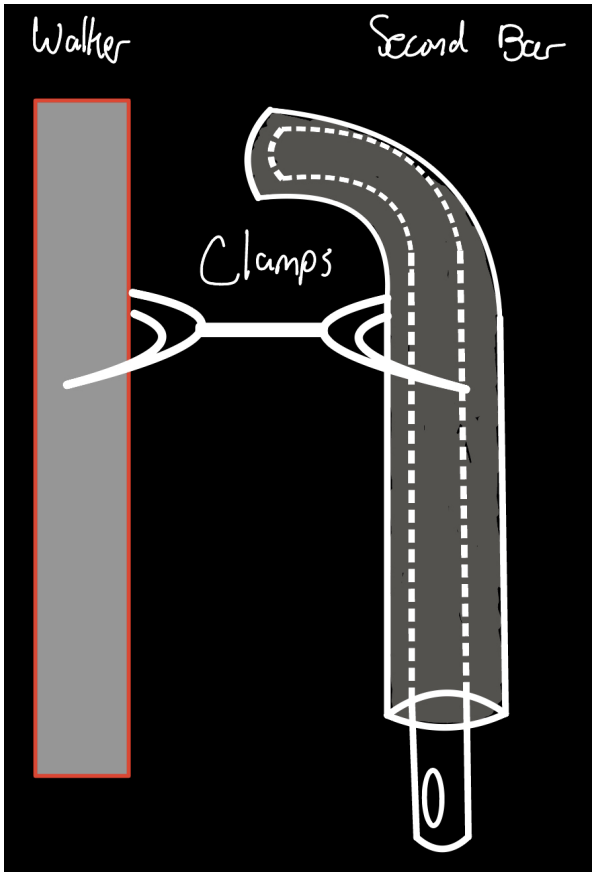


Figure M

Secondary Bar Attached to Side Snap Clips (Attached To Walker): The following figure displays how the snap clips attach to the secondary bar on the other side of the walker.	 Figure N

Detailed List of Skills and Resources

Skills and Resources	
Skills	**Resources**
• Collaboration • Research • Communication	• Mill • Lathe • 3D printing
Missing Skills	**Missing Resources**
• Time management • Staying focused while working	• Higher budget • Measurements of clients walker • Braking system is unidentified

Assessment of Time Required

The time required to implement our design is 2-3 weeks (approximately 16 days). In order to get the best results and go through the full iterative design process our project timeline would look something like this:

- Problem refinement loop (3 days).
    - Speaking with our client in order to identify the real problem (1 day).
    - Discussing whether we are solving the right problem (1 day).
    - Implementing user and technical benchmarking (1 day).
- Persistence loop (13 days)
    - Creating a design criteria and identifying design constraints (based on initial conversation with the client) (2 days).
        - Making sure to use benchmarking tactics while in this loop.
    - Generating an idea and checking if the constraints are satisfied (2 days).
        - Checking back with the client to gain feedback (1 day).
    - Using feedback to create a new/better idea and checking if the constraints are satisfied (2 days).
        - Checking back with the client again to gain feedback (1 day).
    - Creating physical prototypes (3 days).
    - Testing prototypes and seeing if the solution works based on clients emotional response (2 days).

The actual time each team member has to contribute is about 2 days a week (6-10 hours weekly). This includes our scheduled team meetings, lectures, and labs. Realistically, since our team is not working on this project for 2-3 weeks straight our team should be able to follow along with the process and implement the design well by following the outline above, but it would take longer. Since we usually meet about 2-3 days a week (for 6-10 hours weekly), the realistic estimated time required is about 1 month and a half to 2 months.

The updated project plan snapshot as of June 7th:

https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=nH4DkE19jHIrWFB10c7bTYosjspi9goQ%7CIE2DSNZVHA2DELSTGIYA

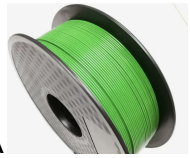
Critical Product Assumption

One important critical product assumption that was brought to the team's attention by the client is that durable materials such as metal may rust due to weather constraints. Since the single-handed steering component of the walker being weather resistant is a vital target specification more research needs to be done in order to figure out the right

material to be used. Another critical product assumption we would have to consider is how adaptable the bar component would be if the client needs to always completely remove it for storing or sitting in the seat of the walker. This means our team would have to conduct more research on how to make the bar component more flexible, versatile, and adaptable.

Bill of Materials (BOM)

For our project specifically, we were given a budget of $100. Our BOM must therefore satisfy this budget.

BOM					
Item Number	Part Name	Description	Quantity	Unit Cost	Extended Cost
1	Steel round PVC pipe 	¾” PVC Pipe Will have holes drilled in to allow for the stack pin to go (for main bar).	3	$8.86	$26.58
2	 Clamp	Need bigger size	2	$18.98	$37.96
4	PLA 	Wire is 1.75mm. 1kg net weight.	1	$9.00	$9.00
5	Foam 	6cm/2.36in and 150cm/59.05in	1	$9.00	$9.00

6	Hinge 	Fits ¾” Pipe Stainless Steel	1		$24.50
7	Adapter (Bar to Clips)	3D printed with PLA. Will be used to connect the main bar to the clips.	2	N/A	N/A
8 (Maybe)	Braking Handle	Handle attached to main bar to allow for one handed braking	1		
9 (Maybe)	Breaking Bar (Under brake handles) (Using one of the PVC pipes)	Bar attached to the braking handle that will pull up on the brake handles	1	N/A	N/A
10	Adhesive 	This will be used for sticking the rubber and foam to the PVC pipes. So that the main bar and secondary bar is more comfortable and provides more grip.	1	$12.99	$12.99
Total	$120.03				

*Additional BOM notes:

- ➔ Snap clips are too expensive and not the right size. Since we need so many of them our team will have to consider making this component rather than buying it so it is less expensive.
- ➔ Our team may have to reconsider how much adhesive/what type of adhesive is needed based on what we need it for. At this moment we are unsure about what we 100% need the adhesive for.
- ➔ While the BOM total is currently over budget, the team will try to reduce the cost in the future by finding less expensive products from different companies, and potentially altering the make/brand of the given materials.

References for Parts:

Metal Bar:

PLA:

https://www.alibaba.com/pla/3D-printing-materials-PLA-ABS-PETG_60755973703.html?mark=oogle_shopping&biz=pla&searchText=plastic+rods&product_id=60755973703&language=en

Foam:

https://www.amazon.ca/Noodles-Floating-Swimming-Projects-Assorted/dp/B0C2Q88Y7X/ref=sr_1_7?keywords=pool%2Bnoodle&qid=1685636189&sr=8-7&th=1

Clamp:

https://www.amazon.ca/Jikaihong-Support-Hangers-U-Hook-Holder/dp/B09WMXHYL2/ref=asc_df_B09WMXHYL2/?tag=googleshopc0c-20&linkCode=df0&hvadid=578924164988&hvpos=&hvnetw=g&hvrand=15892144241052717759&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9000668&hvtargid=pla-1678045915423&th=1

Rubber grip handle:

https://www.amazon.ca/dp/B09MSDJDBB/ref=sspa_dk_detail_0?psc=1&pd_rd_i=B09MSDJDBB&pd_rd_w=TVBqh&content-id=amzn1.sym.d8c43617-c625-45bd-a63f-ad8715c2c055&pf_rd_p=d8c43617-c625-45bd-a63f-ad8715c2c055&pf_rd_r=4AAJ9P7BQBACVMS78VX8&pd_rd_wg=PRmDf&pd_rd_r=0c1f00e8-57cf-4781-b251-66e1529807c2&s=hi&sp_csd=d2lkZ2V0TmFtZT1zcF9kZXRhaWw

Adhesive:

[12 Pack Super Glue Clear, Strong Adhesive Superglue Gel Fast Drying Instant Cyanoacrylate (CA) Glue for Plastic, Wood, Metal Stone, Jewelry Beads Making, Phone Ceramic Crafts Repair (3 Gram/Tube) : Amazon.ca: Tools & Home Improvement]

Conclusion

To summarize, we identified the correct problem at hand and utilized the insightful feedback received from Janice. We have a solid plan and enough time to carry out our ideas. After determining our bill of materials, we are slightly over budget. In the future, we will focus on determining more cost effective items.