GNG2101

Design Project User and Product Manual

<**MOBILITRAY**>

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Table 1. Acronyms

Acronym	Definition
BOM	Bill of Material
PEX	Cross-linked Polyethylene
PLA	Polylactic Acid
PVC	Polyvinyl Chloride

1. Introduction

This document serves as a comprehensive guide for users and stakeholders involved in the utilization and understanding of MobiliTray, a project developed by Group 4.1 as part of the GNG2101 course at the University of Ottawa. This manual facilitates seamless user experience, maintenance, and potential future modifications for end-users and subsequent development teams.

1.1. Context and Assumptions

The MobiliTray is designed as an add-on accessory tray for posterior walkers, aiming to enhance the functionality of these mobility aids for individuals with physical disabilities, particularly those with cerebral palsy. The assumptions made during the design and development process include considerations for lightweight construction, ease of use, and compatibility with existing posterior walkers.

1.2. Purpose and Scope

The User and Product Manual is intended to be a comprehensive resource for individuals involved in the MobiliTray project. This includes end-users who will interact with the finalized prototype, as well as future development teams seeking to understand, modify, or improve upon the existing design. The document aims to bridge the gap between technical details and user-friendly instructions, ensuring accessibility for a diverse audience.

1.3. Security/Safety or Privacy Considerations

Given the nature of the Mobilitray as an accessory for posterior walkers, the primary safety consideration revolves around the stability and secure attachment of the tray to the walker. Users are advised to follow setup and usage instructions diligently to prevent accidents or damage.

2. Overview

2.1. Problem Statement and Significance

The MobiliTray addresses the challenges faced by individuals with physical disabilities, who rely on posterior walkers for mobility assistance. The problem lies in the limited functionality of standard posterior walkers, which lack convenient surfaces for carrying items, hindering the user's ability to perform everyday tasks independently.

The significance of this problem is profound, as it directly impacts the user's autonomy and quality of life. Independence in daily activities is crucial for individuals with physical disabilities, and the MobiliTray aims to bridge the gap by providing a practical solution to enhance the usability of posterior walkers.

2.2. Fundamental User Needs

Increased Independence: Users require a solution that enables them to carry personal items, meals, or other necessities while using a posterior walker, fostering greater independence in daily activities.

Safety and Stability: The fundamental need for safety and stability is paramount. The user must feel secure using the MobiliTray attachment without compromising the stability of the posterior walker. The walker must also be able to withstand at least 5 pounds and must stay stable with all the items on top while the user is moving around.

Ease of Use: The product should be user-friendly, considering the diverse range of users with varying abilities. Simple and intuitive operation is essential. Since the user has difficulty using their hands, the product must not have any small intricate parts that may be difficult to assemble (screws, pins, etc.)

2.3. Product Differentiation and Key Aspects

2.3.1. Differentiators:

Customized Design: Unlike generic tray solutions, the MobiliTray is specifically designed to integrate seamlessly with posterior walkers, ensuring a tailored and secure fit.

Lightweight Construction: The emphasis on lightweight materials ensures that the additional accessory does not impede the maneuverability of the walker or cause unnecessary strain on the user.

Versatility: The tray is designed to accommodate a variety of items, including meals, personal belongings, and other necessities, enhancing the versatility of the walker.

2.3.2. Key Aspects:

Material: The system incorporates a durable yet lightweight material to maintain structural integrity without adding excessive weight to the walker.

Attachment Mechanism: The tray attaches securely to the walker without compromising its stability, providing a reliable platform for users.

Adjustability: The system allows for some degree of adjustment to cater to different user preferences and needs.

2.4. Key Features and Major Functions

The MobiliTray offers the following key features:

Tray Attachment: Secure and easily attachable tray designed for posterior walkers.

Lightweight Design: The use of lightweight materials for the tray to ensure ease of use and portability.

- Stability: A stable platform that does not compromise the walker's stability during use.
- Easy to use: very simple to use, anyone can operate it.

2.4.1. System Architecture/Construction

The MobiliTray comprises a durable and lightweight frame that is specifically designed for easy attachment to posterior walkers. The system does not rely on complex electronics or a microcontroller, ensuring a straightforward and reliable user experience. The attachment mechanism involves a secure locking system that maintains the stability of the tray during use.

2.5. Conventions

This document adheres to specific conventions to enhance readability and guide users through instructions effectively. The following conventions are employed:

Action: Whenever a specific action is required on the part of the reader, it is indicated by a line beginning with the word 'Action.' This convention alerts the user to take a proactive step or follow a set of instructions.

Note: Important supplementary information, tips, or additional details are highlighted with the 'Note' label. Users should pay special attention to these notes for a comprehensive understanding.

Figure References: Throughout the document, references to figures are made with corresponding numbers. Users can refer to the List of Figures for visual aids associated with specific sections.

2.6. Cautions & Warnings

To ensure the safe and effective use of the Mobilitray, users should be aware of the following cautions and warnings:

Stability Caution: Ensure that the tray attachment does not interfere with the normal operation and stability of the posterior walker. Any instability or imbalance should be addressed immediately.

Weight Limitation: Be mindful of the weight capacity of the tray. Do not exceed the recommended weight limit to prevent damage to the support and break the tray.

Secure Attachment: Ensure a secure attachment by thoroughly inspecting the tray clips before utilizing the posterior walker. If any sign of looseness or instability is detected, promptly address, and rectify the issue before proceeding with the use of the walker.

3. Getting started

Walkthrough:

1. Attach the pole clips to the top bar
2. Attach the Tray clips to the lower bar
    a. When the tray is in the folded state, see where the bottom tray Velcro interacts with the posterior walker poles and stick on the other end of the Velcro
3. Lift the tray until the hooks lock onto the tray anchor holes
4. Release the tray allowing it to rest in its horizontal position
5. Place the non-slip mat on the tray so that it covers the full surface

3.1. Configuration Considerations

This prototype is designed for user-friendly functionality. It employs hooks attached to anchors, creating a system that can be easily folded and detached. The poles and tray are secured to the posterior walker using clips, allowing for independent movement with a broad range of motion. This design enables effortless folding and assembly as needed.

While the tray is connected to the walker, it assumes a downward orientation without protrusion if not anchored to the hooks. Additionally, the hooks rest on top of the tray, optimizing spatial efficiency. When the tray is in use, the coordinated action of the hooks, anchors, and clamps provides structural support for the horizontal tray surface.

Crucially, the hooks engage with the anchors exclusively when the tray achieves a horizontal orientation, ensuring the entire system remains in a rigid position. This configuration guarantees a seamless and stable user experience without requiring the use of intricate tools or dependence on external connections.

3.2. User Access Considerations

Users	Accessibility Considerations
Elderly individuals	Easily manageable for individuals with reduced strength – Very light tray with easy assembly
Physically challenged individuals / Those who require a walker for support	Easily Folded/Unfolded for individuals with reduced strength or dexterity. – only one step to put tray in usable position.

3.3. Accessing/setting up the System

Step 1: Attach the Pole Clips to the Top Bar

- Identify the top bar of the posterior walker.

- Securely attach the pole clips to the top bar. Ensure a firm connection to support the weight of the poles.

Step 2: Attach the Tray Clips to the Lower Bar

- Locate the lower bar of the posterior walker.
- Affix the tray clips to the lower bar, ensuring a stable attachment to support the tray.

Step 3: Velcro Placement When Tray is Folded

- When the tray is in the folded state, observe the interaction between the bottom tray Velcro and the posterior walker poles.
- Apply the other end of the Velcro to the point where it interacts, ensuring a secure connection.

Step 4: Lift the Tray

- Gradually lift the tray until the hooks attach to the supports.
- Release the tray and it will set in its horizontal position

Step 6: Place the Non-Slip Mat on the Tray

- Lay the non-slip mat evenly on the tray surface, covering the entire area.
- Make sure the non-slip mat is securely attached to the two mat holders on the end of the tray

Adjusting Features for personal use:

- **Pole Height Adjustment** - If needed, adjust the height of the poles for optimal user comfort.
- **Velcro Positioning** - Make sure the Velcro is positioned to perfectly align with the tray Velcro to achieve the desired level of security when the tray is in the folded state
- **Non-Slip Mat -** Adjust the placement of the mat to accommodate for specific items or remove the mat altogether to use the tray surface for different activities such as writing.

3.4. System Organization & Navigation

3.4.1. Poles

- The Poles are crucial to holding the tray up and consist of 3 parts:
- **Hook x2 -** The hook is attached to the bottom of the pole and is used to attach to the tray anchors

- **Pipe x2 -** The pipe is the long rigid part of the pole that allows the posterior walker to support the tray from above
- **Clips x2 -** The clips are essential for attaching the pole to the walker

3.4.2. Tray

- The tray consists of 4 parts that allow it to be used and held:
- **Tray x1 -** The tray is the base and main component of the prototype. It is what the client will use to hold all their items.
- **Support beams x2 -** The supports are set at the far left and right ends of the tray from the user.
    - They are what attaches the tray to the posterior walker and give additional support to the bottom of the tray
    - Will already be attached to the tray via screws.
- **Velcro Tape x1 -** There will be two strips of Velcro on the bottom of the tray that allows the tray to stay sturdy after folding.
    - Attaches to Two separate pieces of Velcro tape attached to the legs of the posterior walker.
- **Clips x2 -** Used to attach the tray to the lower posterior walker poles.
    - Attached to one end of the support beams.
- **Mat Holders x2 –** Used to allow the non-slip mat to stay sturdily on the tray while in folded position

3.4.3. Accessories or attachments: Velcro, Non-Slip Pad

- **Velcro Tape -** Attached to the posterior walker's legs to allow for the tray to stick on after folding.
- **Non-Slip Pads -** Addable to the top of the tray allowing for a different, non-slip, surface.

The Following is a diagram of the prototype with all parts listed.

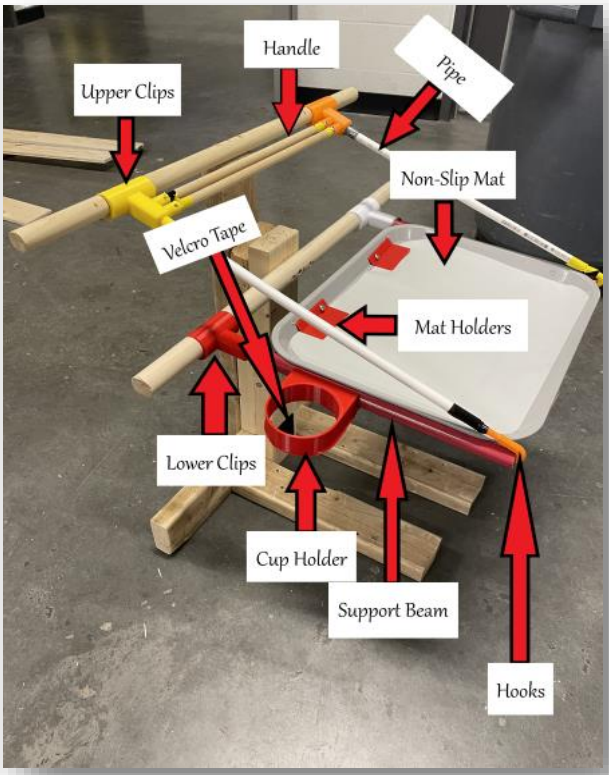
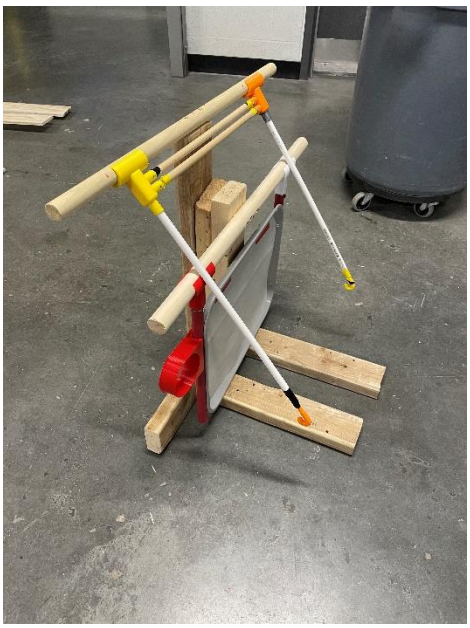


Figure 1

3.5. Exiting the System



Step 1 - Detaching the hooks

- **Procedure -** Gently Elevate the poles using the handle in between and tray to release the connection between the hooks and the support beams.
- **Importance -** This step ensures a controlled and secure detachment, preventing any un-needed stress on the system component.

Step 2 - Folding the Tray

- **Procedure -** Lower the tray, allowing the Velcro to engage and maintain the folded state securely
- **Importance -** Minimizes system profile, facilitating ease of storage and transportation

Step 3 - Lowering the poles

- **Procedure -** Lower the poles ensuring they rest on the tray surface
- **Importance -** Prevents any potential damage and misalignment

4. Using the System

This section provides detailed instructions on using the Mobilitray. The Walker Tray System enhances the functionality of posterior walkers, providing a practical solution for users to carry personal items and maintain independence in daily activities.

4.1. <Hooking>

The hooks are attached at the end of the hook poles that are clipped to the top bar. They are used to hold the tray in an upright position.

4.1.1 <Hook attachment>

Attaching the hooking system can be used by lifting the folded tray above the horizontal position. After the tray supports lift above the hooks, the hooks will slide into the holes allowing the tray to be held up.

4.1.2 <Hook detachment>

To detach the hook from the tray, you must grab the handle that connects the two hooks together with one hand and the tray with the other hand. You now gently lift the tray until the hooks are no longer in the hole and let the tray down with the hooks following right after.

4.2. <Non-Slip Mat>

The non-slip mat is placed on the tray's surface to allow objects to be securely placed on the surface.

4.2.1 <Mat Attachment>

Gently lift the mat holders and slide the non-slip mat below the holders.

4.2.2 <Mat Removal>

Simply just pull the non-slip mat off the tray.

5. Troubleshooting & Support

5.1. Common Troubleshooting

Users may encounter the following issues during the operation of the Walker Tray System:

Unstable Attachment: If the attachment is not securely fastened, the user may experience instability; the tray may shake or collapse when put under stress or being used.

- Action: Ensure clips are properly attached to the walker. Readjust or reattach if necessary.

Unexpected Movement: In case of unexpected tray movement:

- Action: Stop using the tray immediately.
- Check: Verify attachment stability.
- Adjust: Reattach the tray securely if needed.

Hook Misalignment: In case of hook misalignment.

- Action: Stop using the tray immediately.
- Adjust: Detach clips / Push clips along walker beams until the lengths are consistent and the hooks are aligned with the PEX-A pipes.

5.2. Special Considerations

One error that may occur is an error with 3D printing. If the 3D prints are not being printed correctly, the printer may have to be recalibrated, or you may have to adjust the way the print was sliced on your computer program.

5.3. Maintenance

Regular Maintenance Procedures

To ensure the longevity and optimal performance of the Walker Tray System, regular maintenance is recommended:

- Cleaning: Regularly clean the tray and attachment points to prevent dust accumulation.
- Check Fastenings: Periodically check all fastenings and attachment mechanisms for tightness.
- Inspect Wear: Inspect for any signs of wear on moving parts or attachment points.

5.4. Support

Emergency Assistance and System Support

In case of emergencies or the need for system support, users can follow these steps:

1. Team Support: Contact our team for immediate assistance.
    - Asad Ali: mali229@uottawa.ca
    - Peter Bou-Farah: pbouf098@uottawa.ca
    - Keith Tran: ktran033@uottawa.ca

- Chris Al-Rahi: calra090@uottawa.ca

2. Reporting Issues: To report identified problems, send an email to the support team detailing the issue and any relevant information.

6. Product Documentation

6.1. <Subsystem 1: Tray>

This component consists of the tray surface itself, the tray supports, and all attachments that connect to the tray. This subsystem is responsible for providing a surface for which items can be supported by.

6.1.1. BOM (Bill of Materials)

Item Name	Description	Quantity	Unit Cost ($CAD)	Link
Tray Surface	Tray Surface	1	12.34	Amazon
3D Printer Filament	Material for cup holder and non-slip pad anchors.	92g	0.025	Amazon
Velcro Tape	Velcro for securing tray when folded down.	1	0.41	Amazon
PEX-A Expansion Pipe	Material for beams to support the tray from underneath.	1	11.78	Home Depot
¾” Screws	For securing connections between components.	4	0.12	Amazon
1” Screws	Used to secure the tray to its support beams.	4	0.56	Amazon
Silicone Mat	Non-slip surface	1	16.94	Amazon
Total Cost		$46.49		

6.1.2. Design Considerations

The main design goal of the tray surface was to provide as much usable space on the tray as possible while remaining simple to use and construct. Hence, all attachments to the tray are done in a way that does not obstruct the tray’s top surface. All components were tested to ensure they are durable and can withstand prolonged, regular use. The force the tray could support was calculated and was heavily prioritized in the design process of the product.

6.1.3. Materials

The tray is also required to be able to support up to five pounds of weight on its top surface, while remaining lightweight so that the user can fold it up and down with ease. Hence, the material of the tray is plastic, as it is strong enough to withstand the pressure of five pounds, while also remaining very light in weight. The tray itself is also thick enough so that it does not bend or snap when carrying up to five pounds.

The supports beneath the tray are made of PEX-A expansion pipe. This material is sturdy enough so that they do not bend when weight is applied, and the coefficient of friction on its surface is high enough for the hooks to easily catch and stay hooked. One possible alternative to this material that shares these same necessary qualities is wood, though this material was never tested.

The non-slip pad is made of silicone. This material has a high coefficient of friction along its surface, is flexible, and is water and stain-proof. These qualities make this material ideal for a non-slip surface that is easily removable and washable.

The cupholder and non-slip pad anchors are made from PLA. This material is ideal for being both sturdy and light. It can be substituted with metal or plastic, though these materials are untested.

6.1.4. Equipment list

3D Printer: For printing the cup holder and non-slip pad anchors.
Screwdriver or hand drill: For screws to secure connections between components
Pliers: For removing support material from 3D prints
Bandsaw: For cutting PEX-A pipes.

6.1.5. Instructions

Explain step by step instructions on how to build this specific subsystem. Include as many pictures as possible and diagrams for clear understanding of the process. Make sure to attach all files you are referencing.

Step 1: Download the STL files here.

Step 2: Import the STL files to a slicing program on your computer. Ensure the prints are correct to the following dimensions: 3.5” x 5.45” x 1.273” for cupholder, 3” by 1.725” by 0.4” for anchors.

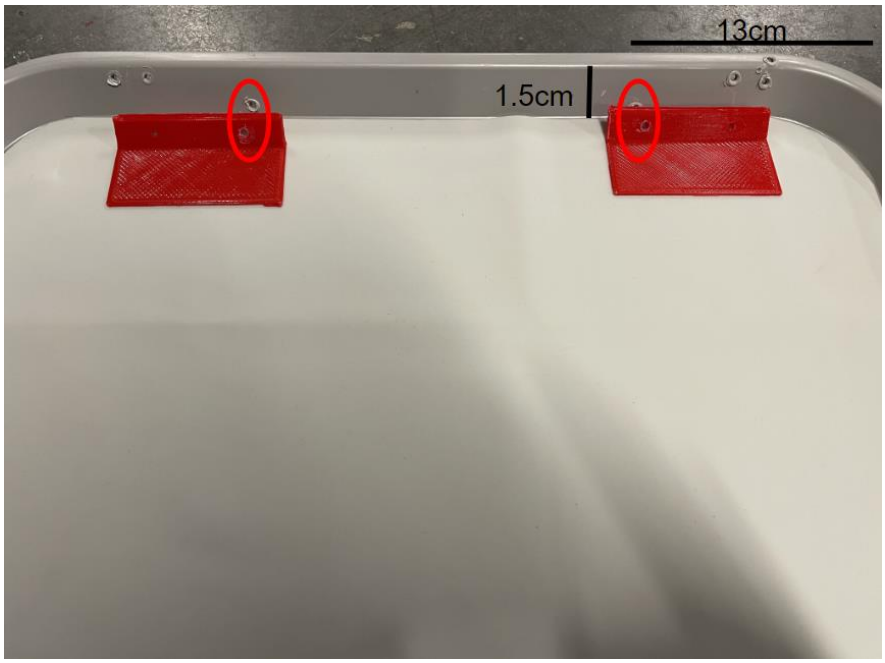
Step 3: Print one cupholder and two non-slip pad anchors. Once finished printing, remove supports and clean up any excess filament.

Step 4: Attach one side of the Velcro tape to the walker and the other side to the bottom of the tray in the locations shown below.

Step 5: Cut PEX-A expansion pipe into two, with both having a length of 36cm.

Step 6: Screw in the two pipes at the sides of the underside of the tray using 1” screws at the locations shown in the figure below.

Step 7: Place non-slip pad on the tray’s top surface and screw in the two anchors at the edges of the tray using ¾” screws at the locations shown in the figure below.



Step 8: Screw in the cup holder to either the left- or right-side pipe using ¾” in the desired location, in a manner like the one shown in the figure below.

6.2. <Subsystem 2: Hooks>

This component consists of the hooking mechanism used to hold and suspend the tray.

6.2.1. BOM (Bill of Materials)

Item Name	Description	Quantity	Unit Cost ($CAD)	Link

3D Printer Filament	Material for printing the hooks	16g	0.025	Amazon
PEX Pipes	Plastic Pipes for attacking hooks to	2	6.89	Home Depot
Wooden Dowel	Wooden Sticks to reinforce the plastic	1	3.03	Home Depot
Total Cost	$			

6.2.2. Design Considerations

The main design goal of the hooks was for them to be able to catch and hold onto the tray supports with ease, able to hook onto the tray by simply lifting the tray up, then releasing after reaching a certain height. Thus, the hook was calculated to have the right curvature and depth to maximize this aspect. They were also thoroughly tested to ensure they are durable and can withstand prolonged, regular use and support the specified weight limit.

6.2.3. Materials

The hooks are 3D printed from PLA. This material is sturdy but lightweight and facilitates a light weight for the overall system. Its surface is also rough, allowing it to catch onto the supports and suspend the tray more easily. This material can be substituted with wood, though this material was not tested.

The pipes that extend from the clips to the hooks are made from PVC, and the dowels that reinforce them are made of wood. PEX is a strong, durable, and lightweight material, making it an ideal material for suspending the tray whilst keeping the system's weight to a minimum. Wood is also sturdy and light in weight to a degree. The PEX pipes together with the wooden dowels can be replaced by nonhollow wooden rods, though this was not tested.

6.2.4. Equipment list

3D Printer: For printing the cup holder and non-slip pad anchors.

Screwdriver or hand drill: For screws to secure connections between components.

Pliers: For removing support material from 3D prints.

Handsaw: For cutting wooden dowels and PEX pipes.

Band Saw: Used for cutting wooden planks to make the display as well as shortening the hook pipes.

6.2.5. Instructions

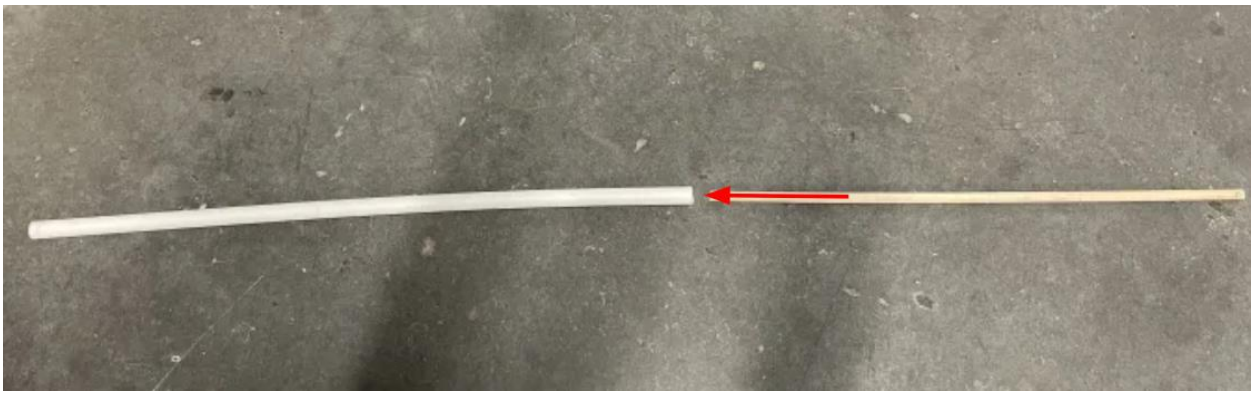
Step 1: Download the STL files here.

Step 2: Import the STL files to a slicing program on your computer.

Step 3: Print two hooks. Once printed, remove supports and clean up any excess filament.

Step 4: Cut PEX expansion pipes down to a length of 52cm. Cut the wooden dowel in half, with each half cut down to a length of 46cm.

Step 5: Insert the wooden dowels into the hollow PEX pipes as shown in the figure below.



Step 6: Insert the hooks as shown in the figure below.

6.3. <Subsystem 3: Attachment>

This component consists of the hooking mechanism used to hold and suspend the tray.

6.3.1. BOM (Bill of Materials)

Item Name	Description	Quantity	Unit Cost ($CAD)	Link
3D Printer Filament	Material for cup holder and non-slip pad anchors	g	0.025	Amazon
Wooden Dowels	Wooden dowels to connect top bar clips.	1	3.03	Home Depot
¾” Screws	For securing connections between components.			

Total Cost	$

6.3.2. Design Considerations

The main design goal of the attachment clips was to be able to clip on and off of the metal bars of the posterior walker and be able to hold the tray system steady, while also able to pivot about the axis of the bars to allow the tray to be folded. Each of the clips were tested to ensure they are durable and can withstand prolonged, regular use. The force and weight that the clips can withstand was calculated and was a central focus of the design of the component.

6.3.3. Materials

The clips are 3D printed from PLA filament. This material is sturdy yet lightweight, which allows us to minimize the total weight of the system while still supporting the specified weight of five pounds. Plastic could be used as a substitute material for its flexibility, an important aspect of the clip-on functionality, but this material was not tested.

6.3.4. Equipment list

3D Printer: For printing the cup holder and non-slip pad anchors.

Screwdriver or handheld drill: For screws to secure connections between components.

Pliers: For removing support material from 3D prints.

Handsaw: For cutting wooden dowel.

Band Saw: Used for cutting wooden planks to make the display as well as shortening the hook pipes.

6.3.5. Instructions

Step 1: Download the STL files here.

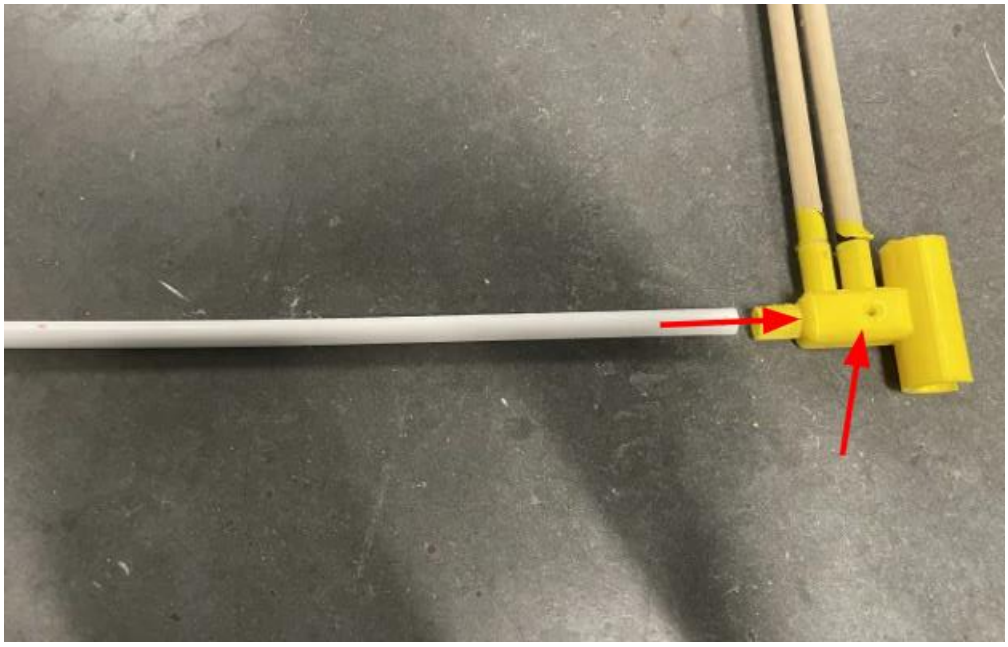
Step 2: Import the STL files to a slicing program on your computer. Ensure the prints are correct to the following dimensions: 1.5” x 2.756” x 3.89” for the 5/4” diameter clip, 1.25” x 2.756” x 3.626” for the 1” diameter clip.

Step 3: Print two of each clip size. Once printed, remove the support material and clean up any excess filament.

Step 4: Cut the wooden dowel in halves, with each half reduced to 40cm in length.

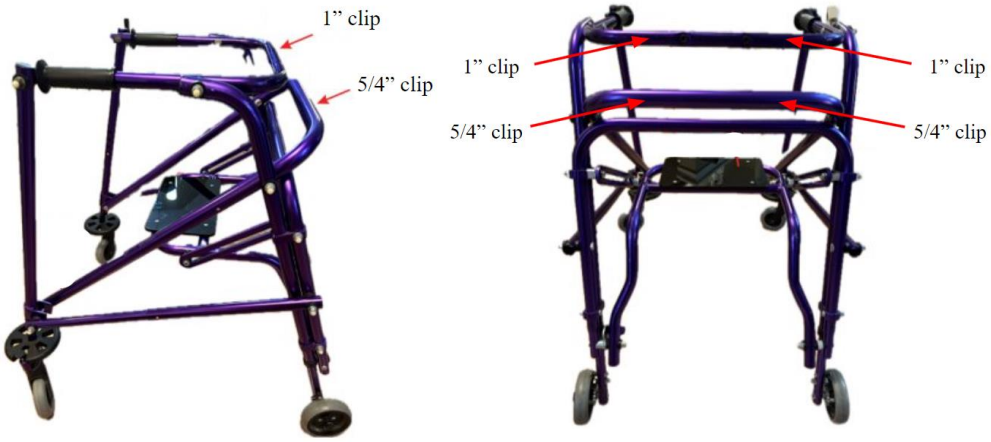
Step 5: Insert both ends of the wooden dowels into the side holes of the 1” clips, as shown in the figure below. Screw in each end of the dowel using ¾” screws to secure the connection.

Step 6: Insert the PEX pipe and hook into the 1” clips, with the hook curve facing upward. Screw in the pipes and clips of the tray using ¾” screws at the location shown in the figure below.



Step 7: Insert the 5/4” clips into the PEX-A pipes connected to the tray. Screw in ¾” screws into the location shown below on both clips.

Step 8: Attach the tray system to the walker. Clip on the 1” clips and 5/4” clips at the locations shown in the figures below.



6.4. Testing & Validation

The metrics we tested the prototype for are summarized in the table below, along with the marginal values, ideal values, and actual values that were produced. Reasoning for the testing of each metric is listed below the table.

Metric #	Metric	Units	Marginal Value	Ideal Value	Actual Value
1	Carrying capacity of the tray system	N	>20	>44.48	35.59

2	Total mass of the tray system	kg	<2.27	<1.4	0.6
3	Surface area of the tray's top surface	m^2	0.8	0.12	0.163
4	Coefficient of friction of tray's top surface	N/A	0.2	0.75	0.86
5	Cost to manufacture	CAD$	<$100	<$30	$61.31
6	Ease of use	subj	>6/10	>8/10	9/10
7	Compatible with posterior walker	Binary	Yes	Yes	n/a
8	Lateral stiffness at pivots during rotation	N*m	5	1	1
9	Aesthetically pleasing	subj	> 2/10	> 5/10	3/10
10	Maximum tensile load supported by the tray supports	N	100	400	275

Carrying capacity of the tray system: since the main purpose of the tray is to carry items, this was the most important metric to test. The efficacy at which the product could fulfill this metric greatly determined the efficacy of the entire system. The minimum value was 20 Newtons, which is just under the five pounds of weight specified by the client, and the ideal value we established was 44.48. The final prototype was able to support 35.59 N of weight.

Total mass of the tray system: this was an important metric, as the system needed to be light enough to operate with ease, and not impair the movement of the walker. Though the marginal upper limit was 2.27kg, the final prototype was well below this, with a mass of just 0.6kg.

Surface area of the tray's top surface: this metric determined how much usable space the client will put small objects on. The marginal value was 0.8m^2, the ideal value established was 0.12, and the prototype was able to achieve 0.163 m^2.

Coefficient of friction of the tray's top surface: the client requested that the tray have a non-slip surface so that objects do not easily slip or fall off the tray. The marginal value was 0.2, the ideal value we established was 0.75, and the prototype overcame both values with a value of 0.86.

Cost to manufacture: since the group was given a limit of $100, this was our marginal value. However, the final cost ended up being $61.31.

Ease of use: this metric is subjective, but still important, as the client suffers from accessibility issues and thus requires a system that is easy to use. The design is very simple, needing only to lift the tray up and down to operate, so the final prototype was ranked a 9/10 in this regard.

Compatible with posterior walker: It is important that the product is compatible with the product it was requested to work with. However, since a real, physical posterior walker was never provided, nor was a full, detailed, and thorough list of measurements, it was impossible to test whether the product was compatible with the walker or not.

Lateral stiffness at pivots during rotation: This metric describes how much force is required to pivot the clips around the bars of the posterior walker. This is important as it determines how easily the tray can be folded up and down. Although we did not have the real walker, we tested this metric using wooden dowels that fit our best approximation of the diameters of the walker bars. Although the marginal value was 5 Newton meters, the final prototype achieved a value of 1 Nm.

Aesthetically pleasing: though this is not important, the client requested that the tray be purple in colour. Since this was not accomplished, the final ranking for this metric is 3/10.

Maximum tensile load supported by the tray supports: this metric describes the maximum load the clips can withstand. The marginal value was 100 N, the ideal value established was 400 N, and the actual value achieved was 275 N.

7. Conclusions and Recommendations for Future Work

7.1. Key Takeaways

Our journey in developing the Walker Tray System has been enlightening, providing valuable insights into user-centric design and interdisciplinary collaboration. Key takeaways include:

1. **User-Centered Design Matters**: Prioritizing user needs led to a more functional and user-friendly product. Regular user feedback sessions were instrumental in refining the design.
2. **Iterative Prototyping**: The iterative prototyping process allowed us to identify and address design flaws early, resulting in a more robust final prototype.
3. **Interdisciplinary Collaboration**: Collaborating across disciplines enriched the project with diverse perspectives. Effective communication and teamwork were essential for success.

7.2. Achievements

- Successful development of a functional Walker Tray System that enhances user mobility and convenience.

7.3. Future Work Recommendations

1. **Enhanced Material Exploration**: Given more time, we would conduct a more in-depth analysis of materials for potential substitutions. This could involve exploring lighter yet durable alternatives to optimize the tray's weight.
2. **Extended User Testing**: Conduct extended user testing to gather more diverse feedback on usability and comfort, ensuring the product caters to a broader range of users.

3. **Market Research and Cost Optimization**: Conduct thorough market research to optimize costs without compromising quality. Explore manufacturing processes that could lead to a more cost-effective product.
4. **Comprehensive Accessibility**: Expand accessibility features, considering users with varying physical abilities. This may involve further customization options and a focus on universal design principles.
5. **User Education Materials**: Develop comprehensive user education materials, including video tutorials and FAQs, to facilitate a smoother user onboarding experience.
6. **Continued Collaboration:** Collaboration with future design teams and researchers is encouraged to build upon our work. Sharing insights, design files, and test results through a collaborative platform ensures a seamless transition for subsequent teams.

8. APPENDIX I: Design Files

Table 3. Referenced Documents

Document Name	Document Location and/or URL	Issuance Date
Progress Update	GNG2101_PDC_LabA04_Group1.docx	10/12/23