GNG 2101

Design Project User and Product Manual

<The One Handed Walker Steering Manual>

Submitted by:

<AAAO - A2.2 one handed walker steering>

<Shahd Al Zuhaika, 300227606>

<Rayane Laouadi, 300250220>

<Mehdi Ezzine, 300268811>

<Sydney Ceolin, 300197739>

<Mark Uchanski, 300229193>

<7/12/2022>

University of Ottawa

Table of Contents

List of Figures

List of Tables

---

1 Introduction

This User and Product Manual provides the information necessary for walker users to effectively use the one handed walker attachment and for prototype documentation. The group was tasked with a project to create a device that allowed the client to use and steer their walker with one hand and came up with this final covered in this document. With this product, it is assumed that the user will have an outside party helping during the initial installation of the product.This manual will guide you through the process of creating this product by giving you an overview of what the problem this product is aiming to solve. This overview will explain what the issue is and why it is important. Next, a general walkthrough of our product and how it works will be provided, you will be given the overall idea of the final product, instructions on how to install and uninstall this product, and the different components that make it up. Once the general idea of the product is understood, this document then moves on to explain how this product is used and any steps needed to get the proper and best functionality of the product. Moving on, you will then be able to read about any errors or hazards that can be associated with this product and how to resolve and avoid them. In addition, this section will provide the contacts necessary for further support in the case of an emergency. Next, the production process will be described in great detail, this section will go over the different prototypes we created, any discarded ideas, why they were discarded, the results we gained when testing, and finally the final prototype reached from our trial and error stages. Finally, the last section of this document will go over any future considerations we have for this product and any ideas we would have liked to incorporate if the time would have allowed us.

2 Overview

Our client is an individual with a variety of health issues leading to mobility impairment, including hypermobility syndrome, myopathy, and epilepsy. This combination has left the client dependent on a walker, but due to frequent dislocations of both shoulders and spine, as well as other appendages, this fix alone is insufficient as the client is frequently unable to steer with complete control, which poses a risk to their safety. The client requires a system that will allow them to steer the walker efficiently with only one arm, that is transferable to be used with either arm,and is easy to install, operate, and maintain. Our product is a straightforward solution that allows our client to go on with their daily activities without any additional discomfort. It is lightweight, sturdy, and very easy to use. The key feature that differentiates out product from the rest is the specific approach we used for the braking. Additionally, our product does the same functions as other existing solutions for less than half the price due to its minimal components and connections.

Figure 2.1- Final Prototype

The product is a simple aluminum bar that is mounted onto the existing handles of the walker by the means of simple PVC tee joints (Figure 2.2). Hanging under this aluminum bar by the means of 3-D printed connections (Figure 2.3) is a PVC bar that is used for braking. The 3-D joints were designed in such a way that allows for the the brake bar to easily alise and rotate, hence allowing for easy braking with minimal effort.

Figure 2.2- PVC tee joint

Figure 2.3- 3D printed connections

2.1 Cautions & Warnings

This device is made to be remarkably simple to use and install so the user would not have to worry about how to assemble or use it, nonetheless, with any product, there is always some caution to be taken. When choosing the material, we were sure to choose a material sturdy enough for the bar to hold the weight of the user is needed but not too heavy that it would cause strain to carry to disassemble. The aluminum alloy we used for the bar is hollow and hence is noticeably light and would not cause damage, but caution should be taken when taking apart the bar for transferring the walker. Due to time constraints, we were not able to produce a more

convenient way to take apart the bar, and hence it might require some maneuvering to take the bar out for storage. All the components of the device will not cause any injury due to the careful evaluation of the material, but the extra maneuvering required to remove the bar from its place can cause the user to pull a muscle or cause a strain if the user has certain conditions that result in reduced arm strength or shoulder joints, and hence great caution must be taken. This is because the main function of our product relies on it being a press fit. When taking the bar out refer closely to section 4.3 of the manual and the user manual video found in appendix I.

3 Getting started

Our product has the advantage of being very simple and straightforward in its use.The main components are the main handlebar (1) , the brakebar joints (2) , the break bar (3) and the pvc joints (4).

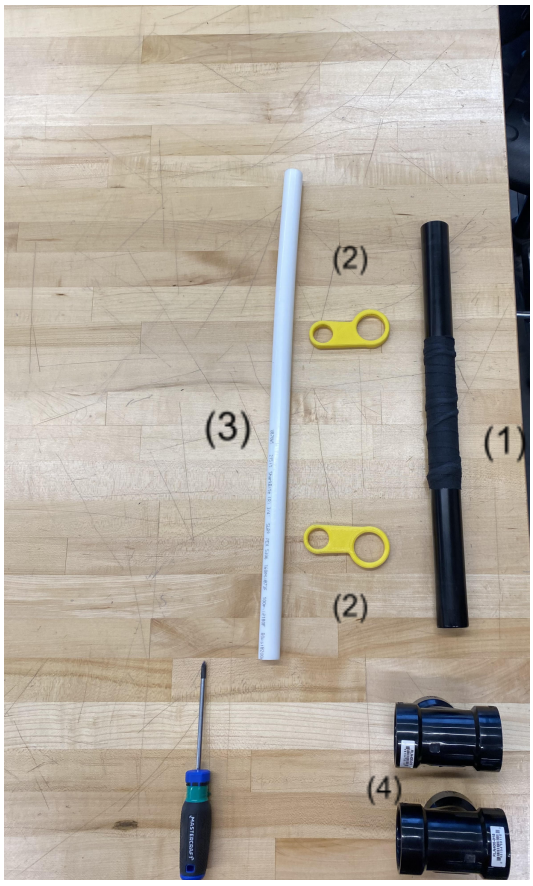

Figure 3.1- Parts inventory of the device

Our product offers a straightforward way to steer a walker of regular size with only one hand. The way it works is that the handlebar is press fit onto the walker and secured by PVC

joints which hold it in place. The brake bar goes under the brake handle and is attached to the handlebar via the brake bar joints.

3.1 Configuration Considerations

To properly install the PVC joints around the handles of your walker, you will need to dismount them if your device does not have open handles.

Dismounting needed

Figure 3.1.1- Closed handle walker

No Dismounting needed

Figure 3.1.2- Open handle walker

To dismount the handles, you will need a screwdriver adapted to the size of the screws on your device, plus any other tools that are required to take off this part. For more information, please refer to your walker's user manual and /or assembly guide.

3.3 Accessing/setting-up the System

Users using a closed-handle model of a walker will need to perform the preliminary step of dismounting them to install the PVC joints (4) around the handles. For another open-handle type of walker, this step is not required.

Once the PVC joints are installed, you can move on to installing the brake bar onto the handle, first place the connectors (2) onto the handlebar (1) by sliding it into the proper bigger whole of the two, then slide the brake bar (3) into the smaller one, the result should look like this:

Figure 3.3.1- Final assembled product

Now, as seen in the picture above, insert the handlebar into the open end of one of the PVC joints and make sure the brake bar is properly below one of the brake handles. You can now insert the other end of the handlebar into the other joint by tilting the joint up, inserting the bar in, and pushing it down. Now adjust the brake bar so it is sitting below the other brake handle (if there is one on your device). The result should look like the picture above.

3.4 System Organization & Navigation

In this section a proper rundown of each component of the system and the main features of the product is given.

3.4.1 the handle bar

The handlebar is going to be the main interface that the user interacts with, it is an Aluminum tube that spans the inner length of the device, with a rubber coated middle section where the hand of the user sits. Each end of the handle pushes on one handle of the device, that is what allows the user to steer his walker by differentially exerting a minimal amount of force (by way of wrist movement) on either side they wish to direct the device in. The rubber coating serves the purpose of thermally insulating the user interface and provides additional grip needed to steer the device.

3.4.2 The rotational braking

The rotational braking mechanism is composed of a PVC tube that sits below the brake handle and two pieces connecting it to the handlebar. The connections allow the brake bar to rotate up or down around the handlebar thus bringing up the brake handles with it.

3.4.3 The PVC joints

The main use of the PVC joints is to keep the press-fit handlebar in place and to prevent it from sliding off the handles when the user exerts the force required to steer the device. It also provides additional stability to allow the user to comfortably rest their weight on it, additionally, it prevents excessive amounts of vibrations or displacement of the handlebar.

3.5 Device removal

Walker users need to be able to fold their device with ease and in a short amount of time. That is why product removal was a key aspect we focused on. We came up with a removal mechanism that required very little force, could be done in no time and when done allows your to fully fold your walker. Thus simply by moving one the end of the brake bar away from the brake handle, tilting up one of the PVC joints and exerting a minimal amount of force you are able to remove the device swiftly.

4 Using the System

The one-handed steering system has three main functions. The following subsections provide detailed, step-by-step instructions on how to use the various functions of the one-handed steering system.

4.1 Steering system

The one-handed steering system is composed of a handlebar attached to both handles of a walker. The grip section is positioned in the middle of the bar as shown in figure 4.1. To move the walker forward just put your hand on the grip section and push slightly forward according to your pace. To turn left or right just slightly put more force on the direction side. The system has three main functions. The following subsections provide detailed, step-by-step instructions on how to use the various functions of the one-handed steering system.

Figure 4.1 Steering system

4.2 Brake system

The brake system is composed of a smaller bar attached to the handlebar and inserted in or positioned under the two original brake handles of the walker, depending on the type of the brake handle whether it is circular or non-circular. To break the walker, grab the breaking bar from its center and push it up towards you as shown in figure 4.2. If you are on a downhill or uphill, please keep holding the breaking bar up to avoid any down sliding of the walker.

Figure 4.2 Brake system

4.3 System removal for storage

The one-handed steering system is easy to remove from the walker for storage. To remove the system just pop up one side of the handlebar from its end joint, and then slide off the handlebar from the other end joint. Figure 4.3 shows how to step by step remove the steering system from the walker. When finished, place the steering system safely to avoid unintentional damage.

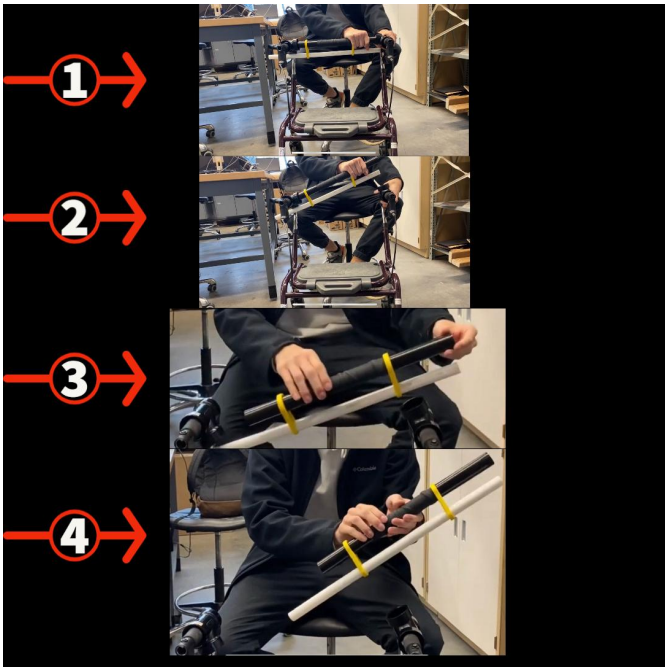

Figure 4.3 Step by step dismantling of the one-handed steering system

5 Troubleshooting & Support

Our product places an emphasis on simplicity and user ease, and as a result consists of very few parts. There is no software aspect of our design, so the only room for error is possible need to replace a broken existing component.

5.1 Error Messages or Behaviors

As there is no hardware in our product, it is entirely the responsibility of the user to check each piece to ensure safety and proper functionality.

Due to the nature of the product and the materials used, the main component that is at risk of failure is the two connecters that attach the rotational braking bar to the main support bar. The user may notice cracking in the pieces, a looser fit between the connector pieces and either of the two connected bars, or an increase in difficulty to rotate the braking bar.

5.2 Special Considerations

Due to the strength and weather resistant nature of both PVC and the aluminum bar used in our design, the likelihood of failure is very low. In the case that one of the other pieces should fail, it would be a complete failure and the user would be immediately aware.

5.3 Maintenance

For overall maintenance, it is recommended to replace the two connector pieces every 6 months and to replace the braking bar, the PVC joints, and the support bar every two years to ensure optimal functionality.

In the case that the user finds that the grip in the centre of the main support bar is beginning to wear and no longer provides sufficient grip or protection against the temperature of the metal support bar in cold climates, the user would simply need to apply a new layer of the rubber coating on top of the existing coating. There is no need for the user to remove the old layer, as it is very thin and will not compromise the function of the new layer, and would simply be a hassle for the user.

In order to replace the two connector pieces, the user simply needs to slide them off of the ends of each bar, and slide the new ones on to whatever position is most comfortable for them.

As the entire design of our product is very simple to take apart and put back together, requiring no permanent fasteners, the user is able to replace any individual piece if broken with ease. They will simply take it apart as usual and use the new part when putting it back together, following the original configuration instructions.

5.4 Support

In the case of a broken piece, the user can contact us directly. The group member in charge of customer support is Sydney Ceolin, who can be reached by email at sceol044@uottawa. When broken components or product issues are reported, they are all recorded to look for trends, on which we will be making product adaptations and providing new user maintenance instructions.

For the two connector pieces, we can either create new pieces for the user, or send them the CAD file for the pieces so that they can 3D print them themselves for quicker delivery time.

For the braking bar, the PVC joints, and the support bar, we can also send new pieces if the user would prefer. Alternatively, the pieces can all be easily purchased at any hardware store if the user requires them immediately.

6 Product Documentation

The documentation for the design of the product is detailed in the following subsections. Due to the intended simplicity of the design, the majority of technical documentation and testing was done surrounding two areas. Material testing, and mitigating accumulated tolerances. Screencaps of FEA simulations done to test mechanical properties of chosen materials are displayed in section 6.2.

6.1 AAAO assembly

6.1.1 Bill of Materials

Table 6.1.1.1. Bill Of Materials

Component Number	Name	Quantity	Price/Unit($ CAD)	Total Cost ($CAD)	Link
1	Main Bar	1	N/A	N/A	N/A
2	Hinge Joints	2	0.55	1.10	3D-Printed
3	Brake bar	1	5	5	N/A
4	PVC T-Joints	2	1.79	3.58	PVC T-Joint

6.1.2 Equipment list

Table 6.1.2.1. Equipment List

Equipment Needed	Reasoning	Example
Multi Bit Screwdriver	Gain access to Walker handles to install PVC TJoints	Example Screwdriver

6.1.3 Instructions

In order to construct the subsystem, first source components 1,3,4 (Table 6.1.1.1.). Part 1 should have a length such that it is marginally larger than the average gauge length between handlebars of a walker. This value can be obtained during the benchmarking phase of research. For component 3, the length and diameter are up to the designer. We emphasized ease of operation, safety, and cost. And this drove our material selection and dimensions. A designer can choose to focus on other goals and obtain a different material choice and dimensioning for their brake bar. I.e. brushed aluminum with a knurled center for a premium feel, should that be the goal of the designer. For component 4, T-Joints should be selected and acquired based on the looseness of the fit. They need to inhibit the main bar (component 1) from dislodging itself from the walker frame under load. As such an internal diameter of the T-joint should be as follows:

$$DiameterOfHandlebar + \frac{1}{2} = InnerDiameterOfTJoint$$

Finally, for manufacturing the hinge joints, either additive manufacturing can be used in the form of 3D printing or subtractive manufacturing can be used in the form of milling or CNC machining. Once more the choice of method is left to the designer as they must decide what purpose the product must fulfill. The diameter of the holes should be as follows: the opening for

the main bar (component 1) should be a tight clearance fit. Whereas the opening for the brake bar (Component 3) should be a loose transition fit.

6.2 Testing & Validation

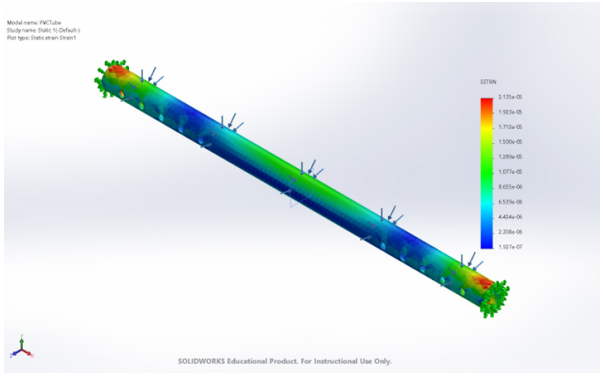

Figure 6.2.1- Analytical testing I

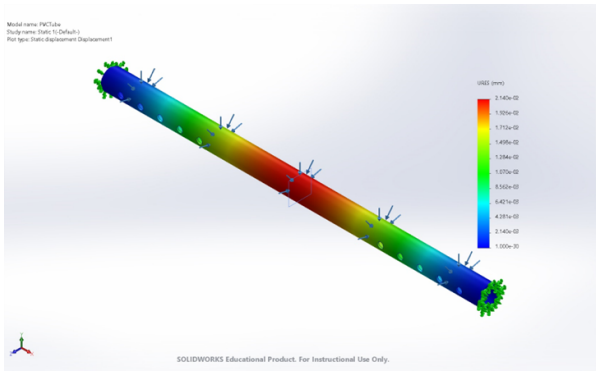

Figure .6.2.2- Analytical testing II

In order to test material properties of the main bar (which spans the gauge length of the given walker) SolidWorks FEA simulations were used. The object of these analytical tests was to determine the maximum elastic deformation the bar could sustain under a load of 1100 N (~112 kg), and that stress concentrations were located near the primary fixtures. This is important since the PVC T-joints (Part#4 in Figure.3.1.), ensure those stresses do not cause the bar to dislodge.

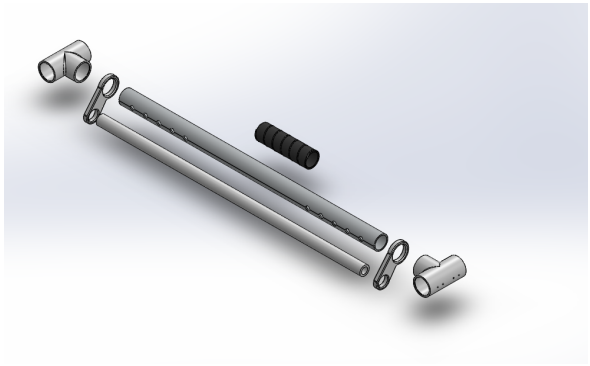

Figure.6.2.3.- Final CAD design

Another concern in designing the product was mitigating any accumulated tolerances incurred while manufacturing parts and sourcing them. This was of particular concern to the hinge joints (visible as Part#2 in Figure.3.1). To ensure versatility and prevent the need for replacement parts to be made, should the main bar (Part#4 Figure.3.1) vary in diameter. The decision was made to have the hinge joint fit loosely to the main bar. This would prevent any major frictional forces preventing easy use of the braking system. SolidWorks 3D modelling was

used to ensure plenty of room for error between the hinge joints and main bar as detailed in *Figure.6.2.*

7 Conclusions and Recommendations for Future Work

Throughout the semester the design went through plenty of changes and towards the end, we had to discard some finer approaches due to time constraints. Fortunately, we were still able to produce a design that satisfied the client and impressed the judges. We learned it is important to plan and work together as a team or else it will show that the project was not done properly. As previously mentioned, we were not able to carry out iterative testing for the store away factor as we had to prioritize testing the main functionality. For further improvement it is advised to come up with an effortless way to take the bar out for store away as the one currently used would require too much force, more than the user can provide. Originally, we decided to have a joint like a pin joint that would allow the bar to disconnect from only one side and hang on the side, allowing the walker to be folded and transported. This was one of the discarded ideas we would have liked to incorporate, and if we took the project further, we would focus on testing different approaches to making it smoother. Since we wanted to make this design simple and easy to use so that our client would not require much help from others, we had already started with a simple approach. Thanks to that, we ended up only discarding a few ideas, most of which did not affect the functionality.

APPENDICES

8 APPENDIX I: Design Files

Table 8. Referenced Documents

Document Name	**Document Location and/or URL**	**Issuance Date**
User Mnaual Video	https://youtu.be/hzYLSG2DXy4	6/12/2022
MakerRepo to the project	https://makerepo.com/MehdiEzzine/1405.gng-2101-aaao-accessible-walker-handle-	23/11/2022