Project Deliverable J: User Manual

GNG 2101 – Intro. to Product Dev. and Mgmt. for Engineers
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Abstract:

Accommodating to disabilities is a very important engineering topic in today's society, as we are always looking for ways to help the less fortunate. Our client is diagnosed with cerebral palsy, which is a disability that results in poor coordination, and weaker muscles. Our goal was to create a walking aid device that was mobile and easy to use for her. After months of research and following the design process, we believe we have achieved our goal. Our lightweight posterior walker has the ability to fold up with the twist of a pin. Additionally, we have personalized the walker height for our client, as she talks about the back and shoulder pain she gets from using her current one. With this custom height she will not have to worry anymore about the pain from slouching. With our unique tripedal design, our walker is lighter and more mobile than our competitors. This user manual will go more into detail about the development, and implementation of our posterior walker.

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Introduction

Originally, our product was designed for the disabled. However, with Canada's aging population due to the baby boom, the market for walking aid devices has skyrocketed. Finding a solution to walking challenges in the elderly is as important now, as it has ever been. If you have a difficult time with balance, coordination, or even tire easily, then our walker could be a solution for you. Our walker was specifically designed to be lightweight, and easy to operate. What makes our walker different from others is our three-legged design. With the reduced number of legs, our walker is lighter and more mobile than the rest.

Main Body:

A. Bill of materials

Our prototype was created with:

- 30' of 6061 Aluminum piping (OD:1.5" , ID: 1.3")
- 10' of 6061 Aluminum piping (OD: 1.25" , ID:1")
- 2- ¼"-20x5" hex head bolts with corresponding nuts
- 2-5" caster wheels
- 2- 5" wheels
- 2- Stainless steel 1.5" OD washers
- 2- 9" sheet metal support bar with 0.5" slot track
- 6- 0.5" 6061 Aluminum Piping spacers (OD: 1.5", ID: 1.3")
- 1- 26" 0.5"OD Steel Bar
- 2- V-Brake Set, Aluminum Alloy Bike Front Rear Pair Set Brake Accessory
- 2-TZOU Brake Avid FR5 Aluminum Alloy V-Brake Disc Brakes Lever Mountain Bike Bicycle Brake Handle Crank
- 2- Crutch Hand Grips (From Hugo)
- 3- Push pins (used for adjusting height)

B. Features and capabilities of the posterior walker

- **Accessibility**

  This posterior walker is engineered to be effortlessly accessed and fit into most family vehicles on the market. After folding, the entire walker can be fit in passenger seats and trunk.

- **Lightweight Body Structure**

  The innovative lightweight body frame is applied on the posterior walker. The application of aluminum and our 3-legged design results in the total weight of the walker at 8.7∓ 1lbs (≅3.95kg). It allows the user to self-operate with less physical strength required.

- **Adjustable Braking System**

  The brake system of the posterior walker has the similar operating principle with bicycle brakes. Users can brake the walker according to their needs, which reduces the risk of lunging forwards and maintaining the walker in control.

- **Height Adjustability**

  The rear leg of the posterior walker is equipped with adjustable pins for the users to adjust to the most suitable height.

- **Easy-to-operate Folding Mechanism**

  To fold the posterior walker, the user unlocks the supporting bar then loose the end screw and the joint rotates freely.

  To fold the posterior walker, the user locks the supporting bar then loose the end screw and the joint rotates freely.

C. Prototypes

Prototype 1:

The first prototype we made was built from popsicle sticks and glue. The main goal of the prototype was to demonstrate the balance of the overall structure. Since our walker has less support, we wanted to see if it was still stable. Lastly, it showed where the most amount of stress would be on the walker. We tested this by applying force to the top, and seeing where the sticks would be.

Fig 1.1: Side view of Prototype 1

Prototype 2:

Our second prototype was strictly analytical. The net of our final design was created on GeoGebra 5, and was meant to show the lengths and angles of all parts which would make up the walker. Also, we could see a mathematical view on where the centroid of the walker is located, and what type of force (tension or compression) is acting on each individual part.

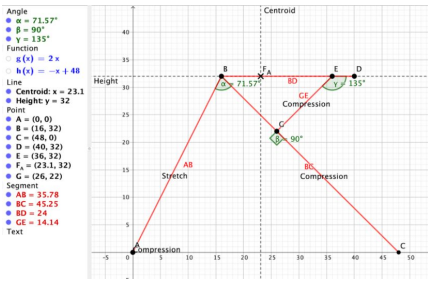

Fig 1.2: Prototype 2

Prototype 3:

Our third and final prototype was drafted on SOLIDWORKS. It is meant to portray a 3D representation of our walker, and its individual parts. In other words, its purpose is focussed around communicating our idea with customers/clients/others with exact spec,materials and lengths as our physical prototype would have had.

Fig 1.3: Side view of Prototype 3

Fig 1.4: Top view of Prototype 3

D. How It's Made

In this section we will go through how we built/assembled our walker

First we built the mainframe of our Posterior walker

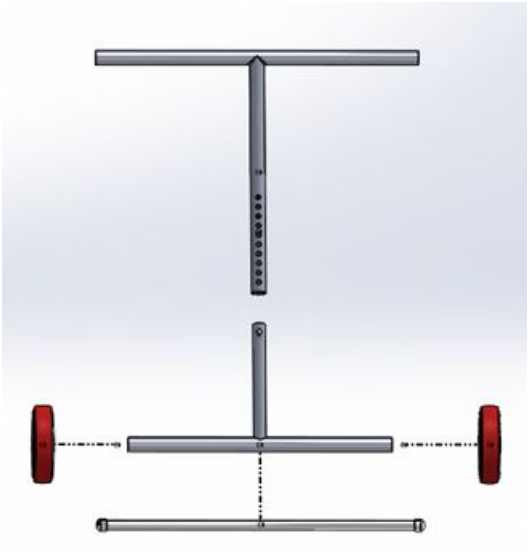

Figure 2.1: Expanded mainframe

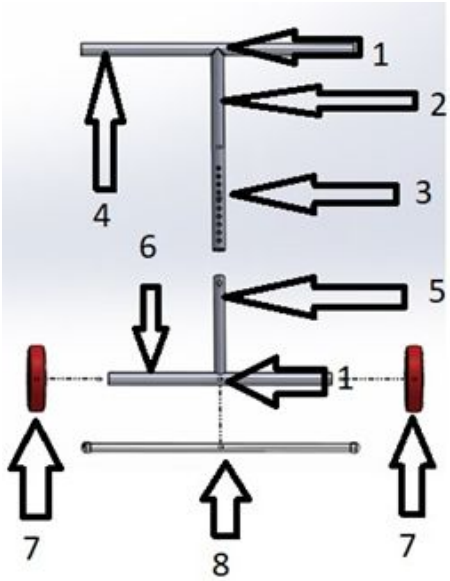

Figure 2.2: Expanded mainframe with numbered parts

1. Using a Tig Welded Machine, parts 2 was welded into the middle of part 4
2. 25" section of 6061 Aluminum piping (OD:1.5" , ID: 1.3")
3. Using a drill press with a ¼" Metal bit, we drilled 10 holes 1" apart into the bottom section of part 2
4. 33" section of 6061 Aluminum piping (OD:1.5" , ID: 1.3")
5. 12.75" section of 6061 Aluminum piping (OD:1.25" , ID: 1.0")
6. 27" section of 6061 Aluminum piping (OD:1.5" , ID: 1.3")
7. 5" Wheel
8. This is a 26" 0.5"OD Steel Bar. It is ran through the middle of part 6 as well as part 7. Connecting the back wheels to the axle

*** Parts 2 and 5 are connected via a push pin. This pin can be put into any of the holes shown in section 3*

Second we built the arms of our Posterior walker

Fig 2.3: Expanded handle view

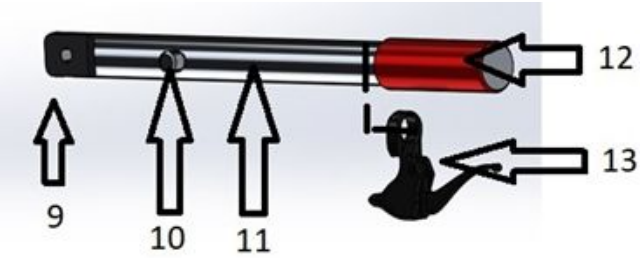

Fig 2.4: Expanded handle with numbered parts

9. Using a hydraulic press we crushed a 3” section at the end of part 11until it was flat in the middle. Next, using a drill press with a ¼” metal bit:we drilled a hole in the middle of the newly flattened portion of the pipe

10. This is a Knob which is welded onto part 11 to connect a sheet metal support bar, which is used to fold the walker.

11. 18” section of 6061 Aluminum piping (OD:1.5” , ID: 1.3”)

12. Crutch Hand Grips (From Hugo)

13. TZOU Brake Avid FR5 Aluminum Alloy V-Brake Disc Brakes Lever. This is fastened to part 11 by means of a clasp, which comes with the lever

Third we built the Legs of our Posterior walker

Fig 2.5: Expanded leg view

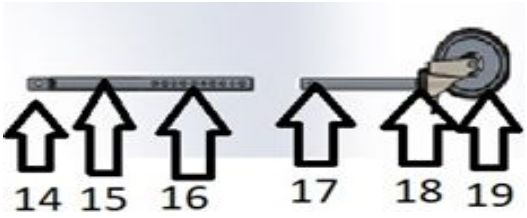

Fig 2.5: Expanded leg with numbered parts

14. Using a hydraulic press we crushed a 3” section at the end of part 15 until it was flat in the middle. Next, using a drill press with a ¼” metal bit:we drilled a hole in the middle of the newly flattened portion of the pipe

15. 23” section of 6061 Aluminum piping (OD:1.5” , ID: 1.3”)

16. Using a drill press with a ¼” Metal bit, we drilled 10 holes 1” apart into the bottom section of part 16

17. 12” section of 6061 Aluminum piping (OD:1.25” , ID: 1.0”)

18. Using a Tig Welded Machine, parts 17 was welded into the middle plat of part 19

19. 5” Caster Wheel

** Parts 15 and 17 are connected via a push pin. This pin can be put into any of the holes shown in section 16.*

Finally we attached the arm, legs, and support bar to the mainframe

Fig 2.7: Expanded shoulder joint view

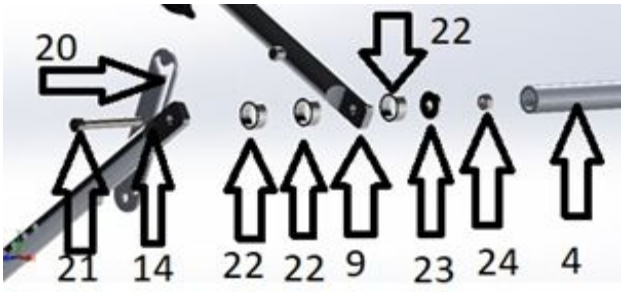

Fig 2.7: Expanded shoulder with numbers

20. 9” sheet metal support bar with 0.5” slot track
21. ¼”-20x5” hex head bolts
22. 0.5” 6061 Aluminum Piping spacers (OD: 1.5”, ID: 1.3”)
23. Stainless steel 1.5” OD washers
24. Corresponding nut for ¼”-20x5” hex head bolts

* Part 23 and 24 are welded together, This new part is then welded to the end of part 4.

The Hex bolt (21) is inserted through the hole in the top of the arm (14), then through 2 spacers (22), the hole in the top of the leg (9), another spacer (22), and then is screwed into the nut (24). By this time the nut (24) has already been welded to the washer (23) which has been welded to the mainframe (4). This will occur on both sides of the walker.

The sheet metal support bar (20) is then connect via the knobs on both the legs (14) and the arms (9).

E. Health and safety guidelines and precautions

When using the walker, it is essential to tighten the bolts on the handle to prevent them from collapsing when the walker is in use and check tightness of bolts and whether the support bar is locked before each use. Due to the COVID-19 pandemic, we weren’t able to perform

certain tests to determine its maximum weight capacity which is a critical part to any product that is used for support.

F. Operations

General use

To use the walker, enter the walker from the front, and face the open section of the top frame. Hold the hand grips located on the arms of the walker. Walk forwards.

Folding

To fold up the walker, locate the joint in which all frames converge at the top of the walker (shoulder joint). On either side of the horizontal bar, there is a pin. Simply loosen the pin on either side, and the legs and arms can rotate freely. Once the walker is completely folded up, simply re-tighten the pins and the walker is fastened in a folden position

Braking

To slow down or use the brakes on the walker, stop walking and interact with the braking levers underneath each handle. Hold the brakes until you reach a complete stop.

G. Maintenance

Over time our walker can be prone to everyday wear and tear. Keeping the shoulder joints as well as the caster wheels relatively clean will help with performance. Adding some 3-ONE OIL, or regular machine oil to the moving parts will help keep them well lubricated and function as desired. The crutch hand grip can wear out and may need replacing depending on how often the walker is used.

Conclusions and Recommendations

A. Lessons Learned

Throughout the entire project we developed a better understanding for project development and management. We learned about teamwork and time management plays an important part in any project. Teamwork played a crucial part in our project and it's not only working together as one big group, but splitting the task between each member then coming together to put all of the work done to make one. Time management also played an important role in the project. We learned that we should always prepare for anything when it comes to scheduling because things can happen randomly and we learned to work around them to prevent from delaying the project.

B. Recommendations

A significant amount of research must be put into materials before tackling this project. Lightweight metals like aluminum take a lot of practice to manipulate, whether you're flattening tubing, or especially welding. I recommend being very comfortable with MIG welding, and very comfortable at TIG welding on direct current before starting to practice TIG on alternating current. One of our members, Adam, spent upwards of 30 hours training and practicing welding, and was not happy with his results

Bibliography and Appendices

 Link to MakerRepo

https://makerepo.com/abone023/gng2101-c7-lightweight-posterior-walker