DELIVERABLE F - Prototype II

SUBMITTED BY:

A02 TEAM A2.1

Nina Blaney, 300234634

Shehryar Ali Memon, 300248675

Isaac Winsor, 300226614

Oluwatamilore Ilupeju, 300251697

Gautam Mehta, 300241579

Professor Lakhani

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University of Ottawa

Abstract

This document intends to illustrate our second prototype which will be a medium-fidelity prototype focusing on the material of the handlebar, connections and the twist-lock system of our one-handed walker. It also includes future plans regarding the project and the feedback received from the client from our last meeting.

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Introduction

This document features images and highlights of our second prototype, with complete testing results and analysis. It incorporates design features regarding the chosen material for the handle and connections, while also portraying the “twist-lock” design feature and its shortcomings. This is a medium-fidelity focused and functional prototype. This document also showcases the feedback we received from our client after the third client meeting i.e., the client’s likes and dislikes of the group concept that was presented to her. Future plans about the upcoming prototypes are also provided to give the reader a clear idea of how we are approaching this design problem.

Prototype II

Overview

Our second prototype was to test the strength of PVC as the material for the walker handle as well as the functionality of our connection subsystem. The prototype was a twist lock system, consisting of the male and female twist locks. The original design was done in CAD and the 3D printing was carried out later on. The female twist lock was designed to go over the PVC pipe that we acquired while the male twist lock was to go into the female twist lock and lock into place along with the PVC pipe (which served as our walker handle).

Testing

For the testing of prototype 2, our team wished to test the weight capacity, weight, and folding time metrics. In deliverable B, we stated our marginal and target values for these metrics based on our technical benchmarking of similar products and the feedback/statements we received from the client. For weight capacity, the marginal value was that our product could support more than 300 lbs, while our target value was over 400 lbs. Our marginal value for the weight of the product was less than 8 lbs and our target value was less than 5 lbs. Lastly, our marginal value for the folding time was less than 30 seconds and the target value was less than 15 seconds.

To determine the weight of the prototype we simply set the entire prototype (PVC pipe included) on a food scale, which informed us that it was well under our target value of 5 lbs, at just over 1.2 lbs. This may not be the weight of the entire assembly, however, this is the largest subsystem of the product and the weight was under 25% of our target value so we were very pleased with that.

To test the folding time of our prototype was also very simple. We took into consideration how the client would need to perform this task, so we had one end of the PVC pipe fastened in a vice grip to simulate being connected to one side of the walker and we timed ourselves unlocking, folding, and relocking the system while only using one arm. We timed ourselves unlocking three times and took the average of those three times. The results were 7.3s, 7.8s, and 7.1s, giving us an average time of 7.4s. With the simplicity of our design, we expected the results to be quicker, but the 3-D printed twist-lock system was pretty “sticky”, making it a bit more difficult to unlock. However, if this wasn’t such a tight fit, it would be easier for the system to unlock itself while the client was using it.

Lastly, we tested the weight capacity of our prototype. This made sense as the final test because the goal of this test was to determine the maximum weight our product could support, which could lead to the prototype breaking. In order to test the weight capacity of the prototype, we set one end of the prototype on one table with the other end on another table and applied force on the middle of the prototype (where the twist-lock system is located) with weights. Unfortunately, our prototype broke with just 50 lbs of force, which is much less than our marginal value. The twist-lock system that connected the two halves of the PVC pipe is where our prototype failed. We were not satisfied with the weight capacity of the prototype, so we will either need to add some additional support around the twist-lock system or change our design.

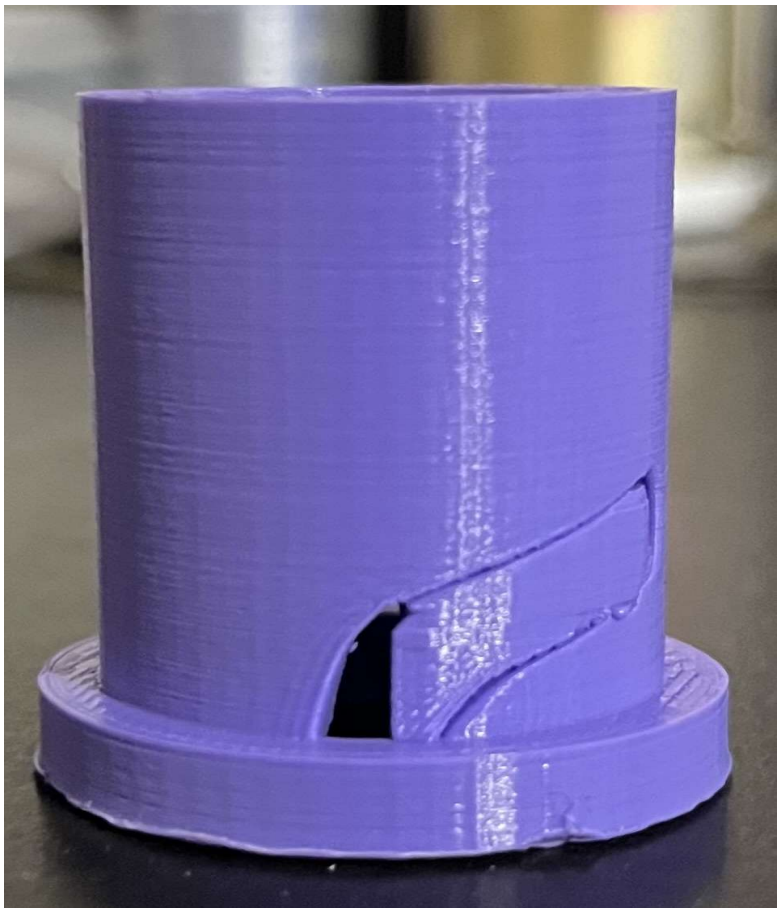

Figure 1: Front view of Twist-lock

Figure 2: Top view of Twist-lock

Bill of Materials GNG2101 A02 A2.1

Results

For the results of the testing, the more pronounced result was the strength of the material that the final design is going to be made from. As stated before, the results show that the material is very durable and can handle high stress on it.

The results also lead to the conclusion that the current design made for the client is not going to work. So, the group has decided to change directions and go for a more simplistic design, opting out of initial design ideas, such as including a lightning system, to make sure that at the end the client receives an attachment that can make her walker one-handed.

This new design will be the PVC pipe that would get attached securely to one end of her walker, then simply pivoted down and attached at the other end (figure 3). For the future, and if time permits, a small clamp could be attached to the bar section to allow for the attachment of a simple flashlight for the client to use when it is nighttime.

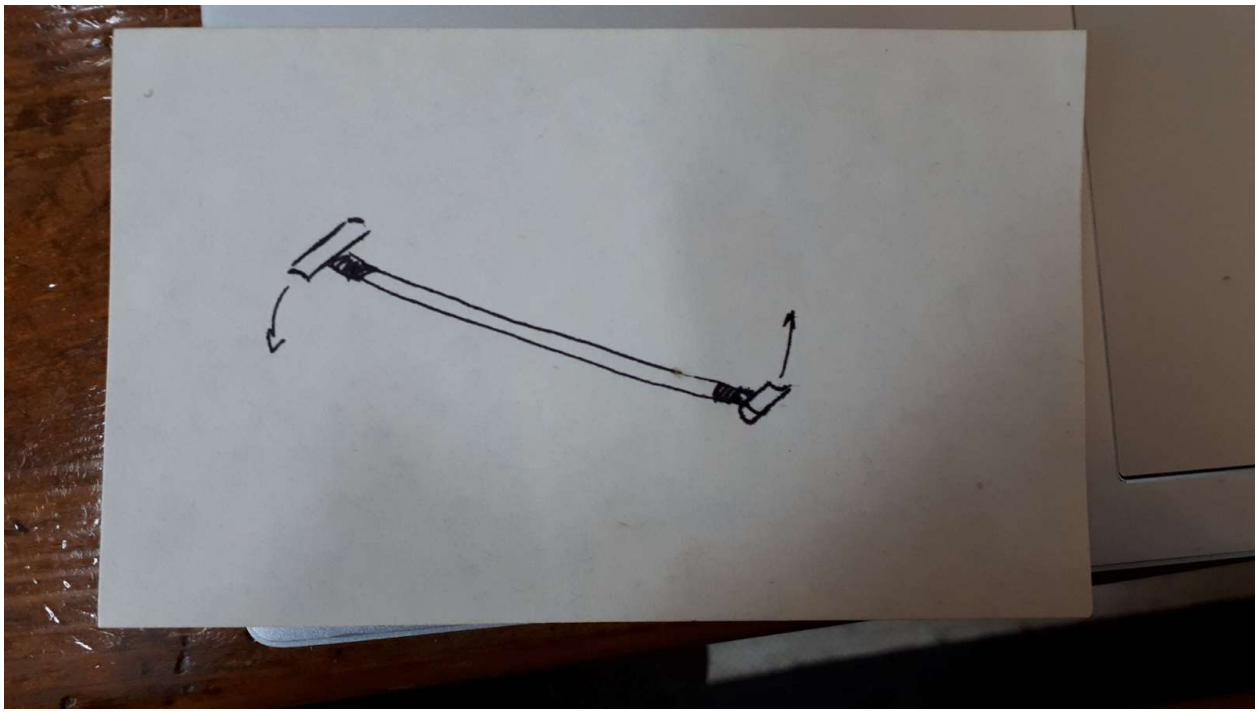

Figure 3: Simple Sketch of Attachment

Future: Final Prototype

As mentioned, the plan for the final prototype is to deliver the client an attachment that attaches to one side of their walker and swings down to attach to the other handle/side. This allows the client to quickly fold the walker when needed. The new design also negates the pre-planned lighting system to allow for full focus to be put on making sure the client gets a working addition to her walker that fully functions.

Client Meet

During the client meeting, discussions were held about the current development of the attachment for the client. Full transparency was held during the meeting, as the client was told that the initial design was failing to meet set out expectations and to make sure that she at least gets a working product at the end, the attachment will be made simple, and, of course, within the most important parameters laid out, (for example, the material being lightweight, and the design not taking too long to fold).

Main Feedback

During Client Meeting 3, we explained to the client that we had to change the initial plans for our Prototype 2 to a latch system because our twist-lock connection system concept was not feasible which we found out after testing. We also let her know that we tested the strength of our PVC pipe and it was revealed to be very durable and lightweight. In addition, we informed her that the concept of the lighting system had been put on the back burner as we chose to focus on the main handle device first.

Her response was;

- She was impressed that our PVC pipe was strong, durable and lightweight.
- She was happy that we used a PVC pipe and not a metal pipe because metal pipes are prone to corrosion and are also cool to the touch in temperate climates like North America during winter.
- She was also happy with the latch concept and she said it was very reasonable.

Conclusion

Due to the failure of the twist-lock system, we were forced to modify our design plans and our approach, however, we are confident that this design is feasible as it is simpler and more robust than the previous design since the client also expressed that she preferred our newer latch design. We plan to start testing on the tensile strength of the connections as soon as they are purchased, along with developing a way to incorporate our braking handle on our device. We hope to have a fully functional high fidelity prototype by design day if everything stays on track.

Wrike Screenshots

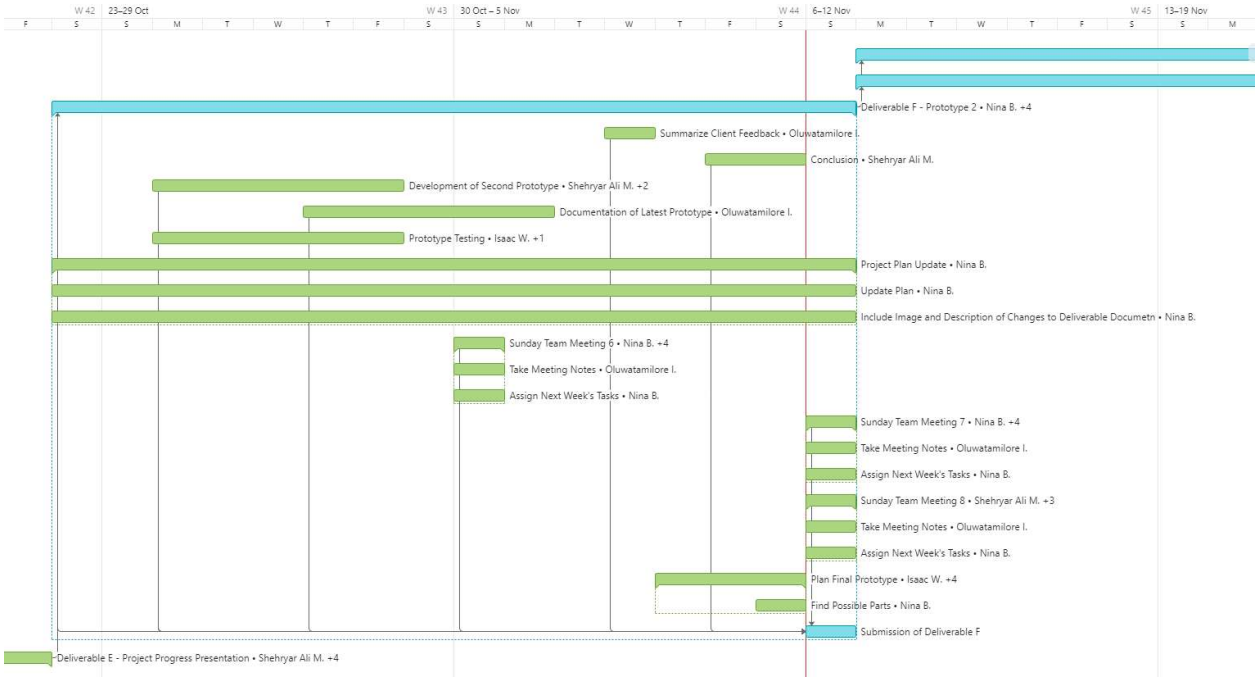

Figure 4: Wrike Screenshot for Deliverable F

Above is the screenshot of the project plan that was followed from the point that Deliverable D ended, to when F is submitted (which is why the submission of Deliverable F is still marked as in progress).

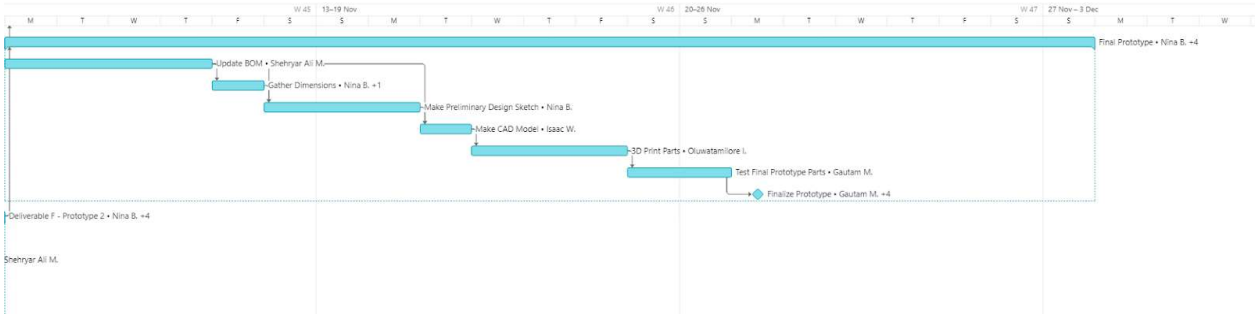

Figure 5: Wrike Screenshot Final Prototype

Above is the screenshot of the plan for the creation of the final prototype. While it might not seem as much, every task is very important (hence everything being dependent on the predecessor), with the milestone being “Finalized Prototype”, planned on being completed around the end of November, but also giving us enough buffer room in case anything happens that makes the group fall behind on the original plan.