Deliverable F

Prototype 1 and Test Plan

GNG 1103 Lab Section 8

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1. Introduction

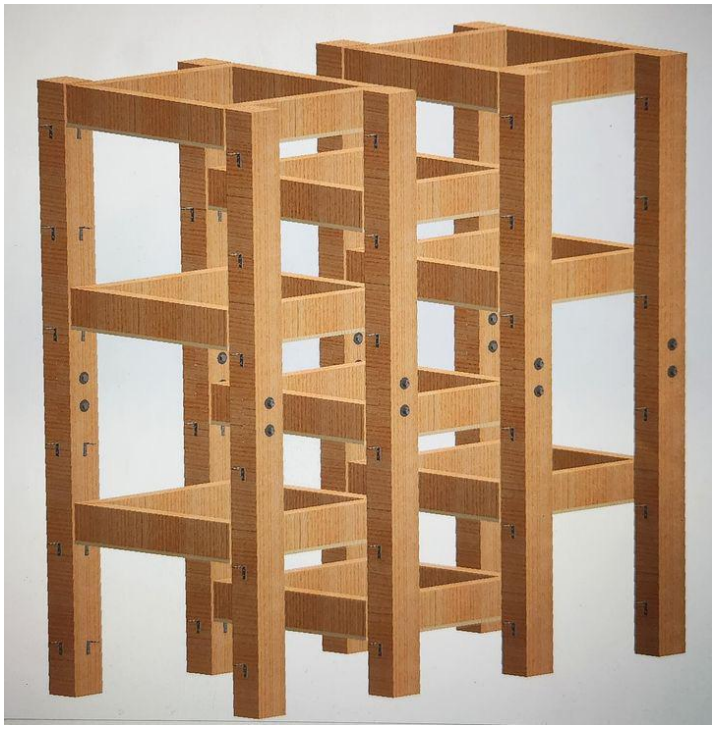
In order to advance in the production of the grow wall, we need to devise a test plan for our first prototype. The test plan will stem from our client's feedback on our designs and we will use that information to improve our solution. We will develop our first prototype based on our model's objectives from Deliverable E.

To test the prototype we will target a specific part of the model and formulate a test plan. A simple analysis of critical components will also be done to describe the prototype in further detail.

Finally, the grow wall prototype will be tested using a Test Plan that we will create. It will include the objectives of the test such as communication, analyzing critical systems, feasibility, and risk reduction. A test criterion is necessary to quantify the success of testing the prototype, therefore we will create a stopping plan which allows us to stop the test.

2. Prototyping

2.1. 3D model



Prototype 1

2.2. Prototype Plan

The plan for our first prototype included developing 2 different physical models. One being a fully 3D printed model of our full idea which would be partially functional. The other being an actual life-sized built model of a shelf that most resembles one we would make for our final actualized prototype. The main initial objectives for both prototypes were as follows:

- Develop a smaller-scale model which would allow us to view and gain a general idea and understanding of how the final prototype could look and function.

- Use the partially functional smaller model to simulate motion and view potential interference points.

- Gain experience in building an actual first shelf and analyze factors such as the durability, size, weight, and view.

- Examine the choice of wood used and compare it to other types of feasible wood to see if changes could be made to the final product.

- Perform different practice tests to see how well the shelf functions under different stresses to narrow down specific metrics for future building.

The creation of both our prototypes has given us the opportunity to fully cover/begin covering these objectives allowing us to make large progress towards the creation of both the 2nd and final prototypes.

3. Analysis and Feedback

We presented our 3 final designs to the client, and she examined our structures and gave us some useful feedback in order for the design to be chosen. She really liked all the designs, but our Modular Garden Shelf was the best-rated one, she mostly gave us positive feedback for this design. She even revoked some of the design criteria factors that we assessed to not satisfy her needs for example the leather-like design because it could be prone to be climbed by kids. She said that the kids were in the community center and mostly supervised and she assured us not to worry about that. For the Plant Fountain design, she was surprised and fascinated by the circular shelves and water fountain hydroponics but after a close review, she thought it was not feasible. Most of the feedback received from Zig-Zag Plant Wall was also positive, The client mentioned that the Modular Garden Shelf appeared to fit her needs better.

3.1. Customer Feedback

Using the previously registered feedback, we can conclude some changes and actions we need to partake in the better our prototype.

To start off, regarding the Modular Garden Shelf, we automatically concluded that it was the perfect design for our client and their needs. For example, the type of shelving used permits her to have a hydroponic watering system, but after some further conversation, she mentioned that she would like to do some soil gardening as well. Therefore, we modified the shelf to have the possibility to have a removable insert to accommodate both the hydroponic system and soil gardening. Furthermore, she told us that the overall design of the Modular Garden Shelf is exactly what she envisioned and would fit perfectly in the space she has to offer.

Secondly, for the Zig-Zag design, the client had some concerns. So, evidently, we decided to drift away from that idea, but we still tried to find a solution. For example, the slanted shelves design was thought to be quite complicated to maintain and manage. Therefore, we envisioned another idea where the shelves would be parallel to the ground. However, in that case, it was fairly similar to the Modular Garden Shelf design, therefore the latter design was highlighted.

Last, in the case of our most eccentric design, the Plant Fountain, the client fell in love with the idea immediately. The sheer outstanding design impressed them greatly. However, this complicated design did even make it to the qualifying round, because of its hard maintainability and lack of safety.

4. Test Plan

It is understood that the modification of our prototypes is essential to the creation of our future projects. The following is a list of the different tests along with reasoning that will be performed to evaluate our prototypes for future reference.

Test ID	Test objective	Prototype and test method	Results to be recorded and use	Test duration and start date
1	Gain general understanding on the look and function of our final prototype.	The prototype used will be the 3D printed model. Model will be visually and physically analyzed by each group member.	Overall look and motion will be recorded to identify disproportionalities and potential interference points. Results will be used to potentially rescale components of future projects as well as eliminate interference points.	Test will be taken once the prototype is complete. Test duration is from 5 - 10 minutes.

2	Evaluate shelf strength to view if design / wood type is suitable for our set requirements.	The prototype used will be the to scale 2'x2'x4" shelf model. The tests performed will be vertical load stress tests. The shelf will be connected to four 4"x4' vertical blocks by 4 Everbilt 1-½" corner braces. Using cinder blocks, up to 980N of force will be applied at the center, edges, and four corners of the shelf separately until limit or failure is reached.	During each specific test, the force will be incremented slowly and alongside it the time period relating to said force. The test will stop at the first sign of any type of deformation anywhere throughout the shelf or corner blocks or once the force limit requirement is met. The result to be recorded will be the force and time with which any failure occurs if it does. The result will be used to reevaluate potential weak points in the shelf design to replace / redesign.	Before test can be taken, shelf must be fully built with appropriate scale and mounting measures. As well, corner blocks must be acquired and equipped with corner braces. Test duration is from 1.5 - 2.5 hours.
3	Assess different types of wood to find an option which is strong, safe, weight/cost-effective, and suitable.	The prototype used will be the to scale 2'x2'x4" shelf model. Performance results from **Test ID 2** will be analyzed and research will be performed on factors such as wood density, cost, and general performance to evaluate wood choices.	A comparison chart will be created to compare wood choices using the results of **Test ID 2** and individual research of our wood choices. A point system will be used to identify the choice of wood that has the best qualities/results and is most suitable for future reference.	Research may begin before **Test ID 2** but this test cannot be completed before **Test ID 2**. Test duration is 1 - 2 days.

4.1. Mathematical Capacity

Following shown is the mathematical proof for the wanted weight capacity.

The garden box that we will be testing has the dimensions of 2’ x 2’ x 4”. And using the density of gardening soil and the volumic capacity of the box we can determine the latter.

a) Volume of the box

DATA	CALCULATIONS
Height of the box (h) = 4’’ = 0,1016 m	V = w * d * h
Width of the box (w) = 2’ = 0,6096 m	V = 0,6096 m * 0,6096 m * 0,1016 m
Depth of the box (d) = 2’ = 0,6096 m	V = 0,3776 m^3
Volume of the box (V) = ?	

b) Mass capacity wanted

DATA	CALCULATIONS
Volume of the box (V) = 0,3776 m^3	m = D * V
Density of gardening soil (D) = 0,75 g/ml = 750 kg/m^3	m = 750 kg/m^3 * 0,3776 m^3
Mass capacity wanted (m) = ?	m = 28,3168 kg

Thanks to these calculations, we can determine the minimum weight capacity of the garden boxes wanted is around 28,3168 kg and we can modify our design accordingly.

5. Transfer of Knowledge

Based on our previous deliverables we are able to use our past knowledge to execute our next phase of production: Our first prototype. We experienced many valuable lessons such as problem-solving, generating ideas, being flexible with our thoughts and feelings, communicating with the group, and how to be versatile for the client. Using all of those skills we were able to devise a test plan that will help us kickstart the next phase of our plan: prototype 2.

6. Wrike Plan

Below is the Wrike plan that shows each separated task with the corresponding subtasks for each group member.

https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=GhlELdncB5fnxFlBxMk6aupGQz0HXMcp%7CIE2DSNZVHA2DELSTGIYA

7. Conclusion

On considering the different facts in this work, the final testing for prototype one will be finalized by March 12th. Using this devised testing plan, we will ensure that everything is on time and that it goes smoothly. In addition, the client's feedback will be used to make the necessary changes to guarantee the safety of the users, the functionality, and, most of all, the client's satisfaction.

By combining the two previous aspects: the client's feedback and the results from the testing will make sure that the following prototypes please our client's wants and needs, whilst further testing goes swimmingly.