Report of Prototype 2 and Future Plans

GNG 1103-A01

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Introduction

This document outlines the groups creation of prototype two the associated tests and design changes, as well as the plans for the final prototype. The goal of prototype two was to create a skeletal physical prototype in which the smaller, more detailed components can be added in afterwards.

The client feedback received from the previous client meeting, as well as additional research by the group, was used to modify the design to better fit the design specifications.

Prototype 2

Critical components

The second prototype has been chosen to be a physical model that still captures the intrinsic foundation that is to be expected from a plant processing laboratory (e.g., tables, shelves, countertops, fridge, freezer). With this in mind, we have decided that the smaller details would shine with the help of a more tangible, physical representation. The creative liberty of having said tangible model allowed us to let the components speak for themselves in a visual perspective to retain the client's interest.

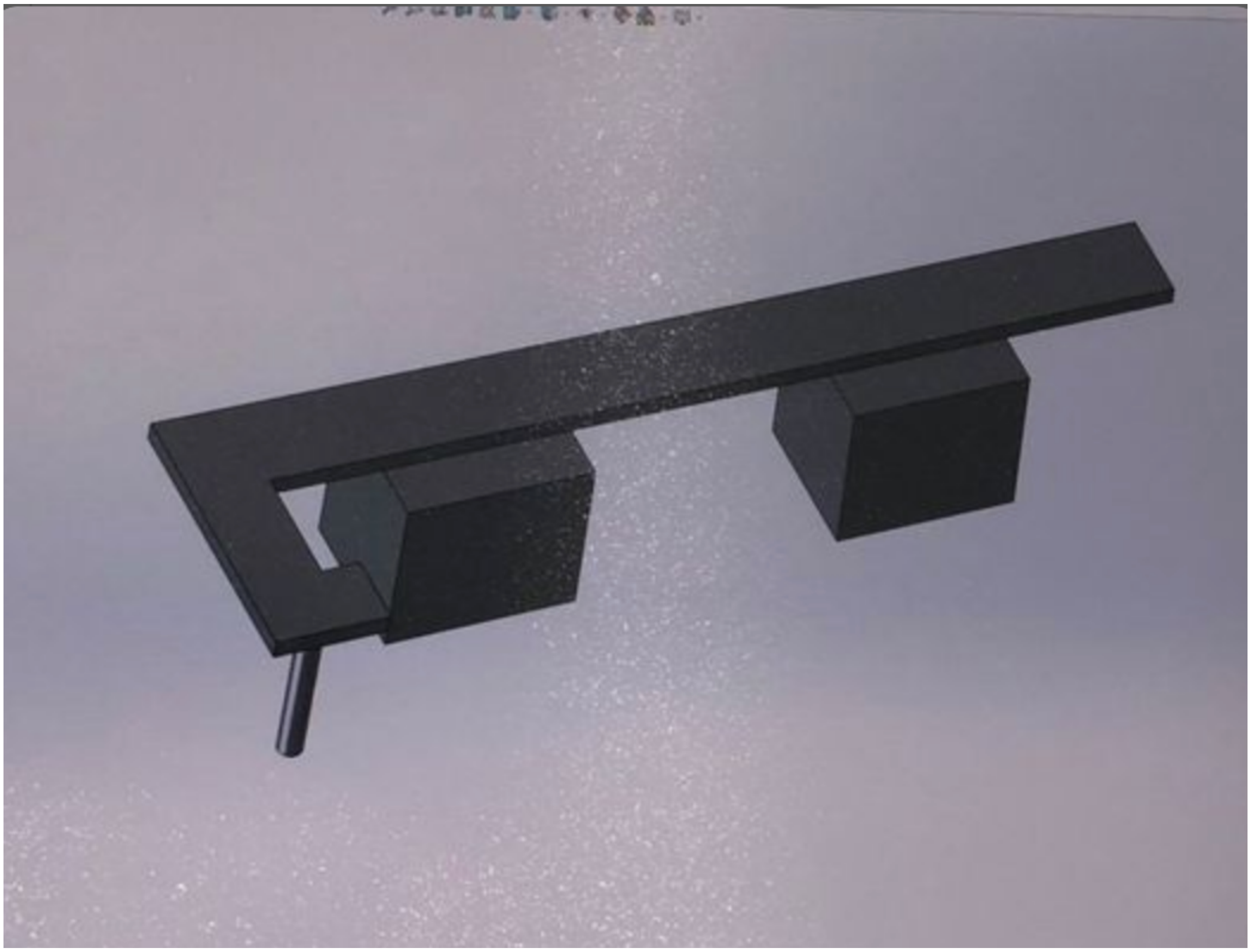
Design updates

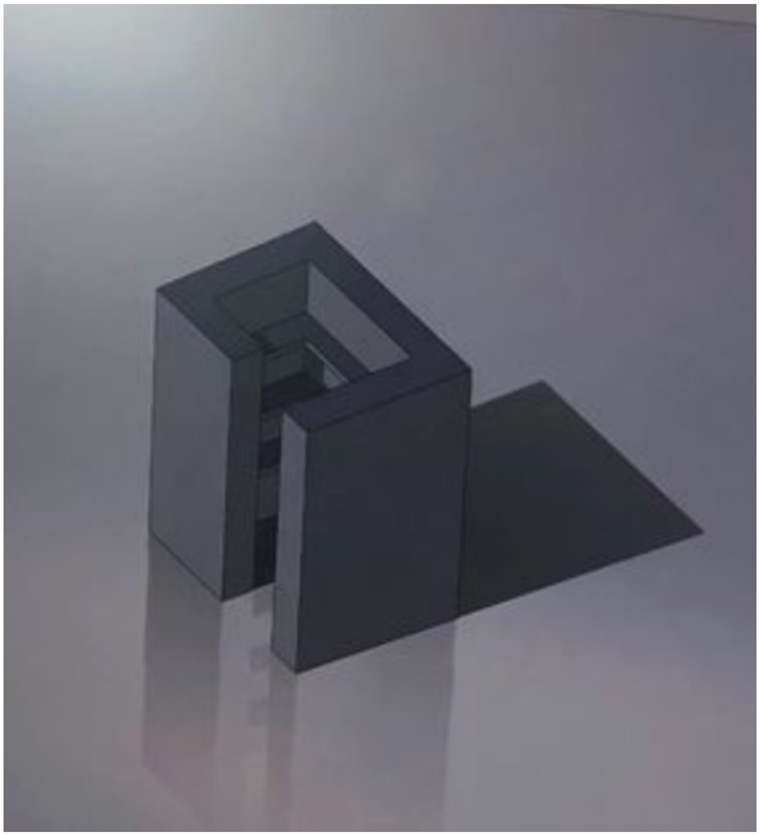
The group has not yet received feedback from the client and thus will not be making any changes to the current design

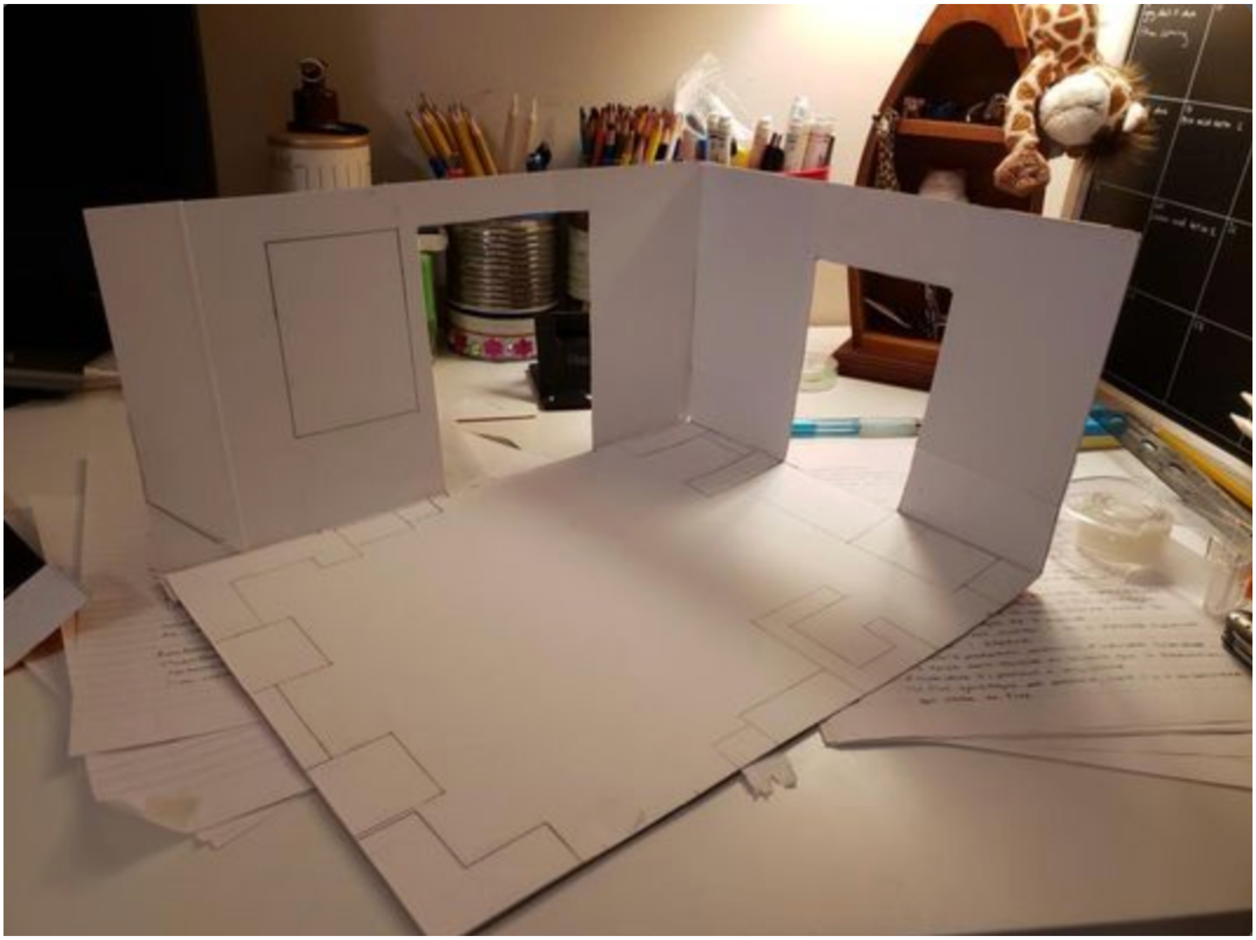
Creation of the prototype

This prototype was created using a combination of software and physical materials. The group began to 3D print the inside components of the building and constructed the building structure with cardboard. We had originally intended to create the building structure with MDF, however due to unforeseen circumstances this was not possible. We will still try to create an MDF structure so that the prototype if more professional and fine-tuned, and keep the cardboard structure as a backup. In the future, smaller details will be added to improve the prototype and make it more similar to the finished product.

Visuals of Prototype 2







Testing Prototype 2

ID	Design Specification	Value	Verification method
1	Tables must be mobile and sanitary		Materials test, mobility test
2	Table must be strong enough to carry large load	$\geq 1782N$	Materials test, numerical test
3	Table must be large enough to accommodate a deer	$\geq 1.9m^2$	Numerical test
4	Freezer must be able to accommodate a deer	$\geq 1.9m^2$	Numerical test
5	Floor and countertops must be sanitary		Materials test
6	Materials must be able to withstand temperature change	(-30 to 30)	Materials test Numerical test
7	Building insulation	Maintain 20 degree Celsius	Online test

Test ID	Objective	Materials	Expected Outcome
1	Validating Specification 1: The table must be sanitary	Table material sample, cleaning solution, swabs, Petri dishes, agar	Tables should show no bacterial growth
2	Validating Specification 1: The table castors (wheels) must be mobile even under stress	Prototype, weights	The table should move quickly
3	Validating Specification 2	Prototype, weights, simulation	The table should not show any signs of stress or deformation
4	Validating Specification 3	Prototype, measuring tape	The table should measure more than 1.9m^2
5	Validating Specification 4	Prototype, measuring tape	The industrial Freezer should measure more than 1.9m^2
6	Validating Specification 5	Floor and Countertop material sample, cleaning solution, swabs, Petri dishes, agar	The floor and countertops should show no bacterial growth based on common cleaning methods
7	Validating Specification 6	Prototype, temperature chamber/fridge or freezer	Materials should not show any signs of stress or deformation or mold
8	Validating Specification 7	Simulation, prototype 3d model including materials, Types of insulation methods	The building should maintain a temperature of 20 degrees Celsius

Test ID	Method
1	Clean the table material sample with a standard cleaning solution, then swab the surface and transfer the swab to a petri dish with agar. Incubate and check for bacterial growth. As the prototype won't be a full-size model, it will take a sample of table material and assess its ability to not hold bacteria after being cleaned once.
2	Place a load on a table similar to the intended one, using the same castors. This load can be applied by having individuals sit on the table to test if the mobility of the table remains consistent. The total weight should be a minimum of 100 kg.
3	Since the prototype is approximately 40 times smaller than the actual table, we will adjust the load proportionally for testing. The actual table is designed to support 1782N so we will apply a load of 44.55N (1782N divided by 40) for the prototype. Gradually add weights to the prototype table until it reaches the load of 44.55N. Observe the prototype table for any signs of stress or deformation. The prototype must be a smaller version of the life-size one, including the materials.
3	In addition to the physical testing, conduct a load test simulation. Use a software tool to model the life-size prototype and materials and apply a virtual load of 1782N. Monitor the simulation for potential stress points or deformations under the load. This simulation will provide valuable data for improving the design without physically testing the prototype.
4	Use a measuring tape to measure the table's surface area and compare it to the maximum surface area of a deer when butchered.
5	Use a measuring tape to measure the internal dimensions of the industrial freezer. Ideally, the deer could be hanged upside down.
6	We would verify the floor's hygienic conditions in a prototype building using a thorough cleaning procedure. The testing would be based on a floor and countertop material sample. To eliminate any loose debris, the floor, constructed of a material similar to that used in butcher shops, would be carefully cleaned. The floor would then be cleaned using a standard cleaning solution. This might be done with a mop for a more focused clean or a hose for a more thorough rinse. After applying the cleaning solution, the floor would be scrubbed to remove any stubborn dirt or bacteria. The floor would then be cleaned again and air-dried. Swabs would gather samples from the floor surface after cleaning—petri dish technique. Then, the method of petri dish analysis is the same as test number 1.
7	Position the materials in a thermal chamber and expose them to a temperature spectrum from -30 to 30 degrees Celsius. The testing would be based on material samples. Monitor the materials for any indications of stress or deformation. Alternatively, the materials could be placed in a refrigerator or freezer or left outdoors

	during winter lows. Also, inspect the materials for further deterioration, such as mold growth.
8	To test the insulation of a building prototype, we would replace it with several insulating materials common in Ottawa and Canada. The prototype would then be placed in an artificial setting that mimics the climatic conditions in Ottawa. We would set the prototype's internal temperature to 20 degrees Celsius. We would use a thermometer to monitor the inside temperature of the prototype because it is susceptible to variable exterior temperatures and weather conditions. The purpose is to determine whether or not the interior temperature remains consistent, so assessing the efficacy of the insulating materials in maintaining a steady internal temperature. This simulation would offer a full assessment of the insulating capacities of the building prototype.

Plan for Prototype 3

General plan for prototype 3

In prototype 3, the group will add the finishing details to prototype 2 and complete the fully functional solution. This will be a physical model which showcases all the design specifications. Due to the nature of the project, the focus of the final prototype is to demonstrate the design of the building, floorplan, aesthetic, and other components.

Test plan for prototype 3

ID	Design Specification	Verification method
1	Exterior of building is aesthetically appealing	Survey
2	Interior of building is aesthetically appealing	Survey
3	Building is usable	Usability heuristics
4	Building meets basic safety standards	comparative

Usability analysis

User analysis

Users	Usage	Lab experience
Guardians	High	Intermediate
General Public	Intermediate	Low
Owner	Intermediate	Intermediate

Analysis of components being used

Building component	Level of Usage
Tables	High
Storage	High
Doors (including garage)	High
Greenhouse	Intermediate
Computer stations	Intermediate

Usability Heuristics (to be filled out during prototype 3 creation)

ID	Usability Heuristic	Criteria met	Building Components
1	Visibility		
2	Similarity		
3	Control & Freedom		
4	Error Prevention		
5	Error Handling		
6	Consistency		
7	Recognition & Recall		
8	Flexibility & Efficiency		
9	Aesthetic & Minimalist		
10	User Help		

Conclusion

Overall, prototype 2 was successful. The goal of prototype 2 was met, and the tests also yielded favorable results. Although some of the initial plans for prototype 2 had to be changed, we were still able to achieve the main goal, which was to create a skeletal building. The group will continue working to improve the prototype.