

GNG1103
Design Project User and Product Manual

User and Product Manual for Lab and Plant Processing Building

Submitted by:

group A04

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List of Acronyms and Glossary

//Table 1. Acronyms

Acronym	Definition
BOM	Bill of materials: an outline of the budget for prototype materials and building costs
MDF	Medium density fibreboard: material used during prototype construction

1 Introduction

This User and Product Manual (UPM) provides the information necessary to effectively use the plant processing and lab station as part of an environmental monitoring building, and for prototype documentation. This manual is intended for users who are environmental monitors or require the use of a lab-like building. The contents of this document are client specific and thus may not apply to the majority. The document outlines the subcomponents of the building design, added and modified features, and the creation and development of a prototype. It is advised that users take caution during prototype construction as the handling of objects with sharp edges is required.

2 Overview

There was a need of a lab and plant processing station as part of an environmental monitoring building which could support the client's goal in protecting the land and promoting a sustainable future. The building will be used to process collected plants and fauna to gain information on the state of the surrounding environment and the effects of specific industries on the land. The client required that the lab and plant processing station be large, include a variety of storage spaces and countertops, and mobile worktables.

The developed design features components unique to the required use of the building which were created in full consideration, and to the benefit of the client. These features include the greenhouse, garage entrance, and variety storage spaces. The function of the greenhouse is to facilitate plant growth during winter seasons, and to cater to the needs of specific plants. The garage entrance is to make transport of large materials more convenient, and storage spaces were deemed essential in a lab setting for plant and fauna samples, equipment, and other objects which may need to be stored.

Due to the nature of the project, the design and prototype were created based on the assumption that the lab is separate from the main building. Taking into consideration the client's uncertainty, the design may be easily modified to fit the required needs, including a merge with the main building.

2.1 Conventions

In this document, is actions or cautionary actions are required on the part of the user, it will be indicated in boldface writing of either '**CAUTION**' or '**ACTION**'. These commands are for the convenience of the user and are included to facilitate effective use of this manual.

2.2 Cautions & Warnings

This project is associated with risks and as such it is advised that users take precautions to prevent possible injury. Users should take note of the following risks associated with the project and prototype construction:

- The use of objects with sharp edges
- Use of small objects which are choking hazards

- Use of hot materials
- Use of flammable materials
- Possibility of cuts and injury
- Possibility of injury during equipment use

The majority of the listed risks are directly related to prototype construction. There are little to no risks associated with building design using online tools.

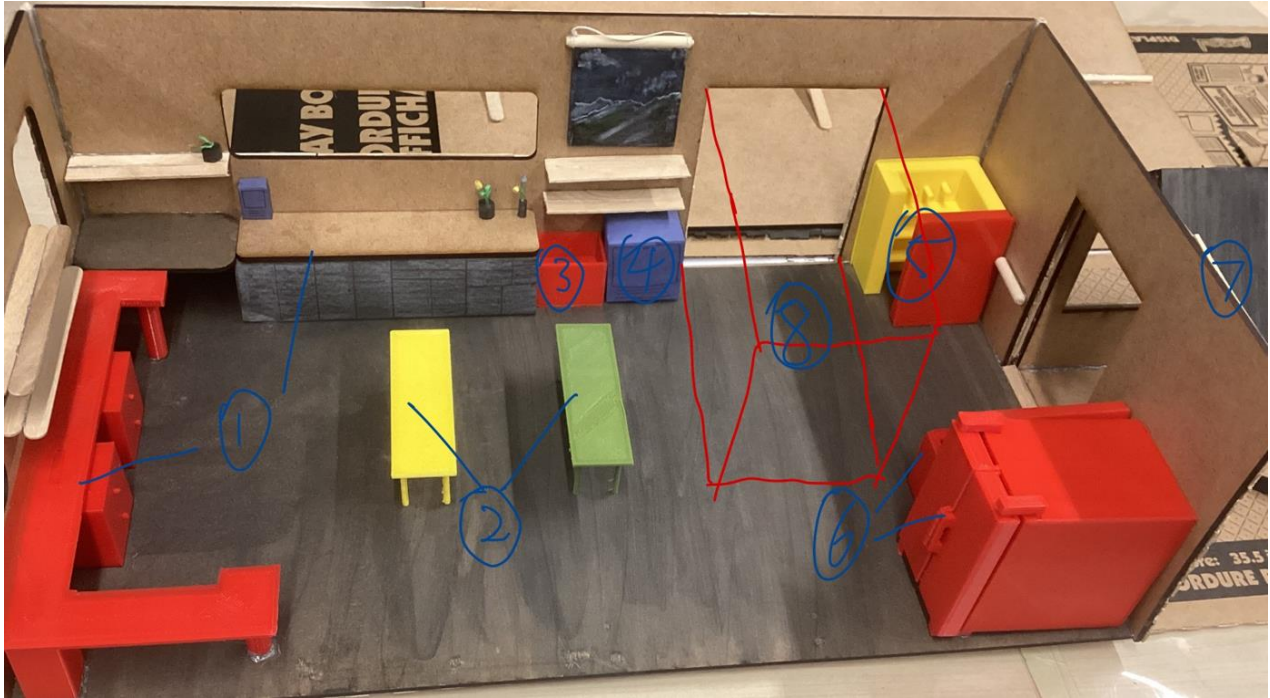
3 Getting started

This section will lead you through the required considerations to be taken during the project and prototype construction. Important components will be pointed out, including their function and purpose.

3.1 Configuration Considerations

Figure 1. Configuration of the physical prototype





1,2. Table model

Display focus: Show flexible space utilization and ease of movement.

Features: simulate laboratory work and storage environment.

3.Sink model

Display focus: Introduce the use of sinks in laboratories, such as cleaning experimental equipment.

Features: Demonstrate its advantages in saving space and improving work efficiency.

4.Food dehydrator mode

Display Focus: Demonstrates how the food dehydrator can be used in the laboratory for sample preparation and processing.

Features: Explain its importance in food science and biological experiments.

5.Storage rack model

Display Focus: Display storage racks used to store experimental materials and equipment in the laboratory.

Features: Emphasizes the importance of storage racks in laboratory organization and space utilization.

6.Walk in freezer

Display Focus: Introduce its storage function and temperature control in the laboratory to demonstrate its capacity and storage space layout.

Features: Demonstrating extraordinarily large capacities and the importance of surface capacity.

7.Greenhouse model

Display Focus: Suitable for plants and storage spaces with specific temperature requirements.

Features: Simulate usage scenarios under severe or irregular weather conditions.

8.Garage model

Display Focus: Display design that facilitates transportation and quick entry and exit.

Features: Demonstrate the convenient handling and storage process of items.

3.2 User Access Considerations

1,2. Experimental table model:

Make sure you highlight its flexibility and ease of movement when displaying it.

Prepare an explanatory note emphasizing how the model simulates the working and storage environment of the laboratory.

3.Sink model:

During the demonstration, focus on the role of the sink in cleaning experimental equipment.

Show how it saves space and improves productivity with hands-on examples or pictures.

4. Food dehydrator model:

When presenting, demonstrate how a dehydrator can be used in the laboratory for sample preparation and processing.

Prepare materials describing their importance in food science and biology experiments.

5. Storage rack model:

Highlight the function of storage racks in storing experimental materials and equipment.

Emphasize its importance in laboratory organization and space utilization.

6. Walk-in Freezer Models:

Demonstrate its storage capabilities and temperature control, emphasizing its large capacity and storage space layout.

Prepare diagrams or illustrations to demonstrate application in the laboratory.

7. Greenhouse model:

Highlight plants and storage spaces suitable for specific temperature requirements.

Demonstrate how the model simulates usage scenarios under severe or irregular weather conditions.

8. Garage model:

Showcase its design for easy transportation and quick entry and exit.

Prepare demonstration materials showing how items can be easily handled and stored.

3.3 Accessing/setting up the System

Overall functional display: users may use a lego man or car to simulate the scene after entering the laboratory. This may start from the garage (8) to display that after entering the

laboratory, one can freely reach both sides to get the required tools, and then simulate entering the right side. Users may go to the storage space (5, 6, 7) to get the experimental supplies. Then enter the left work area (1, 2, 3, 4) to conduct experiments.

3.4 System Organization & Navigation



3.4.1 main building

The main building is the scale modeled physical prototype, is it supposed to help visualize what the building should look like in real life. We made sure to have a proper scale size for all of the windows, doors and utilities inside to demonstrate an accurate layout. The main building connects to the extensions and houses the lab area.

3.4.2 green house

The green house is a place to grow and complete research on plants. This space is demonstrated on the right side of the picture circled in red. Green houses are mainly used during the summer to ensure proper temperature and lighting. This space allows additional research space for the

researchers, and makes sure to have proper documentation in a controlled environment. This room is accessible with a small hallway for easy access.

3.4.3 roof

The roof is designed to block you from the exterior elements. This part of our model can be removed in order to have a better look into the prototype.

3.4.4 utilities

The utilities consist of all of the different appliances in the lab area. The tables, refrigerators and other utilities are all placed in their designated area to maximize the work station's efficiency. The tables in the middle are able to move in order to adapt the workspace for larger items.

3.5 Exiting the System

For our physical prototype, we must ensure to follow these steps in order to properly put away our system to minimize the potential damage.

- Before disassembly, we need to make sure that we take pictures and write notes on the visual wear and tear. Having a complete inventory check and proper documentation will ensure that our prototype won't be mishandled and ensure that parts won't be missing.
- Then disassembling it would be the next step, it consists of simply taking off the roof and loose items inside the prototype. Ensure that the parts are dusted and clean before storing it, and then place its designated area.
- The prototype can be placed in a box if necessary, but it isn't obligatory as the structure is very sturdy. Be sure to include the paper with the written inventory and notes when putting it away for good.

4 Using the System

The following sub-sections provide detailed, step-by-step instructions on how to use the various functions or features of the lab and plant processing station.

4.1 Worktables and Storage Spaces

The worktables included in the design come in three varieties: wood countertops, steel countertops, mobile aluminum tables. The wood countertops are included as part of the computer workstation. To maintain these countertops, they should be exposed to minimal amounts of humidity and water, and should be kept away from fire sources, or objects which may result in a fire. The steel countertops and mobile tables were included to provide sanitary workspaces for users. To maintain these features, users must regularly clean and disinfect surfaces before and after use to ensure maximum safety.

Storage spaces were included as part of the client's need for the building. A variety of storage spaces have been included and are at the users discretion for use. To maintain these storage spaces, it is recommended that users keep objects organised, and store objects according to similarity of use.

4.2. Greenhouse

The greenhouse included in the lab and plant processing building is intended for use during harsh weather. The greenhouse is for users to maintain plants during winter seasons, or to accommodate plants which have specific growing needs. Users are to be made aware that the greenhouse can pose possible risks such as danger due to glass shattering, fire hazard of flammable objects such as dry plants, slipping hazards, and possible injury due to lifting heavy weight. The greenhouse is at the users discretion for use

5 Troubleshooting & Support

This section outlines the issues associated with the project, safety protocols in the event of an emergency, and methods of maintenance and support for the project if failure occurs.

Maintaining the lab and ensuring user safety in a lab environment requires the ability to detect problems based on unusual behaviours or error messages. To do so, start by restarting the equipment or make sure the connections are correct for quick repairs. If issues persist, update software, recover data from backups, or consult lab supervisors or support staff for advice. In order to recognize problems in a lab by look for odd behaviour or error messages in experiments or equipment. Restarting and verifying connections are quick fixes; for more complicated problems, utilize backups, update software, or seek advice from lab specialists or supervisors.

5.1 Error Messages or Behaviors

Instrumentation Malfunction:

- Error Messages/Behaviours: Incorrect readings, sensor failures, or device calibration issues.
- Likely Cause: Sensor malfunction, calibration drift, or software interface errors.
- Possible Corrective Actions: Recalibrate sensors, check connections, consult equipment manuals, or restart software interfaces.

Experimental Setup Issues:

- Error Messages/Behaviours: Inconsistent results, experimental apparatus failures, or environmental variations.
- Likely Cause: Improper setup, equipment misalignment, or external interference.
- Possible Corrective Actions: Review experimental protocols, realign equipment, troubleshoot environmental factors, or seek guidance from lab manuals.

Parts Prone to Breaking:

- Sensors and Probes: Prone to wear, miscalibration, or electrical failure.
- Data Cables and Connectors: Susceptible to damage from constant handling or improper connections.
- Lab Equipment Interfaces: Vulnerable to software conflicts, outdated drivers, or compatibility issues.

- Power Supplies and Circuitry: May fail due to power fluctuations or component aging.

5.2 Special Considerations

1. Safety Protocol:

- Prioritize safety procedures when troubleshooting to ensure safety of all lab members.
- Be cautious while troubleshooting around lab equipment with high voltage or other hazardous material.

2. Documentation and Reporting:

- Document/log all troubleshooting attempts, steps taken and outcomes.
- Report troubleshooting attempts to supervisors or other appropriate staff members.

3. Supplier support:

- Utilize Supplier for support when troubleshooting equipment.

4. Equipment downtime:

- Determine if equipment overuse is the reason for malfunction before troubleshooting.

5.3 Maintenance

In order to maintain the lab model, routine maintenance must be conducted:

In order to maintain the durability and cleanliness of the tables and other surfaces, they must be routinely disinfected. This routine will ensure the safety for all lab staff members as ensure that all organisms do not get contaminated.

Another part of the maintenance that is required in the lab is proper waste disposal. Proper waste disposal by disposing hazardous materials according to rules and regulations ensures personal and environmental safety.

5.4 Support

In order to reach/get emergency assistance or system support, lab members must follow the following steps:

1. Report the issue to the Staff supervisor or security officer via a detailed, a specific and detailed report of the issue at hand.

2. Report issue to IT desk or other lab designated technical support.
3. Create a detailed technical report for the system support so that they can handle the issue going forward.

Emergency Assistance and System Support:

Points of Contact:

Lab Supervisor/Manager: Responsible for overseeing lab operations and handling emergencies.

Name: [Name of Supervisor/Manager]

Email: [Supervisor's Email Address]

IT Help Desk/Technical Support:

Name: [Name of IT Help Desk/Technical Support Personnel]

Email: [IT Support Email Address]

Email: [Supervisor's Email Address]

IT Help Desk/Technical Support:

Name: [Name of IT Help Desk/Technical Support Personnel]

Email: [IT Support Email Address]

6 Product Documentation

The house's 3D model has various distinguishing aspects that add to its usefulness and visual appeal. It has a glass greenhouse, a one-of-a-kind roof with a window, and a white façade with grey pillars. The greenhouse is intended to give ideal sunlight for plant development, while the top window allows natural light to enter, improving the interior lighting conditions.

Alternative materials such as stainless steel, plastic, or wood could be used for certain house parts, but these were not tested in this prototype. The materials were chosen based on their availability, cost-effectiveness, and suitability for the intended purpose.

Using environmentally friendly materials, such as recycled glass for the greenhouse and sustainably sourced wood for the façade, improves the building's environmental friendliness and coincides with the clients program sustainability goals.

The house's final prototype is a carefully planned design that meets the client's unique demands. The greenhouse is separated into four sections: the roof, the walls, the internal components, and the greenhouse. The roof and walls are built using a laser-cutting method, with an inside layer of MDF board and an outside layer of matchsticks, giving the house a natural aspect.

The inside components are made with 3D printing technology and PLA material, which ensures precision and durability. The greenhouse, mostly made of matchsticks, has a lot of open window space, allowing much sunshine.

When the roof is removed, the well-thought-out interior decor is exposed. It has more windows for better ventilation, which was added in response to suggestions from clients and focus groups. To increase storage capacity, the room's lateral length has been increased. A sloping roof design has also been implemented to guarantee adequate drainage and minimize the risk of damage from heavy precipitation and snowfall.

The house also has a walk-in freezer, a pathway that leads to the greenhouse, and an equipment storage cabinet. The workspace is on the left side of the room and includes a sink and dehydrator, two movable tables in the middle, and a fixed multipurpose counter table. Researchers have easy access to both areas because a garage divides these components. This all-encompassing design strategy guarantees that the home is sustainable and functional and supports client activities.

6.1 Prototype Creation

6.1.1 BOM (Bill of Materials)

Table 4. BOM for lab and plant processing building

Bill of Materials	
Tables (x2)	8000.00

Storage	6000.00
High-bay LED lights (x10)	1690.00
Sink	200.00
Freezer	40000.00
Fridge	1000.00
Stools	500.00
Steel countertops	12903.23
Wood countertops	5376.34
Concrete foundation	4703.33
Reinforced concrete flooring	5503.88
Exterior finish	2042.50
Wood	261105.95
Garage door access	2000.00
Greenhouse	6090.00
Roof Shingles	732.60
Trusses	1341.99
plywood	3109.40
construction	250800.00
building material cost	286629.65
total	613099.22

Table 5. BOM for prototype construction

Bill of Materials	
Material	
MDF sheets	\$2.50 x 5 = \$12.50
3D printing plastic	\$0.00

Popsicle sticks (3 bags)	\$1.25 x 3 = \$3.75
White Glue Gun Sticks	\$2.00
Transparent Glue	\$2.75
Software and Programs	
Onshape	\$0.00
AutoCAD	\$0.00
Inkscape	\$0.00
Total	\$21.00

6.1.2 Equipment list

- Laser Cutter
- Plyers
- 3D printer

6.1.3 Instructions

3-D MODEL (ACTION):

1. Create a 3d plan on Onshape with the correct dimensions as a sketch
2. Make sketches of the wall
 1. They will be square or rectangular to take the thickness of the wall into consideration
3. Extrude the sketch by using the wanted wall height number
 1. Some will be various length to take into account the windows or doors
4. Select the top face of the shorter extruded wall and insert a plain
5. On top of the place sketch a rectangle with the same dimension

6. Extrude it
 1. Make sure you make it a new body to edit the aesthetic later
7. Do the same process for all the windows except for the roof and top of the greenhouse
8. For the greenhouse it will consist of a pentagon with the dimensions agreed on in the floor plan
9. You can create a pentagon sketch by selecting the triangle and increasing the number of angles
10. Sketch outer wall with window space
11. Extrude it to desired height as new body's
12. On the top surface of the green house creat a plain
13. Then create a second plane of higher height
14. On the second elevated plate make a second pentagon smaller, then lift the two plains
15. On the sides create another plane on the angles
16. Create sketches of trapezoids
17. Extrude them in opposite direction so it deletes the same
18. After with the same sketch extrude in the windows as new bodies
19. Turn the viewpoint so you see the bottom and make the loft hollow by choosing the shell option
20. Make the roof by going on the side and make a triangle with a triangular hole in the middle
21. Extrude it sideways and make it a dark red
22. Then do the same process for the window
23. The roof design is the same process as the windows in the greenhouse except its a combination of circles of different color with higher transparency
24. The furniture are simpler and consists of squares and rectangles being extruded on top of different plains at different angles.

FINAL PROTOTYPE (CAUTION):

1. Through the 3d models created of the furniture 3d print them
 1. Make sure they are smaller in dimensions as they wouldn't fit in the 3d printer
2. Make squares for the 2 walls on Inkscape that is a ratio of 1 m of the building to 4 cm for the house

3. For the base use the floorplan and insert into Inkscape and adjust the measurement to the ration mentioned above
4. Laser cut both files using the 1/8 thick and 12 by 24-inch MDF sheets
 1. Make sure to follow the correct procedure to maintain safety and best result
 2. Apply the correct power and speed as shown on the sheet on the wall beside the laser cutter
5. Then do the same rectangle for the roof
6. **(CAUTION)** Use popsicle stick and cut the round angle to make the green house
7. After the furniture is finished 3d printing take out the excess material from the printing process with pliers
8. For the walls use glue to stick different sized popsicle sticks and alternate
9. Then use glue to put the walls and greenhouse together

6.2 Testing & Validation

ID	Design Specification	Value	Verification method
1	Room capacity	Fit ≥ 10 people	numerical
2	Storage capacity	Accommodate large tires at most	numerical
3	Natural light exposure	As much as possible	Social (ask 50 people, 20 must say it fulfils specification)
4	Building aesthetics	Must look pleasing	Social (ask 50 people, 20 must say it fulfils specification)

Testing #1

Assuming each person requires 5m^2 of usable space,

of people = area of building / 5 m

$62.4 / 5 = 12.48 = 12$ people

Result: the building can accommodate 12 people at a time and fits the design specification

Testing #2

If the standard truck tire takes up 1.6 m^3 of space,

Largest storage size = # of truck tires $\cdot 1.6 \text{ m}^3$

= 5 tires $\cdot 1.6 \text{ m}^3$

= 8 m^3

Result: the largest storage space required is 8 m^3 .

Testing #3

We showed our design to approximately 50 people, of which 30 stated that they thought there were enough windows in the design to allow good sunlight exposure. This fulfills the specification.

Testing #4

We showed our design to approximately 50 people, of which 20 stated that it 'looked nice'. This fulfills the specification; however, the group is considering a modification to the design to make it more aesthetically pleasing and to better fit First Nations traditional designs.

7 Conclusions and Recommendations for Future Work

The creation of this project was overall successful. Working on this project has taught many valuable lessons, including time management, distribution of work, effective goal making, and many more. In the future, our group would take more time to learn about the client's background and their specific wants for the project design. Our group would also consider other aspects of the project including power sources and more methods to promote sustainability within the design, in order to better capture the desires of the client. Others who continue this project may also consider more innovative floorplans and exterior designs which relate to the background of the client.

APPENDICES

8 APPENDIX I: Design Files

Additional project files may be found on maker repo. The maker repo can be accessed through the following link:

<https://makerepo.com/ochia060/1770>

9 APPENDIX II: Project Pictures

Figure 2. initial design

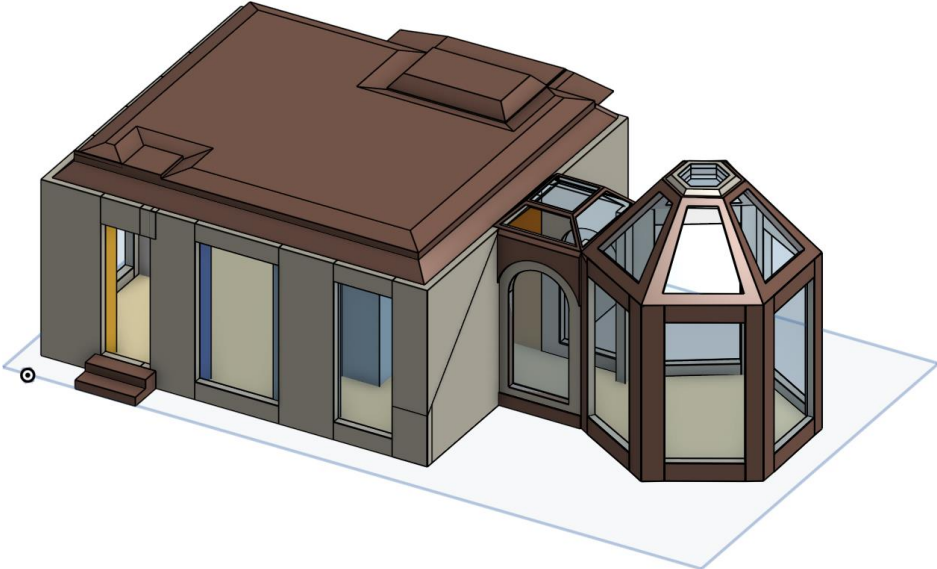


Figure 3. final design



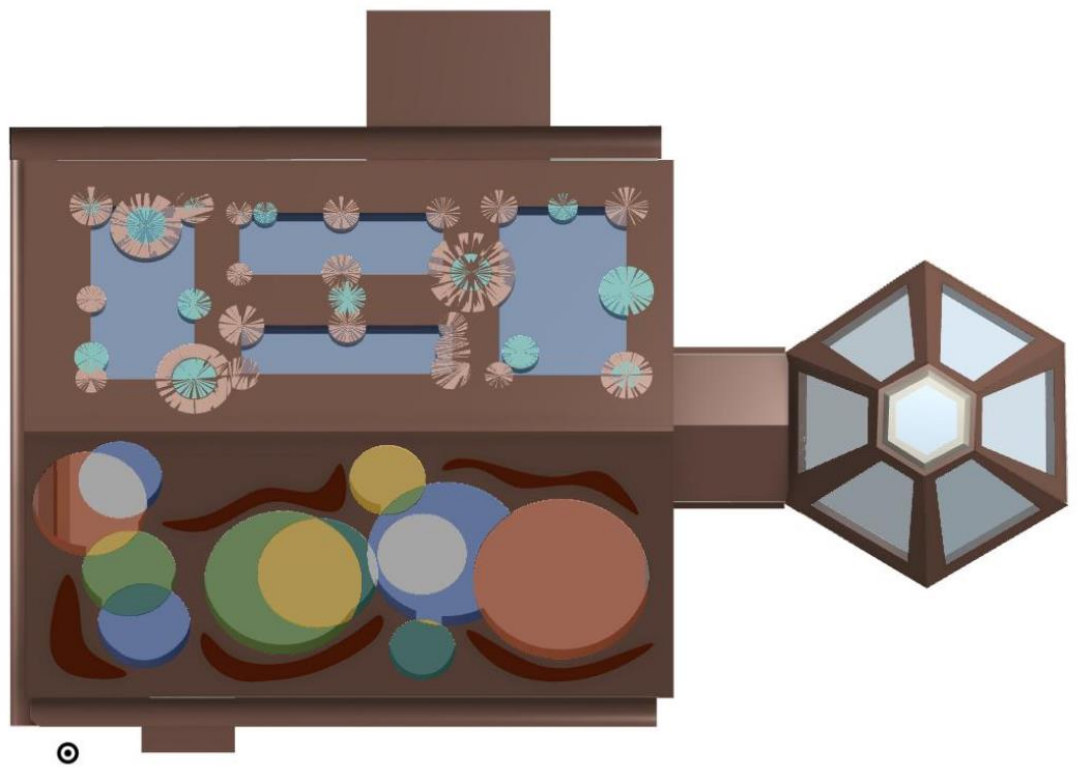
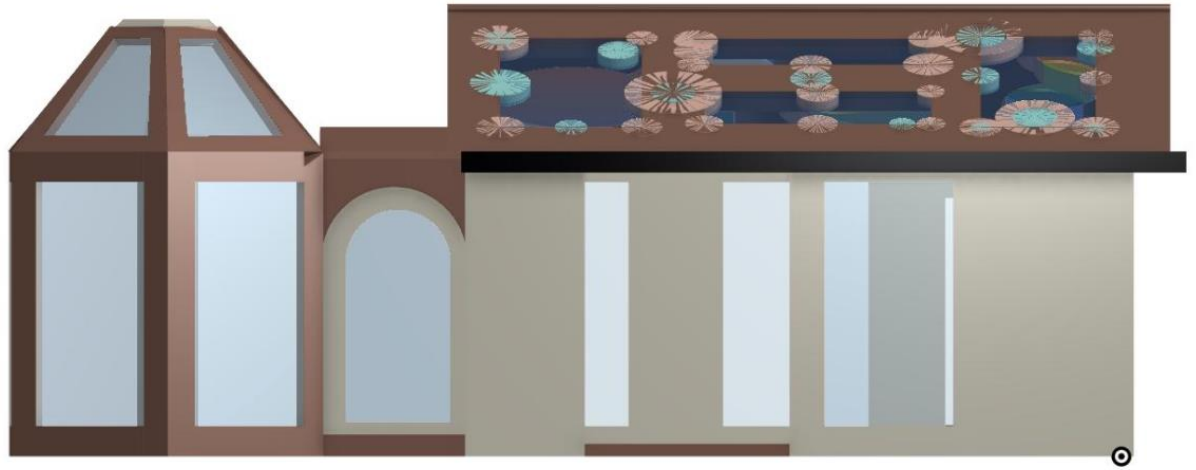


Figure 5. final floor plan

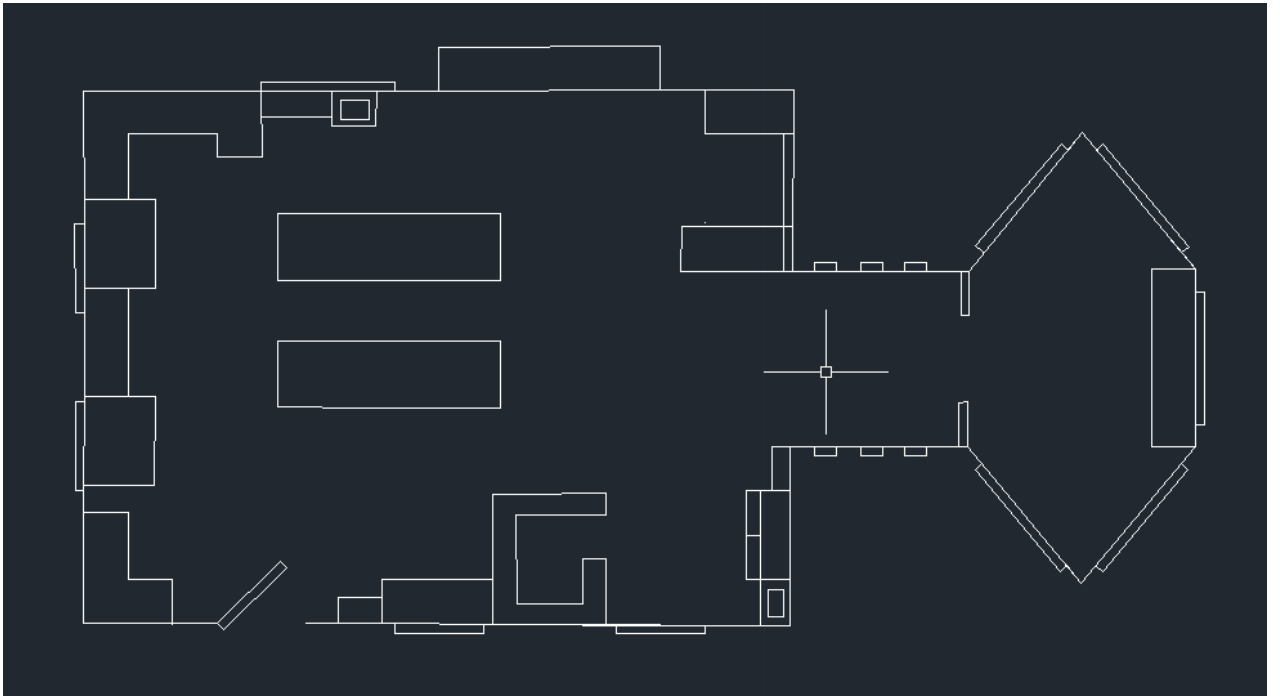




Figure 6. final prototype







