Project Deliverable C - Design Criteria

February 6th, 2020
Group D1 - Construction

This document will reflect on the needs provided by the client and how they can be implemented into our greenhouse construction. The interpretation or each need is reflected through basic solutions that can be expanded upon throughout our brainstorming process. Similarly, the needs have been ranked according to their apparent importance. Additionally, each need will be divided and expanded into 3 specific categories including: functional requirements, non-functional requirements and constraints. Functional requirements will reflect any obligatory needs that are a part of the system's functionality. While non-functional requirements will reflect anything that doesn't affect the performance of the greenhouse. Finally, the constraints will reflect on any requirements that may constrict our overall design. Overall, the goal of this document is to define a clear target and create a guide for its development.

Before our first client meeting, one of our priorities was to construct a structure that may be somewhat difficult to construct as long as it's functionality was ideal. However, after becoming aware of the community's idea to allow a school of children to help construct the greenhouses, we have decided to create a much simpler structure to compensate for a child's lack of experience with tools. Similarly, our original idea did not recognize that the family sizes in these communities are rather large, as a result, our new structure must support the necessary produce for a family of 5 people.

Prioritized Design Criteria:

The importance of each design criteria is organized 1 to 5. The most important criteria being 5 and the least important being 1.

Importance (Rating)	Need	Design Criteria
5	Easily Transportable	Weight (lbs) Detachable joints
5	Energy self sustainability (structural component to support solar panels)	Energy source Independency
5	Accessible and plentiful water supply	Water collection system
4	Child Safe (a local school will be working with them)	Easily constructed Minimum tool use
4	Relatively large to support family of 5	Volume (ft^3)
4	Animal proof	Enclosed system
3	Wind resisting structural features	Heavy base (lbs)

3	Budget under $500 (flexible budget)	Cheap materials ($)
3	Insulation for use in temperatures as low as -35℃	Dense materials (kg/m^3)
2	Security features	Door locks

Function Requirements:

- Easily constructed
    - Must be constructed using simple tools only for the safety of those building it. This can be tested in order to be verified.

- Independent functionality
    - Must use some natural source of energy to power itself. There must also be a place within the greenhouse for any power related equipment. The amount of energy can be determined mathematically and tested for verification.

- Water collection system
    - Must collect, store and distribute water throughout the greenhouse. This can be verified experimentally.

- Animal proof and theft proof
    - Must be an enclosed system so that animals cannot access the produce. Similarly there must be locks for anyone else who attempts to steal from other families. This can be verified through testing.

- Security features
    - Must have a lock on the door in order to prevent any theft. This can be tested for verification.

- Insulation
    - The greenhouse must have insulation for temperatures as low as -35℃ to allow plants to survive. This can be tested experimentally.

Constraints:

- Cost
    - The overall price of the system should cost about $500. This will be estimated initially and checked throughout.

- Sizing
    - The size of the greenhouse must be at most 6 feet by 6 feet while maximizing space within for produce. This can be tested through analysis.

- Weight
    - The system should be relatively heavy, especially at the base to resist the strong winds of the environment. This can be tested experimentally.

- Operating temperature
    - The system must be able to survive temperatures as low as -35℃ and the environment that relates to that temperature. This can be verified through testing.

Non-Functional Requirements:

- Aesthetics
    - The system will likely be painted to appeal to the client.

- Product life
    - The greenhouse will be constructed to last as long as possible with the materials provided.

- Safety
    - The greenhouse will be built to accommodate various interactions and therefore have minimal pinch points and be structurally sound.

- Reliability
    - The greenhouse will at least be able to be used up until winter and possibly throughout the winter depending on the insulation properties.

Benchmarking:

Specifications	**Importance Value**	Hybrid™ Clear and Twinwall Green Frame	EcoGrow™ Twinwall Panels Green Frame	Monticello Greenhouse
Company		Palram	Rion	Riverstone Industries
Picture of Structure	N/A			

Materials	N/A	- Polycarbonate Panels - Twin Walled - Galvanized Steel Base - Aluminum Frame	- Resin PVC Frame - Polycarbonate Panels	- Aluminum Frame - 8mm Twin Walled - Polycarbonate Panels
Shape	N/A	Rectangular base with a traditional triangular based prism roof.	Semi-octagonal based prism on top of a square based prism.	Triangular based prism on top of a rectangular based prism.
Dimensions	3	6ft x 8ft base Height: 3.47 m Width: 3.08 m Length: 4.12 m	6ft x 8ft base Height: 1.98m Width: 2.04m Length: 2.63m	8ft x 8ft base Height: 3.81m Width: 4.10 m Length: 6.22 m
Weight	2	46.3 kg	65.5 kg	29.5 kg
Cost	2	$989.00	$1,695.00	$3,629.00
Portability/Ease of Assembly	3	- DIY installation - Maintenance Free Design - 2 Person Assembly	- Smart pin and lock connector construction - Uniform profiles	- Intuitively Designed - 4-8 hour assembly time - Interchangeable Parts
Security Features	1	- Lockable Door Handle	- Door handle with holder to keep closed	- Lockable double doors
Durability	2	- No glass to shatter or break - Strong PVC which is UV protected	- Durable frame made to withstand weather - UV protection - No glass	- Thickness matching commercial greenhouses - Designed to withstand heavy winter conditions
Additional Information	1	- Built in Gutters - Roof Vent	- Roof Vent - Insulated	- Roof Vent - Integrated Gutter System - Expandability
Total		31	30	29

As a result of this research it appears that the Hybrid™ Clear and Twinwall Green Frame displays the most ideal characteristics that apply to our greenhouse.

Conclusion:

After organizing all available information, our group now has a great sense of a proper greenhouse design. This document will be used to reflect on the overall goal of our structure and ensure that our final product satisfies the needs of our client and stays within our specifications. Similarly, we must conduct further research on the animals in the area in order to determine an ideal solution for ensuring they cannot interfere with plant growth. In conclusion, our vision now has a specific set of instructions to follow.