

Deliverable C – Design Criteria and Target Specifications (G7)

Introduction

This report covers the design requirements linked the needs specified in Deliverable B. These design requirements are split into functional requirements, non-functional requirements, and constraints, and then prioritised (based on a scale from 1 to 5). These specifications are used to create benchmarks for several aspects of the interior design and irrigation system of this project. The target specifications will be based on these design criteria. The influence of the client meeting on our design process will also be described in depth.

Part 1

The needs stated in Deliverable B are:

- The grow wall should be modular and expandable.
- The grow wall should be rodent proof.
- The grow wall should be user friendly/kid-friendly and be easily transportable (parts fit in minivan, two people carry, easy assembly).
- The grow wall should optimize production of earlier-mentioned crops.
- Reliable/sustainable material (winter and wind resistance, rust etc...) and environment friendly (no fertilizers, minimal invasiveness)
- Aesthetic (igloo...).
- Low cost.

Priority on a scale of 1 - 5, 1 being a low priority and 5 being a high priority. Priority can be seen in the square brackets, [], next to the criteria.

Functional Requirements

- The grow wall should optimize production of earlier-mentioned crops. [3]
- Reliable/sustainable material (winter and wind resistance, rust etc...). [4]
- The grow wall requires sources of light, UV, humidity (no sunlight available indoors) [5]

Non-Functional Requirements

- The grow wall should be modular [5] and expandable. [3]
- Low cost. [2]
- Aesthetic (igloo...). [1]
- The grow wall should be user friendly/kid-friendly [5] and easily transportable (parts fit in minivan, two people carry, easy assembly). [3]
- Environment friendly (no fertilizers, minimal invasiveness). [3]

Constraints

- Size within limits of the community center bounds (8ft high x 8-10ft wide)
- No fertilizer
- Soil compatible with the “three-sisters” vegetables
- Limited access to electricity (uniquely for providing a source of light)
- Manual operating system
- Limited water supply

Part 2

Table 1: Technical benchmarking.

Types of Irrigation Systems			
Device Specifications	Type 1: Ebb and flow	Type 2: Drip irrigation	Product 3: Manual irrigation (Gardening pot)
Provides sufficient water supply	Yes	Yes	Yes
Easy to use	Not easy, automated (no soil).	Easy, semi-automated.	Very easy, but time consuming.
Desired vegetables can be grown using this system	May vary, advanced skills required for cultivation.	Yes	Yes
Electricity requirements	High (Pump required)	Medium	Low
Easily maintainable /fixable in case of damage	Difficult	Difficult	Easy
Price (\$/sqft)	100\$/pump (x3) and 80\$/water timer and 0.30\$/ft for PVC piping	0.20\$/ft (1/2in tubing) and 100\$/pump (X3)	Moisture sensors (30\$), watering pot (20\$X4, varying size)

Part 3

Table 2: Engineering Design Specifications

	Design Specs	Relation (=, <,>)	Value	Units	Verification Method
	<i>Functional Requirements</i>				
1	Light requirements	Low-light plants: = Medium-light plants: = High-light plants: =	50-150 150-250 250-450	Umol/m ² s	Photosensor
2	Water Supply	≥	2 105	inches/weekinches/year	Visual inspection of tank / consult user
	<i>Non-functional Requirements</i>				
1	Modular hydroponics	Y/N	Yes	Boolean	Consult with construction team, possibly modular tray around which construction team will build.
2	Expandable	Y/N	No	Boolean	Not applicable to grow wall, consult construction

3	Cost	<	500\$	CAD\$	Of the options above, we will try to choose the cheapest, limit other costs.
4	Aesthetic (igloo...)	Y/N	N/A	Boolean	Igloo aesthetic non-applicable to grow wall, crops will be arranged to suit optimal growth and accessibility before aesthetics.
5	User friendly and child-safe	Y/N	Yes	Boolean	Implementing safety and simplicity features in design (i.e. Traditional soil system), in combination with construction team.
6	Environment friendly	Y/N	Yes	Boolean	Limit our use of harmful products (i.e. No artificial fertilizers)
7	Transportation requirements	≤ ≤	2 3x7	People Inches/part (must fit in minivan)	Consult with construction team.
<i>Constraints</i>					
1	Dimensions	=	8x8-10	ft	Measuring
2	No fertilizer	Y/N	Yes	Boolean	Natural soil, we will use available compost as well.
4	“three-sisters” vegetables	Y/N	Yes	Boolean	Strategic localization of compatible plants.
5	Manual operating system	Y/N	Yes	Boolean	Irrigation system will be manual (traditional soil and watering). Grow Lighting will be automated.

Table 3: Target specifications, along with products for reference

Criteria	Unit	Type1: Ebb and Flow	Type2: Drip Irrigation	Type3: Manual	Prefer	Target value
Modular hydroponics	Boolean	Somewhat; reservoirs, pumps and electric wiring are restricting	Somewhat; pumps, moisture sensors and tubing may be restricting	Not inhibiting relocation whatsoever	Higher	Yes
Water requirements	Litres	Low; Nutrient solution pumped out of reservoir and gravity returns water to be used again. Water needs based on plant requirements (2"/week)	Low-Moderate; precision of tube setup allows for more directed water absorption by roots	Moderate; water losses to evaporation are expected	Lower	Based on availability at Donald community centre, consult client for exact availability
Expandable	Boolean	Depends on the tank size and pump capacity, but generally not easy to expand	Might require a little plumbing work to expand	Generally, easy to expand	Expanding may not be an option for indoor grow wall due to	Yes

					dimension restrictions	
Cost	CAD\$	100\$/pump (x3) and 80\$/water timer and 0.30\$/ft for PVC piping	0.20\$/ft (1/2in tubing) and 100\$/pump (X3)	Moisture sensors (30\$), watering pot (20\$X4, varying size)	Lower	500\$
User friendly and child-safe	Boolean	No, because of the complicated machinery that is working to automate the plant growth	No, because plumbing would take up a lot of space	Yes, because there is lots of room and easy to customize and modify	Higher	Yes
Environment friendly	Boolean	No, because there is no soil and the plants require nutrients in the water which are sold in plastic packaging. (High electricity)	Yes, because there is still soil that can be maintained naturally. Medium to High electricity use.	Yes, because soil is custom and there is very little electricity use.	Higher	Yes
Transportable	# of people And size (ft)	Somewhat; system requires reservoirs, increased weight and size	Transportable, pumps may require two people due to weight	Yes, because less equipment is used.	Higher	Parts transportable by 1-2 people and fitting into minivan (3x7)
Dimensions	ft	Can easily take up too much space	Can take a little too much space	Takes up the least amount of space	Exact	Must not exceed 8x10
No fertilizer (Natural)	Boolean	0	Soil system – artificial fertilizers not required	Soil system – artificial fertilizers not required	None	No chemical processing / artificial fertilizer. Ideally uses compost
“three-sisters” vegetables	Boolean	0 – Soil not used	1 (affirmative)	1	N/A	Yes
Manual operating system	Boolean	Yes	Yes	No	According to client needs	Yes

Part 4

The client meeting allowed for a comprehensive set of needs to be developed which was turned into design criteria and requirements. The client emphasised that simplicity (for educational purposes), efficiency, and naturality were their priorities, which were then separated into different subcategories. Group 7 has noted all the needs and has interpreted the clients’ absolute necessities and preferences for the design to be created. The needs which were considered necessities were given higher priority, while those which were preferences will be tailored to the constraints which we’ve identified. The client meeting led to a significantly more comprehensive understanding of the problem, and the expectations for this team and any design it develops. In other words, the meeting helped build an understanding of the customers and users, and how they will be using the product to serve the targeted Inuit communities.

Needs that were changed from Deliverable B to C:

- Designing a greenhouse → Designing the interior and irrigation system of the grow wall
- A new requirement involves the design of an artificial grow light system to serve the energy/UV needs of the plant
- A heating system is no longer required because the system is indoors
- The priority is no longer centred around maximal production, but rather on safety and user-friendliness for educational use

Conclusion

This report covered the criteria generated from the needs in Deliverable B. These criteria were categorised as functional or non-functional requirements and constraints. The specifications of other similar functioning products were used for technical benchmarking. These specifications were used to develop target specifications for future designs. Finally, the influence of the client meeting was discussed along with the changes in needs from Deliverable B to Deliverable C.

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