

GNG 1103 – Engineering Design Project Deliverable D

Need Identification and Problem Statement

Deliverable D - Conceptual Design

Group #12

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Introduction:

The purpose of this project is to improve a hydroponics system for our clients. This hydroponics system is intended to educate children about entrepreneurship. It should be able to successfully grows plants without soil.

The hydroponics system will have the following features:

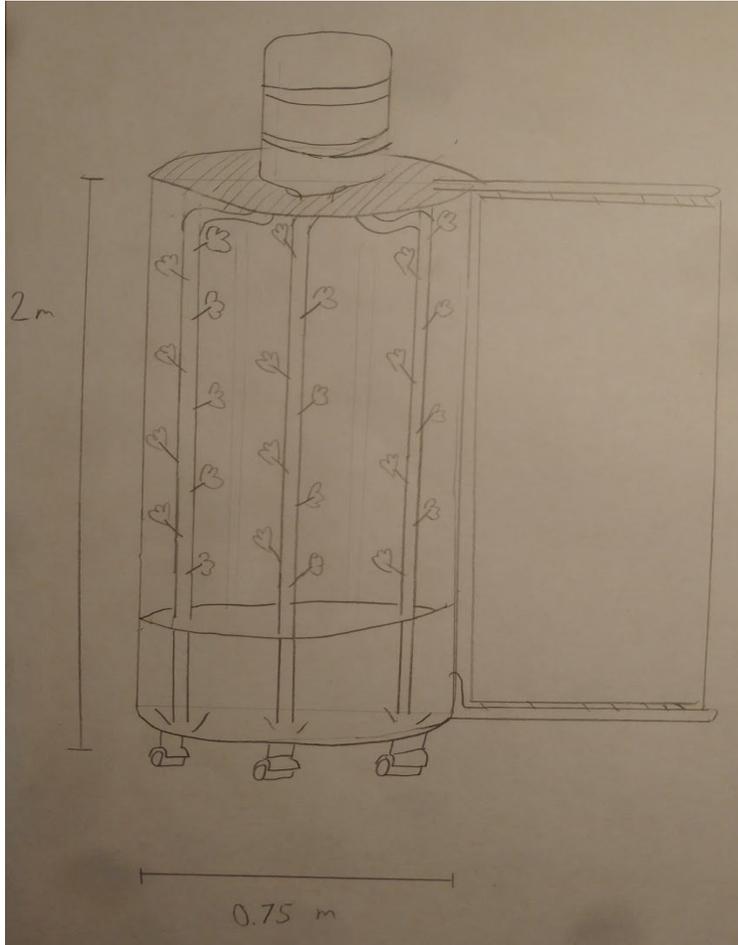
- A reservoir and watering system.
- Wheels for easy transportation.
- Be small enough to fit inside an elevator and for children to access.
- pH/ Water level monitoring
- Space for branding.
- Efficiency

Each team member provided 3 concepts. Through a final discussion all the concepts from all the team members were considered and combined to form 3 final conceptual designs. Finally, the three solutions were analyzed and evaluated using a selection matrix to select one final design.

Design Concepts

The following are the three designs we feel best fulfill the criteria.

Design 2.1 (By John Kenny)



Features:

This hydroponics system is cylindrical and contains 5 - 8 towers of plants. It is supported by 6 - 8 wide wheels. It is 2 metres tall and has a diameter of 0.75 metres. The bottom of the structure is taken up by a cylindrical reservoir. On top of the structure there is a hole where a jug is able to be inserted. Normally the water is pumped upwards from the reservoir into to towers. The water jug can also be used to water the plants; this does not require electricity. In the event of loss in power the hydroponics system will default to taking water from the water jug. To one side of the structure is one large banner for the purpose of branding and information. It is suspended in the air. There are lights on the ceiling of the cylinder, shining down onto the plants. It has a pH sensor and water level monitoring.

Advantages:

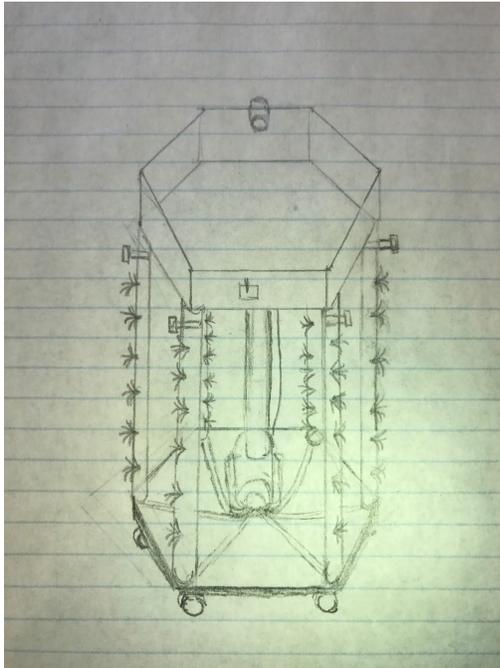
- Having a reservoir at the bottom gives the structure stability.

- This hydroponics system does not rely entirely on electricity.
- Banners are good way to provide space for branding and information without sacrificing much weight.
- Having it be in the shape of a cylinder is an efficient use of space.
- A water container in the shape of a cylinder has less stress points. It is less likely to break from the water pressure.
- The towers are an efficient use of space.

Disadvantages:

- Having all the water at the bottom means it will require more energy to pump up to the plants.
- The banner is an added cost.

Design 2.2 - Recirculating drip hydroponics system 1 (Cameron Meyers)



Features:

- This hydroponics system consists of 6 tubes each holding 6 plants.
- It has a large water reservoir at the top (this is also where the nutrient solution is added)
- Once the water drips down each tube onto the roots of all the plants a pump bring it back up so it can be used again
- There are valves attached to each tube to regulate the drip cycle
- A pH sensor and water level monitoring system are attached to the tank
- A large light is installed in the center to provide ideal lighting for all the plants
- The tubes can spin around to be harvested easily
- The wheels allow it to be moved from floor to floor (with help of elevator)

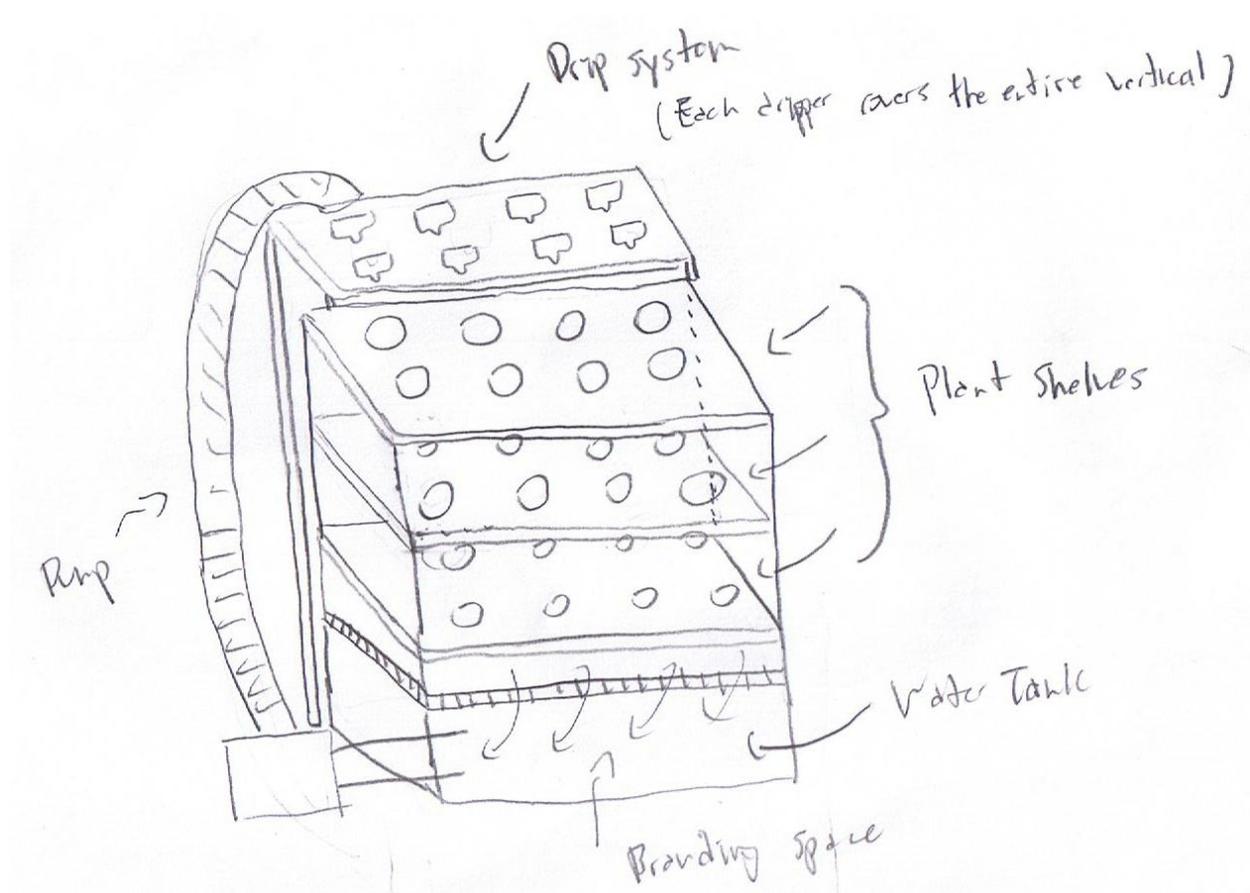
Advantages:

- Lots of space for branding on top
- Easy to harvest

Disadvantages:

- Requires someone tall to refill

Design 2.3 - Hydroponic shelves (Victor Cheung)



Features:

- Has sturdy plant beds that can be removed from the system
- The plant beds have a locking mechanism to ensure that they are vertically aligned with the drip taps
- Uses vertical drip systems to cover each column of plants
- Each plant bed has a set of lights to cover the plants above
- The shelves are behind glass to show the plants
- Uses pvp pipes and a pump to cycle the water
- An attachable plaque for branding
- Filter on top of the water tank

Advantages:

- Easy to clean, easy to access
- Since the plant beds are removable, an adult can remove the top plant beds and put it on a table for kids to reach
- Large reservoir
- Good plant density
- Has branding space

Disadvantages:

- It could be possible that the plants on the top will receive more water than the plants at the bottom of the shelves, the clients may need to rotate the position of the shelves during each drip cycle
- Proportionally, there will be less focus on the branding if there are move levels of plant beds
- Since the clients have a lot of freedom to move things around, the hydroponic system may have a higher risk of problems

Concept Analysis and Evaluation:

Hydroponic System		Design 2.1 - John Kenny		Design 2.2- Cameron Meyers		Design 2.3 - Victor Cheung	
Specifications	Importance (Weight)		Score		Score		Score
Functional Requirements							
pH/ Water level monitoring	3	Yes	15	Yes	15	No	0
Drip System	5	2	10	3	15	1	5
Portability	5	3	15	3	15	1	5

Branding Space	5	3	15	2	10	1	5
Constraints (Estimated)							
Size	5	2	10	3	15	3	15
Efficiency	3	3	9	3	9	2	6
Reservoir Size	4	3	12	3	12	3	12
Non-Functional Requirements (Estimated)							
Aesthetics	2	1	2	2	4	1	2
Total			88		95		50

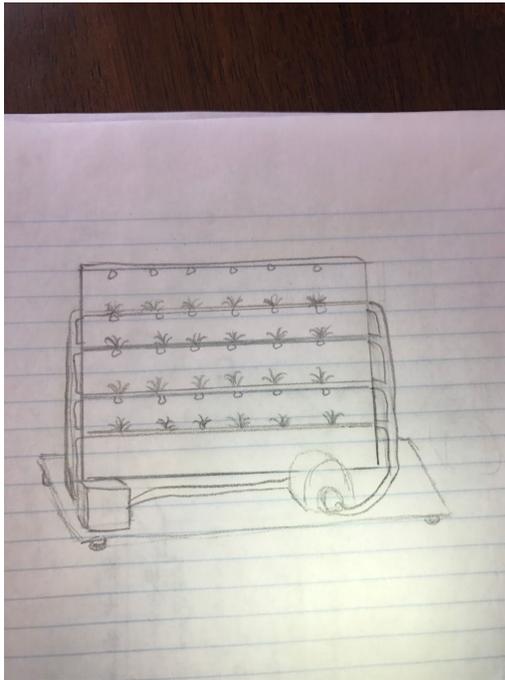
According to the results from the selection matrix, "Design 2.2 By Cam Meyers" is chosen. This design is both functional and appealing. With its portability and easy to use features the kids will be growing basil in no time. We took it to another level with rotatable cylindrical tubes that can be faced at the light source or to the surroundings for easy harvest. The water reservoir was situated on the top of the structure to make it more efficient. It uses circulating technology to reduce maintenance and to overall improve the functionality. If necessary this design may be further altered to get the best result in the future.

Conclusion:

Having each team member come up with their own ideas provide creative and unique solutions. The top three designs, as voted by the team members were selected. These designs were 2.1, 2.2, and 2.3 as stated above. With the help of a selection matrix Cam Meyers' design 2.2 was chosen to be the one that best fit the required criteria. For the reasons outlined above it is the best hydroponics system for the purpose of educating.

Appendix:

Design 2.4 - Recirculating drip hydroponics system 2 (Cameron Meyers)



Features:

- This hydroponics system consists of 4 rows each holding 6 plants
- It has a large water reservoir at the bottom (this is also where the nutrient solution is added)
- It is recirculating (with pump)
- There are lights above each plant
- The wheels allow it to be moved from floor to floor (with help of elevator)

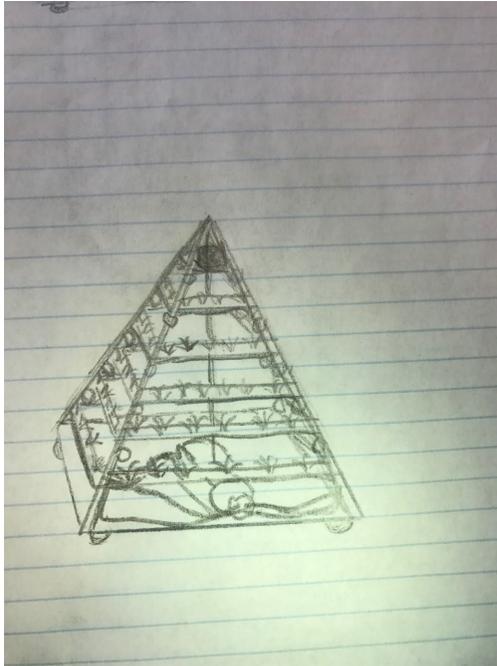
Advantages:

- Space for branding on top
- Easy for kids to harvest
- Easy for kids to refill

Disadvantages:

- Not connected to platform
- No pH reservoir
- No reservoir sensor

Design 2.5 - Recirculating drip hydroponics system 3 (Cameron Meyers)



Features:

- It is a 3D pyramid that contains many plants
- The water reservoir is inside the pyramid (this is also where the nutrient solution is added)
- It is recirculating (with pump)
- Line of lights
- The wheels allow it to be moved from floor to floor (with help of elevator)
- It can be opened up to allow refill of water/fit through doors
- Has a pH and water level sensor

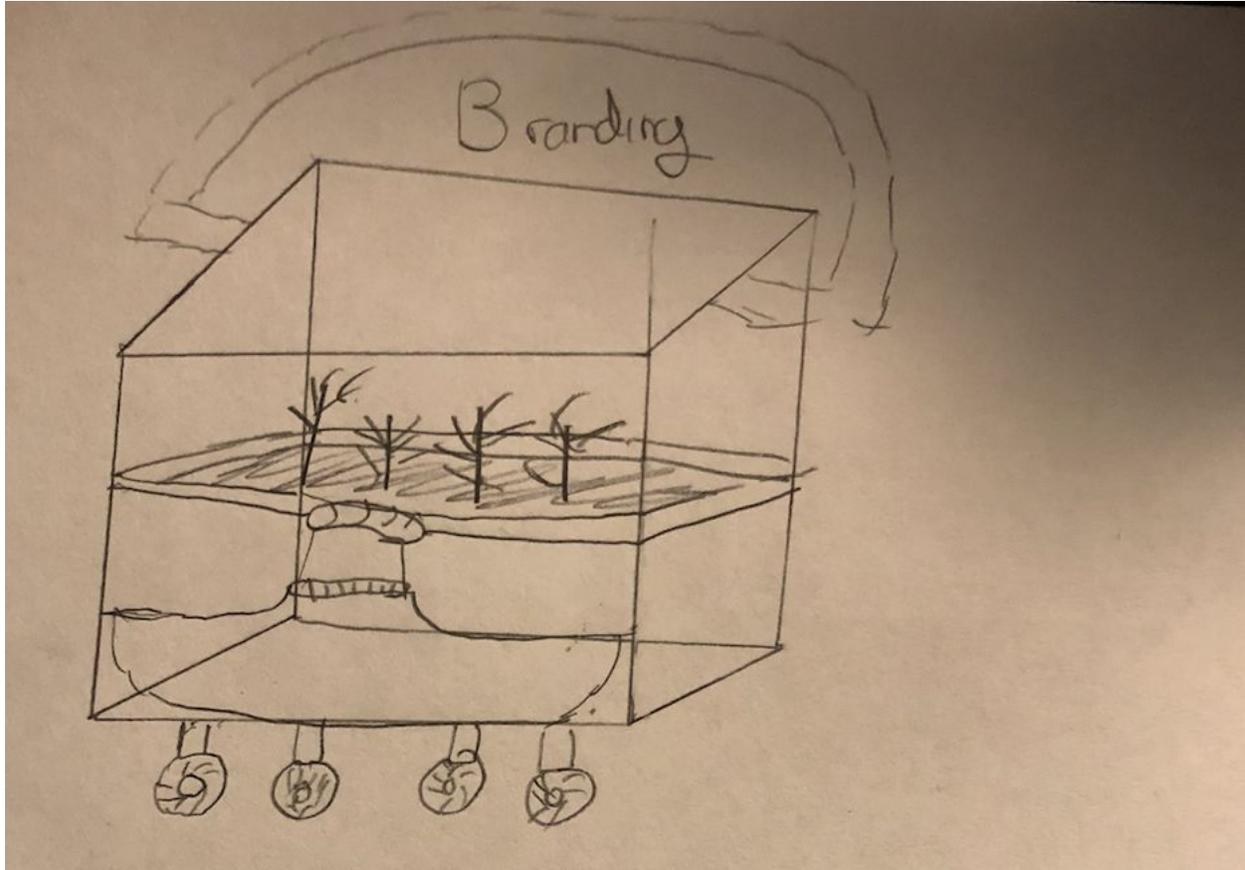
Advantages:

- Space for branding (if a flag is used)
- Easy for kids to harvest
- Easy for kids to refill

Disadvantages:

- If flag is not used there is no space for branding

Design 2.6 By Shehryar Malik



Features:

- The hydroponics system is a rectangular design that can hold multiple levels of plants which maxes out at 5 levels
- There are 4 adjustable wheels
- Multiple valve reservoir system to stop leakage or water drippage
- Light system attached to every level of plants
- Adjustable branding at the top of the system

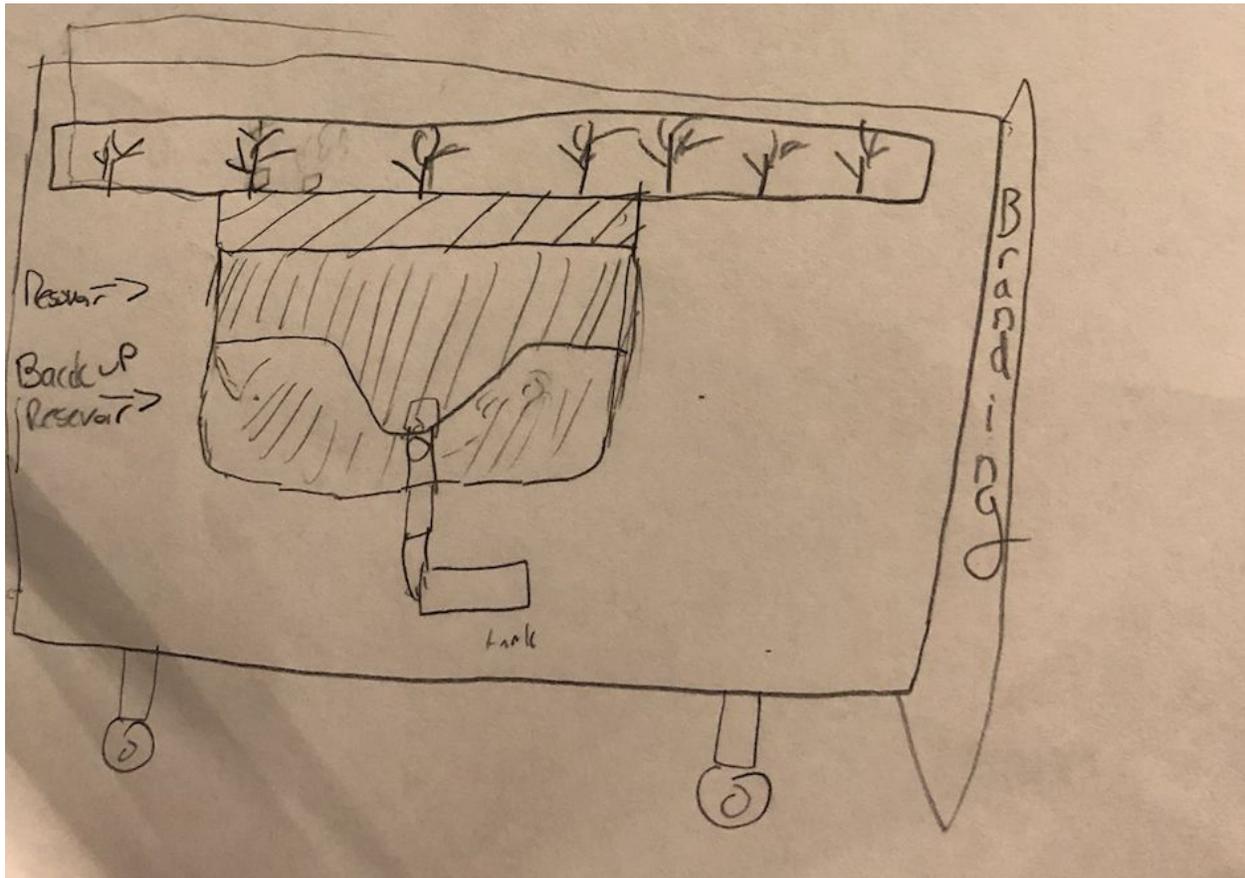
Advantages:

- A lot of efficiency as many plants can be held.
- High efficiency as design is very strategically made for plants

Disadvantages:

- Not adjustable for the kids
- Branding does not stand out
- No backup for reservoir
- No PH sensor
- No water level sensor

Design 2.7 By Shehryar Malik



Features:

- Multiple reservoirs (main and backup) to prevent any drought
- One big level level for plants to grow
- Light system attached in between the reservoirs and top level
- Branding on the side
- Waterflow goes in a vertical manner

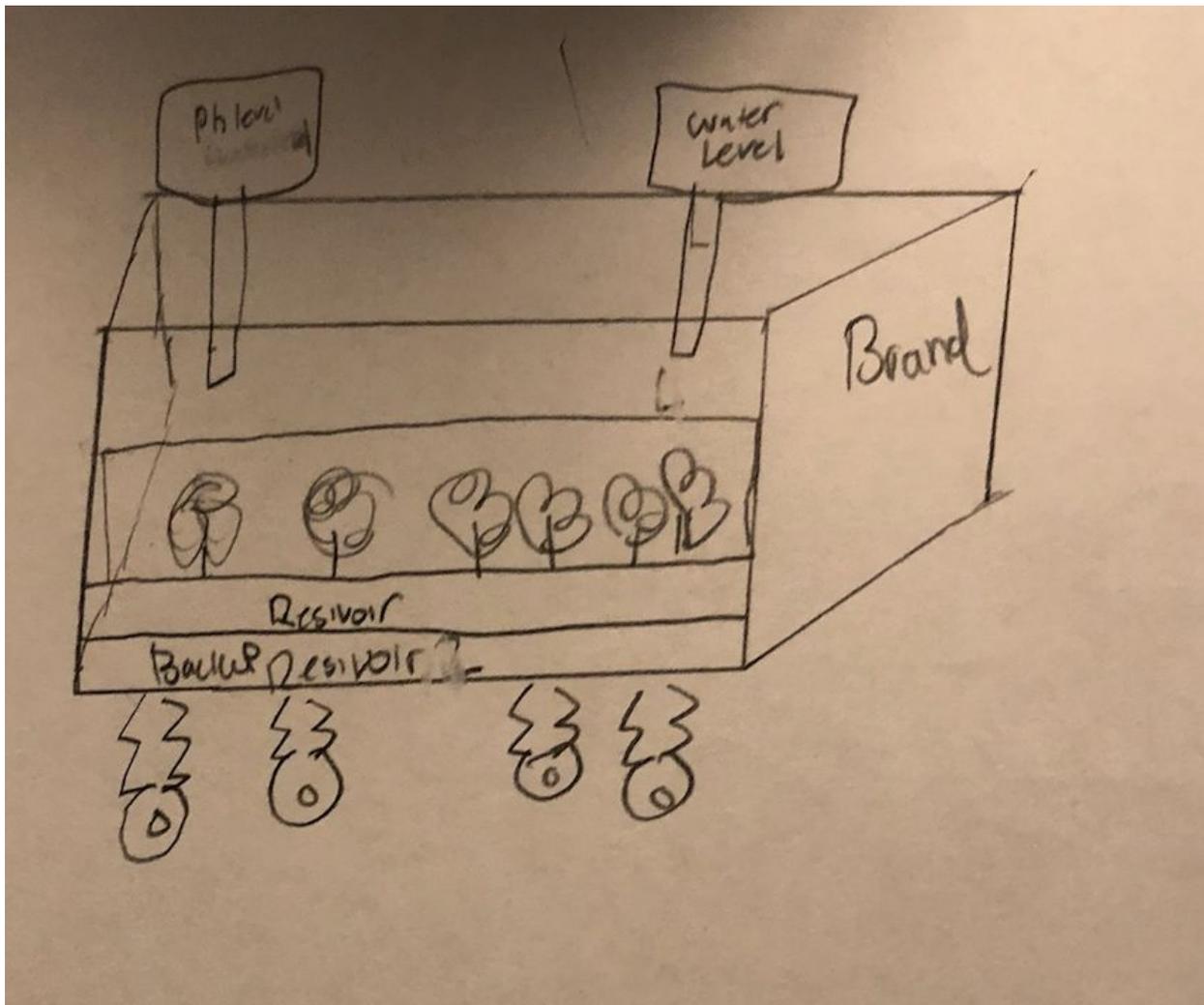
Advantages:

- Back up reservoir
- Efficient waterflow system
- Reliable Tank for waterflow
- Branding stands out as it is next to the plants
- Stable when moving the system around due to the orthogonal wheels

Disadvantages:

- Very little space for plants
- No braking system
- No pH sensor
- No water level sensor

Design 2.8 By Shehryar Malik



Features:

- Programmable pH and Water Level systems connected via Bluetooth
- Slidable trays to remove/add plant levels
- Multiple reservoir systems
- Adjustable height
- Movable wheels with braking and lock system
- Automated pumping due to programmed water level system

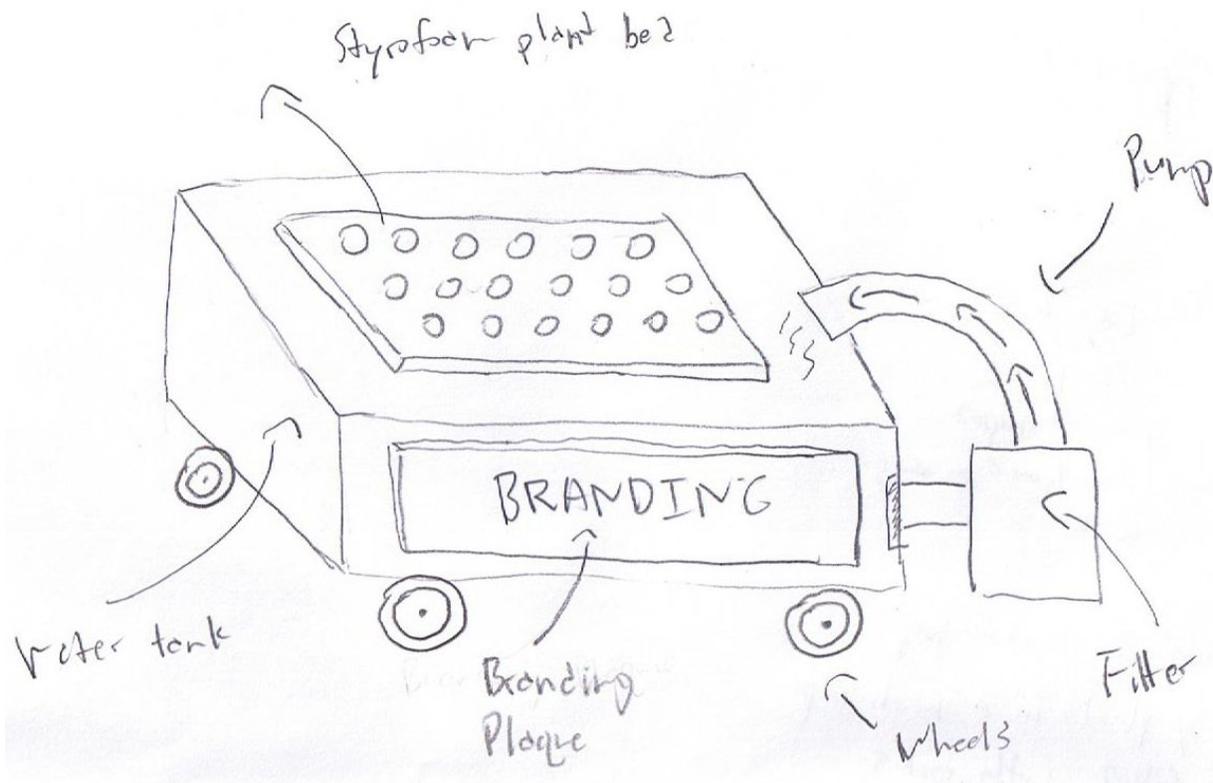
Advantages:

- Back up reservoir
- Height can always be adjusted
- Water and pH levels can be tracked
- Braking and lock systems for the wheels
- No need for humans for pumping

Disadvantages:

- Branding not as evident

Design 2.8 By Victor Cheung



Features:

- Plants are submerged on top of a floating styrofoam raft and held in place by a mesh net
- Uses pvp pipes and a pump to cycle the water
- Comes with wheels to move the system
- An attachable plaque for branding
- Filter at the side of the water tank

Advantages:

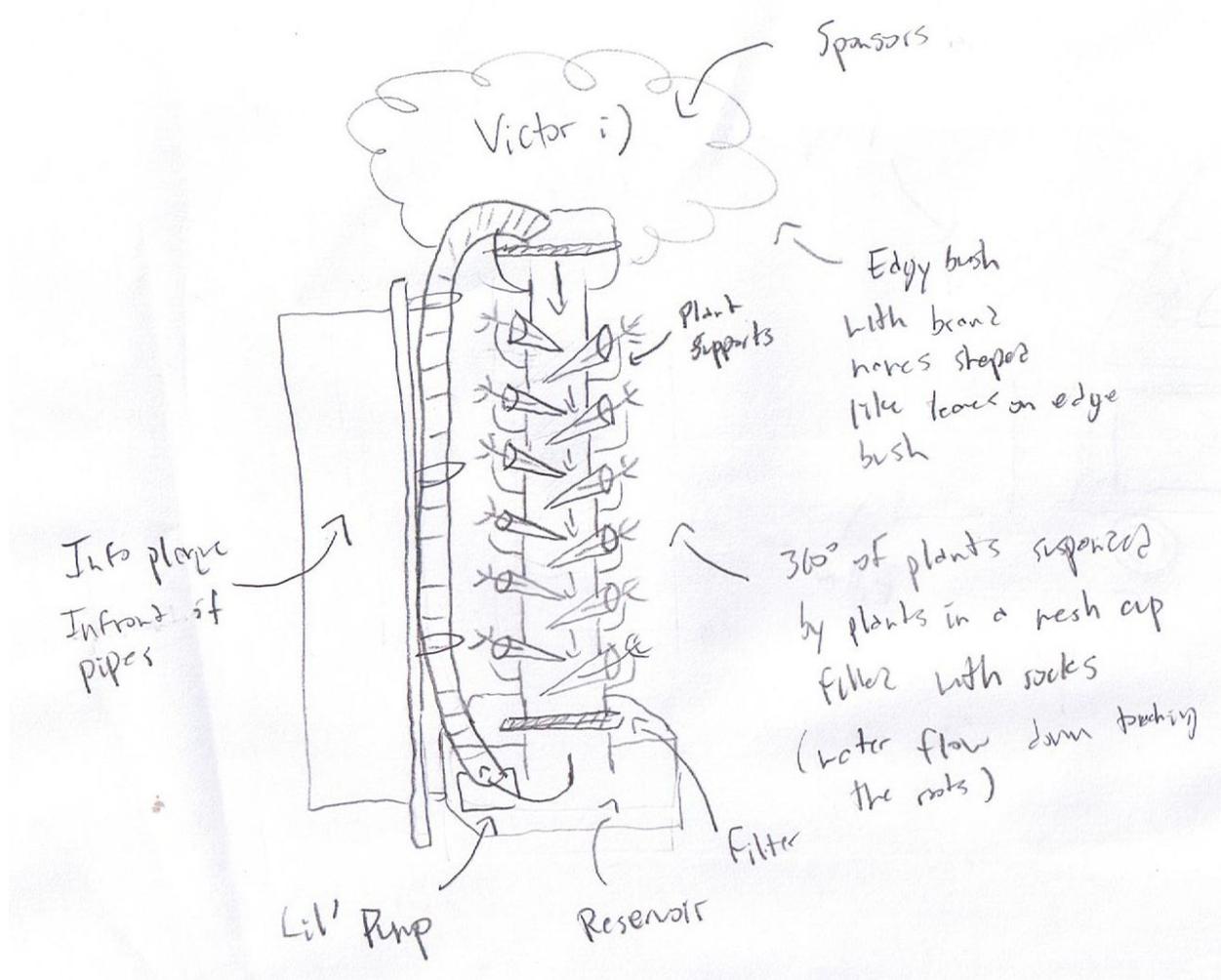
- Very large reservoir
- The roots of the plant are submerged with the water. This may improve plant growth
- Has four wheels to move around
- Proportionally has a lot of branding space
- Easy to assemble
- Easy for the youth to reach
- The tank is easy to access

Disadvantages:

- Overall a low plant density
- When filled with water, it will be heavy

Design 2.9 (Victor Cheung)

Hydroponic Tree (Victor Cheung) *RARE*



Features:

- Plants are meant to be placed covering 360 degrees of the pillar
- One single stream of water will hydrate the entire column of plants
- Plants are inserted inside detachable cones that are filled with coconut hay
- The sides of the detachable cones are made of mesh
- There are lights around the pillar for the plants
- Comes with a bush on top of the system where the logos of the sponsors are attachable
- Has a branding sign next to the pipe that will also support the pipe
- Has branding on the reservoir
- Has wires on the pillar to support the structure of the plants as they grow bigger
- Uses pvp pipes and a pump to cycle the water
- Filters on the top and bottom of the system

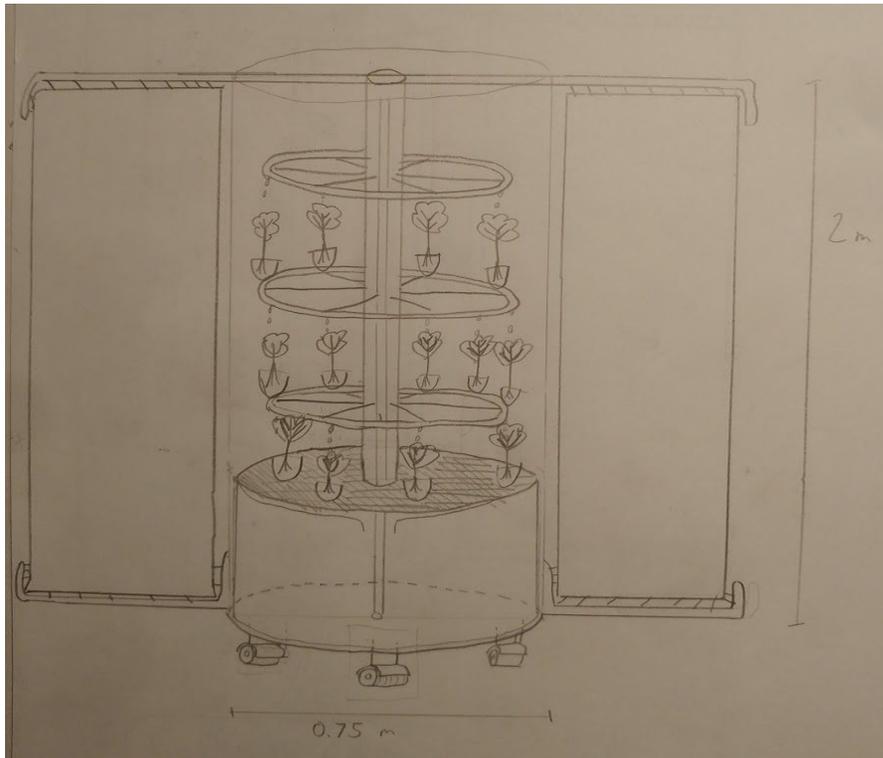
Advantages:

- Probably the most plant dense design
- Since the plant cones are removable, the plants itself are easy to clean and observe closely
- Large reservoir
- Has aesthetically pleasing, all inner workings such as pipes are covered by branding
- Has lots of branding space
- Has an edgy nature theme

Disadvantages:

- Lights will be directly facing the audience, may be hard to look at
- The tree needs to be tall to look like a tree, this system will be difficult for children to have access and the water pressure on the pipe may be a problem
- The inner workings of the pillar are impossible to access
- Branding space also limits access to the pipes and top of hydroponic system
- Because of the awkward position of the plants, extra care must be taken to monitor the plant structures and effort is needed to attach the plants to the wiring as they grow
- Difficult to build

Design 2.10 By John Kenny



Features:

This hydroponics system consists of 4 - 6 levels of plants. The plants are held in cups that are filled with foam. The plants are held together in a cylindrical shape, with a height of 2 metres and a diameter of 0.75 m. The base of the cylinder contains the reservoir. The watering system uses a pipe that pumps up the water from the bottom of the reservoir and up through the centre of the cylinder. The same circular levels that support the plants also hold water to water the plants on the level below. The top of the reservoir is a grate to allow water to spill back into the reservoir. The hydroponics system is suspended by 6 - 8 wide wheels. On the left and right side are banners that provide room for branding and information. The banners are completely removable. The entire system is encased in a plexiglass cover that is also removable.

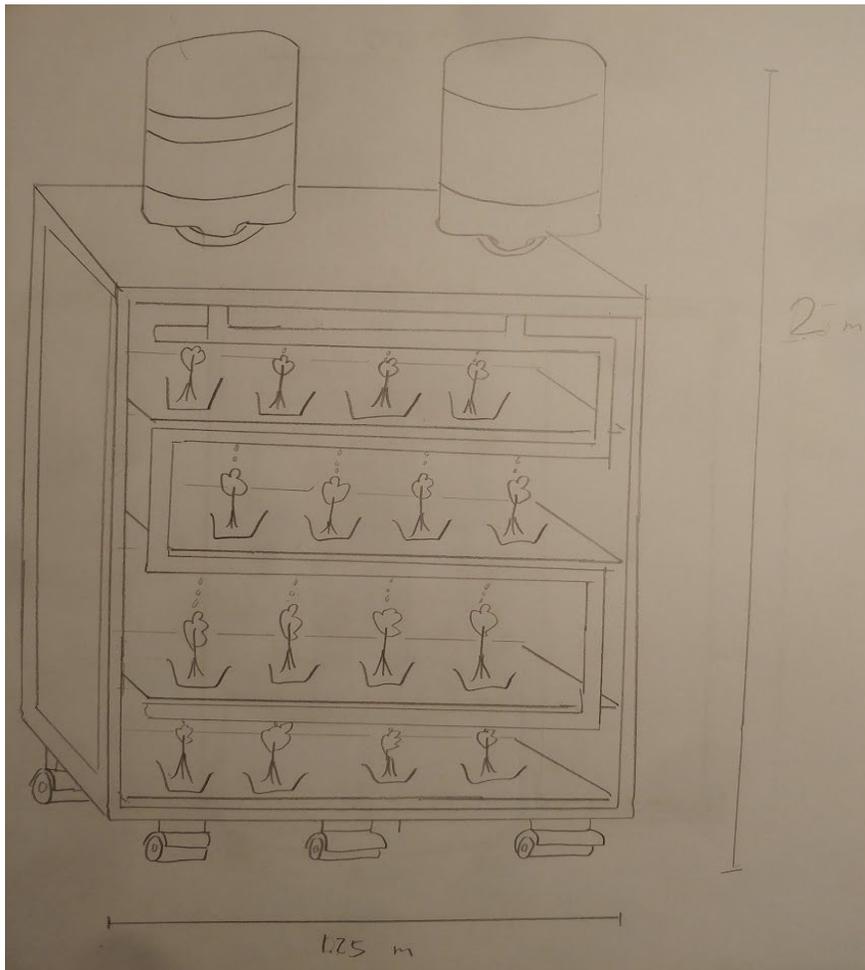
Advantages:

- Having a reservoir at the bottom gives the structure stability.
- Banners are good way to provide space for branding and information without sacrificing much weight.
- Having it be in the shape of a cylinder is an efficient use of space.
- A water container in the shape of a cylinder has less stress points. It is less likely to break from the water pressure.

Disadvantages

- Having all the water at the bottom means it will require more energy to pump up to the plants.
- The banners and the plexiglass will result in added costs.
- The grate is unnecessary because most of the water will not leave the cups.
- It requires electricity to run.
- The central pillar takes up space.

Design 2.11 By John Kenny



Features:

This hydroponics system is in the shape of a rectangular prism. It contains 4 levels of plants, It is 1.25 metres wide and 1.5 metres tall. The plants are placed in rows in cups filled with sponge to retain moisture. It is supported by 6 - 8 wide wheels. The watering system is fed by 2 -3 large jugs of water that are placed on top of the structure. The water is fed into one long winding pipe. The water drips through many smalls holes in the pipes in order to water the plants. There is room for branding on the sides and on the jugs.

Advantages

- Since it is wider it easier more can be seen at once and it is better for presentation.
- Since it is a rectangular prism it is easier to store.
- The watering does not depend on automation.
- Jugs would be easy to obtain.
- This system would be a lot easier to build.

Disadvantages

- A rectangular design is not as efficient for materials.
- Someone must manually place a filled water jug on top of the structure to refill it. This can be difficult.