Deliverable E – Project Plan and Cost Estimate

Jacob Olaveson, Alec Fraser, Nicole Milman, Matas Minkstimas, Khalid Ahmad Al-Satari, Cyrille Zakaria

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Hydroponics/Irrigation

Dimensions of one tray: 2 ft x 2 ft x 4 +/-2 in

Dimensions of hole/space between trays: 20 in x 20 in x 4 in (depth)

Dimensions of beams: 4" x 4" x

Overview of Materials needed:

- Water pump
- Trap Union / Drain water Piece and rocks/pebbles to filter water for reuse + stopper valve
- Polyethylene, silicone or other flexible tubing going laterally (and perforated) across planting trays to act as sprinkler (see video for general idea: https://www.youtube.com/watch?v=hazWfD45wNM), ¼ in tubes roughly
- Stopper/valve per vertical pipe (5 total 1 for whole system, one per vertical pipe x3, 1 for drain water system)
- PVC piping ¹/₂ in pipes roughly
- PVC elbow fittings (6) and tee fittings (3) slip joint $\frac{1}{2}$ inch
- 3 adapters
- At each level, valve will split in 3 directions to evenly distribute the water in a trident type of fashion. These pipes will be attached to the movable shelves

All components needed for Hydro/Irrigation					
#	Product	Dimensions	Price (tax included)	Quantity	
1	PVC pipes	- ¾ diameter, 10" length(x2)	- 5.30\$ for 10ft	1	
	<u>1/2 inch PVC pipes</u> , <u>3/4</u> inch PVC pipes.	- ½" diameter: 10" length 27.5" length (x3) 24" length (x3) 49" length (x3) 66" length (x3)	- 7.11 for 10 ft	3 purchases	
2	PVC slip connection	Tee fitting	0.86\$ per piece	8x	
	fittings	Elbow fitting	0.67\$ per piece	13x	
		Cross fitting	2.97\$ per piece	3x	
3	Polyethylene tubing	 ¼" diameter (0.17" inner diameter): 32" length (x27) 55" length (x3) 33.5" length (x3) 12" length (x3) 	31.62\$ per 100ft	80.4 ft (1 purchase)	
4	Water pump	For ¾ inch	22.60\$	1	
5	Stopper valves, barbed	For ¼ inch fitting	0 (3d printed)	30	

	connection			
6	Funnel	Outer circle diameter:	0 (3D printed)	1
		30 inches		
		Inner circle diameter:		
		6 inches		
7	<u>Water tanks</u>	- 10 L tank for	23.73\$	1 of ea.
		water supply		
		- 2L Recycled		
		soda bottle		
			Free	
8	Barbed cross connectors	1 mm x 1 mm x 1mm	13.10\$ for 40	9
	for ¼ inch tubing			
9	<u>½ inch to 3/4 inch pvc</u>	1.16" by 0.94" by	3.70\$	1
	pipe adapter	1.04"		
10	½ inch pipe to ½ barb	11.8 x 6.5 x 2.5 cm	22.66\$	9 needed (2 purchases)
	<u>adapter</u>			
11	<u>Clamps</u>	17.84 x 21.62 x 25.05	14.66\$ per pack of 14	33 (2 purchases needed)
Total cost (tax included)			≈ 325.32\$	

Design



Our system will begin with the water pump, going into 3/4in PVC pipe --> adapter --> ½ inch PVC pipe. This will split into multiple pipes at different vertical positions. Each vertical column of pipes will have their own 3d printed stopper valve, which will be attached to the polyethylene tubing we are going to use to allow for the modular use of the construction teams build.

Each vertical column will be between 2 beams of wood, allowing for a 4-inch gap. This will mean each of our ½ inch PVC pipes (3) will have 5/8" gaps between them.



This is the side view of one of 3 vertical pipe sections mounted along the beam.

Risk and prototyping

Risks

- The valves won't hold the water
- The pump won't be powerful enough
- The tubes are not the right size

Prototyping

Test ID	Test Objective (Why)	Description of Prototype used and of Basic Test Method (What)	Description of Results to be Recorded and how these results will be used (How)	Estimated Test duration and planned start date (When)
1	Testing the functioning of each stopper valve (that each valve prevents the flow of water to the tubes)	We will run the water system and turn off each individual valve one by one to see if the water flow to that section is successfully blocked.	If they work properly then we can proceed with the process	10 minutes
2	Testing the pressure of the water pump (that the flow is strong enough to supply higher up plants)	We will turn on the system to test the pressure necessary / if the pressure capacity is sufficient in bringing water to the furthest pot laterally and vertically.	If they work properly then we can proceed with the process	5 minutes
3	Checking the distribution of water by the perforated tubing acting as sprinklers	Attaching the clamps and testing the water distribution / checking moisture levels at each soil section by touch.	If they work properly then we can proceed with the process	20 minutes
4	Testing the stability of the pipes that are fixed to the beams	Mechanically testing with moderate shaking and application of force, as well as running the system and checking for leaks	If they work properly then we can proceed with the process	10 minutes

Grow lights

#/	All components needed for Hydroponic Growing lights				
link	Product	Dimensions	Price (tax included)	Quantity	
1	Govee LED light strips	2 X 16.4 ft	39.50\$ for 2 rolls of 16.4 ft	X 5 (number of shelves/2)	
2	Low voltage wires	65.4 ft	34\$	Specified length	
3	Low voltage 3-piece wires and connectors	32.8 ft	23\$	Specified length	
4	3M Small clips	-	17\$ for 100 pieces	X 1	
5	3 pin male female connectors	-	25\$ for 10 pieces	X 1 (Number of shelves)	
<u>6</u>	Power bar	-	48.60\$	X 1	
2	Flex Seal - Waterproof Spray	-	45.2\$	X 1	
-	Soldering kit	Provided by University of Ottawa			
-	Wire cutters		Provided by University	of Ottawa	
-	Electrical tape or heat shrink		Provided by University	of Ottawa	
-	Heat gun	Provided b	y University of Ottawa or from	n personal place of residence	
Total C	Cost (tax included)	≈ 390.30\$			

Bloc Diagram and Designs





Designs





Risks and Prototyping

Risks

- According to the recommendations from Govee, the LED light strips should not be cut to modify length and dimensions. However, some YouTube videos have shown that if you cut the Govee LED strips at the right spot and reconnect it properly, it should not affect the light output.
- 2. Another risk with the Govee lights is that they are not waterproof rated. Because these lights will be placed near plants, water, and children, we will need to waterproof the LED strips so that they can survive some splashes of water.
- 3. Because we are modifying these lights there is always a risk that we may make a mistake, or that something goes wrong which could result in the lights to stop working. To mitigate this risk, we will take our time while handling this project to ensure a smooth operation.
- 4. Smaller risks that are possible:
 - a. There are problems with the wires, and they do not conduct the right power.
 - b. There are problems with the 3M tape or the strip adhesive, and it does not hold properly.
 - c. There are problems with connections, and they do not support the system.

To mitigate these risks, we will examine every component and assure they are working properly.

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Test	Test Objective (Why)	Description of Prototype used	Description of Results to be Recorded	Estimated Test
ID		and of Basic Test Method (What)	and how these results will be used	duration and planned
			(How)	start date (When)
1	Check if the Govee lights	Cut the Govee lights and plug	If they work properly then we can	10 mins
	can be cut and still work	them in to see if they light up	proceed with the rest to place under the	
		and still have all the feature or	shelves	
		not		
2	Check if the Govee lights	Connect the 2 separated strips	If they work properly then we can	10 mins
	can be reconnected and	and see if they light up and still	proceed with the rest to place under the	
	still work	have all the feature or not	shelves	
3	Check if the app works	Connect the strip and use the	If they work properly then we can	10 mins
	properly with the lights	арр	proceed with the rest to place under the	
			shelves	
4	Check if the different	After connecting each strips	If they work properly then we can	20 mins
	sections of light work	using the wires, try the app and	proceed with the rest to place under the	
	properly with the app	see if it recognizes each section	shelves	
		as it should or not		
5	Check if the wires	Connect the cut strips with the	If they work properly then we can	20 mins
	conduct the right	wires and see if they work or not	proceed with the rest to place under the	
	amount of electricity		shelves	
6	Check if the	Spray the strips and place water	If they work properly then we can	30 mins
	polyurethane spray	on them and try to light them to	proceed with the rest to place under the	
	protects the system	see if the work or not	shelves	
	from water spills			
7	Check if the 3M clips can	Place the 3M clips and place the	If they work properly then we can	A couple of days
	properly stick and	wires in them to see if the hold	proceed with the rest to place under the	
	support wires	or not	shelves	
8	Check if the app allows	Play around with the app	If they work properly then we can	30mins
	for timers and specific		proceed with the rest to place under the	
	lights presets		shelves	

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#	Product	Dimension	Price	Quantity
1	3D printed square	0.8ft by 0.8ft, 5in	Free	24
	pots	depth		
2	3D printed square	0.8ft by 1.8ft, 5in	Free	6
	pots	depth		
Total price			0 \$ (3D printing P	rovided by University
			of C	Ottawa)



The lower shelf contains 2 pots side by side, these pots will contain the lager and heavy plants. There will be 3 of these shelves in the grow wall with a total of 6 big pots.

Prototyping

- 1. Checking if the pots fit in the shelves
- 2. Check if the water is flowing normally

Total price

Total Hydroponics/Irrigation system cost	≈ 325.32\$
Total Glow light cost	≈ 390.30\$
Total soil/Pots cost	0\$
Total Hydroponics team cost (Tax included)	≈ 715.62

References

Grow light

https://humboldtssecretsupplies.com/blogs/articles/4-things-to-know-about-grow-light-led-lightemitting-

diodes#:~:text=Primarily%20growing%20plants%20require%20blue,maximized%20emission%20of%20th ese%20lights.

https://www.myledy.com/5-different-ways-to-waterproof-led-strip-lights/

Soil

https://www.canadiantire.ca/en/pdp/vaso-mini-ceramic-square-planter-pot-4-in-terra-cotta-1591467p.html?loc=plp

Hydroponics and irrigation

General Idea for tubing perforation:

https://www.youtube.com/watch?v=hazWfD45wNM

The idea we've taken from this video is the perforation of polyethylene tubes to act as sprinklers. There will be three ¼ tubes going across each row of each level

Possible tank solution:

link to 10L tank

Stopper valve solution: 3D printed.

Possible Bendable Tubing:

https://www.homedepot.ca/product/canada-tubing-polythylene-tubing-0-17-inside-diameter-x-1-4-outside-diameter-x-100-ft-coil-/1001537757

https://www.amazon.ca/MIXC-Blank-Distribution-Tubing-Irrigation/dp/B079GSWTTL/ref=pd_day0fbt_img_sccl_1/130-4402776-6616930?pd_rd_w=SxfwV&content-id=amzn1.sym.e82ca4ac-a045-4a62-acd9dbf98697b10e&pf_rd_p=e82ca4ac-a045-4a62-acd9dbf98697b10e&pf_rd_r=AHJ2M65Q0S0DC8BJ3TNQ&pd_rd_wg=1nI6Y&pd_rd_r=0837718b-9315-460e-b84a-e54e61e965c9&pd_rd_i=B079GSWTTL&th=1

Possible trap unions:

https://www.homedepot.ca/product/system-15-1-1-2-inch-pvc-dwv-p-trap-union-cohxh/1001011926

PVC elbow fitting slip connection ¹/₂ inch:

https://www.homedepot.ca/product/lesso-1-2-in-pvc-schedule-40-90-degree-elbow/1000166792

PVC tee fitting slip connection ¹/₂ inch:

https://www.homedepot.ca/product/lesso-pvc-tee-soc-x-soc-x-soc-1-2inch/1000166805?rrec=true

$\frac{3}{4}$ to $\frac{1}{2}$ PVC fitting

https://www.homedepot.ca/product/lesso-3-4-in-x-1-2-in-pvc-schedule-40-bushing-m-xf/1000182036

PVC cross fitting ¹/₂ inch:

https://www.homedepot.ca/product/lesso-cross-socxsoc-pvc-sch-40-1-2-inch/1000166757

- Polyethylene Tubing, 0.17 inside diameter x 1/4" outside diameter x 100 ft coil.
- PVC pipes (3) down the middle
- Barbed cross-connectors for 1/4" tubing

General Idea for tubing system:

https://www.youtube.com/watch?v=hazWfD45wNM

Possible Pumps:

https://www.homedepot.ca/product/milescraft-drillpump750-water-pump/1001675482

Possible barbed cross-connectors:

https://www.amazon.ca/Connector-Irrigation-Watering-connecter-Vegetable/dp/B08CZPP6XG/ref=sr_1_9?crid=3KDWTN5SQ7XLC&keywords=drip+irrigation +4-way+couplings&qid=1676753173&sprefix=drip+irrigation+4way+couplings%2Caps%2C114&sr=8-9

 $\frac{1}{2}$ in pvc:

https://www.homedepot.com/p/VPC-1-2-in-x-10-ft-White-PVC-SCH-40-Potable-Pressure-Water-Pipe-30-05010HD/319692959

³/₄ in pvc:

https://www.homedepot.com/p/Charlotte-Pipe-3-4-in-x-10-ft-PVC-Schedule-40-Pressure-Plain-End-Pipe-PVC-04007-0600/100348472