Deliverable F: Prototype 1 and Client feedback

By group 3.1

Introduction:

This deliverable will contain the feedback our group received from the client, and show our first prototype. It will also contain the results of the testing we performed on the prototype.

Client's Feedback:

The client was positive about our design concept, but there are still some problems:

1. Ensure that the pipes are dustproof. Our team decided to install a filter at the entrance of the pipes
2. Ensure the temperature of the house. Our team will install a thermostat to control the temperature
3. Ensure the heat exchange chamber is able to raise the temperature by more than 15 degrees Celsius during Winter. Our team selected geothermal and solar energy which are sustainable and environmentally friendly

Prototype I:

Testing Goals:

The goal of this prototype is to create visualization of our design in 3D that more functional prototypes created in the future will be based on. In these tests we will experiment with different layouts to find optimal locations to place different components of our design.

As we are simply testing the design's layout the prototype does not need to be functional. Thus it will be made out of easy to procure materials such as paper and cardboard.

Stopping criteria:

The tests will be concluded once we believe we have found the most optimal layout for the design. Criteria for an optimal layout includes the following.

1. A layout that reduces the amount of material needed for assembly.
2. A layout that is easy to construct and optimal for installing components in.

3. A layout that will be structurally sound.
4. A layout that optimized air and heat transfer throughout the system.

Prototyping test plan:

Test ID	Test Objective	Description of Prototype used and of Basic Test Method	Description of Results to be Recorded and how these results will be used	Estimated Test duration and planned start date
1	● Determine optimal layout of the system	● Small scale paper/cardboard model. ● Visual analysis	● The shape and layout of the model will be recorded.	● From March 5th to March 6th.
2	● Test the electronic components used within our design.	● Assembled electronic components in the design. ● Physical testing of electronics & code.	● Battery life in hours ● Temperature control software. ● Compatibility of components ● Calibration of sensors	● From March 6th to March 13th.
3	● Testing the fully assembled small scale prototype.	● A functional heat exchange chamber for our prototype. ● Testing how well HEC can retain heat.	● How well the HEC retains heat.	● From March 6th to March 27th.

Feedback

Users	Comment	Rank
1	I am quite concerned about using polyethylene as the material of the pipes since it can easily crack and become damaged when exposed to high or low temperatures.	4
2	It is very simple and convenient in use, but installation requires a lot of time and preparation.	3
3	The use of solar energy has high requirements for the weather and storage capacity of batteries , and the solar energy does not have sufficient power supply.	3

4	It can dig a few feet down and snake around under the yard without excavation, rather than digging up your entire yard. It can save a huge cost.	5
5	In winter, when it is very cold, the heating mode is not good enough to ensure the temperature of the room. Wood burning may be required to cope with cold temperatures while using the system.	4

Target Specifications updated:

Updated target specifications in accordance to data gained from the 1st prototype.

Functional requirements

	Design specification	Relation	Value	Units	Verification method
1	**Temperature control**	**=**	**22-23**	**ºC**	**Test**
2	**Emission**	**=**	**0**	**N/A**	**Test**
3	**Control system**	**=**	**Yes**	**N/A**	**Test**
4	**Vent operation**	**=**	**Yes**	**N/A**	**Test**

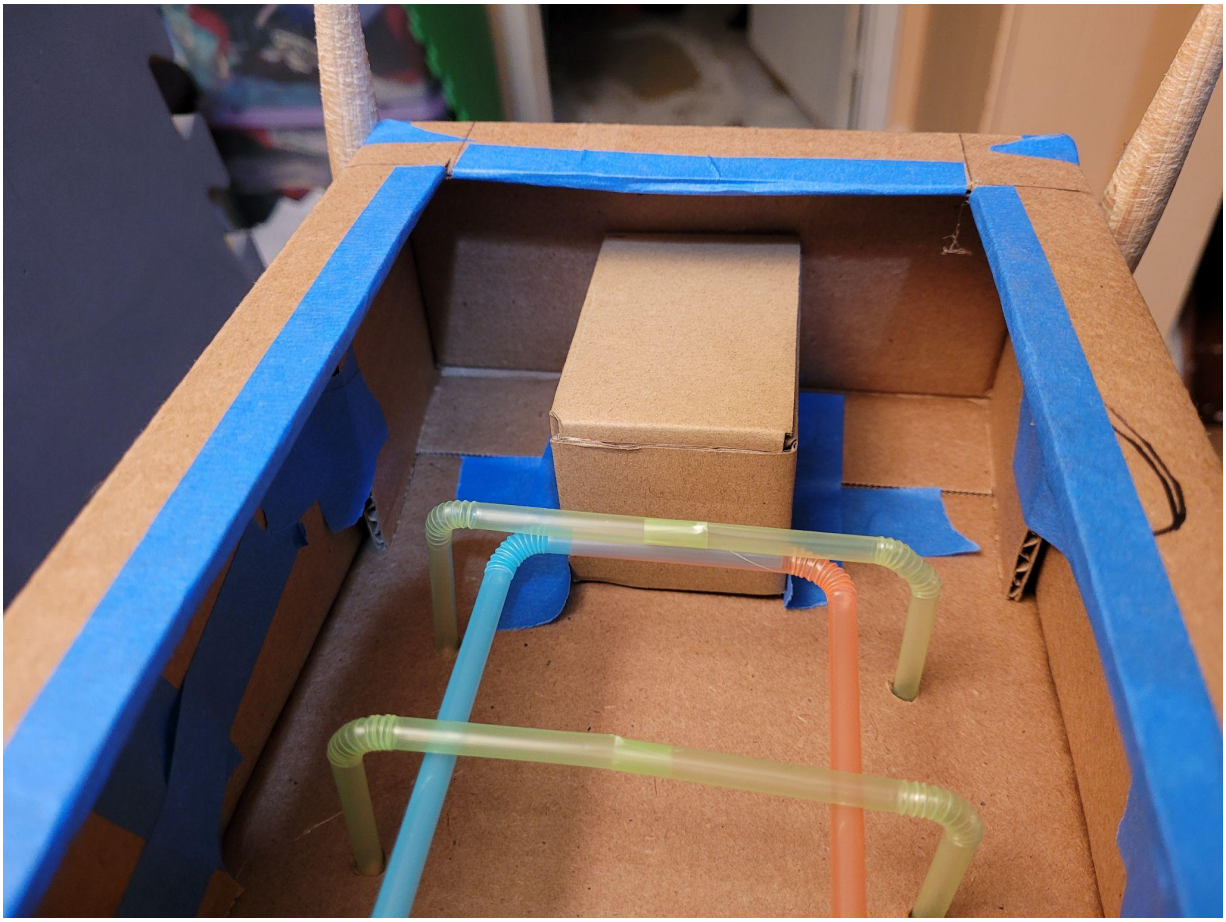
Non-functional requirements

	Design specification	Relation	Value	Units	Verification method
1	**Looks**	**=**	**Yes**	**N/A**	**Test**
2	**Life span**	**>**	**40**	**Years**	**Test**
3	**Reliability**	**=**	**Yes**	**N/A**	**Test**

Constraints

	Design specification	Relation	Value	Units	Verification method
1	Cost	<	20,000 - 30,000	CAD	Estimate/ Final check
2	Available different seasons	=	yes	N/A	Test
3	Maximum Area	<	140	M^2	Estimate/Final Check
4	Operation conditions:	=	-60.8 to 49.6	^oC	Test
5	Weight	<	N/A	KG	Test

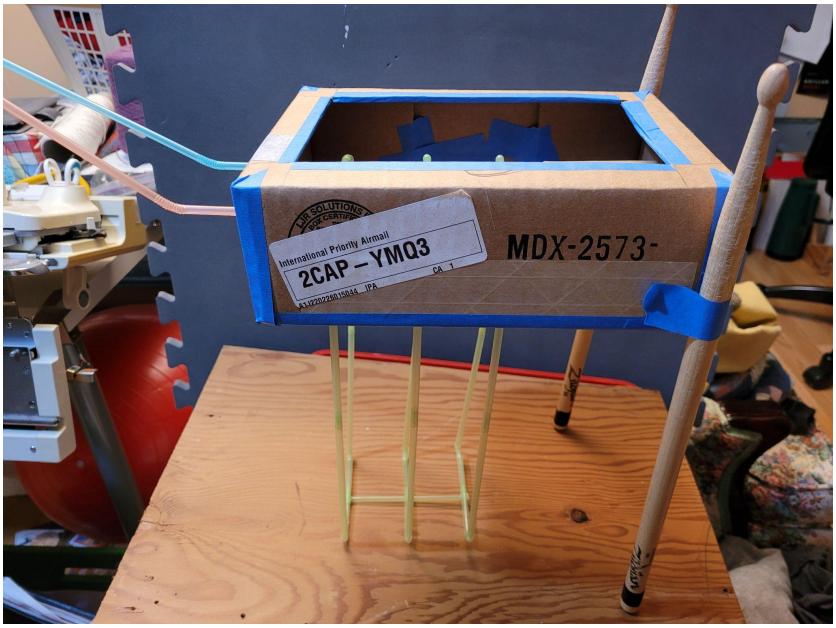
Pictures of Prototype:



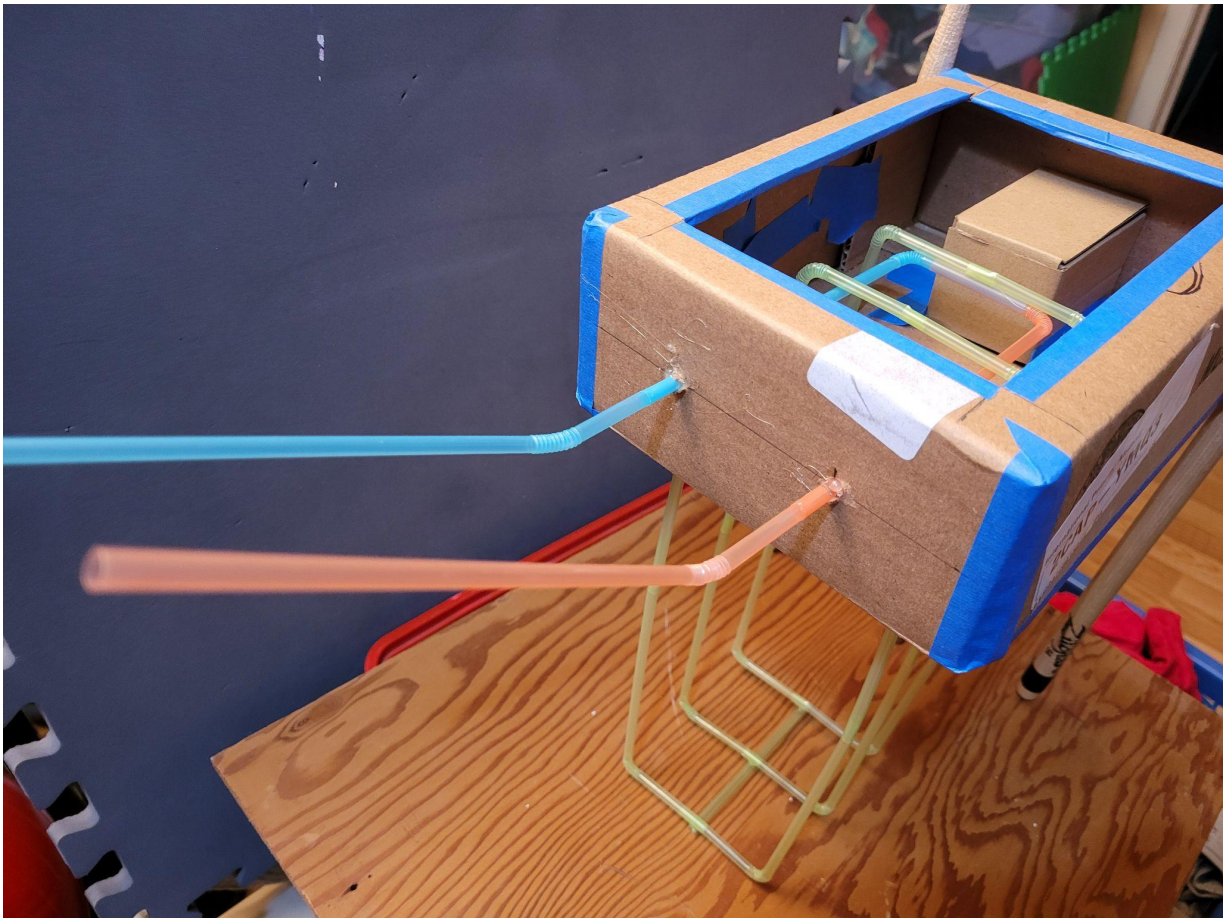
Top view of prototype.

The small box next to the pipes will contain the electronics.

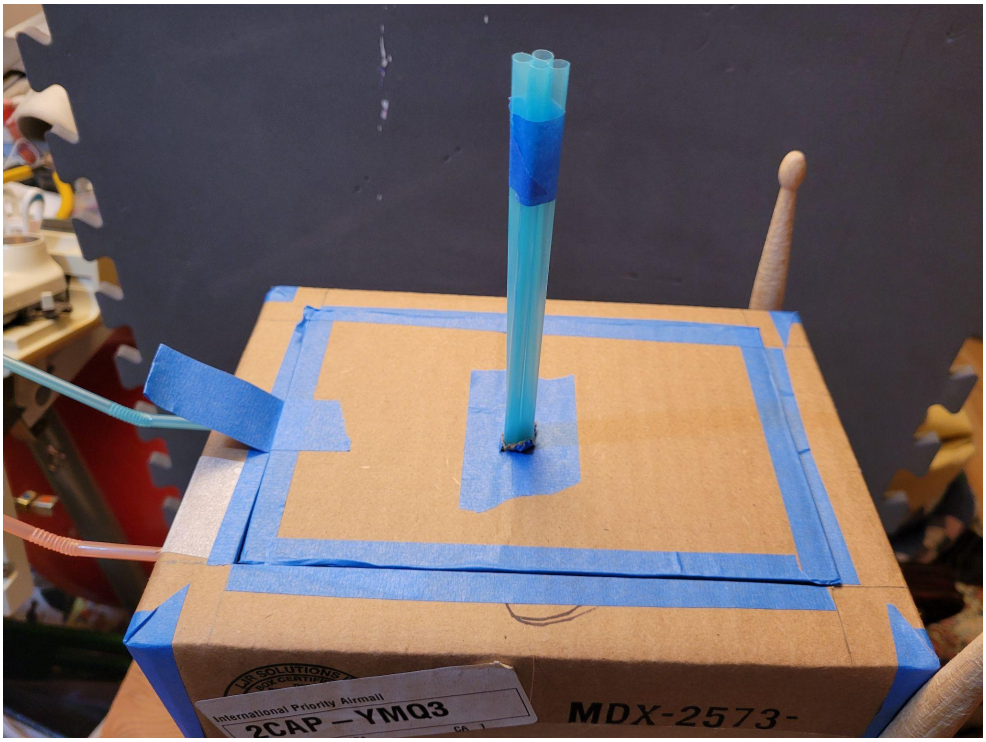
Legend
• **Blue** pipes are air intake. • **Red** pipes are air output. • **Green** pipes are for mixing air.

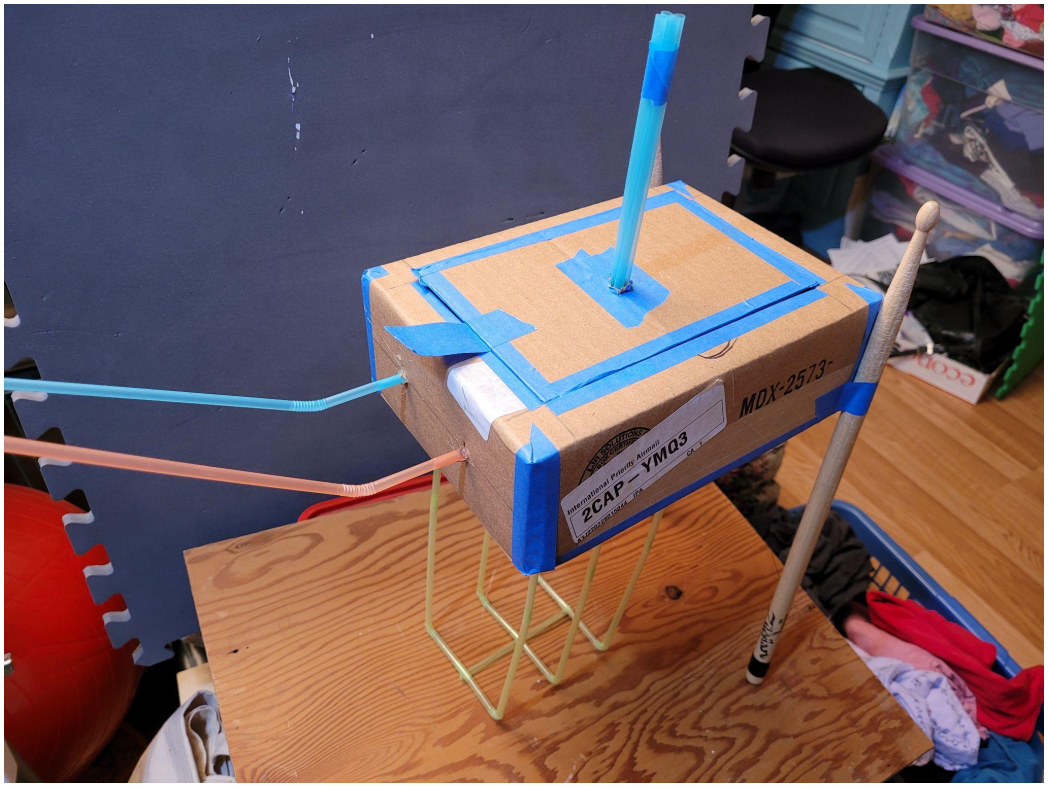

International Priority Airmail
2CAP – YMQ3
MDX-2573-


2CAP – YMQ



Side view of prototype.





HEC closed and with pipe leading up to air intake on the surface.

Pipe

- Polyethylene material is suitable for most soil environments, does not affect the environment and the cost is low.
- Our design contains a vertical set of pipes which will be connected to a heat exchange table buried besides the house. The vertical design can effectively reduce space occupation and ensure that the system can be installed in most people's houses.
- The filter uses Synthetic materials to prevent anything or hair from entering the pipe so that the pipe will not be blocked.

Solar panel

- The maximum output of the solar panel is 5V/2.1A, which satisfies the operating voltage of the cooling fans, which make the air flow in the pipes.
- In the service life of 5-15 years, and greatly reduce the cost and environmental pollution.

Heat Exchange Chamber

- The Heat Exchange Chamber has pipes, a temperature sensor and a water sensor. The water sensor connects to the sump pump, identifies the water level, and the sump pump controls the water level and temperature sensor to measure the temperature inside and outside.

Sump Pump

- Suitable for varieties of water such as city water, groundwater, sea water
- Installed with a water sensor to ensure the water level higher than the pump
- The power output of the sump pump is 3W and the flow rate is 100L/H, and it is adaptive to 3~5V power supply

https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=Zs4dJe1HMsC3I9I2wdHjEHb9S816Worj%7CIE2DSNZVHA2DELSTGIYA