P2 Report

Desert cooler Redesign

Guide : Prof. B. K. Chakravarthy

Submitted

by

Vaibhav Watile

216130004

IDC School of Design
अभिकल्प विद्यालय

Approval form

This is to certify that the Industrial Design Project entitled "Redesign of Desert Cooler" by Vaibhav Watile is approved for partial fulfillment for the Masters of Design degree in Industrial Design, at IDC School of Design, IIT Bombay.

Digital Signature
Battula K Chakravarthy (i01111)
27-Jul-23 07:37:10 AM

Prof. B. K. Chakravarthy
(Project Guide)

Digital Signature
Mandar Rane (i07183)
27-Jul-23 04:54:40 PM

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Vaibhav Watile
216130004
IDC School of Design, IIT Bombay
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And to all the faculty of ID for their invaluable feedback, that really helped to look the project through different perspective.

Lastly I would like to thank my friends, who helped me to brainstorm ideas, gave inputs and right feedback at various stages during the duration of project.

Abstract

India has summer season from the month of March to May, and although geographically it's a Peninsular Country, it also has vast terrain which faces hot and dry climatic region. In summer, the maximum ambient temperatures are as high as 40-45 oC during the day and 20-30 oC at night. Considering the climatic conditions evaporative coolers are the best suited for the region. It works on the principal of evaporative cooling, hence the name. Desert cooler are most efficient when assembled outside the house, as the evaporation is fast leading to more cooling. However there are humidity issues when assembled inside the house. The cooler assembled outside the house has to experience major shifts in temperature, with constant contact in water, metal desert coolers in this scenario tends to get rusted over time. However its usage is during the summer season only, and during off season it needs to be stored.

Contents

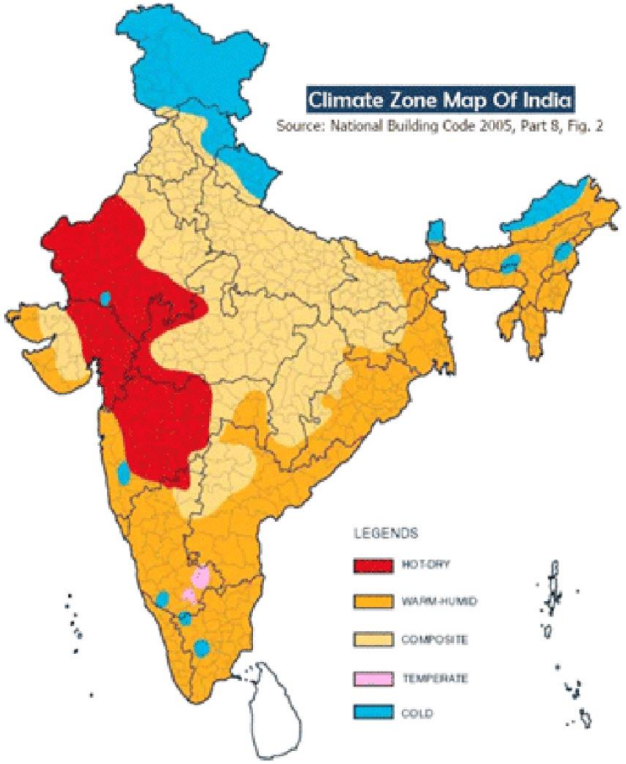
1. Introduction

What is desert cooler? It is cooling solution which is used in hot and dry climatic regions. The cooler works on the simple principle of evaporation of water. The cooler has cooling pads (material is wood shavings, also called as wood wool or honeycomb pads made of cellulose material) on its three sides, which is constantly kept wet with the water flowing over it with the help of motorized pump. When the fan is turned on the air is sucked inside the space, the high temp. air transfers its heat with the water which then evaporates and thus the air becomes cooler as it enters inside, and then this air is pushed out of the cooler.

1.1 Scenario

The **hot and dry zone** lies in the western and the central part of India. A typical hot and dry region is usually flat with sandy or rocky ground conditions, and sparse vegetation comprising cacti, thorny trees and bushes. There are few sources of water on the surface, and the underground water level is also very low. Due to intense solar radiation (values as high as 800-950 W/m2), the ground and the surroundings of this region are heated up very quickly during day time. In summer, the maximum ambient temperatures are as high as 40-45 oC during the day and 20-30 oC at night. The climate is described as dry because the relative humidity is generally very low, ranging from 25 to 40% due to low vegetation and surface water bodies.

The **composite zone** covers the central part of India. A variable landscape and seasonal vegetation characterize this zone. The intensity of solar radiation is very high in summer with diffuse radiation amounting to a small fraction of the total. The maximum daytime temperature in summers is in the range of 32 – 43 o C, and night time values are from 27 to 32 o C. The relative humidity is about 20 – 25 % in dry periods and 55 – 95 % in wet periods.



Generally, composite regions experience higher humidity levels during monsoons than hot and dry zones. Otherwise most of their characteristics are similar to the latter.

2. Research

2.1 Air Cooler types available in market

There are several types of deset cooler available in the market depending on the need of the people and their placment the the space. Some of which are mentioned below.

Personal cooler

Tower cooler

Window air cooler

Air cooler with
Top exhaust

Metal body
Air cooler

Desert cooler

2.2 Benchmarking

Hindware collapsible air cooler

Here the cooler addresses the issue of storing it during the off season. The cooler can be disassebled and can be packed in the tank, the total size shrinks to almost half.

Symphony storm 100i

The cooler utilises the long form to provide an ample space for the water tank to store 100lits. It also comes with the i-pure technology, which along with cooling purifies the incoming air.

Crompton - Optimus 65IoT

IoT enabled Optimus 65i comes with mobile app to let you have full control over the cooler. It also comes with a feature to control the humidity.

3. Industry Visit –
3.1 Canbara Industries (Mumbai)

The Indusrty was started in 2008, and are engaged in manufacturing air coolers. The installed capacity is of 75000 units of Desert Coolers per month. Besided air coolers, company is also involved in manufacturing mixer grinders, fans, induction cooktop, gas stoves, hand blender and toaster.

Customer considerations stated by the manufacturers -

- Long range air throw
- More volume
- Material consideration
- Cooling efficiency
- Honeycomb - density? Air flow? Load on motor?
- Transportation - knockdown
- Easy empting of the tank
- Graphics and form
- Fit, form and finishes (attention to details)

Factory Visit - Canbara Industries (Palgarh)

The factory has all the facilities from making molds, to injection molding and an entire assembly line for cooler production, and also there is an inhouse motor manufacturing assembly. However the water pump and the motor for movement of louvers is outsourced.

Insights from the visit

- Wood shavings are made from Himalayan Pines
- Smelling is an issue, which would happen because of no proper access to clean the tank
- Dust accumulates over the panels which leads to scales formation, which eventually affects the cooling
- When water level in the tank drops, the water dripping from the panels falls directly down (to low water level), which creates sound, that adds to the overall sound of the cooler.

Factory Visit - Canbara Industries (Palgarh)

Mold making facility

Molds

Injection Molding

Factory Visit - Canbara Industries (Palgarh)


Fan Balancing


Assembly line



Pipe details



Louvers mechanism

Factory Visit - Canbara Industries (Palgarh)

Cooling panels

Internal details

3.2 Ram Coolers Visit (Nagpur)

- Cooling is more in '*wood wool panels*' as compared to '*honeycomb panels*'
- *'Honeycomb panels'* last more than the *woodwool*
- Metal coolers are preferred in the Nagpur region
- Wrapping and packing services is provided by the company in off season (with charges)
- The company sells ~ 10,000 coolers every year
- Metal coolers are powder coated and painted
- All coolers have 2yrs warranty
- Fan types : Exhaust and Semi Exhaust fans
- Fan sizes available are 15 in, 16 in, 17 in, 18 in, 21 in and 24 in

Most preferred coolers

Cooling Capacity	Fan size	Tank size	Built material
250 sq.ft.	15 in	67 lits.	Metal
350 sq.ft.	16 in	60 lits.	Metal
400 sq.ft.	17 in	67 lits.	Metal

Ram Coolers Visit (Nagpur)

Most sold desert coolers

Wide area cover

Slim body

Joinery

4. User Research

(Cities visited Nagpur and Wani; images from, Pratapgarh(U.P.), Bhandara, Nagpur, Wani (M.S.))

Storage in off season

Desert cooler are used mostly during the summer, and in some parts during rainy season also people don't disassemble it. So storing becomes a big issue during the off season.

The most popular are the metal dessert cooler, which are very efficient in terms of cooling, and can be disassembled during the off season as well.

However there are problems relating to that as well. As the cooler is made from the sheet metal it rusts if not stored properly under the shed during the rainy season, to the panels are very heavy, it takes hours to assemble/ disassemble the cooler.

Here are some examples of how people store it during the off season (*Images from Nagpur, Wani, Prayagraj*)

User Research

(Cities visited Nagpur and Wani; images from, Pratapgarh(U.P.), Bhandara, Nagpur, Wani (M.S.))

Installation

The most efficient way to get the cool air is to position the desert cooler such that the body with cooling panels are exposed outside and the fan is directed inside. In this scenario as the cooling pads are exposed to the hot wind of the surrounding, the evaporation process is fast which leads to a rapid cooling.

In some cases people place it inside their homes, near a window. Keeping near the window helps to get rid of the humidity. If placed in packed room with no proper ventilation, the air would become very humid and uncomfortable.

For people installing it on the window in the higher floor of their houses, it’s a bit challenging.

User Research

(Cities visited Nagpur and Wani; images from, Pratapgarh(U.P.), Bhandara, Nagpur, Wani (M.S.))

Rusting and scale formation

There majorly two types of cooling pads used in desert cooler – wood wool and honeycomb pads. Wood wool made from shavings of Aspen wood, and it is said to provide more effective cooling compared to the honeycomb pads, however has less life.

And Honeycomb pads made from cellulose material, they are thin sheets structured in the form of a honeycomb patter, it is said to have a longer life (~5yrs) compared to the wood wool pads.

Spoiling of the cooling pad majorly happen because of the hard water.

4.1 User Interview

Name : Abhishek Y
Occupation : Merchant Navy
Age : 26
Cooler type used - desert cooler with metal body

Problems

- Heavy to manage
- At times gives shock
- Portability inside the house

Name : Prathamesh T
Occupation : Student
Age : 26
Cooler type used - desert cooler with metal body

Problems

- Too noisy - difficult to listen anything
- Unidirectional flow - less control on the flow
- Heavy to assemble and disassemble

Name : Prakash
Occupation : Engineer
Age : 45
Cooler type used - desert cooler with metal body

Problems

- Consumes lot of water
- Rusting
- Hard water spoils the wood wool

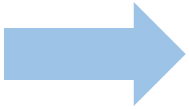
Name : Hritik
Occupation : Designer
Age : 24
Cooler type used - desert cooler with metal body

Problems

- Difficult to install on first floor on window
- Falls down in heavy wind

4.2 Problems Identification

1. Consumes lot of water
2. Gives shock
3. Makes lot of noise
4. In metal coolers, the holes get chocked because of the grass
5. Difficult to assemble and disassemble.
6. Air flow gets disturbed because of mis matching of fan opening with window
7. Hard Water spoils the wood wool
8. Portability in house
9. Rusting in metal coolers - nut & bolt, metal tank, body
10. Storing in off season
11. Height adjustability issue
12. Buttons are not reachable from the window
13. Not sufficient cooling option available, cools too much or too little - No optimisation
14. Cannot be used in closed spaces, humidity is an issue
15. No low power or low water level mode
16. Air throw should be longer
17. Water pump gets spoiled due to hard water

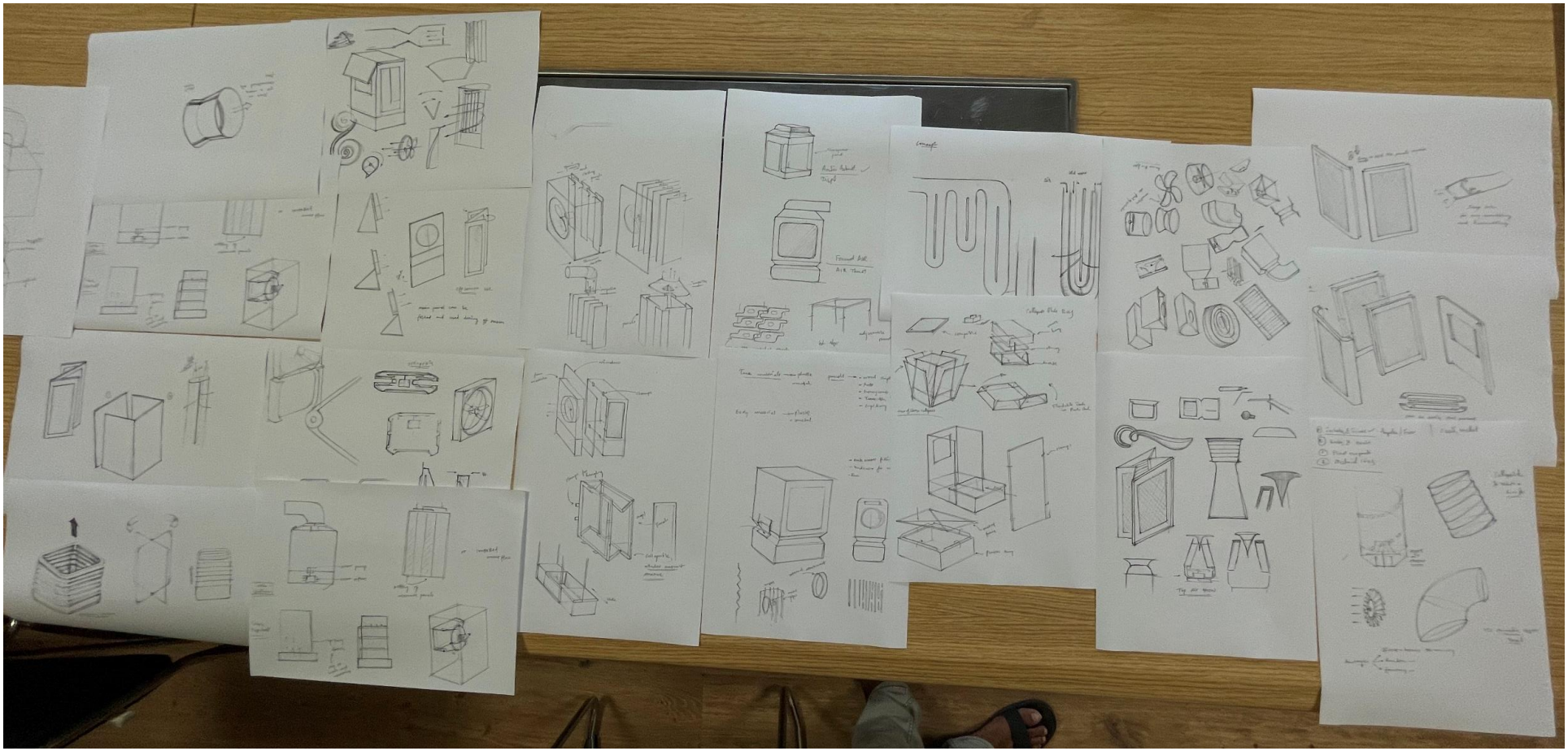


- Consumes lot of water
- Gives electric shock (in metal coolers)
- Makes lot of noise
- Holes get chocked because of grass
- Humidity is an issue in closed spaces
- Hard water spoils wood wool
- No optimization
- Height adjustability – stand
- Buttons are not reachable from the window

5. Design brief

“ To design a desert cooler which is collapsible, has a long air throw, which has easy access to clean the water tank and is optimised in terms of cooling and water consumption.

6. Ideation



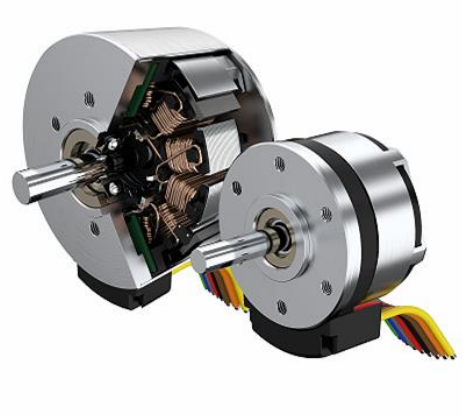
6.1 Card sorting

Ideas were sorted in the following groups

- Air throw
- Collapsibility
- Wall mounted
- Innovative

6.2 Technology solutions proposed

Optimisation - Fan speed and water pump RPM can be controlled based on the humidity and temperature of the room.

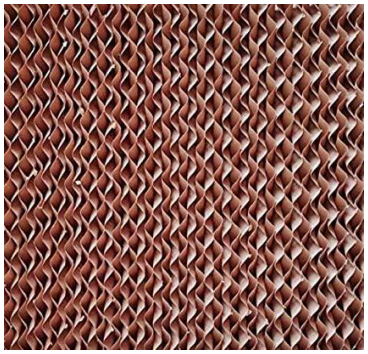


BLDC motor are used for low power consumption. And also to get varying speed control.

Water softner are used to clean hard water, which is the reason for spoiling the cooling pads.

6.3 Side cooling panels

Wood Wool



Honeycomb panels

Existing

Coconut coir

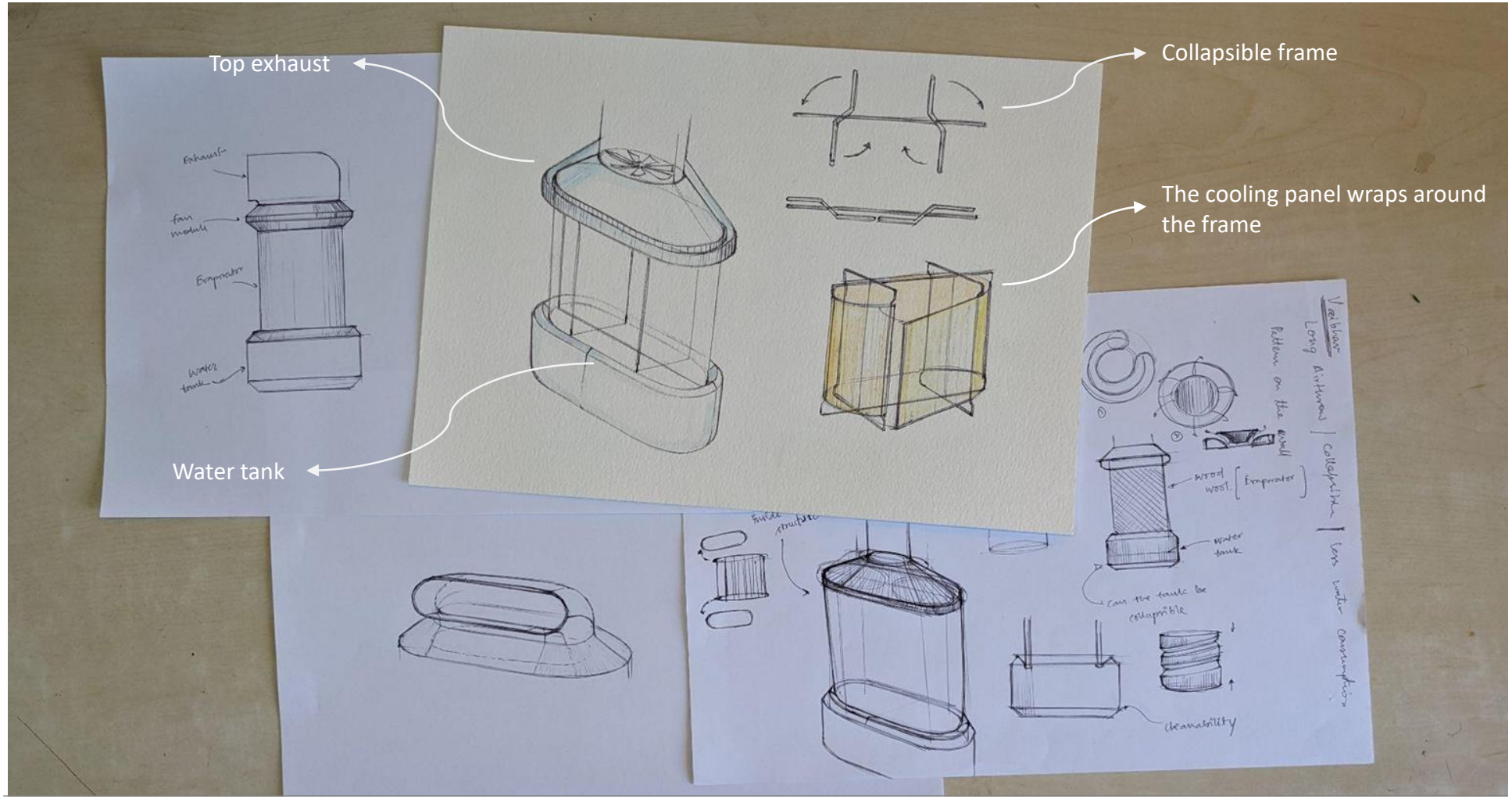
Jute

Terracotta module

Possible solutions

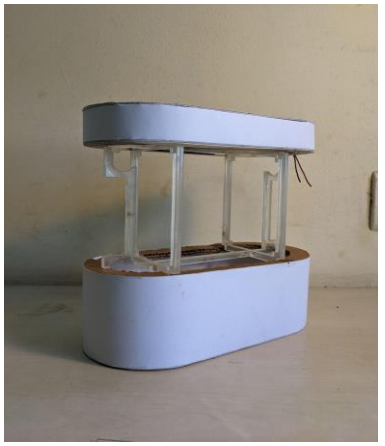
7. Concepts

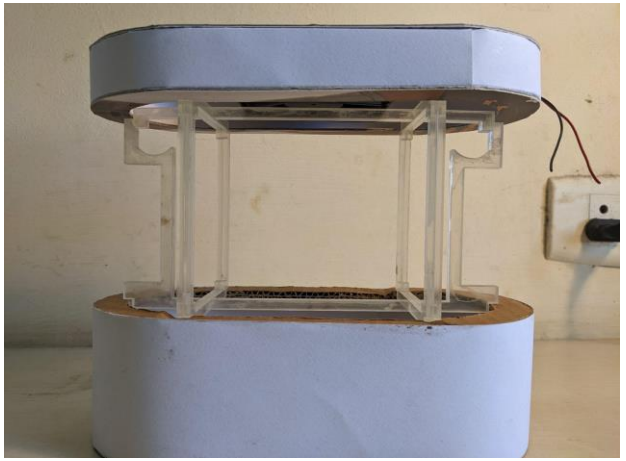
7.1 Concept 1



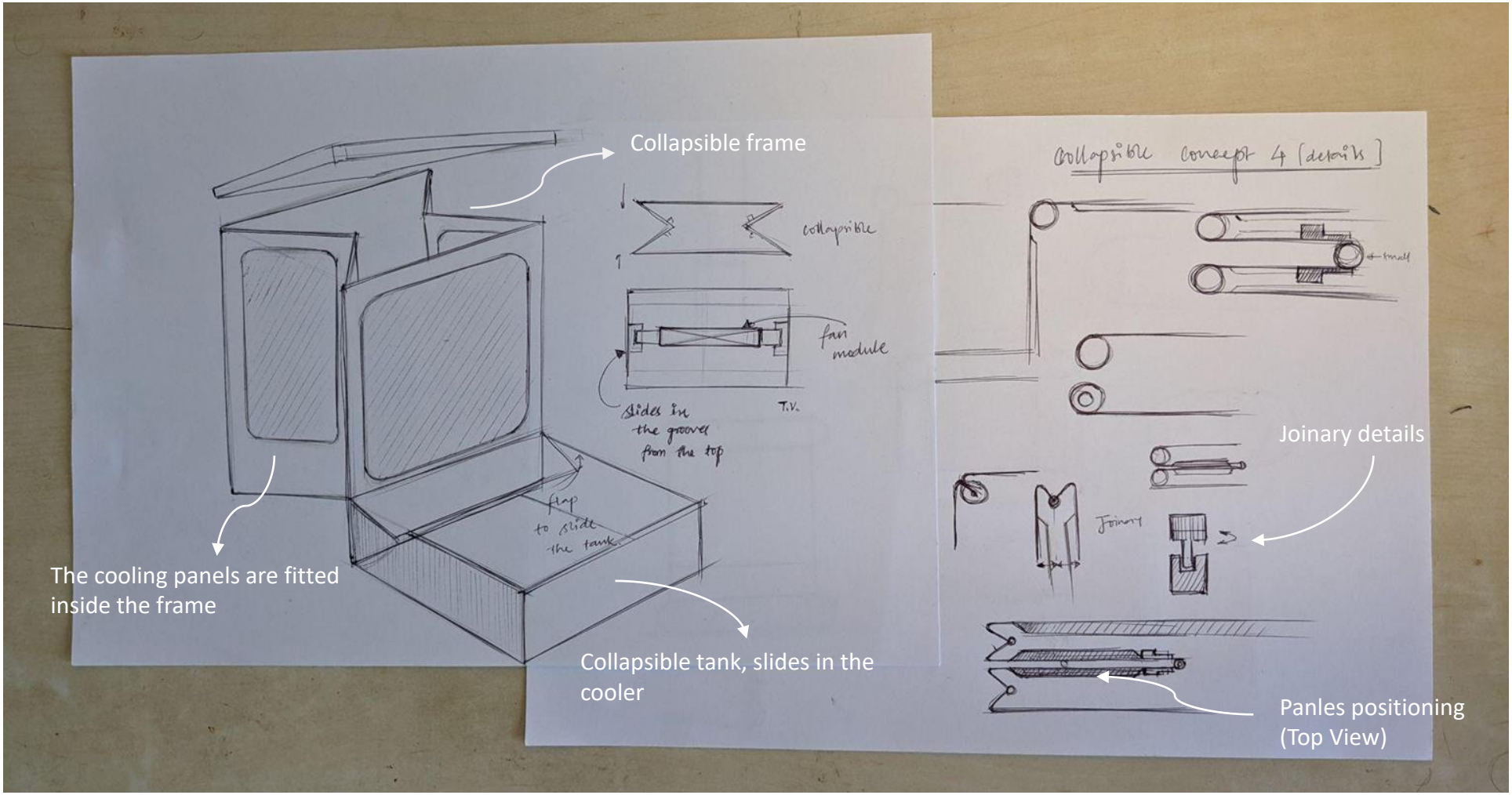
Concept 1 - **Mockup**

Concept is a semi collapsible exhaust type desert cooler. Herein the frame is made collapsible which fits between the top exhaust and the bottom tank. The cooling panel wraps around the middle structure, which also holds the pipe to water the cooling pads. The main fan fits horizontal in the exhaust.



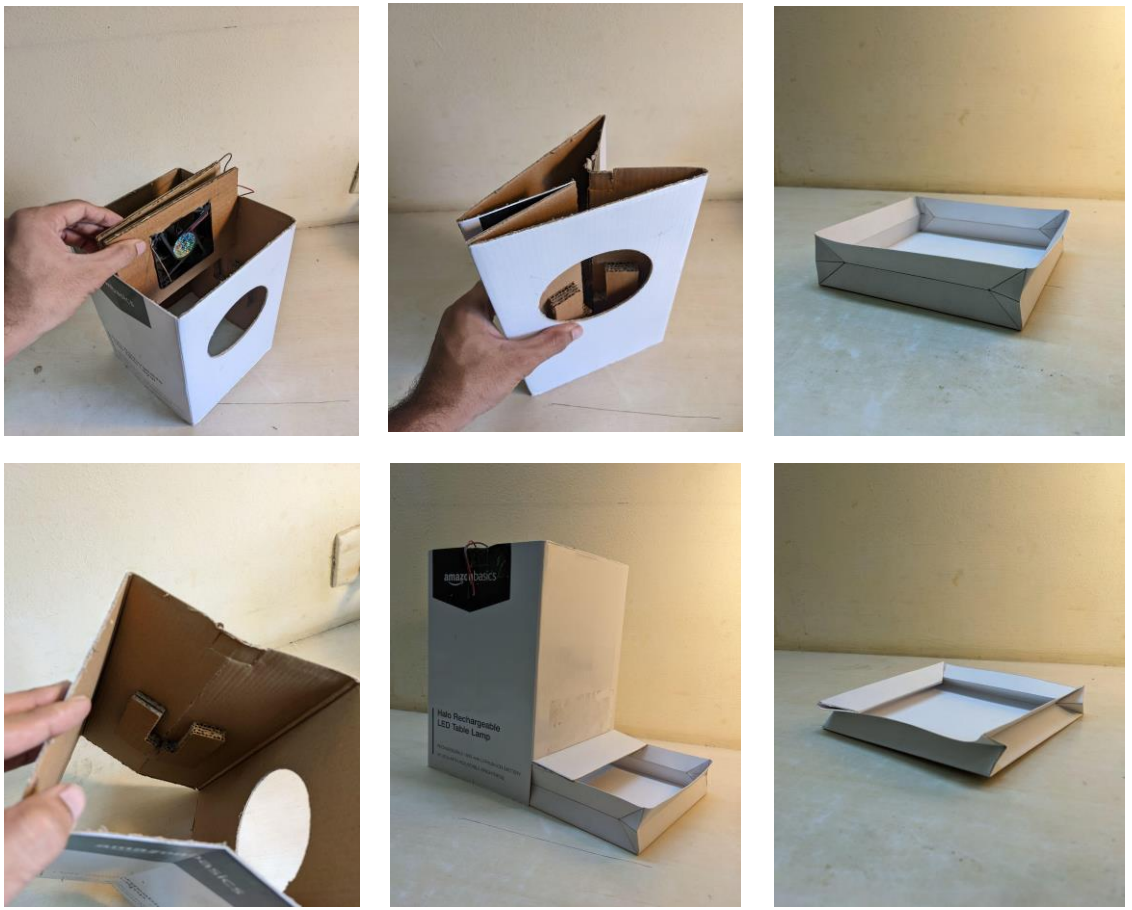


7.2 Concept 2

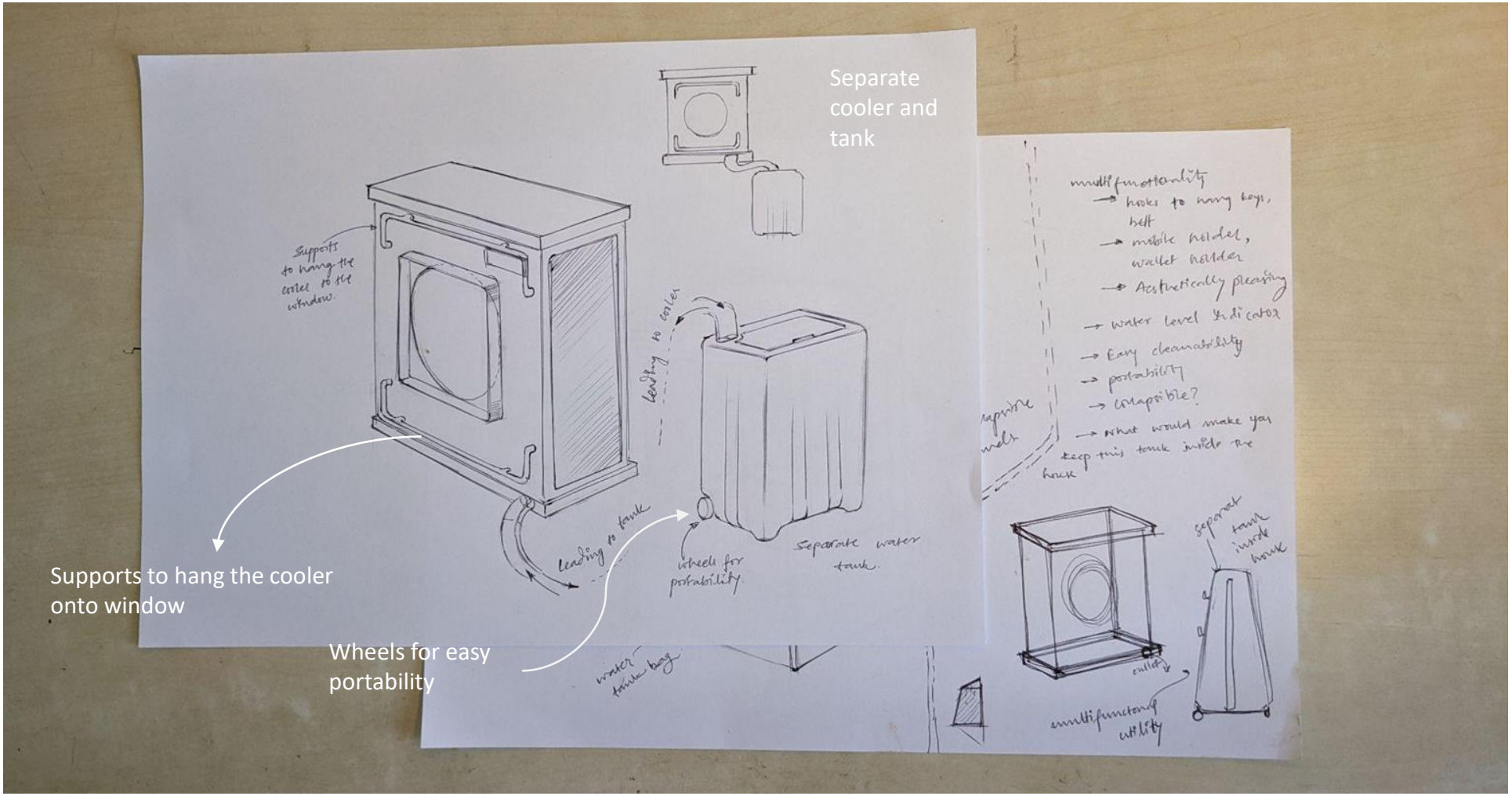

Collapsible frame
collapsible
fan module
Slides in the groover from the top
T.V.
flap to slide the tank
The cooling panels are fitted inside the frame
Collapsible tank, slides in the cooler
Collapsible Concept 4 [details]
Joinary details
Joinary
Panles positioning (Top View)

Concept 2 - Mockup

Collapsible design allows for easy storage during the off season. The Entire body frame collapses and becomes flat, also the tank becomes flat, and comes out as separate module, which also helps in cleaning as well as storability, the fan module is yet separate which fits in the frame – providing it structural stability, strength and balance.

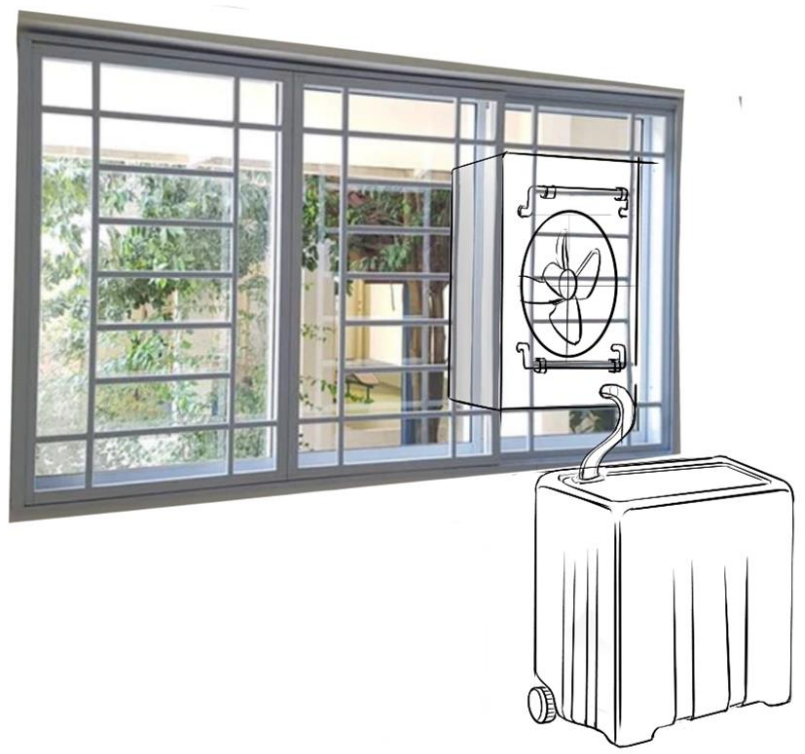


7.3 Concept 3

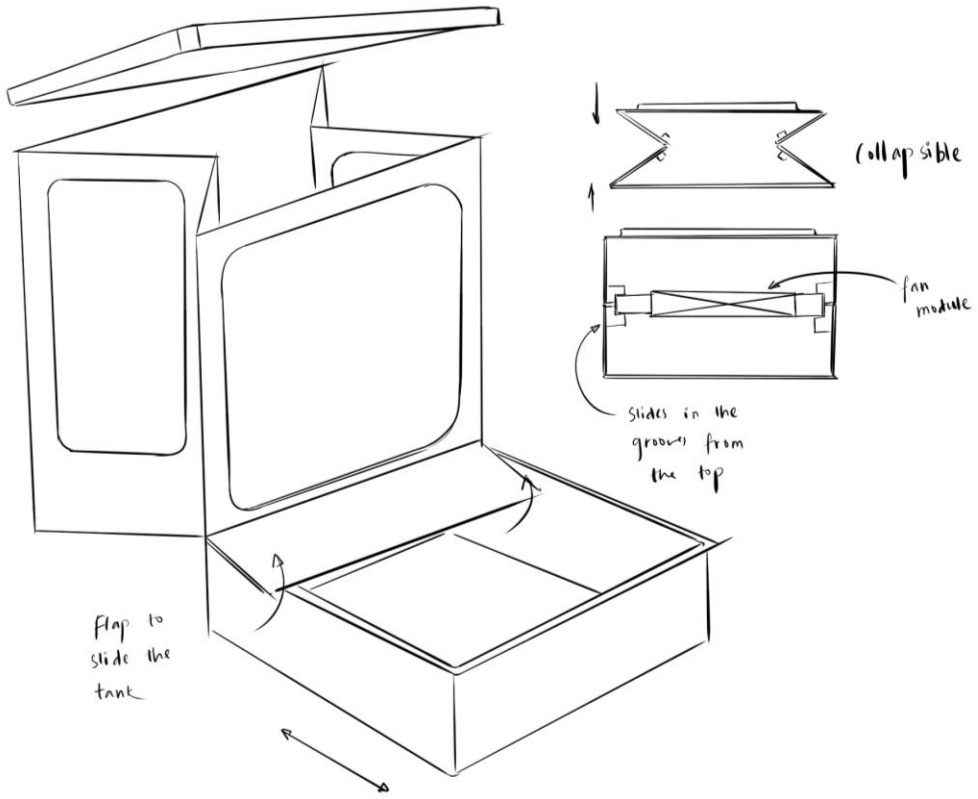

Separate cooler and tank
Supports to hang the cooler onto window
Wheels for easy portability

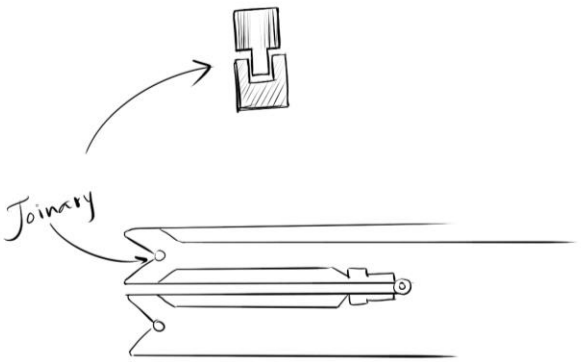
Concept 3 - Illustration

Considering the most efficient way for the desert cooler to work is when placed on the window. Concept 3 was thought, wherein the tank is made sperate from the body which serves dual purpose – the body becomes lightweight enough to hang on the window, and secondly the tank can be easliy taken to the tap to fill it. Especially when the installtion is on the higher floors, it will be a very convenint option as the body is lightweight and filling the tank inside the house is easy, compared to filling it outside (in the existing design)

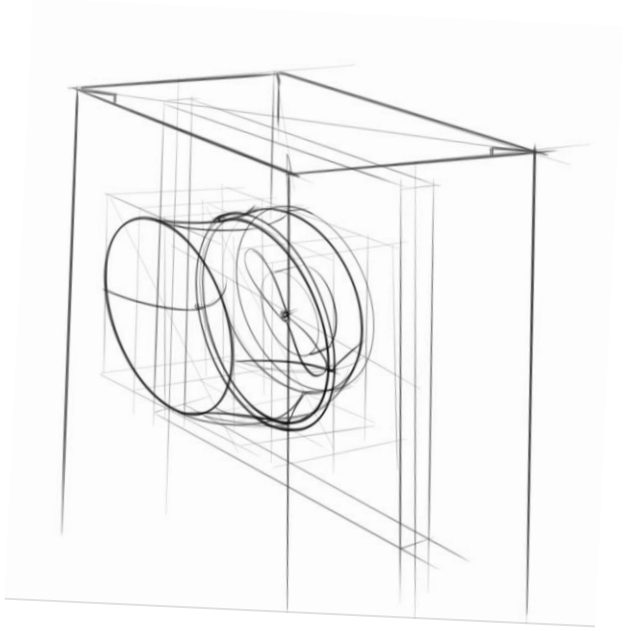


8. Selected Concept – Concept 3 : Collapsible body and tank

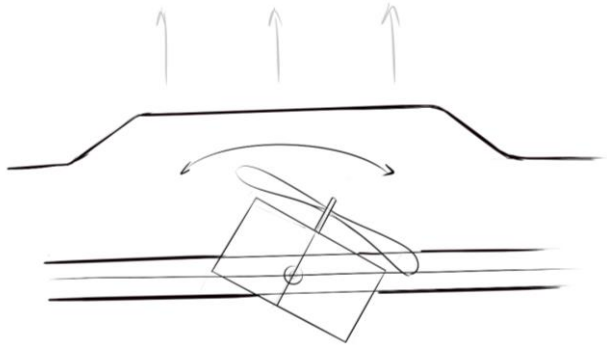




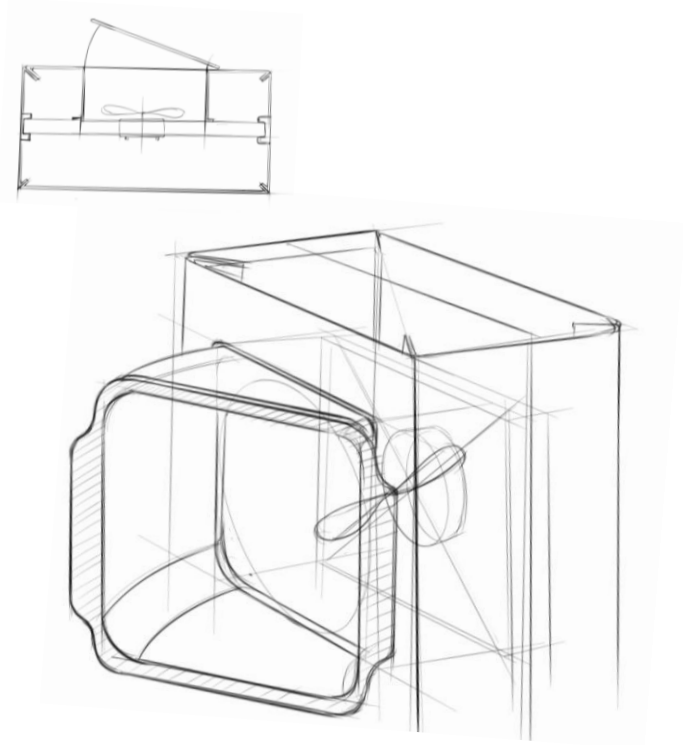
8.1 Air throw



Internal duct to channel the air

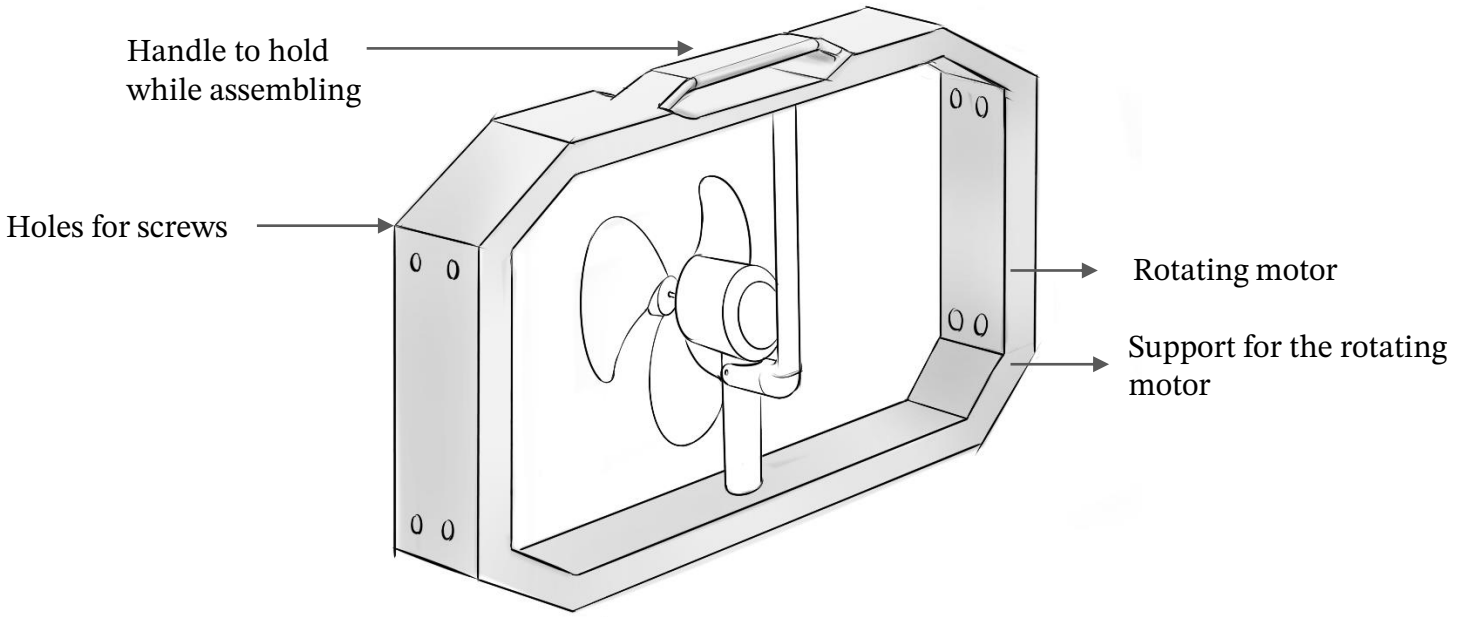


Rotating fan mechanism

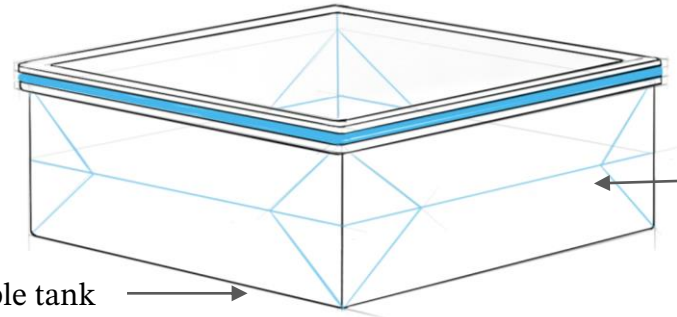


External duct to channel the air

8.2 Fan module

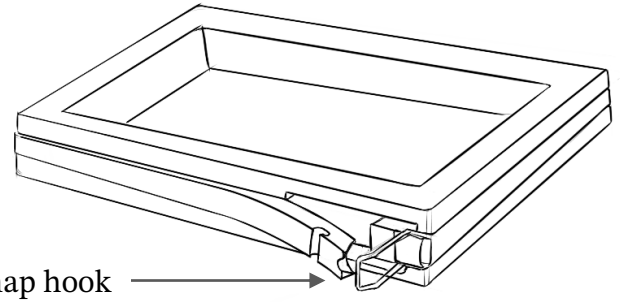


8.3 Water Tank

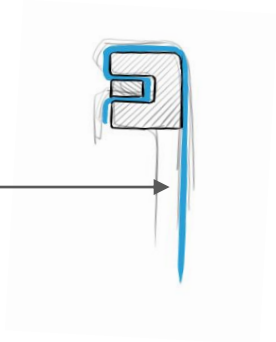


HDPE Sheet

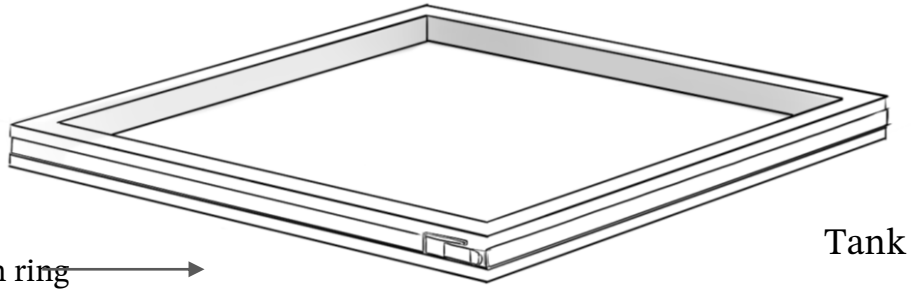
Collapsible tank



Snap hook



HDPE sheet passes through the rim and gets hooked

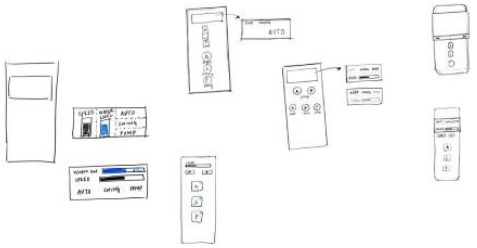


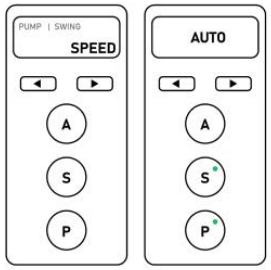
Tank rim ring

Tank dimesnions

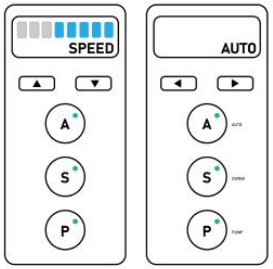
Depth - 12"
Width - 16.85"
Length - 20.89"

8.4 Remote

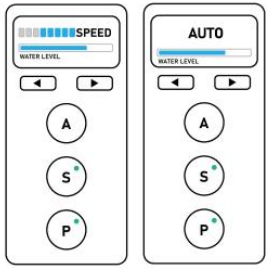




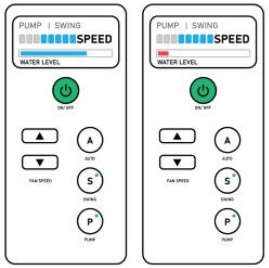
All the functions are visible, the ones functioning are dark, rest light color



Remote control shows – different speeds level
Other Functions have a small light, which glows when its ON

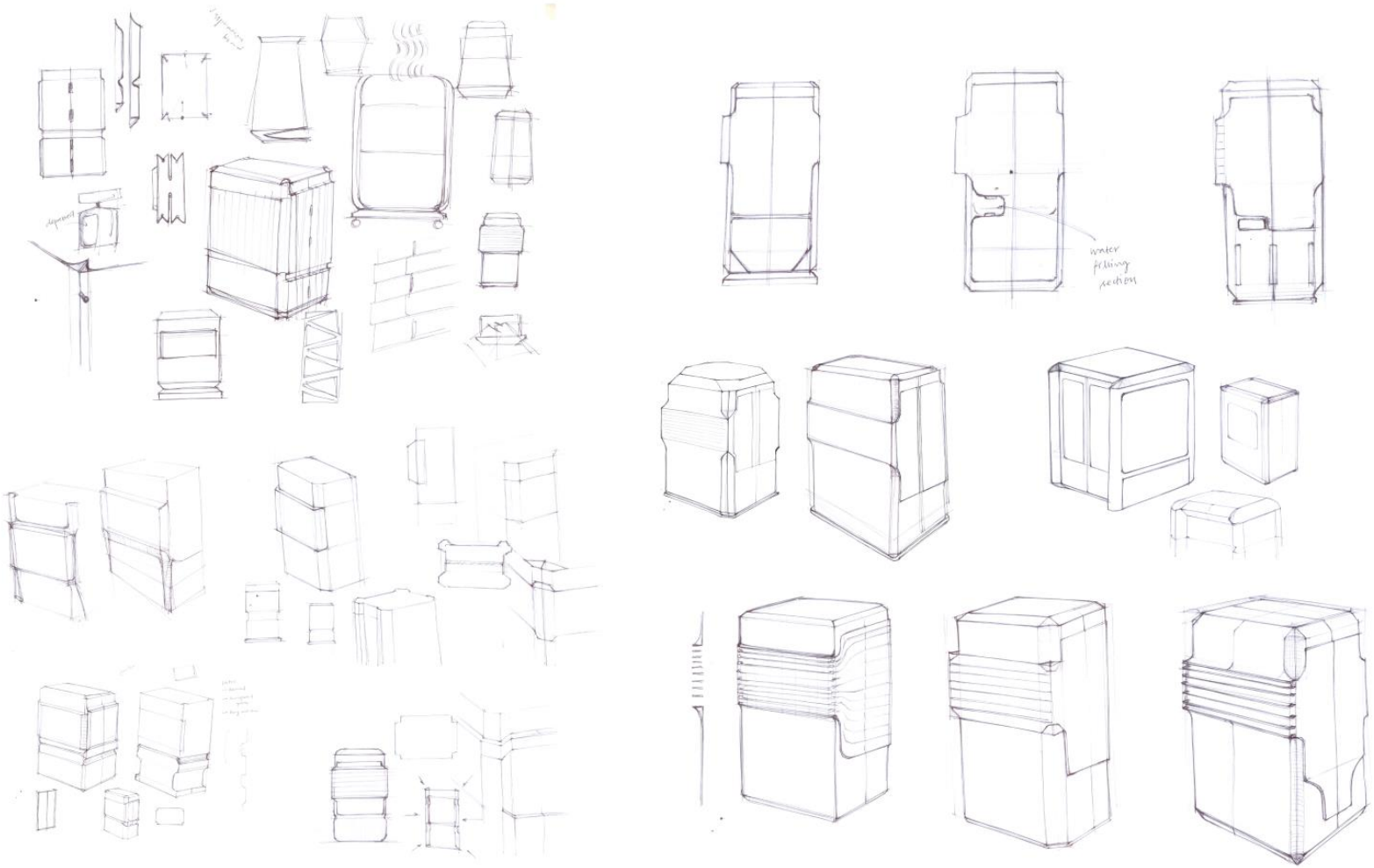


Water level indicator, as it is difficult to see water level from inside the room



Power button and, color coding the Power button and the water level indicator, for ease of interaction.

8.5 Body form Explorations



9. Final Model

Final Model

Cooler frame collapsed to 1/3 of its width

Final Model

Exploded View

Final Model

Exploded View

10. Materials & Manufacturing Processes

Materials :

Tank -
Considering the need for flexibility and water proofing, ***HDPE*** can be used for manufaturing the cooler tank.

Body -
ABS or ***PolyPropelene (PP)*** can be used for the manufacturing of the body of the cooler.

Manufacturing Process :

Tank -
For the tank manufaturing - ***Blow Moulding*** and ***Ultra sonic welding*** are the two processes needed

Body -
The body can be entirely ***Injection Molded.***

11. References

- https://www.hindwareappliances.com/ifold-desert-air-cooler/
- https://www.newworldencyclopedia.org/entry/Climate_of_India
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- https://symphonylimited.com/air-cooler/household-cooler/