IDC School of Design
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MyRay

A project report on P2 Project

Smart Solar Vegetable/Fruit Dehydrator for Farmers of Maharashtra

Guided by **B.K.Chakravarthy**

Project by

Prince R. | 22M2225
M.Des Industrial Design

Approval form

This is to certify theat the Industrial Design Project entitled **“Smart Solar Vegetable/Fruit Dehydrator for Farmers of Maharashtra”** by **Prince R.** is approved for partial fulfillment for the Master of Design degree in Industrial Design.

Prof. B.K.Chakravarthy
[Project Guide]

Signature of the Internal Examiner

Signature of the Chairperson

Signature of the External Examiner

Declaration form

I, declare that this written report represents my ideas in my own words, and where others' ideas or words have been included I have adequately cited and referenced the original sources.

I also declare that I have adhered to all principles of academic honesty and integrity and have not falsified, misinterpret□ed or fabricated any idea, data, facts or source in my submission.

I understand that any violation of the above will be caused for disciplinary action by the Institute and can also evoke penal action from the source, from which proper permission has not been taken or improperly been cited.

Signature of Student
Prince R.
22M2225

Acknowlegment

I would like to express my heartfelt gratitude to my guide, Prof. B.K.Chakravarthy, for his essential assistance thoughout the project. Special thanks to the professors of Industrial Design Department for their critics and guidance . I am also grateful to all of the instructors, staff, and students at the Industrial Design Centre (IDC) for their assistance, advice, and suggestions. I would like to thank Prof.Mane for his guidance in the making of this project.

Finally I'd like to express my gratitude to my family and friends of Industrial Design Batch of 2024 & 2025 for their unwavering support.

Abstract

This project proposes the design and development of a Smart Solar Dehydrator aimed at mitigating post-harvest losses and enhancing the income of farmers in the agricultural sector. The dehydrator incorporates intelligent features to optimize drying parameters, including temperature, humidity, and drying time, tailored to the specific characteristics of different vegetables. By leveraging solar energy, the system is not only environmentally sustainable but also cost-effective for farmers.

The dehydrator's adaptive capabilities extend to weather and seasonal variations, utilizing real-time data to adjust its operation. The system is equipped with a user-friendly interface, enabling farmers to input vegetable type and quantity easily, receiving recommendations for optimal drying settings. Additionally, the integration of IoT allows for remote monitoring and control, enhancing accessibility for farmers and facilitating efficient management of the dehydration process.

This innovative solution not only addresses the challenges of inadequate storage and transportation but also empowers farmers to preserve excess produce, turning it into a marketable resource. By safeguarding the quality and shelf life of vegetables, the Smart Solar Dehydrator aims to contribute to the reduction of agricultural wastage, promoting sustainable agricultural practices and bolstering the economic resilience of farmers.

Contents

01

INTRODUCTION

This section encompasses key facets of the agricultural landscape in India, addressing the Agricultural Sector's significance. It explores the critical issue of food wastage, delving into the detrimental contributors that lead to inefficiencies in the food supply chain. The section further examines the adverse impact on farmers, specifically their financial losses, and introduces methods of preserving excess produce, including dehydration. Additionally, it explores the ecological rationale behind the utilization of solar dehydrators in sustainable food preservation practices.

Agricultural Sector of India

With a population of 1.27 billion, India is the world's second most populous country and the seventh largest by land area. Boasting diverse landscapes, including the Himalayas, Thar desert, Gangetic delta, and the Deccan Plateau, India exhibits vast agro-ecological diversity. As the world's third-largest economy, valued at $2.1 trillion, India's economic growth is expected to reach 6.75 percent in 2018. Agriculture, the largest source of livelihoods, contributes 23% to the GDP and employs 59% of the workforce, with 82% of farmers being small and marginal.

Despite achievements in food grain production and being a global leader in pulses, milk, and jute, India faces challenges. The agriculture sector's contribution to GDP has declined, and the country still has a significant population of undernourished people. Social dynamics in agriculture are changing with increasing feminization, driven by rural-urban migration, women-headed households, and cash crop production. Sustainability concerns arise from resource-intensive agricultural practices, water stress, desertification, and land degradation.

India's agriculture needs improved management to enhance nutrition, increase incomes, and empower women. Diversification into agri-allied sectors like animal husbandry and fisheries has provided livelihood opportunities and increased resilience. Despite challenges, strategic policies focused on agricultural diversity, productivity, and careful price and subsidy considerations can contribute to a more sustainable and resilient agricultural sector in India.

Food Wastage

India is one of the largest producers of fruits and vegetables in the world. However, due to various factors, such as inadequate storage and transportation facilities, lack of market infrastructure, and fluctuating demand and supply, a significant amount of fruits and vegetables go to waste in India. This wastage occurs at different stages of the supply chain, including post-harvest handling, storage, transportation, and distribution.

Estimating the exact amount of vegetable and fruit wastage in India due to farmers being unable to sell their produce is challenging. However, according to a report by the Ministry of Food Processing Industries in 2017, it was estimated that India loses around 30-40% of its agricultural produce, including fruits and vegetables, due to post-harvest losses and wastage.

Efforts have been made by the government and various organizations to address this issue and reduce wastage. Initiatives such as the creation of cold storage facilities, improvement of transportation infrastructure, and promotion of food processing industries have been undertaken to minimize post-harvest losses and ensure better market access for farmers.

Detrimental Contributors to Food Waste

Market Volatility

Vegetable prices can be highly volatile due to factors like weather conditions, transportation issues, and market dynamics. If the market experiences sudden price drops or if farmers are unable to sell their produce at a reasonable price, they may choose to discard the excess rather than incurring financial losses.

Infrastructural Limitation

Inadequate storage facilities, especially in regions with high agricultural production, can lead to spoilage of vegetables before they reach the market. Without proper storage options, farmers may face challenges in preserving their produce until it can be sold.

Transportation

Transportation problems, such as delays, poor infrastructure, and high costs, lead to food wastage by causing spoilage of perishable goods during transit. Insufficient access to refrigerated transport hampers farmers' market reach, resulting in discarded surplus produce. Addressing these challenges through improved logistics and infrastructure is essential to reduce agricultural food wastage.

Distribution

Inefficient or unreliable supply chains can contribute to mismatches between supply and demand. If farmers are unable to transport their produce to markets promptly or if there are delays in distribution, the vegetables may spoil before reaching consumers, leading to wastage

Seasonal Variation

Certain vegetables are seasonal, and their demand may vary throughout the year. Farmers often plan and plant crops based on expected demand, but if the demand suddenly decreases due to factors like weather changes or shifts in consumer preferences, it can lead to surplus produce that may go to waste.

Farmer’s Loss

Farmers incur financial losses due to transportation issues that contribute to food wastage. Delays, inadequate infrastructure, and high transportation costs can result in the spoilage of perishable goods during transit, leading to abandoned or discarded produce. These challenges not only impact farmers' profitability but also hinder their ability to access broader markets, exacerbating the economic repercussions of food wastage in the agricultural sector.

India is producing sufficient food to feed everyone, but over 40% of the food produced is lost or wasted along the supply chain or at consumer level.

The total loss value is estimated to be around ₹ 5220 crore per year.

Preservation of Excess Produce

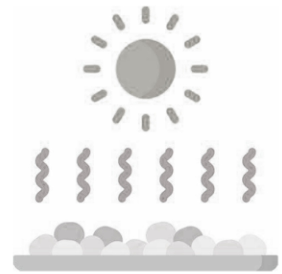
Preserving excess produce can help save farmers' pockets by extending the shelf life of their harvest and reducing waste. Implementing effective preservation methods such as refrigeration, cold storage, and proper packaging helps prevent spoilage during transportation and storage. Additionally, farmers can explore value-added processes like canning, drying, or pickling to transform surplus produce into longer-lasting products, opening up opportunities for sales beyond the immediate harvest period. These preservation strategies not only minimize losses but also enable farmers to better manage their inventory, enhance market access, and ultimately improve their economic sustainability.

In India, pickling and drying are traditional methods of preserving vegetables, ensuring that seasonal produce can be enjoyed throughout the year.

Pickling (Achar)

Ingredients:Vegetables (commonly mangoes, lime, mixed vegetables), spices (mustard seeds, fenugreek seeds, turmeric, red chili powder), salt, and oil.

Process:Vegetables are cut into pieces and mixed with a blend of spices, salt, and sometimes oil. The mixture is then sun-dried or stored in airtight containers, allowing the flavors to meld over time. The acidic nature of the pickling process helps inhibit the growth of microorganisms, preserving the vegetables for an extended period.



Drying (Sundrying)

Ingredients:Various vegetables like okra, tomatoes, and green chilies.

Process:Vegetables are sliced or chopped and laid out in the sun to dry. The natural heat of the sun removes moisture, preventing the growth of bacteria and molds. Once adequately dried, these vegetables can be stored for an extended period.

These traditional preservation methods not only contribute unique flavors to Indian cuisine but also serve as practical ways to prevent wastage and make the most of seasonal abundance. The choice of spices and regional variations in preparation adds diversity to pickles, making them an integral part of Indian culinary heritage.

Dehydration

Dehydration of vegetables is a traditional method employed to remove moisture, thereby extending their shelf life. Dehydration of vegetables serves various purposes and offers several advantages in terms of storage, transportation, and culinary applications.

Extended Shelf Life
Dehydration removes the moisture from vegetables, inhibiting the growth of microorganisms like bacteria and molds. This significantly extends the shelf life of the vegetables.

Reduced Weight and Volume
Dehydrated vegetables are lightweight and have reduced volume compared to their fresh counterparts. This makes them more convenient for storage and transportation, especially in situations where space and weight are crucial considerations.

Convenience in Storage
Dehydrated vegetables can be stored in airtight containers for an extended period without the need for refrigeration. This makes them a valuable resource in areas with limited access to refrigeration or during times of food scarcity.

Nutrient Retention
Proper dehydration methods help retain a significant portion of the nutritional content of vegetables. While some loss of nutrients is inevitable, dehydrated vegetables can still be a good source of vitamins and minerals.

Versatile Culinary Ingredient
Dehydrated vegetables are versatile in the kitchen. They can be rehydrated and used in various dishes such as soups, stews, casseroles, and pasta. Their concentrated flavour can enhance the overall taste of the dish.

Emergency Food Supply
Dehydrated vegetables are a practical choice for emergency food supplies. They are lightweight, non-perishable, and can provide essential nutrients during times of need.

Cost-Effective
Dehydrating surplus or seasonal vegetables allows farmers to preserve their harvest efficiently, reducing waste and potentially increasing their income by selling dehydrated products.

Reduction in Food Wastage
Dehydration is an effective method to prevent the wastage of excess produce. By preserving vegetables through dehydration, farmers can reduce losses and contribute to more sustainable agricultural practices.

Flavourful Snacks
Dehydrated vegetables can be transformed into crunchy and flavourful snacks. They make for a healthy alternative to store-bought snacks that may be high in additives and preservatives.

Overall, the dehydration of vegetables is a valuable technique that aligns with both practical and culinary needs, offering an efficient way to manage agricultural surpluses and enhance food security.

Solar Dehydrators

Solar dehydrators are devices that use solar energy to remove the moisture content from food, including fruits, vegetables, and herbs. They harness the power of the sun to preserve and dry food, providing an eco-friendly and energy-efficient alternative to traditional drying methods.

Why Solar Dehydrators?

Renewable Energy
Solar dehydrators use clean and renewable solar energy, reducing dependence on electricity or fossil fuels.

Cost-Effective
Once constructed, solar dehydrators have minimal operating costs, making them a cost-effective solution for small-scale farmers or individuals.

Sustainable Preservation
Solar dehydration is an eco-friendly preservation method that helps reduce food wastage and dependence on chemical preservatives.

Empowers Local Communities
Solar dehydrators can be built with locally available materials, empowering communities to create their own sustainable food preservation solutions.

Quality Preservation
The gentle heat provided by solar dehydrators helps preserve the quality, color, and nutritional content of the food being dried.

02

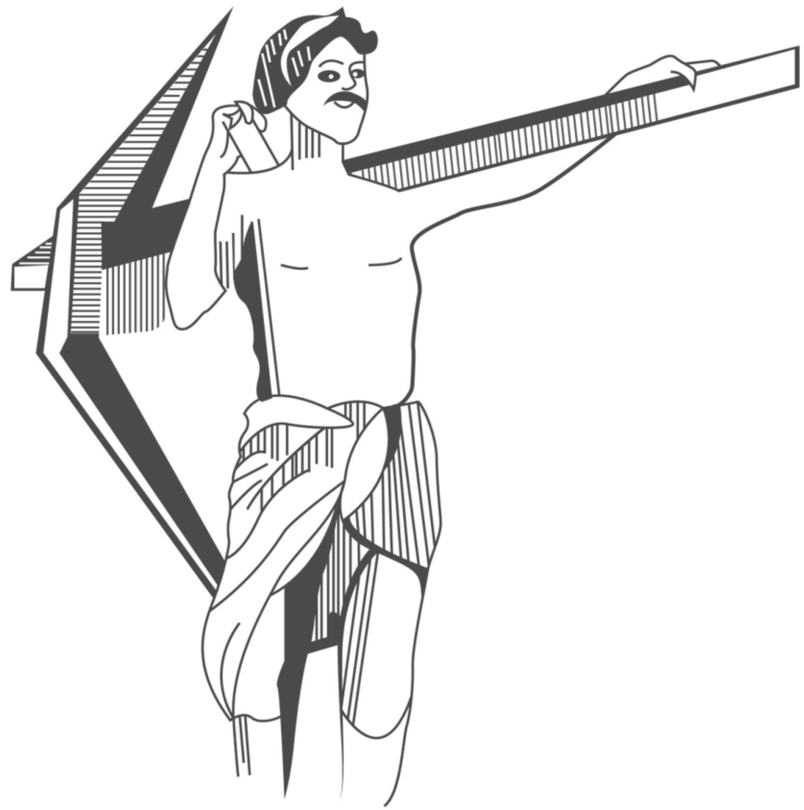
ARENA

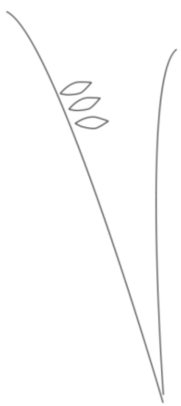
This section intricately explores the area of work and focus within a defined framework. It delves into the cause that motivates the activities, providing insights into the contextual factors influencing the designated sphere. Additionally, the section examines the system in place, shedding light on the interconnected elements and structures that contribute to the overall functioning of the defined arena.

Cause

Safeguard the revenue of the farmers

The cause of the project is to safeguard farmers' revenue by aiding them in efficiently utilizing and monetizing their excess produce. The project aims to address the challenge of agricultural surplus, offering a solution that not only reduces food wastage but also empowers farmers economically through effective management of their harvests.

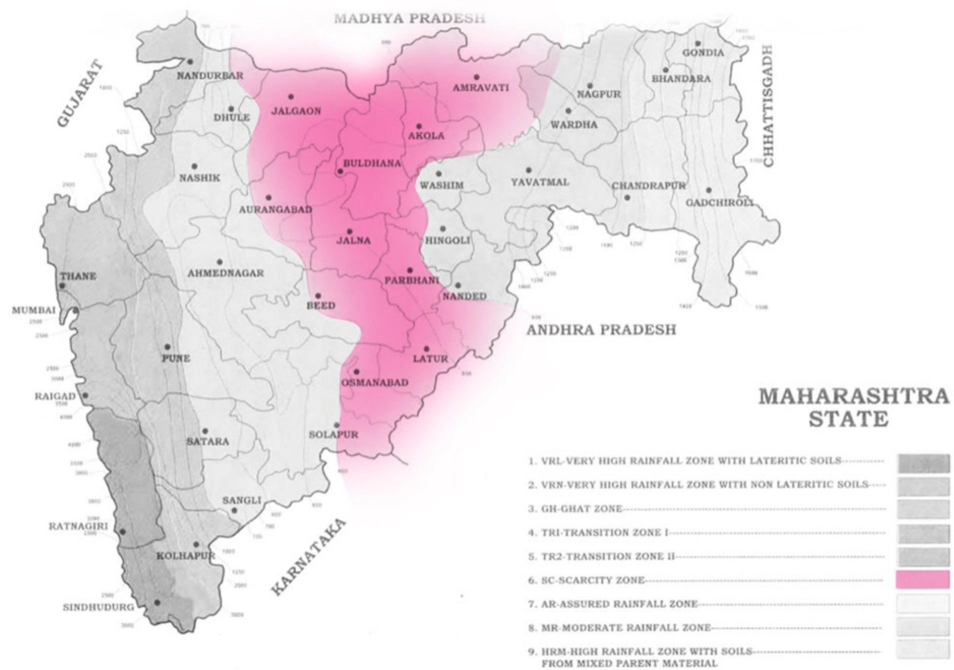




Context

Farmers of Aurangabad, Jalgaon & Jalna Region of Maharashtra.

The project focuses on farmers in Maharashtra's Aurangabad, Jalgaon, and Jalna regions, which fall under a scarcity zone with low rainfall. This challenge extends to parts of Andhra Pradesh and Odisha. Addressing the common struggle of water scarcity in these regions, the project aims to help farmers efficiently manage and monetize their excess produce, offering tailored solutions for sustainable agriculture and economic resilience.



03

MARKET RESEARCH

The Market Research section encompasses a Synchronic and Diachronic Analysis of solar dehydrators, providing insights into both their current state and historical development. Additionally, this section delves into Market Trends and evaluates Existing Products within the solar dehydrator market.

04

CASE STUDY & FIELD VISIT

In the Case Studies and Field Visits section, insights were gathered from diverse experiences, including visits to the ConSolFood Conference in Jaipur, S4S Technologies in Aurangabad, the World Spice Expo in Navi Mumbai, and Sayadhri Farms in Nashik. These visits provide comprehensive perspectives and observations within the context of conferences, technologies, expos, and farms.

CONSOLFOOD 2023

Engaging with numerous experts in India who contribute to the intersection of Energy, Technology, and Society (socio-cultural), has been a valuable experience. The focus on innovative approaches in Solar Food Processing has been particularly enlightening, with insights shared by presenters from diverse corners of the globe, including France, Mexico, Austria, the USA, Spain, Japan, and India. This collaborative knowledge exchange was set to continue from July 12 to 14, 2023, promising a dynamic exploration of advancements at the nexus of energy technology and societal impact.

International Conference held in Vatsalya Sustainable Campus, Jaipur on Solar Food Processing.

12-14 July, 2023
Jaipur, Rajasthan

Our stay in the campus dormitory provided a firsthand experience of sustainable living habits. Meals were prepared using solar cooking methods, offering a glimpse into eco-friendly culinary practices for breakfast, lunch, and dinner. The campus also utilized renewable energy for purifying water, aligning with environmentally conscious choices. Additionally, engaging sessions on astronomy and science added an educational and enriching dimension to our stay, contributing to a holistic and sustainable living experience.

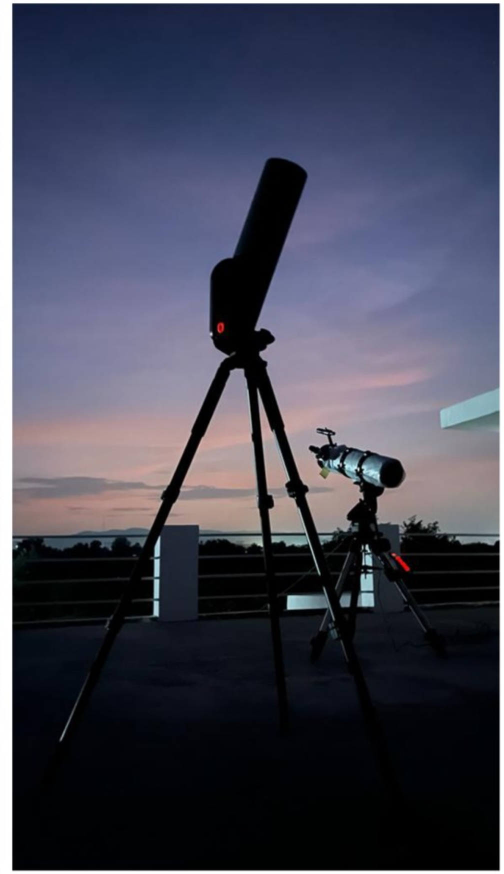
Solar Cooking

We enjoyed solar-cooked meals prepared using parabolic mirrors powered by an automatic sun-tracking device. This innovative cooking method harnessed solar energy efficiently, allowing for precise alignment with the sun's position throughout the day. The experience of having food made through this sustainable and technology-driven approach added a unique and eco-friendly dimension to our culinary encounters.

Vatsalya Campus

Vatsalya Society, commonly referred to as Vatsalya or Vatsalya Jaipur on its website, is a non-profit organization (NPO) established in 1995 under the Society Institution Registration Act 1958. Initially focusing on orphaned and abandoned children, particularly those living on the streets, through short-term and long-term programs for two decades, Vatsalya has transformed into a comprehensive community school located in the villages of Achrol, Rural Rajasthan. Over the years, it has expanded its outreach to include various initiatives in public health, nutrition, women empowerment, climate change mitigation with a focus on solar energy, and a distinctive STEM-based learning school. Notably, Vatsalya operates from a self-developed Carbon Neutral Green Campus, a one-of-a-kind establishment in Rajasthan. The organization has also played a significant role in public health and nutrition across Rajasthan, collaborating with government entities, Unicef, GAIN, and the European Commission.

A Photograph with **Karthikey Gupta**, Director of Vatsalya Society



S4S Technologies

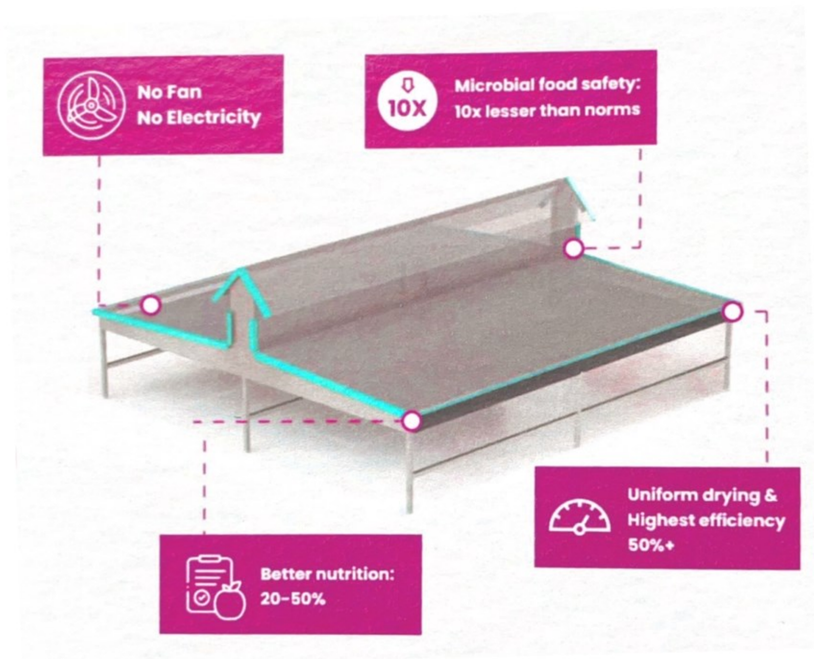
S4S operates throughout the entire process, supporting female farmers in transitioning to processors and generating extra income through value addition. Our proprietary solar conduction dryers (SCD) are distributed to smallholder farmers for processing lower-grade agricultural produce. These electricity-free, solar-powered food dehydrators efficiently decrease moisture content, allowing farmers to preserve their produce for a year without resorting to chemicals or preservatives. Crucially, the dryers contribute to an annual income boost of $1000-1500 for women farmers.

A Startup, Cofounded by CTARA Alumnus, Ashwin Pawade, Processing Solar Dried Vegetables.

25 July, 2023
Aurangabad, Maharashtra

A photo capturing entrepreneurial women utilizing S4S's solar dehydrators.
Photo Credit: S4S Technologies

First Dryer

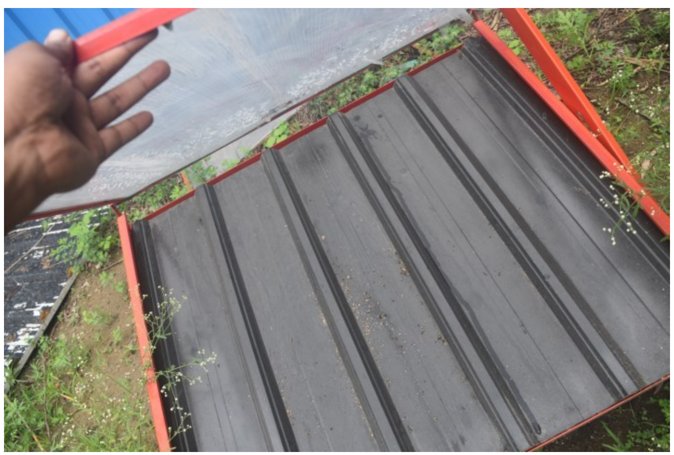


Latest Dryer

Latest Dryer has two parts, 1) Electric Air Blowing Hopper, To remove Free moisture. 2) Solar Dryer for removing the rest of moisture. This Speeds up the drying process.

Existing Product @ S4S

Existing Product @ S4S



Outcomes @ S4S

onion

garlic

ginger

Sahyadri farms

Seeding goodness

Sahyadri Post Harvest Care Ltd.

India's largest integrated fruit and vegetable platform, excels in primary processing, frozen & aseptic products, fruit jams, ketchup, beverages, and zero-discharge waste processing through farmer partnerships.

Nashik, Maharashtra

22 September 2023

Solar Tunnel Drying

Drying Capacity – Upto 500KGs

Dim – 8 ft x 21 ft

Solar Tunnel Drying - Details

Air Exits

Air Inlets

Stacking Racks
with Wire
Mesh Trays

03

SCIENCE BEHIND

Working Principle

1 Black Body Radiation

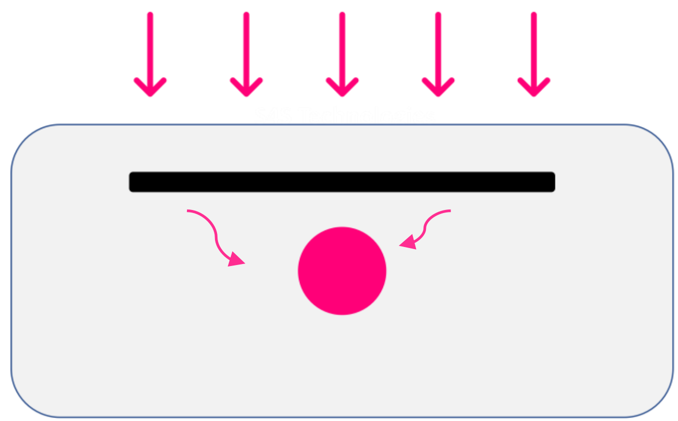
Heat absorbed by a Black Body is radiated back, and energy emitted is proportional to the forth power the temperature difference.

2 Greenhouse Effect

The Rate of amount of energy entering a system is greater than the rate of amount of energy escaping the system.

3 Stack Effect

Cold air is more dense than hot air. Hot Air Raises, and Cold air fills the place of Hot Air.



Temperature : 27°C   Humidity : 10%

Humidity , Airflow and Temperature

Humidity: In solar dehydration, low humidity is essential for effective drying. High humidity slows down the drying process because the air can hold less moisture. To achieve efficient dehydration, the air inside the dehydrator should be dry enough to absorb moisture from the produce.

Airflow: Proper airflow is crucial to ensure even drying. It helps in carrying away the moisture that evaporates from the produce. Good airflow prevents the formation of mold and ensures that all parts of the produce dry uniformly. Fans or vents are often used to maintain consistent airflow throughout the dehydrator.

Temperature: Temperature control is vital for preserving the quality of the produce during drying. The temperature must be high enough to remove moisture but not so high that it causes the produce to cook or lose its nutritional value. Typically, a range of 40°C to 60°C (104°F to 140°F) is maintained, depending on the type of produce being dried.

Effective Drying

Effective drying refers to the process of removing moisture from the produce in a way that retains its nutritional value, color, texture, and flavor while ensuring a long shelf life. It involves optimizing the drying conditions (humidity, airflow, temperature) to achieve a balance between fast drying and quality preservation.

Achieving Effective Drying in Solar Dehydration:

1. Controlled Environment: Use adjustable louvers to control the sunlight entry, maintaining the optimal temperature. Ensure the dehydrator is well-sealed to prevent outside humidity from affecting the drying process.
2. Consistent Airflow: Implement fans or design vents that facilitate uniform airflow across all drying trays. This ensures even drying and prevents hotspots or areas where moisture could accumulate.
3. Monitoring Humidity: Use sensors to monitor and regulate the humidity inside the dehydrator. This can be achieved by adjusting the airflow or adding desiccants to absorb excess moisture if necessary.
4. Temperature Management: Keep the temperature within the recommended range for the specific type of produce. Adjust the louvers or use a thermostat-controlled heating element to maintain consistent heat.
5. Loading: Arrange the produce in thin, uniform layers to ensure even exposure to air and sunlight. Overloading the trays can lead to uneven drying.

06

PROBLEM IDENTIFICATION

Farmer’s Concerns

Based on the interview with Sahyadri Farm, these where the concerns extracted from the interview

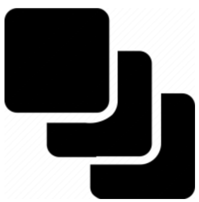
“ Farmers are worried about the need to constantly monitor the drying process to determine when the vegetables are fully dried. “

“If the drying process is not completed properly, residual moisture can lead to fungal growth, spoiling the produce. ”

“Different vegetables require different drying conditions, making it challenging to monitor and manage a diverse batch of produce.”

“High humidity levels during certain days make it difficult to achieve effective drying, as the air cannot absorb moisture efficiently.”

Farmer’s Pain Points



Multiple

“Diverse vegetables pallet , have to monitor differently. “

Humidity

“ Fungus due to moisture. “

“During highly humid day, What we do? “

Ventilation

Pest

“ Fungus due to moisture. “

Seasonal

“Rainy Season “

“During highly humid day, What we do? “

07

BRIEF

Design Proto-Brief

1

Design a Decentralised Solar Dehydrator for Individual and Small scale Farmers, that can be used throughout the year.

2

Design a system that is SMART, manages Humidity, AirFlow, Pest and Insect Control, Contextual Optimisation

3

Design a Efficient Cycle to use the Solar Dehydrator and make effective profits

Design Brief

Design a Decentralised Smart Solar Dehydrator for Individual and Small scale Farmers, that can be used throughout the year.

SCALABLE
MODULAR
EFFICENT
EASE OF USE
WEATHER RESPONSIVE
PROTECTION

08

EXPLORATION & IDEA

The Experiment and Ideas section encompasses a series of experiments, activity analyses, ideation processes, and concept mockups, providing a detailed exploration of the project's conceptualization and experimentation phase.

Experiments

Initially tried dicing tomato, and drying for 24 hours. In Black painted metal mesh,

But, when picking the dried vegetable, the seed and flesh would stick to the mesh itself.

This is a 3D metal mesh, that twists like pasta, this mesh has absorption and emission surface area in many angles, so it was good for Black body radiation.

Experiments

This is a second drying experiment set in the Shenoy's Solar Oven.

CARROTS , POTATOS and BEETROOT where diced and Layout-ed in two setting.

One set in Sunlight

and Other without sunlight.

Experiments

Experiments

It was very difficult to pick the dry vegetables. Most of the Potatoes were stuck to the metal plates.

Difference in colors were observed between the two sets.

Experiments

Carrot's color value was preserved when not kept in sunlight. This will give a higher market value for the produce.

Beetroot's color value was preserved when not kept in sunlight. This will give a higher market value for the produce.

Potato , on the other hand color value was preserved when kept in sunlight. This will give a higher market value for the produce.

The product kept in shade turned black instead.

Experiments

Sealing to test life and crispness.

Experiments

Traditional Drying in Fabric or Plastic sheets

Here, the flower seller spreads the flowers in gate so that it gets viewed. Similarly, spreading will help the produce get better heat and dry fast

Heat Sink, from Dr. Rane’s Lab

Solar Collector

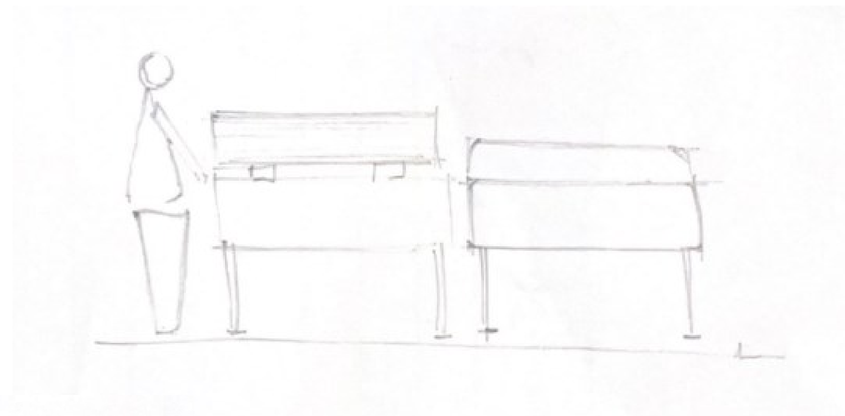
Activity analysis

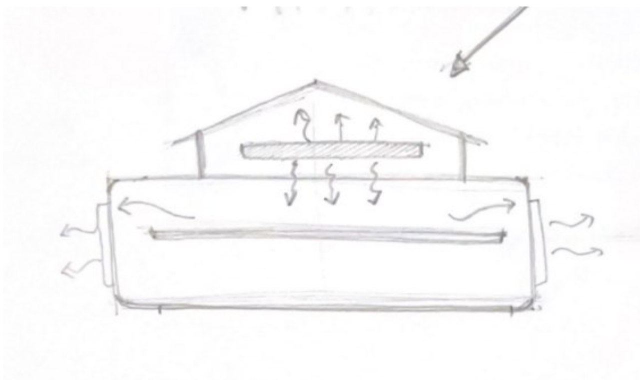
Pre Drying Activities
Dicing
Layouting

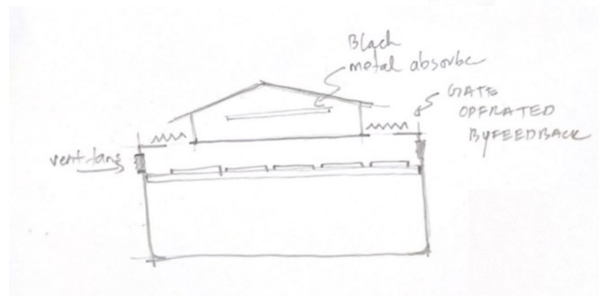
Drying Activities
Air Temperature Control
Air Humidity Control
Air Flow Control
Drying Time
Monitoring Drying Status
Vegetable based Settings
Surrounding Weather Responsive
Protection (Pest, Fungus, Moisture)

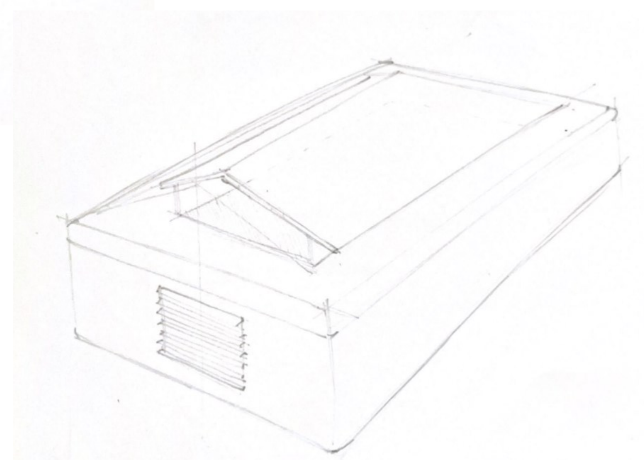
Post Drying Activities
Picking (without damage)
Storage
Packing

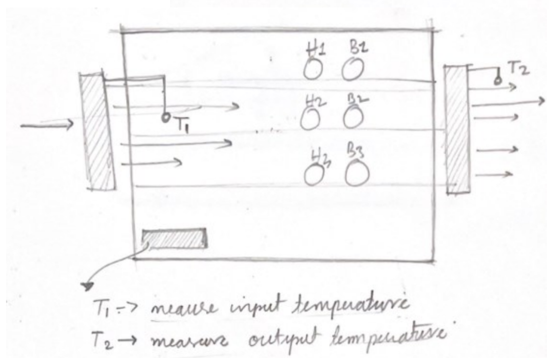
Ideations

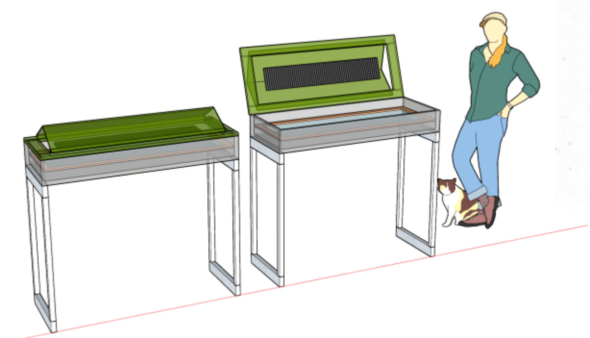


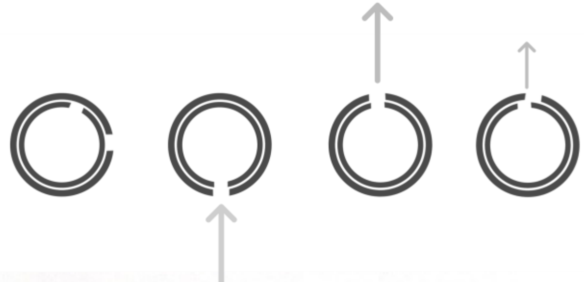



Black
metal absorber
GATE
OPERATED
BY FEEDBACK
vent fans



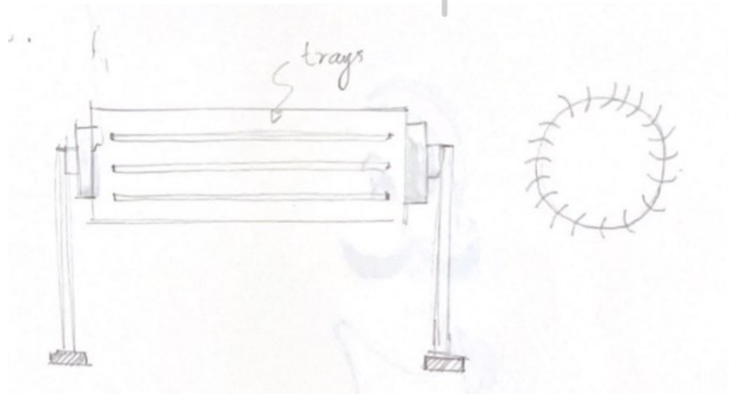

H1 B1
H2 B2
H3 B3
T1
T2
T1 -> measure input temperature
T2 -> measure output temperature

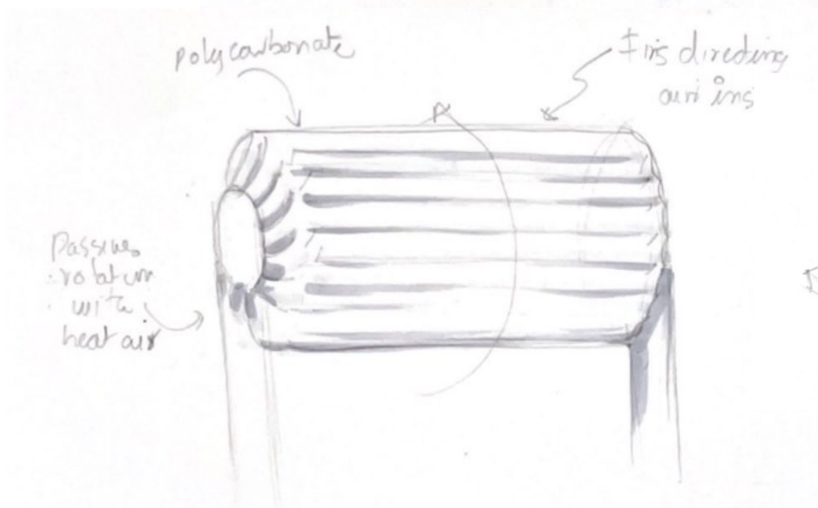


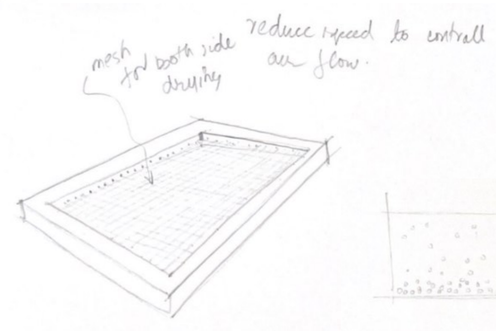


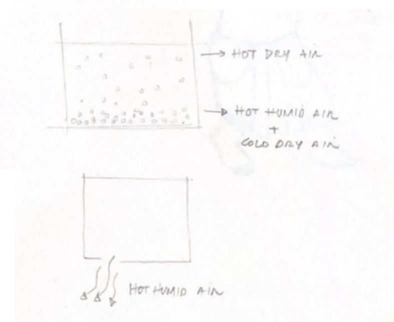
Ideations

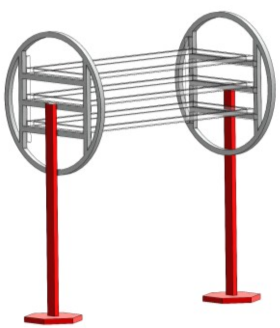
Rotating wings directing air inside and outside, depending on the air temperature the rotation would work





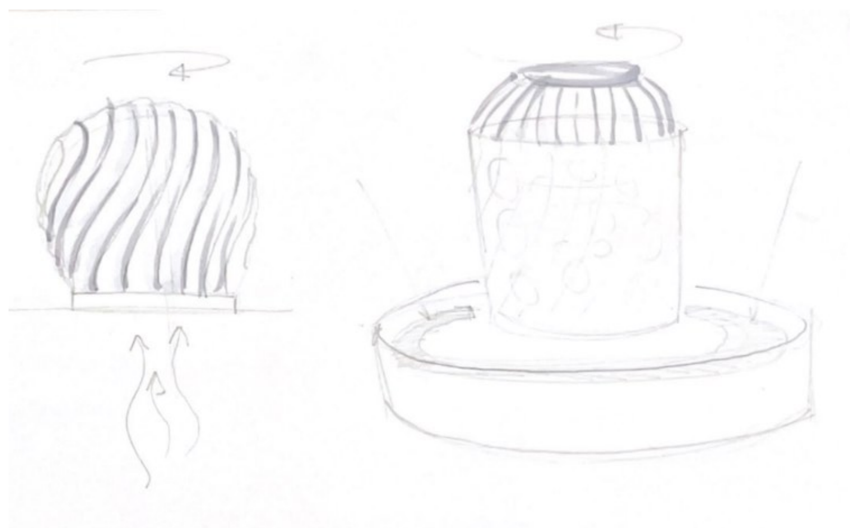


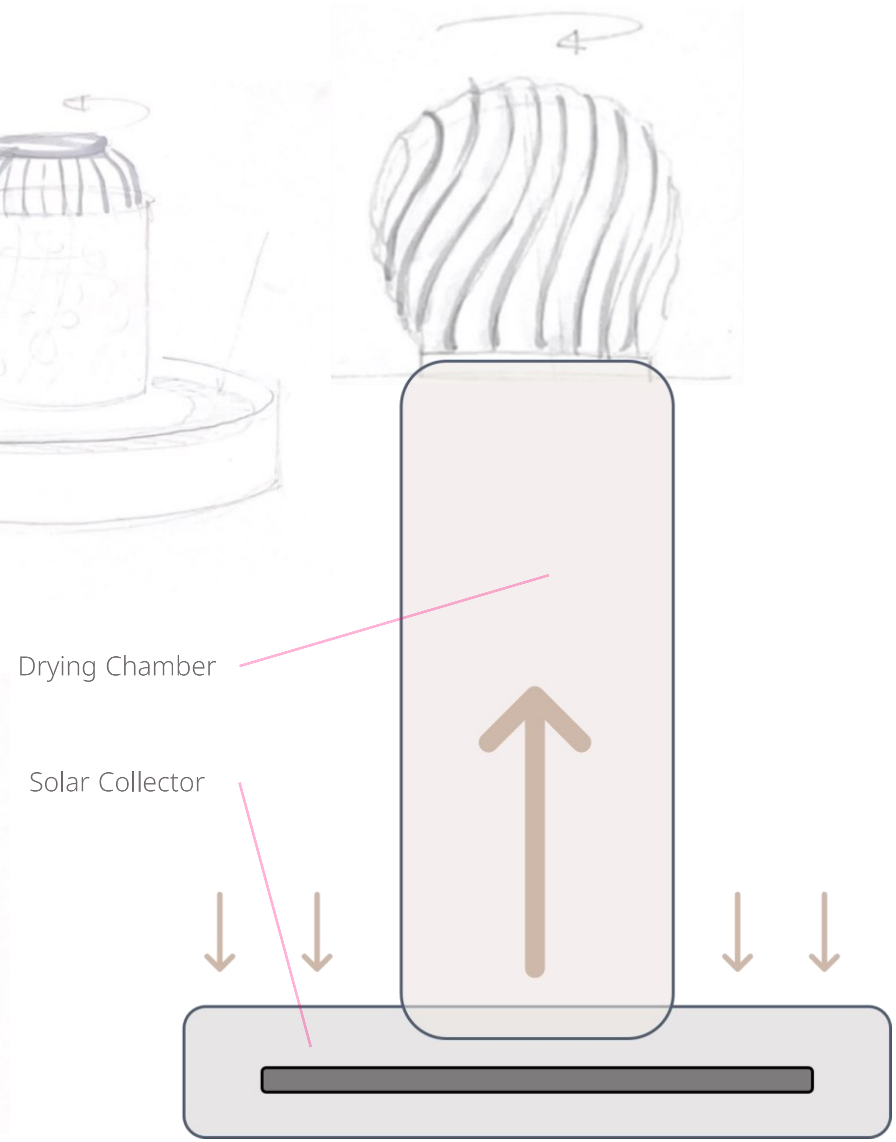


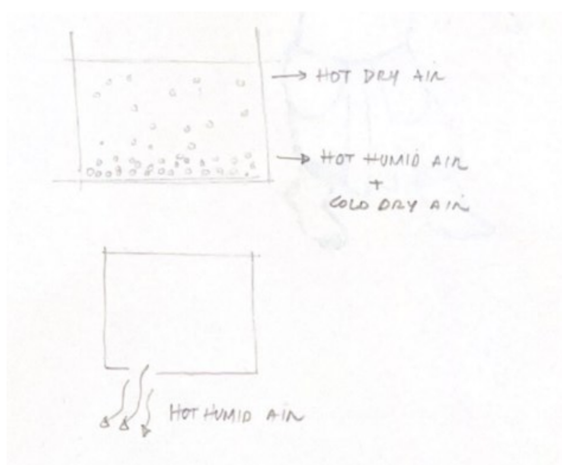


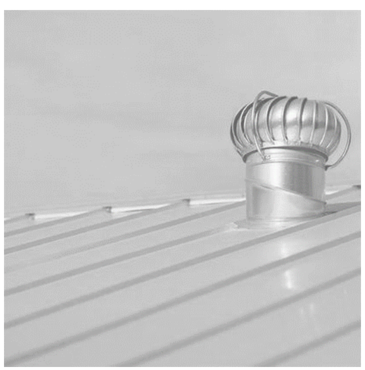
Ideations

Inspiration from the Roof Turbines vents. Stack Effect. Rotating wings directing air inside and outside, depending on the air temperature the rotation would work



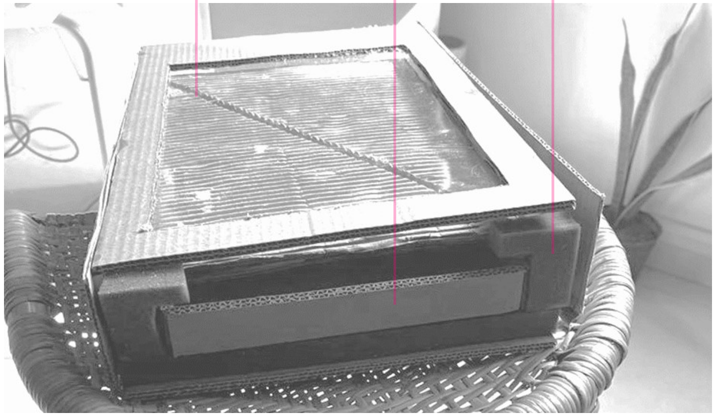






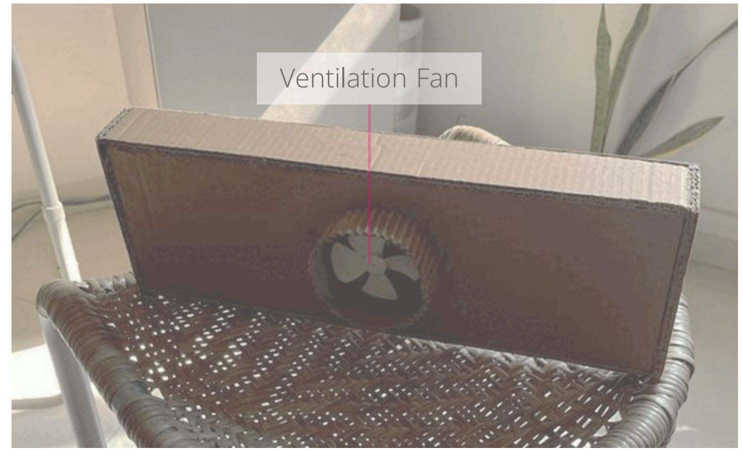
Mock-Up 1

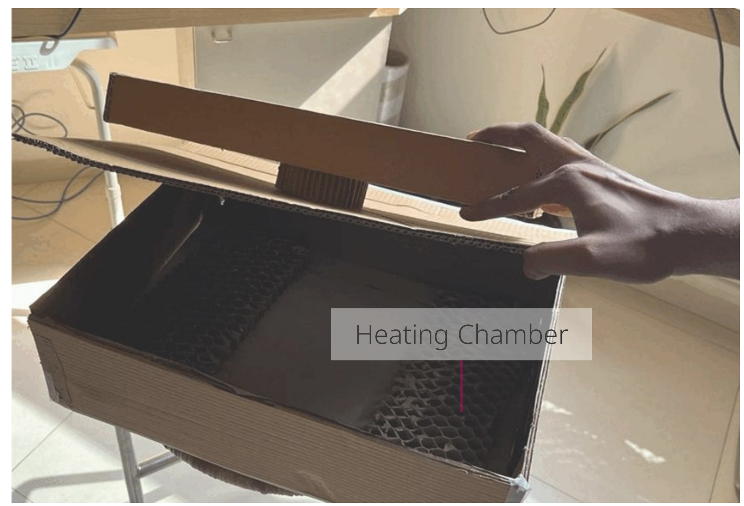
Solar collector and the drying chamber are the same. The walls are insulated. No Direct Sunlight.



Mock-Up 2

Here, the solar collector is separate and the heating chamber is separate, this helps to regulate light entry and precise control over heating.





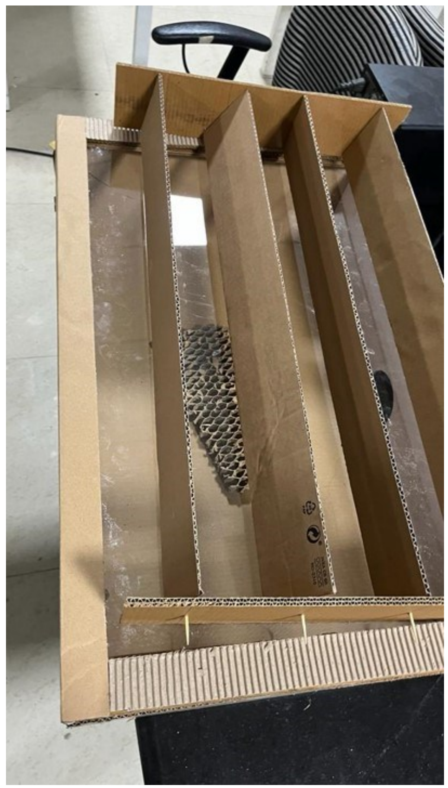
Mock-Up 3

Vent Fan

Air Inlet

This Slider sets the Air Inlet Amount. Mapped to weather

Mock-Up 3



Louvers that adjust the sunlight entry, allowing control of the percentage of sunlight based on the louver angle. Each type of vegetable requires a specific setting for optimal drying and color retention.

09

SOLAR DEHYDRATOR DESIGN

This section consolidates the final design elements, incorporating a Moodboard, Final Concept, Drawings & Visualizations, Interaction Design, Automation, Mockup, and a Working Prototype. It offers a holistic view of the design evolution, from conceptualization to the practical implementation of the project.

Final Brief

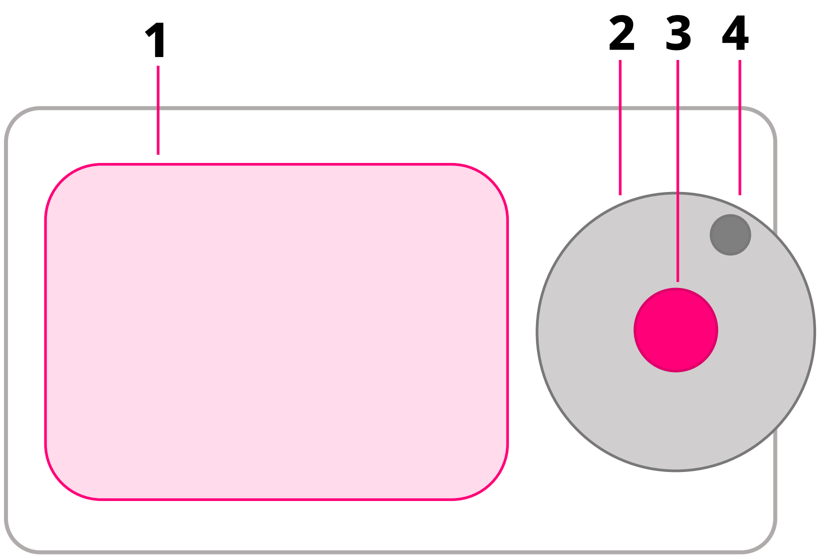
Design a smart solar dehydrator with a 25 kg capacity for bulk drying of vegetables. It should be fast, user-friendly, and weather-responsive, allowing farmers to easily load, set drying parameters, and remove dried produce.

Moodboard

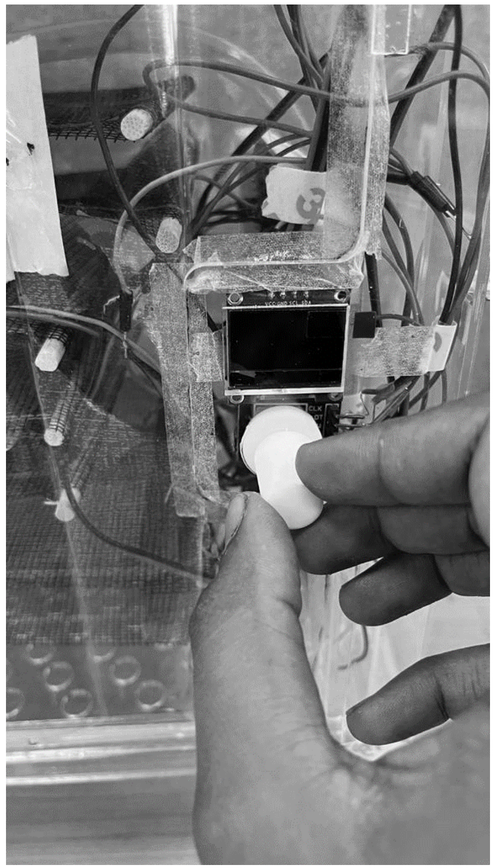
Interface

The interface is supposed to be used by the farmers to set the vegetable type, quantity and desired drying time.

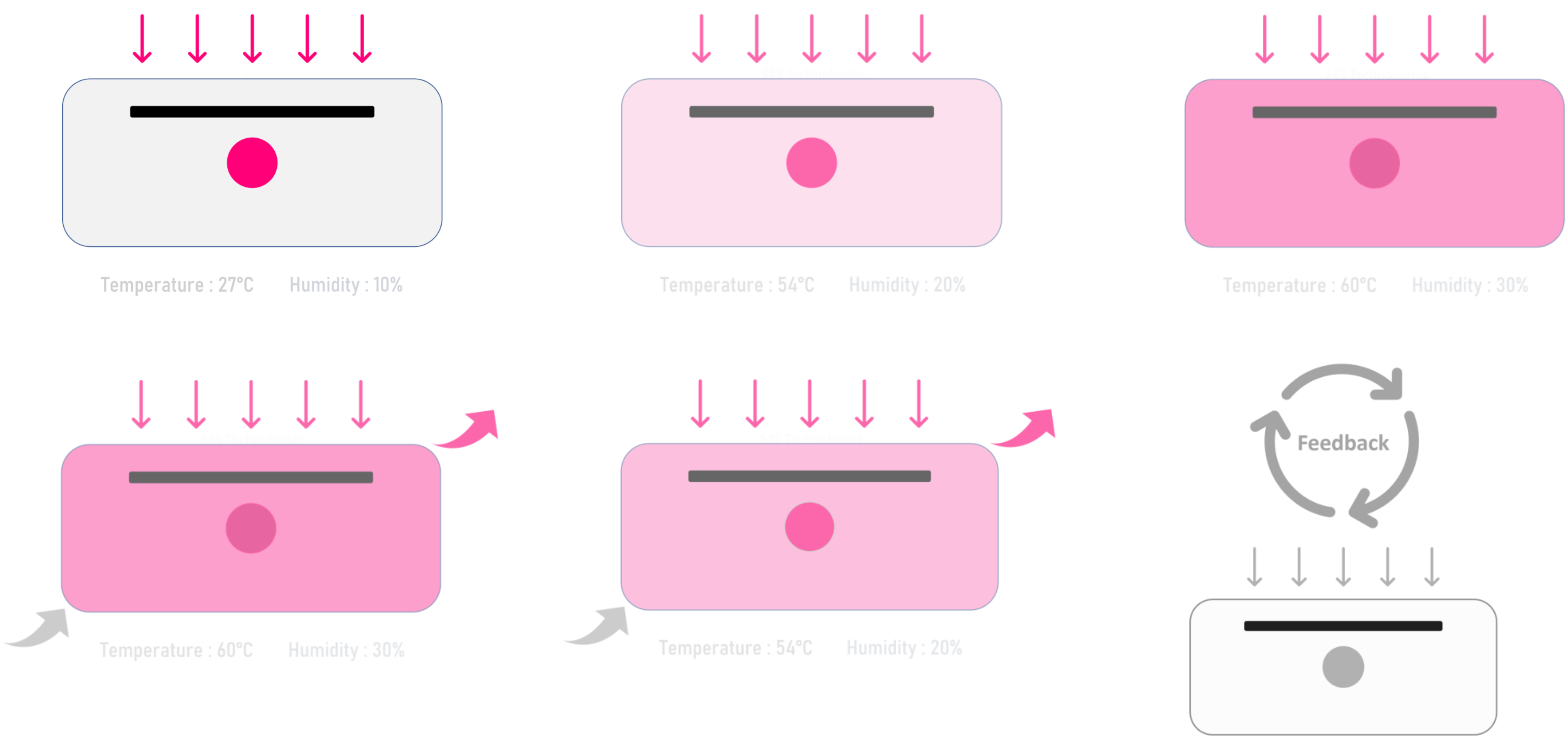
For monitoring, the interface should communicate back real time drying status, temperature , and humidity values.



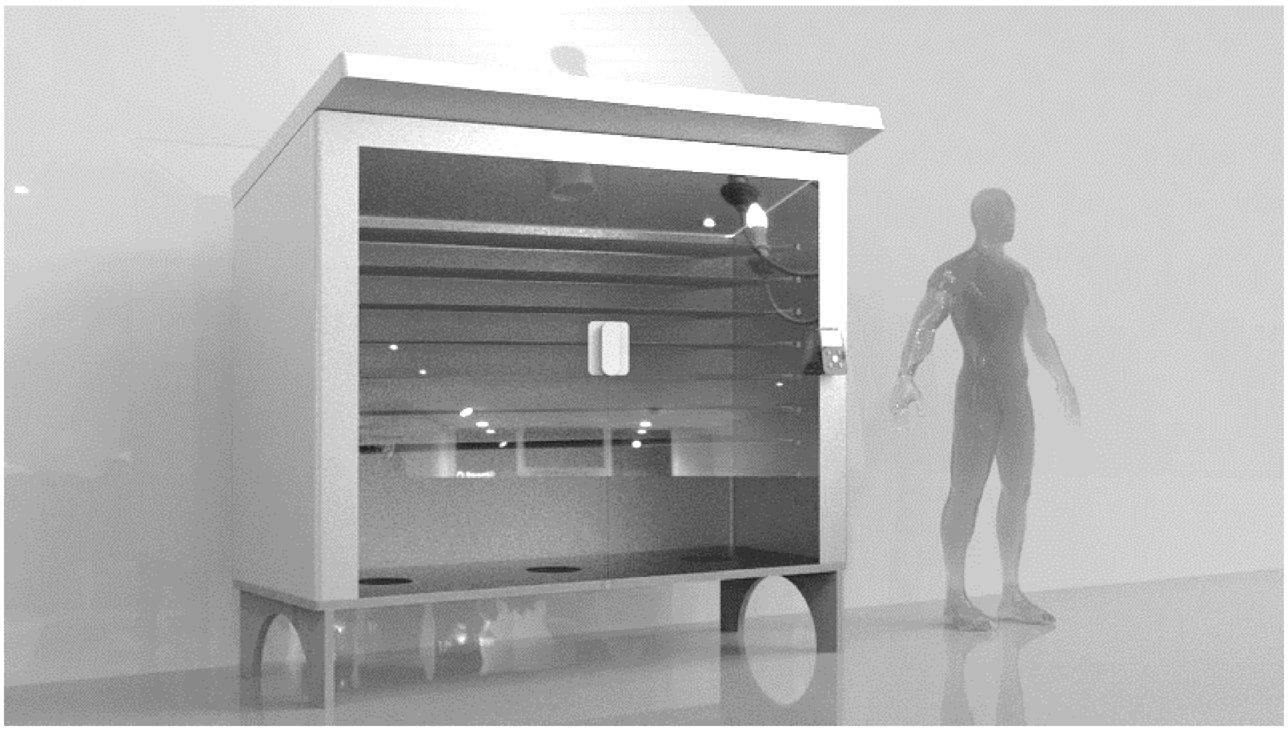
1. Display
2. Selection Knob
3. OK Button
4. Dial Grip



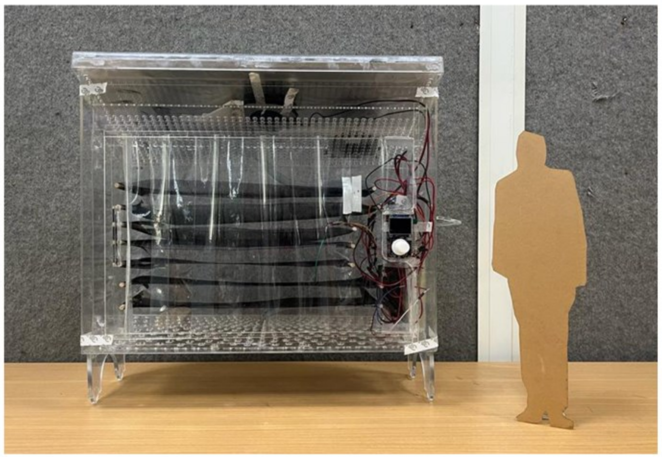
Automation


Temperature : 27°C
Humidity : 10%
Temperature : 54°C
Humidity : 20%
Temperature : 60°C
Humidity : 30%
Temperature : 60°C
Humidity : 30%
Temperature : 54°C
Humidity : 20%
Feedback

Final Design

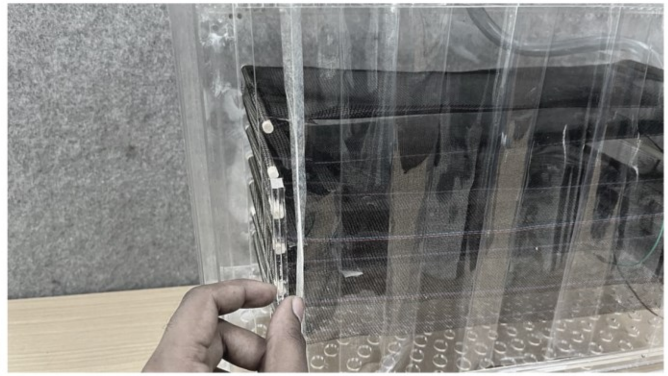


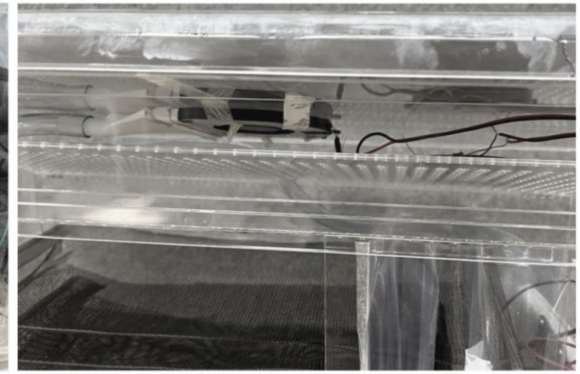
Working Prototype (1:5)

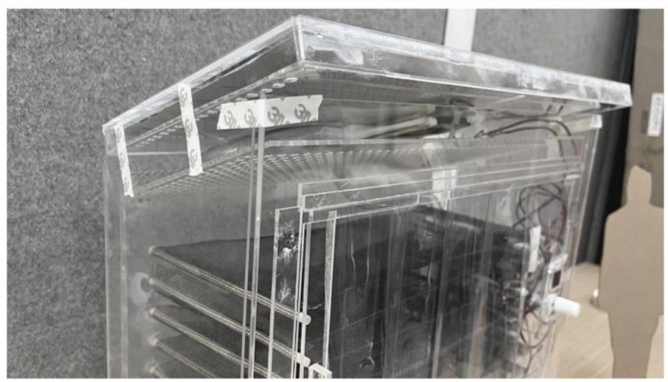


Presenting the refined working model of the ultimate concept, scaled at 1:5. This model serves as a comprehensive demonstration of the solar collector, air temperature management, and incorporates two computer fans for precise regulation of air intake from the solar collector and controlled air exit.

In this model, the integration of baffle panels ensures a uniform and efficient airflow. The materials used in this prototype include trays for the fabric, and a sliding PVC strip sheet curtain acts as a sealing door. The exterior is constructed with a double-walled acrylic framework, serving as a placeholder for the MS sheet metal."





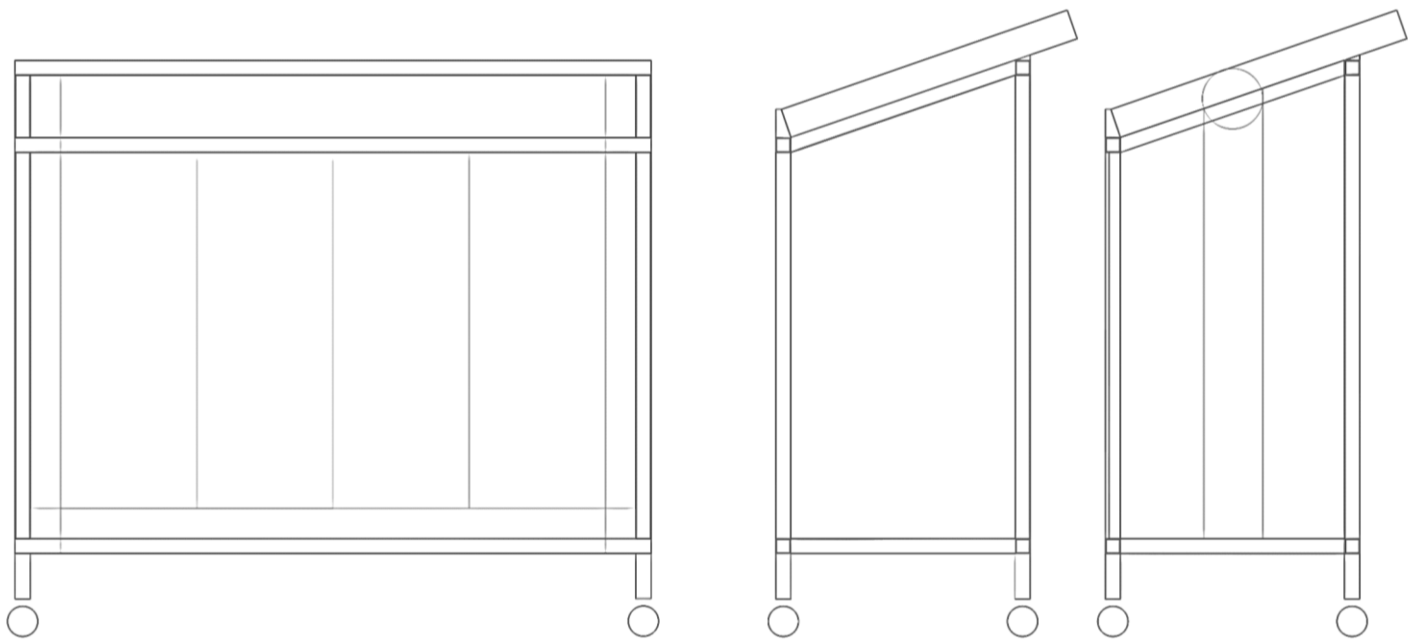


10

MANUFACTURING & FABRICATION

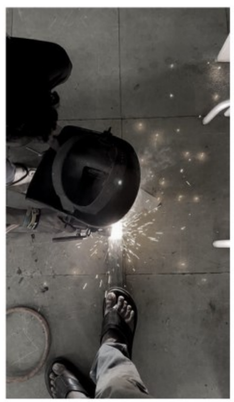
The Manufacturing and Fabrication section provides an in-depth exploration of the project's production phase, offering detailed drawings, a material palette, insights into the manufacturing and fabrication processes, and a comprehensive bill of materials.

Drawings (1: 10)



Drawings (1: 20)

Fabrication



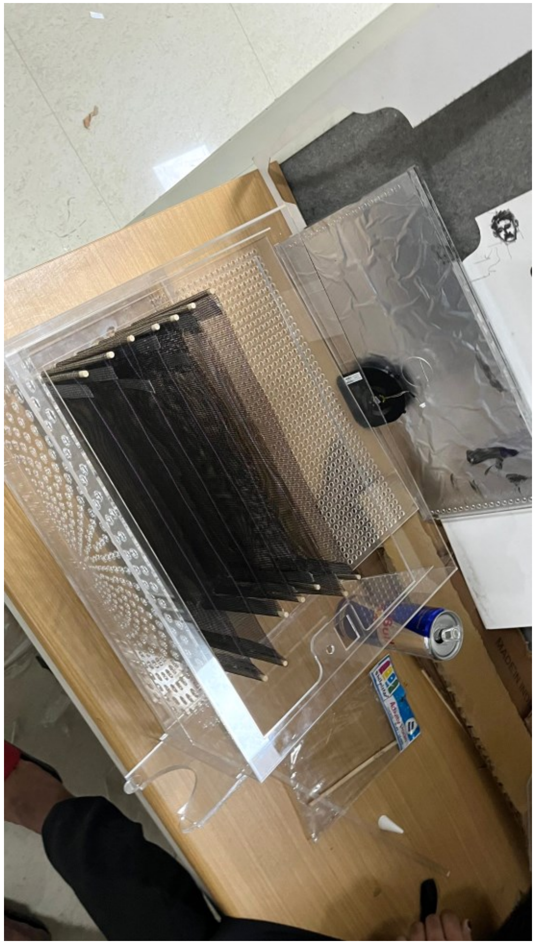
Fabrication of Solar Dehydrator Frame with 50mm Square M.S. Sections at PD Cell, IDC, IIT Bombay

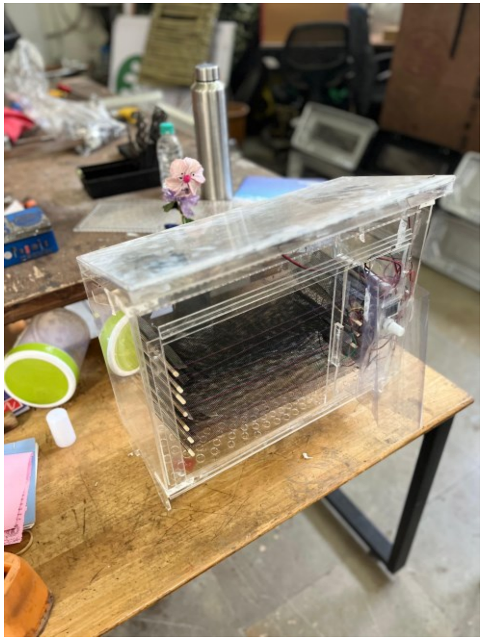
Fabrication


Fabrication of Solar Collector, that uses Alumnium Section Plate and Polycarbonate Sheets and Asawa Insulation sheet, thanks to **Prof Mane.** Fabricated at Heat Pump Laboratory, IIT Bombay.


Transporting the Module from Heat Pump Lab to IDC, for testing

Model





Modified Model

11

BRANDING

12

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Solar Food Dehydration – Eartheasy

Solar Drying—A Sustainable Way of Food Processing | SpringerLink

Solar Dehydrator: The Complete Buying Guide (arkaenergy.com)