

Portfolio



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Contents

01



Dosage-Pal

1-6

02



Sky-Harvest

7-11

03



BioColor Tag

12-16

04



Scan-Verso

17-20

All Individual Projects

01 Dosage-Pal

Overview

A smart prescription pillbox lid designed to solve medication forgetfulness, repeated dosing, and drug abuse.

Theme

Prescription Adherence
Safety & Locking Mechanism
Data Synchronization



SMART PRESCRIPTION DISPENSING SYSTEM REDEFINING
PERSONALIZED MEDICATION ACCESS

Shoucheng Chen

01 Background

Reality

In the United States, the use of prescription drugs should be a precise, safe, and regulated process. However, reality reveals numerous loopholes, especially in terms of low self-discipline in medical adherence, lack of tracking, and risk of abuse.



Medication Omission

Based on an 2022 research of NCBI adherence statistics overview, nearly 50% of patients with chronic conditions do not take medications as prescribed.



Absence of Objective Monitoring

FDA Medication Guide points out current prescription bottles do not track dose timing; caregivers must rely on self-reporting, which highly impairs dose adjustment.

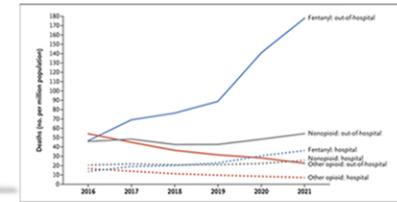


Drug Abuse Mortality Risk

According to CDC wonder, between 1999 and 2023, the number of overdose deaths caused by prescription opioid drugs continued to rise. In 2023, although the number slightly decreased to 13,026, the fatal risk still remained at an extremely high level.

Severity

Trends in drug overdose deaths by location and drug type. The chart shows the number of drug overdose deaths per million population in the United States from 2016 to 2021, a period that includes several years before and after the COVID-19 pandemic.



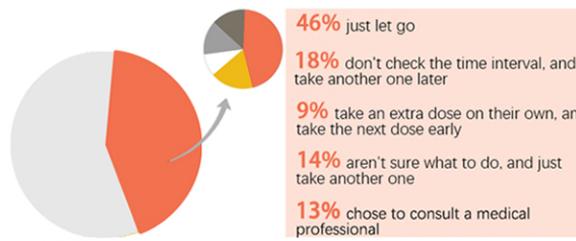
Data extracted from N Engl J Med |
Fentanyl-associated overdose deaths outside the hospital [New England Journal of Medicine]. Accessed July 24, 2025. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC304991/>.

Current prescription drug bottles

These figures are not cold statistics, but represent real-life crises that have occurred countless times. We have also seen that traditional medicine bottle designs have remained unchanged for decades and lack the ability to meet modern complex medication needs.

02 Questionnaire

ACTIONS AFTER FORGETTING TO TAKE MEDICATION



43% of all people taking medication forgot to take their medication

57% of all people taking medication do not forget to take their medication

USER CATEGORIES

Based on the survey it is also concluded that many factors influences actions of different people taking medicines, the most vulnerable groups are:



Elderly People
By Age Group



Chronic Illnesses
By Patients



Opioid Medication Takers
By Prescription

03 Persona

Zhong Li

Age: 71
Occupation: Architect
Pain Point: Long work hours and frequent site visits make him forget or delay taking medication.

Shi

Age: 65
Occupation: Retired Engineer
Pain Point: Struggles with remembering multiple medications for chronic conditions

Ms.Li

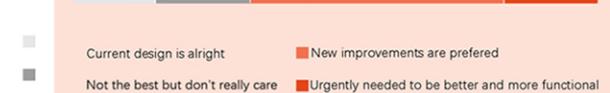
Age: 54
Occupation: Office Manager
Pain Point: Needs to track both her own and her parents' medications, which can get confusing.

Xue er

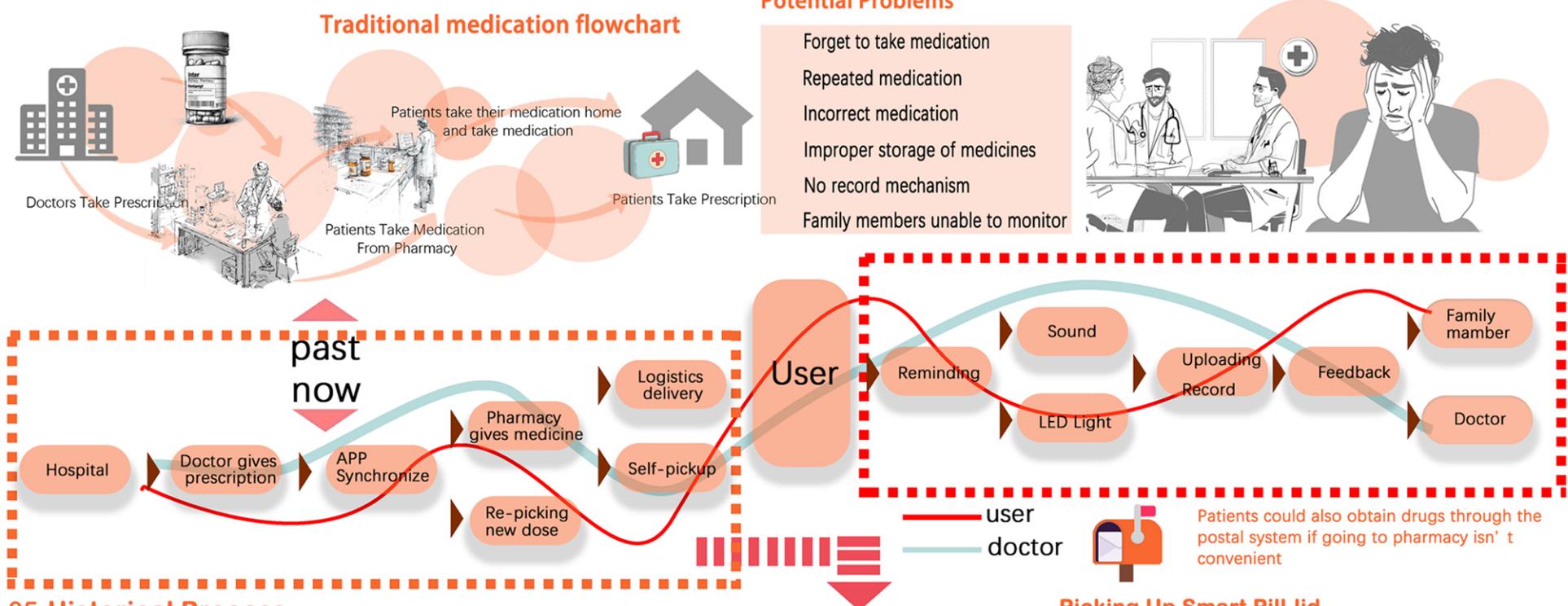
Age: 43
Occupation: Freelance Photographer
Pain Point: Unstable travel routine causes missed doses and irregular adherence.

CONCLUSION

From our survey one thing became clear: people are not satisfied with the current design of prescription medication bottles.



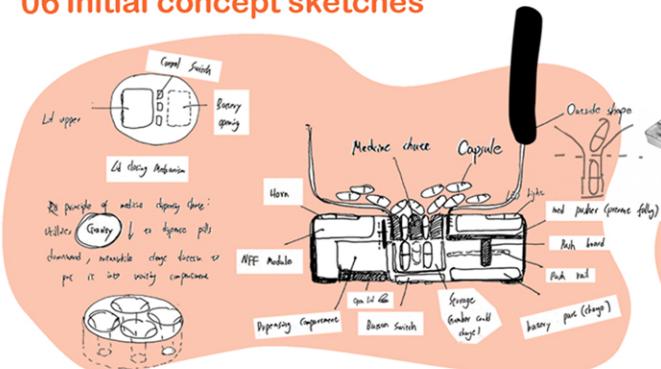
04 Methodology



05 Historical Process



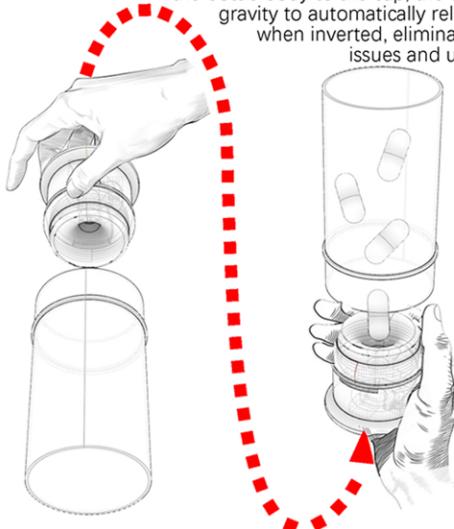
06 Initial concept sketches



07 Three Big Breakthroughs in Design

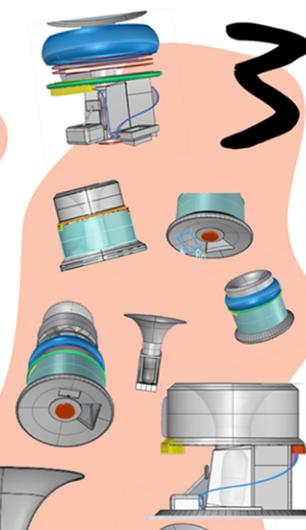
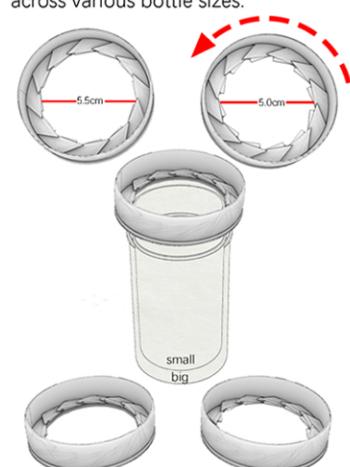
1.Gravity-Triggered Inverted Structure

The process of drugs falling automatically with the aid of **gravity**, without the need for additional external force. Shifting focus from the bottle body to the cap, the design utilizes gravity to automatically release capsules when inverted, eliminating jamming issues and unlocking new possibilities.



2. Self-Adjusting Iris Diaphragm

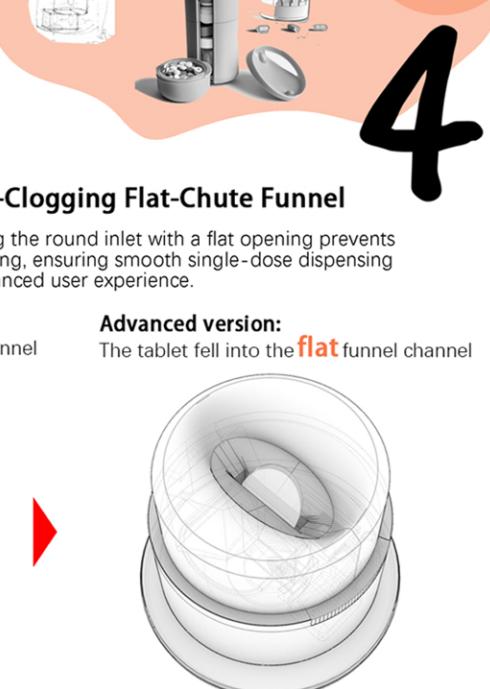
Moving away from bulky traditional adapters, it adopts a camera-inspired iris mechanism for a sleek, universal fit across various bottle sizes.



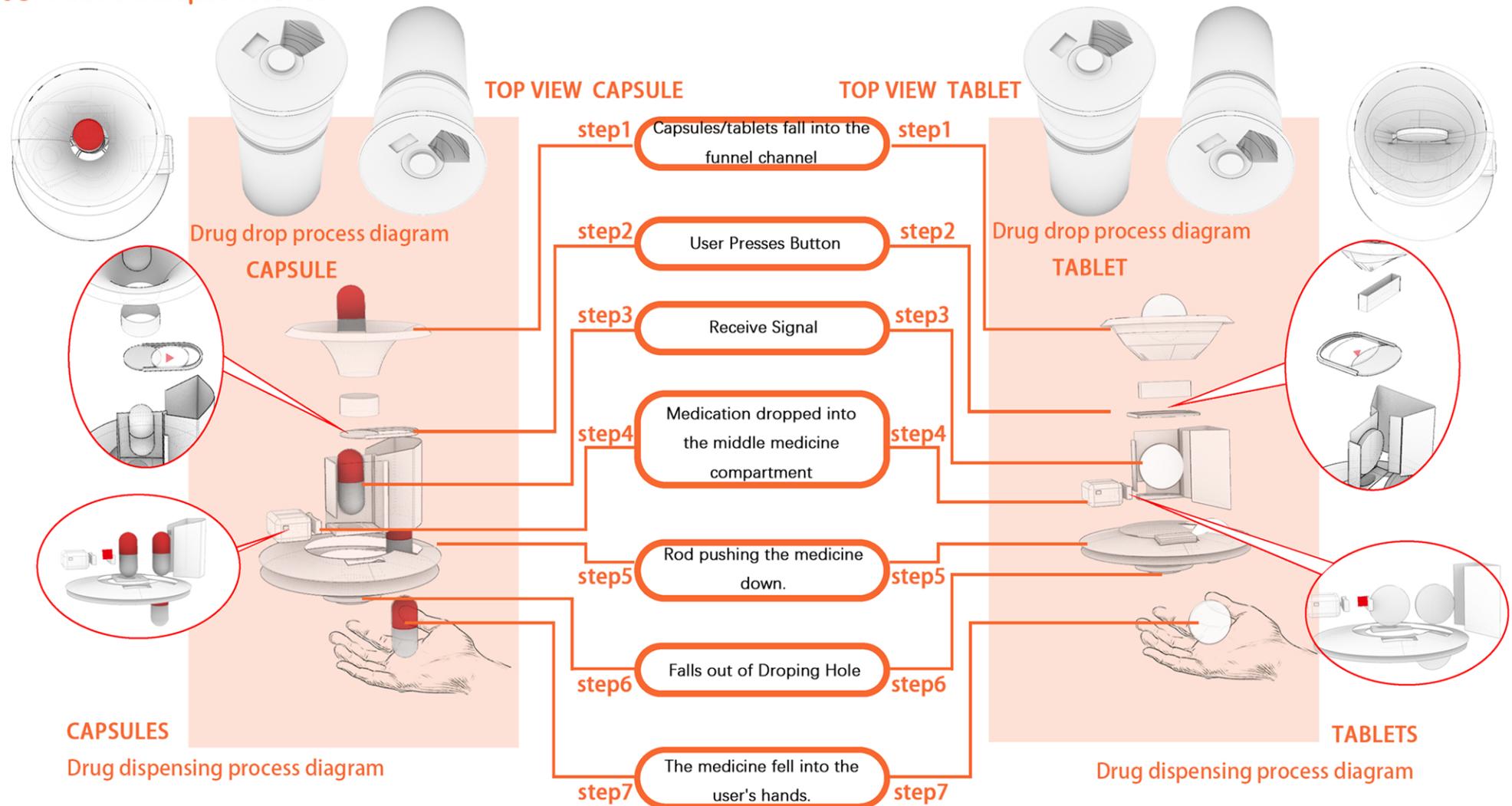
3. Anti-Clogging Flat-Chute Funnel

Replacing the round inlet with a flat opening prevents pill stacking, ensuring smooth single-dose dispensing and enhanced user experience.

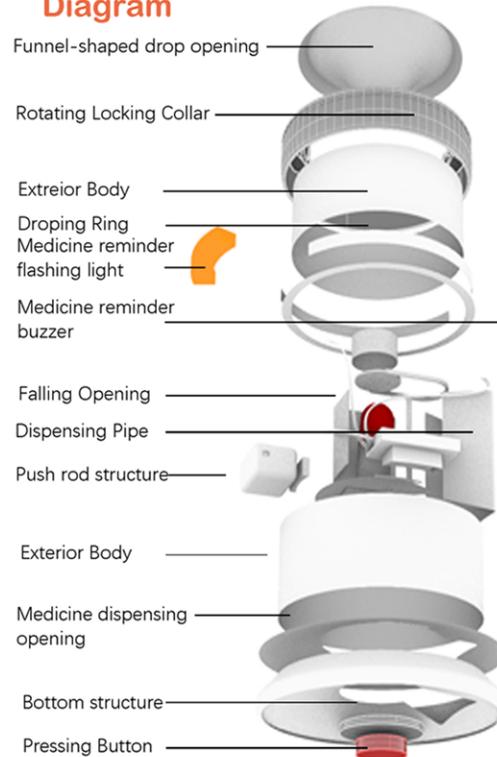
Advanced version:
The tablet fell into the flat funnel channel



08 Initial concept sketches



09 Structural Decomposition Diagram



10 Appearance of the medicine bottle cap



At night, there may be patients who need more than one medicine bottle. Different flashing colors and sounds have been considered.



11 Photos of the experiment process



Test Conclusions

After ten rounds of testing, Capsule No. 2 was found to have the highest drug coverage rate and was selected as the best option.

Tablet No. 1 was found to have the highest drug coverage rate and was selected as the best option.

Sample Pass Rate

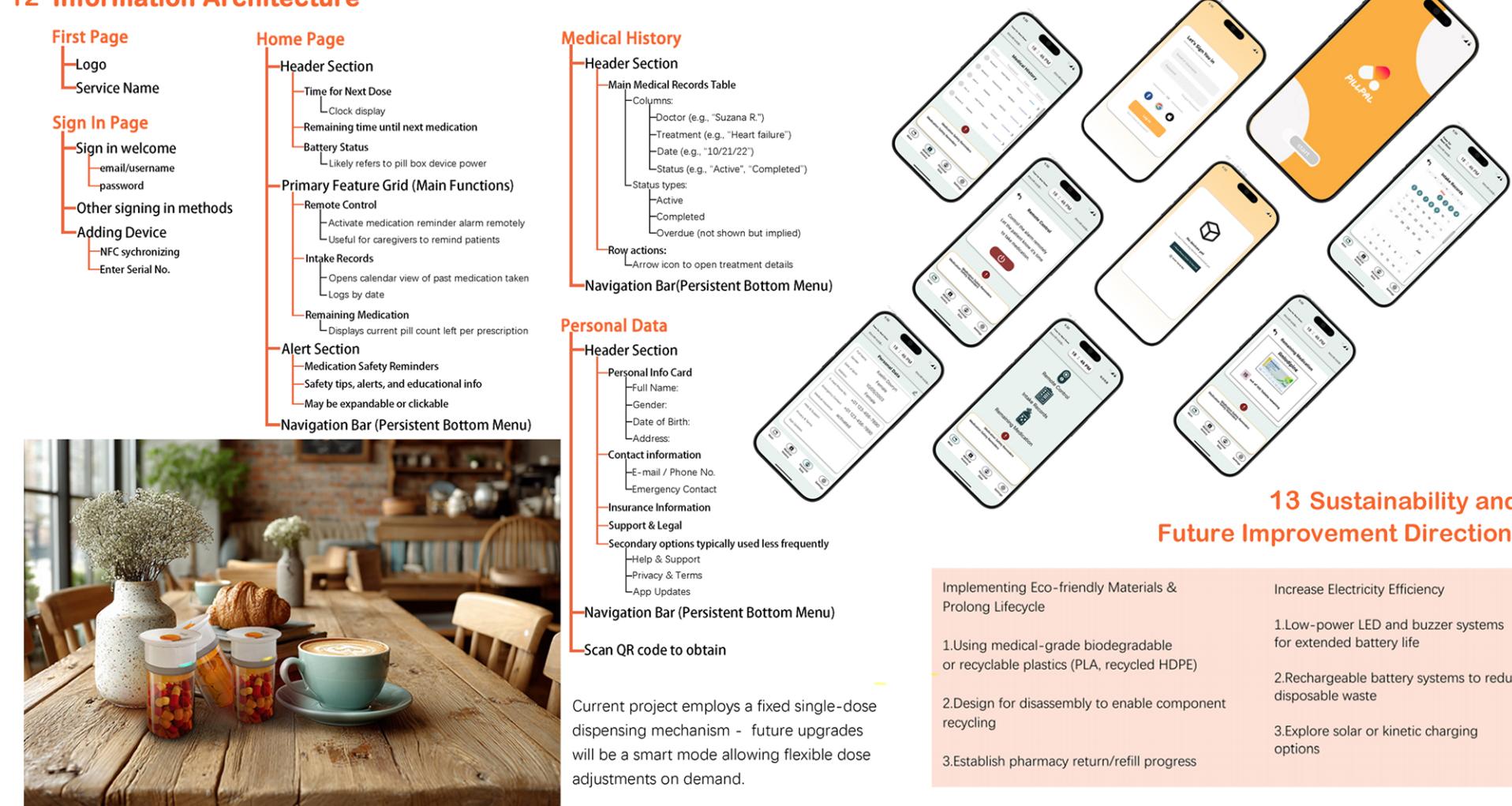
Capsule	1	2	3	4	5	6	7	8	9	10	total
1	4/10	7/10	8/10	9/10	10/10	3/10	8/10	10/10	5/10	8/10	72/100
2	10/10	10/10	10/10	10/10	10/10	10/10	9/10	9/10	10/10	9/10	97/100
3	6/10	6/10	8/10	9/10	7/10	5/10	0/10	7/10	3/10	8/10	59/100
4	5/10	5/10	3/10	0/10	2/10	7/10	9/10	5/10	6/10	6/10	48/100

Take ten pills at a time and drop them all at once, at a height of 5-x centimeters.
the best Passed number/total number of tests

Pill Tablet	1	2	3	4	5	6	7	8	9	10	total
1	10/10	10/10	9/10	9/10	10/10	10/10	10/10	10/10	9/10	10/10	98/100
2	8/10	7/10	8/10	9/10	10/10	7/10	8/10	9/10	8/10	10/10	84/100
3	6/10	7/10	8/10	9/10	7/10	6/10	5/10	7/10	4/10	8/10	67/100
4	5/10	5/10	2/10	3/10	5/10	7/10	9/10	8/10	4/10	5/10	53/100

Take ten pills at a time and drop them all at once, at a height of 5-x centimeters.
the best Passed number/total number of tests

12 Information Architecture



13 Sustainability and Future Improvement Directions

- | | |
|---|--|
| Implementing Eco-friendly Materials & Prolong Lifecycle | Increase Electricity Efficiency |
| 1.Using medical-grade biodegradable or recyclable plastics (PLA, recycled HDPE) | 1.Low-power LED and buzzer systems for extended battery life |
| 2.Design for disassembly to enable component recycling | 2.Rechargeable battery systems to reduce disposable waste |
| 3.Establish pharmacy return/refill progress | 3.Explore solar or kinetic charging options |

02 Sky-Harvest

Overview

A fruit and vegetable rooftop cultivation and drone delivery system that aims to shorten the distance from "farm to table".

Theme

Urban Space Reuse
Agricultural Planting
Drone Delivery



Related Projects

amazonfresh
Model: Unmanned fresh food vending station
Reasons for failure
Rent costs account for 45% of revenue
Freshness complaint rate of 32%
Theft and damage

Farmigo
Model: Community bulk ordering + designated delivery point
Reasons for failure
Minimum order quantity requirements led to the loss of users
Last-mile delivery costs even more

BRIGHT FARMS
Model: Large commercial building with two floors Roof farm
Reasons for failure
The price was still 25% higher than expected

creates bottlenecks and limits flexibility in supply, making the system slow to respond to changing demand.

No personalized planting or product selection mechanisms

leaving consumers unable to influence crop types, harvesting timing, or product variety according to their preferences and needs.

01 Background

Urban residents face delays and inefficiencies in the fresh food supply chain, with long transport times leading to a decline in the freshness and flavor of fresh produce. Currently, there are several major pain points for urban consumption:

Low transport efficiency & prolonged delivery cycles

lead to reduced freshness, compromised flavor, and diminished nutrient content by the time produce reaches consumers.

High vulnerability Urban Supply Chain

such as extreme weather events, transport strikes, or policy changes, which can quickly impact availability and pricing.

Dietary inequalities

in urban areas, where lower-income neighborhoods are dominated by unhealthy options like fast food and ultra-processed snacks, crowding out access to fresh produce.

Over-reliance on centralized retail channels

creates bottlenecks and limits flexibility in supply, making the system slow to respond to changing demand.

02 Questionnaire



Omaid Mustafa
Personal Info
Male
28 Years Old
Local New Yorker / UX designer
Knows almost everything about NYC
Enjoy Watching Movies / Eat Brunch

Pain Points
Buying groceries in the city is not easy. I often have to commute to go to Brooklyn to get to one of the stores which is most cost-worthy. I think how to keep and know the freshness of things I am purchasing is essential.

Common Services
TRADER JOE'S
CHIPOTLE MEXICAN GRILL



Gabbi Xue
Personal Info
Female
29 Years Old
RTO employee in NYC
living in nyc for few months already
Enjoy Eating Salad, Vegetables

Pain Points
As a temporary resident, there are too many choices for supermarkets in the city, but I often find it hard to buy and cook fresh various fruits or veggies to make my own personal diet meal.

Common Services
Weee!
WHOLE FOODS MARKET



Lara Bennett
Personal Info
Female
43 Years Old
Landscape Designer
Live in NJ, work on the Island
Have a unique taste in Bonsai

Pain Points
I love to travel a lot and enjoy trying out new things. For instance, I really like the Yubari Melon while I was traveling in Hokkaido, Japan. But it's impossible or too rare to find them in US. It would be awesome to have them here.

Common Services
H MART
COSTCO WHOLESALE



Jing Bin
Personal Info
Male
52 Years Old
Senior designer in China
Traveling in nyc for 2 weeks
Like to try different fruit tarts

Pain Points
I think the best way to know a place is trying out their local foods, but if I want to cook or get something I eat back home, it is always hard to find fresh materials.

Common Services
SHAKE SHACK
Walmart

03 Research

Manhattan As Test Ground

Manhattan's extreme density ($\approx 70,000$ people/sq mi) creates concentrated demand for fresh food, making it a prime location to pilot scalable solutions like rooftop farms or drone delivery that could maximize limited space and serve large populations efficiently.

Age Distribution



Manhattan is the ideal test ground for VertiFresh due to its high population density, diverse cultural preferences, fast-paced lifestyle.

Summary

Manhattan faces many challenges in accessing fresh from the earth products due to



long-distance supply chains



limited availability of user customized options



inconvenience of traditional retail

04 Solution Development

Problem Statement

Manhattan residents face challenges due to long-distance supply chains, limited access to fresh and diverse produce, time constraints for in-person shopping, and rapid loss of freshness during transportation, impacting community health, dietary quality, and environmental sustainability.

DEFINE

- Last-mile delivery for perishables is inefficient.
- Demand for fresher, tastier options is rising.
- Urban diets lean unhealthy due to poor access.
- Overreliance on manual labor slows delivery.
- Freshness declines rapidly in current systems.

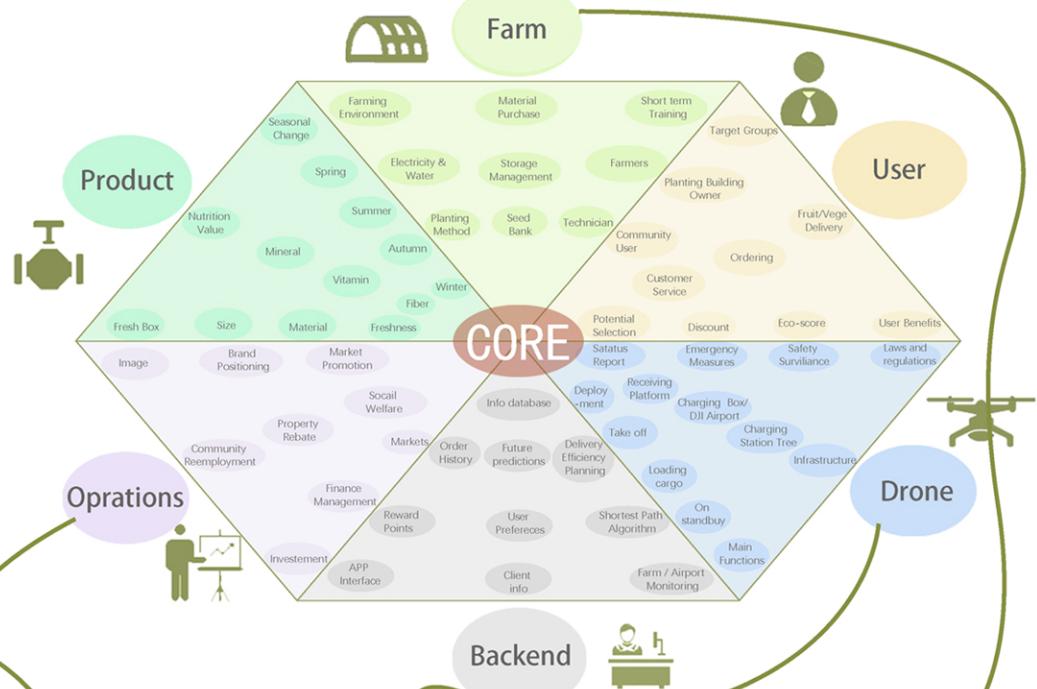
IDEATE

- Rooftop farms ensure freshness
- Drone delivery with smart routing
- Vertical charging towers for quick deployment
- Airspace "green corridors" for food routes
- Cuts transport steps, lowering carbon emissions.

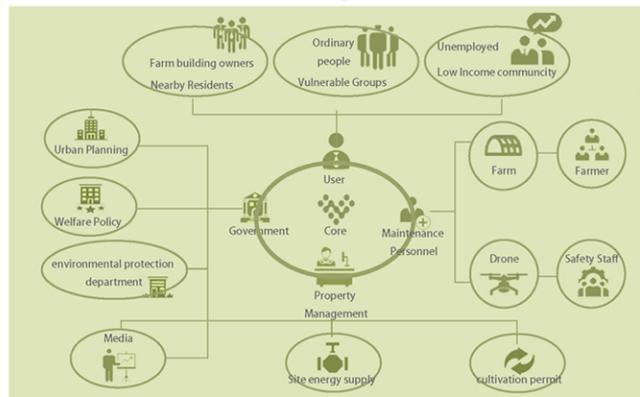


For high-rise window height restrictions, the delivery can be resolved by installing additional self-service parcel lockers on the ground

06 System Architecture



05 Stakeholders Map



07 Business Model Canvas

Key Partnerships

- Building/estate owners with rooftop access
- Drone operators & logistics agencies
- Local government for airspace & safety regulations
- Urban agriculture suppliers

Key Activities

- Rooftop farm setup & maintenance
- Drone delivery & route optimization
- Customer order management
- Crop planning & monitoring

Key Resources

- Rooftop spaces & equipment
- Drone fleet & charging stations
- Farm management software & AI tools
- Skilled technicians & operators

Cost Structure

- Farm installation & upkeep
- Drone purchase & maintenance
- Technology infrastructure
- Labor & training

08 Farm & Agriculture

Feasibility Analysis of Roof Gardening

High-rise buildings
Middle-level buildings
Low-rise buildings



Low-rise buildings
(1–5 stories)

Middle-level buildings
(6–20 floors)

High-rise buildings
(20 floors or more)

sunlight Relatively insufficient sunlight

Adequate sunlight

Adequate sunlight

wind Low wind speed

Moderate wind

Strong winds

temperature Stable temperature

Small temperature fluctuations

Large temperature differences

Facility Composition

Greenhouse

Greenhouse structures are primarily composed of a steel pipe frame, steel supports, covering materials, and polycarbonate panels.



Drone

Multi-Layer Drone Deployment Tower

A drone automatic deployment and charging tower composed of multiple DJI Dock modules stacked vertically.

Management and Dispatch Facilities

The dome-shaped building serves as the central management and dispatch facility for the entire system.



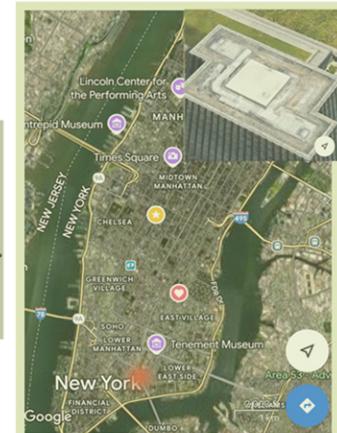
09 Facility Coverage Planner

Data Source

Geojson.io Satellite Map
Extracted high resolution satellite images to capture the whole potential farm deployment area, and export it into Geojson file



Potential Available Sites



Employment Linkage

The staff of farms advocate linking unemployed residents to subsidized rooftop gardening and drone safety monitoring roles, where community service hours earn points redeemable for fresh-produce—creating a sustainable cycle of workfare, and mutual aid.

Implementation Support

Eco-Points: For Staff

Earn points through planting and related activities, redeemable for discounts, while tracking cost and eco-impact compared to traditional methods.



Eco-Points: For Users

Earn points by returning boxes or recycling promoting community participation and showing clear environmental and cost benefits.

Final Outcome

It takes 19 farms to cover the whole area of Manhattan considering drone delivery radius as 1km



11 Drone Delivery System



DJI Matrice 3D

Autonomous GPS-guided drone with obstacle avoidance and a custom mount for secure fresh box delivery.



DJI Airport 3

Fast-charge docking station (20min) with weather monitoring and data sync.



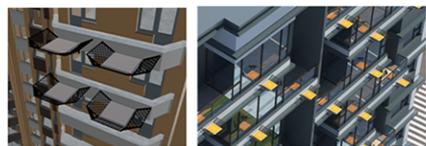
Rotating Charging Station

Wireless, dual-mode charging base for multiple drones, 40% more efficient.



Receiving Platform

Simple steel structure at windows/balconies for verified, secure drop-offs.



Safety Measures

Comply with Manhattan drone laws-height limits no-fly zones, and privacy rules.

Use DJI 03 live feed for real-time monitoring.

Sensor dashboard tracks battery, motor, and GPS status.

A dedicated safety monitor oversees system status at all times.

Apply geofencing to block restricted areas.

Enable one-click emergency takeover for instant control.



12 Methodology

A* Shortest Delivery Route

Data Source

Input

A predefined 10×10 grid map that simulates a drone navigation area → Free space (drone can fly over it) → Obstacle (e.g., rooftop/building, drone must avoid) in python

```
grid = [
    [0, 0, 0, 0, 0, 0, 0, 1, 0, 0],
    [0, 1, 1, 0, 1, 0, 0, 1, 0, 0],
    [0, 1, 0, 0, 1, 0, 0, 1, 0, 0],
    [0, 1, 0, 1, 1, 0, 0, 0, 0, 0],
    [0, 1, 0, 0, 0, 0, 1, 1, 1, 0],
    [0, 1, 0, 1, 1, 0, 0, 0, 1, 0],
    [0, 0, 0, 1, 0, 0, 1, 0, 0, 0],
    [1, 1, 0, 0, 0, 1, 1, 0, 1, 0],
    [0, 0, 0, 1, 0, 0, 0, 0, 1, 0],
    [0, 1, 0, 1, 0, 1, 1, 0, 0, 0]]
```

Elements Setup

heapq → Manages the open set (priority queue) efficiently.

math → Provides Euclidean distance as the heuristic.

matplotlib, numpy → Used for visualizing the final path.

python

```
import heapq
import math
import matplotlib.pyplot as plt
import numpy as np
```



Eco-friendly fruit box



Logo

The core is to find the shortest route from a start point to a goal on a grid.

It combines the actual distance traveled (g) with an estimated distance to the goal (h) using Euclidean distance. It checks eight directions (including diagonals) and avoids visited or blocked cells. The path with the lowest total cost ($f = g + h$) is expanded first, continuing until the goal is reached or no path is found.



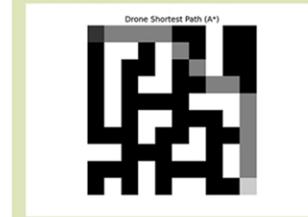
First Visualization

- Starting point: Grayish white

- End point: Dark gray

- Path: Medium gray

- Buildings: Black (impassable)



s) and avoids visited or blocked cells. The path with the lowest total cost ($f = g + h$) is expanded first, continuing until the goal is reached or no path is found.

```
start = (0, 0) # ⬆️ goal = (9, 9) # ⬇️
```

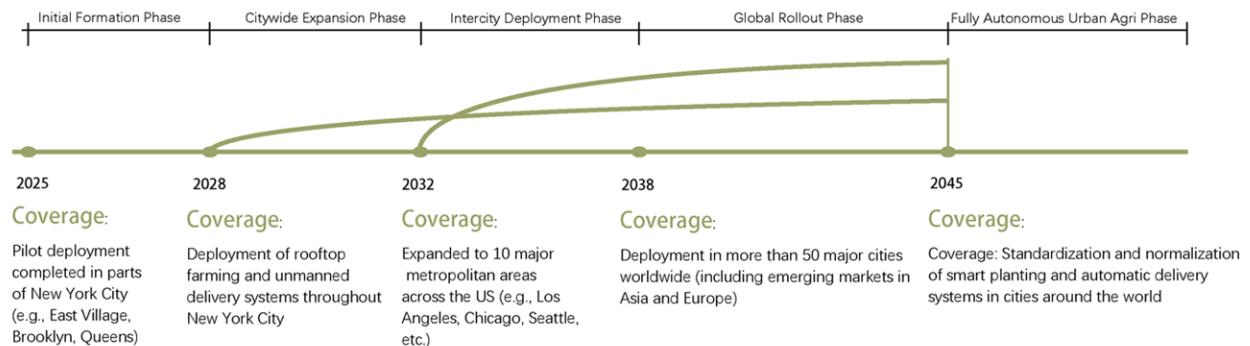


Drone Path (A*) - Styled View

13 APP Interface



14 Future Time Lapse



15 Sustainability and Future Improvement

Infrastructure & Technology	Operations & Coordination
~ Charging Station Upgrades	~ Drone Delivery and Charging System
~ Photovoltaic power supply integration	~ Policy and Airspace Coordination
~ Technology Iteration and Range Optimization	
~ Extreme Weather Adaptability	
Environmental & Resource Management	
~ Rooftop agriculture and energy recycling	
~ Improve resource recycling	
~ Soil and planting system optimization	

03 BioColor Tag

FRESH INDICATOR

Overview

Freshness indicator label based on natural colorings

Theme

Nature-Driven Sensing
Food Safety & Sustainability
Design for Visual Interaction

 Supermarkets and fresh food retailers lack intuitive freshness display tools in shelf management.

 A UK WRAP report indicates that approximately 50% of household food waste stems from misjudging freshness, particularly for meat and dairy products.



Management Burden

For families, managing perishable foods is a burden: it requires constantly monitoring food conditions and accurately determining their edibility and shelf life, a process that often causes psychological stress and operational inconvenience.



3 Summary

Existing "time labels" and "expensive electronic monitoring" failed to meet the mass-market demand for low-cost, intuitive freshness detection; consumers struggle to make accurate judgments, and retailers lack visual display tools, resulting in food waste and trust crises coexisting.

1 Background

Scale of Food Waste

According to FAO data, approximately 1.3 billion tons of food are wasted globally each year, with perishable foods accounting for the highest proportion.

Economic Losses

Food waste results in global economic losses of approximately \$940 billion per year.

Cold Chain Failure

Approximately over 25% of perishable foods spoil due to improper temperature control in the coldchain.

Consumer Misjudgment

According to an NRDC survey, 91% of consumers misunderstand "best before" dates and discard food that is still edible.

2 Pain Point Interviews



Jenny Wu

Hotel Manager

Needs a reliable way to ensure buffet and stored ingredients stay fresh, since staff often misjudge food quality.



Feng

Independent Artist

Lives alone and forgets what's in the fridge leading to food spoilage or unsafe eating.



Jia Qi

Fund Manager

Buys premium food but discards it too early out of uncertainty, wasting money and nutrition.



Yu dong

Clothing Agent

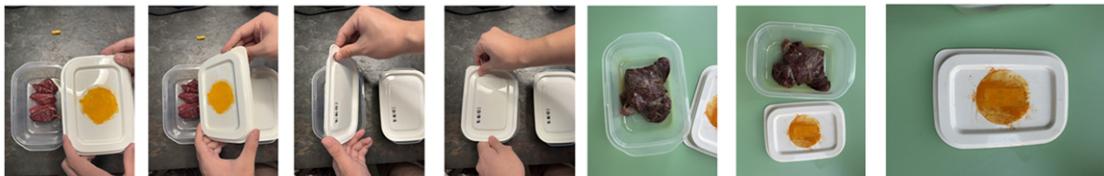
Travels often and returns unsure if stored meat or dairy is still safe to eat.

4 Color Reaction Experiment

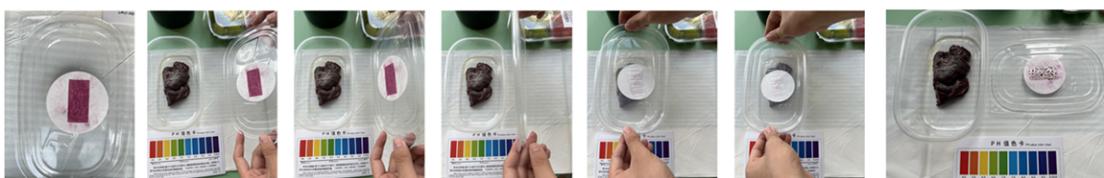
First, the study tested anthocyanin and curcumin under the form of dry powder-observing their color changes based on pH response.



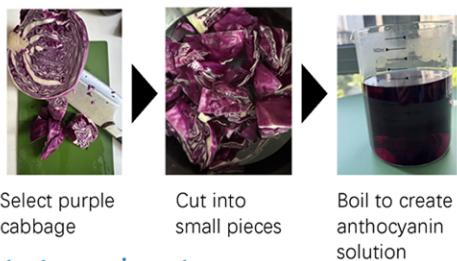
Curcumin powder color change



Anthocyanin powder color change



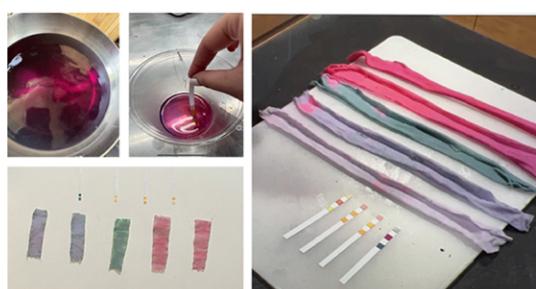
Anthocyanin Liquid Extraction Process



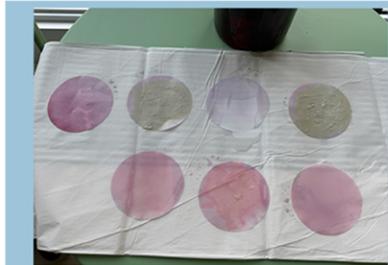
5 Material Adhesion Experiment

In adhesion experiments on paper and fabric substrates, anthocyanins demonstrated excellent coloring performance.

However, when considering the feasibility of subsequent industrial applications, **paper-based materials** showed more significant advantages.



PH test experiment



Acid



White vinegar
lemon water
hair conditioner

Alkali



Shampoo
laundry detergent
baking soda

Conclusion - 1

Experiment turned out as expected, dry powders are chemically stable, color changes are extremely slow and nearly invisible, thus not applicable.

Conclusion - 2

Anthocyanin extract mixed with three acids and three alkalis showed significant color changes within five minutes.

Results from mixing hydrogen sulfide, ammonia, and other gases with volatile compounds. This process also warns us that meat is already rich in microorganisms, and the gas mixture produced by rotting meat contains high concentrations of ammonia.

6 Meat As Reaction Testing Subject

Step1

Extract anthocyanin aqueous solution



Step2

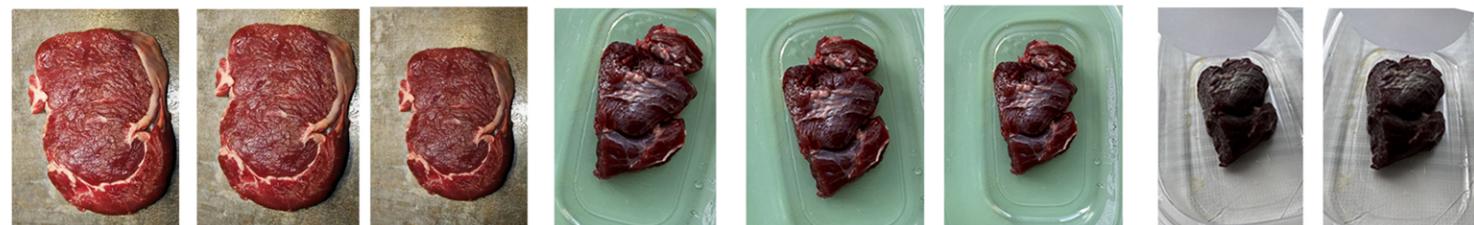
Start experiment, corresponding to Figure 3, put the test paper on the meat.



Step3

Corresponding to Figure 5, the test paper has undergone a color change reaction.

Meat Decomposition Process



Fresh meat 1 hour 3 hours 6 hours 9 hours 12 hours 18 hours 24 hours



Observation

Anthocyanins, as water soluble natural pigments, exhibit relatively stable chemical properties in powder form but demonstrate high reactivity in aqueous solutions. Therefore, to utilize anthocyanins for detecting decaying gases, they must be maintained in a moist or solution state.

Conclusion

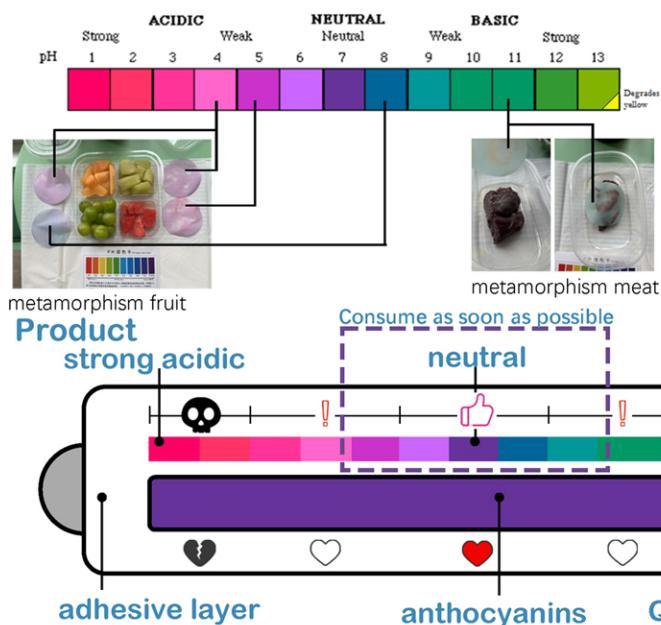
At room temperature, the freshness quality deterioration of beef during the post-mortem phase is indicated by monitoring changes in anthocyanin color.

7 Product Design Process

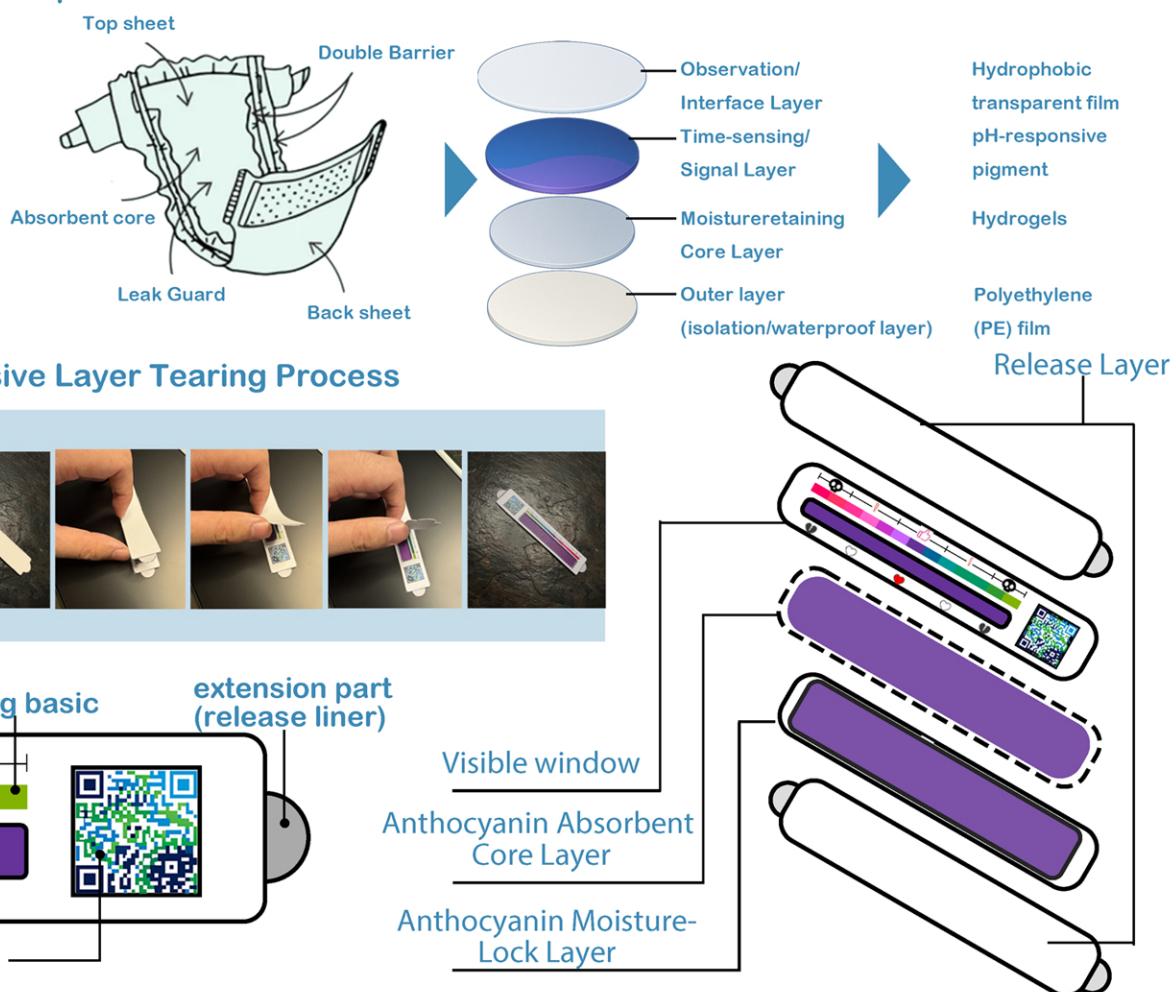
Conclusions and future research directions
The experimental results indicate that when using anthocyanins to detect spoilage gases maintaining them in a moist or solution state is a necessary prerequisite.

Therefore, how to effectively maintain the appropriate humidity environment (moisture retention) of anthocyanin sensor units/materials has become a key technical issue that needs to be addressed to realize their practical application.

Freshness Indicator



8 Inspiration



9 Interface



10 Scenarios



Consume
as soon as
possible



Through interdisciplinary design and systematic verification, this product will provide new insights for smart packaging and biosensing fields, demonstrates the application potential of natural molecules in green sustainable technologies, and promotes their transition from laboratory to practical application.



Innovative



Eco-Friendly



Practical
Application



04 Scan—Verse

Overview

Aiming at a new generation of content recording methods , it generates realistic 3D images and restores memories in 360 degrees.

Theme

3D Scanning
Object Digital Preservation
Gesture Interaction



Background

User Behavior Trends

The Rise of Digital Collecting



According to a Statista survey (2023), over 67% of Gen Z and Millennial users have tried recording important items or memories in digital form (photos, videos, memos, etc.).However, only 13% of users have tried 3D scanning technology, mainly due to high tool barriers and a lack of clear application scenarios.

Growing demand for personalized digital spaces



Adobe (2022) reported that over 72% of users hope to personalize their digital spaces in the future (e.g., customized avatars, virtual rooms, and collection walls);Especially in the fields of metaverse, virtual identities, and immersive memory preservation, demand for "self-curation" and "interactive memory" is rapidly increasing.

Preference for AR/VR Interaction



According to data from the XR Association (2023), 57% of AR users believe that "interacting with objects" is more immersive than "viewing information displays."Gesture-based interaction is considered one of the most natural input methods, particularly suited for "personalized emotional experiences."



Lily

I don 't just want to look at memories — I want to interact with my 3D objects like they' re still part of my world.



Yu

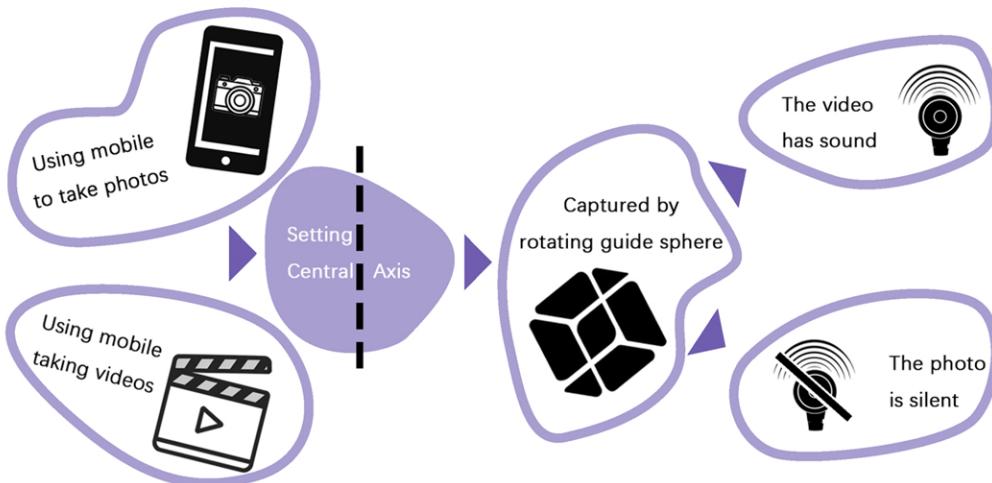
When I gesture at my scanned models and they respond — it' s like bringing my childhood inventions back to life.

Conclusion

Creating a platform that can bothstore personalitems and enable interaction and curation with them in AR has become highly necessary. Therefore, ScanVerse was introduced to address this need: it not only solves the problem of "how to preserve," but also addresses the deeper need of how to make memories tangible and interactive.



Photography and scanning process



Scan Process

Step 1: Finding valuable object



Step 2: Capturing the object



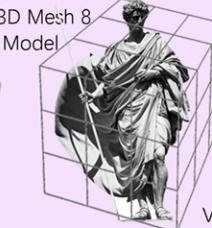
Step 3: Generate Model into App



Step 4: View scanned items in the album



Go into Scanning Page to Begin Scanning

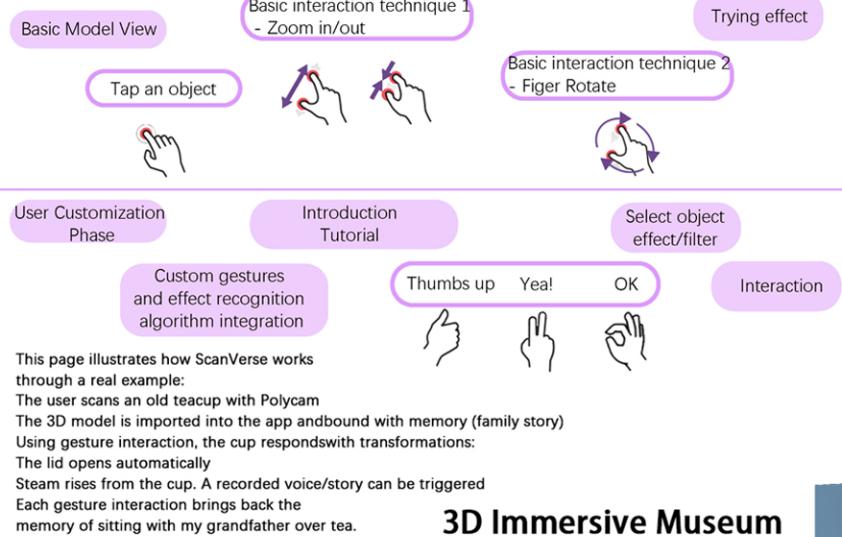


View scanned items in the album

Customize Gesture Interaction



Interaction Flow



Gesture training via Teachable Machine

The screenshot shows the Teachable Machine interface with three main sections:

- Default**: Shows 27 image samples from a webcam.
- Gesture 1**: Shows 38 image samples from a webcam.
- Gesture 2**: Shows 50 image samples from a webcam.

Input switch is set to **ON Webcam**. **Preview** and **Export Model** buttons are at the top right.

```

<div><Teachable Machine Image Model - p5.js and ml5.js></div>
<script src="https://cdn.jsdelivr.net/npm/ml5js@latest/lib/addons/m5.js"></script>
<script src="https://cdn.jsdelivr.net/npm/ml5js@latest/lib/addons/m5.js"></script>
<script type="text/javascript">
  var m5 = ml5.imageClassifier('models/bike');
  let imageModelURL = '/my_model/';
  // Video
  let video;
  let flipVideo();
  // To store the classification
  let label = '';
  </script>
  <script>
    flipVideo = alt.flipImage(video);
    startClassifying();
  </script>
  <function draw() {
    background(255);
    image(flipVideo(), 0, 0);
    // Draw the lines
    fill(255, 100);
    stroke(255, 0, 0);
    textLabel(width / 2, height - 40);
  }
  </function>

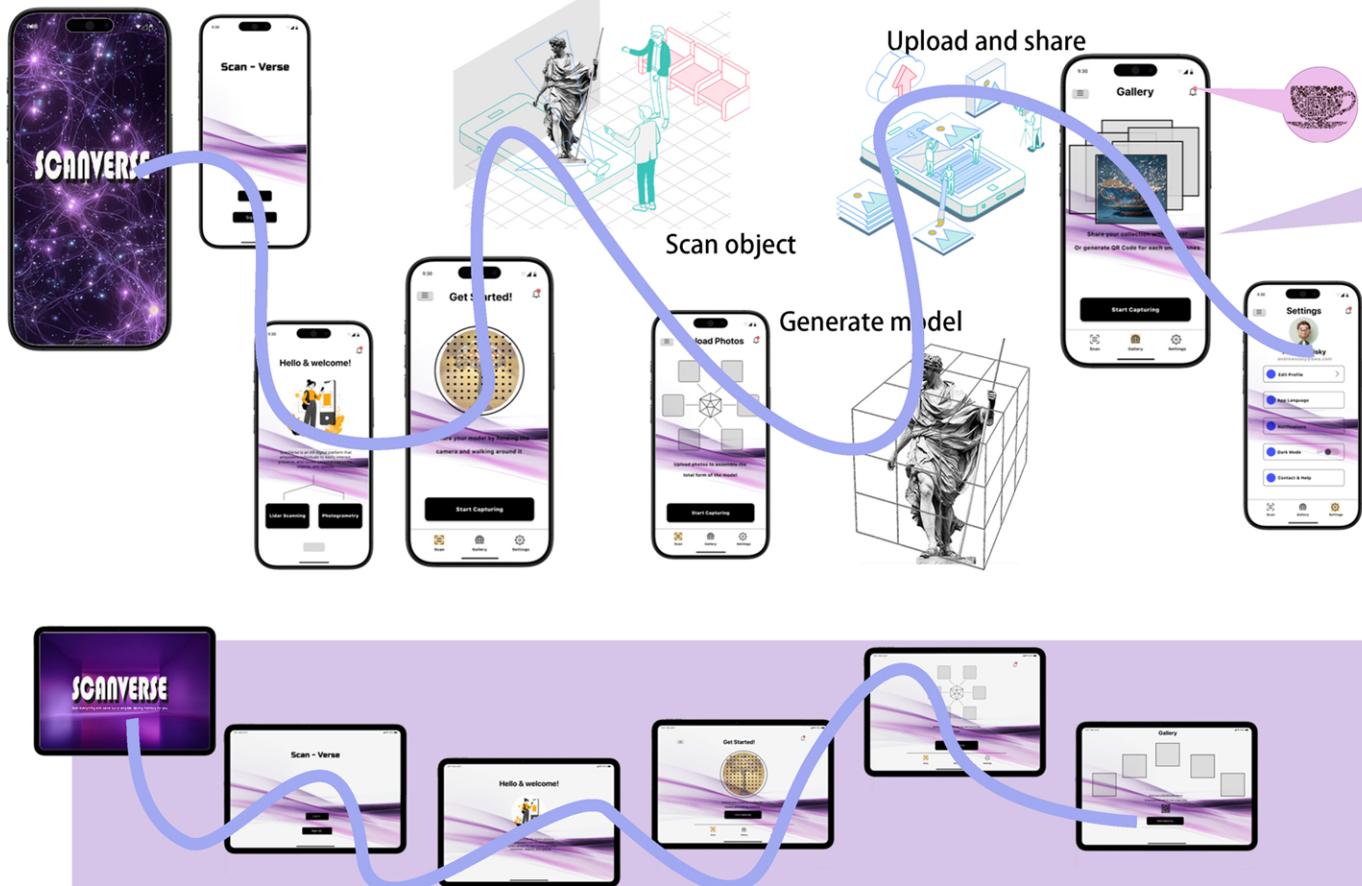
```



3D Immersive Museum



Device Interface Display



QR Code Generation & Sharing Flow



An interactive AR digital memory platform to allow users to collect, share, and interact personal memories and items in an immersive way.