

Design Work Portfolio

Fusing culture and technology to create tangible, gamified, and human-centric innovations.

2023-2025

Mingze Zhao

Catalogue





PALACE ECHO

Family Tour Kid's Experience Enhancement System

***Interactive** ***Parent-Child Tour** ***Story-Learning Method**

Interactive Stories of Forbidden City Cultural Relics" engages families through handheld devices and guidebooks, turning visits into playful, story-driven explorations with rewards. It fosters parent-child interaction, cultural interest, and ongoing discovery.

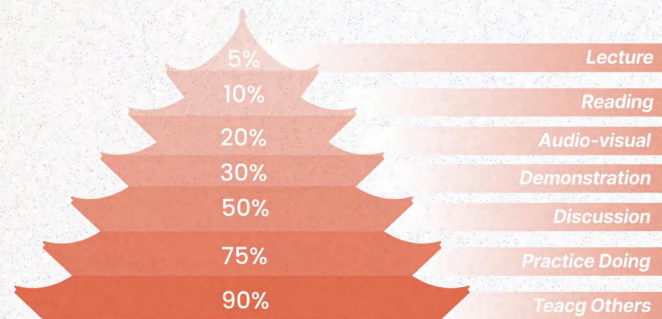
● 2025/7-2025/9 ● Personal Project

RESEARCH-COGNITIVE CHARACTERISTIC OF CHILDREN

What Make They Interested:

- Prefers concrete information (objects, models, role-playing) over abstract concepts (geometry, symbols, descriptions)
- Things they were familiar with before
- Strong sensory stimulation

Children Attention Span



What make they remember :

- Multi-sensory learning, learning by doing, activity
- Create by themselves and learn through project-based learning
- Recall in the middle and late stages of memory
- Active Learning

4yrs	8-20 minutes
5yrs	10-25 minutes
6yrs	12-30 minutes
7yrs	14-35 minutes
8yrs	16-40 minutes
9yrs	18-45 minutes
10yrs	20-50 minutes
11yrs	22-55 minutes
12yrs	24-60 minutes

Children Attention Span

3-4 Year-Old	5-6 Year-Old	7-9 Year-Old	10 - Year-Old
Cognitive Stage	Curiosity Stage	Interest Stage	Knowledge-Seeking Stage
Short trips, mainly for sightseeing	Zoos, botanical gardens, parks, etc.	Out-of-province/ overseas travel	Historical places, museums, etc.
Natural scenery, educational and entertaining activities	Handmade DIY, parent-child interaction	Museum science and other educational tourism	Technology experience/ outdoor expansion parent-child activities

- Children aged 8-10 prefer activities such as science, nature, **technology experience, outdoor activities, and educational playing activities** during their visit.

Theory-Museum Affect

Visitors showed high interest for the first 20-30 minutes, but soon became tired, with a gradual "rushing" style of viewing and becoming more and more picky.

- Physical fatigue: walking for a long time
- Continuously viewing similar exhibits leads to aesthetic fatigue; high density of exhibits triggers "competition for attention," making visitors more likely to give up.
- Attentional resources are limited



[illegible]

Time: 14/08/2025

Want children to learn some cultural relics knowledge while having fun.

Not interested in text or audio explanations.

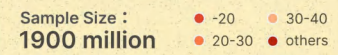
Hard to understand professional introduction signs without relevant historical knowledge.

Become physically tired and dizzy near the end of the tour.

Lack of interaction with children.

Difficult to understand artifacts in depth when seeing them.

The proportion of Forbidden City tourists by age group in 2024



```

graph LR
    A[Sightseeing & Check-In] --> B[Sightseeing]
    B --> C[Natural Exploration]
    D[Outdoor Exploration] --> E[Experience]
    E --> F[Cultural Heritage Experience]
    G[Cultural Immersion] --> H[Learning]
    H --> I[Technological Study]
    B --> F
    E --> I
    C --> H
  
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- Concrete Things (Such As Roof Beasts And Dragon-Patterned Steps) And Multi-Sensory Tasks + Immediate Feedback Can Increase Engagement And Memory.
- "Local Goals" In The Middle Can Prevent The Fatigue Curve From Falling

- Breaking down the long process into small goals and using hardware interaction (a sense of completion every 10-15 minutes) can improve concentration, delay fatigue, increase parent-child interaction and knowledge retention.

- Completion rate ↑
- Dwell time ↑
- Distraction rate ↓
- Parent-child conversation ↑

Goals

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Introvert Extrovert
Thinking Feeling
Judging Prospecting
Assertive Turbulent
Intuitive Observant

" My mother took me to the Forbidden City on the central axis to learn history and culture. "

- Artifacts spark curiosity, but stories feel out of reach.
- Struggle to understand introduction boards.
- Repetition makes me dizzy and tired near the exit.

Goals

- in
her
ng

Introvert Extrovert
Thinking Feeling
Judging Prospecting
Assertive Turbulent
Intuitive Observant

"I want to take my child to visit the Forbidden City to increase his experience. It is also a good family activity."

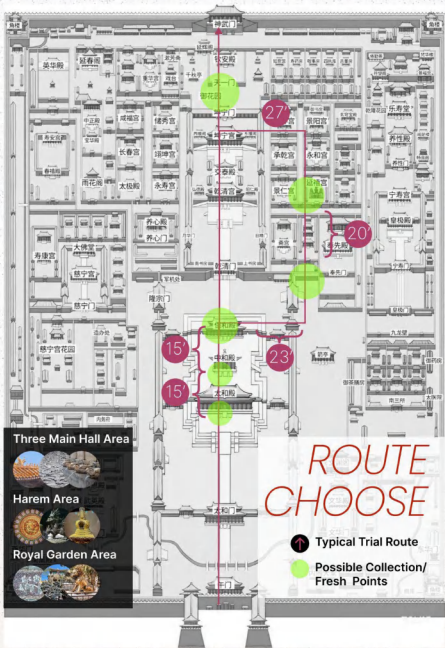
- He listens at times, but often runs off – little interaction
- I sometimes can't understand the introduction signs

```

graph TD
    FE[Future Exploration] --> Offline[Offline]
    FE --> Online[Online]
    Offline --> FP[First Place]
    Online --> IS[Interact with Story]
    FP --> IS
    IS --> TH[Think about History/Background]
    TH --> NFP[Next "Fresh Points"]
    NFP --> RP[Return Place]
    RP --> FE
    IS --> E1[Ending 1 +10]
    IS --> E2[Ending 2 +30]
    IS --> E3[Ending 3 +50]
    FP --> CR[Choose Route]
    CR --> Device[Device]
    Device --> Children[Children]
    Children --> AQ[Ask Question]
    AQ --> Parents[Parents]
    Parents --> Refer[Refer to]
    Refer --> Guidebook[Guidebook]
    Guidebook --> RP
    RP --> Exchange[Exchange Souvenirs based on]
    RP --> Record[Record points/ completion/ route badge on website]
    Exchange --> Stimulate[Stimulate]
    Record --> Stimulate
    Stimulate --> FE

```

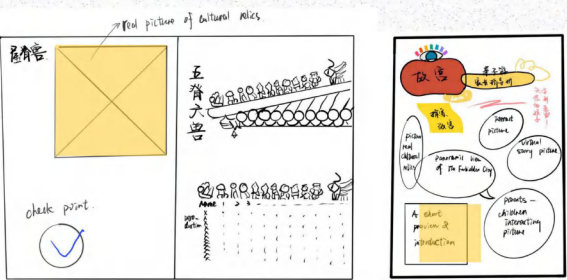
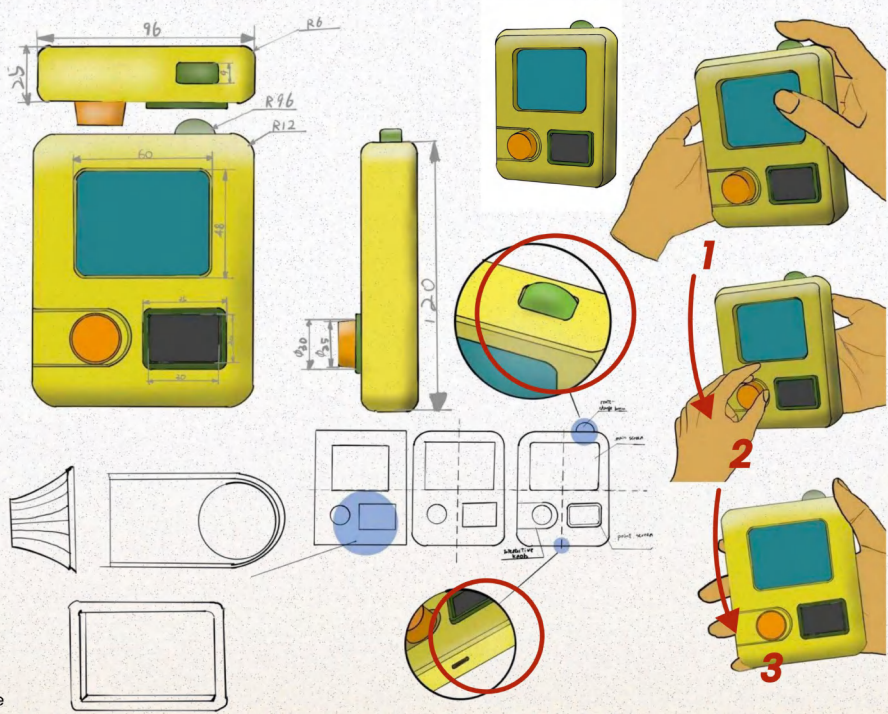
OUTCOME



REASON

According to the characteristics of children's interests, we selected cultural relics in the Forbidden City that have concrete forms and historical background stories for expansion.

SKETCH

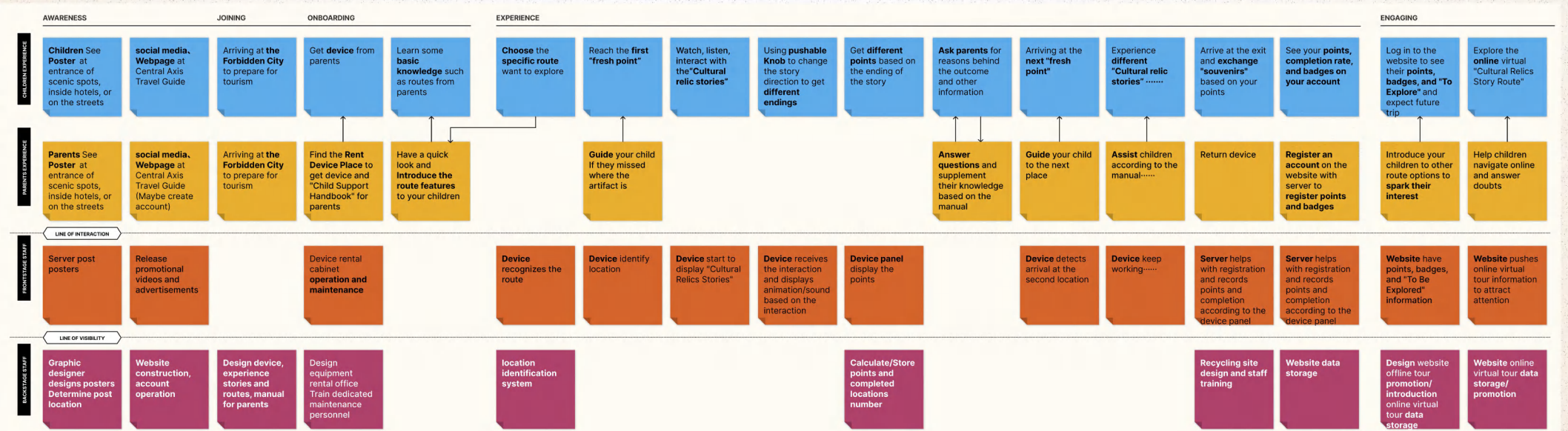


Content Design

FINAL MODEL



SERVICE BLUEPRINT



This service blueprint outlines the "Cultural Relic Experience for Children" journey across five phases: Awareness, Joining, Onboarding, Experience, and Engage. It visualizes how children and parents experience—from seeing posters or social media ads, to getting devices on-site, selecting story routes, and earning points through interactive storytelling.

Using color coding and layered structure, it maps user actions, front-stage and back-stage processes, and supporting systems. The service integrates offline exploration with online follow-up—such as point recording and virtual routes—creating a cohesive, engaging loop that blends cultural learning with family interaction.

STORYBOARD



● ARRIVAL/RENTAL EQUIPMENT



● Arrive At "Interaction Area"



● Interaction/Trigger Story/Get Points

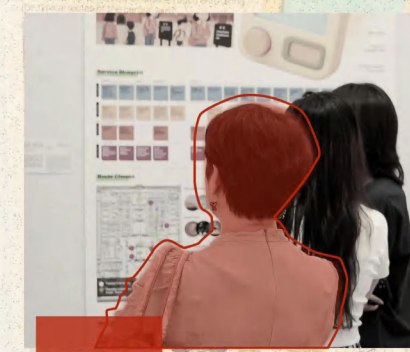


● Parent-Child Interaction/Explanation



● Souvenirs/Website Records/Online Exploration

FEEDBACK



ABOUT DEVICE

"The guidebook quickly improves parents' knowledge of the Forbidden City's relics and creates more chances to interact with their children, allowing them to act as "educators." However, I wonder if its content could be made as engaging as the device's interactive features to enhance both parents' travel and learning experiences."

• Parents Experienter

"This device lets me interact with Forbidden City relics through stories, learning while "listening." It combines education and entertainment in a way I've never experienced in tourism. I hope to hear engaging stories about its architecture, layout, and figures, and I wish the device had a "map guidance" function for freer, more independent exploration—something that would make the experience even better."

• Children Experienter

ABOUT GUIDEBOOK



FEATHERQUEST

Badminton Skill Enhancement Assistance Training Game System

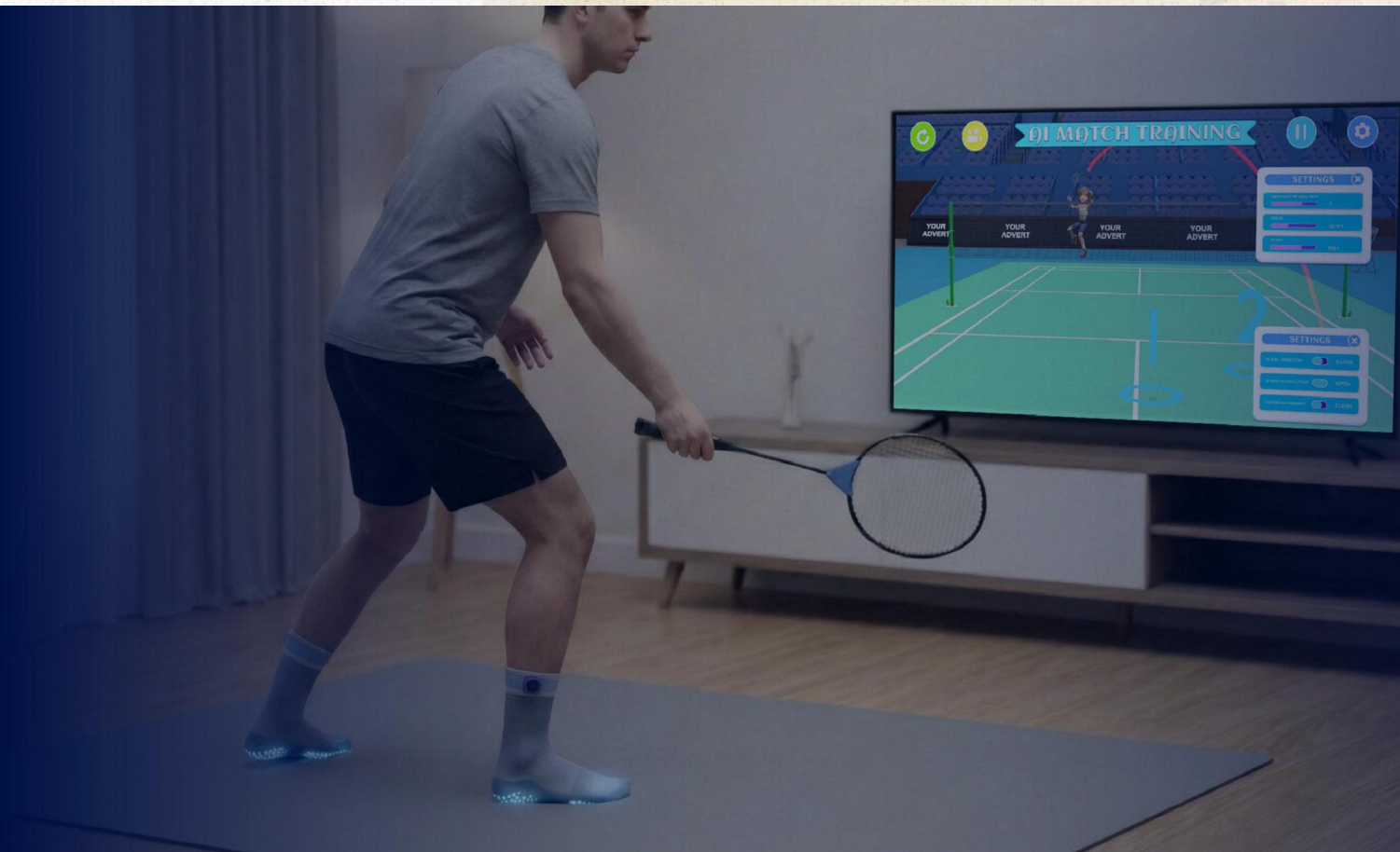
*Gamelike

*Skill Improvement

*Simulated Match

The FeatherQuest training system includes a training game and two gaming devices. Providing a low-cost home training mode through a beginner's guide to basic technology, an AI driven training mode with adjustable difficulty and replay based correction, a competition mode inspired by professional games, and multi ball training for muscle memory development.

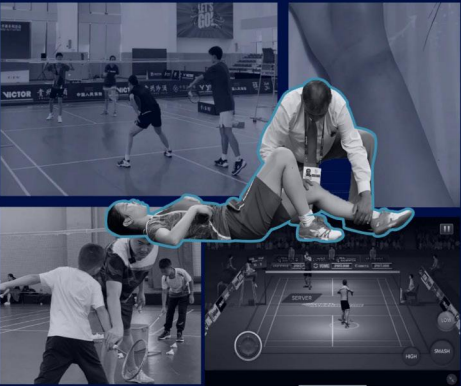
By combining sports science with interactive gaming, FeatherQuest reduces barriers for professional coaches and promotes long-term participation, health protection, and skill enhancement for amateur players of different levels.



INSPIRATION

I am a badminton enthusiast. Many of my badminton friends, including myself, have not received professional training due to time constraints and high costs, making it difficult for us to further improve.

Therefore, I have been wondering if there is a system that can help people develop proper badminton skills at home.



OVERUSE INJURIES

Overuse injuries are a widely recognized issue: *they involve the cumulative damage caused by repeated repetition of certain movements without adequate recovery or correction of technical errors.* For example, in adolescent athletes, repeated stress, stretching, and tendon/muscle fatigue can lead to injuries.

INSIGHTS



RESEARCH

Interview



Coach Yuan

Professional guidance/standardized action teaching is very necessary to prevent injuries and improve skills. *The best time is when they first start playing play badminton*, because at this time they have not formed muscle memory of wrong actions.



Student Wang

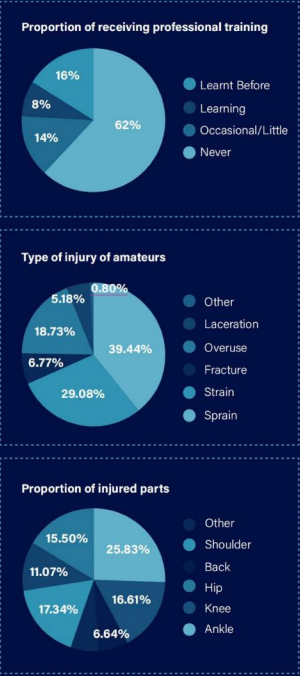
Professional guidance is very helpful to me. Through learning, I gradually surpassed many people who were at my level or even better than me. *At the same time, I feel that the burden on my body has decreased.*



Amateur Sun

After multiple injuries, I realized the importance of receiving guidance. However, *due to the workload, I do not have time for systematic training.* I only occasionally find some teaching videos for practice, *but there is no feedback or correction, so the effect is not significant.*

Survey



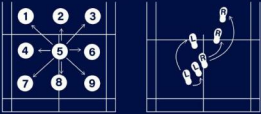
Badminton Training Methods

1.Basic



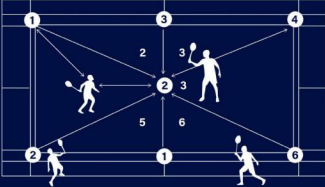
Grip Basic stance Basic hitting motion

2.Footwork



Starting steps, movement methods under different position changes and different ball speeds.

3.Multi-ball Training



Build muscle memory through high-frequency repetition to improve the quality, accuracy, and fluidity of hitting the ball in all four corners and to various landing points.

4.Thought Training

Mental/tactical awareness/rhythm control/ball trajectory planning.

Necessity of Technique

1. Prevent injury

Correct grip and strike - prevent wrist, elbow, and neck injuries.

Correct footwork - prevent injuries to the lower back, knees, and ankles.

2. Skill Enhancement

Correct footwork: Faster and more efficient exercise, reducing endurance consumption

Correct hitting technique

3. Tactical understanding

CONCEPTS

A sports induction badminton training game that helps players establish a solid foundation, improve their skills through real-time feedback, and maintain motivation through gamified modes.

1. Beginner's Guide

Real-time guidance corrects posture, swing path, and hand positioning to prevent early bad habits.



2. Training Mode

The system tracks footwork and swing accuracy, and provides replay comparisons showing the ideal movement path vs. the player's actual steps.



3. Match Mode

Users choose famous matches inspired by professional players and compete against AI that imitates their play styles.



4. Multi-Ball Training

A repetition-focused mode where continuous virtual shuttles are fed to specific areas.



Technical implementation

- Kinect/RGB-D+motion recognition
- IMU sensor
- Flexible materials
- Pressure sensor

Feedback form

- Visual contrast animation
- Trajectory display
- Trajectory and landing point of virtual reality ball
- Digital rating/voice feedback
- Tactile vibration feedback
- Level Settings

Steps to play

After wearing it, adjust it to suit players of different body types.

Evaluate the player's level

Select modes

Beginner mode
Training mode
Challenge mode

Rest reminder

Settlement screen

1. Initialization



2. Assessment level



3. Task Display



4. Sound Feedback



GAME RESEARCH

1.Main gameplay



Hit left and right Drop Shot



Hit left and right Drop Shot

2.Controller(Joy-Con) Usage



Uses of the Joy-Con

Serve/ Underhand Shot Smash/ Overhead Shot

Hold down ZR and swing the Joy-Con to pull of a Drop Shot aiming at near the net.

3.Strap devices & Joy-Con



3.Some comments

"Motion controls are also wonky too often to want to revisit it too often."
—Reddit

"The ball control, placement, and tactical elements are acceptable, but the overall repetitiveness is high."
—GameFAQs

1. Posture Scoring



The final score is obtained by weightedly *averaging the angle similarity and position similarity*.

```
kp_cur = extract_keypoints(res_cur)
kp_cur_norm = normalize_keypoints(kp_cur) if kp_cur is not None else None

sim = pose_similarity_refined(kp_ref_norm, kp_cur_norm, kp_ref, kp_cur)
score = similarity_to_score(sim)
score = max(0, min(1, score))
cv2.putText(img, text="Score={0}(score={1})".format(score, 50),
            cv2.FONT_HERSHEY_SIMPLEX, fontScale=1.2, color=(0, 255), thickness=3)

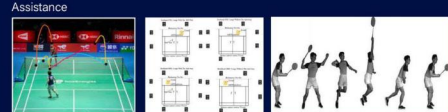
cv2.imshow('Reference Pose (no face)', img_ref_draw)
cv2.imshow('Live Compare Pose (no face)', img_bg)
```

id	id1	id2	id3
1	1	1	1
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100	100	100	100

```
//堆内存SV格式
Serial.print(now); Serial.print(" ");
Serial.print(y); Serial.print(" ");
Serial.print(x); Serial.print(" ");
Serial.print(y); Serial.print(" ");
Serial.print(z); Serial.print(" ");
Serial.print(aa.x); Serial.print(" ");
Serial.print(aa.y); Serial.print(" ");
Serial.print(aa.z); Serial.print(" ");
Serial.print(gyro.x); Serial.print(" ");
Serial.print(gyro.y); Serial.print(" ");
Serial.print(gyro.z); Serial.print(" ");
Serial.print(asReal.x); Serial.print(" ");
```

```
try:
    while True:
        start time = time.time()
        line = ser.readline().decode(encoding='utf-8', errors='ignore').strip()
        if line:
            parsed = parse_line(line)
            if parsed:
                a1a2, a3 = parsed
                #更新脚色A1→脚色B, A2→小脚色, A3→大脚色
                ellipse A1.set fillColor=val to color(a1)
                ellipse A2.set fillColor=val to color(a2)
                ellipse A3.set fillColor(val to color(a3))
                fig.canvas.draw()
```

Visual Reference



coding

```
// Create input and Execute model  
yield return: worker.StartAsync(async () => {  
    // Get output for (i+1) = 2*i model.outputs.Count; i += 1  
    b = outputs[i].worker.PeekOutput(); model.outputs[i];  
    // Get data from output  
    softmaxC0 = b.outputs[2].data.Download(b.outputs[i].shape);  
    heatmapC0 = b.outputs[3].data.Download(b.outputs[i].shape);  
    // Release outputs  
    for (i = 2; i < b.outputs.Length; i++)  
        b.outputs[i].Dispose();  
    PredictPose();  
    summary;  
    Predict positions of each of joints based on network  
    //summary;  
    private void PredictPose()  
}
```

Call the backend inference engine (Unity Barracuda) to pass the processed data to the AI model

[illegible]

Convert the obtained human body coordinates to Unity world coordinates

↓

```
void KalmanUpdate(VNectModel_IcnpntMeasurement  
measurementUpdate(measurement)  
{  
    measurement.Pos3D.x = measurement.X.x + (measurement.Now3D  
    measurement.Pos3D.y = measurement.Y.y + (measurement.Now3D  
    measurement.Pos3D.z = measurement.Z.z + (measurement.Now3D  
    measurement.X.x = measurement.Pos3D.x;
```

A LEGO Technic cannon constructed from grey, orange, and white bricks, mounted on a grey base.

Ball Machine



Unity+BarracudaBodyTracking+Machine learning model training file

Filter and smooth the body movements of characters

PRODUCT DESIGN

Sketch

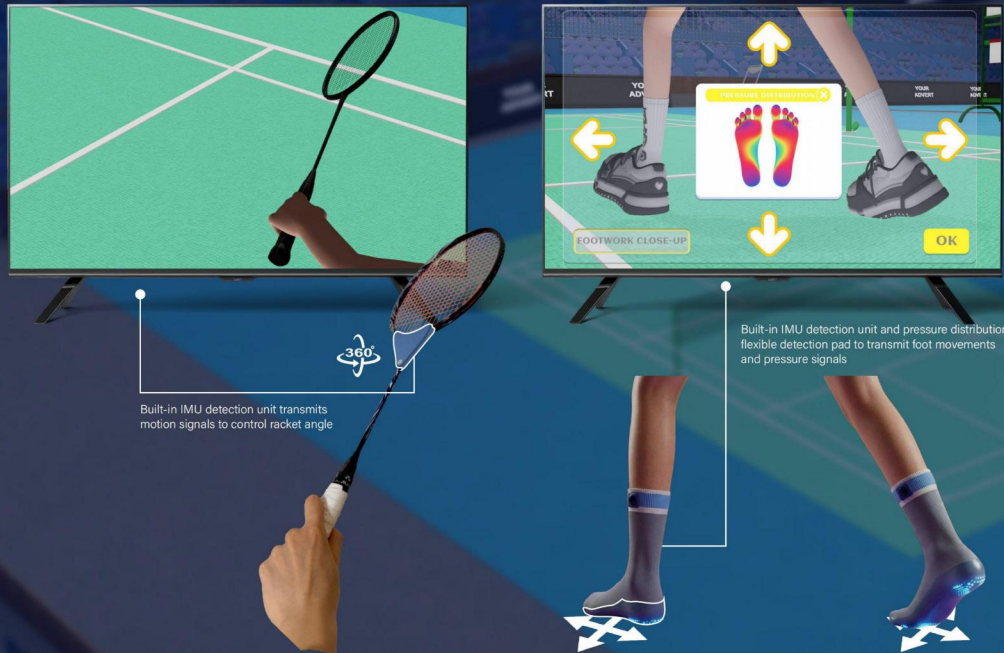


Rendering & Exploded view

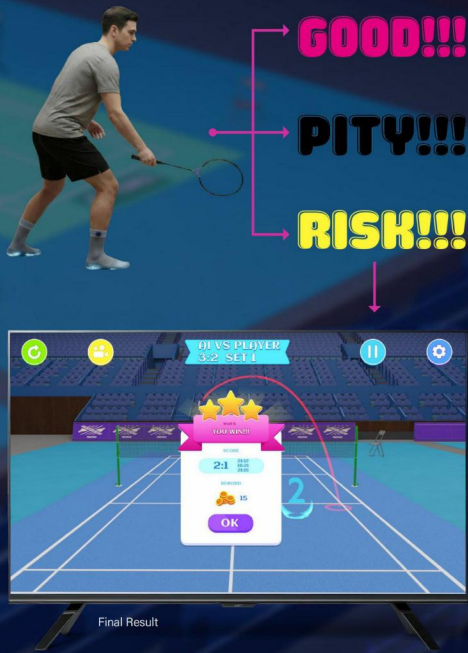


GAME DISPLAY

Operation Method



Match Scenario



PERSONAL PROJECT

Echo Hunt

Echo Hunt is an AR interactive experience project based on Chinese dream core aesthetics. It digitally reconstructs everyday scenes that are gradually disappearing — such as convenience stores, internet cafes, corridors of teaching buildings, and abandoned amusement parks. Inviting players to explore the map and discover souvenirs — ancient items from past memories, guiding players to trigger memory fragments during exploration.

In the game, players do not passively accept stories, but enter virtual dreams as wanderers, gradually piecing together a memory map of their own through interactions with old objects and spaces.

Experience Design / AR Technology / Virtual Design



Background

What is Chinese Dreamcore ?

Chinese Dreamcore is a network aesthetic style or subcultural label that has emerged on the Chinese Internet in recent years and integrates specific Chinese cultural elements and collective memory. It is a localized and cultural variant of Dreamcore aesthetics.



Core Features

Strong localization symbol	Deepening the emotional tone
Building environment	Nostalgia of the times
Daily items	The Ambiguity and Alienation of Collective Memory
Visual elements	The feeling of alienation in development
Cultural icon	Calming unease
Natural Scene	The strangeness under the childhood filter

Research

The reasons for the popularity of Chinese Dream Core

The popularity of Chinese dream cores is not accidental, it is a response to personal growth memories and social changes. In the fragmented era of the internet, this aesthetic is endowed with a collective nostalgia attribute that transcends individuals through images, sounds, and interactive experiences. It is both a cultural reproduction and a digital site construction.

Psychology

Why do people want to immerse themselves in it?

The resurgence of old emotions

The decompression dream of modern life

Sociology

Why can it spread quickly?

Internet and subculture amplification

The aesthetic charm of cultural mix and match

Spiritual compensation in the post pandemic era

Interview

Q: Why do you think you feel inspired by content related to Chinese Dreamcore?

A: I feel more familiar and intimate with Chinese dream core. It is composed of some elements from my childhood.

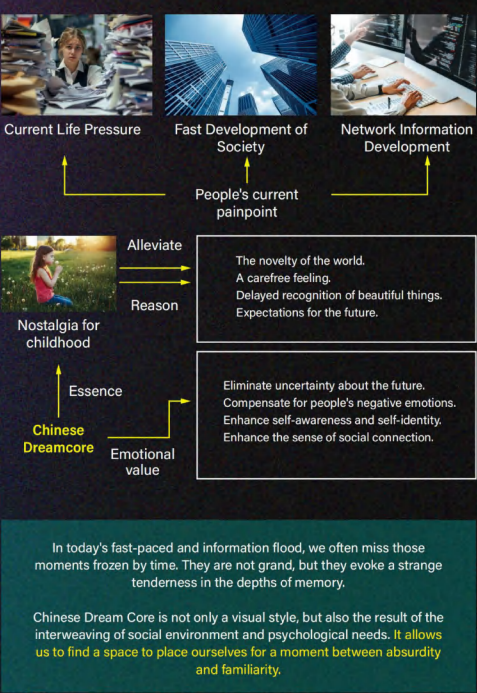
Q: Do you consider yourself a nostalgic person? If so, what is the reason for missing?

A: I think this nostalgia may be related to resisting the pressure of reality and beautifying memories.

Questionnaire



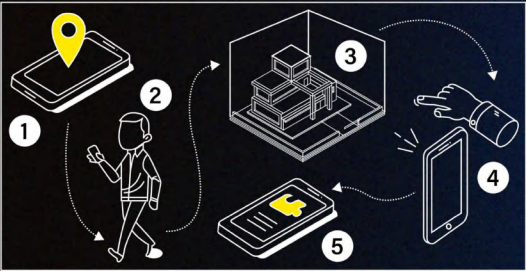
Conclusion



Concept

I plan to use **Chinese Dream Core** as the aesthetic tone, combined with AR augmented reality technology and gesture interaction, to create an **immersive experience between memory and reality**.

Players will explore real space through a map, switch to an AR perspective at specific locations, and search for scattered vintage items from the 2000s : electronic pets, crisp noodles, transparent pencil cases... When they appear on the phone screen, players need to complete specific gestures to collect them.



- This process of searching and collecting is not just a game, but also an emotional recall.
- It evokes childhood wonder and curiosity,
 - It reconstructs the shared space of collective memory,
 - It creates a unique dreamlike and surreal atmosphere between familiarity and unfamiliarity.

Keywords: Nostalgia / Dreamcore / Ar / Collective Memory / Exploration

Related game research

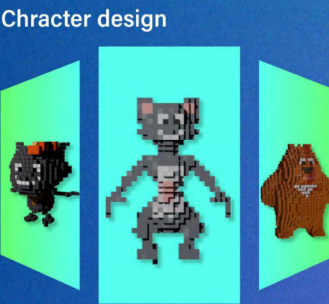
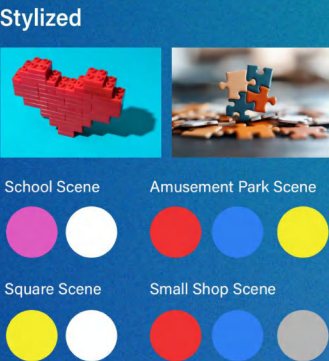


Pokemongo
Core experience: Capture and train Pok é mon in real scenes through mobile phone cameras, participate in team battles and exchanges
Social function: Players can join different factions and participate in online PvP battles and offline Raid activities

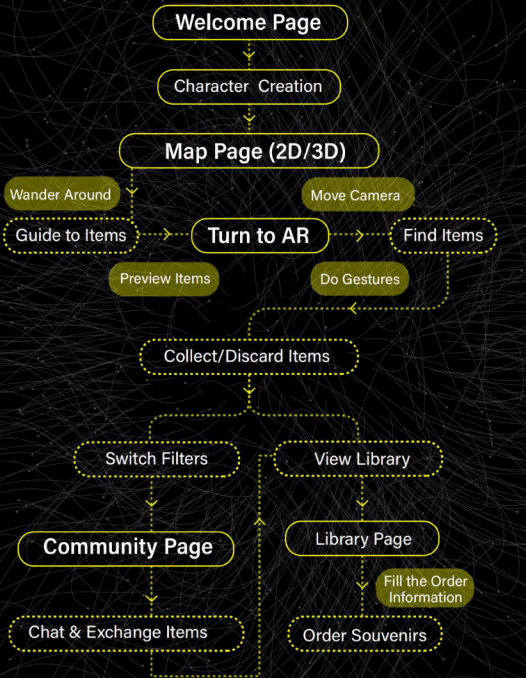


Real scene synthesis Medals Collection

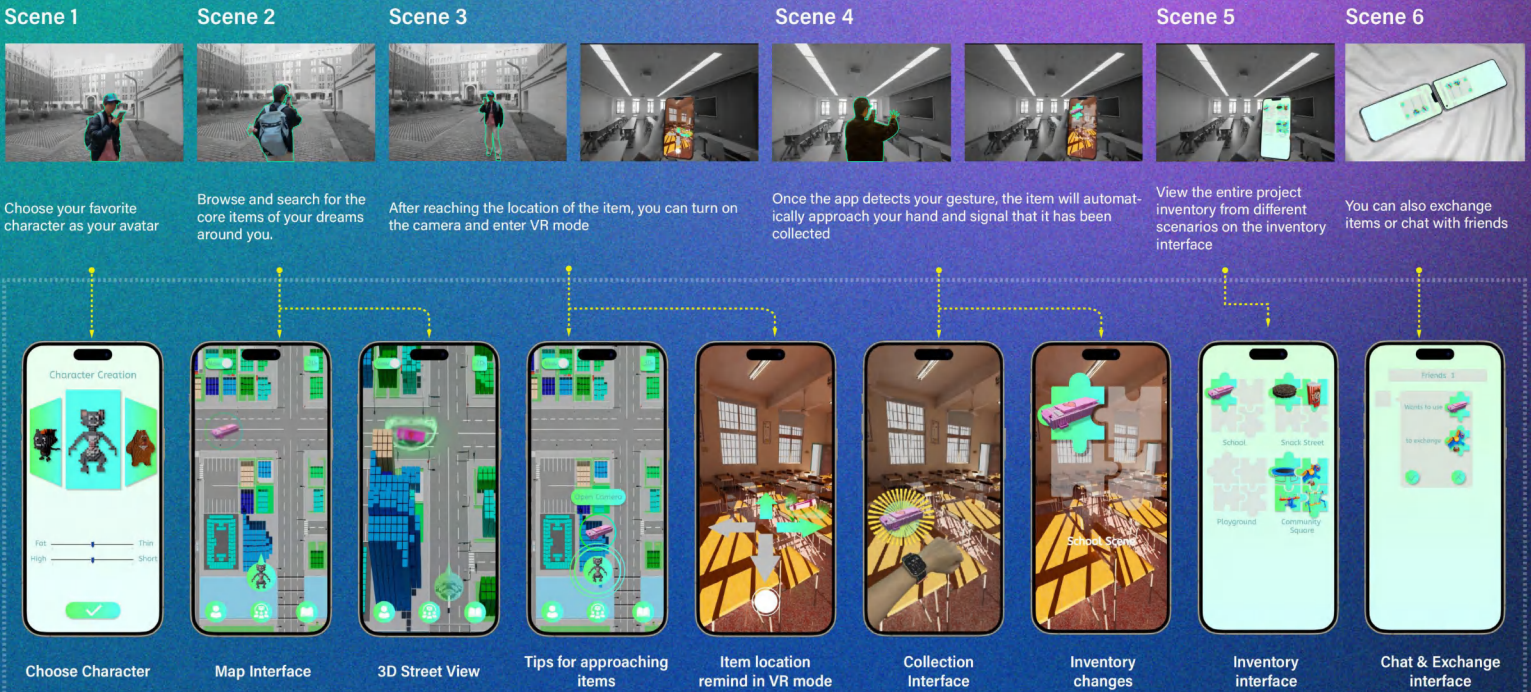
Design process



Game Framework



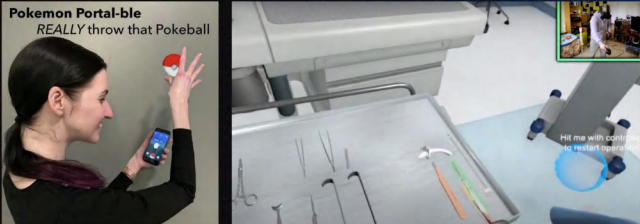
Flow Chart & High Fidelity



Technical Study

AR gesture interaction solution

The portal-ble AR gesture interaction solution can be used to develop AR gesture interaction applications based on mobile devices such as mobile phones.



Case:<Pokemon Go> AR gesture interaction

Case:<Surgeon Simulator AR>

AR gesture interaction technology

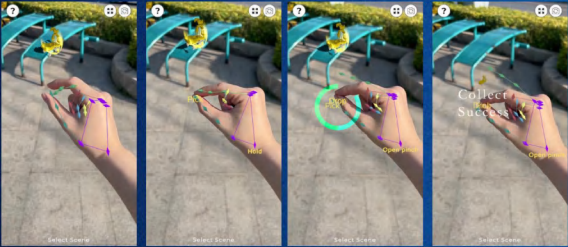
Google Project Tango and Apple's LIDAR sensors have further improved the application performance of smartphones in scenarios such as 3D ranging, environmental recognition, and gesture recognition.



Case:<Ingress>



Interaction testing



Then make specific gestures to collect items

Collect Items	Discard Items	Switch Filter
Switch Filter Back	View Library	Back to Map

Final Affects



1. View item location information on the map

2. Follow the map to the nearby location of the item



3. Explore the souvenirs stored at this destination



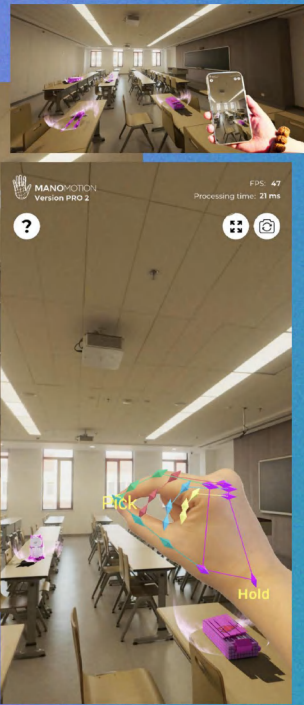
The mobile phone can detect the item information on the map in real time and display it on the mobile phone through AR technology.

Game interaction effect

I used the demo software to test it at four representative locations. The results are as follows: the collecting gestures can be recognized and the objects can be recognized.



Classroom Scene



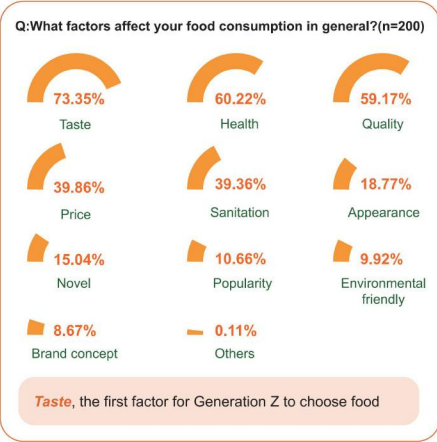
Snack Street Scene



Amusement Park Scene

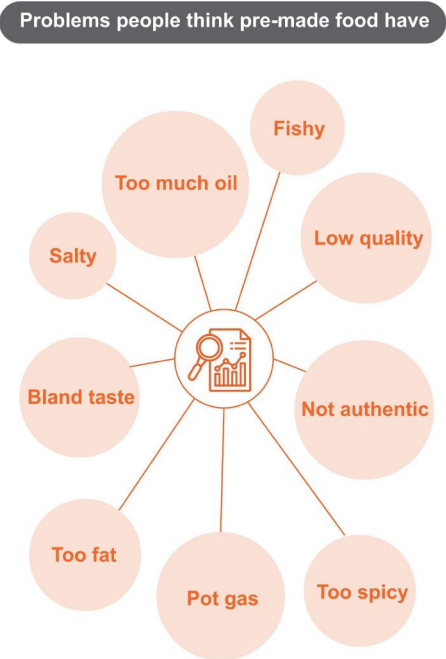


USER RESEARCH



Conclusion

Through research, we found that what Generation Z pays most attention to in food/takeout is **taste, quality, hygiene and safety.**



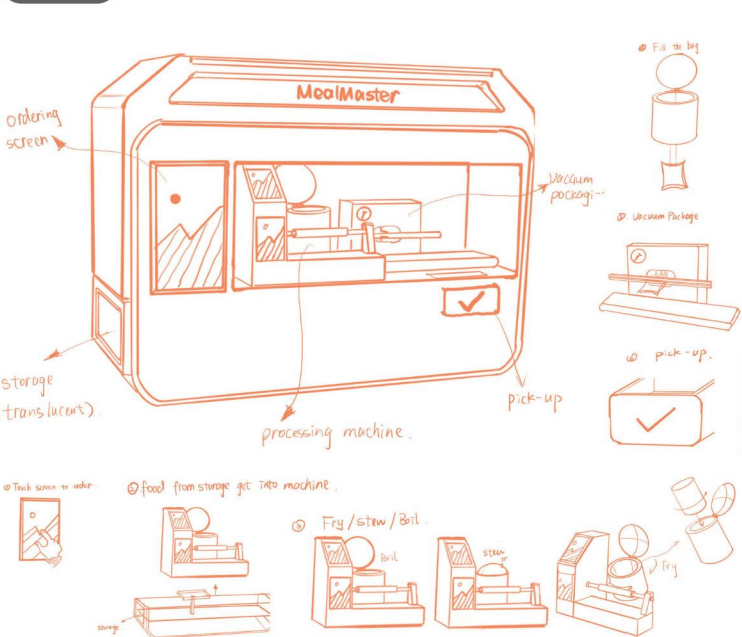
DESIGN CONCEPT

By embedding standardized processing procedures into diversified prefabricated food packaging equipment and recording, generating, and publicly disclosing key food information through digital applications, the project transforms the previously invisible production process into a traceable, understandable, and supervised data structure.



PRODUCT DISPLAY

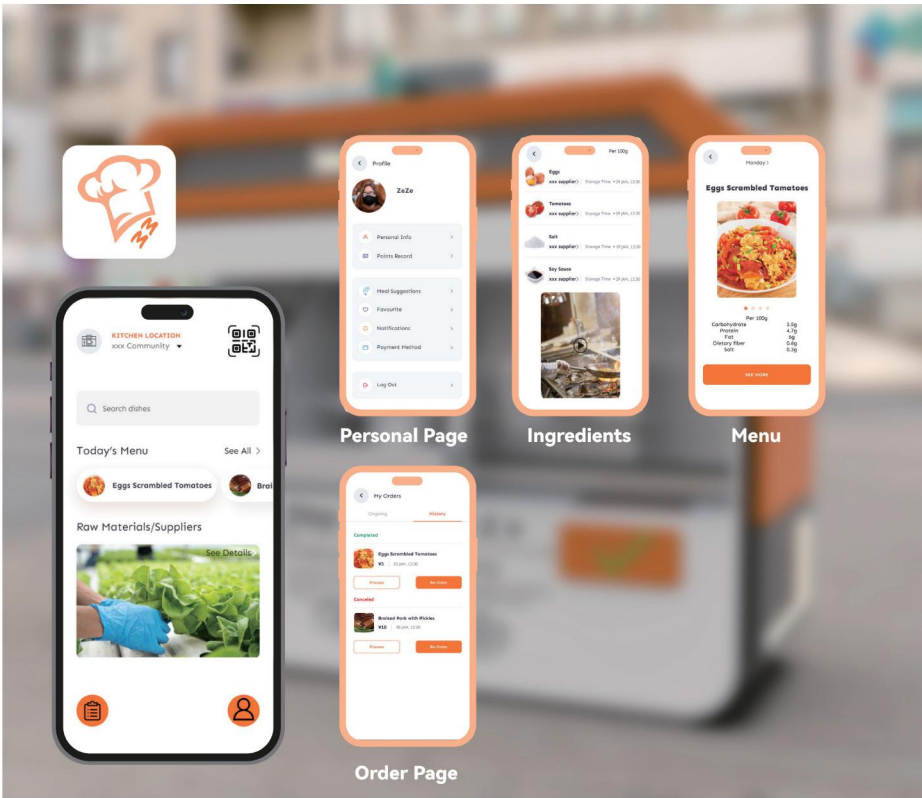
Sketch



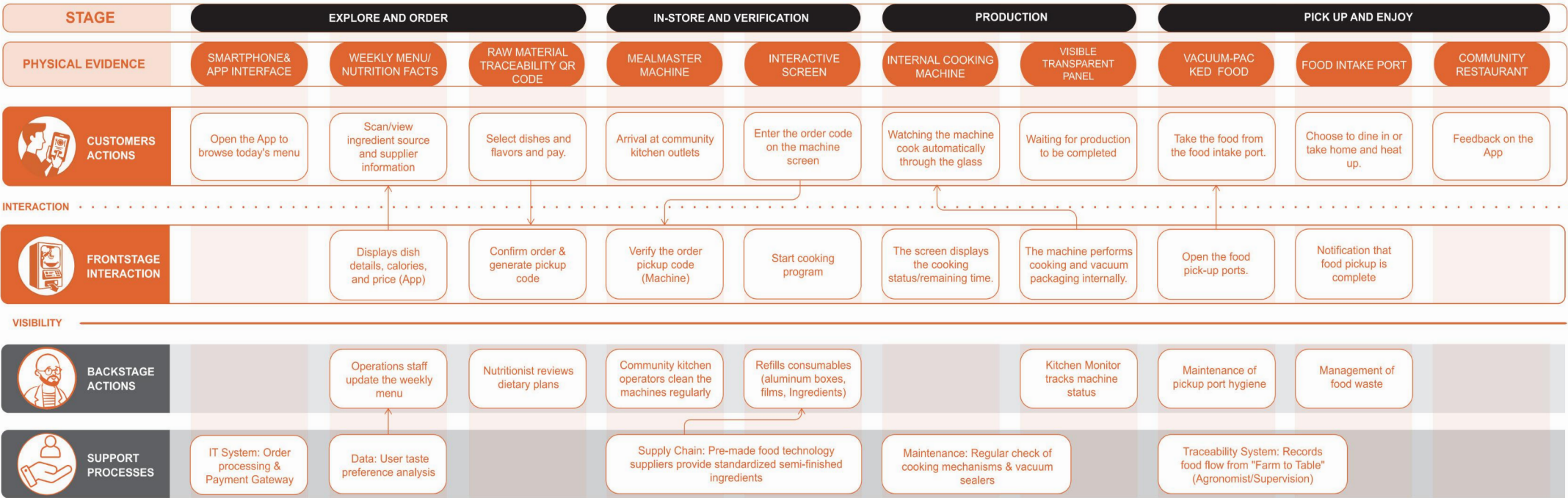
Rendering



INTERFACE DESIGN



SERVICE BLUEPRINT





STORYBOARD

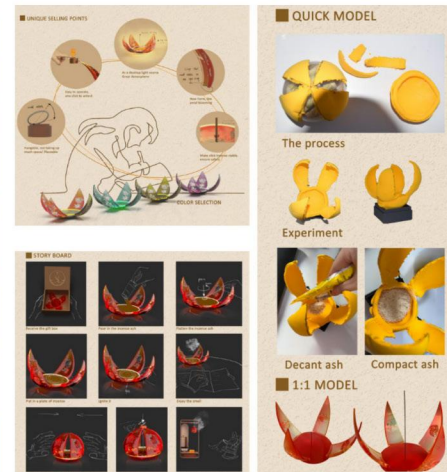


Other Work



Heancense

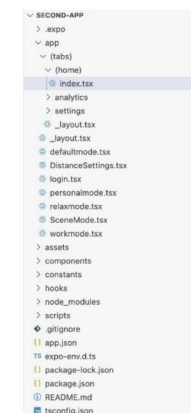
This Product Develops Traditional Chinese Incense Culture And can Help stage Self-Healing. When We Are Impatient And Depressed, We Can Enjoy The Incense Seal And smell The Fragrance Of incense, Thus Relieving Irritability And Anxiety.



This Project Introduces A Modular Building-Block-Speaker Designed To Enhance Children's Musical And Sensory Development. Each Block Creates A Unique Tactile Experience Using Materials Like Rubber, Wood, And Velvet, And Plays A Specific Piano Note When Connected. This Allows Children To Compose Music Intuitively Through Creative Construction.



App Architecture



Features



Team Work



LUMO