Silk World

A Smart + Playful Sericulture Learning System

Silk World reimagines traditional silkworm raising through a hybrid digital–physical experience. By combining a virtual silkworm-raising game with an intelligent silkworm house,the project makes sericulture easier to learn, observe, and pass on.

Group Project

#EdTech #LearningSciences #UXDesign

Role: UX Researcher · Learning Designer · Interaction Designer

Duration: 3 months

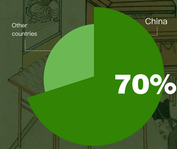
BACKGROUND

FROM HANDS TO TOOLS, SERICULTURE PRESERVES CARE, CRAFT, AND CONTINUITY

China is the world's largest sericulture country

2024

Global cocoon production

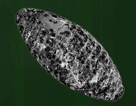


100,000 tons

The history of sericulture in China spans over 5,000 years and is a microcosm of Chinese agricultural civilization

Sericulture has been included in primary school textbooks in China as a practical teaching task, aiming to cultivate children's sense of responsibility, patience, and reverence for life

- Silkworm raising has shaped everyday life, craft traditions, and agricultural knowledge across East Asia for thousands of years.
- Its long-standing role in family education reflects how hands-on practices were used to cultivate patience, responsibility, and respect for life.
- Today, sericulture remains a valuable bridge between cultural heritage and modern experiential learning for children.



Stone-carved silkworm pupae

The Neolithic Age
(approximately 3000 BC - 2000 BC)

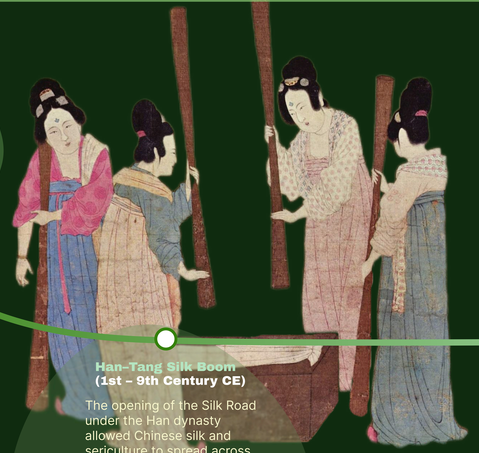
The discovery of stone cocoon and silkworm-pupa relics shows that silkworms played an important role in daily life over 6,000 years ago in the Yuncheng Basin, one of the origins of Chinese civilization.

Leizu is the "silkworm Goddess" in Chinese legends and is revered as the "First Silkworm Lady".

In the oracle bone script of the Shang Dynasty, characters such as "蚕", "丝" and "桑" appeared

The Xia, Shang and Zhou periods
(approximately 2070 BC - 256 BC)

Oracle bone Script



Han–Tang Silk Boom
(1st – 9th Century CE)

The opening of the Silk Road under the Han dynasty allowed Chinese silk and sericulture to spread across Central Asia and Europe.

Song–Yuan–Ming–Qing Civil Sericulture Era
(10th – 19th Century)

Across ancient China, especially during the Song through Qing dynasties—silkworm raising served as a form of everyday education in both households and communities.

The New Silk Path:
Education, Technology & Culture
(20th Century – Today)

In the 21st century, silkworms have re-emerged in classrooms and homes as tools for life education and environmental awareness.

RESEARCH

Modern Silkworm-Raising Practices ——
People raise silkworms for interest and enjoyment using simple, everyday materials

Paper Roll

Commonly found in schools and small family farms
Low cost, easy to replace manure
Poor ventilation leads to manure accumulation, requiring frequent cleaning

Egg tray

Commonly used during the pupation stage of silkworms .
Its porous structure facilitates fixation.
Easy to clean, but the paper tray easily absorbs water and requires a dry environment.

Storage Box

Commonly used in schools, medium-scale silkworm rearing.
Controllable ventilation holes, large space, can accommodate more young silkworms.
Not easy to clean.

Plastic Lunch Box

The most common method for home farming:
The containers are lightweight, have lids, and are easy to observe.
Space is limited, making them unsuitable for large-scale farming.

Common Difficulties Faced in Home Silkworm Raising

QUESTIONNAIRE

Subsequently, our team conducted a questionnaire survey and user interviews to understand the local sericulture industry, user demands and pain points. A total of 125 questionnaires were collected.

Experience

We have found that many people have only raised silkworms 1-2 times, and some have never raised silkworms at all

1-2 times	52%
never raised	33.6%
3-5 times	9.6%
over 5 times	4.8%

Reason

People primarily raise silkworms out of interest , enjoying observing their growth; the second reason is fulfilling school-assigned tasks.

48.8%	Enjoy observing the growth of silkworms
37.6%	School homework/study tour tasks
31.2%	Want to experience nature

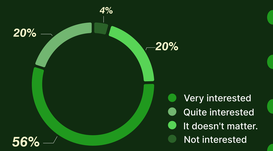
Educational significance

The vast majority of people believe that sericulture is educational

Very suitable | Give it a try | Inappropriate

Preference

We have found that many people have a interest in smart silkworm houses



Users prefer modern and simple style silkworm houses

Users hope the silkworm house will have more intelligent functions to simplify silkworm raising.

- Real-time monitoring of the health status of silkworms
- Automatically dispense mulberry leaves to prevent forgetting to feed
- Real-time observation and remote control functions on the mobile App
- Automatically adjust temperature and humidity
- Remind to feed/clean up
- Growth progress records/logs are automatically generated

Difficulties

There are many troubles in raising silkworms at home

- The supply of mulberry leaves is unstable
- It is difficult to prevent and control silkworm diseases
- The breeding environment is difficult to control
- It's not convenient at home.
- There is no time for management and care

Expectation

79.2%	The user hopes to visualize the growth of silkworms
40.8%	They hope that someone can explain the growth cycle of silkworms
46.4%	They hope to share the growth of silkworms
48.8%	They hope to record and observe the growth of silkworms

Goal

We hope that through this smart product, we can promote the integration of industry and education. By reflecting on the growth of silkworms, we can prompt users to think about life and, to a certain extent, drive local development

CURRENT SILKWORM RAISING JOURNEY MAP

Phase	Phase 1 Preparation period		Phase 2 Growth period		Phase 3 Silk spinning period	Phase 4 Harvest perido		Phase 5 Gap period
Stage	Silkworm seedling acquisition	Site and equipment preparation	Daily feeding and cleaning	Age-based assessment and molting identification	Preparation for coiling and spinning	Observation of cocoon withdrawal and adult moths	Harvesting and selling silkworm cocoons	Waiting and summarizing
Target	Obtain healthy silkworm seedlings of the appropriate age	Create a stable environment suitable for silkworm seedling growth	Ensure a clean environment for silkworm seedlings to feed.	Accurately determine age change and feeding rhythm	Ensure successful cocoon formation	Experience the complete life cycle, breeding and seed preservation.	Harvest high-quality cocoons, and gain commemorative value.	Summarize the experience and prepare for the next breeding session.

Actions

- Purchase silkworm seedlings online, sign for delivery, and inquire about seedling care precautions.
- Search online for key points on silkworm farming
- Lay out paper, set up the silkworm rearing area, and prepare mulberry leaves.
- Start raising silkworms and observe their feeding and growth.
- Feed the animals at regular times each day and clean up their feces; control the light and humidity.
- Repeatedly
- Observe the silkworm's condition to determine its age and when it will molt.
- Improper handling caused some silkworms to die.
- Making a cocoon frame in preparation for cocoon formation
- Improper handling prevents silkworms from spinning cocoons
- Observe and record the emergence of the cocoon; keep the species or release them.
- Successfully collected silkworm cocoons
- Sell the cocoon or keep it as a souvenir
- Summarize, record, and share experiences

Feeling

Expect → Anxiety → Tired → Curious → Dull → Bored → Puzzled → Frustrated → Expect → Nervous → Formal → Excited → Achievement → Moved → Satisfied → Sad → Miss → Yearn

Pain Points

Unable to determine silkworm age	The supply of mulberry leaves is unstable and cleaning is troublesome.	Silkworm fails to spin cocoons	Some people are afraid of moths and don't know how to deal with them.	Without systematic records, experience is difficult to pass on.
Low survival rate of silkworm seedlings	The workload is too heavy to sustain and complete.	Lack of temperature and humidity regulation	Don't know how to process and utilize silkworm cocoons.	Interruption of emotional experience. Weak continuity
Lacking equipment or space, the preparation process is cumbersome.	Highly dependent on experience, difficult to teach.	Improper cluster frame construction		

Opportunities

1. Launching "Silkworm Seedling Pre-order Transportation" Service
2. Develop intelligent silkworm house module

1. Mulberry leaf delivery system
2. Standardized automated feeding
3. Intelligent silkworm farming with task incentives

1. AI identifies age-related changes and sends reminders.
2. Environmental control module

1. Design interactive elements to guide users in understanding the uses of silkworm cocoons.
2. Establish a commemorative redemption system for "Silkworm Cocoons Returning to the Village".

1. Silkworm growth log system + user profile function

FIELD INVESTIGATION

Through a two-day field investigation, we identified the real challenges and needs surrounding local silkworm-raising practices.

The staff of Ma Village

Q: Do you think it is difficult to raise silkworms at home?

The failure rate of home breeding is high
- unstable air **humidity/temperature**
- The odors in the urban air are **complex**
- Silkworms need to be fed mulberry leaves **frequently**

Q: What do you think is the biggest problem of Machun Village at present?

- The tourists **can't be retained**
- The characteristic industry has **no reputation**
- The industries related to the integration of **industry and education** are not doing well

Q: How much time is spent raising silkworms approximately?

- The failure rate of home breeding is high unstable air **humidity/temperature**
- The odors in the urban air are **complex**
- Silkworms need to be fed mulberry leaves **frequently**

Q: Do you know what should be noted when raising silkworms?

- Pay attention to common **diseases**, such as "empty body disease" and "silkworm pupae"
- **Pesticide pollution** can enter silkworms through mulberry leaves, causing poisoning and reduced yields, especially in autumn when the situation is severe.

Villagers of Ma Village

Silkworm farmers

Q: Do you think it is difficult to raise silkworms at home?

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DESIGN DEFINITION & PRODUCT MODEL

Research Insights

Environmental Sensitivity

Silkworms are highly sensitive to **temperature and humidity** changes. Optimal growth occurs at 25–28°C and 70–80% humidity.

Dietary Habits

They only eat **fresh** mulberry leaves, and are picky about leaf **moisture and texture**. Delays or quality issues in feeding can affect their health and development rapidly.

Health Sign

Their **appetite and crawling speed** are indicators of health, making real-time behavioral tracking valuable for early warnings.

Low Exposure

86% of users have either never raised silkworms or only done so 1–2 times which highlights the need for **beginner-friendly** tools.

Learning Motivation

Main motivations include **observing growth** (48.8%) and **completing school assignments** (37.6%) indicating that learning is curiosity- and task-driven.

Educational Recognition

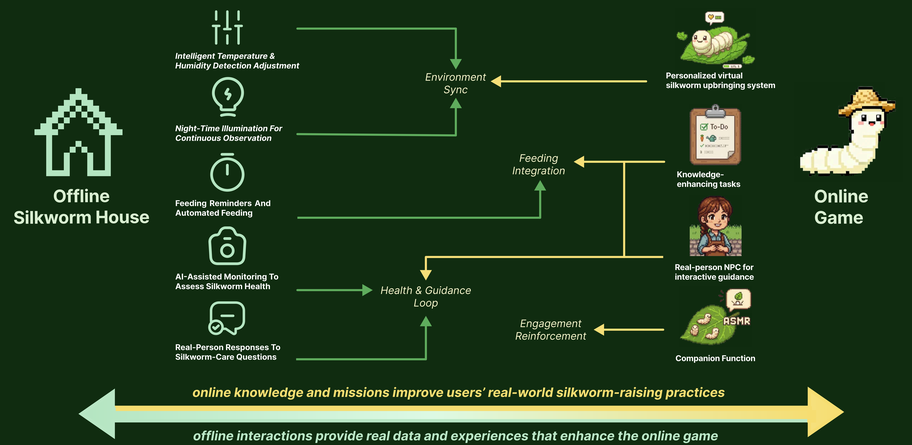
A strong 92.8% believe silkworm raising has **educational value** validates potential for formal/informal learning use.

Core Difficulties

Users struggle with feeding, disease control, and time management suggests **automation and support tools** are needed.

Concept Map

Our project integrates both online and offline modes to create a richer, more immersive silkworm-raising experience.



Game Psychology

After analysing the research findings and user needs, we aimed to design a game that transforms silkworm care into an engaging and psychologically grounded learning experience.

Self-Determination Theory

A motivation framework explaining why users stay engaged, enjoy the experience, and return to the game.

Keyword	Design Principle	Player Experience
Autonomy	Users can freely explore and choose their silkworm-raising methods.	Players feel motivated when they can customise their silkworm house, choose feeding modes, decide how to raise their silkworm.
Competence	Make users realize, "I have learned more about silkworm raising."	Clear growth feedback and successful task completion give players a sense of mastery and improvement.
Relatedness	Make users feel a sense of companionship and human touch.	Players feel connected by interacting with real Ma Village sericulture experts (NPCs) and other players.

Related Feature

- Customizable Silkworm House Interface
- Manual / Auto Feeding Mode Switch
- Silkworm Rearing Task Interface
- Health Monitoring & Growth Curve
- Real-Person NPC
- User-To-User Interaction & Chat

Cognitive Load Theory

A learning framework explaining why the interface helps users understand silkworm care without being overwhelmed.

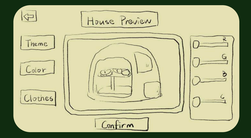
Keyword	Design Principle	Player Experience
Intrinsic Load	Complex biological content becomes digestible through guided missions.	Visualize the key knowledge of silkworm growth so that even novice users can understand it.
Extraneous Load	Remove cluttered, complex, and repetitive information.	Clean visual grouping and unified icons reduce unnecessary processing demands on the user.
Germane Load	Through cause-and-effect feedback, players can truly understand "why they should do this".	Players form deeper understanding through results-based feedback.

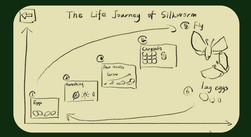
Related Feature

- Knowledge Missions
- Stage-based Guidance
- Unified Status Indicators
- Smart Reminders
- Minimalist UI Layout
- Cause-Effect Visualisations
- AR Silkworm Learning

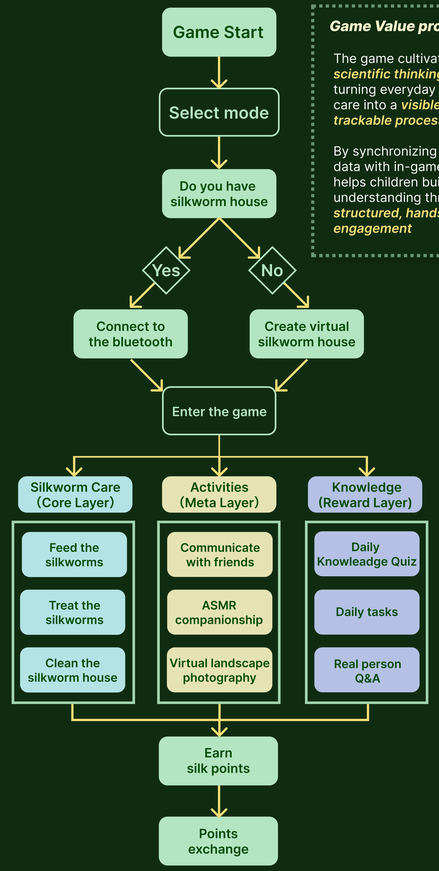
Low-Fidelity

We discussed some game interfaces and hand-drew designs for them.





Game flow



Game Value proposition

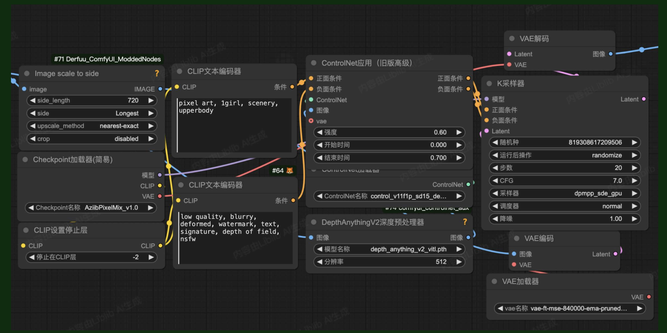
The game cultivates ***scientific thinking*** by turning everyday silkworm care into a ***visible, trackable process***

By synchronizing offline data with in-game tasks, it helps children build understanding through ***structured, hands-on engagement***

Stable Diffusion (ComfyUI) — Image Generation Workflow

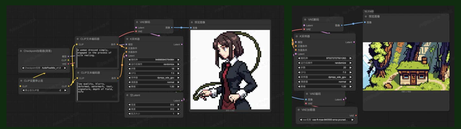
We are not major in game art, so we used AI to generate some game graphics and have built a Stable Diffusion workflow in ComfyUI, which is specifically designed to generate pixel-style illustrations that are concise and suitable for game interfaces.

This workflow integrates LoRA models for mosaic style and sticker drawing, and can generate coherent visual effects for each scene input.

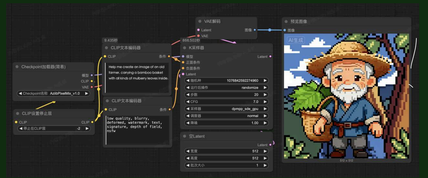


Workflow

Checkpoint Loader → LoRA (*2) → CLIP Text Encoder → Sampler (KSampler) → VAE Decode → Image Output



During workflow debugging, we observed that differences between modules and step counts (with ~20 steps being optimal) have a substantial impact on the resulting image quality.



FINAL UI

Main Character

We designed some of the main characters in the game based on the history and traditions of Ma Village.

Horse-headed Goddess | Q-version silkworm baby | Silkworm Grandpa | Silkworm Grandma

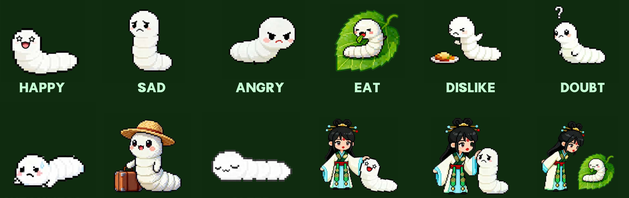
Icon

Some main icons in the game.

FEED | CLEAN | HUMIDITY | TEMPERATURE | SILKWORM COCOON

HEALTHY | SLEEP | SICK | HUNGRY | DEAD

Reactions



HAPPY | SAD | ANGRY | EAT | DISLIKE | DOUBT

WEAKNESS | TOUR | SLEEP | PLAY | CONSOLE | FEED

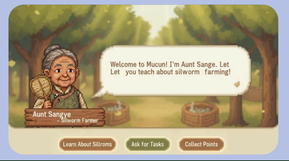
High-Fidelity Interface

Our high-fidelity interface are inspired by the landscape and cultural heritage of Ma Village. By adopting a warm pixel-art aesthetic reminiscent, the interface creates an approachable visual atmosphere that supports learning and emotional connection.

Silkworm Care

Activities

Knowledge



PHYSICAL DEVICE | Build an intelligent silkworm house using Arduino

Coding

Arduino-based intelligent feeding and monitoring for silkworms, covering automatic feeding, temperature & humidity monitoring, and camera recording. Additionally, the monitoring device uploads silkworm status to app in real time.

```
#include <Adafruit_SSD1306.h>
#include <DHT.h>
#define DHTPIN 7; #define DHTTYPE DHT11; #define TEMP_LIMIT
28.0;
Adafruit_SSD1306 display(128, 64, &Wire, -1);
DHT dht(DHTPIN, DHTTYPE);


void loop() {
  if (millis() - lastRead < 2000) return;
  float h = dht.readHumidity();
  float t = dht.readTemperature();

  if (isnan(h) || isnan(t)) { display.println("DHT read error"); return; }

  bool tooHot = (t > TEMP_LIMIT);
  digitalWrite(LED_BUILTIN, tooHot ? HIGH : LOW);


  display.clearDisplay();
  display.print(t, 1); display.print("℃");
  display.print((int)round(h)); display.print("%");
  drawFace(tooHot); // 表情反馈
  display.print(tooHot ? "LED: ON  (HOT)" : "LED: OFF (OK)");
  display.display();


  Serial.print("T="); Serial.print(t,1); Serial.print("℃  H=");
  Serial.print(h,0);
  Serial.println(tooHot ? "%  HOT" : "%  OK");
}


#include <TM1637Display.h>
#include <Servo.h>
#define CLK 8; #define DIO 9; #define BUTTON_START 2; #define
BUTTON_PLUS 3; #define BUTTON_MINUS 4;
#define SERVO_PIN 9; #define BUZZER_PIN 10; #define LED_PIN 11;
#define LDR_PIN A0;
TM1637Display display(CLK, DIO);
Servo servo;
int feedTime = 60;
bool counting = false;
unsigned long lastCount = 0;

void setup() {
  pinMode(BUTTON_START, INPUT_PULLUP);
  pinMode(BUTTON_PLUS, INPUT_PULLUP);
  pinMode(BUTTON_MINUS, INPUT_PULLUP);
  pinMode(BUZZER_PIN, OUTPUT);
  pinMode(LED_PIN, OUTPUT);
  servo.attach(SERVO_PIN);
  servo.write(0);
  display.setBrightness(0x0f);
  display.showNumberDec(feedTime, true);
}

void loop() {
  int light = analogRead(LDR_PIN);
  digitalWrite(LED_PIN, light < 500 ? HIGH : LOW);

  if (!counting) {
    if (digitalRead(BUTTON_PLUS) == LOW) { feedTime =
minr(feedTime + 10, 9999); display.showNumberDec(feedTime, true);
delay(200); }
    if (digitalRead(BUTTON_MINUS) == LOW) { feedTime =
max(feedTime - 10, 0); display.showNumberDec(feedTime, true);
delay(200); }
    if (digitalRead(BUTTON_START) == LOW && feedTime > 0) {
counting = true; tone(BUZZER_PIN, 1000, 300); lastCount = millis(); }
  } else {

    if (millis() - lastCount >= 1000) {
      feedTime--;
      display.showNumberDec(feedTime, true);
      lastCount = millis();
      if (feedTime <= 0) {
        tone(BUZZER_PIN, 1500, 500);
        servo.write(90);
        delay(1000);
        servo.write(0);
        counting = false;
        feedTime = 60;
        display.showNumberDec(feedTime, true);
      }
    }
  }
}
```

Senser Set Up

Set Logics Of Temperature Display

Logics Of Temperature Display

- Temperature 20-30℃ 😊
- Temperature <20℃ >30℃ 😨

System Modules

We can set the feeding time automatically through a timer, accompanied by a feeding reminder sound. During the night feeding, the light will also turn on.

With the Bluetooth module installed, real-time feeding can be carried out on the APP

This design significantly reduces the difficulty of feeding, and enables quick feeding even without direct contact.

Major Components

Arduino UNO R3

Buzzer

Micro Servo

Button

Fan

ESP32-CAM

DHT11 Temperature and Humidity Sensor

OLED display screen

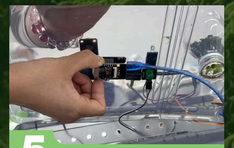
Photoresistor

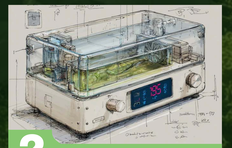
Digital display

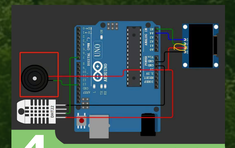
Build Process

1 Brainstorming

3 Programming


5 Assembling


2 Designing

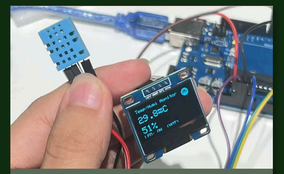

4 Developing

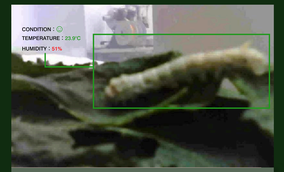
Intelligent Silkworm House Function Design

6 Finished Product
Intelligent Silkworm House

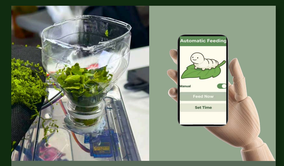
We have built an intelligent silkworm house using Arduino, which includes functions such as growth record keeping, temperature and humidity monitoring, and automatic feeding. In order to embody the concept of nature, we chose to use moss and green plants for scene arrangement in landscaping.

- The Smart Silkworm House is designed as an ***interactive educational device*** that blends biological observation with IoT-based automation.
- Inspired by the rich sericulture heritage of Ma Village and modern STEAM pedagogy, the product aims to enhance children's ***experiential learning*** through real-time interaction with silkworms.


Temperature And Humidity Monitoring System



System Of Intelligent Monitor



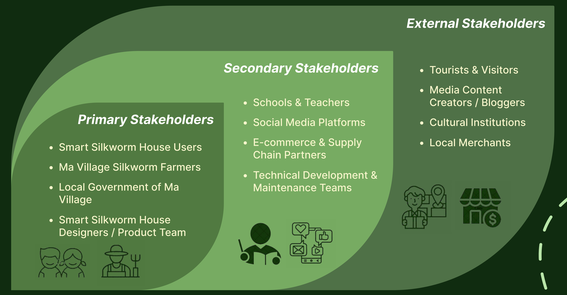
Automatic Feeding System

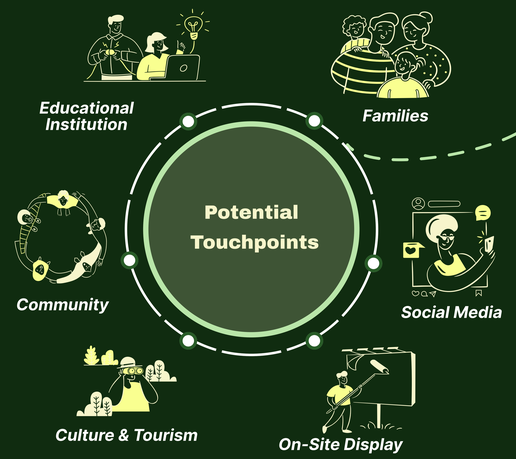
A motorized feeder releases mulberry leaves at set times or via app control, ensuring regular feeding and reducing manual work.

MARKETING SOLUTION

Beyond building the system, we mapped how different stakeholders could engage with the product—revealing its real-world pathways, touchpoints, and long-term growth potential.

Stakeholders Map





AISAS Model —— *Understanding user motivations across every stage*

Attention
Smartization & Emotional Appeal

Users are first drawn in by the smart, therapeutic, and family-friendly positioning of silkworm raising—amplified by trending topics such as intelligent monitoring, homework-related parenting discussions, and culturally nostalgic content around traditional sericulture on social platforms.

A

Interest
Novel Hobby & Educational Value

The smart silkworm house transforms the farming task into a light, playful, and educational hobby, offering automated functions, stage recognition, STEAM value, and strong emotional resonance similar to digital pets and travel journaling.

I

Search
Online Information Exploration

Users actively search for product details across platforms—comparing brands, reading reviews and user stories, checking certifications, and evaluating reliability before making decisions.

S

Action
Online–Offline Experience System

Users engage in a dual-phase system: online they download the app, adopt a virtual silkworm, complete feeding and environment-regulation tasks; offline they purchase and connect the smart house, perform real feeding, adjust humidity, buy mulberry leaves, and even participate in village research activities.

A

Share
High-Engagement UGC Loop

Users naturally share their silkworm-raising journey, from cute daily updates and AR photos to NPC interactions and village visits, creating authentic user-generated content that strengthens trust, emotional bonding, and community spread.

S

Project Promotion

Content

- Creative Advertising
- Farmer Q&A Livestreams
- First-Person Silkworm Life Streams

Creates visibility and curiosity through creative social media content and livestreamable storytelling.

Uses physical materials and curated narratives to reinforce learning and cultural value.

- Posters & Print Materials
- Effect Display Boards
- Character Merchandise

Online Strategy

- Create a RedNote account and share smart silkworm house content
- Post nature-education facts and device-making clips to boost visibility
- Grow reach using tags for healing, nature, and STEAM learning

Uses digital channels to convert interest into engagement via apps like Red Book and short-video platforms like Tiktok.

Experiences

Engages users through real-real-world interactions such as tourism, STEAM workshops, and exhibitions.

- Ma Village Tourism Services
- Cultural Markets & Event Booths
- Smart Silkworm House Demonstrations

Offline Marketing

REFLECTION

Working on this project deepened my understanding of how EdTech can cultivate community-based learning ecosystems that merge real-world practices with accessible digital environments.

1. ***Learned that effective educational systems must balance user learning motivations, cultural context, and stakeholder economic goals through fieldwork research on Ma Village***
2. ***Reflected on how technology can translate traditional agricultural knowledge into interactive learning without losing authenticity.***
3. ***Recognized the importance of designing EdTech that supports experiential learning, where digital tools enhance hands-on understanding.***