

# 2025.8-2025.9

## OVERVIEW

"WONDERORB" supports children with tactile sensitivity by applying neural plasticity and gradual desensitization. It provides multimodal, gamified training at home and during treatment waiting periods. The system tracks responses to different materials, offering parents data for progress monitoring. It integrates perceptual feedback, game-based interaction, and a simple machine learning system for adaptive judgment. Future work will optimize visual and auditory experiences, refine feedback grading, and enhance the parent app to generate personalized suggestions based on data and parental input.

## GROUP PROJECT WITH:

Tianhao Wang Jingyun Qiao

## INDIVIDUAL RESPONSIBILITY:

Product technology implementation (code,Machine learning) / Product rendering / App design / Visual design

Therapeutic products for children with tactile sensitivity:

# WONDERORB

[PROCESS LINK](https://www.youtube.com/watch?v=Xlw_oB1jYSo)

[FINAL LINK](https://www.youtube.com/watch?v=ujKzmvCCZI)

CHECK THE  
CODE  
LIBRARY



MAIN SOFTWARE



2#



# BACKGROUND

## Children with Tactile Defensiveness

Tactile perception develops early and is key to comfort, bonding, and stress control. Without intervention, sensitivity can affect emotions, social skills, and daily life.



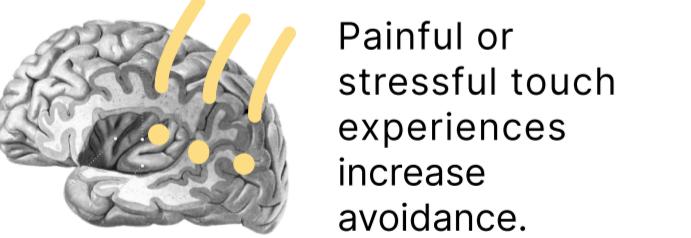
## REASONS / PROCESS

### 1. Physiological

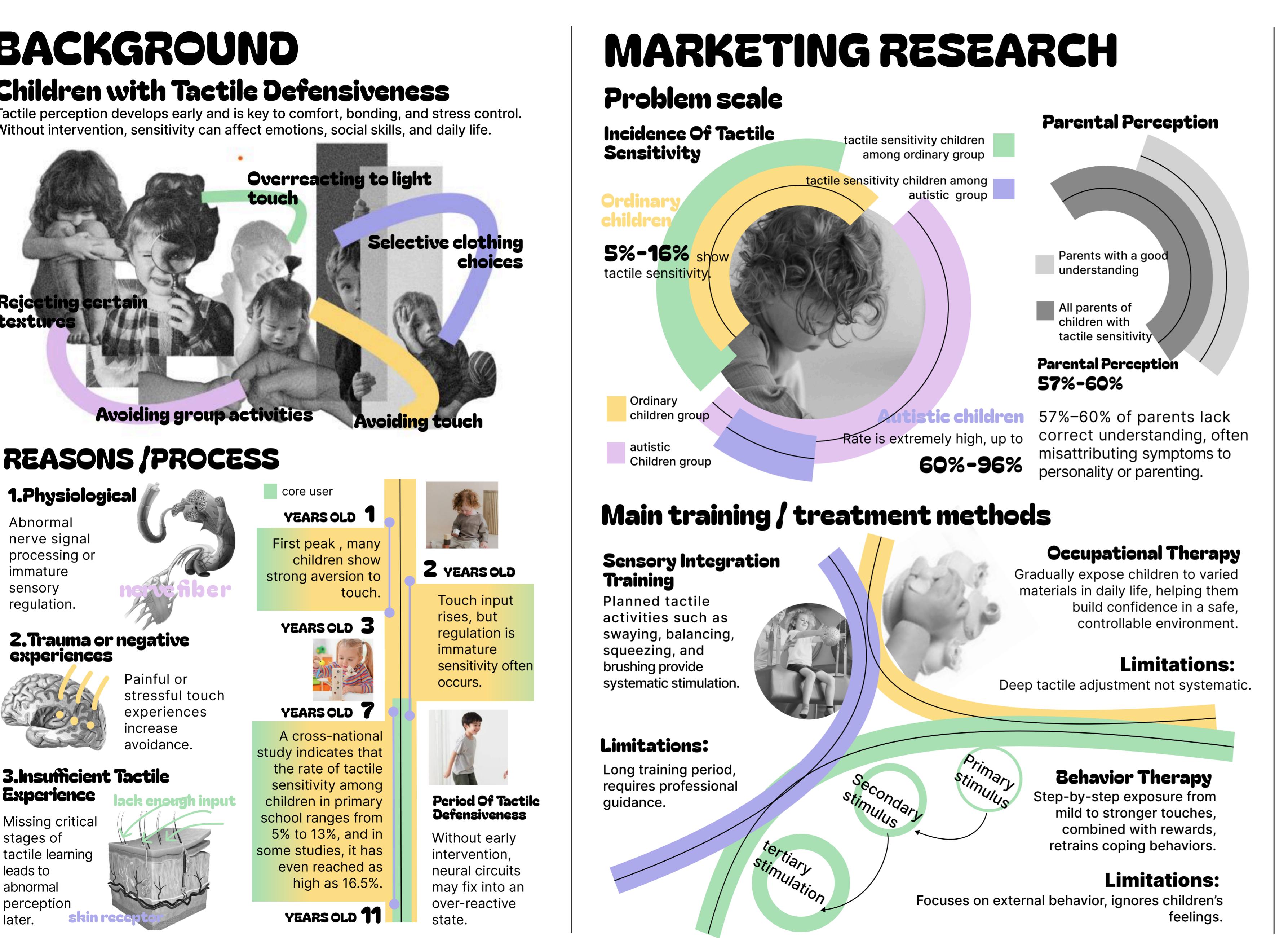
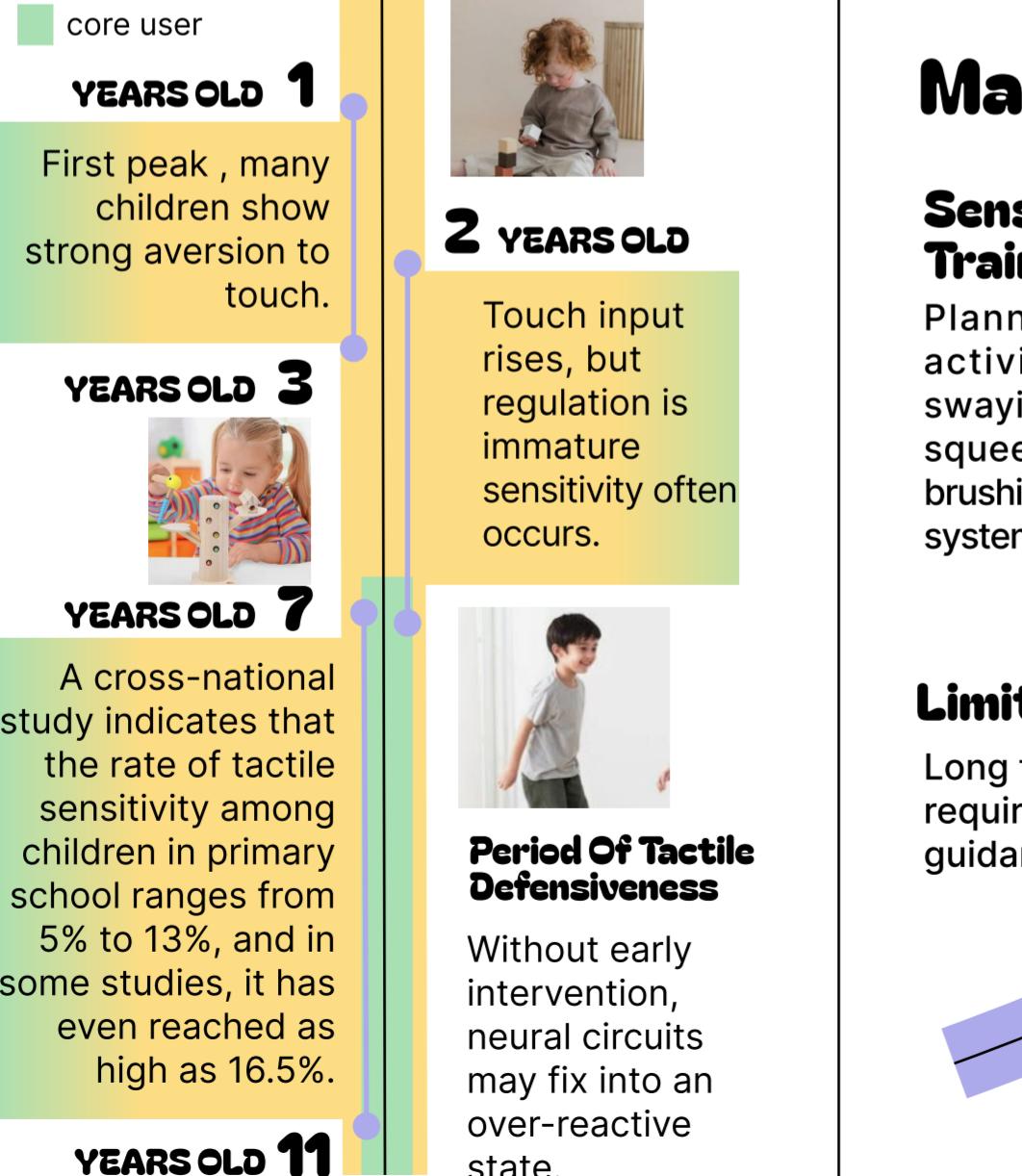
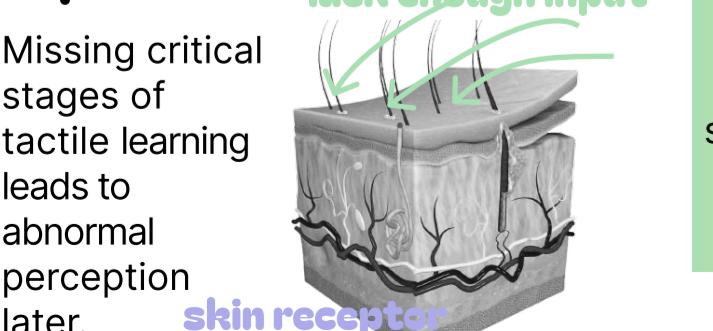
Abnormal nerve signal processing or immature sensory regulation.



### 2. Trauma or negative experiences



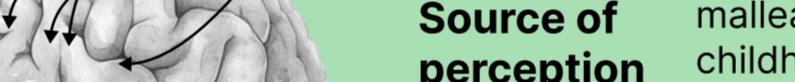
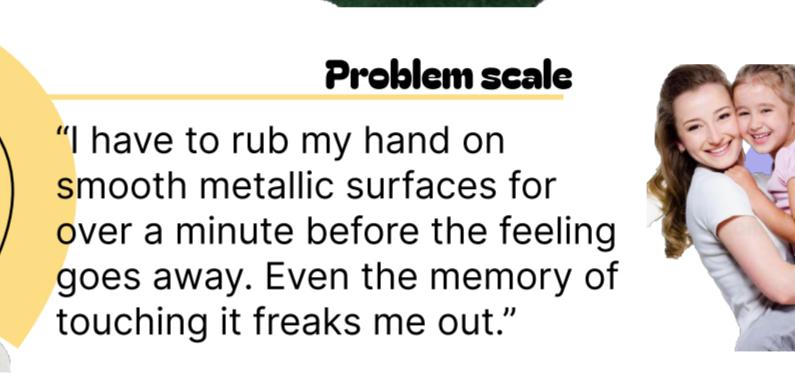
### 3. Insufficient Tactile Experience



# USER RESEARCH

## User Community Interview

We conducted offline and online community interviews. Here are some of the feedback.



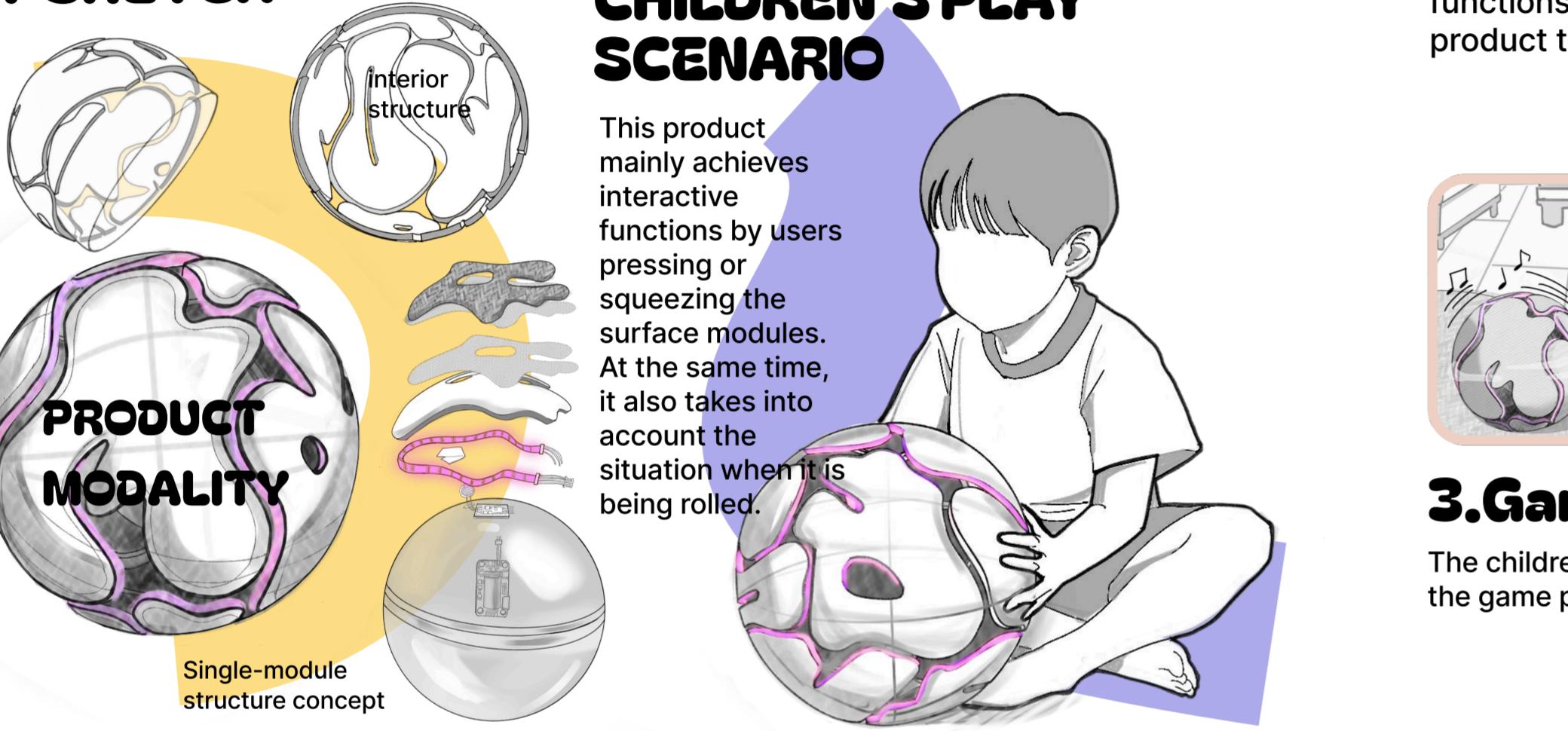
# PRODUCT CONCEPT

## OBJECTIVE

Through multimodal interactive games and sound effects, we stimulate children's interest in touching different materials. During the interaction process, we reinforce the reward feedback channel for sensitive touch sensations. At the same time, through the sense of smell, this subconscious sensory perception helps alleviate the discomfort caused by tactile interaction for the children.

## PRODUCT SKETCH

We have decided to design a teaching aid product that enables children to interact directly without the need for any other interface. The simple spherical product shape can simplify children's cognitive burden regarding the usage of the product.



## FABRIC DESIGN



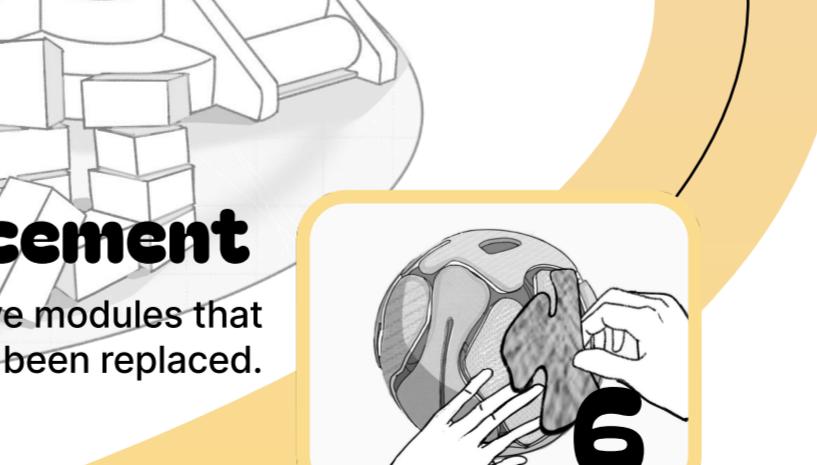
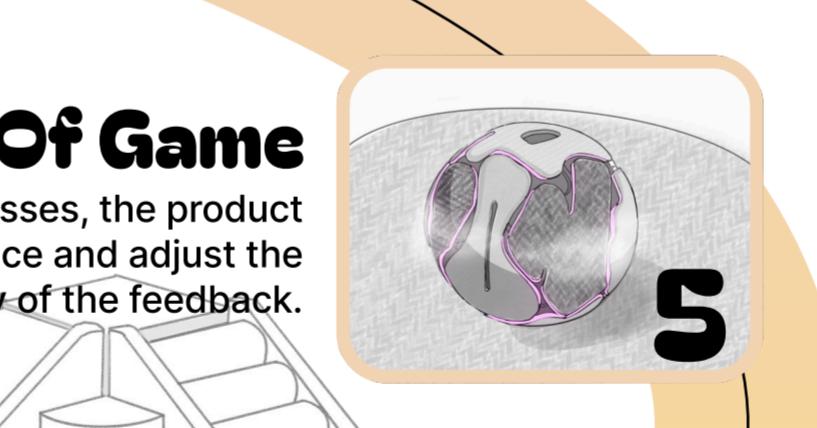
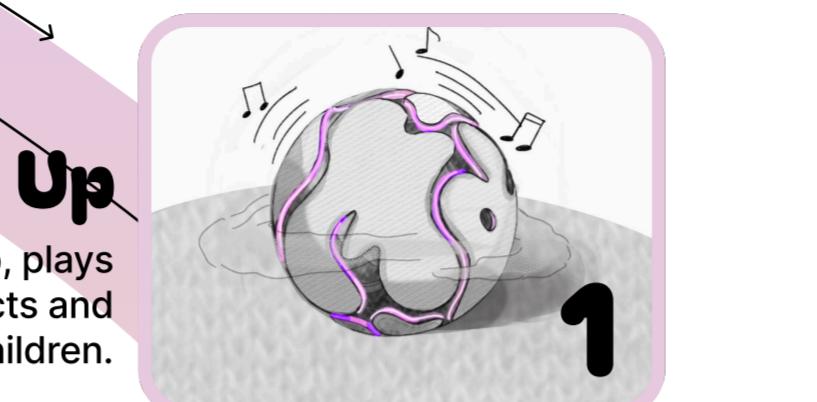
## FINAL CUTTING RESULT



This fabric module includes 14 textile samples designed to simulate both comfortable and discomfort-inducing tactile sensations for children with tactile defensiveness.

# STORYBOARD/ USERSCENARIOS

acting path



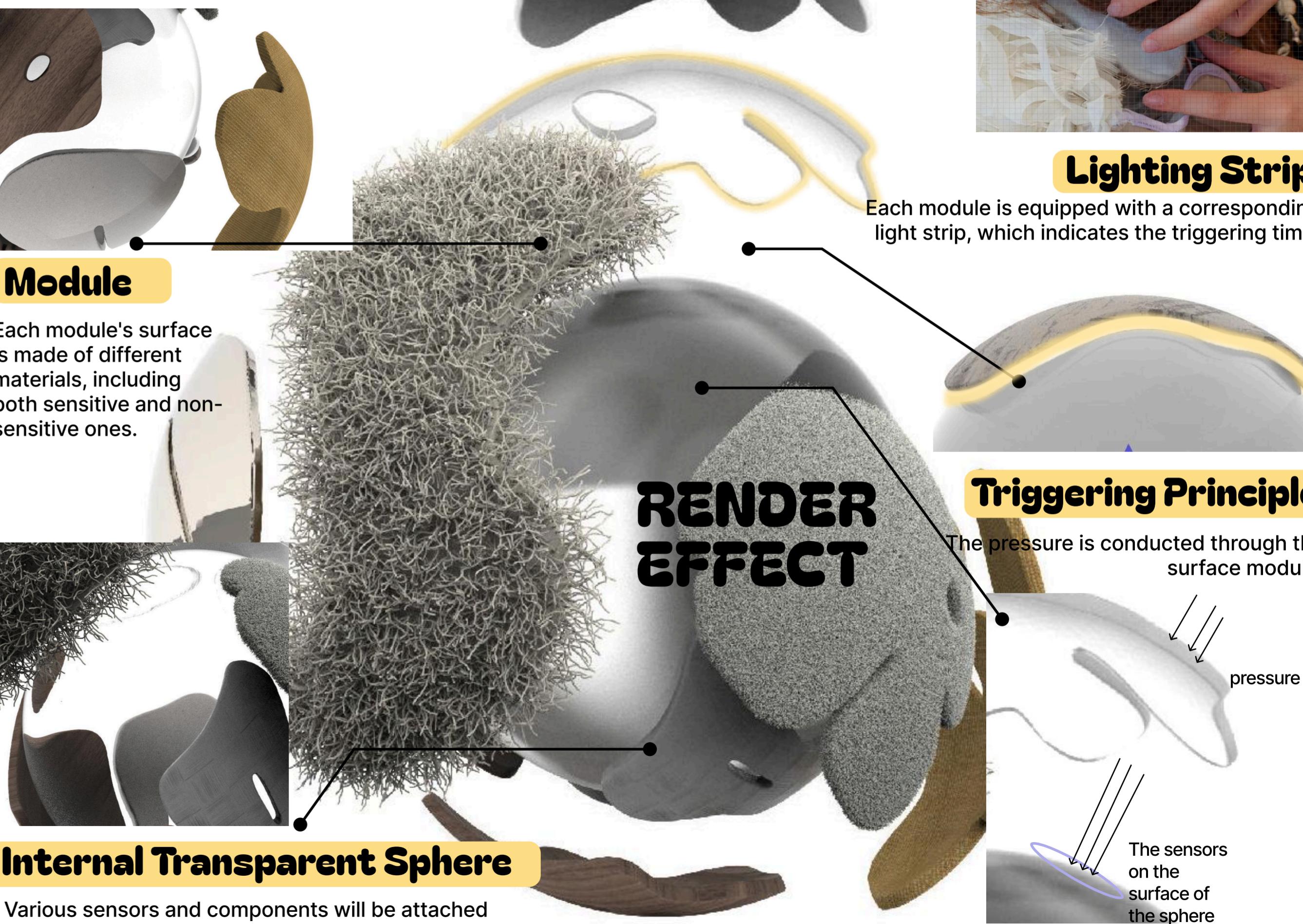
## Scene Imagery

[https://www.youtube.com/watch?v=Xlw\\_oB1jYSo](https://www.youtube.com/watch?v=Xlw_oB1jYSo)

# PRODUCT DESIGN

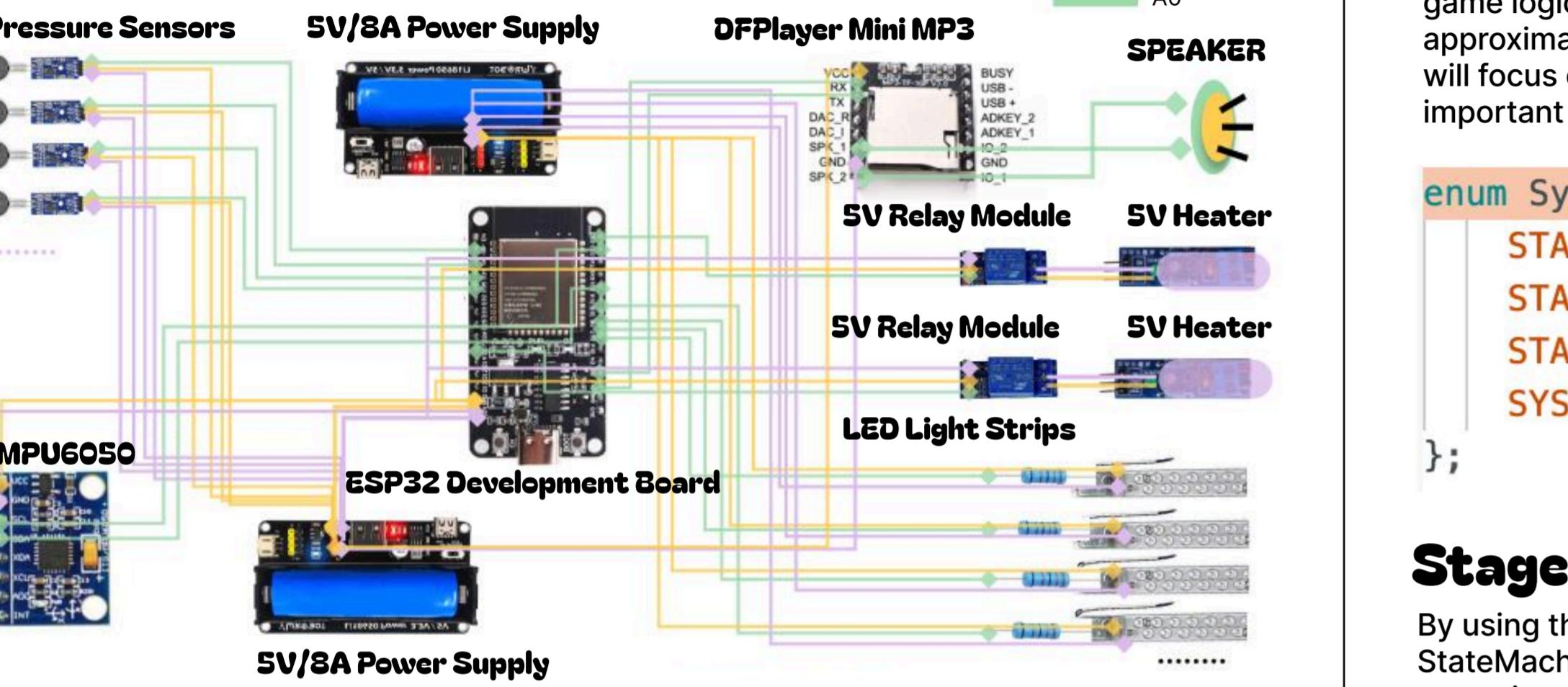
## MODEL DESIGN

For the final target product, we conducted a simple initial modeling and rendered the initial effect. Based on this, we further determined the hardware implementation methods for the specific functions.



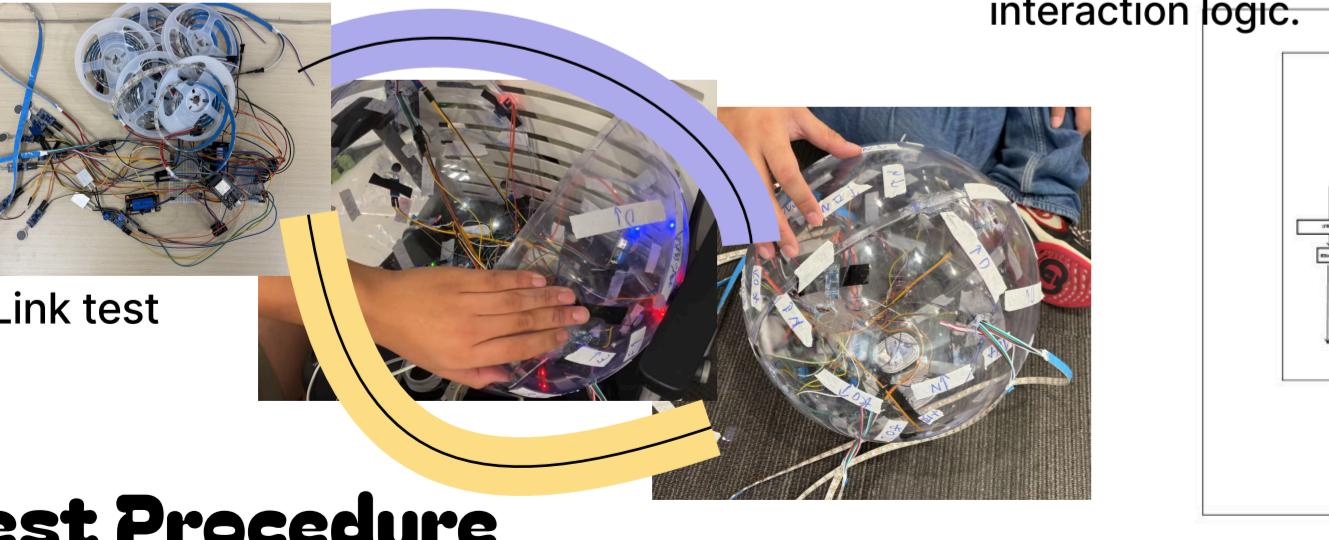
# EMBEDDED SYSTEM DESIGN

Tactile perception develops early and is key to comfort, bonding, and stress control. Without intervention, sensitivity can af=



## ELECTRICAL CONNECTION

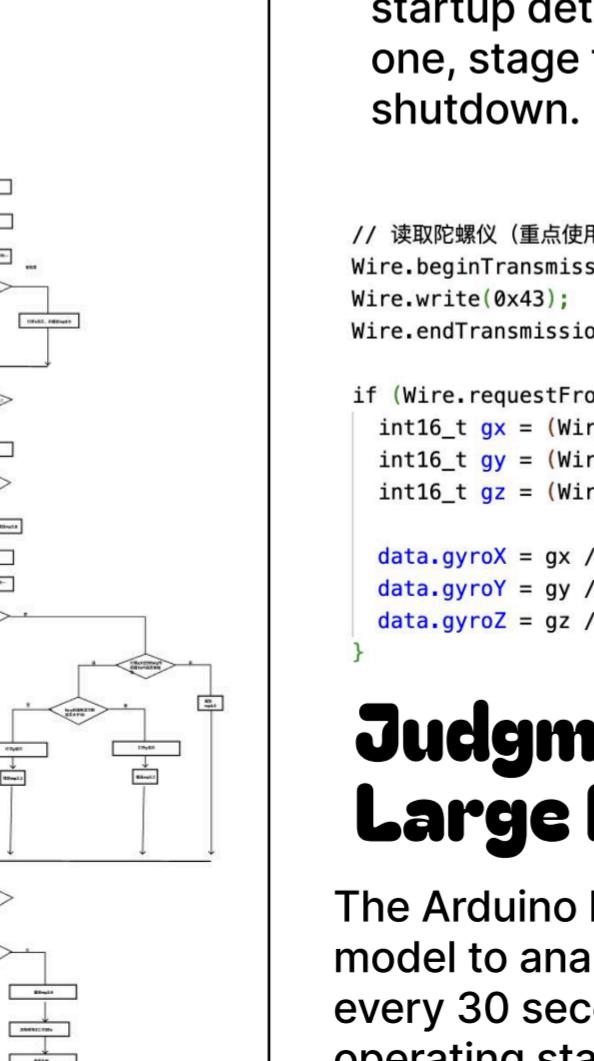
During the connection process, a 330-ohm resistor was used to ensure the operation of the LED light strip, and a relay was utilized to control the heater. After the link is completed, it undergoes two rounds of testing and is then installed inside the product.



## Test Procedure

## GAME PROGRAM LOGIC

The program logic diagram is used to implement complex interaction logic.



## Judgment Of The Large Model

The Arduino library will use the large model to analyze the gyroscope data every 30 seconds to determine the operating status of the product.

# CODE DESIGN

## OVERVIEW

The code fully replicates the basic game logic, consisting of approximately 600 lines. Here, we will focus on explaining the important parts.

```
enum SystemState {  
    STAGE0_STARTUP,  
    STAGE1_TIMER1,  
    STAGE2_TIMER2,  
    SYSTEM_SHUTDOWN  
};
```



## Game Basic Interaction

The light strips and the pressure sensors are in one-to-one correspondence. The pressure sensors serve as the triggering medium for the light strips and the MP3 player.



## Stage-Based Timing

By using the StateMachine class, the operation of the product is divided into four stages: startup detection, stage one, stage two, and shutdown.

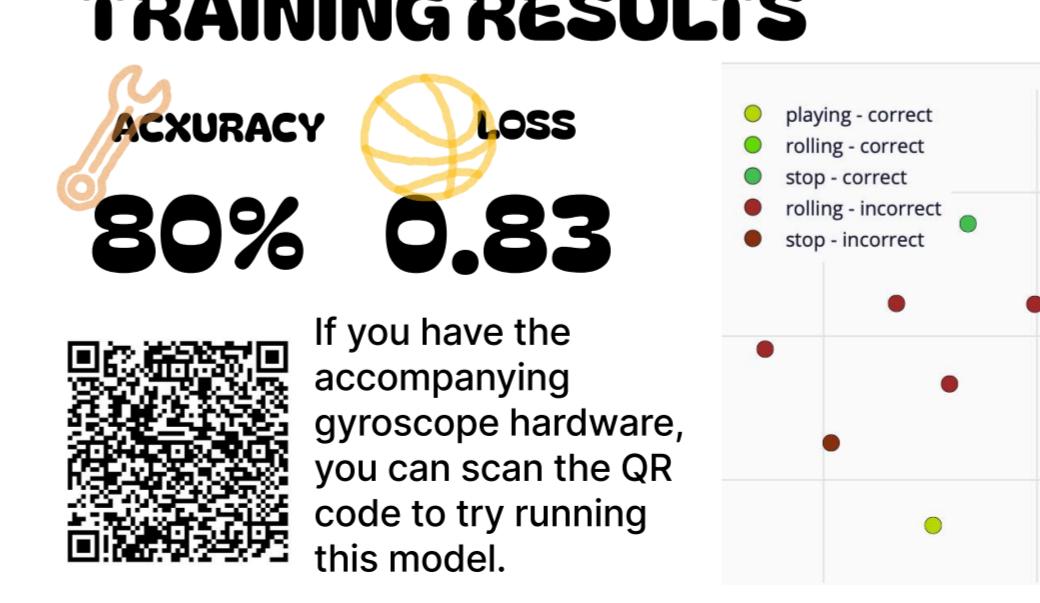


# TRAINING RESULTS

ACURACY  
**80%**

LOSS  
**0.83**

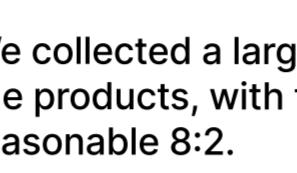
If you have the accompanying gyroscope hardware, you can scan the QR code to try running this model.



# MACHINE LEARNING

Since the product involves three methods: impact, rolling, and module replacement, we attempted to embed a small model within the product. Determine the status of the product based on sensor data.

## DATA COLLECTION

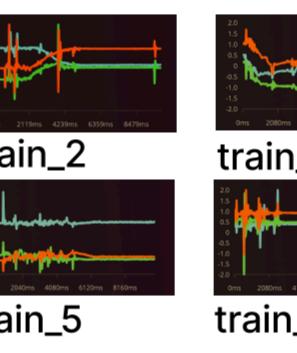


We collected a large amount of data for different states of the products, with the train/test split ratio maintained at a reasonable 8:2.

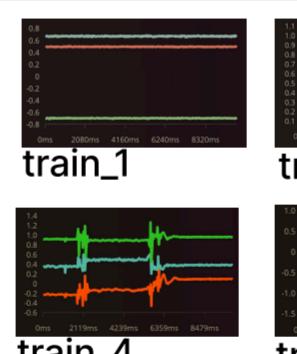
**Data Group One: Play**  
A Total Of 23 Pieces Of Data (22 Training Data, 2 Test Data)



**Data Group Two: Rolling**  
A Total Of 23 Pieces Of Data (22 Training Data, 2 Test Data)



**Data Group Three: Stop**  
A Total Of 23 Pieces Of Data (22 Training Data, 2 Test Data)



# REASONING PROCESS

Time Series Data

XY Z

Spectral Analysis

Frequency (Hz): 9  
Import the three-axis data of the gyroscope mpu6050 and perform a detection every 10 seconds.

**Output Features**

Filter Scale Axes : 1  
Input Decimation Ratio: 1

y Spectral Power: 0.39 - 3.66 Hz  
y Spectral Power: 0.28 - 0.84 Hz  
x Spectral Power: 1.41 - 1.97 Hz

A total of 39 data features were analyzed.

Number Of Training Cycles: 30  
Learning Rate: 0.0005  
Training Processor: GPU

**MODEL TRAIN**

Start training the classification model for the input data

Following the aforementioned process, the data was input multiple times and the parameters were constantly adjusted. Eventually, a complete small model that could be used by Arduino was generated.

## APPLICATION MODE

The model output is in the Arduino library.

**Model code**

Arduino library

As a callable algorithm, it is integrated into the product system.

**APPLICATION MODE**

Product

An AI inference is triggered automatically every 30 seconds. It analyzes the movement data from the gyroscope and determines the device status based on the amplitude of the data.

Model invocation in Arduino

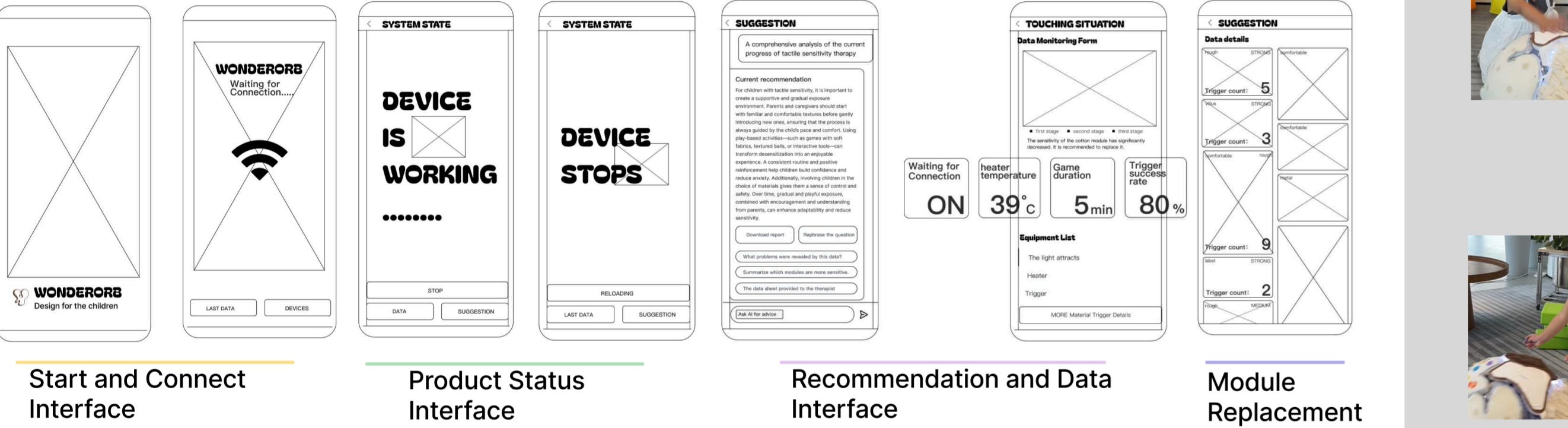
Model invocation in Arduino

# APP DESIGN OVERVIEW

The app is closely related to multiple user processes and scenarios. It includes functions such as viewing product data, assisting in module replacement, and providing relevant treatment suggestions.

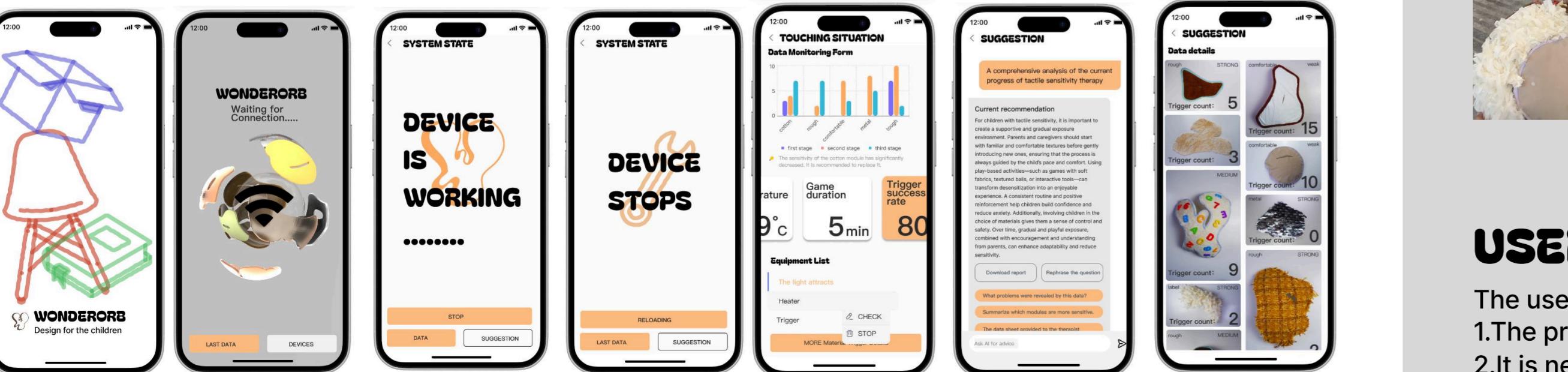
## STYLE DESIGN

The app design strictly corresponds to the user flow.

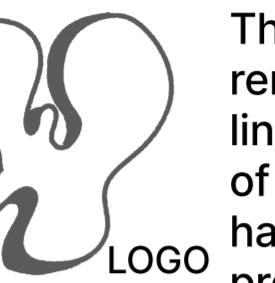


## FINAL APP OUTPUT

Different interfaces and the corresponding product usage procedures can be understood in greater detail in our process video (the link is on the homepage).



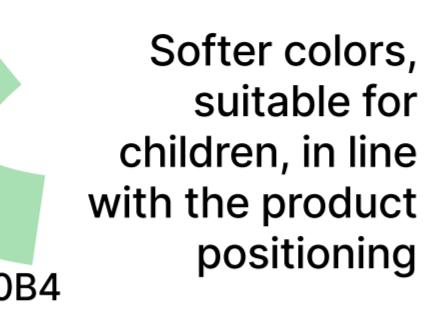
## STYLE DESIGN



LOGO

The visual style remains mainly linear, and in terms of details, it is in harmony with the product itself.

## THEME COLORS



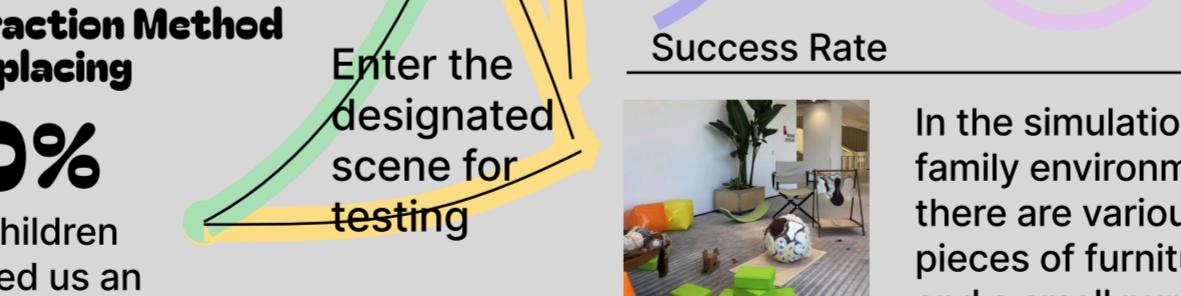
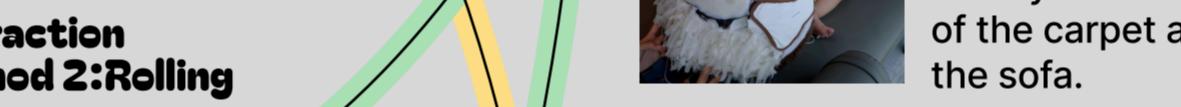
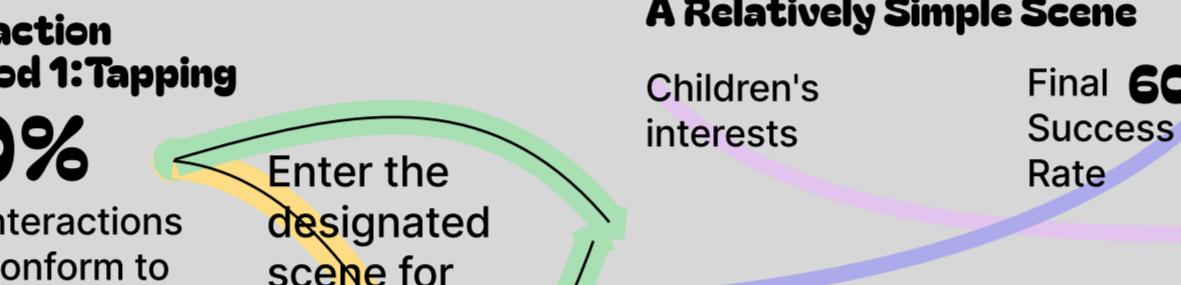
Softer colors, suitable for children, in line with the product positioning

# USER TEST/FEEDBACK

## DIFFERENT INTERACTION METHODS AND SCENARIO TEST

We invited users to take a simple test, and then recorded and collected the data. Overall, users can interact and complete the process to some extent. However, there was a considerable interest shown in the external environment and other interaction methods, which might undermine the actual effectiveness.

## Test Result



## USER FEEDBACK

The user believes that there are two areas that can be improved :  
1.The product is too large for children and lacks sufficient control.  
2.It is necessary to make the product more attractive to children.



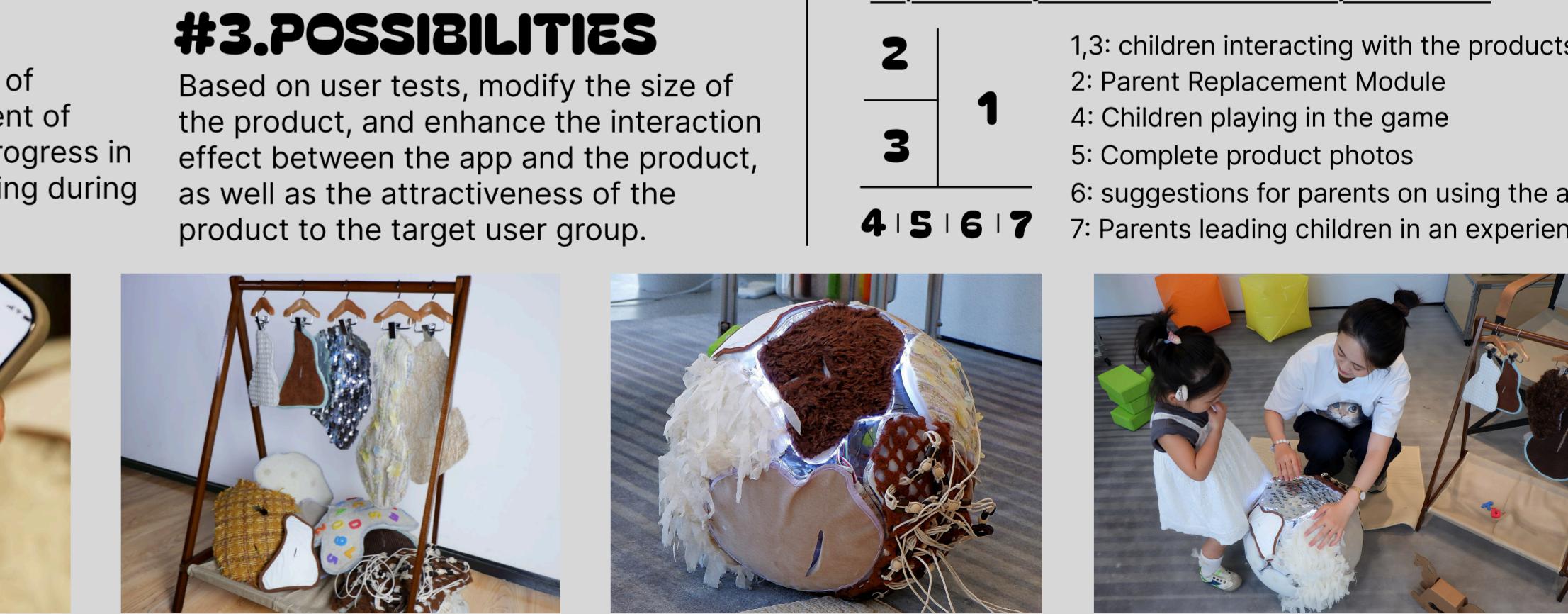
## SUMMARY

### #1.PROUD ASPECTS

The thing I am most proud of is that I successfully completed the design of a highly complex software system and successfully integrated a machine learning system through self-study and relevant software.

### #2.GAINS

I have realized the crucial role of cooperation in the advancement of project design. I have made progress in coordinating and communicating during the design process.



## FINAL OUTPUT

Through play and multisensory guidance, this device helps children gently overcome touch sensitivity and grow with confidence.

## LINK

<https://www.youtube.com/watch?v=ujKzmvcCCZI>

- |   |   |
|---|---|
| 2 | 1 |
| 3 |   |
| 4 | 5 |
| 6 | 7 |
- 1,3: children interacting with the products  
2: Parent Replacement Module  
4: Children playing in the game  
5: Complete product photos  
6: suggestions for parents on using the app  
7: Parents leading children in an experience