BACKGROUND
Modern people often adopt bad sitting postures

Modern people often adopt bad sitting postures, like crossing legs or lying down, for short-term comfort. While relaxing at first, these postures can lead to long-term damage to the spine, joints, and circulation, increasing the risk of scoliosis and strain. Maintaining proper posture is crucial for health.

Current situation

Process
- Focus on doing things
- Unconsciously crossing legs or twisting body
- If this continues for a long time, the bones and organs will be affected.

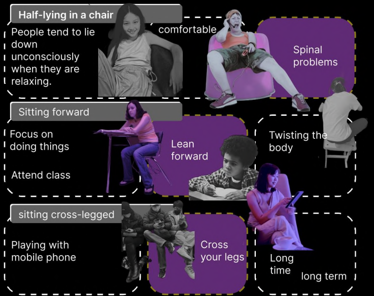
Around 60%-80% of adults and 50%-70% of young people have poor posture due to unconscious behavior, leading to spine and muscle issues, and even some serious health problems.

Common bad sitting posture

Half-lying in a chair may feel comfy but puts uneven pressure on the spine, straining the lower back and leading to fatigue, pain, and lumbar issues over time.

Leaning forward may seem comfortable but increases spinal pressure, straining the lower back and risking soreness, misalignment, and disc herniation.

Crossing legs may feel relaxing but can impair circulation, increase spinal pressure, and cause lumbar and pelvic discomfort over time.



RESEARCH
Based on scenario analysis

In daily life, unconsciously maintaining a bad sitting posture is a common behavior for many people, especially in scenarios such as office, entertainment and meetings.

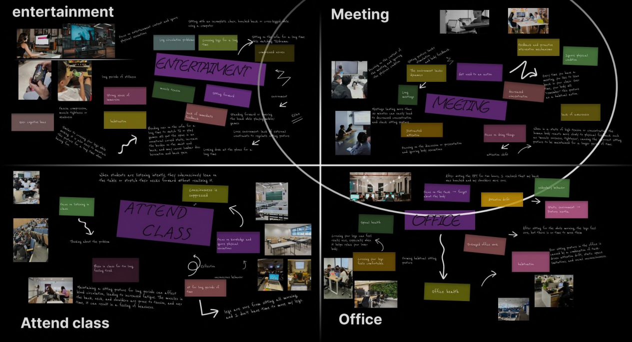
The dangers of bad sitting posture

action	action	pain points
Focus on doing something	Forgot how to sit	Lack of dynamic intervention and guidance mechanism
Sitting for long periods of time	Posture gradually deforms	Lack of immediate sensory feedback
Entertainment and leisure time	excessive relaxation	lack of self-awareness

opportunity

1. Posture-based feedback at irregular intervals
2. Provide feedback or adjustments when the sitting posture is deformed
3.Real-time posture correction reminders

Scenario analysis



Detailed analysis of human body contents

Spine

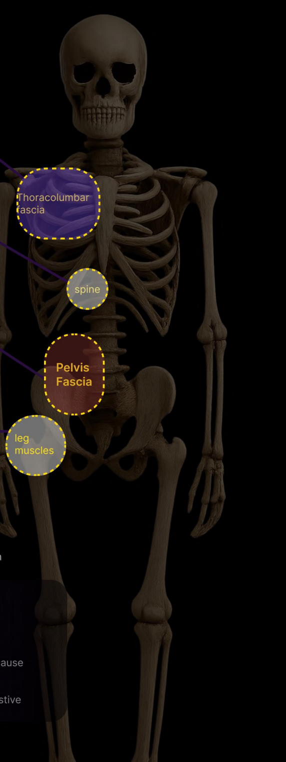
Thoracolumbar Fascia
The tension or relaxation of fascia tissue affects its support for muscles and bones, which may cause pain and limited movement.

Spine
Changes in the natural curvature increase the pressure on the spine and cause lumbar disc herniation.

Pelvis Fascia
It affects the normal curvature, increases pressure on the outer hip, and causes chronic pain.

Leg Muscles
Certain muscle groups become overly tense or stretched due to continued poor sitting posture, leading to muscle fatigue and dysfunction.

Pressure · Imbalance · Fatigue · Dysfunction



summary
Bad sitting posture mainly affects the following parts of the human body

1.Spine and pelvis: cause spinal deformation, pelvic tilt, and imbalanced posture

2.Muscles and fascia: cause muscle tension or weakness, fascia adhesion, and cause pain

3.Internal organs: compress the abdominal cavity, affecting respiratory and digestive functions

CONCEPT

From product analysis and user insights, key solution directions emerge.

- Meeting the different needs of different people in different locations
- The intensity of feedback needs to be controlled
- Better record our data and make it easier for us to control equipment

Wearable devices — Wearable design — Good adjustment / Product lightweight

Air bag — Airbag physical reminder — Physical condition ing / Expansion

App — App further optimized — Visualize data for users / Record and compare data

Operation process

At the beginning

You want to correct your unconscious bad sitting posture,

You choose wearable devices

App

You can enter the App to control your wearable device

Select device

You wear this leg bad posture adjuster on your thigh

Your next action

You unconsciously put one leg on top of the other.

Your behavior

You can do your normal thing

result

The airbag will exert force on your legs, and you will consciously change your posture.

Select device

You are wearing a back posture correction wearable device

Change

You can identify sitting posture problems by recording data, provide timely feedback and intervene, gradually change unconscious bad habits, and develop a healthy sitting posture.

Record

The relevant App will record the data when the airbag is triggered each time, so that you can adjust the airbag trigger data according to the data.

Adjust

You can adjust the airbag triggering conditions through the data recorded by the App to better adapt to your daily life.

Prototype Display

An airbag system with variable pressure is ideal for non-invasive behavioral prompts. It provides adjustable feedback, flexibility, and safety, outperforming other methods in responsiveness, adaptability, and comfort. Therefore, it is the preferred design solution.

Wearable — Considering portability, wearable is a good choice

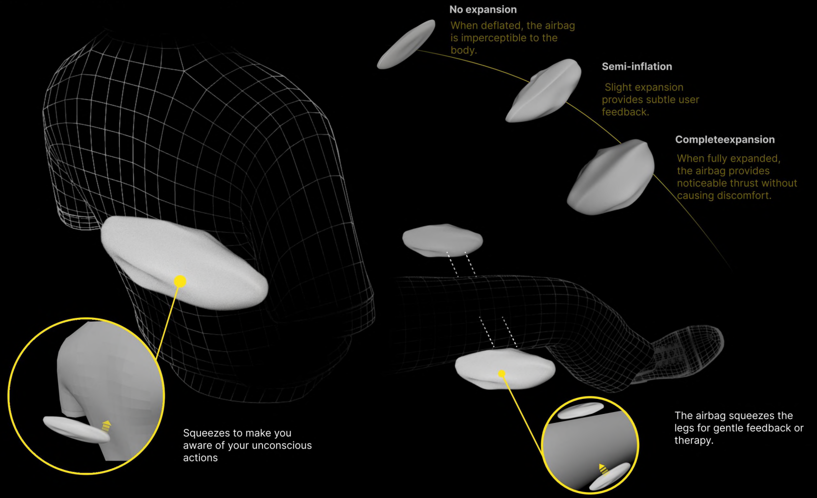
Air bag — Can provide different levels of thrust

Extrusion — Physical push is the best clue to unconscious behavior

Product

process

- Bad sitting posture detected
- Trigger different levels of airbag compression
- User feels squeezed



Principle

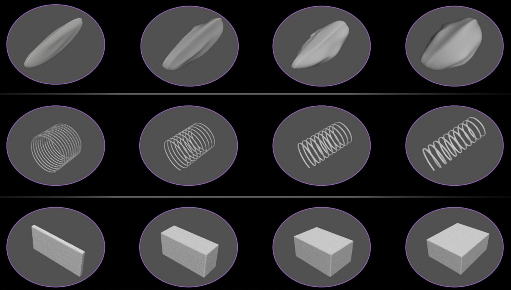
Basic principles and core concepts

• Choice of materials

To identify materials suitable for delivering a sense of thrust-based tactile feedback, we conducted a systematic comparison of different options.

pressure change

	Initial state	Inflation-33%	Inflation-66%	Inflation-100%
Air bag Provide thrust through different compression levels of the airbag				
Spring Provide thrust through different compression levels of the spring				
E-TPU Provide thrust through E-TPU compression.				



Initial state
Sensory level = 0, the user cannot feel the thrust

Inflation-33%
Sensory level = 3-4, Users can feel the edges of objects

Inflation-66%
Sensory level = 6-7, users can feel the squeezing of objects

Inflation-100%
Sensory level = 0, the user cannot feel the thrust

Airbag vs Spring
The airbag provides gentle cushioning and the spring rebounds quickly.

Airbag vs E-TPU
Compared to E-TPU, the airbag offers more responsive and adjustable rebound performance

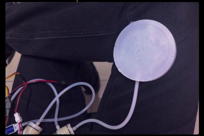
• Testing phase

"Further validation was conducted following the selection of the airbag to ensure its effectiveness and suitability for the intended application."

Prepare different airbags

Connect the airbag to the air pump

Test the inference effect of different sizes of airbags



Test result

1.Heavy feedback (19–25 N) had the highest correction rate (98%) but lower comfort.

2.Medium airbag (~8 cm, 50 cm²) offered the best balance.

3.Medium airbag (~8 cm, 50 cm²) offered the best comfort–intervention balance.

Summary

Why choose airbags ?

1.Airbag feedback offers high comfort with 87% user acceptance.

2.Fast response and precise control with 5–10 adjustment levels.

3.Improves posture and reduces fatigue by 34%.

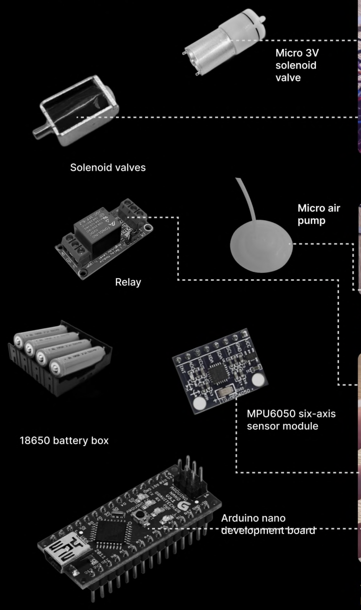
4.Low cost (~¥30), suitable for mass production.

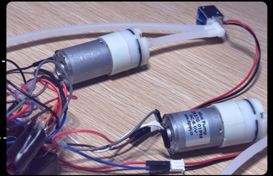
5.Delivers 7–25 N of gentle, safe force.

Technology and Innovation

Product principle structure

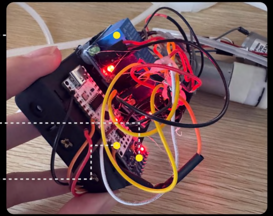
Core operating principle + key components/modules + operating logic.





The solenoid valve and air pump work together for real-time posture correction.

The airbag is the core actuator that interacts with the user, inflating to gently correct poor posture.



The system is controlled by an Arduino Nano, integrating MPU6050 posture detection, relay control, and battery power to enable portable posture correction.

Coding and Test

writing the program code and conducting tests to verify its performance and correctness.

Flowchart Steps

```
+----------------------+
|     System Start     |
+----------------------+
           |
           v
+----------------------+
|     Detect Tilt      |
|   (Left / Right)     |
+----------------------+
       /         \
      v           v
+-------------+  +-------------+
|  Tilt Left  |  | Tilt Right  |
+-------------+  +-------------+
       |                |
       v                v
+--------------------+  +---------------------+
| Inflate Left Airbag|  | Inflate Right Airbag|
+--------------------+  +---------------------+
       |                |
       v                v
+--------------------+  +--------------------+
|  Detect Neutral?   |  |  Detect Neutral?   |
+--------------------+  +--------------------+
       |                |
       v                v
+--------------------+  +---------------------+
| Deflate Left Airbag|  | Deflate Right Airbag|
+--------------------+  +---------------------+
        \               /
         v             v
     +--------------------+
     |  Loop Monitoring   |
     +--------------------+
```

Code introduction

1.Define and initialize area

Load libraries, set pins, and define thresholds for detecting and adjusting posture abnormalities.

2.The main loop loop() starts

Continuously collect X-axis acceleration data to determine posture (forward, backward, or neutral).

3.Detection logic

Control airbag inflation or deflation based on left or right tilt to adjust posture.

1.Define and initialize area

```
#include <Adafruit_MPU6050.h>
#include <Adafruit_Sensor.h>
#include <Wire.h>

// --- 引脚定义 ---
const int VALVE_PIN = 4;      // 控制电磁阀的继电器引脚 (两个系统共用)
const int PUMP_1_PIN = 5;     // 控制第一个泵的继电器 (系统1)
const int PUMP_2_PIN = 3;     // 控制第二个泵的继电器 (系统2)

// --- MPU6050 设置 ---
Adafruit_MPU6050 mpu;

// --- 状态机变量 ---
bool isSystem1_Inflated = false; // 系统1 (x < -2) 的状态
bool isSystem2_Inflated = false; // 系统2 (x > 2) 的状态

// --- 阈值定义 ---
const float ACCEL_THRESHOLD_LOW = -2.0; // 系统1的触发阈值  这里是角度
const float ACCEL_THRESHOLD_HIGH = 3.0; // 系统2的触发阈值  这里也是角度  一左一右

void setup(void) {
  // 启动串口通讯
  Serial.begin(115200);

  // 初始化所有继电器控制引脚为输出模式
  pinMode(VALVE_PIN, OUTPUT);
  pinMode(PUMP_1_PIN, OUTPUT);
  pinMode(PUMP_2_PIN, OUTPUT);

  // ==========================================================
  //        新增: 启动/复位时的强制安全放气程序
  // ==========================================================
  Serial.println("!!! 系统启动或被复位 !!!");
  Serial.println("强制执行5秒安全放气程序，确保所有气囊排空...");
```

Introduce the necessary libraries (Wire, MPU6050)

Define pins and thresholds

1

```
  // 将所有相关引脚设为低电平，执行放气
  digitalWrite(VALVE_PIN, LOW);
  digitalWrite(PUMP_1_PIN, LOW);
  digitalWrite(PUMP_2_PIN, LOW);

  // 强制等待5秒，确保物理上完全放气
  delay(5000);

  Serial.println("5秒安全放气完成。系统现在安全。");
  Serial.println("----------------------------------------");
  // ==========================================================
```

Posture detection process

2

2.The main loop loop() starts

```
void loop() {
  // (loop 函数内容与上一版完全相同，无需修改)
  sensors_event_t a, g, temp;
  mpu.getEvent(&a, &g, &temp);

  float accelX = a.acceleration.x;

  Serial.print("X轴加速度: ");
  Serial.print(accelX);
  Serial.print(" | 系统1: ");
  Serial.print(isSystem1_Inflated ? "已充气/保压" : "待命");
  Serial.print(" | 系统2: ");
  Serial.println(isSystem2_Inflated ? "已充气/保压" : "待命");
```

Read seated tilt data and output the current attitude and the status of both airbag systems.

3

3.Detection logic

```
  // 系统 1 的逻辑 (x < -2)
  if (accelX < ACCEL_THRESHOLD_LOW && !isSystem1_Inflated) {
    Serial.println(">>> 系统1: 触发充气 (泵工作3秒)...");
    digitalWrite(VALVE_PIN, HIGH);
    digitalWrite(PUMP_1_PIN, HIGH);
    delay(3000);//这里是充气时间
    digitalWrite(PUMP_1_PIN, LOW);
    isSystem1_Inflated = true;
    Serial.println(">>> 系统1: 充气结束，进入保压状态。");
    Serial.println("----------------------------------------");
  }
  else if (accelX > ACCEL_THRESHOLD_LOW && isSystem1_Inflated) {
    Serial.println(">>> 系统1: 触发放气 (5秒)...");
    digitalWrite(VALVE_PIN, LOW);
    digitalWrite(PUMP_1_PIN, LOW);
    delay(5000); //这里是放气时间
    isSystem1_Inflated = false;
    Serial.println(">>> 系统1: 放气结束，重置待命。");
    Serial.println("----------------------------------------");
  }

  // 系统 2 的逻辑 (x > 2)
  if (accelX > ACCEL_THRESHOLD_HIGH && !isSystem2_Inflated) {
```

Tilt (System 1) detection and inflation control

Return to normal sitting position (forward leaning release)

4

```
    Serial.println("### 系统2: 触发充气 (泵工作3秒)...");
    digitalWrite(VALVE_PIN, HIGH);
    digitalWrite(PUMP_2_PIN, HIGH);
    delay(3000);//这里是充气时间
    digitalWrite(PUMP_2_PIN, LOW);
    isSystem2_Inflated = true;
    Serial.println("### 系统2: 充气结束，进入保压状态。");
    Serial.println("----------------------------------------");
  }
  else if (accelX < ACCEL_THRESHOLD_HIGH && isSystem2_Inflated) {
    Serial.println("### 系统2: 触发放气 (5秒)...");
    digitalWrite(VALVE_PIN, LOW);
    digitalWrite(PUMP_2_PIN, LOW);
    delay(5000); //这里是放气时间
    isSystem2_Inflated = false;
    Serial.println("### 系统2: 放气结束，重置待命。");
    Serial.println("----------------------------------------");
  }

  delay(100);
```

Tilt (System 2) detection and inflation control

Return to normal sitting position

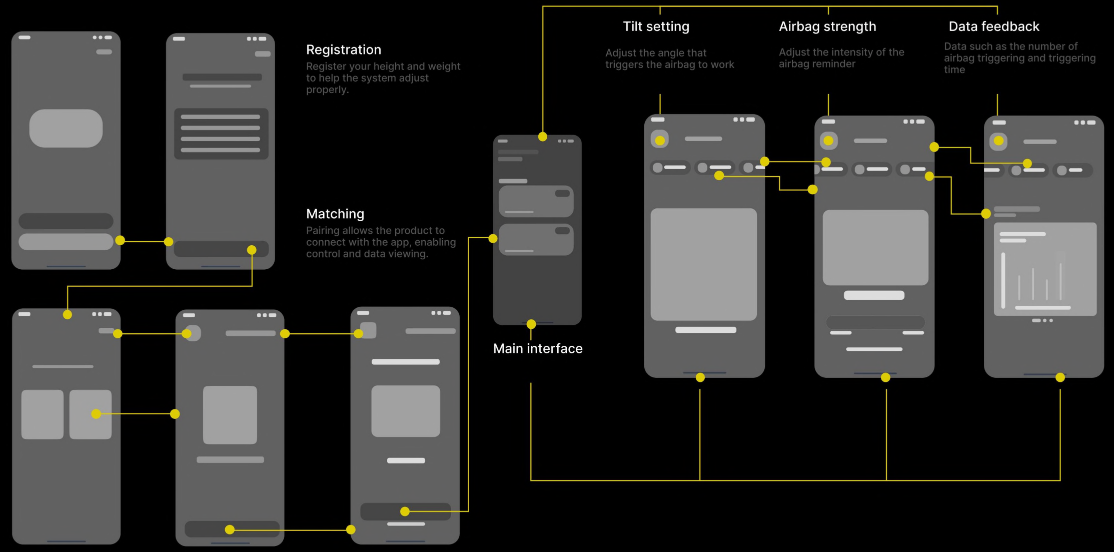
5

Final outcome

The combination of physical products and the Internet

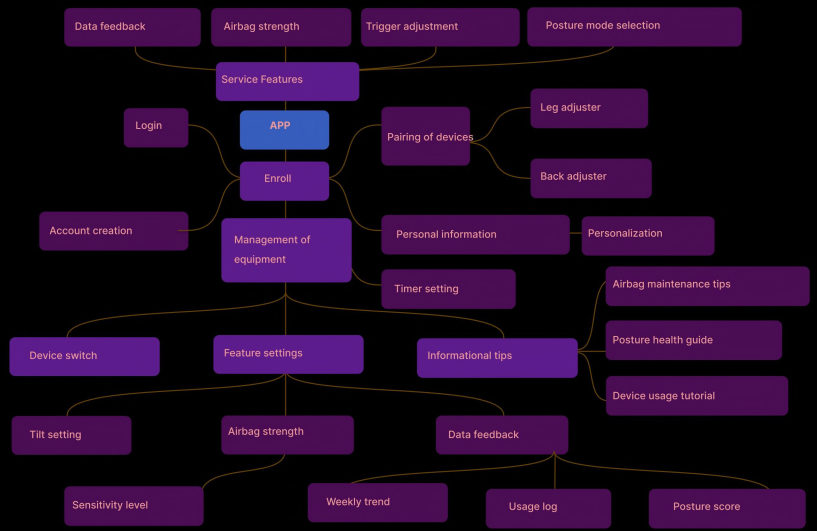
- **UI low fidelity**

In the early stages of product development, UI low-fidelity prototypes are used to quickly explore layout ideas and user flows without focusing on visual design.



- **UI flowchart**

Creating a UI flowchart helps clarify the overall user journey, ensures logical screen transitions, and aligns the team on the product's interaction structure before detailed design begins.



User testing

The character is focused, working intently at their desk.

They unconsciously cross their legs or start slouching.

A moment of discomfort breaks their focus.

They pick up the posture corrector from the table.

The device is placed on the lap and secured.

As posture slips, the airbag inflates gently — they sit upright again.