Prototype 2

StressLess Group Project

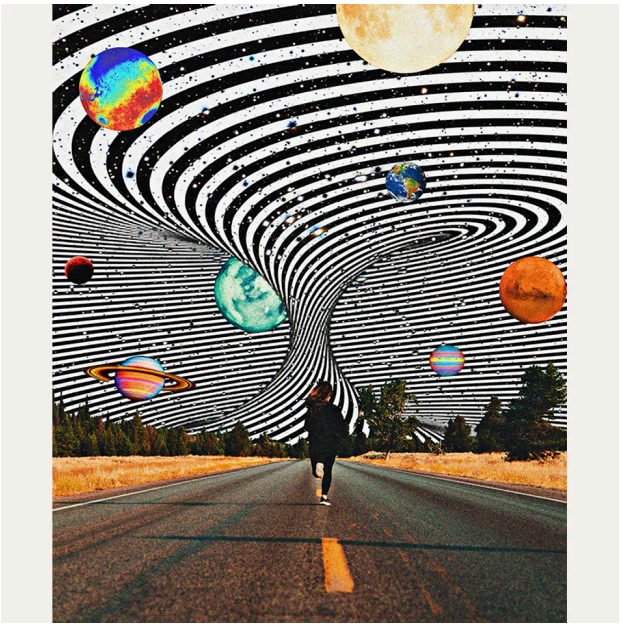
Embroidery Research – Neha

Within this prototype, we made more of an effort to consider how we make use of the wristband material that we decided would be nylon. In our initial prototype, we focused on how we could ease the stress levels of the user; however, we did not focus on providing the user with an outlet where they could attempt to deal with their stress. We came across the use of embroidery, a technique whose output would provide users with tactile interactions that they could focus on rather than engaging in harmful stress-induced behaviours such as skin pulling. Upon researching this art style, we came across the use of flowers in embroidery. This is as a result of the psychological advantages flowers provide to users, with a large increase in relaxation and reduction in stress levels, something integral for our project. From here, we made a mood board taking inspiration from the embroidery of various flowers and plants. We attempted to take inspiration from a wide range of flowers of different sizes, petal lengths and leaves to provide the user with a variety of tactile interactions. However, upon researching the use of flowers in embroidery, we came across the usage of space in embroidery. We decided to implement space within our project, as we felt that it calmed users, emphasising to them how inconsequential their worries are relative to the vast size of the universe. This connects to the artists' research we conducted below, whose aims were to invoke senses of peace and perspective with their cosmic imagery. We decided to hone down the idea of the universe to the solar system, due to the widespread knowledge many have of it. This allows them to connect with our project better, as they can connect with the components of the solar system, such as planets.

Artist Research – Nana

We looked at artists to try and decide what our embroidery art should be. We looked at some floral textile artists but in the end decided on taking inspiration from space artists because their message was linked to ours the best.

Morysetta (Larisa Murariu)



Larisa Murariu is a digital collage artist and graphic designer from Romania, also known as Morysetta (Murariu, 2025); the name comes from the idea of Larisa's personal moon being known as Morysetta, an imaginary astronaut. Her art is created through the online layering of online images and images she captured herself. She often creates album covers for musical projects. Murariu's work is often centred around space because she wants space to represent the subconscious since both are boundless. She believes that when we die, we all dissolve into a soup of life energy from which new life force is formed. Space signifies the unknown, the unexplored, and the part of ourselves that we don't fully grasp. This links well to the idea of relaxation, and that's the sort of imagery/idea we'd want to present with work so that the user feels calmer and at peace. Her work explores the art movement of surrealism and the distortion of reality, using bright, dreamlike colours in her work to reinforce this. Her most popular work is "Escapism", an NFT collection of seven original collages. We were inspired by her bold use of colour when creating the space elements of her artwork and wanted to include this in our work to make our device more visually engaging.

Pandora Mond

Pandora Mond is an oil painter who studies at the Ruskin School of Drawing and Art and focuses on large-scale painting of the sea and planets (Lansonneur, 2020). She does this to make something visible and material out of what is inherent; that is the paradox behind this project: the planets in her work are simply too far away to be seen. Her artwork on planets is on the more abstract and experimental side, with the lack of precision in her paint strokes and the occasional splatter. This helps create a more relaxed feeling for the work, the same effect we'd want our monitor to have. Mond's work is very textured and adds an extra level of depth to the paintings. With our wristband, we

also want to have different textures and materials on it to create the design. Mond has been quoted as saying, "My paintings are internal landscapes. They aim to evoke rather than describe the vastness and beauty of the natural world, to create an immersive space for quiet meditation in our harried lives." We felt that having space imagery in our work would make the user feel more immersed in reality and able to meditate, like how Mond has described.

Embroidery

Moodboard Inspiration – Neha

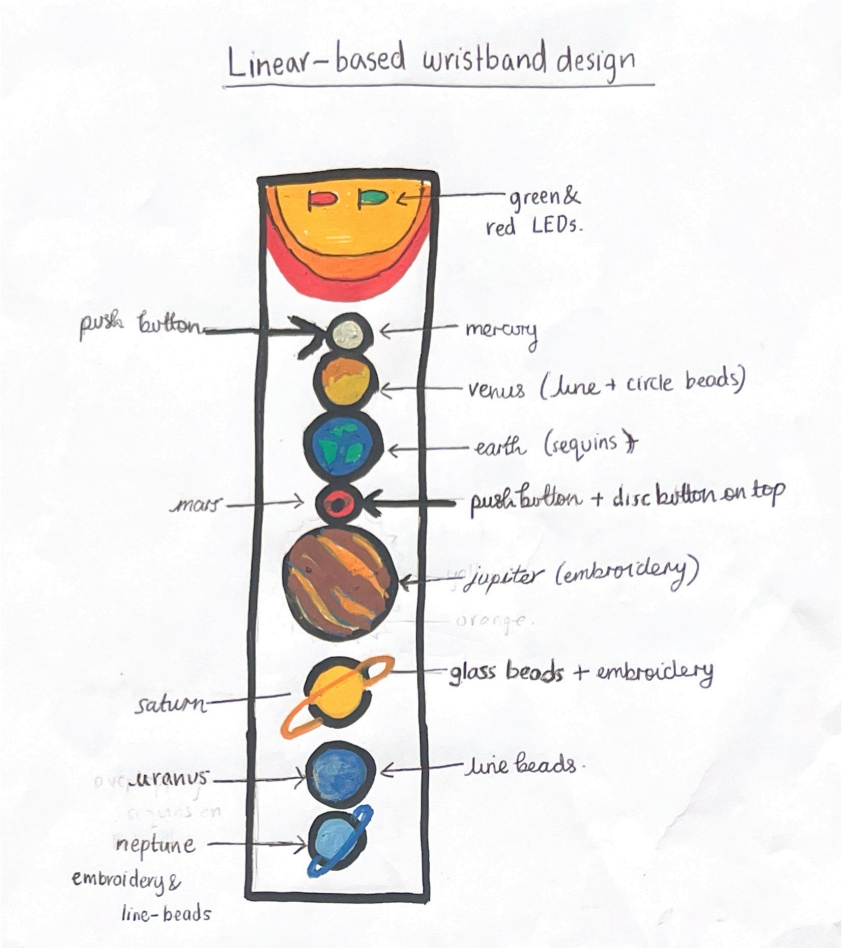
This moodboard focused on the incorporation of space to inspire our nylon wristband design. This implored us to use beads within embroidery, another tactile interaction for the user. We began to explore what other components we could include in the embroidery and decided upon the use of sequins, push buttons, and disc beads, which all provide different textures to interact with. Our inspirations included both linear and cyclical arrangements of planets, both of which we attempted to incorporate in our initial sketches, shown below.

Sketches

We had two different designs for the layout of the planets on the wristband; however, we kept the tactile interactions the same across the two designs.

1) The buttons we found were very small, therefore, we allocated their use to the smallest planets, Mercury and Mars. Mars additionally had a disc button placed on the button.
2) The sequins were used on Earth and Uranus.
3) Neptune was made with embroidery and line beads
4) Venus is made of line and circle beads
5) Saturn was made with pearl beads and embroidery
6) The sun and Jupiter were entirely made with embroidery

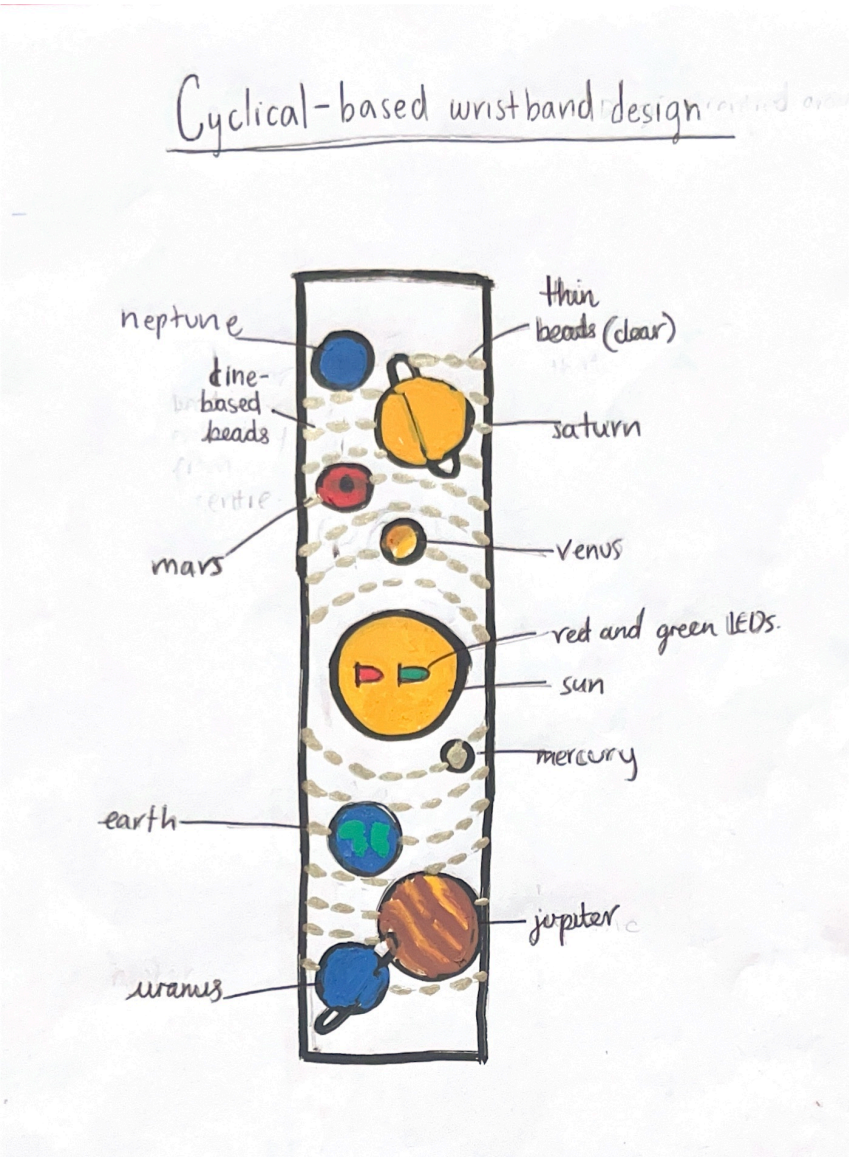
1. Linear-based



Within this sketch, we placed the sun at the top of the wristband, with a green and red LED placed at the top. This was inspired by our initial research into hardware and software, where we conceptualised the use of a green LED to flash, indicating a ‘standby mode’ and a red LED indicating the high stress levels for the user.

This design provides the additional feature that each consecutive planet has different interactive elements. This allows the user to move between tactile interactions easily due to the proximity between the planets.

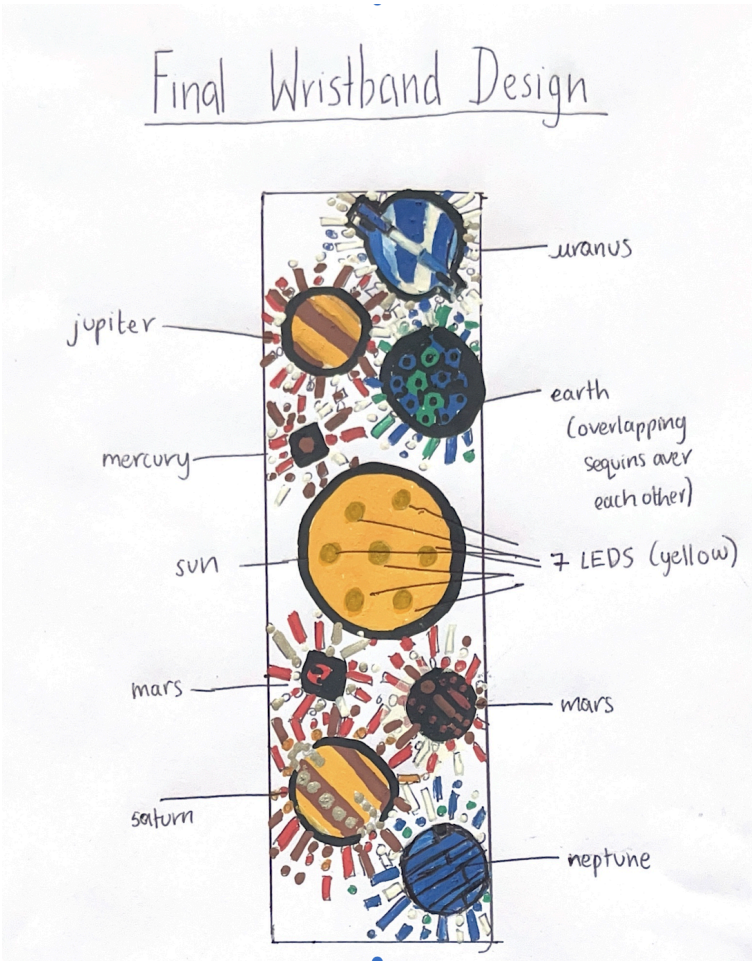
2. Cyclical-based



This design of the wristband kept the sun placed in the centre of the wristband, and the planets surrounded the sun as they do in orbit. The same concept of using a red and green LED was kept within this design.

Here, we implemented the concept of a visible orbit by embroidering silver line beads. This allows for a textural representation of planetary movement around the sun, which provides a continuous motion for the users to trace. A repetitive motion such as this can aid stress reduction by providing a tactile engagement that does not need visual aid to understand the larger pattern.

Final Design for Wristband



For our final iteration of this prototype, we decided against the use of red and green LEDs; instead, we decided to implement the use of yellow LEDs. With the yellow LEDs, they would turn on in response to a detection of high stress levels. This decision was influenced by the following factors:

1) Research into the psychological effects of colours: from this research, we concluded that the colour yellow has positive calming effects for humans. The colour yellow has the additional benefit for students that it improves their alertness.

2) The yellow LEDs would blend in better with their location on the sun, which would draw less attention to our wearable. It is important for our wearable to consider how we can draw as little

attention as possible to it, as drawing attention could further cause stress to the user.

3) Having one LED constantly powered would drain the battery in our wearable. This would cause the user to have to recharge the battery more often, disincentivising its use.

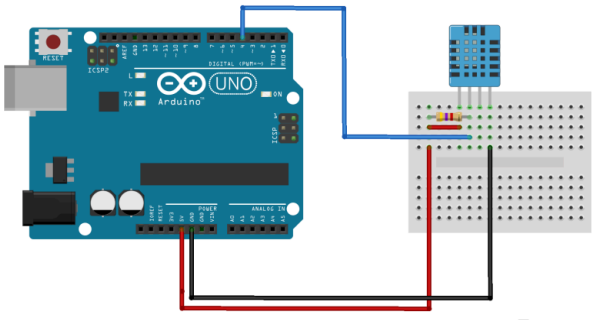
After experimenting with the sequins, we realised that they lost their colour after being touched a few times. This led to us only using sequins in one of the planets, as we did not want to remove this tactile interaction for the user. If this were to be released to a market, we would attempt to find higher-quality sequins.

Additionally, placing the LEDs between the yellow embroidery for the sun was difficult and led to a few LEDs breaking in the process. We attempted to embroider around the sun, however, this distorted the embroidery. This led to us placing felt on top of the LEDs, which had two advantages. The first being the introduction of a new tactile interaction for the user and a dulling of the light emitted by the LEDs, which reduces attention to the wristband, the concern of bright LEDs and increasing stress for the user were outlined above.

Within our second design, we conceptualised the use of line beads to illustrate the rotation of planets around the sun. However, we decided that it would be better to provide more textures and moved to having stars around the planets. We explored having a few stars around the planets, however, we decided to maximise the space we had on our wristband and have more stars moving away from the planet, using circular beads to represent these stars and beads shaped like lines to show the movement.

Code – Nana

When making the final code for our project, we decided we would use the Arduino IDE to connect the LEDs to the code so they turn on sequentially and rhythmically and also link the temperature sensor to the code so that rapid increases in temperature are detected and recorded. We also wanted to have a screen linked to Arduino code for debugging purposes: the screen would indicate when high stress levels are identified. Before doing this, we wanted to test the LEDs and temperature sensor separately.



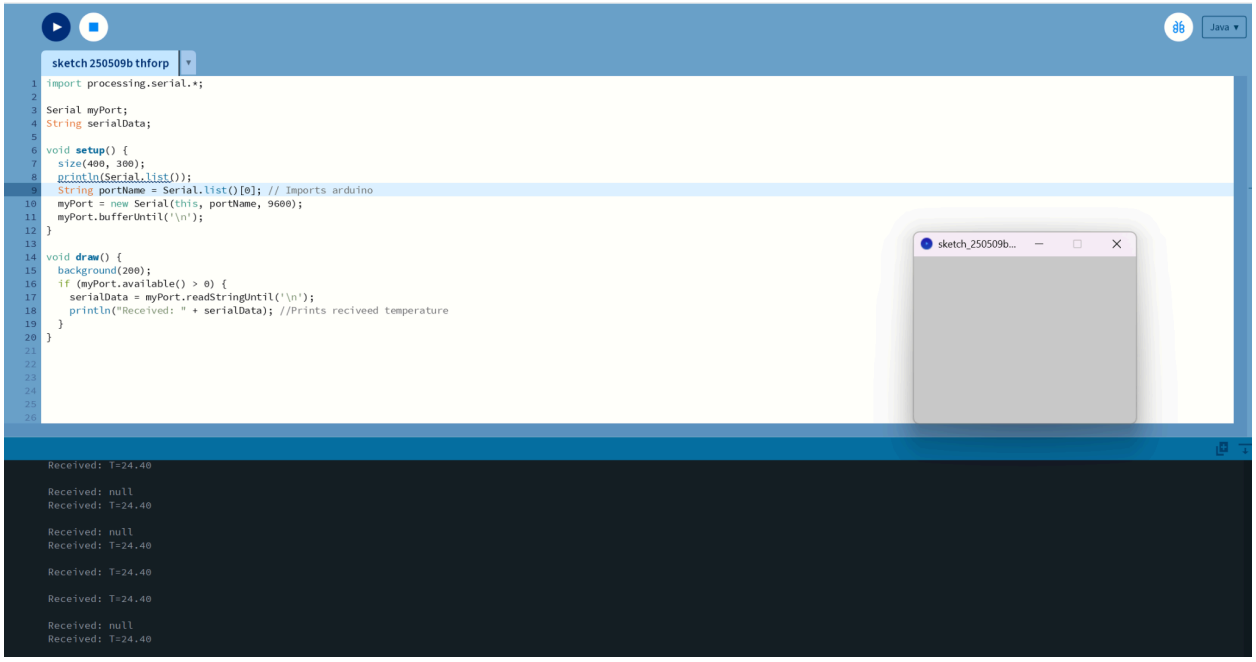
To begin with, we built the circuit just for the temperature sensor to see if we could read the temperature from it. The circuit consisted of a DHT11 temperature and humidity sensor and 3 jumper cables. Usually, a resistor would be needed, but this was not the case here, as we were using a DFRobot DHT11 built onto a board with a resistor. The diagram to the left shows the circuit with a pull-up resistor, but we did not use one in our actual board. However, the circuit has the same principle points (our ground connects to the analogue ground, power to 5V and digital pin to pin 2).

The code to the right is again with the Arduino IDE. The beginning of the code is just importing the DHT.h library and defining what sensor is being used and where it is being used – pin 2. For the sensor, the baud rate needs to be 9600, so we change our Arduino rate to 9600 as well. In the setup function, it has a serial print function to show when the temperature sensor starts running – this will show up in the serial monitor once the code is running. Then, in the loop function, a delay is imposed for 2000 = 2 seconds, so there's a delay between each temperature taken. The code then reads the temperature, saves it as a float variable and prints it into the serial monitor. This happens continuously due to the section of code being in the loop function.

sketch_may9a-th1.ino

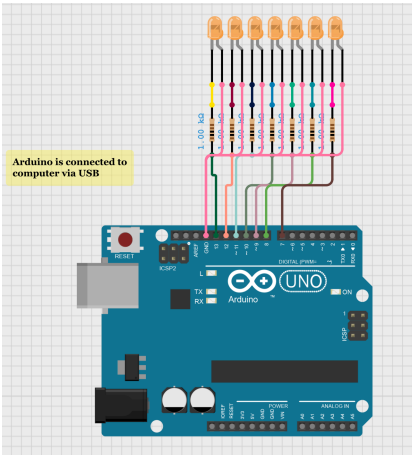
```
#include "DHT.h"

#define DHTPIN 2     // Digital pin connected to the DHT sensor's DATA pin
#define DHTTYPE DHT11   // DHT 11

DHT dht(DHTPIN, DHTTYPE);

void setup() {
  Serial.begin(9600);
  Serial.println("DHT11 test Program");
  dht.begin();
}

void loop() {
  delay(2000); // Wait a few seconds between measurements

  float h = dht.readHumidity();
  float t = dht.readTemperature(); // or dht.readTemperature(true) for Fahrenheit

  if (isnan(h) || isnan(t)) {
    Serial.println("Failed to read from DHT sensor!");
    return;
  }

  // Send the temperature to Processing
  Serial.print("T=");
  Serial.println(t);
}
```

We then wrote code to get the results from the Arduino and temperature sensor into Processing so we could make a screen for debugging. First, we import the processing.serial library and establish a serial connection using the first available port. The bufferUntil('\n') method ensures that we read whole lines from the Arduino. In setup(), we set the window size and connect to the Arduino at 9600 baud. We also print a list of serial ports to help find the right one. In draw(), we set a light grey backdrop and verify whether data is available from the serial port. If it is, we read a line of input, store it in serialData, and then output it to the console.



After this, we tested out a variety of different light sequences, experimenting with the order the lights turn on and how fast they turn on. We built a circuit consisting of seven yellow LEDs; we chose yellow LEDs as they would be representative of the sun, which is yellow. We connected the LEDs to digital pins 7 to 13.

In this first code, we create a gentle "breathing" light effect using seven LEDs linked to an Arduino board. First, we define the pins to which each LED is linked (pins 13–7) and give each one a variable name for clarity. In the setup() function, we use pinMode() to establish each of these pins as outputs, preparing them to deliver signals to the LEDs. Inside the loop() function, we use analogWrite() to gradually increase the brightness of all seven LEDs at the same time. We accomplish this by gradually increasing the PWM (pulse-width modulation) value from 0 to 255 in small increments, creating a seamless fade-in effect. Once the maximum brightness is achieved, we fade them out by lowering the PWM value down to 0. The delay(5) between each step makes the transition smooth and obvious. Finally, we provide a little pause (delay(500)) before the cycle resumes, resulting in a rhythmic, pulsing light that resembles breathing. This effect is commonly employed in wearable technology as a relaxing visual signal.



For the second code, we've built a sequential LED lighting effect that mimics a wave or build-up of light across seven LEDs. Each LED is connected to pins 13–7, which we designate as variables at the top of the code for clarity. In the setup() function, we configure all of the LED pins as outputs so that the Arduino can control them. This setting preps us for the lighting sequence – like in the previous code. The loop() method handles the animation. It begins by turning on LED7 instantaneously using digitalWrite(). This generates an immediate flash to start the sequence. The remaining LEDs, from LED6 to LED1, will gradually brighten one by one. We use analogWrite() in conjunction with a loop to gradually increase the brightness level (PWM values from 0 to 255), adding a small delay(5) after each step to provide a smooth and visible transition. After all LEDs are fully lit, we wait shortly (delay(250)) before starting to fade them out in reverse order—from LED1 to LED6—again using progressive analogWrite() fading. Finally, LED7 is turned off immediately, resetting the display for the following cycle. The overall effect creates a flowing and dynamic lighting experience that might be used as visual feedback in a wearable device.

```
int LED1 = 13;
int LED2 = 12;
int LED3 = 11;
int LED4 = 10;
int LED5 = 9;
int LED6 = 8;
int LED7 = 7;

void setup() {
  pinMode(LED1, OUTPUT);
  pinMode(LED2, OUTPUT);
  pinMode(LED3, OUTPUT);
  pinMode(LED4, OUTPUT);
  pinMode(LED5, OUTPUT);
  pinMode(LED6, OUTPUT);
  pinMode(LED7, OUTPUT);
}

void loop() {
  // Breathe effect for all LEDs simultaneously
  for (int i = 0; i < 255; i++) {
    analogWrite(LED1, i);
    analogWrite(LED2, i);
    analogWrite(LED3, i);
    analogWrite(LED4, i);
    analogWrite(LED5, i);
    analogWrite(LED6, i);
    analogWrite(LED7, i);
    delay(5);
  }
  for (int i = 255; i > 0; i--) {
    analogWrite(LED1, i);
    analogWrite(LED2, i);
    analogWrite(LED3, i);
    analogWrite(LED4, i);
    analogWrite(LED5, i);
    analogWrite(LED6, i);
    analogWrite(LED7, i);
    delay(5);
  }

  delay(500); // Pause before repeating
}
```

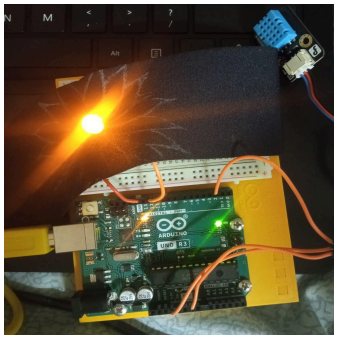
```ino
int LED1 = 13;
int LED2 = 12;
int LED3 = 11;
int LED4 = 10;
int LED5 = 9;
int LED6 = 8;
int LED7 = 7;

void setup() {
  pinMode(LED1, OUTPUT);
  pinMode(LED2, OUTPUT);
  pinMode(LED3, OUTPUT);
  pinMode(LED4, OUTPUT);
  pinMode(LED5, OUTPUT);
  pinMode(LED6, OUTPUT);
  pinMode(LED7, OUTPUT);
}

void loop() {
  // Light up LED7 instantly
  digitalWrite(LED7, HIGH);
  delay(250);

  // Gradually light up LEDs 6, 5, 4, 3, 2, 1 in sequence
  for (int i = 0; i < 256; i++) {
    analogWrite(LED6, i);
    delay(5);
  }
  for (int i = 0; i < 256; i++) {
    analogWrite(LED5, i);
    delay(5);
  }
  for (int i = 0; i < 256; i++) {
    analogWrite(LED4, i);
    delay(5);
  }
  for (int i = 0; i < 256; i++) {
    analogWrite(LED3, i);
    delay(5);
  }
```

sketch_may10a-breathingsequence2.ino

```ino
  for (int i = 0; i < 256; i++) {
    analogWrite(LED2, i);
    delay(5);
  }
  for (int i = 0; i < 256; i++) {
    analogWrite(LED1, i);
    delay(5);
  }

  delay(250); // Keep all LEDs on for a moment

  // Gradually turn off LEDs 1, 2, 3, 4, 5, 6 in sequence
  for (int i = 255; i >= 0; i--) {
    analogWrite(LED1, i);
    delay(5);
  }
  for (int i = 255; i >= 0; i--) {
    analogWrite(LED2, i);
    delay(5);
  }
  for (int i = 255; i >= 0; i--) {
    analogWrite(LED3, i);
    delay(5);
  }
  for (int i = 255; i >= 0; i--) {
    analogWrite(LED4, i);
    delay(5);
  }
  for (int i = 255; i >= 0; i--) {
    analogWrite(LED5, i);
    delay(5);
  }
  for (int i = 255; i >= 0; i--) {
    analogWrite(LED6, i);
    delay(5);
  }

  // Turn off LED7 instantly
  digitalWrite(LED7, LOW);
  delay(250); // Shorter delay before repeating
```

We ended up picking the second sequence, as we felt that in the correct arrangement, “the sun” on our wristband would look like it was lighting up from the middle. On top of that, we thought the timing of the second sequence was more accurate for a guided breathing sequence.

We also wanted to make sure the nylon material we were using for the wristband would not disrupt the connectivity of the LEDs. We also checked if we could have LEDs running at the same time as the temperature sensor. Thankfully, the LED was compatible with the nylon material and the wiring of the temperature sensor and LED do not interfere.



User Review

The second LED sequence in the wearable wristband provides an extremely effective visual aid for guided breathing exercises. The pattern begins with a single LED turning on instantly, serving as a cue to start the breathing cycle. Following then, six more LEDs progressively glow in sequence, resulting in a smooth, progressive picture that mimics the rhythm of a deep inhale. This progressive lighting allows users to control their breath intake at a calm and regular pace.

Once all LEDs are fully lit, the system maintains brightness for a limited period of time, allowing users to catch their breath before the reverse procedure begins. The LEDs then dim in reverse order, gradually leading the user through a controlled exhale. This mirrored form facilitates a full breath cycle, promoting relaxation and mental clarity. The light pattern's regular timing and seamless transitions offer a contemplative experience, allowing users to stay grounded and focused. Unlike audio cues or screen-based images, this LED sequence is discreet, non-intrusive, and appropriate for peaceful settings such as offices, classrooms, or meditation rooms. The simple visual framework is especially useful for people who want to develop

mindfulness practices or manage anxiety with breath control. Overall, this LED sequence is a sensible and effective stress-reduction and guided breathing technique.