

Breathing Soft

The breathing papier mache butterfly

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Introduction

In today's fast-paced world, it's easy to get caught up in the hustle culture and constantly be on the go. Not long after the COVID-19 pandemic which helped most people catch a break to breathe, most of us have already forgotten that this lifestyle can take a toll on our mental and physical well-being. One of the most fundamental yet often overlooked aspects of self-care is the act of breathing. Breathing consciously, and being more aware of our breath, can help reduce stress, improve focus and concentration, and promote feelings of calm and relaxation. By taking the time to slow down and focus on our breath, we can break free from the hustle culture and prioritize our well-being. Our interactive installation, "Breathing Soft," is designed to help individuals discover the power and importance of conscious breathing and how it can improve their overall well-being.

Ideation

This section presents our brainstorming process, the design alternatives and the inspiration sources and present the final concept.
This project aims to portray an interactive installation that promotes conscious and mindful breathing in individuals. The initial idea of the installation was meant to utilize a breathing sensor connected to a soft robot, made of silicone, to visually represent the user's breathing pattern. Upon the final concept, due to lack of materials, we adapted the visual representation to a papier mache butterfly that uses servo motors to flap its wings as the visual representation.

This interactive experience will also include sensory elements such as guided breathing techniques to encourage individuals to take a moment

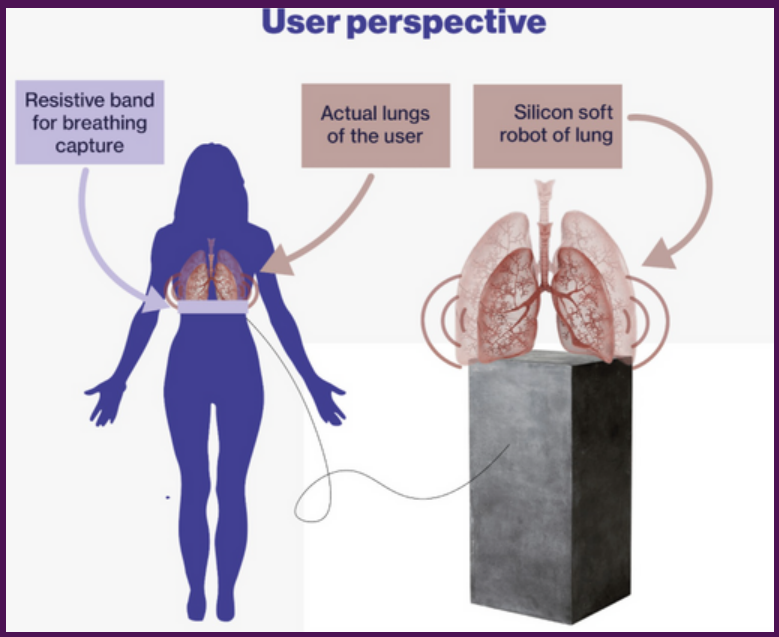


Fig 1. Initial concept representation

to focus on their breath, and learn techniques to improve their breathing.

Design alternatives

	Concept	Specifciations
Breathing room	I'm in a room where when I breathe the pattern I see changes depending on my breathing rhythm	Tech: - projectors or large-sized displays to project on the walls - breathing sensor (if guided) Idea: - the user is in a room. - their breathing data are collected through a sensor - depending on the user's respiration rhythm the image displayed by the projector or the screen changes (or if guided, that moves depending on the guide)
Breathing in VR	I'm in a virtual environment that changes depending on my breathing pattern	Tech: - breathing sensor (if guided) - VR headset Idea: - The user puts a VR headset on - Their data are collected through breathing sensors - depending on the user's respiration rythm, the virtual environment they are in changes (or if guided, that moves depending on the guide)

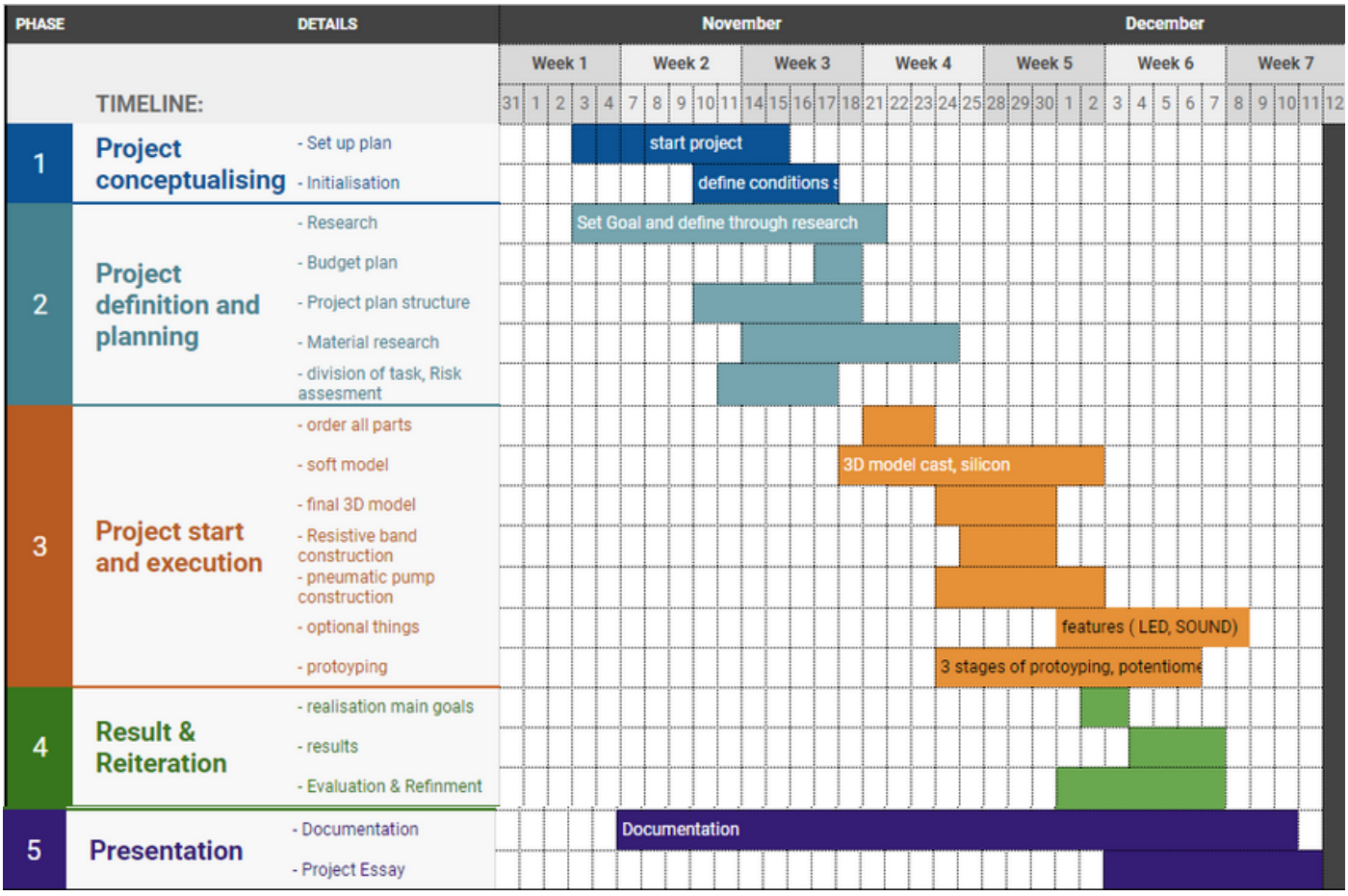
	Concept	Specifciations
Breathing Hologram	I see the hologram changing depending on my breathing and I see my breathing pattern	Tech: - Disk plastic or resin, or plexiglass - Dark room - Screen (large or small depending on the size and number of holograms) - The hologram would be a 3D video (from an animal, nature, to a piece of the body like the lungs, to a silouhette) - breathing sensor, arduino and speakers Idea: - The user enters a dark room - They can see one (or many small) holograms video that moves depending on their breathing pattern (or if guided, that moves depending on the guide) - They will also hear some audio to be more mindful

Sources of inspiration

After brainstorming ideas and alternatives we each took the time to conduct an internet research on similar installations or projects which couldn give us the information needed to decide upon the methods and techniques to use. We created an inspiration board that can be found here.

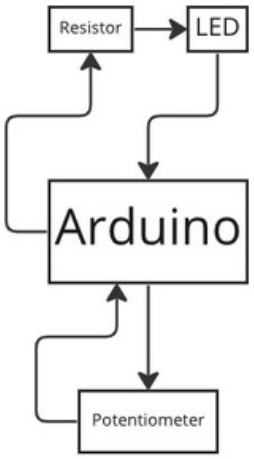
System design & methods

This section presents the methods that we would use to implement this idea, the planning, and the iterative process that our artifact has been through until its final form. We started with a timeline planning of all the steps of the creative process:

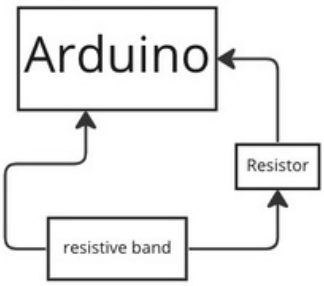


We also made sketches of the iterations we anticipated:

1. Step

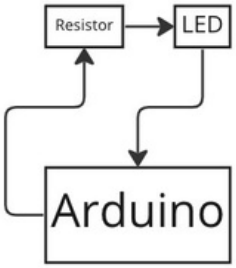


write a code that uses potentiometer input to regulate electricity/ brightness of LED



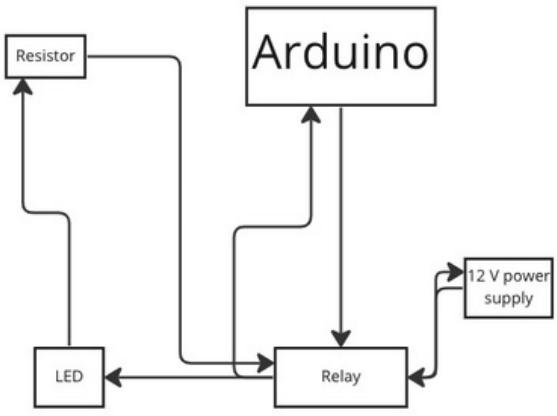
read out electricity change when stretching band, find good resistor value for realistic voltage drop over the resistive band

2.Step



write a code that lets a LED breathe

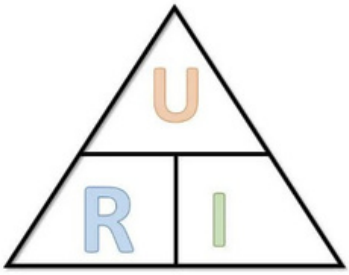
3.Step



Let LED breath &
Let LED be controlled by Potentiometer

Research:

- most of the coding is online available, also the breathing pattern
- How to make the CAST for the silicon?
- **WE NEED:**
  - Datasheet Arduino for Pin layout
  - Datasheet LED
  - Ohm's law



Things we have:



Led 3w

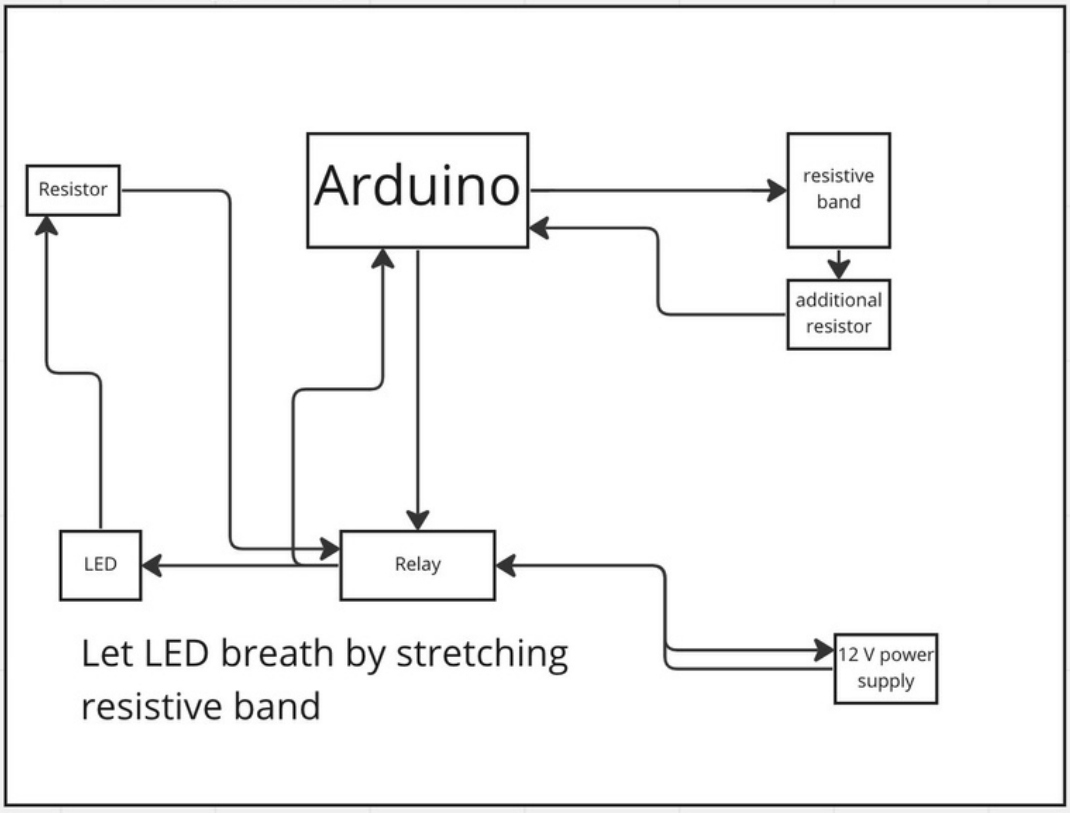


Resistive band for breathing



Relay

final prototype step



Design Journal

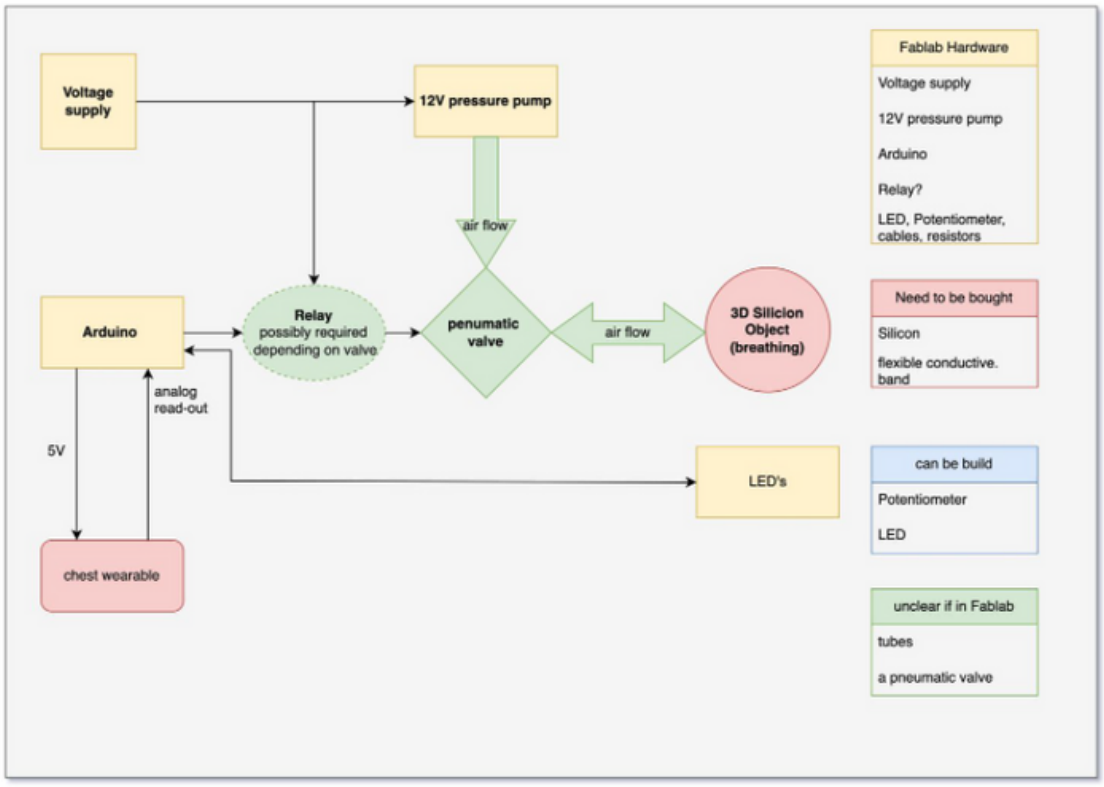
1. 20th & 24th of November

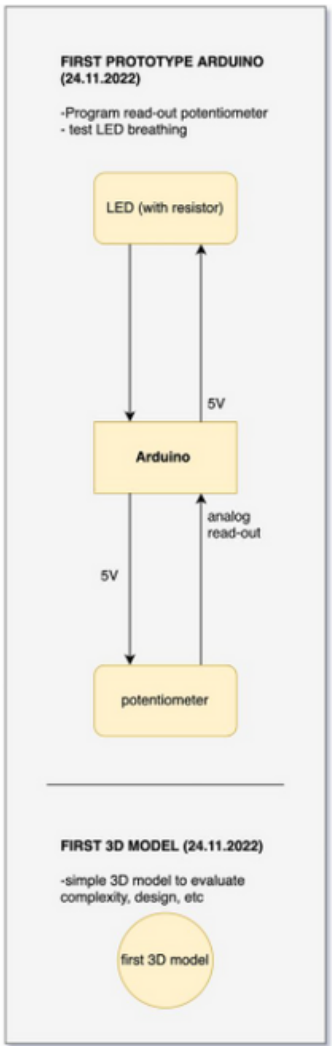
Goals:

- make the concept clearer
- create a list of the necessary materials

Achievements:

- Circuit Flow chart





Pressure pump

- might be too loud.
- is it able to blow air both ways.

Pneumatic actuator

- preferably 4 way 5 hole
- pressure regulator?
- air tubes, quick connect (push on)

Silicon object

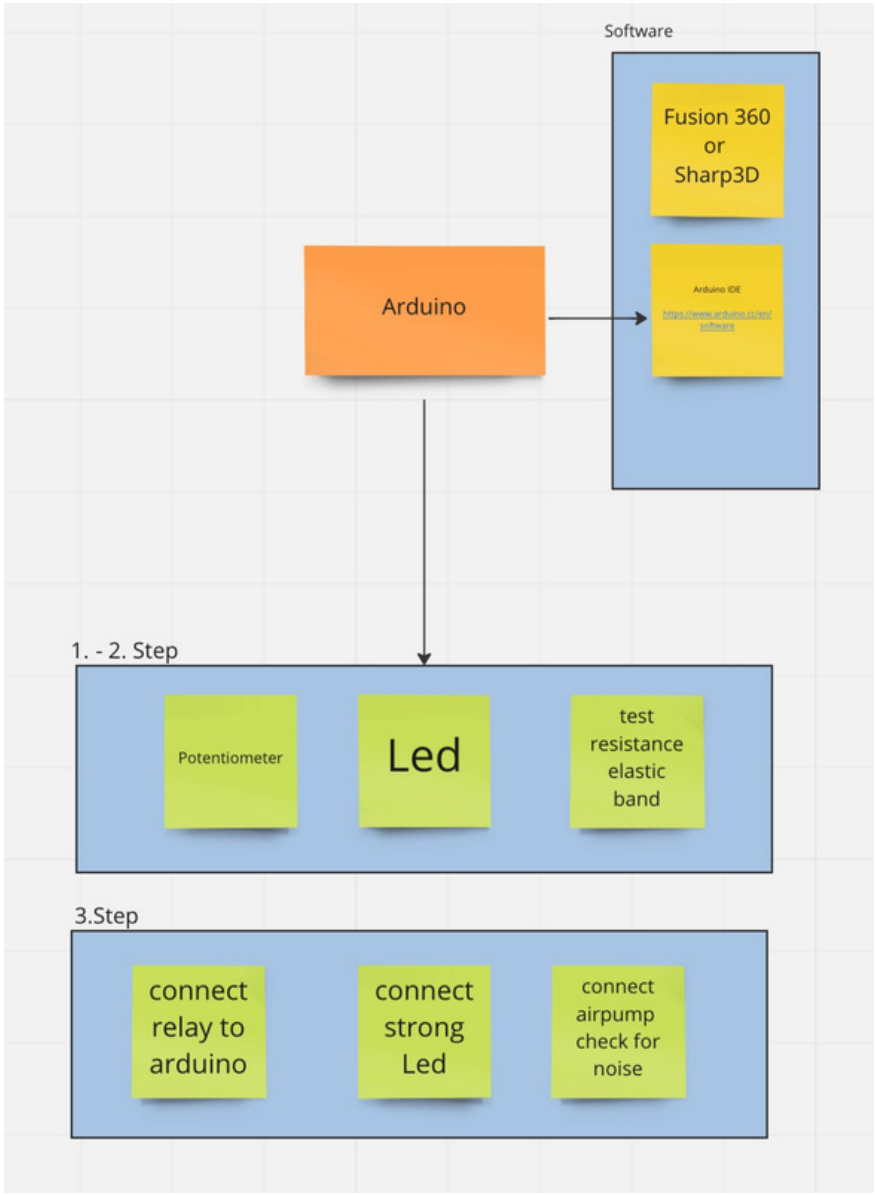
- print first 3D model 24.11.2022
- evaluate, reiterate
- order silicon, be ready when it arrives

Chest wearable

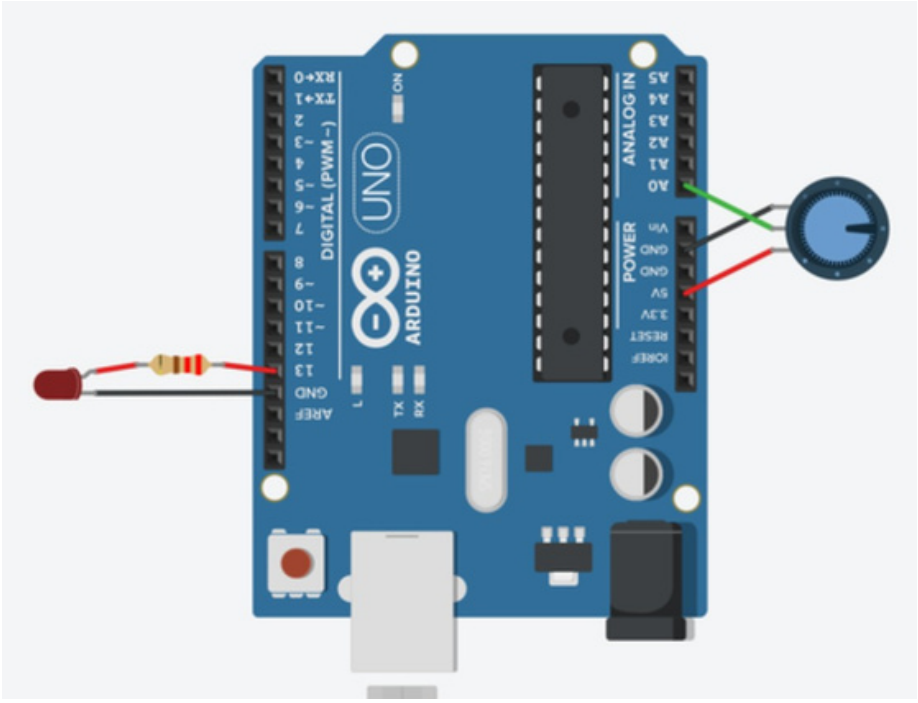
- uses sweing machine (catalina to make band)
- use conductive rubber to create sensor
- rest will be rigid, to concentrate flex on rubber
- maybe bra like material, needs to have different size options.

- List of necessary materials:

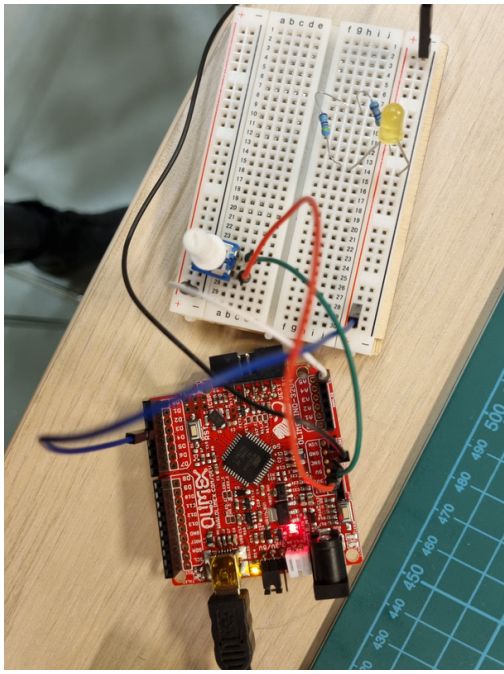
- breathing sensor
- Arduino
- Silicone Ecoflex
- Sound guidance



- First prototypes: 1st prototype is connecting a led to an arduino and simulating a breathing pattern for which we need: Led, Potentiometer, Arduino, and 2 circuits.



2. 1st of December



- Code

sketch_dec1b.ino

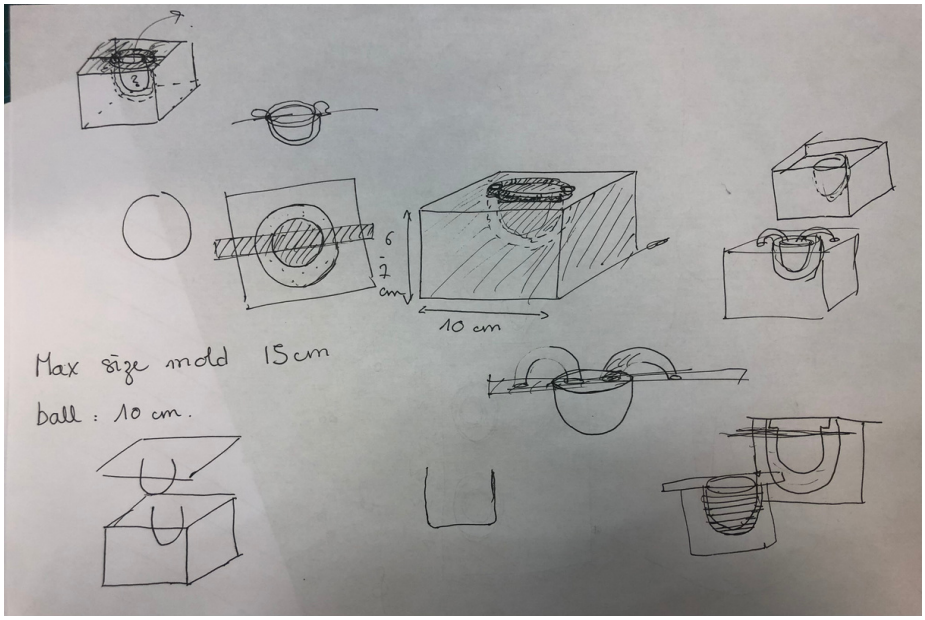
```
int pot;
int led;           // the PWM pin the LED is attached to
//int brightness = 0;    // how bright the LED is
//int fadeAmount = 5;    // how many points to fade the LED by
void setup()
{
  pinMode(A3, INPUT);
  pinMode(3, OUTPUT);
  Serial.begin(9600);
}

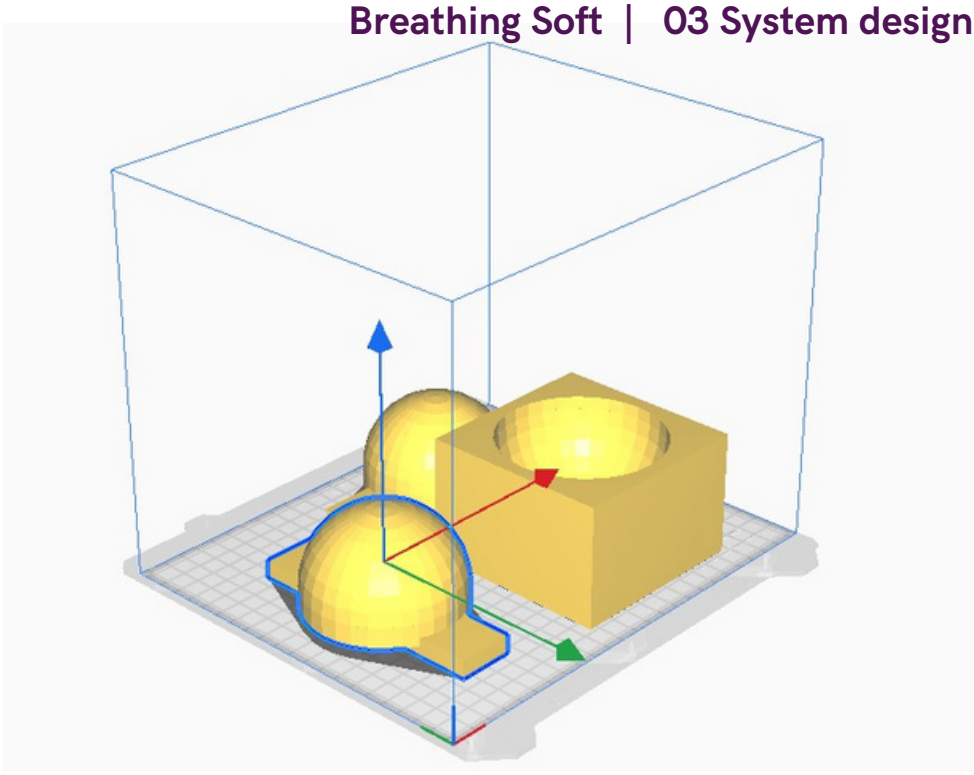
void loop()
{
  //analogWrite(led, brightness);
  int sensorValue = analogRead(A3);
  pot = analogRead(A3);
  led = map(pot, 500, 1023, 255, 0 ); //Map Potentiometer range to 8 bit binary range
  analogWrite(3, led);
  //Serial.print(pot);
  Serial.println(led);
  delay(100);
}

```

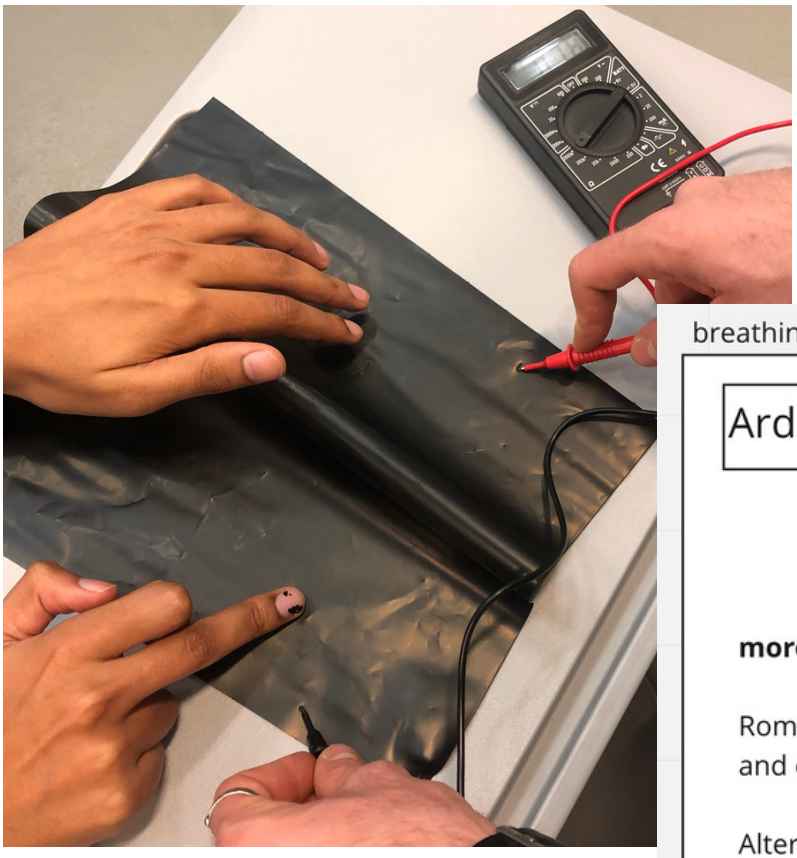
One of the first Arduino tests was mapping the potentiometer range to Led brightness (no light to very bright).

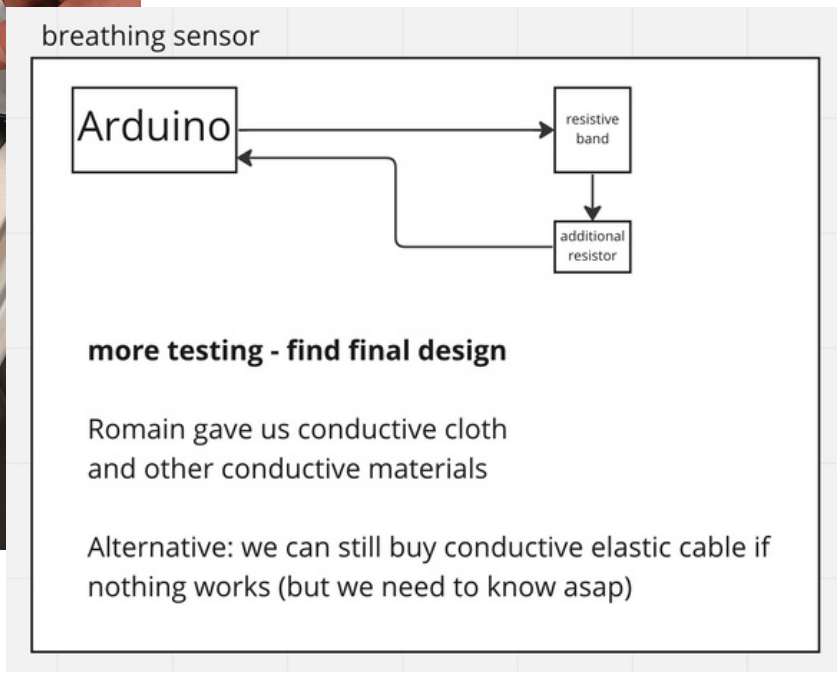
- 3D Model for softrobot cast





- Learning about the breathing sensor: testing the resistance to see how the velostat works and how could we use it in our design.

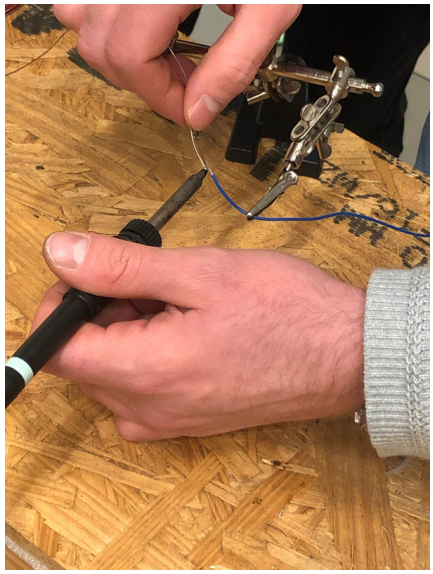




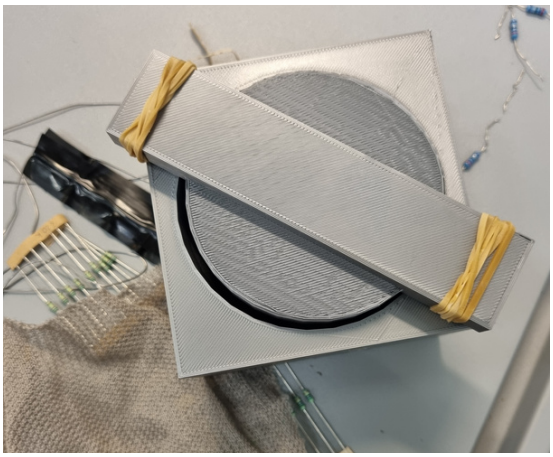
3. 8th of December

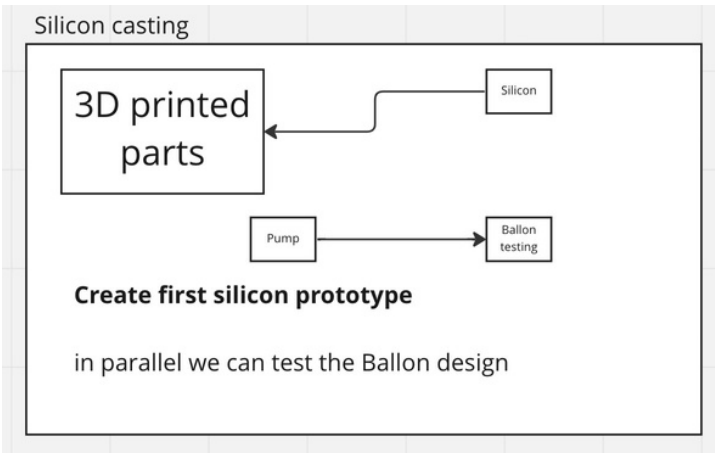
- Breathing sensor: with the recommendation or the FabLab professor we decided to use a conductive textile material to make a breathing sensor, therefore we started testing the resistance in that one and studying where is the best position for detecting the breathing pattern on people.

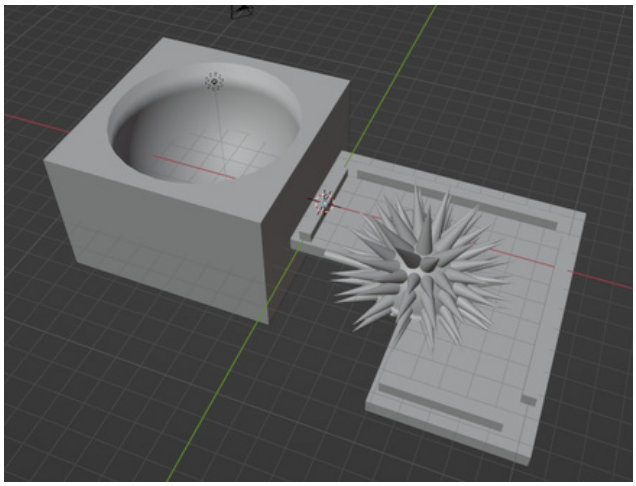


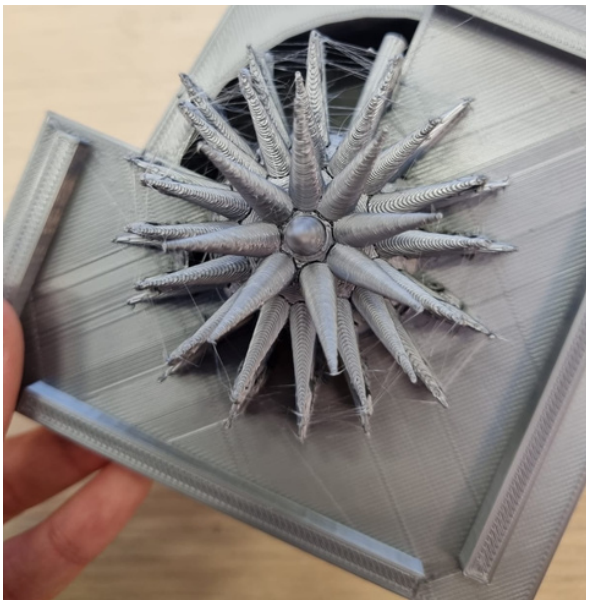


- 3d model: the first cast was succsefully printed but after more research we realised that there are modifications to be made in the structure (adding spikes) so the silicone would expand without breaking.

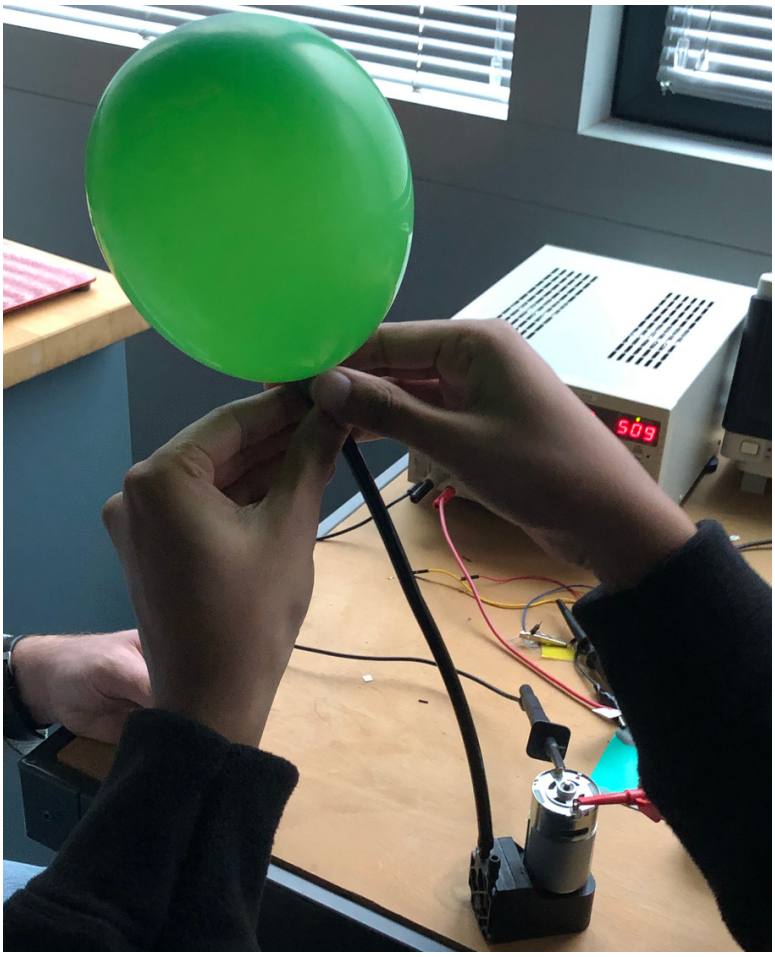








- Airpump: We tested the pump to see how it works and we realized it creates a lot of noise which could affect our meditating experience.



4. 15th of December



- Breathing sensor: We decided to make a band that would go around the torso of a person to input the breathing pattern. We used stiff material for the circumference and the conductive material connected to copper wires to input the resistance.

- Testing the relay with Arduino: Using a power supply with the relay to power the pump

sketch_dec15b.ino

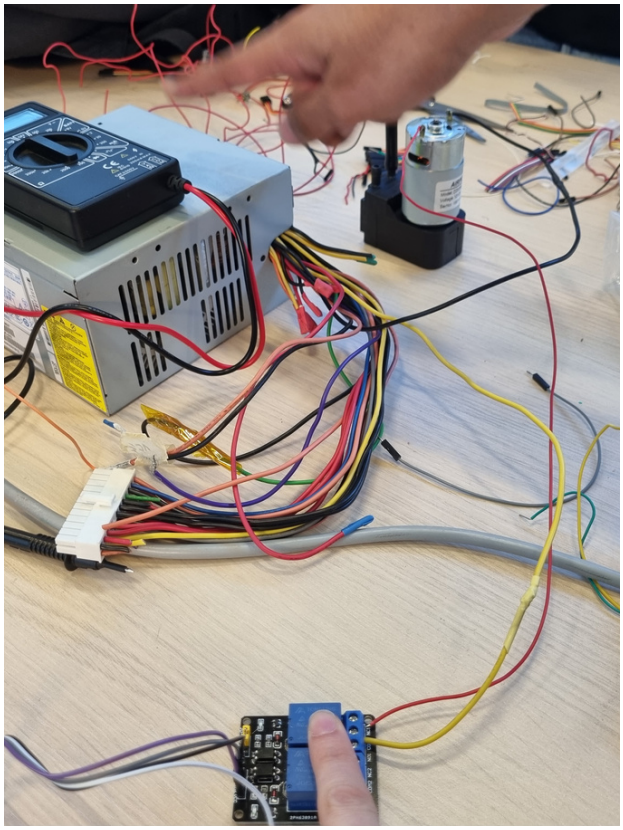
```
int RelayPin = 8;

void setup() {
  // Set RelayPin as an output pin
  pinMode(RelayPin, OUTPUT);
}

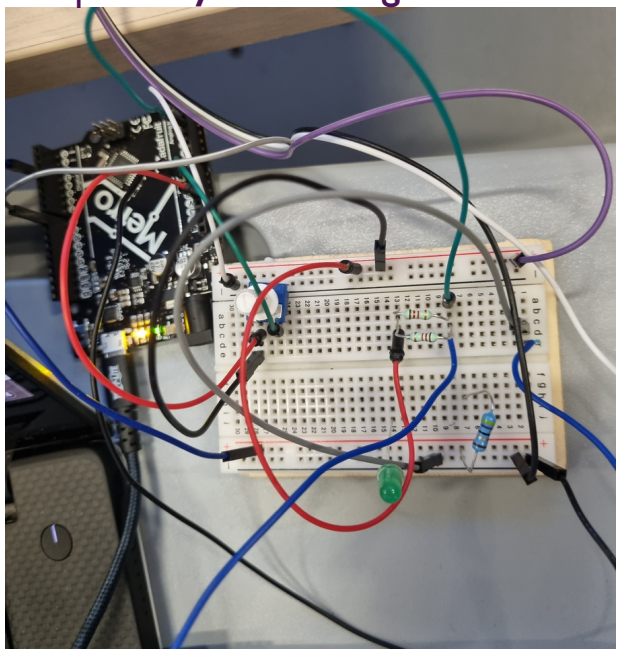
void loop() {
  // Let's turn on the relay...
  digitalWrite(RelayPin, LOW);
  delay(3000);

  // Let's turn off the relay...
  digitalWrite(RelayPin, HIGH);
  delay(3000);
}

```







- Testing the input of the breathing band

4. 10th & 12th of January

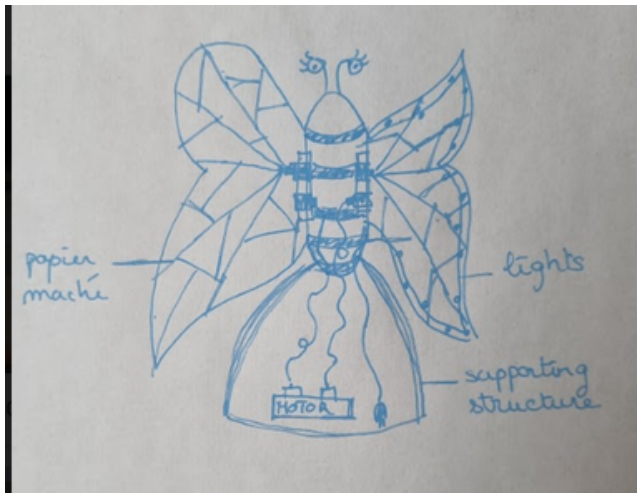
Redesign phase

Due to the delivery problem of the silicone, we adapted our project to an idea that we had resources for.

After a teambuilding exercise of visiting Jardin Des Plantes, we got inspired by the motion of the insects in that exhibition and we decided to create our own butterfly that will move its wings in the same rhythm as the inspiration and expiration of a person.



We decided to use servo motors for the motion of the wings, reusing the breathing sensor constructed in the previous design and construct a papier mache butterfly.

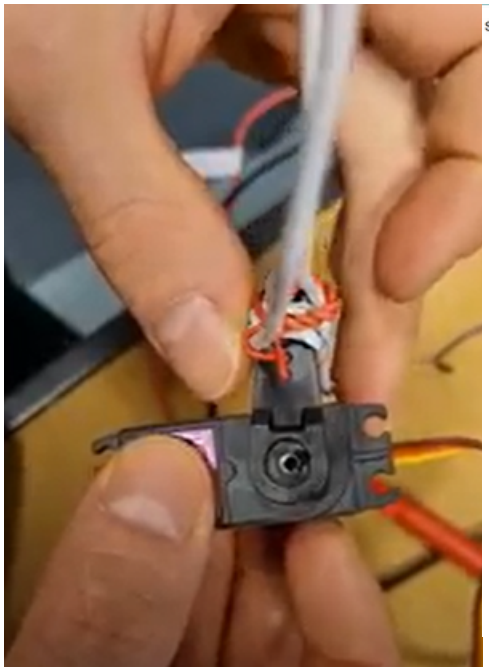


- Butterfly: We used a homemade technique for the papier mache butterfly and created all the parts using moldable sticks as a base.



5. 17th & 19th of January

- Testing the servo motors : We made a test with the Arduino to just move the angle of the mother from 20 to 160 degrees and back, since we expect to have same movement for the wings



sketch_jan17b.ino

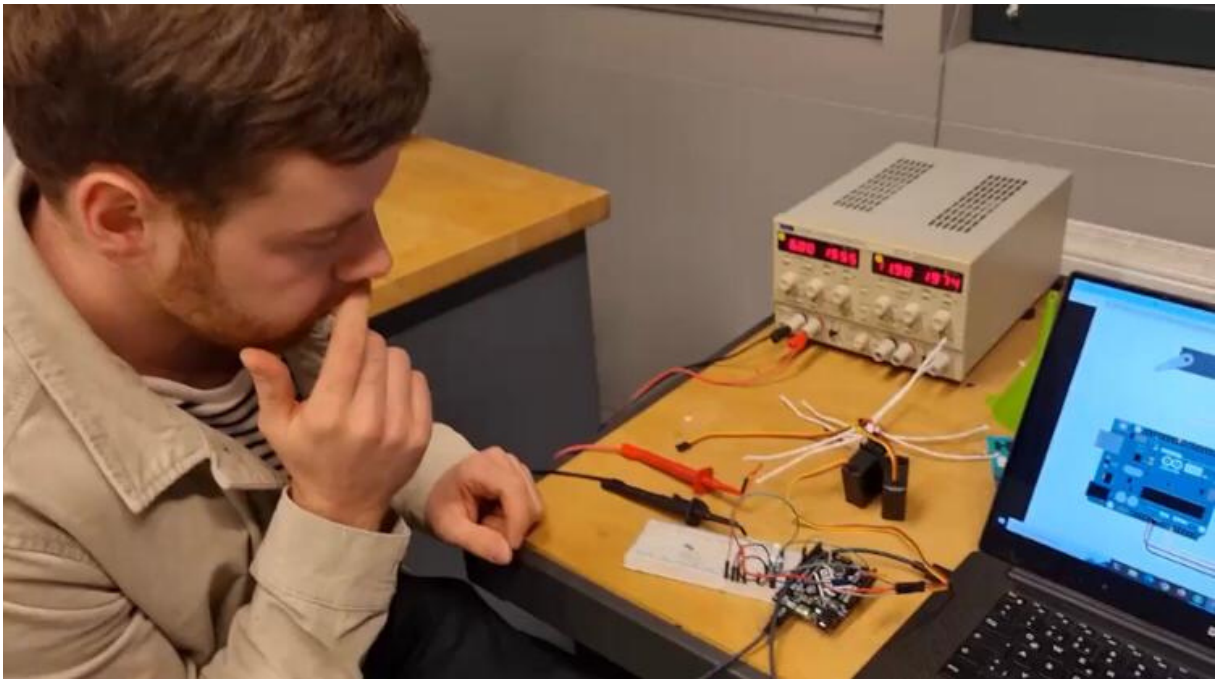
```
#include <Servo.h>

Servo myservo;  // create servo object to control a servo
// twelve servo objects can be created on most boards

int pos = 0;    // variable to store the servo position

void setup() {
  myservo.attach(9);  // attaches the servo on pin 9 to the servo object
}

void loop() {
  for (pos = 20; pos <= 160; pos += 1) { // goes from 0 degrees to 180 degrees
    // in steps of 1 degree
    myservo.write(pos);              // tell servo to go to position in variable 'pos'
    delay(15);                       // waits 15ms for the servo to reach the position
  }
  for (pos = 160; pos >= 20; pos -= 1) { // goes from 180 degrees to 0 degrees
    myservo.write(pos);              // tell servo to go to position in variable 'pos'
    delay(15);                       // waits 15ms for the servo to reach the position
  }
}
```



- Butterfly: Continuing the construction of the butterfly



6. 22nd & 23rd of January

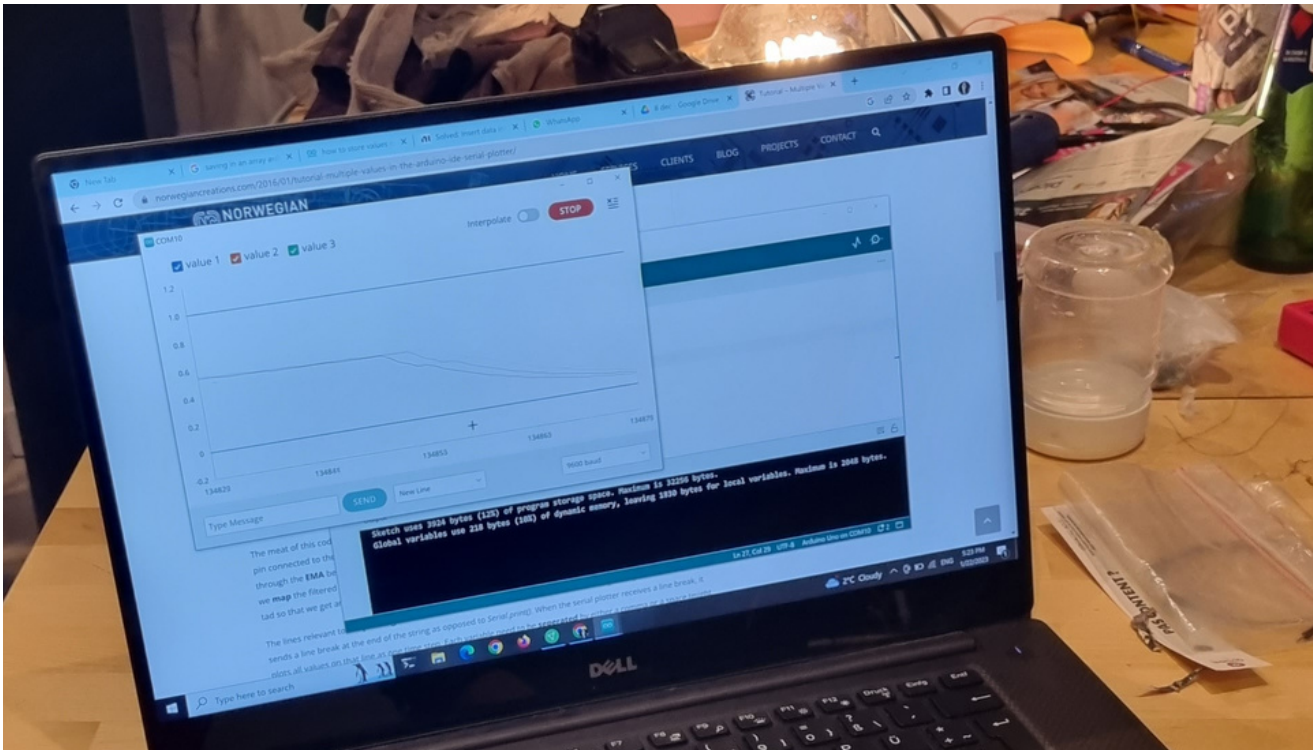
- Prefinal code: We used an average filtering function to reduce the noise from the breathing input and them map the breathing direction to 1 for breathing in and -1 for breathing out.

sketch_jan22a.ino

```
float val = 0;
float alpha = 30;
int cntr = 0;
float lastVal = 0;
bool breathingIn = false;
bool breathingOut = false;
int sensorValue;
float direction = 0.5;
float alpha2 = 15;
void setup() {
 Serial.begin(9600);
 pinMode(A5, INPUT);
}
void loop() {
  sensorValue =  analogRead(A5);
  delay(5);
  val = val*(alpha-1)/alpha + float(sensorValue)/alpha;
  cntr = cntr+1;
  if (lastVal > val+0.5) {
    direction = direction*(alpha2-1)/alpha2 + 1/alpha2;
  }
  else if (lastVal < val-0.5) {

    direction = direction*(alpha2-1)/alpha2;
  }
  else{
    direction = direction*(alpha2-1)/alpha2+1/alpha2/2;

  }
  Serial.print(0);
  Serial.print(",");
  Serial.print(direction);
  Serial.print(",");
  Serial.println(1);
  lastVal = val;
}
```

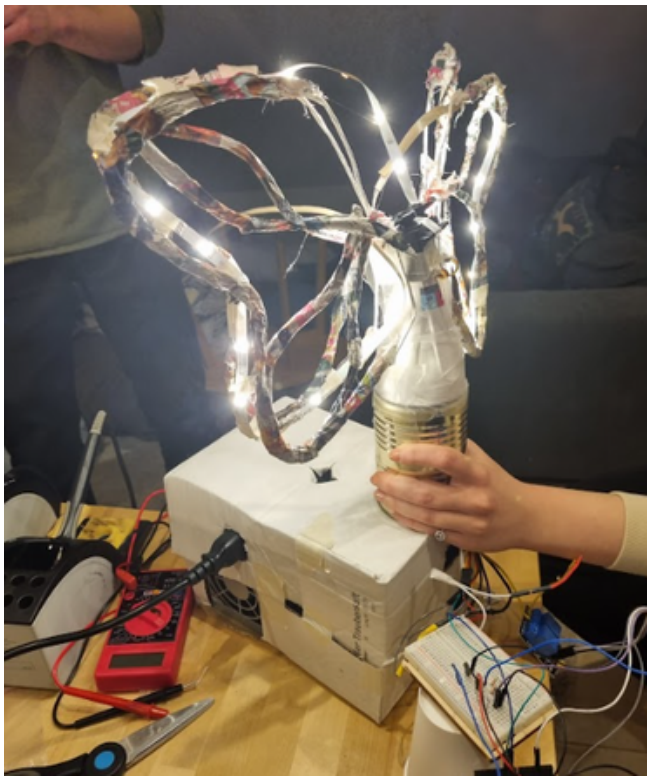


- Final code: We added the mapping of the breathing function to the motors. Since we wanted the wings of the butterfly to start moving direction when there was a change from breathing in to out or vice versa, we set up a threshold after which is clear the person was breathing in or out and that was the sign for the motor to add 1 or decrease with 1 the angle of the motor moving the wing. The wings were 2, and so were the motors, but they were rotated differently, so the code and the angle direction are reversed for the second wing. Now the range is from 30 to 150 degrees so the wing does not hit the body of the butterfly.



- Breathing band: The breathing band has not changed much, sticking to the model from the first meetings, with an added closure systems with buttons that can fit a variety of circumferences.

- Butterfly: We put together all the pieces of the butterfly, connecting the wings to the servos, creating a stander that doubles as a hiding place for the wires and the power source. We also added strips of lights to the skeleton of the butterfly because we initially wanted to make the lights flicker as well in the rhythm dictated by the sensor.





Final Code:

sketch_jan22b.ino

```
#include <Servo.h>
float val = 0;
float alpha = 30;
int cntr = 0;
float lastVal = 0;
int sensorValue;
float direction = 0.5;
float alpha2 = 50;
float topTreshhold = 0.8;
float bottomTreshhold = 0.2;
float threshold = 0.2;
int openORclose1 = 0;
int openORclose2 = 0;
int angle;
int angle2;
int maxAngle = 130;
int minAngle = 50;
Servo myservo1;
Servo myservo2;
int pos = 0;  // variable to st
```

```
void setup() {
  Serial.begin(9600);
  pinMode(4, OUTPUT);
  pinMode(A5, INPUT);
  myservo1.attach(9);
  myservo2.attach(10);
  angle = myservo1.read();
  angle2 = myservo2.read();
}
```

```
void loop() {
  sensorValue = analogRead(A5);
  delay(5);
  val = val * (alpha - 1) / alpha + float(sensorValue) / alpha;

  if (lastVal > val + threshold) {
    direction = direction * (alpha2 - 1) / alpha2 + 1 / alpha2;
  } else if (lastVal < val - threshold) {

    direction = direction * (alpha2 - 1) / alpha2;
  } else {
    direction = direction * (alpha2 - 1) / alpha2 + 1 / alpha2 / 2;
  }

  if (direction > topTreshhold) {
    openORclose1 = 1;
    openORclose2 = -1;
  }
  if (direction < bottomTreshhold) {
    openORclose1 = -1;
    openORclose2 = 1;
  }

  if (openORclose1 == -1){
    digitalWrite(4, LOW);
  }

  if (openORclose1 == 1){
    digitalWrite(4, HIGH);
  }
```

sketch_jan22b.ino

```

  if (cntr % 10 == 0) {
    angle = angle + openORclose1;
    angle2 = angle2 + openORclose2;

    if (angle > 130) {
      angle = 130;
    }
    if (angle < 50) {
      angle = 50;
    }

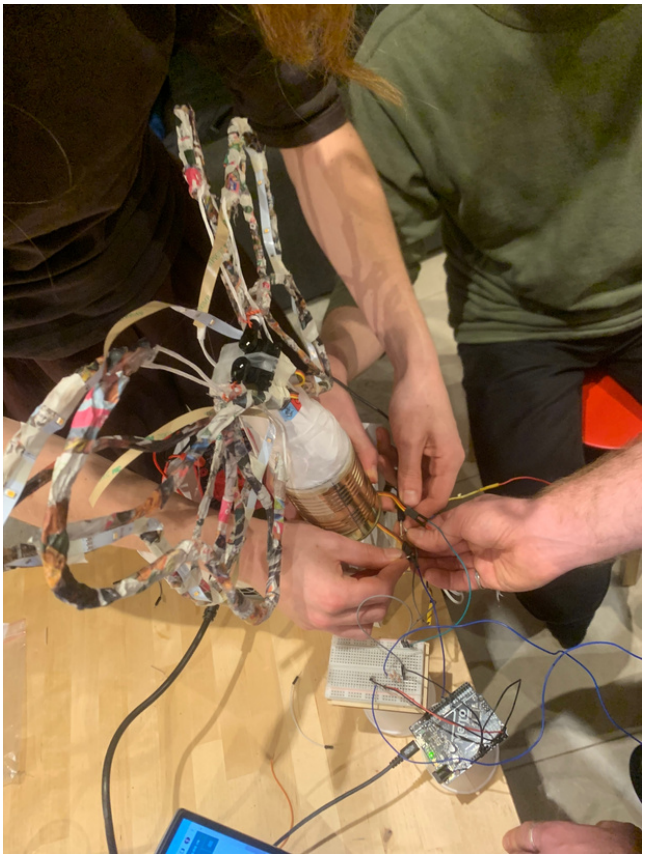
    if (angle2 > 130) {
      angle2 = 130;
    }
    if (angle2 < 50) {
      angle2 = 50;
    }

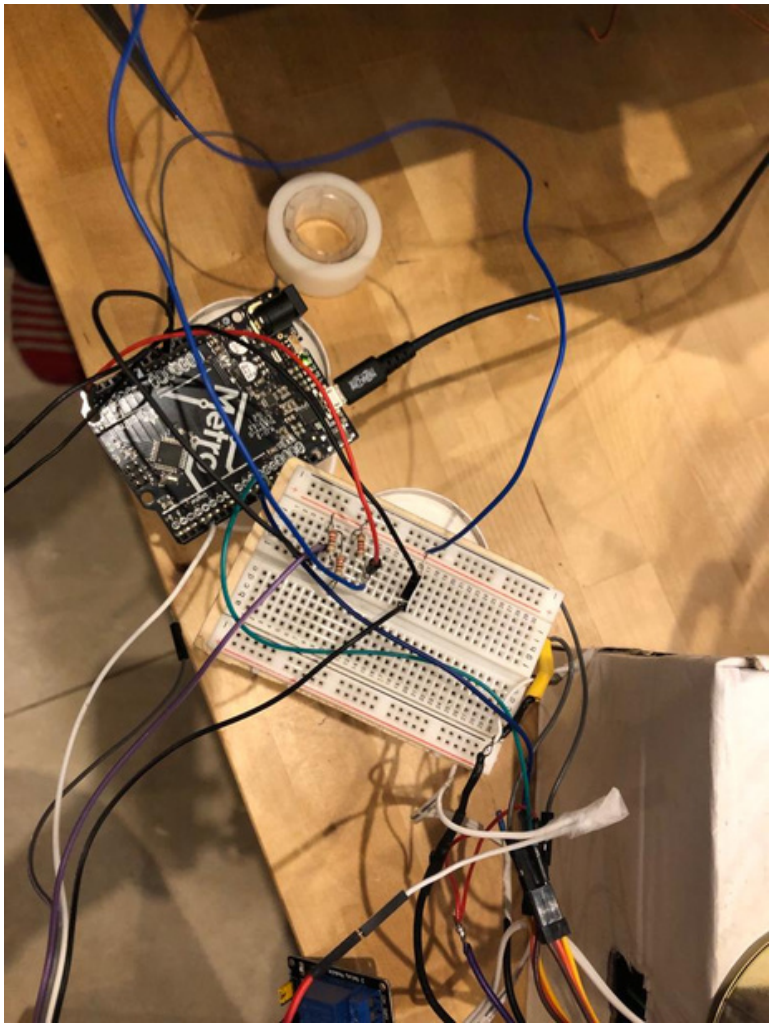
    myservo1.write(angle);
    myservo2.write(angle2);

    Serial.print(30);
    Serial.print(",");
    Serial.print(angle);
    Serial.print(",");
    Serial.print(angle2);
    Serial.print(",");
    Serial.println(150);
  }
  cntr = cntr + 1;
  lastVal = val;
}
```

- Circuit: SKETCH BY LARS
-

- Final tests





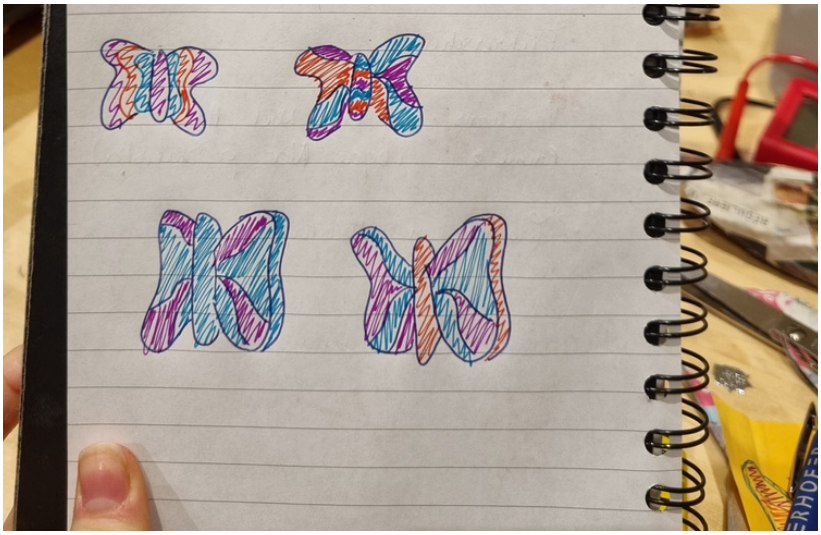


- Guided meditation: Based on a research on the internet and our personal preferences towards a relxaing meditation session we wrote a script and asked a yoga instructor to be the voice of our guided meditation.

[Introduction]
Welcome to this guided breathing and creative design installation. Please find a comfortable seated position and take a moment to let go of any distractions or thoughts. Close your eyes and focus on the present moment.
In front of you, you will find a beautiful model butterfly. As you begin to breathe deeply and steadily, the butterfly will start to flap its wings in sync with your breath.
Breathe in deeply through your nose and watch as the butterfly's wings open wide. Breathe out slowly through your mouth, and watch as the butterfly's wings close.
As you continue to breathe deeply and steadily, allow yourself to become fully immersed in the experience. Imagine yourself soaring through the sky, just like the butterfly.
Allow yourself to let go of any stress or tension, and simply focus on the sensation of your breath and the movement of the butterfly's wings.
You are now ready to begin your journey. Take a deep breath in and let the butterfly guide you.

Enjoy your journey.

- Butterfly design: Using colored tissue paper and more papier mache we created the "skin" of the butterfly.





Conclusion

In conclusion, the "Breathing Soft" project has been successfully designed and implemented as an interactive installation that promotes conscious and mindful breathing. The final design of the installation is a robotic butterfly that flaps its wings in the rhythm of the user's breathing, which is monitored by a breathing sensor. This interactive experience aimed to not only provide a visual representation of the user's breath but also to create an immersive and engaging experience that encourages individuals to focus on their breath and learn techniques to improve it.

The design of a robotic butterfly was chosen as it is an object that can easily capture the attention of visitors and also symbolizes the idea of mindfulness and being present, which aligns with the goal of the project. Through this installation, visitors can take a moment to focus on their breath, learn techniques to improve their breathing, and become more present and aware of their bodies and minds which enhances the overall well-being of individuals.

Appendix

All throught the project, we documented each step of the way using a Notion workspace. For further details of our process, you can access the documentation here.

