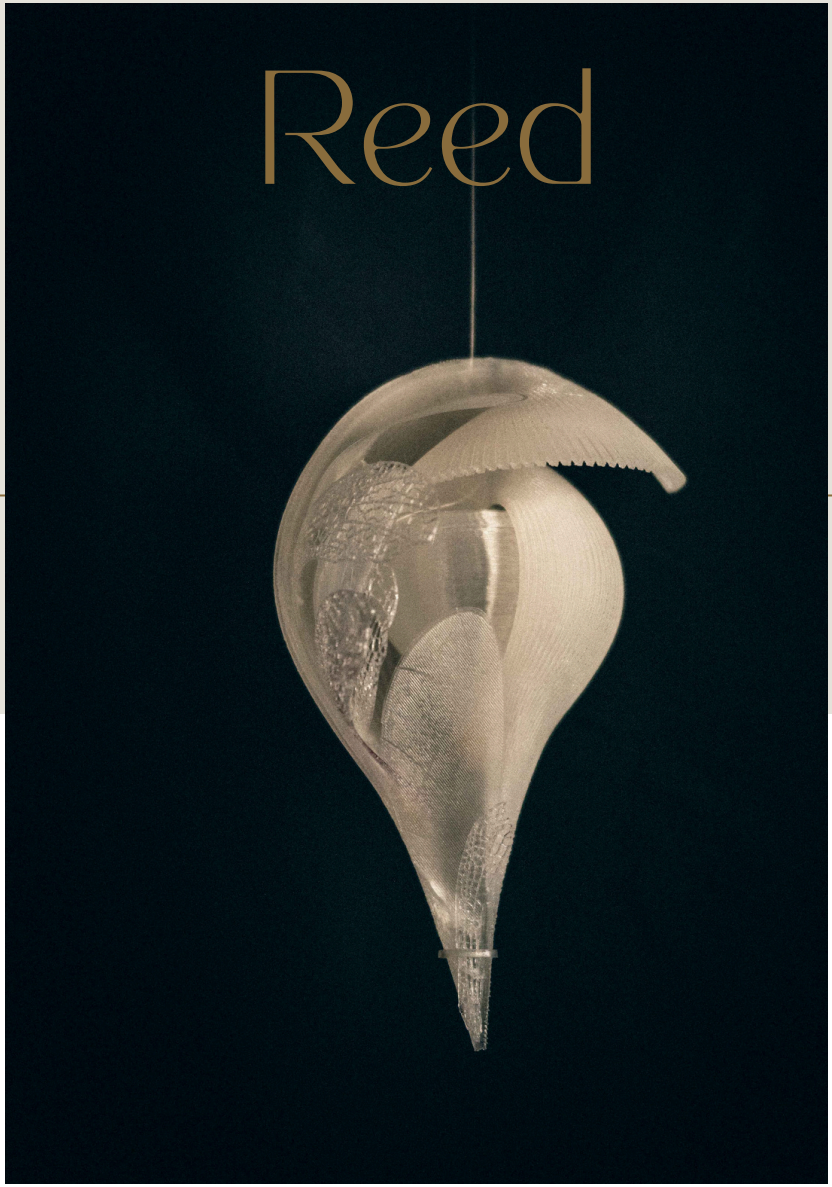
Reed



Breath of days

Reed

Kae Nagano
Fablab Kamakura

Fab Academy 2023-2024 project

Mentor: Cecilia Raspanti
Oscar Tomico
Petra Garajova

Local instructor: Rico Kanthatham
Jun Kawahara

Table of Contents

ABSTRACT

Reed is a sustainable art project aiming to integrate dying as a natural scenery into our daily lives.

In a world increasingly aware of environmental issues, my challenge is to make sustainability an art form. Reed is more than just a project; it's a multifaceted initiative decentralizing responsibilities and reducing individual burdens. By transforming organic leftovers into valuable resources, Reed contributes to waste reduction and environmental sustainability. Through natural fermentation processes, Reed harmonizes with the environment, minimizing human intervention.

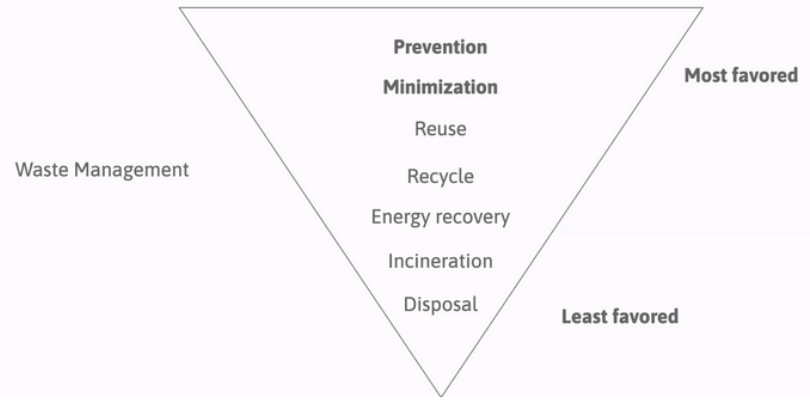
Reed thrives on community engagement, inviting people to interact with its transformative journey, fostering a sense of ownership and collective responsibility. The collaborative effort behind Reed's creation involves engineers, designers, and artists shaping a masterpiece that blends technology with art. Reed will serve as the emotional pulse of the community, leaving an indelible mark as interactions with its light, sound, and dye forge connections between people and nature.

Reed's 1st prototype is a parametrically designed organic unit. When set with organic leftovers and water, it is hung on a tree, allowing natural fermentation to progress. As fermentation progresses, the light and sound change, enhancing the scenery for enjoyment. When fermentation matures, the dye permeates Reed's Seed Wing, flying like a maple seed. People enjoy interaction with Reed by dyeing fabrics or using it as paint, fostering a connection between individuals and the project.

INTRODUCTION

Food Waste

The inception of the Reed project was prompted by personal experiences and reflections. Engaging in Fabricademy classes heightened my awareness of sustainability, directing my attention to aspects of nature, such as vegetable peels and eggshells, which were once casually discarded in daily life. Consequently, my understanding of environmental issues deepened.
However, amidst the busyness of daily life, sustaining environmentally friendly practices proved challenging, leading to occasional disposal of reusable items. This dilemma sparked the quest for solutions.



source: https://class.textile-academy.org/classes/2023-24/week03/

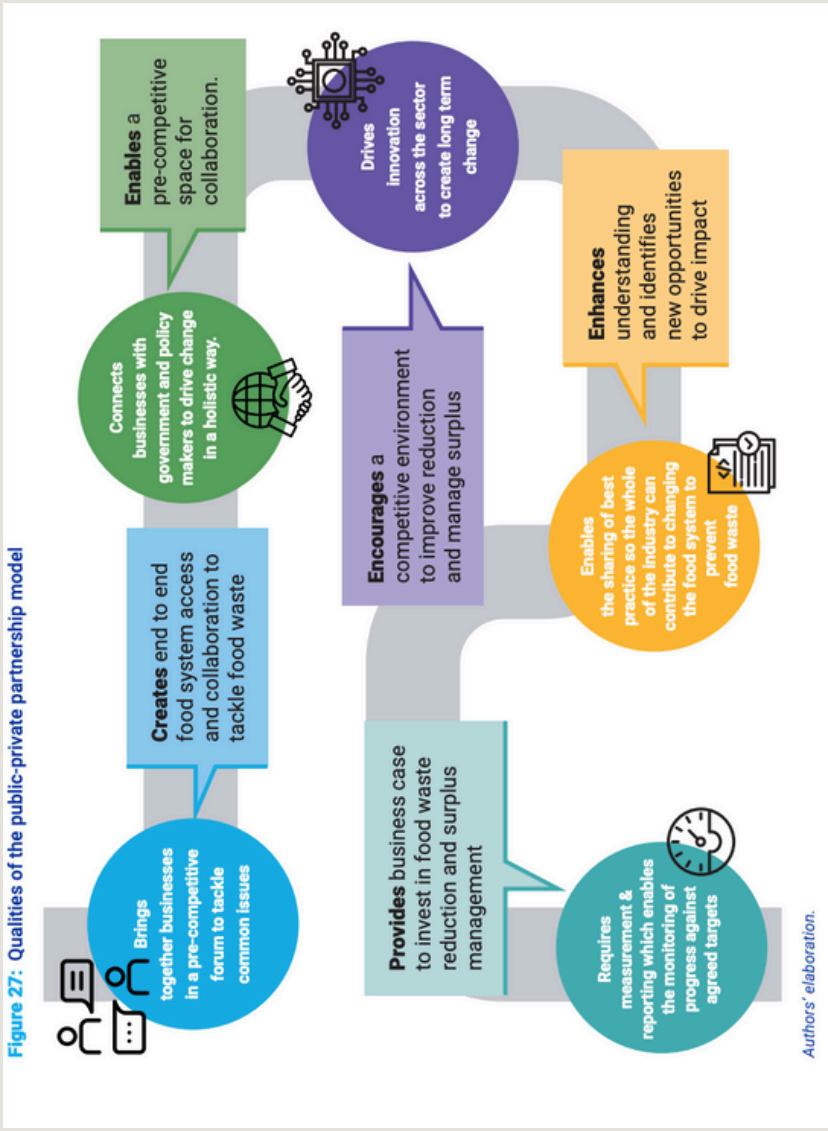
source: Food Waste Index Report 2024. Think Eat Save: Tracking Progress to Halve Global Food Waste https://wedocs.unep.org/handle/20.500.11822/45230

As a common solution, composting is often cited. For instance, the LFC Composter (https://lfc-compost.jp/) is a product designed for easy use even in urban settings.

source: https://lfc-compost.jp/)

While appealing to gardening enthusiasts, concerns such as the risk of insect infestation may arise. Additionally, examples of recycling on a large scale include the use of crushed marine shells as soil amendment materials or the production of calcium supplements.

According to the "Food Waste Index Report 2024: Think Eat Save: Tracking Progress to Halve Global Food Waste (https://wedocs.unep.org/handle/20.500.11822/45230), food waste is a significant issue in urban areas. With over half of the world's population currently residing in urban areas, the role of local governments in food waste management is expected to increase significantly in the coming years.
The report highlights a model where both public and private sectors collaborate to achieve common goals. This collaborative model concept has been incorporated into the Reed project's concept.



source: Food Waste Index Report 2024. Think Eat Save: Tracking Progress to Halve Global Food Waste https://wedocs.unep.org/handle/20.500.11822/45230

INTRODUCTION

Art & Sustainability

I enjoy brainstorming solutions that people can enjoy, given my work in the entertainment industry.
I had the opportunity to visit an art exhibition by Ólafur Elíasson in Japan. He is a renowned artist from Denmark and Iceland, known for his immersive installations that explore nature, the environment, perception, and human interaction. His works often incorporate elements such as light, water, and natural phenomena, creating experiences that encourage viewers to engage with their surroundings and contemplate. Elíasson's art blurs the boundaries between art and science, prompting viewers to reconsider their relationship with the natural world and their role in its formation.
His artistic creations left a deep impression on me and inspired me to incorporate a commitment to environmental consciousness and ecological awareness into Reed.

source: https://olafureliasson.net/

Sayaka Asai is an artist who is fascinated by the beauty of things that cannot be fully controlled, known as "accidental beauty in nature". She creates artworks using a technique called "ice dyeing", where fabric is dyed using ice. Unlike traditional methods like stencil dyeing, which produce clear patterns, her work features blurred boundaries that evoke various associations in people's minds. What I particularly liked about her style is the incorporation of the concept of time, as she not only focuses on the results of her artwork but also enjoys the process of ice melting.

source: https://sayakaasai-jp.mystrikingly.com//

CONCEPT

1st sketch

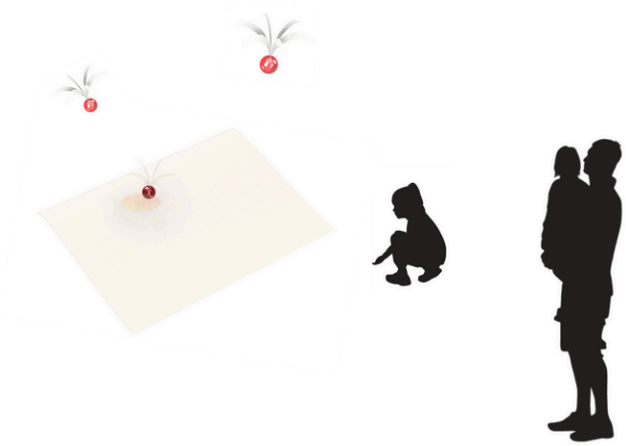
These are the first sketches I wrote when starting the Reed project

Breath of Days **REED**

Hang it on a tree to ferment in the sunlight.
When it ripens, it lights up and begins to play a tune.

Put leftovers from everyday life,
such as vegitable peels, and water into the REED

People place fabric under REED and wait.
Seeds fly from REED and dye the cloth.



Imagine a world

where sustainability and artistry

intersect and blend into nature.

REED represents more than just a project.
It's a multifaceted initiative that aims to decentralize responsibilities, thereby reducing individual burdens.

1 Reduce leftovers

REED transforms organic leftovers into valuable resources. By simply hanging REED on a tree, we contribute to waste reduction efforts while enhancing environmental sustainability.

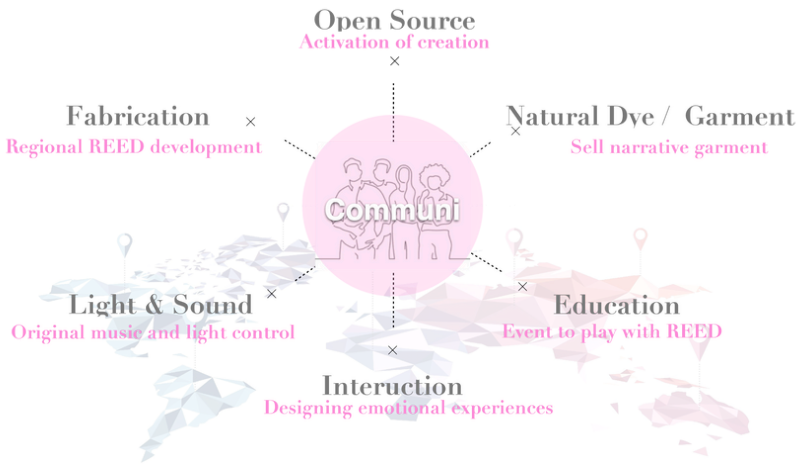
2 Fermentation

Nature takes its course with REED. Through natural fermentation processes, REED works harmoniously with the environment, minimizing human intervention.

3 Interaction

REED thrives on community engagement. It invites people to interact with its transformative journey, fostering a sense of ownership and collective responsibility.

Interdisciplinary Global Collaboration



One of the most exciting aspects of REED is the collaborative effort behind its creation. Engineers, designers, and artists from various backgrounds come together to shape a masterpiece that seamlessly blends technology with art.

REED will become the emotional pulse of the community, leaving an indelible mark as interactions with its light and sound forge connections between people and nature.

DEVELOPMENT

Natural Dye

Research:
In the Fabricademy class, we mainly created dye solutions by boiling ingredients such as onions. Therefore, my initial question was whether dyeing could be achieved through the heat of sunlight.
In this study, fibers are dyed using the natural heat generated by the sun or the fermentation process. While it takes longer than boiling, it is noted to be worth the time invested.

source:https://www.suzannedekel.com/post/fermentation-and-solar-dyeing-the-ultimate-slow-dye

The book "Natural Dyeing Notes: Fermented Dyeing: Indigo, Rhubarb, Madder" by the dyer Hisako Sumi describes the method of "precipitated indigo", which involves soaking fresh leaves in water to extract the indigo component and oxidize it.

△自家製タデアイ顔料と沈澱藍（小樽）△リュウキュウアイ沈澱藍（製造所、沖縄）△インドアイ沈澱藍

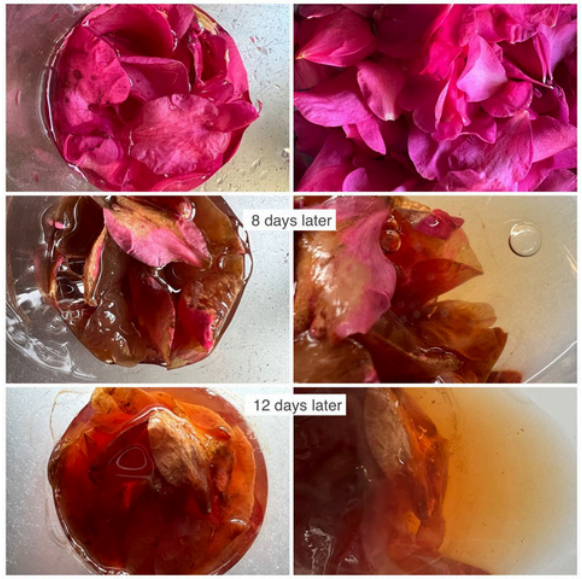
From left: Tadeai, Ryukyuai, Indianeye "Sedimentary Indigo"
source: Natural Dyeing Notes: Fermented Dyeing: Indigo, Rhubarb, Madder
: Hisako Sumi

A simple ice dye method was described in this article.Sprinkle powdered dye little by little on top of the ice.Beautiful pale finish that resembles a watercolor painting.

source: https://www.pacfabricdye.jp/post/ice-dye

Natural Dye Experiment

December. It's camellia season in Japan. I experimented with camellia, which contains anthocyanin. Changes were observed as follows. It was confirmed that the dye solution could be extracted using just water and sunlight.



Recipe1:

* Camellia petal(Raw) 10g
* Water 100cc

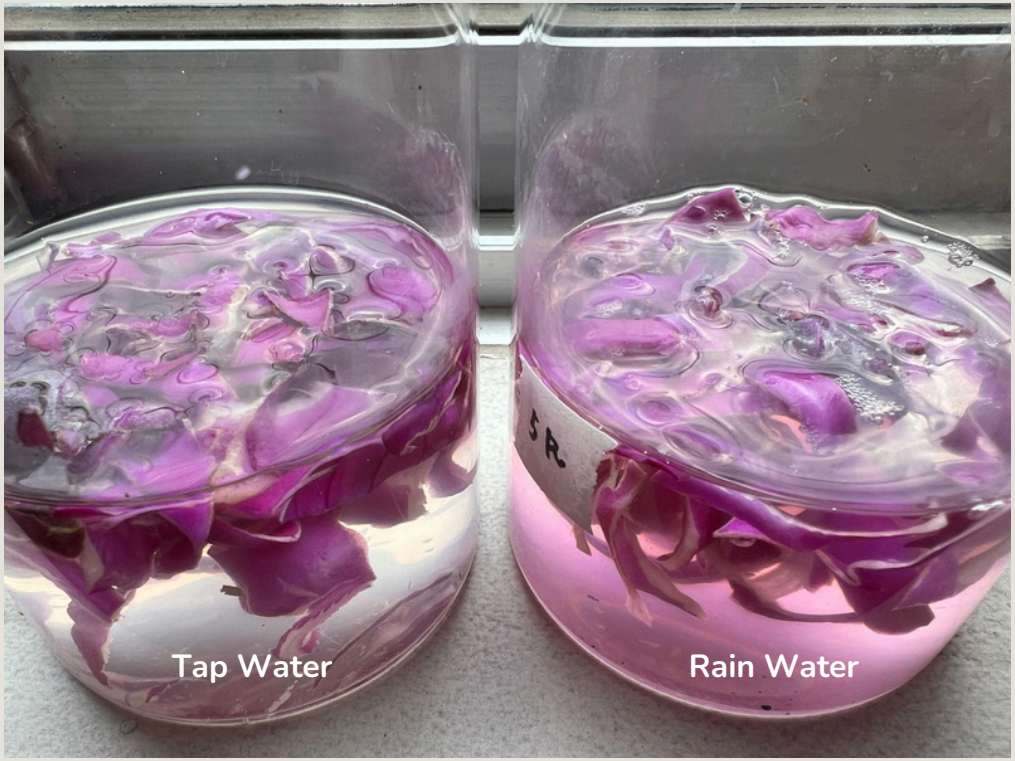
1. Weigh the petals and water, put them in a glass, and mix them gently with a stick.
2. Cover with a coffee filter and secure with a rubber band.
3. Place it in a sunny place, such as a garden or near a window, where it will not be exposed to rain.

Experiment 2 was conducted using the following ingredients. The reason why I tried using rain instead of tap water is that in Japan, tap water has a pH of around 6, and rain has a pH of around 5 (acid rain has a pH of around 4), so rain is more acidic, so I thought it would be better for staining. This is because I thought there might be.

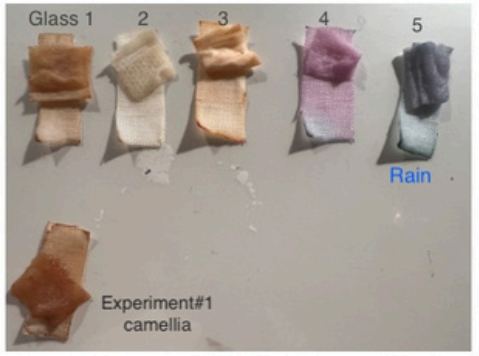
Recipe2:

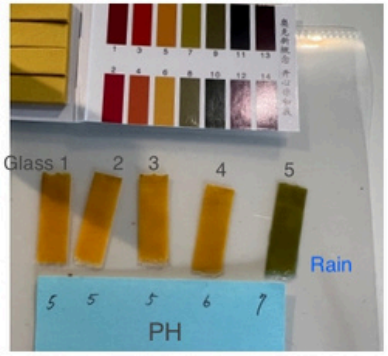
* Glass#1: Camellia petal(Raw) 10g / tap water 100cc
* Glass#2: Camellia petal (dried) 2.5g / tap water 100cc
* Glass#3: Onion skin (Dried) 2.5g / tap water 100cc
* Glass#4: Red cabbage(Raw) 10g / tap water 100cc
* Glass#5: Red cabbage(Raw) 10g / rain water 100cc

1. Weigh the ingredients and water, put them in a glass, and mix them gently with a stick.
2. Cover with a coffee filter and secure with a rubber band.
3. Place it in a sunny place, such as a garden or near a window, where it will not be exposed to rain.



After leaving them for 7 days, interesting observations were made. It was evident that there was a difference in the degree of color extraction from purple cabbage between tap water and rainwater, as shown below. When measuring the pH, it was found that rainwater was more acidic than tap water.

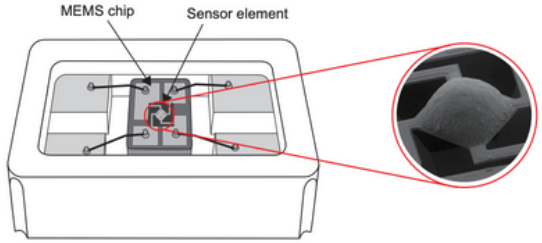




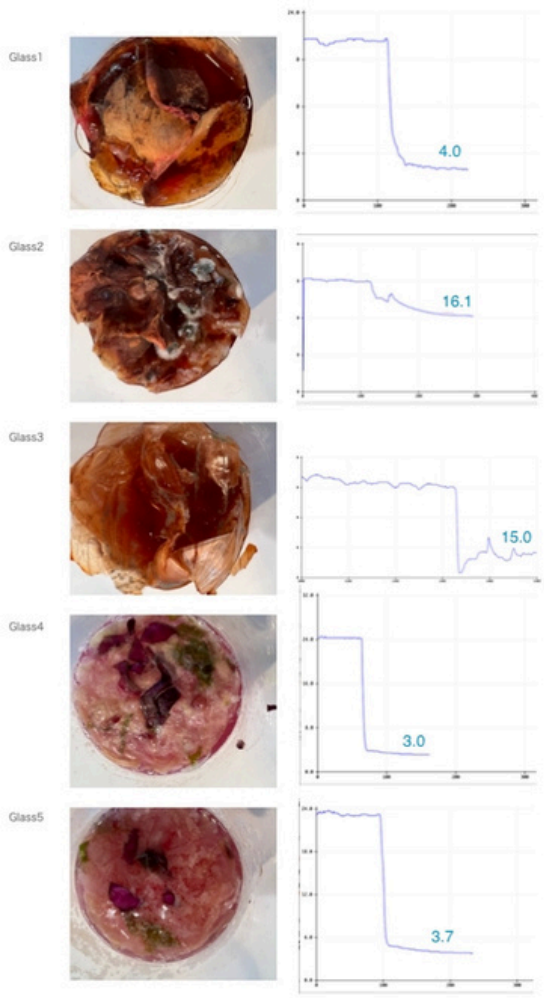
Fermentation sensing

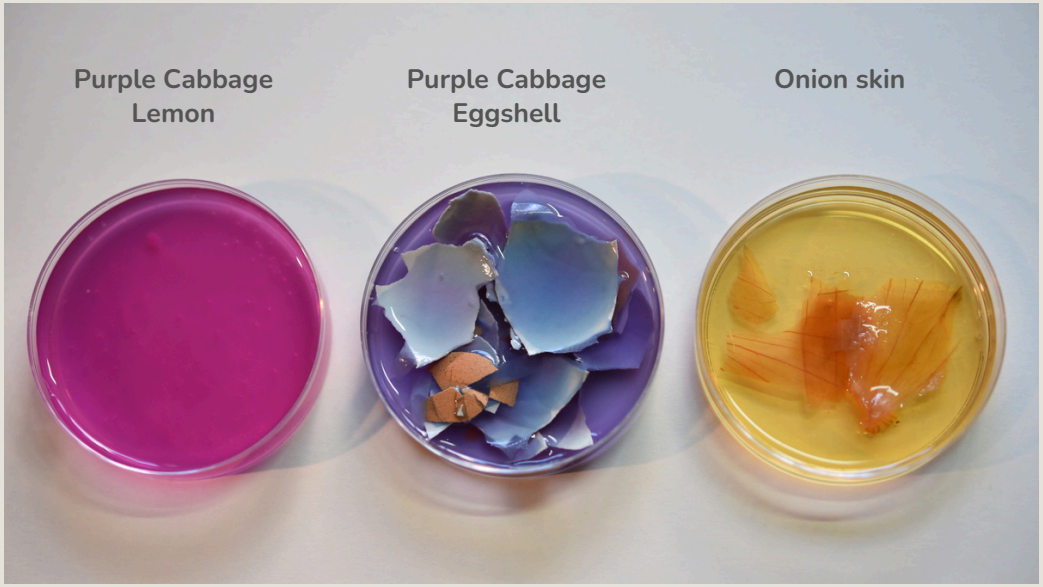
To sense the progress of fermentation, time, temperature, color, odor, etc. can be used. It is assumed that temperature and color are affected by the weather and are difficult to judge. Elapsed time is the most reliable method, but this time I tried out a gas sensor out of curiosity.

Gas Sensor TGS8100 is highly sensitive to things like cigarette smoke and cooking odors. If there is a detectable gas in the air around the sensor, the resistance value will change.



The graph below shows the change in value when the gas sensor is brought closer to the glass. Compared to the first day's observations, the sensor values seemed to have clearly decreased over the week. Therefore, gas sensors have the potential to monitor fermentation progress. However, since it is influenced by the environment, it is necessary to consider the correction method for accurate comparison.

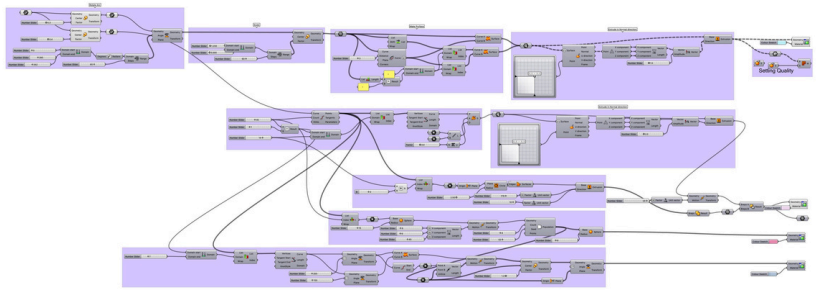


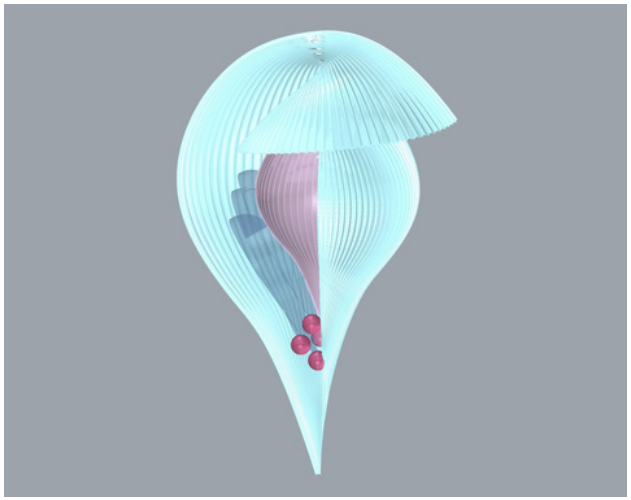


Main Unit

Design

The Main Unit was designed parametrically using Grasshopper. It has an organic shape like a seashell, and has a unit to put the dye liquid inside and a space to store the seeds.

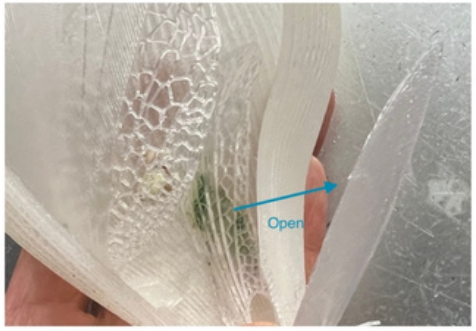


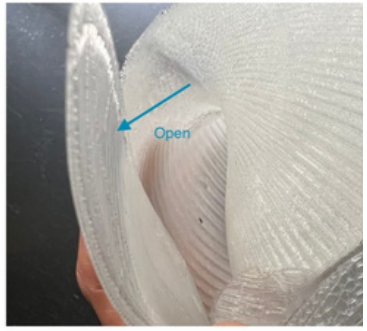


Fabricate organic and functional

The main unit was 3D printed using environmentally friendly PLA material derived from corn. Although PLA is vulnerable to ultraviolet radiation and not suitable for outdoor use, this project deliberately chose a material that is fragile and easily returned to the environment.
It took time to find a way to incorporate electronic devices and the Seed Wing into the interior while maintaining the concept of this organic design. Eventually, it was decided to integrate the Wing into the body. The 3D printed wings are flat. However, if you peel it off the 3D printer bed, roll it up in your hands to fit the shape of the main unit while it's still warm, and hold it until it cools down (about 1 minute), it will become a curved wing like the one below.

The base of the wings was glued to the Main Unit using the adhesive Acrisunday. Acrisunday is mainly used for adhering acrylic, but this time I used it for adhering PLA. The thin wings allow the top to be easily moved even when the bottom is glued to the main body, allowing you to move the dye unit, Seed Wing, and electronics in and out of the interior. When producing a shape like this by integrating it with an FDM printer, the influence of the support material becomes an issue. I think it was a good idea to print the hard unit and soft wings separately and combine them.





Seed Wing

Research

According to the article, there is a diversity in flying seeds as shown in the following picture. Some fly with light thread-like wings like dandelions, some fall while spinning like maples, and some fly like gliders like Javanese cucumbers. Since the way an airplane flies changes depending on its mass, wing balance, position, etc., there is a lot of research on aerodynamics.

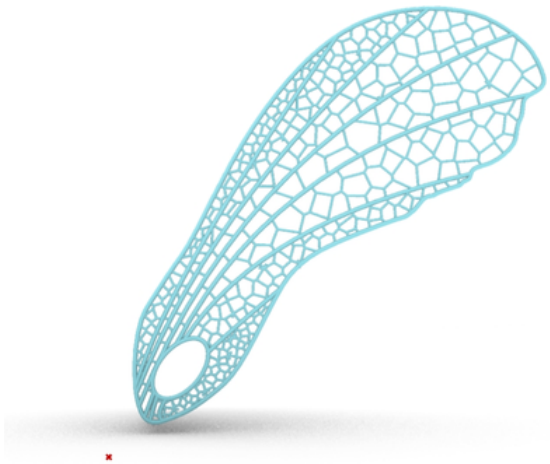
source: https://www.sciencedirect.com/science/article/pii/S0960982222002512

Unlike dandelions, the purpose of this project is not to make it fly as far as possible. It dyes the cloth under the hanging tree, so if it falls in different places within a 1 meter square, You will be able to create dyed items with naturally occurring designs. This time, I decided to create a design with a maple-shaped seed motif.

Design

Two types of wings were designed for this project. The first features a Voronoi pattern commonly found in nature, while the second is simpler in design. The voronoi pattern was chosen not only for its aesthetic appeal but also because lines resembling leaf veins found in seeds such as maple seeds contribute to flight stability. Further design modifications based on simulation results are planned for the next step.
The second type is thinner and 3D printed, allowing for easy bending and possessing flexible characteristics. Initially used for flight experiments, it was eventually integrated into a part of the main unit, leveraging its flexibility to hold electronics and seeds while maintaining the overall design.

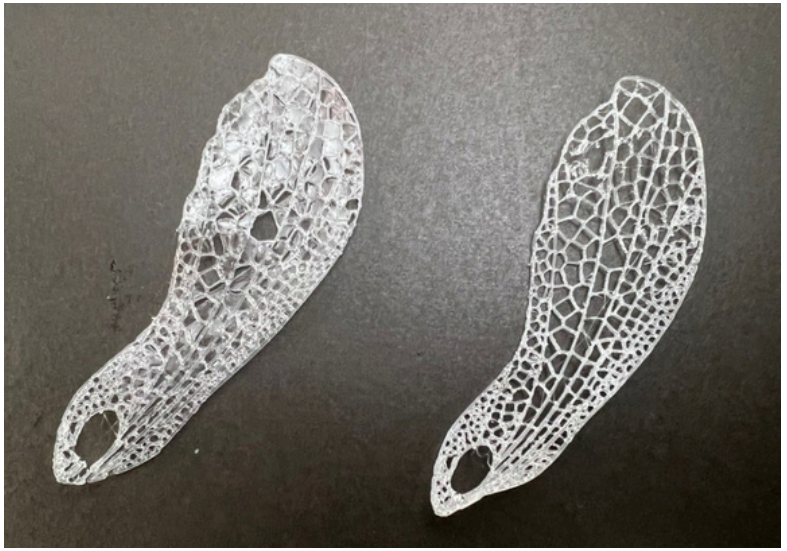
#1: Voronoi Pattern



#2: Simple Pattern

Bio Plastic

To increase the air resistance of the 3D printed Voronoi pattern Seed Wing, bio plastic was painted on it.
The one on the left is coated with BioPlastic, and the one on the right is uncoated. The painting on the left leaves holes. I thought about adjusting the size of Voronoi to make it easier to spread the membrane. but the wings of the species are actually porous. However, the research have shown that maple seed wings are actually porous, similar to dandelion wings, and that this helps stabilize flight. Therefore, I decided to leave the hole in the Seed Wing that I created as is. In the next step, I would like to try optimizing the porosity using Grasshopper's Kangaroo, etc.

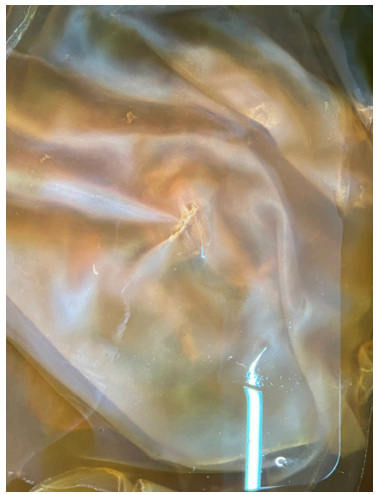


Recipe3: Bio Plastic

* Agar 5g (Kanten)
* Glycerine 15g
* 250ml water

1. Measure agar in the cup
2. Pour water into the cup and stir it with a spoon.
3. Boil for 2 minutes. I used the microwave. Stir occasionally. A large cup is better to avoid spills.
4. Measure Glycerine, then pour into the agar liquid. Stir it.
5. Paint it with paintbrush on the wing
6. Leave it around one hour (room temperature)

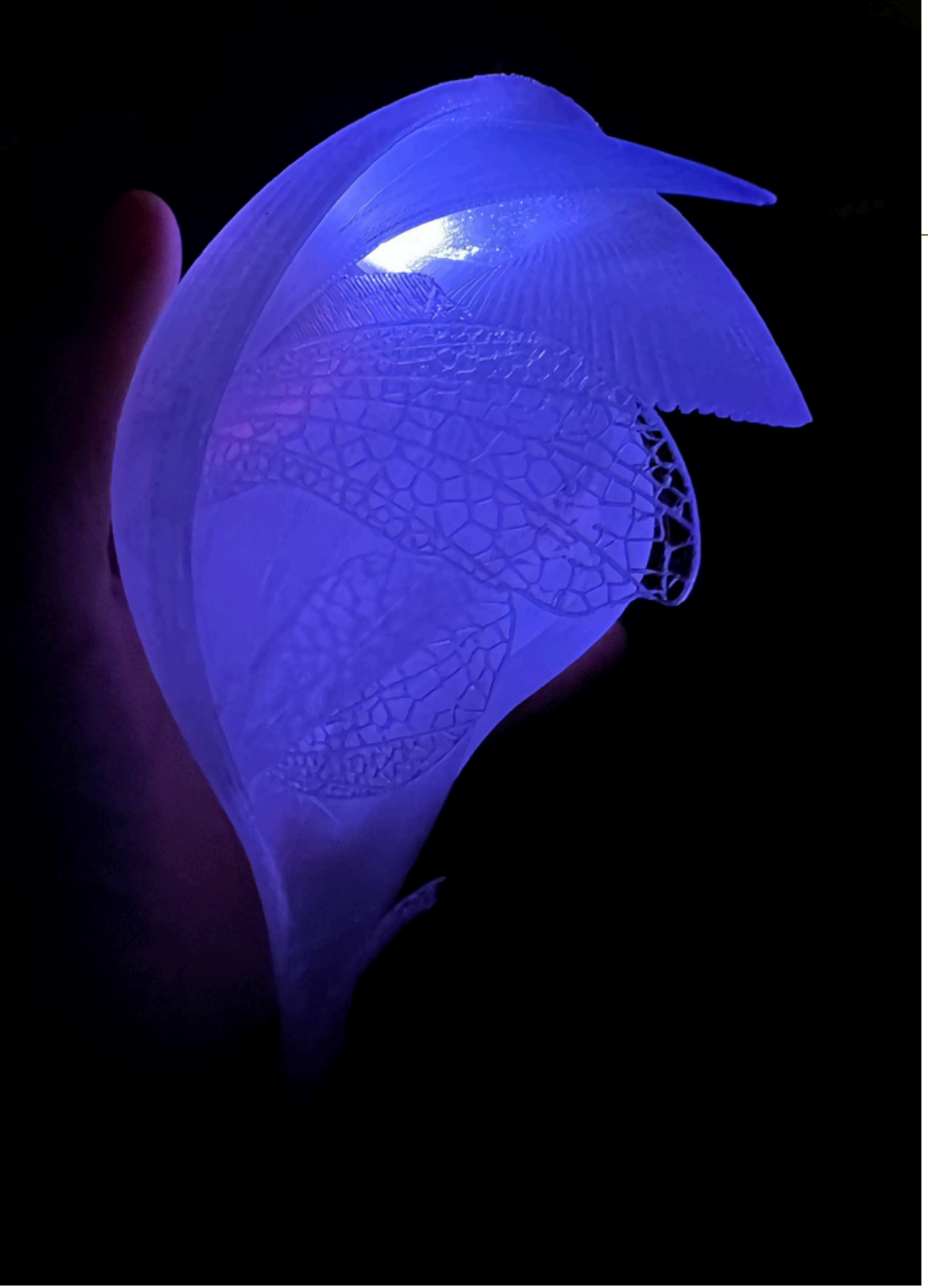
Currently, the wings are made of PLA, a biodegradable material. However, it requires conditions such as high temperatures and microorganisms. So there are problems with leaving the seed wing in nature to decompose. So I tried to make a wing from Kombucha. Thin layer of Scobie skin was dried for 3 hours in a room, then cut it with laser cutter.
The result was beautiful feathers that flew down beautifully when dropped from above. However, if seeds (cotton) containing dye are applied, the feathers lose their balance and cannot maintain their wing shape, causing them to fall straight down. Even if it is thin, it must have a solid structure.



Recipe: Kombucha

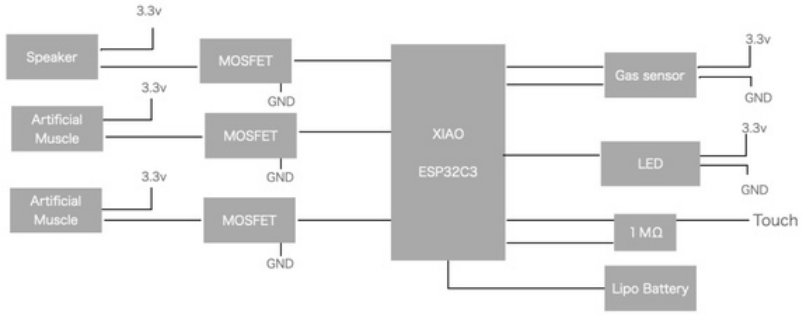
* Scoby
* 2 bags of Black tea
* 1/4 cup Brown sugar
* 500 ml water

1. Wash glass jar thoroughly and pour boiling water over them or boil the jar.
2. Put tea bags in the jar, then pour 500ml hot water
3. Put sugar into the tea. Stir it with a spoon to dissolve.
4. Leave it to cool to room temperature
5. Put sucoby in it
6. Cover the jar with cloth
7. Place the jar in the clean and warm space



Electronics

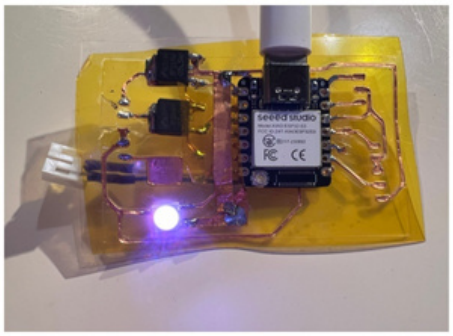
This is a simple block diagram. The LED visually indicates the fermentation status of the dye solution by the way it lights up. A speaker provides an auditory indication of the fermentation status of the dye solution, encouraging people to interact with it.
The artificial muscle is used to release the dye solution from the Dye Unit and release the Seed.

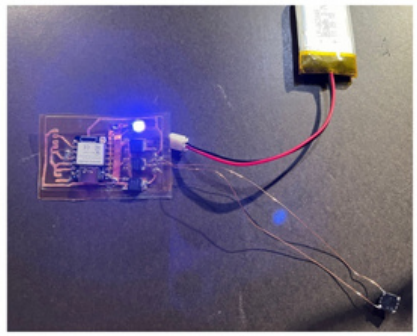


Main Parts:

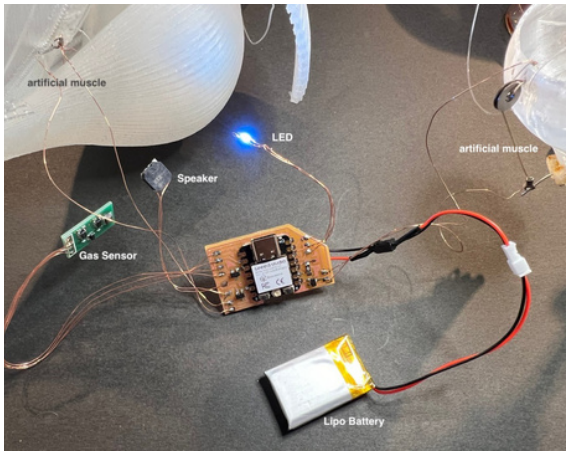
- Micro controller board: XIAO ESP32C3
- LED: NeoPixel
- Speaker:
- Artificial muscle: BioMetal:
- Fermentation sensing: Gas Sensor TGS8100
- Nch MOSFET

A circuit board was created to compactly fit the electronic components inside the main unit. At first, I tried making a flexible circuit board and placing it along the inner wall of the unit. It worked but the circuit board pattern easily peeled off and operation was unstable.

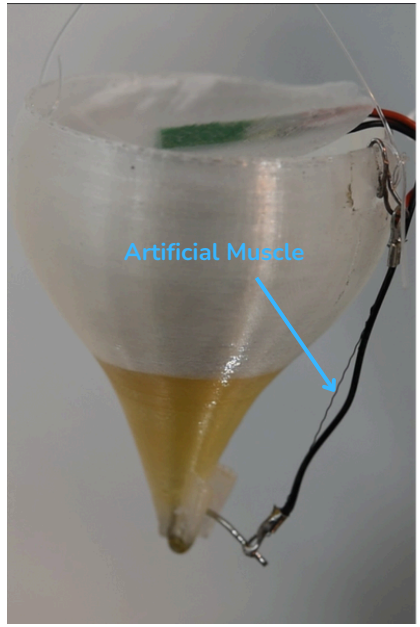


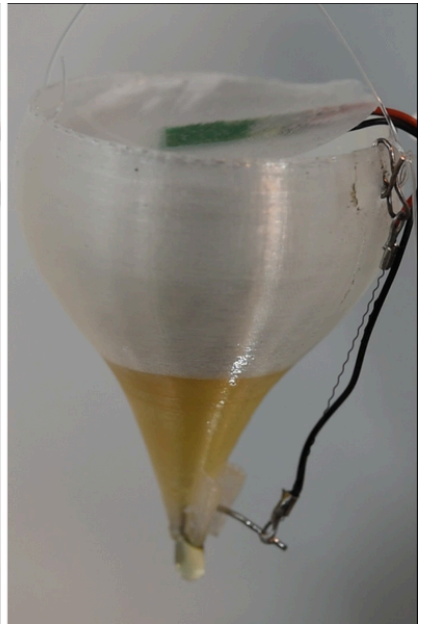


So regular hard board was designed using KiCad and CNC milling machine “SRM-20”.



Below, an coiled artificial muscle is used to open the silicon stopper of the Dye Unit. When the microcontroller sends current, the artificial muscle contracts, pulls the lever connected to the stopper, and the dye solution is released.



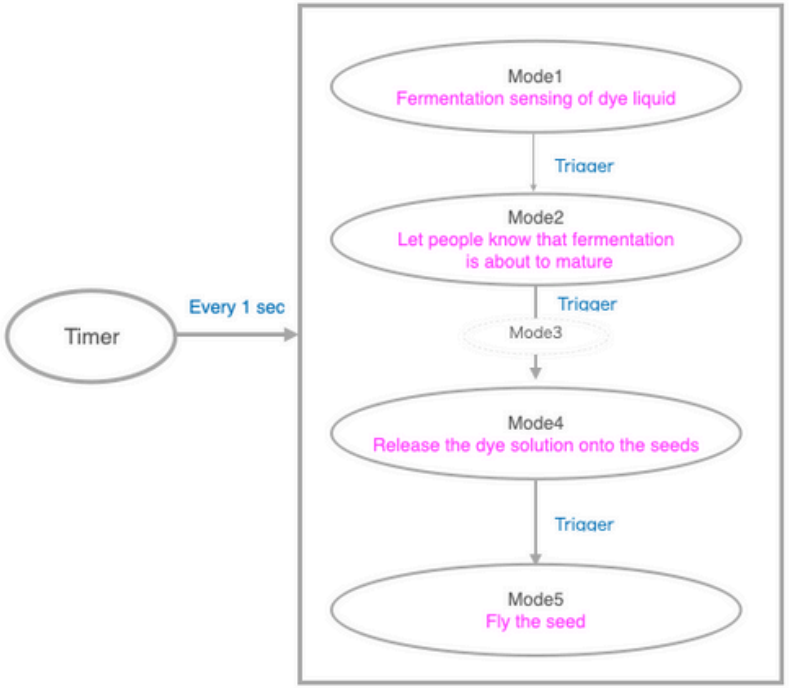


Close Open

The photo on the next page shows Seed Wing falling from the Main Unit. A thin wing is attached to the Main Unit to prevent the Seed from falling. When the time comes for flight, a microcontroller controls artificial muscles to open the thin wings outward, making it easier for the seed to fall.

Programming

The program performs mode transitions as shown below. All program processing is performed in the 1 second interrupt of the ticker. This is because in order to read the value of the gas sensor, it is necessary to give a pulse with a period of 1 second. The only thing that requires a 1-second interrupt is to obtain the gas sensor, but this time I decided that there would be no problem in executing other processing within the 1-second interrupt, so I kept the structure simple.



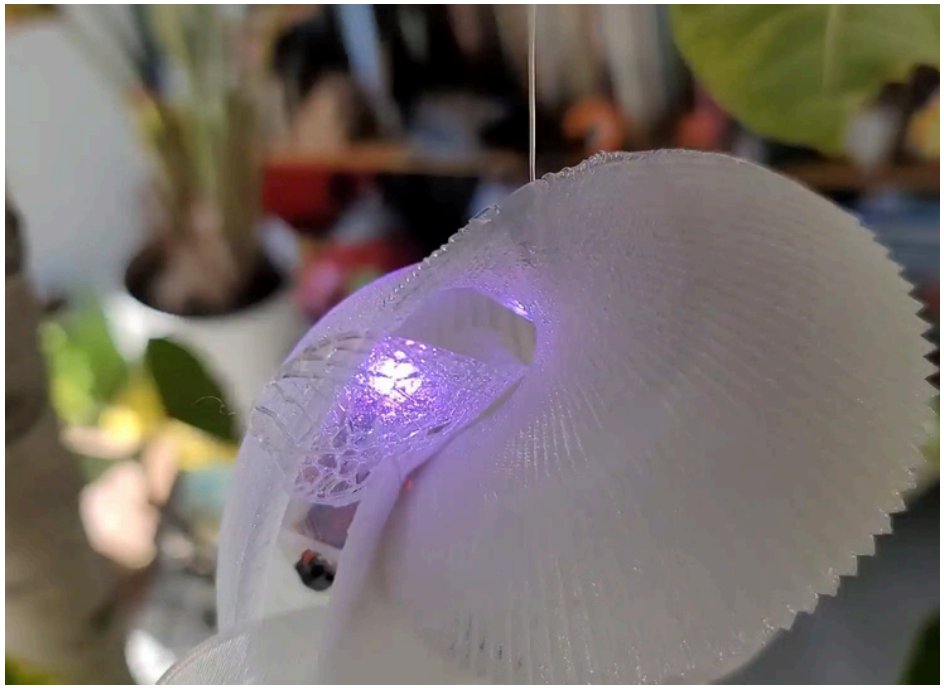
When the program starts, it first enters Mode 1. A gas sensor measures the degree of fermentation of the dye solution, and when it is sufficient, it switches to Mode 2. This research confirmed that fermentation could be sensed with the sensor. But I didn't have time to find the optimal fermentation completion value for each ingredient. Therefore, this program uses the elapsed time to trigger Mode2.

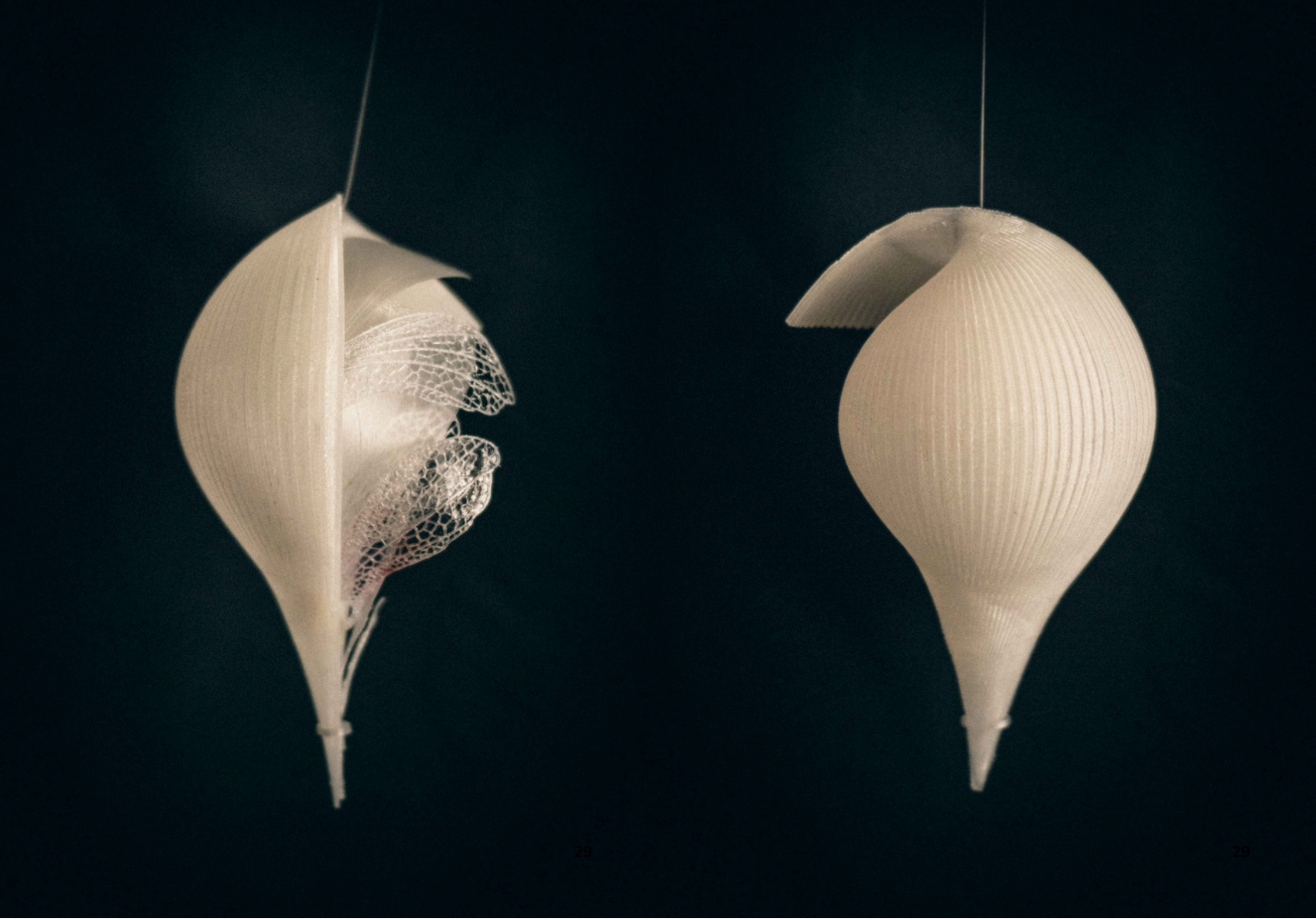
Mode 2 tells people that fermentation has progressed. In the program, the way it lights up (LED color) changes and plays a tone. This time, rather than a song, the format is a random pentatonic sound. Although the system will be larger, I can also use the unit that can play MP3. People feel the four seasons through tones and colors. Those who wish to dye their fabric should make preparations such as setting it around the Reed.

Mode 3 is a buffer mode. I had a problem where even if I stopped the tone, it wouldn't stop ringing if there was data in the buffer, so I added a buffer-like mode. There may be other solutions.

Transitions from Mode2 to Mode3, Mode4, and Mode5 are performed based on elapsed time. In Mode 4, uncork the Dye Unit, and in Mode 5, open the wings covering the Main Unit to make it easier for the seeds to fall out.

This program uses three MOSFETs to control the speaker, artificial muscle 1, and artificial muscle 2. When two or more MOSFETs were used at the same time, the microcontroller's operation became unstable, causing frequent resets. To solve this problem, this program limits the number of MOSFETs to one in each mode. Another solution could be time-shift the multiple MOSFET operations.





29

Exploring Future Endeavors

The first prototype has been completed. Next, I aim to tackle new challenges in pursuit of further evolution.

- Power supply
  - Explore sustainable options such as solar power for energy provision.
- Biodegratable
  - Investigate alternative materials to PLA for the Main Unit and Seed Wing.
  - Research biodegradable options for electronics.
- LED, Sound
  - Enhance lighting and sound effects to correspond with fermentation progress.
- Waterproof
  - Implement measures to protect electronics from rain damage.
- Mechanism
  - Enhance the durability and reliability of fragile components.
- Open source
  - Consider open-source solutions for broader accessibility and collaboration.
- Variation
  - Electronics-Free: Experiment with designs that do not rely on electronic components.
  - Remote Control: Explore interactive features for remote control and user engagement.
  - Interactions: Positive/Passive

Useful Links

My works

- Reed Video
  - https://vimeo.com/927620278
- Reed Portfolio
  - https://class.textile-academy.org/2024/kae-nagano/project/
- Reed Document
  - https://class.textile-academy.org/2024/kae-nagano/development/01-concept/
  - https://class.textile-academy.org/2024/kae-nagano/development/02-process%201/
  - https://class.textile-academy.org/2024/kae-nagano/development/03-process%202/
  - https://class.textile-academy.org/2024/kae-nagano/development/04-deliverables/
- Fabricademy Document
  - https://class.textile-academy.org/2024/kae-nagano/

- Fabricademy
  - https://class.textile-academy.org/
- Fablab Kamakura
  - https://www.fablabkamakura.com/
- Skylab Workshop
  - https://www.skylabworkshop.tech/