Interactive Installation

Team project

Course: DMSP

BREATHING IS NOT A CHOICE

Breathing feels personal, but air never truly is.

Table Of Contents

Air pollution is one of the most widespread environmental health risks today. According to the World Health Organization, around 99% of the global population breathes air that exceeds recommended pollution limits. Rather than being an occasional event, polluted air has become a continuous condition of everyday life in many cities.

This means breathing is no longer simply a biological process, but an environmental one shaped by external surroundings.

What Produces Polluted Air

Transport – vehicle emissions and urban traffic density

Industry – manufacturing processes and fossil fuel combustion

Agriculture – ammonia release and chemical fertilisers

Energy production – coal and oil based electricity generation

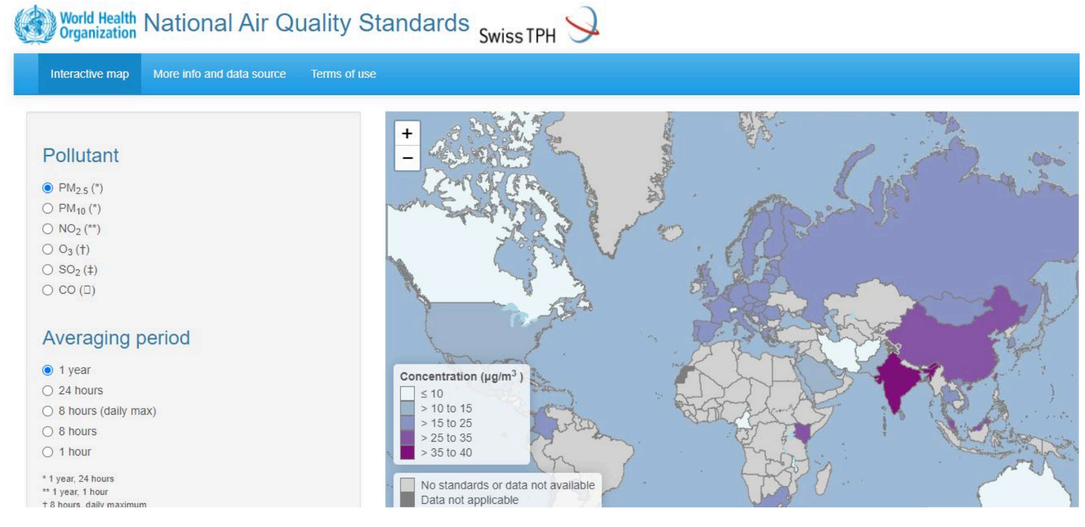
Urban construction – dust particles and material waste

Because these sources are embedded in infrastructure and policy, individuals cannot directly control the air they inhale.

Effects on the Human Body

Polluted air contains particulate matter (PM2.5 and PM10) that enters the lungs and bloodstream. Long-term exposure is linked to respiratory disease, cardiovascular problems and cognitive decline. However, unlike immediate physical threats, polluted air rarely produces instant sensory warning.

The body is affected before the person becomes aware.



The Perception Problem

Although pollution has strong biological impact, it is largely invisible. People encounter it mainly through numbers, charts and alerts rather than sensation. As a result, breathing appears normal even when conditions are harmful.

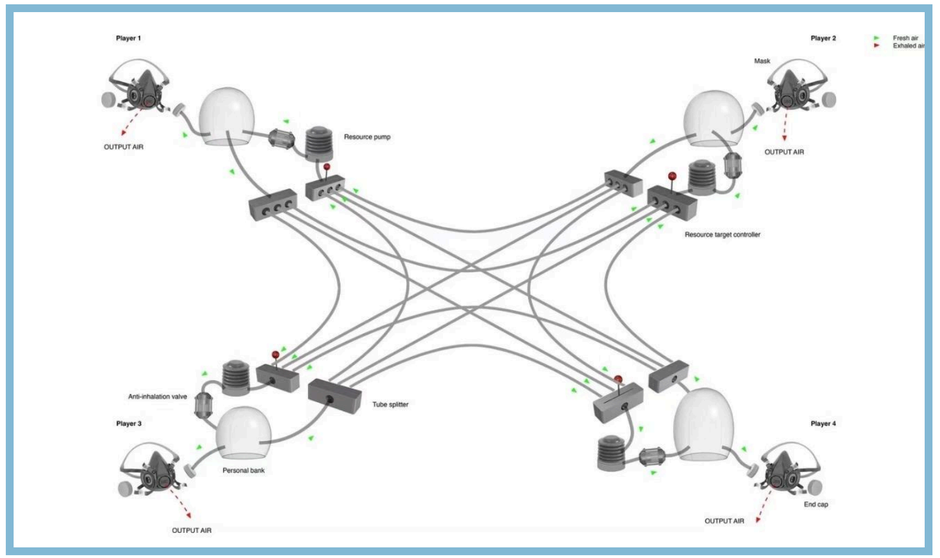
This creates a contradiction: breathing feels personal, yet the conditions of breathing are external.

Author | Rohan Kakad
Work | Breathing Game

"The Breathing Game" is a series of high-risk respirators designed by Rohan Kakad, aiming to explore contemporary issues regarding resource allocation in enclosed systems. Privatization and excessive exploitation of resources are having a widespread impact on the Earth. Humans are physically and mentally unable to cope with the scale of the Earth as a system.

Rohan has designed a powerful, adaptable, and hygienic multiplayer game system that enables participants to consume, store, steal, or share resources with each other.

In this system, air is commodified and competed for, as if it were a resource in a free market economy. This is a semi-scientific experiment with broader implications and the potential to promote new understandings of resource consumption and distribution.



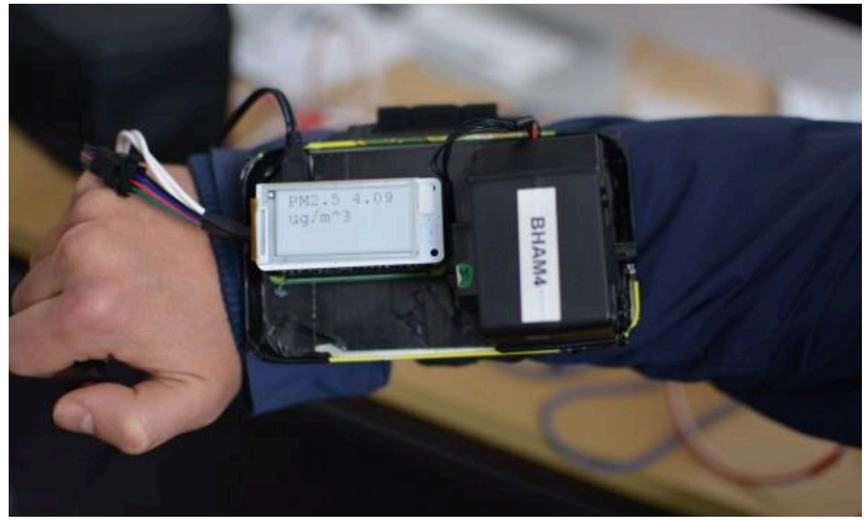
Air of the Anthropocene

The photography project “The Air of the Anthropocene” explores how to make air pollution perceptible.

By connecting particulate matter sensors to custom light source installations, the artist translates real-time pollution levels into the density of luminous particles captured in long-exposure photographs. The more severe the pollution, the denser the visual noise becomes, magnifying microscopic particles into visible forms.

This project moves beyond statistical representations of environmental data, transforming measurements into perceptual experiences.

This approach suggests environmental conditions gain meaning through physical contact rather than mere information transfer. Our project takes this further, extending the transformation from visual perception to bodily experience. Participants not only see polluted air but tangibly feel its impact on their breathing.



The invisibility of daily life

Air pollution is **an invisible and persistent daily environmental condition**. Unlike sudden disasters, it is not highly noticeable. Instead, it gradually permeates into daily life. Due to the limitations of the senses and long-term adaptation, people living in the same environment find it difficult to actively detect the subtle changes in air quality and its long-term, subtle and imperceptible effects on the body, emotions, and daily behaviors.

The deprived right to breathe

The sources of air pollution are deeply embedded in urban infrastructure and public policies, and individuals have little direct control over the air they inhale. At the same time, **the distribution of this right to breathe is extremely unequal**: regions with different development models (such as South Asia, North America, Europe), and different social classes, face vastly different air conditions. This inequality is normalized and lacks visible, perceptible expressions.

Lack of experience

The public's understanding of air pollution is mostly limited to abstract figures and news reports, lacking **immersive and physical experiences**. We know the dangers of PM2.5, but it's difficult for us to translate that knowledge into personal feelings; we understand the pollution data in different regions, but we cannot truly experience the differences. This separation between cognition and experience weakens people's sense of urgency and motivation for action regarding the issue.

02 Issue

Air pollution, as a structural and unequal daily environmental condition, is difficult for individuals to clearly perceive due to sensory limitations and dailyization, resulting in the inequality of " breathe equality" being overlooked, and at the same time, there is a huge gap between public cognition and physical experience.

03 Design Concept

15/01/2025 – Meeting phase

The project integrates knowledge from various fields, explores the value of art in the context of technological culture, and interprets and enriches profound phenomena through creative media. We break down the boundaries between art, academia, science and technology, presenting phenomena that are beyond the reach of human senses. In the initial exchange, team members shared their backgrounds and thoughts, presenting diverse and inspiring viewpoints, laying a solid foundation for the entire project.

22/01/2025 – Thinking phase

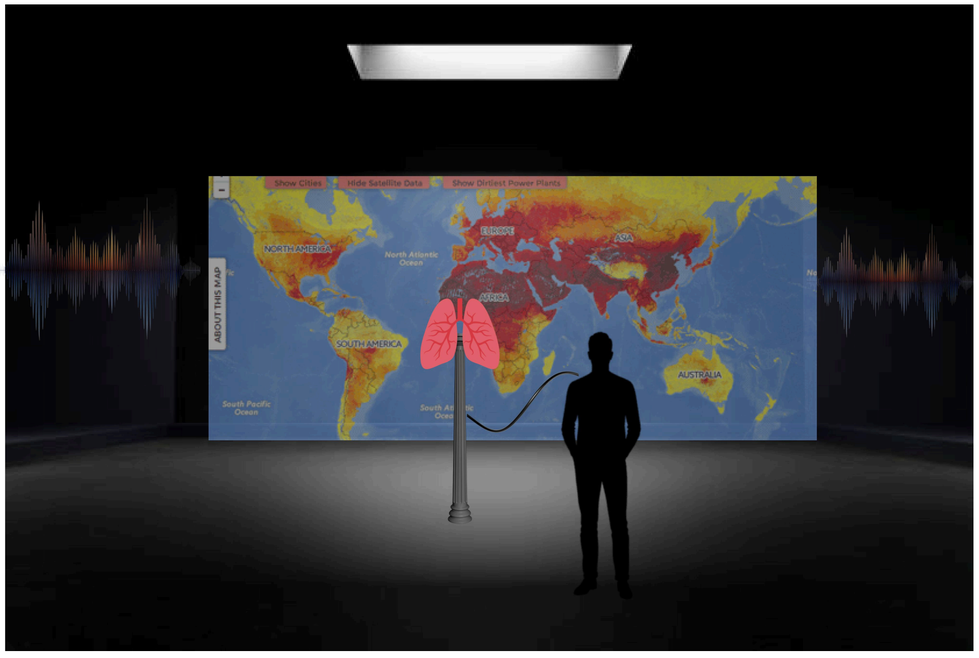
Entering the second stage of project advancement, we witnessed the formal collision and selection of creative ideas. Each member of the team brought great sincerity, carefully organized and fully shared their creative concepts. After thorough communication, they made a joint decision through voting. Everyone's ideas were novel and had unique highlights, all containing their own distinct thoughts on creation. Through repeated discussions and consensus, we finally settled on "Breathing Rights" as the core theme of the entire project.

After determining the direction, we combined our respective professional strengths and areas of expertise to clarify our roles and responsibilities, allowing the team's strength to form an efficient synergy. At the same time, we utilized the collaborative creation platform to continuously share project inspirations, fragmented thoughts, and references to similar artistic creations. Focusing on the core of "Breathing Rights", we continuously expanded our thinking, expanded the creative boundaries, and jointly sketched and discussed the final presentation form and expected effect of the work, making the vague creative ideas gradually become clear and tangible.

29/01/2025 – Concept Implementation and Experience Deepening

When the theme of "Breathing Rights" was officially established, we shifted from creative conception to the implementation of tangible experiences, determined to build this work on the real social fabric.

We understand that only by grounding ourselves in reality can the cry of "Breathing Rights" carry more weight. Therefore, we hope to make social research an important pillar of the project: from the main sources of air pollution, historical trends, to the impact on people's health and government response measures, and then convert these cold numbers into visual language; we also focused our field research on Edinburgh to listen to the stories of those who have moved here from all over the world: Has their living conditions changed due to the air? Has the desire for pure breathing become stronger? What changes are taking place in the body and senses?



05/02/2025 – Collaborative Co-creation and Conceptual Deepening

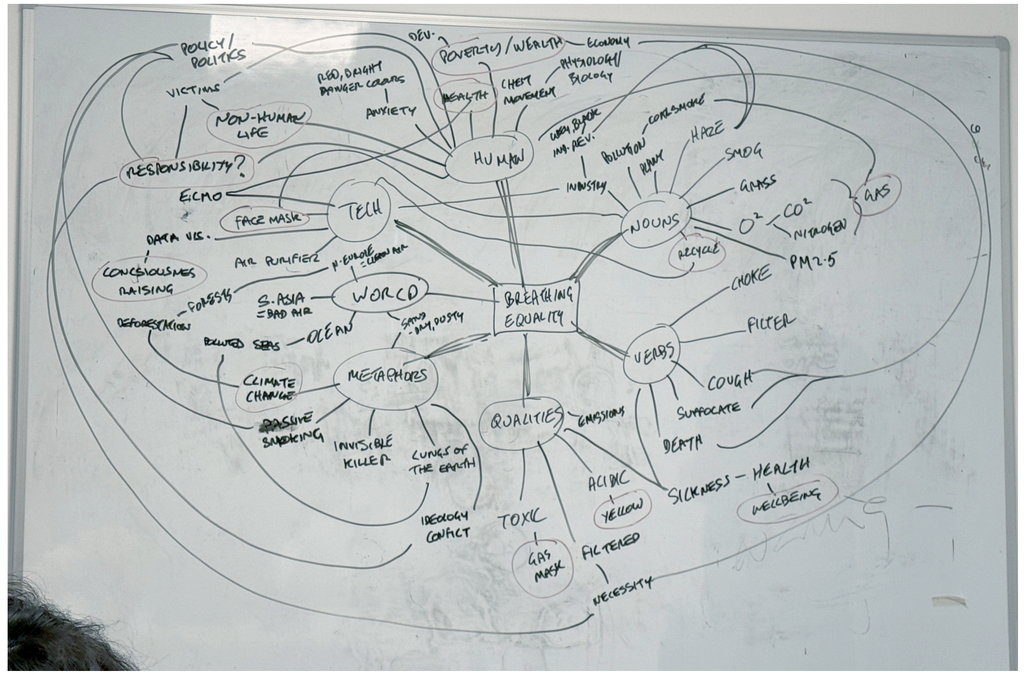
After creative consolidation and collaborative division of labor, we entered the fourth phase of collaborative creation. Through meetings, we further refined the project's core framework. Centered on “breathing equality,” we engaged in multidimensional deep divergent thinking:

Physical Level: Exploring specific pollutants like smog, PM2.5, and carbon dioxide, as well as direct physiological responses such as coughing and suffocation.

Metaphor and Impact: Linking air pollution to broader issues like climate change and secondhand smoke.

Society and Technology: Examining the phenomenon of “air poverty” in regions like South Asia, the connection between poverty and pollution, and how masks serve as vehicles for raising awareness.

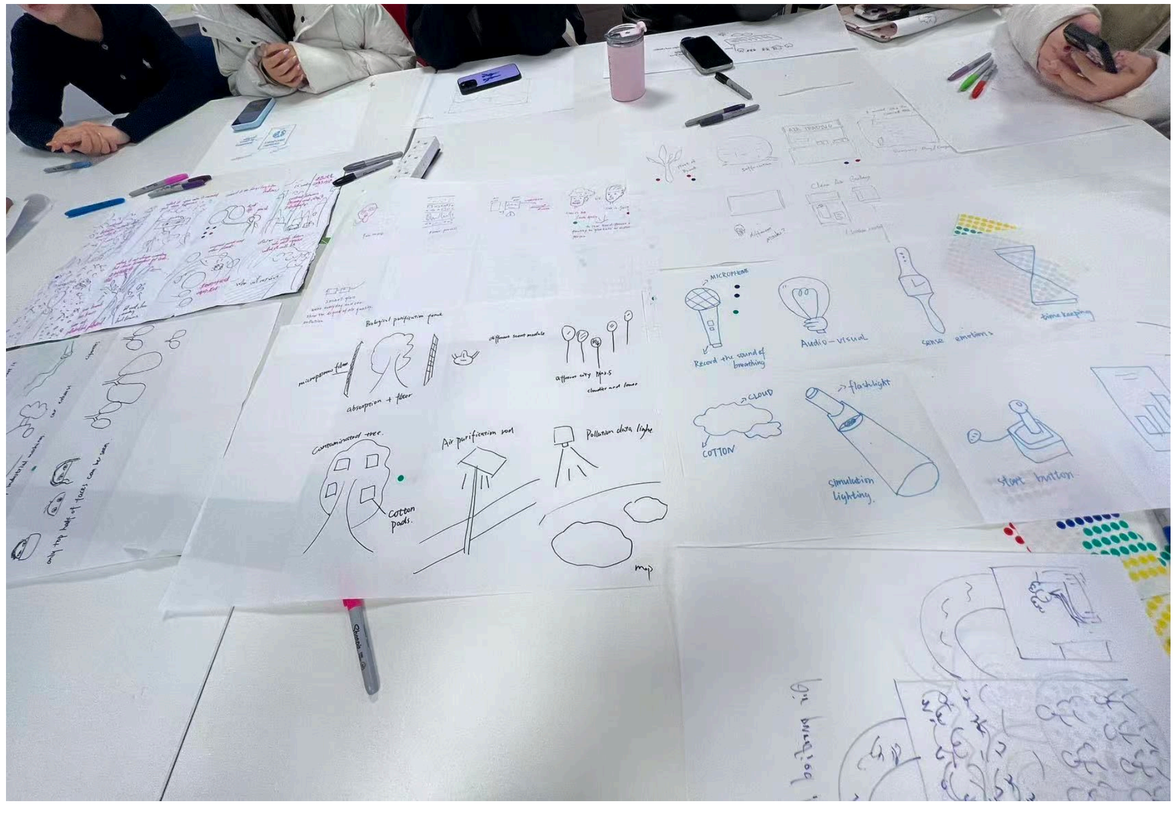
Human Experience: Focusing on health anxieties, pollution realities across different cities, and the complex interplay between policy, responsibility, and non-human life.



03 Design Concept

During the meeting, we explored various approaches to the theme through timed brainstorming and simple doodling.

Passport, microphone recording, air sales points, plant respiration, etc.



Mood Board

Overview

This research focuses on people who have moved to Edinburgh from other cities or countries and have lived here for some time.The participants include international students, immigrants, foreign workers, and digital nomads. Before coming to Edinburgh, they lived in different places with different environments and living conditions.

Instead of seeing all participants as the same group, this research looks at them as individuals. Moving to a new place can change their daily routines, body feelings, and how they sense the environment. Their personal experiences help us understand how things like air and atmosphere slowly affect the body and everyday life.

Selection Criteria

1. They have lived in at least one other city or country before moving to Edinburgh.

2. They have stayed in Edinburgh long enough to form daily routines, such as walking, studying, commuting, or working.

3. They are able to talk about their body feelings, emotions, and daily habits, even if they do not notice these changes at first.

Why This Group Matters

People who move to a new place often experience environmental change slowly and quietly, not in a sudden or dramatic way.

1. They remember how life felt before.
2. They are still getting used to how life feels now.
3. Many changes happen without them paying attention, especially changes in breathing, comfort, energy, and daily movement.

Diversity Within the Group

1. They come from different cities and countries.
2. They have lived in places with different climates and air conditions.
3. They have different roles, such as students, workers, or freelancers.
4. They have lived in Edinburgh for different lengths of time.

Positioning of the Research Subject

This research does not try to measure air quality with scientific tools or judge policies.

Instead, it looks at people as bodies living inside different systems. Their breathing and daily routines are shaped by environments they did not fully choose or control.

By focusing on this group, the project shows how environmental conditions become normal, accepted, and unevenly shared, often without people noticing. This makes the research a strong base for creating an interactive and experiential installation.

Air Quality and Environmental Sensitivity

Many participants have lived in places with higher levels of air pollution before coming to Edinburgh. Some may have experienced smog, heavy traffic pollution, or industrial air. After moving, they may notice differences in how the air feels, smells, or affects their breathing.

Because they have lived in different environments, they have a point of comparison. This makes it easier to explore how air quality affects the body, even when people are not fully aware of it.

At the same time, not everyone in this group has the same access to “clean air.” Their housing location, work schedule, or social status may influence the quality of air they experience daily. This connects personal breathing to larger systems of environmental inequality.
For this reason, this group helps the project connect personal body experience with the broader topic of air pollution and environmental distribution.

Region selection

To engage with "new migrants" from diverse backgrounds, the fieldwork can be conducted in the following types of communities:

1. High-Density International Student Areas This demographic typically has very immediate and intuitive "first impressions" regarding environmental changes, particularly Scotland’s volatile weather and atmospheric quality.

Areas near the University of Edinburgh: These neighborhoods house a vast number of international students.

Tollcross & Haymarket: These locations offer excellent transport links and a high concentration of Purpose-Built Student Accommodation (PBSA).

2. Certain streets and areas experience severe air pollution issues due to chronic traffic congestion and specific geographical conditions.

St John's Road (Corstorphine) is one of the most polluted streets in the city, and indeed in all of Scotland. It has long been recognized as the most polluted thoroughfare in the country.

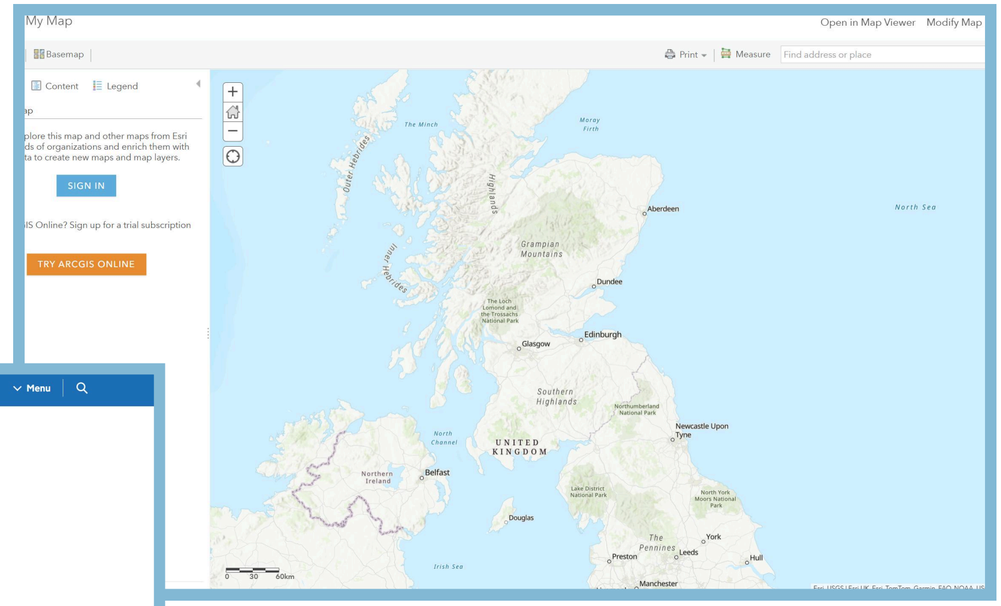
Leith (The Shore): Due to its proximity to the harbour, the area experiences high concentrations of particulate matter, influenced by industrial activities, freight transport, and sea salt aerosols.

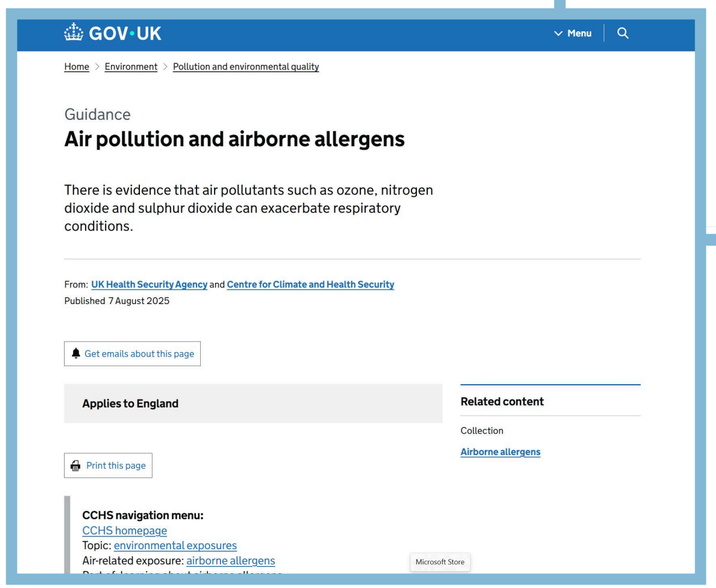
Suburban Edinburgh: Intercept interviews can also be attempted in suburban residential districts to capture a broader range of perspectives.

Second Hand Data

To ensure a more comprehensive data collection, we can access UK-wide websites related to migration and air quality indices, such as the Office for National Statistics (ONS) and GOV.UK.

Website like ArcGIS could be used for data visualization accross the UK





Interview Questions

All the interview should be recored with sound. We may construct the emotion and environment with these sound in the late stage.

Regulations

- The people we interview are immigrants, students, foriegn workers, digital nomads, who lived in other countries before come to Edinburgh, and lived here for a time.
- The interview is divided into 4 parts with different function and preference. Choose one to ask when listed (1 . 2 . 3). Choose ask or not for the “F” (follow up).

The interview is physical and will take around 10 mins to process.

1.5 mins

Background: Figure where did he live before for identifying the difference later on.

1. Where did you live before come to Edinburgh? F: Was environment or lifestyle part of that decision?
   When you imagined living here, what did you picture daily life like?

4 mins

Implication: Memorizing his feeling of body and daily task at present.

1. Did your daily routine change after moving here?
2. Can you tell some difference on your lifestyle back to your hometown.

IF: Awaring Change
Follow Up

To make him realize the change of daily routine after relocating.

1. Do you walk outside more or less?
2. Do you ever feel more comfortable breathing outdoors here?
3. Do you feel physically different when you visit your previous city again?

IF: Not Awaring Change
Tips

To make him realize the change of daily routine after relocating.

1. Have you noticed any changes in your physical energy since moving here?
2. Have your sleeping or exercise habits changed?

2.5 mins

Connection: Link the external perception into internal emotion

1. If you imagine the air in your previous city as a sound or color, what would it be?

   F: What about Edinburgh. Why?

2. How would you describe the air in Edinburgh using a feeling or atmosphere?

   F: Does that feeling connect to any memory or daily experience?

2 mins

Connection: Link the external perception into internal emotion

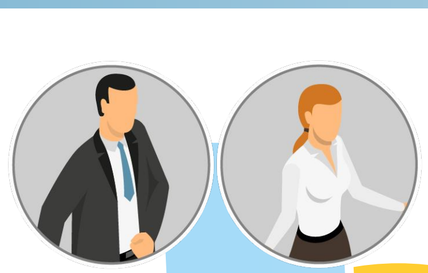
1. Do you think moving city changes your relationship with your environment?

2. Do you think moving city changes your body condition and daily habit?

Do you think you have been in a place with better air quality and made you changed somehow?

06 Workflow

User Flow



RECEPTION

PASSPORTS OF DIFFERENT COLORS ARE ISSUED BASED ON THE COLOR OF THE USER'S CLOTHING AND ACCESSORIES.

PASSPORT COLOR CLASSIFICATION PURPOSE

Invisible institutional classifications are transformed into clear visual markers.

Classification precedes individual choice.

ROOM

gas classification

Understanding Inequality Through Breathing

Different gases correspond to different experience channels

No real harmful gases used

DIFFERENT GASES ARE RELEASED TO USERS BASED ON THEIR PASSPORT COLOR.

EXPERIENCE

Gases are classified based on passport color, with the classification criteria varying according to the degree of gas pollution.

Use an External Airbag to Visualize Internal Bodily Changes

Breathing Sound Level → Airbag Contraction Intensity

Control Airbag Contraction Based on Breathing Sound Volume

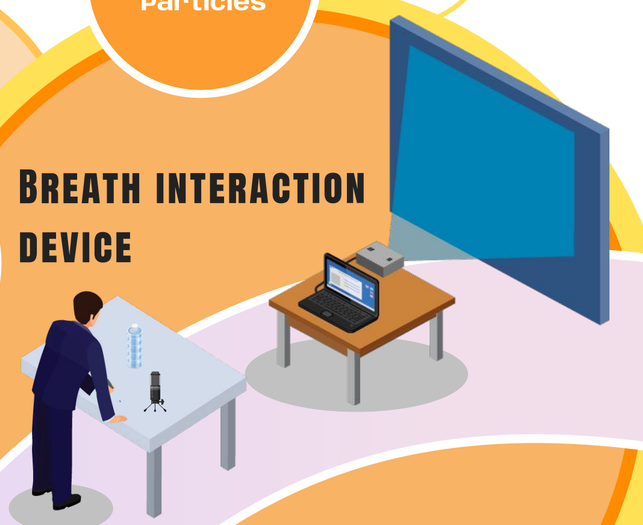
Breath Interactive Airbag

TOUCHDESIGNER

Breath Interactive Particles

Real-Time Visualization of Breathing Sounds with Particle Effects on a Digital Display

BREATH INTERACTION DEVICE



COLLECT USERS' BREATHING SOUNDS

User behavior

Rapid Breathing

Hold Breathing

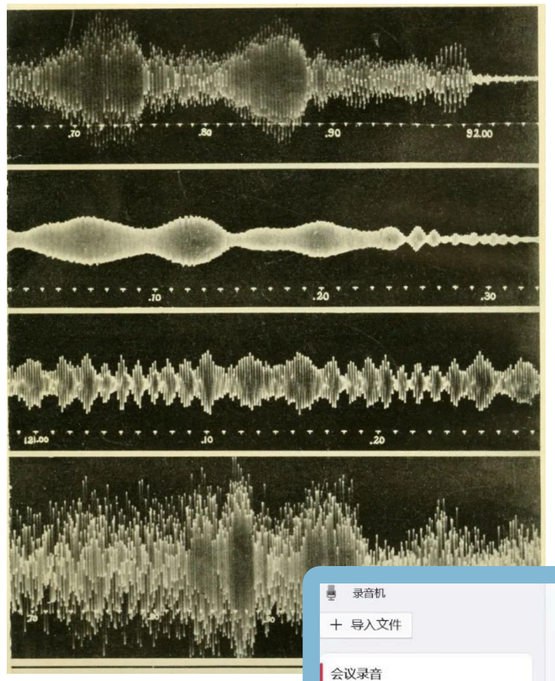
Slow Breathing

Main part

TouchDesigner main process（Capture audio from the microphone——particle）

Audio analysis: analyse the amplitude or frequency of audio

Particle system: Adjust particle properties based on analysis results.



The earliest waveform recording of real sound

The density and fluctuation of waveforms reflect the strength and frequency changes of sound

Using app or technique to record features of audio

Technology needed

Audio （device）In CHOP: Acquire microphone input

Audio Analyze CHOP：Extract volume, frequency spectrum and other data

Math CHOP：Normalise the volume to the range 0-1

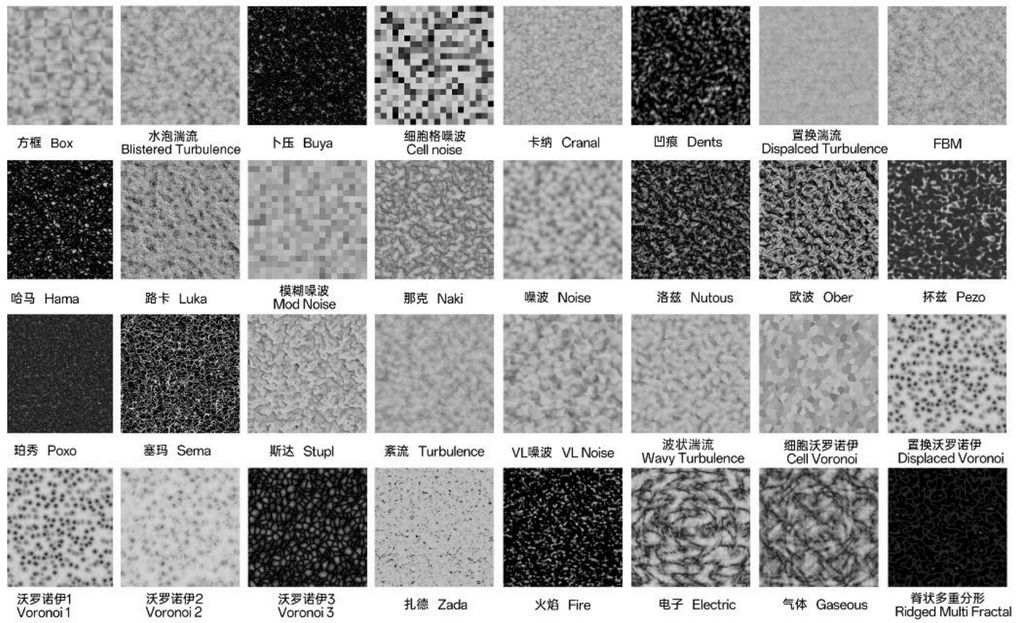
Noise TOP：Generate normal noise textures

Geometry COMP：Create particle network

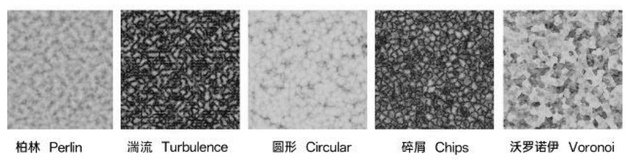
Material：Apply a ‘blue’ luminous material to the particles

Render TOP + Out TOP：Output to screen

C4D Noise



OC Noise



Noise texture

Logical step Adjust)

1. Create an Audio Device In CHOP, select the correct audio device, and set appropriate parameters (such as sampling rate, number of channels).

2. Connect an Analyze CHOP to Audio DeviceIn CHOP and select the analysis type, such as RMS (amplitude) or FFT (frequency). If we analyze frequency, we may want to obtain the intensity of the main frequency (pitch).

3. Extract the values we need from Analyze CHOP. For example, if we analyze RMS, we can obtain the amplitude; If we analyze FFT, we can use a Select CHOP to choose a specific frequency range, and then use Math CHOP to calculate the average or maximum intensity.

4. Create a particle system. You can use ParticleCHOP or Particle TOP (such as ParticleSOP plus Render TOP). Assuming we use Particle CHOP here.

5. Map the analyzed values onto the parameters of the particle system. For example, amplitude can control particle size, emission speed, etc

6.To provide feedback based on the high and low frequencies of sound, we can map the frequency values to the color of particles or another parameter.

TD Chop-Lag screenshot

Audio input and analysis component code——

```
audio_in = op('/project1').create(chopdatCHOP, 'audio_input')
audio_in.par.name = 'audioin1'
audio_in.par.device = 0

audio_analyze = op('/project1').create(analyzeCHOP, 'audio_analyze')
audio_analyze.par.unit1 = 'rms'
audio_analyze.par.unit2 = 'spectrum'

audio_analyze.setInput(0, audio_in)

fft = op('/project1').create(spectrumCHOP, 'fft_analyze')
fft.par.size = 2048
fft.par.overlap = 4
fft.setInput(0, audio_in)
```

Core code of particle system——

```
particle_sys = op('/project1').create(particleCHOP, 'particle_system')

particle_sys.par.particles = 1000
particle_sys.par.life = 2.0
particle_sys.par.gravity = 0.0

audio_response = op('/project1').create(constantCHOP, 'audio_params')
audio_response.par.name = 'audio_response'
audio_response.par.channels = 4
```

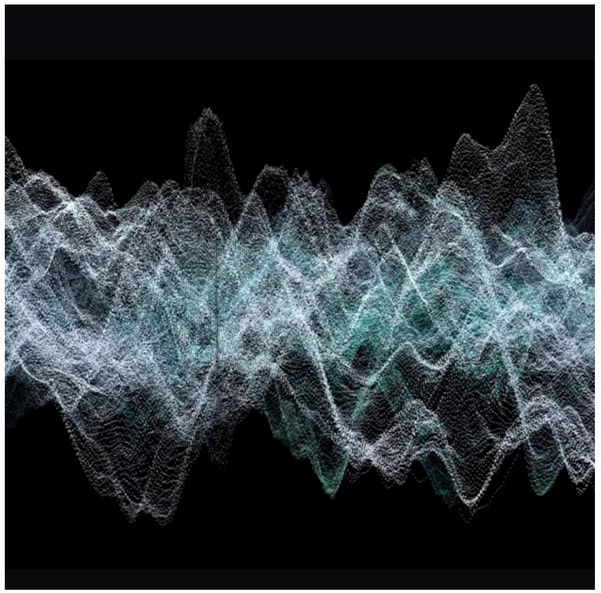
The mapping logic from audio to particles——

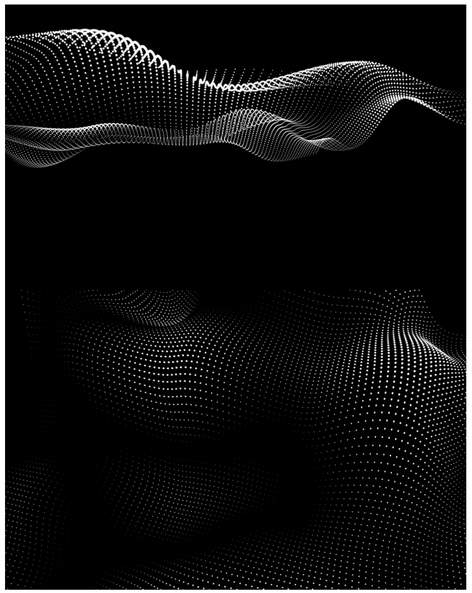
```
audio_processor = op('/project1').create(pythonCHOP, 'audio_processor')

audio_processor.code = '''

volume = op('audio_analyze')['rms'][0]
spectrum = op('fft_analyze')['chan1'][:]
low_freq = np.mean(spectrum[:len(spectrum)//3])
mid_freq = np.mean(spectrum[len(spectrum)//3:2*len(spectrum)//3])
high_freq = np.mean(spectrum[2*len(spectrum)//3:])
output = {
    'volume': volume * 5,
    'low': low_freq * 3,
    'mid': mid_freq * 2,
    'high': high_freq * 4
}

for key, value in output.items():
    op('audio_processor').par[key] = value
'''
particle_sys.par.rate = "op('audio_processor')['volume']"
particle_sys.par.size = "op('audio_processor')['low']"
particle_sys.par.speed = "op('audio_processor')['mid']"
```

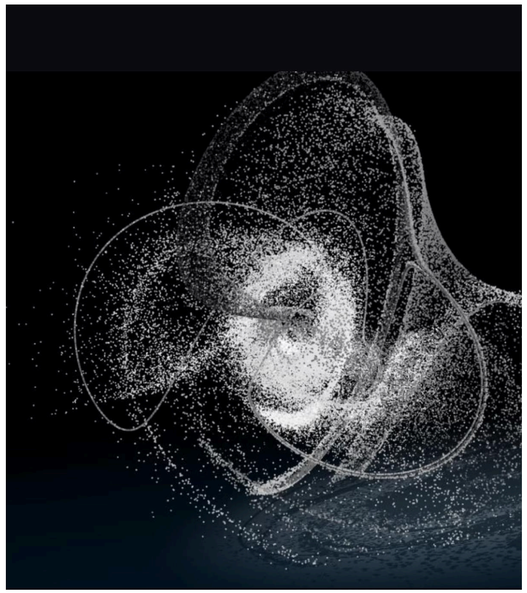
Final output——

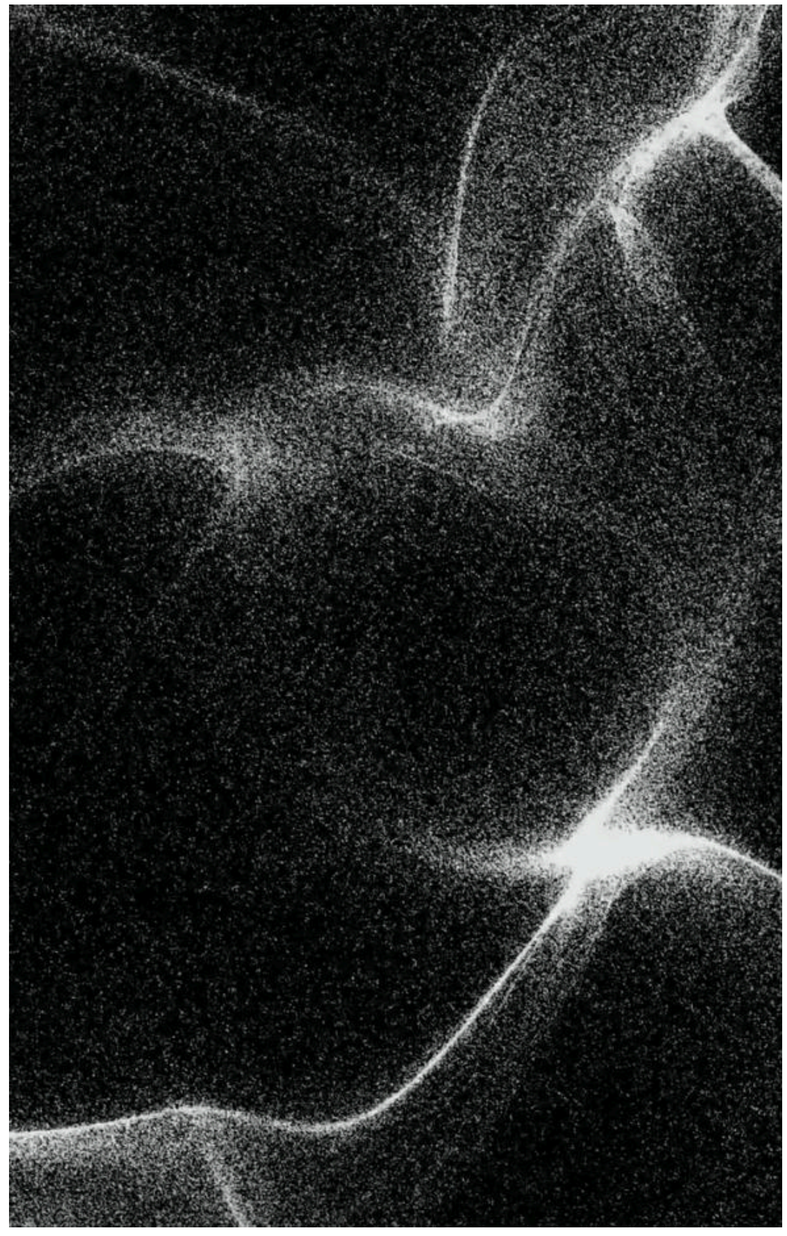
```
main_script = op('/project1').create(textDAT, 'main_script')
main_script.text = '''

volume_mult = op('control_panel').par.volume_sens
low_mult = op('control_panel').par.low_sens
mid_mult = op('control_panel').par.mid_sens
high_mult = op('control_panel').par.high_sens

def onAudioFrame():

    volume = abs(op('audio_analyze')['rms'][0])

    if volume > 0.1:
        burst_strength = volume * volume_mult
        op('particle_system').par.emit = 1
        op('particle_system').par.emitv = burst_strength
        freq_data = op('fft_analyze').fetch()
        if freq_data:
            lows = freq_data[:len(freq_data)//4]
            mids = freq_data[len(freq_data)//4:len(freq_data)//2]
            highs = freq_data[len(freq_data)//2:]
            op('audio_processor').par.low = np.mean(lows) * low_mult
            op('audio_processor').par.mid = np.mean(mids) * mid_mult
            op('audio_processor').par.high = np.mean(highs) * high_mult
    else:
        op('particle_system').par.emit = 0
run("onAudioFrame()", delayFrames=1)
'''
main_script.par.executeonload = 1
```

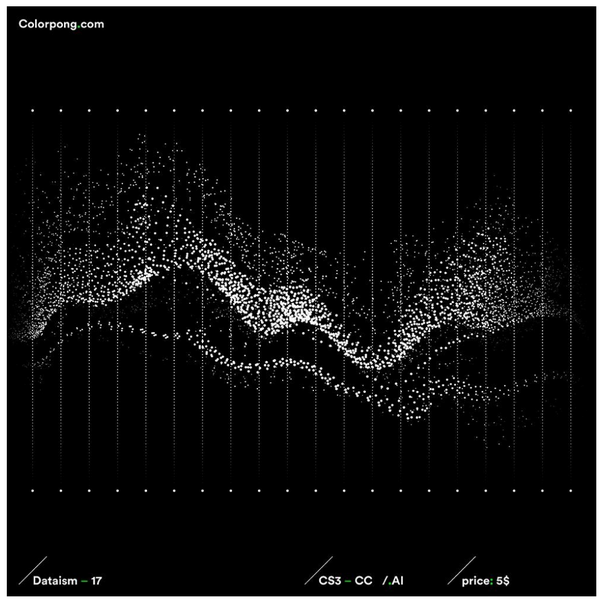
Particle Visualization References

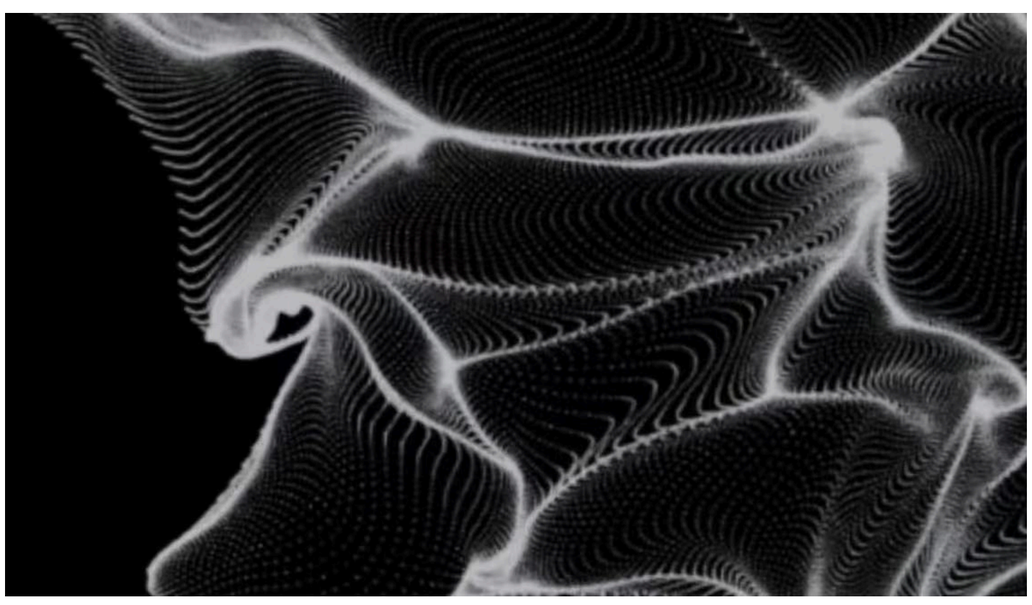






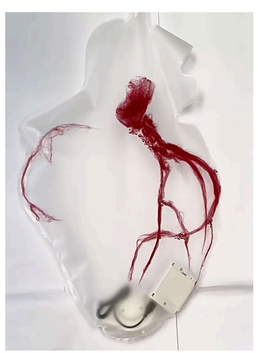




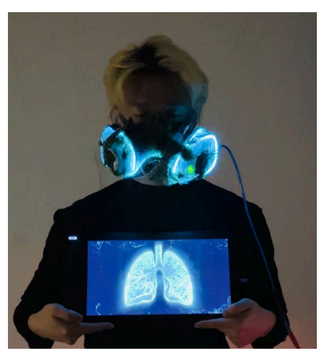


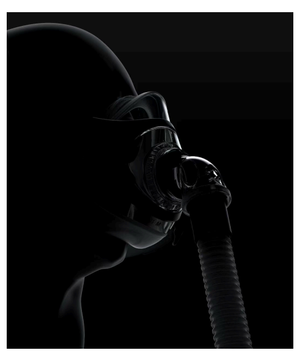
Passport

Air-bag

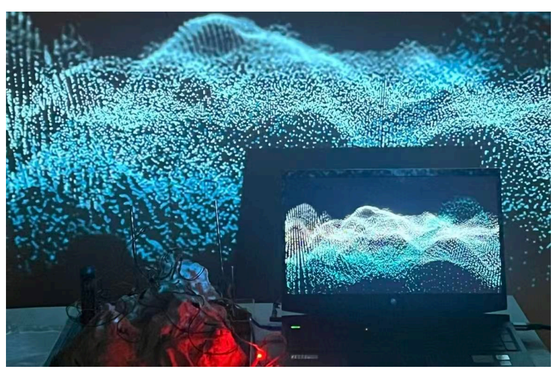


Mask

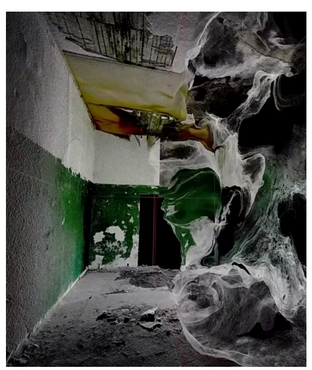


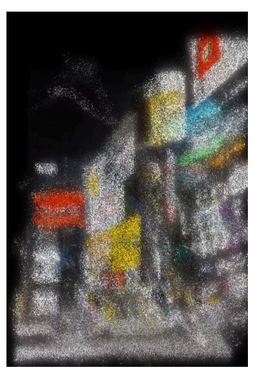


Screen

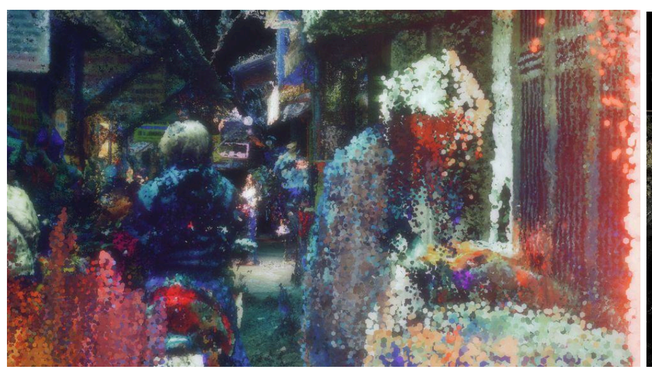


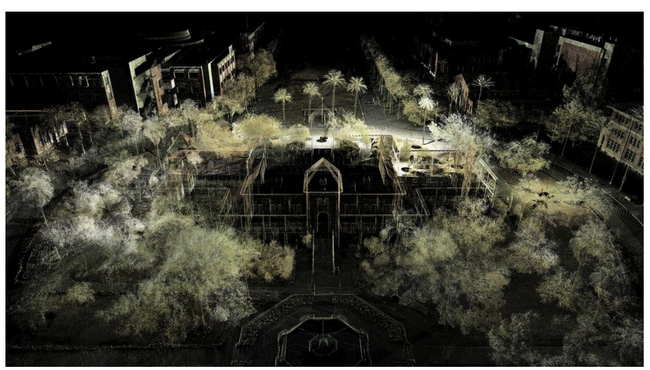
Basic particles



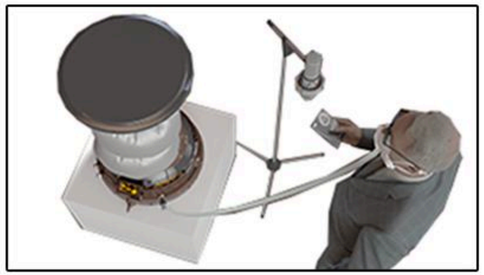


Space particles





Outcome：Effect Picture

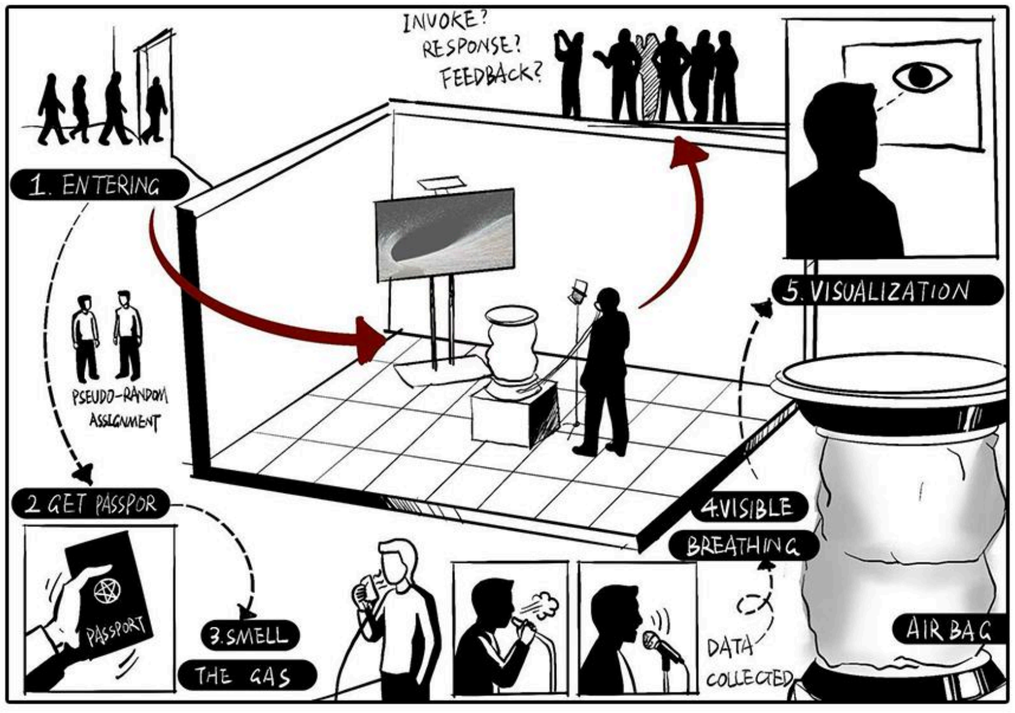


Interactive simulation

interactive airbag-microphone-participant

Participants need to wear a breathing mask.
The microphone will detect the intensity of breathing sounds.
The airbags will provide real-time feedback.
The digital display shows a real-time visual of breathing sounds with particle effects.

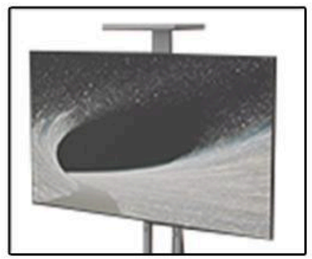
PARTICIPANT EXPERIENCE



Passports were assigned based on the color of the clothing.

Invisible institutional classifications are transformed into clear visual markers.

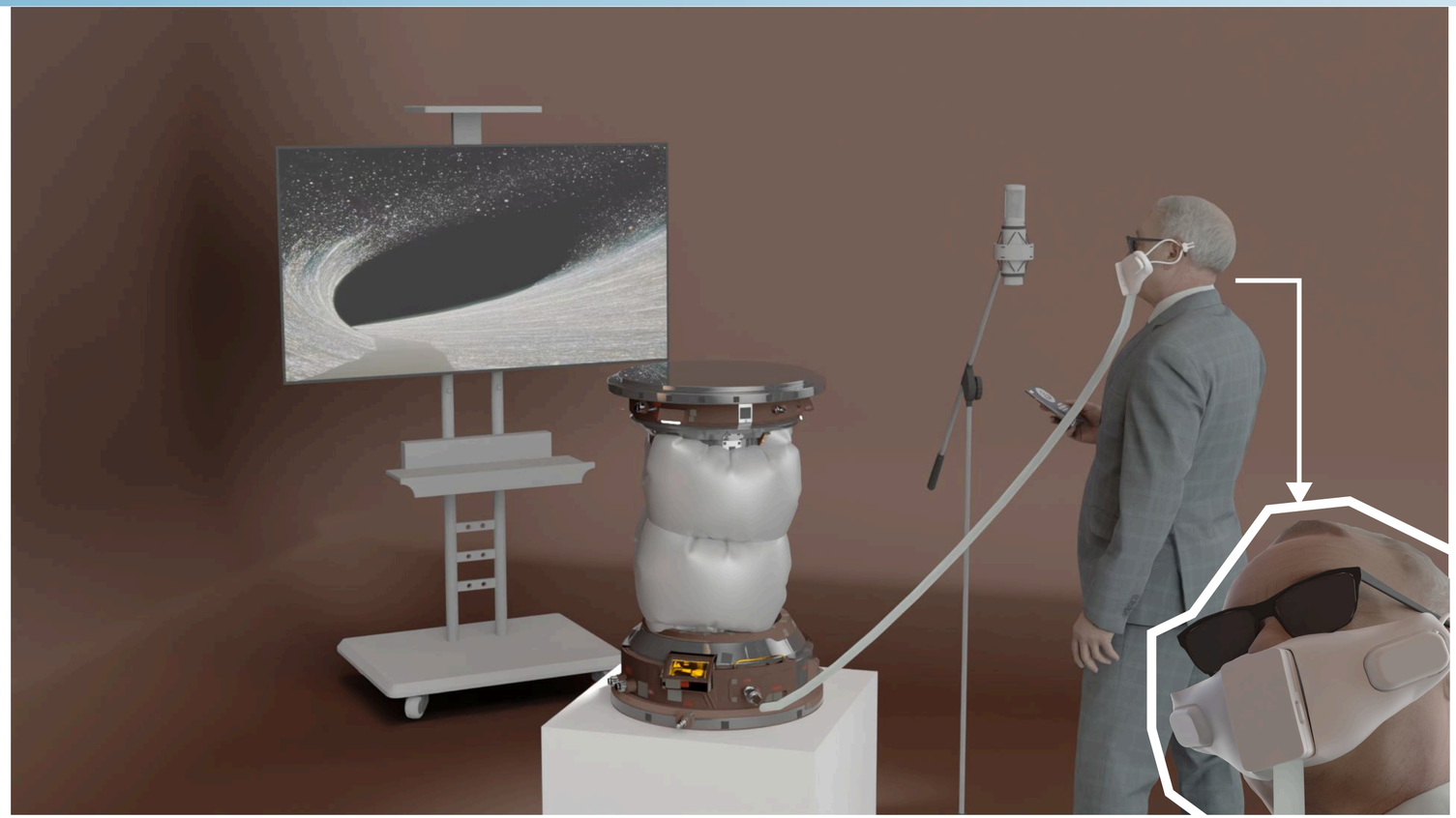
Gases are classified by passport color, with criteria based on pollution level.

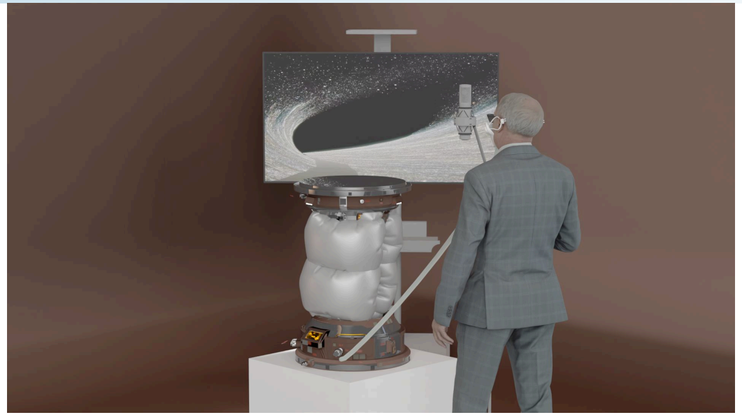


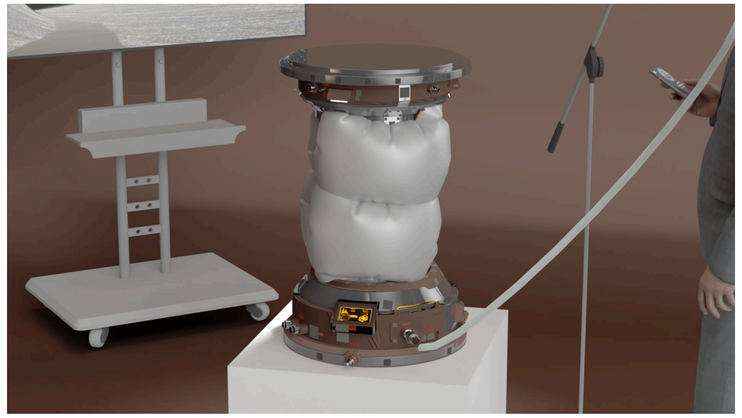
Particle animation used to provide feedback on real-time respiratory data.

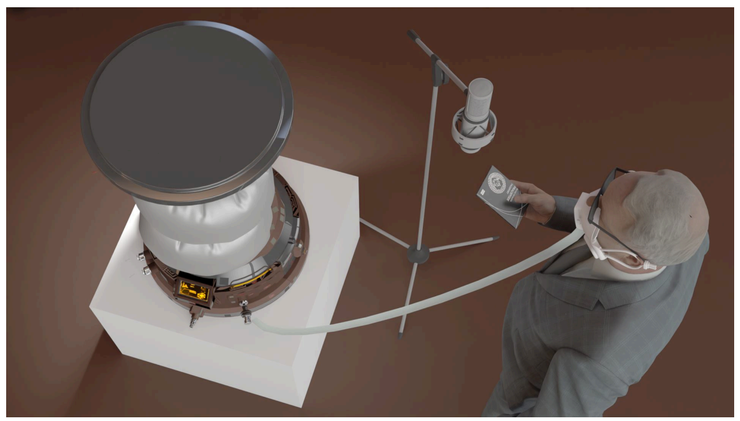
The airbag provides real-time feedback.

Outcome：Effect Picture









Timetable

Week 9:
Define the core proposition and narrative logic of the project
Determine the interaction mechanism (breathing sound → airbag change)
Start the preliminary technical feasibility research

Week 10:
Case study (interactive art / data visualization / installation works)
Technical preliminary testing (sound decibel collection)
Research on airbag materials and touchdesigner effect design

Week 11:
Microphone sound collection test
Preliminary control of airbag contraction

Week 12:
Electronic large screen particle effect test
Real-time visualization test of breathing data
Design of different breathing state logic

Week 12:
Sound system and airbag linkage
Adjustment of airbag change amplitude
Stability test of the interactive device

Week 9:

Space layout design and lighting test
Design of the movement path for on-site audience

Week 10:

Optimization of sound recognition
Optimization of airbag contraction
Optimization of visual effect smoothness

Week 11:

Invite test users for experience, collect feedback (immersion / emotional response)
Adjust the interaction rhythm based on feedback

Week 12:

Final hardware assembly and optimization of appearance details
Complete document organization

08 Team Contribution

Drew Yang: Project Manager, charge of conception, interview and progress review

Xiaoyu Xue: Organization of the main process, creation of the user flowchart, timetable, reference

Tinglan Ma: Organization of the main process, creation of the user flowchart

Ziwei Zhu: Slide Layout design, creation of the design concept, background

Keye Huang: Slide Layout design, creation of the design concept, issue

Jieruo Li: Research, Creation of Participants & Target Group

Lingke Zhang: Code writing, Particle Visualization References

Ziqin Xu: Code writing, Particle Visualization References

Jintong Liu: Creation of Participants, interview and data collection, noting

Zhiyu Hang: Creation of effect pictures，Propose the project framework and visual

Jingya Ma: Creation of effect pictures，participant experience flow and ideas

Image sources

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