P A G O D A . T M O S

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PAGODA.TMOS

Pagoda GS | Pagoda UV | Pagoda PM

Translating ambient air data into natural public interfaces that embody salient emotional design and act as a place of connection for individuals and society to nature.

Air pollution	Natural interfaces	Emotional design
Skin health	Slow interaction	Interactive ceramics
Ambient computing	Modalities	Social interaction

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Abstract

English

Imperceptible elements surround us. From diseases and viruses to natural elements such as air; we cannot see such phenomena directly. As a result, we are taught that our ecosystem consists of imperceptible threats. An invisible threat such as air pollution is an example of this imperceptible danger. We can process such information logically, but it is still hard to perceive it in a more intuitive, sensory, and emotional manner. This project aims to translate ambient data into an emotional experience for individuals and communities, hoping to trigger societal awareness.

Pagoda.tmos consists of three interactive sculptures with natural interfaces. Interfaces that prompt modalities rather than representing information numerically. Each sculpture collects real-time ambient data and represents them through bio-reactive material transformation, kinetic motion and sound production. These ambient pagodas aim for viewers to have a moment of contemplation, reflection, unification, and enlightenment for a resounding experience.

Deutsch

Nicht wahrnehmbare Elemente umgeben uns. Von Krankheiten und Viren bis hin zu natürlichen Elementen wie Luft können wir solche Phänomene nicht direkt sehen. Als Ergebnis wird uns beigebracht, dass unser Ökosystem aus nicht wahrnehmbaren Bedrohungen besteht. Eine unsichtbare Bedrohung wie Luftverschmutzung ist ein Beispiel für diese nicht wahrnehmbare Gefahr. Wir können solche Informationen logisch verarbeiten, intuitiv, sensorisch und emotional können wir sie aber noch nicht wahrnehmen. Dieses Projekt zielt darauf ab, Umgebungsdaten in ein emotionales Erlebnis für Einzelpersonen und Gemeinschaften zu übersetzen, in der Hoffnung, soziales Bewusstsein und Verhaltensänderungen auszulösen.

Pagoda.tmos besteht aus drei interaktiven Skulpturen mit natürlichen Schnittstellen, Schnittstellen, die Modalitäten auffordern, anstatt Informationen numerisch darzustellen. Jede sammelt Umgebungsdaten in Echtzeit und repräsentiert sie durch bioreaktive Materialumwandlung, kinetische Bewegung und Klangerzeugung. Diese atmosphärischen Pagoden zielen darauf ab, den Zuschauern einen Moment der Kontemplation, Reflexion, Vereinigung und Erleuchtung für ein nachhaltig beeindruckendes Erlebnis zu ermöglichen.

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Introduction

Introduction

The world has been faced with invisible threats since the beginning of time. From our hunter-gatherer days to the modern 21st century society, invisible matters are continuously posing a threat to personal health and society as a whole. In 541 A.D, the Justinian Plague appeared in Egypt and spread throughout the Mediterranean, killing about 26% of the world population ('Study Reveals True Scale of One of the World's Deadliest Plagues', 2019). Allergies, a reaction from our immune system that reacts to certain innocuous substances, has been recorded in historical documents from ancient civilizations. Most recently, COVID-19 has been a major example of invisible threats since 2019.

Air pollution is another invisible threat that has been prevalent in any city with industrial activities. Since the industrial growth, large scale manufacturing has significantly increased air pollution levels. In 1952, London dealt with a serious pollution problem with a severe sulfur-laden fog killing 4,000 Londeners (Klein, 2018). In the 1800s the US established regulations for air pollution control . Today, air pollution poses a threat to health and climate, killing an estimated 7 million people worldwide every year (World Health Organization, 2014).

With so many invisible threats that surround each individual, this research focuses on the relationship between the invisible and technology and its effects on human perception and awareness. Air pollution will be used as a case study as the invisible input to be sensed.

Research Question

Sensor technologies have been developed to accurately measure elements that cannot be perceived by the human senses. From thermal to laser vision sensors, technology has advanced in order for humans to have a form of sixth sense. Humans are exponentially relying on technology to sense the world around us. Electronic products and their interfaces have been heavily influenced by the need to translate the world around us into perceivable data. An example of this is Samsung's air purifier display (Image 1). Numeric figures and color are used to display information to the user. It is a simple procedure of transcribing data from the sensor input to numeric data. However, in terms of understanding and increasing awareness based on data, users become dulled by simple data information. During my time as an visual experience designer at Samsung Electronics, I often questioned how user-friendly or intuitive these interfaces were. As a response, my research thesis focuses on this topic.

How can interaction and experiences be designed to heighten perception of invisible dangers in a more intuitive and emotional manner to ultimately change awareness and perception? By exploring sensors and interactive technology, the aim of this research project is to make the imperceptible more perceivable, thus diminishing the discrepancies between invisible threats and human perception.

As a closer examination of the research question, I will first define the term 'intuitive'. An intuitive experience is one that is instinctive; one where the interface or experience focuses on ease of use (usability) and understanding. Usability deals with ease in learnability

of the experience, accessibility, and aesthetics. An emotional experience refers to a broader sense that deals with feelings and a connection one feels with the design and concept.

In terms of awareness, I am referring to a positive change in one's mindset derived from the interaction or user experience. A change can be very subjective based on the user. It is not a quantitative measurement but rather based on a personal scale of change and understanding.

As a response to my research question, I will create possible design experiences that represent the data of air pollution. These experiences are not definite solutions to problems, but rather explorations of possible interfaces that can be used as tools for certain target individuals, groups, and ultimately societies.

Air pollution is a phenomena that penetrates people's everyday life in all locations and areas of the world. It is a personal issue but ultimately a societal issue to tackle. In order to test the hypothesis of salience and slow interaction in an ambient environment, the designs will be explored in public spaces as a means of heightening perception on a societal level. Furthermore, going away from the more "safe" connotation of personal living spaces, outdoor or public spaces have more of an explicit exposure to the invisible threats. Therefore, my aim is to create emotional design experiences for personal and ultimately societal input and awareness.
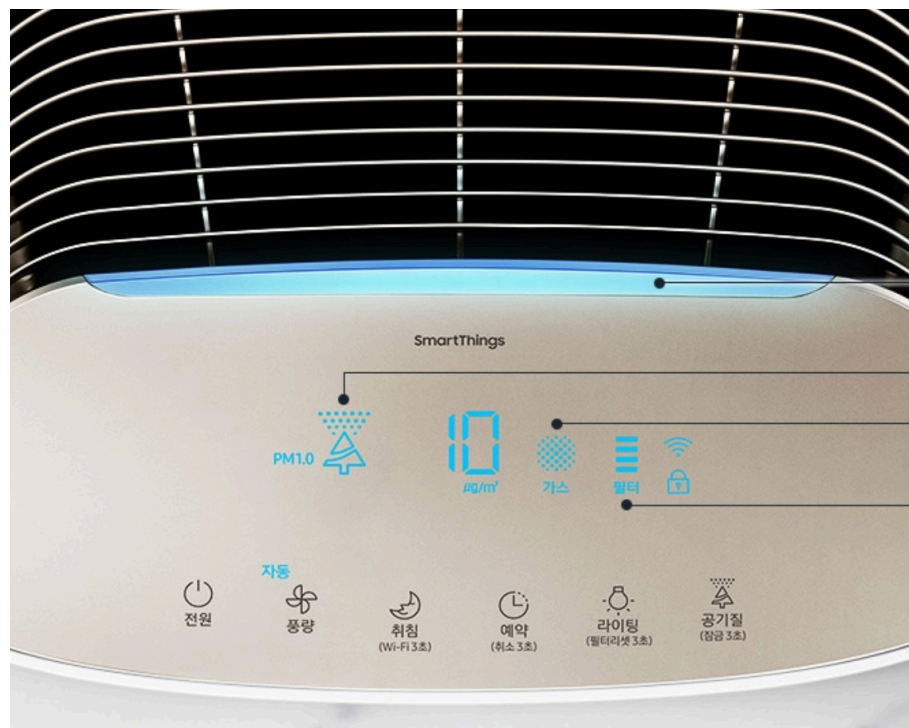
Methods and Structure of Research

In order to elaborate on this research question, I will first examine the current status of air pollution on our environment as well as its effects on the human body. It is important background information on the current climate crisis and the pressing issues at hand in terms of individual wellbeing. It also contextualizes where the research is positioned in today's society in a more practical manner.

The following second chapter examines literature from John Markoff, Cory Doctorow, and others to speculate on future scenarios. This theoretical framework is used to provide conceptual yet probable scenarios to gather new perspectives as a guide to the development of the research project.

The third chapter examines air pollution and its effects on the human skin. To study cases of air pollution and ozone depletion negatively affecting skin, scenario studies are done in the form of in-depth interviews and journey/experience mapping.

The fourth chapter elaborates on target users and their behaviors as a practical approach to theoretical research. UX methodologies are explored to fully understand the user's current mindset, behavior, and needs.

Based on these user scenarios, the fifth chapter is an exploration of design experiments that focuses on the technical and aesthetic part of the design solutions. The experiments focus on data perception through various modes of technology and tools.

Based on these experimentations, in the sixth chapter I will introduce three different *Pagoda.tmos* interaction designs that aim to heighten human perception of invisible threats in an intuitive manner for an individual and societal level.
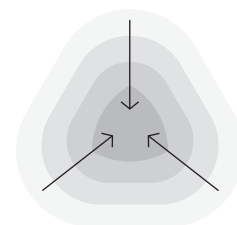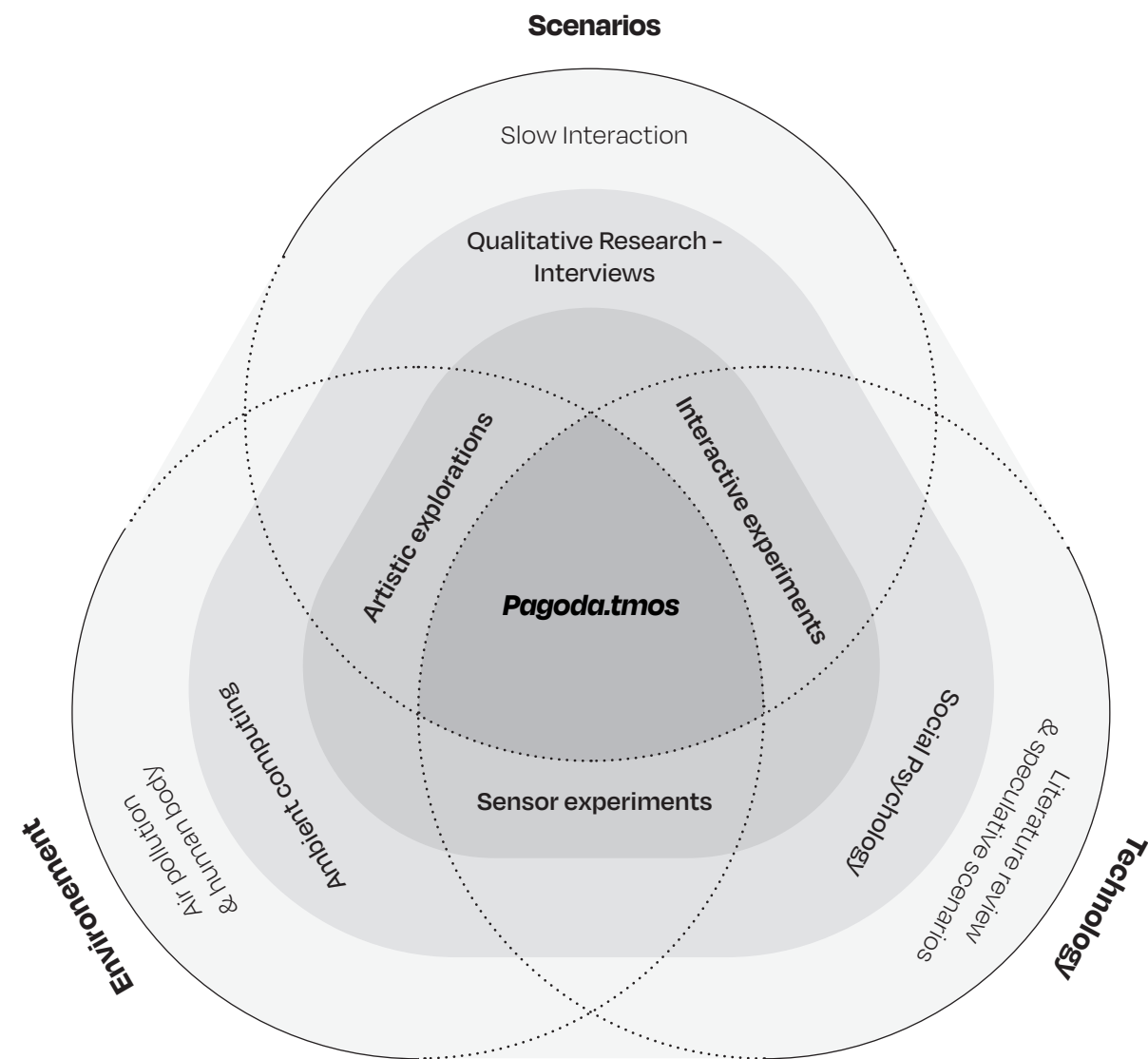
The seventh and last chapter is the conclusion of the research, examining future outlooks and opportunities based on the findings of *Pagoda.tmos.*

With seven main chapters, each contain their own purposeful aim, questions to examine, and consequential methods for examination. The chart in the following page is an overview of the seven chapters.
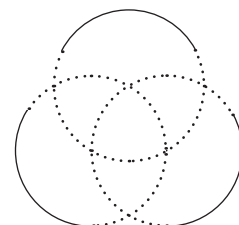
The described structure of this research is also based on the methodological design model presented in the following pages.

Chapter	Aims	Questions	Methods
1 - Environmental & Scientific Research	Understanding air pollution and its effect on the human body	What are the negative effects of air pollution on the human body?	Examination of scientific papers and studies
		Which specific area can I focus on for this project?	Quantitative & qualitative research: Survey and interview
2 - Theoretical Framework	Understanding the relationship between technology and users/society	What are speculative scenarios of technological development in society?	Literature review on speculative scenarios
		How does social psychology explain how groups of people behave and think?	Theories on social psychology examination
3 - Context Inquiry	Understanding scenarios and experiences with air pollution & skin diseases and current perception of technology and their environments	Who is experiencing negative effects of air pollution on their skin and what are their experiences and pain points?	Qualitative research: In-depth interviews and journey mapping
		What are some design projects that approach such subjects?	Case studies of existing projects
4 - Design Explorations & Experimentations	Identifying and experimenting on the necessary technology & design needed for ambient sensing	What kind of technology is need for ambient computing?	Technology (Arduino) experimentations
		What kind of design and interaction is needed for users to understand the environmental data?	Material (Ceramic) experimentations
5 - *Pagoda.tmos* Prototypes & Explorations	Creating prototypes that embody the project	How should the design and technology interaction be in order for the user to understand their environment on an emotional level?	*Pagoda.tmos* prototypes for each identified user scenarios
			VR prototype for a holistic experience
6 - *Pagoda.tmos* Artefacts & Ethnography Research	Examining and speculating possible designs based on future scenarios	What kind of ceramic methods and physical computing engineering is required to construct the designs?	Ceramic prototyping Mechanic and software prototyping
7 - Conclusion	Evaluating and reflecting on the research and research outcomes	What are the overall findings that were discovered through the research?	Ethnographic research Final design exhibition
		Have the research aims been met and what are future opportunities and outlooks on the research?	

Table 1
Aims and Method Chapter Overview

Scenarios

Slow Interaction

Qualitative Research –
Interviews

Artistic explorations

Interactive experiments

Pagoda.tmos

Sensor experiments

Social Psychology

Ambient computing

Air pollution
& human body

Literature review
& speculative scenarios

Environment

Technology

*Research and
development
from exploration
(outside) to
defining (inside)*

*Main 3 areas of research
and development that are
not limited by boundaries.
They have a symbiotic
relationship.*

Figure 1
*Research Methodology
Model*

Project Goal
and Relevance

Undetectable diseases and the climate crisis has shown how much these invisible dangers are threatening individual lives. 2019 was a year of crisis for the 21st century. The COVID-19 pandemic has been a prominent example of how invisible threats are changing individual lives and society.

There have been concept designs (Image 2) for wearables as a response to the unseen disease. This design approach tries to cover one's body in any environmental circumstances (Sun Dayong Designs Wearable Coronavirus Protection Shield, 2020). Another solution would be to understand the environment to therefore have appropriate reactions.

My project approaches solutions based on a more data-aware reality, where technology and tools are presented in an emotional and intrinsic manner to sense the imperceptibles. With current sensors for air pollution, this is a good case study for this approach. This research focuses on emotional design with technology as its backbone.

With theoretical and empirical research, this project focuses on speculative futures as well as practical solutions. By deep-diving into real-life scenarios and experiences, empathetic emotional solutions are made. Furthermore, translating technological properties into creative and emotional experiences aims to provide salience to the topic at hand. The goal is to generate awareness and therefore positively influence their mindset and health through behavior change.

Chapter 1. Environment & Scientific Research

Global Warming Projections & Air Pollution

CHAPTER 1-1

To fully understand the environment we are trying to perceive, it is important to know the current status of the climate crisis and its future outlooks. This chapter examines the first Environment aspect of the Research Methodology Model presented in the structure of research.
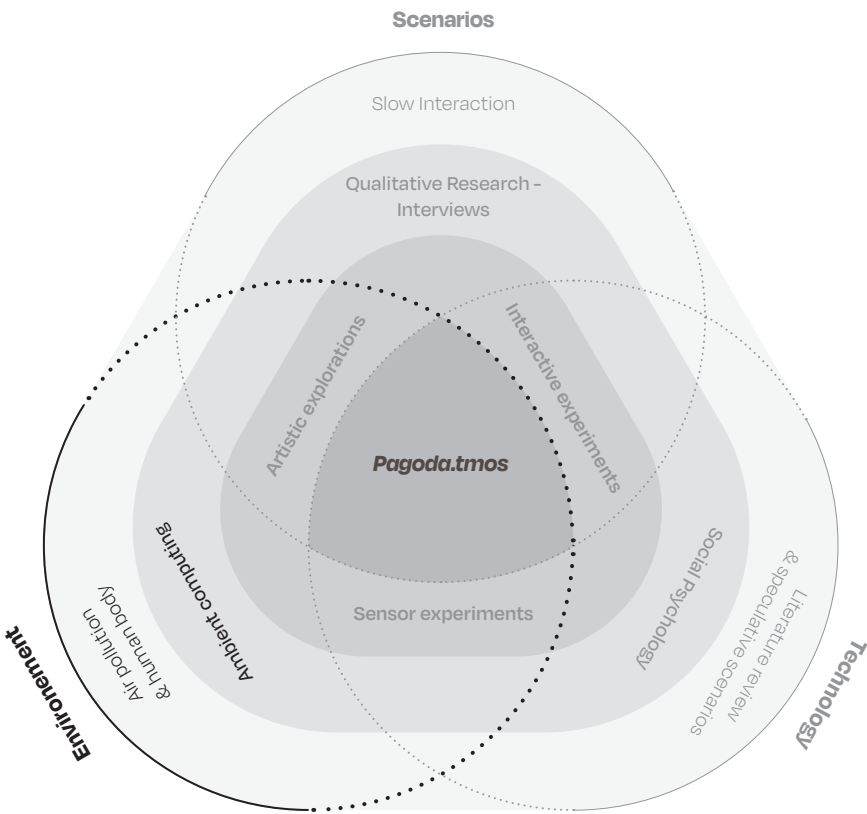
Figure 1
Research Methodology Model

"The Future We Choose: Surviving the Climate Crisis" by Christiana Figueres and Tom Rivett-Carnac gives a detailed insight on the changes in our Earth based on the actions we choose in the future. They present two future scenarios based on Earth's temperature increase, both set out in the Paris Agreement. The first is a projected scenario based on current actions and events, "the world we are now creating, leading to warming of more than 3 degrees. (Figueres, Christiana, 2020)" This world in 2100 will go to a warming of at least 3.7 degrees to 5 degrees. The second is "the world we must create, limiting warming to no more than 1.5 degrees Celsius. (Figueres, Christiana, 2020)" The 1.5-degree-Celsius-warmer scenario would only be achieved if global emissions are cut to half of current levels by 2030, half again by 2040, and net zero by 2050. This projection graph can be seen in Figure 2 (Climate Analytics and NewClimate Institute, 2021).

Nonetheless, within the next 30 years, there will still be a steady or exponential increase in warming. This shows us that environmental and health issues will continue to prevail within our ecosystem. Especially with worsening air pollution, we will continue to see negative health effects on individuals. Figueres speculates the world of 2050, a warmer world headed to an increase of 3 degrees by 2100.

Figueres describes a world where the sky is deceptive. With the naked eye the sky seems clear, however it is not safe to be exposed to the outside world. Fog and smog are basic indicators of air quality for

the human eye. However, there are recent cases and studies done by environment agencies that reveal that visibility is not a clear and precise
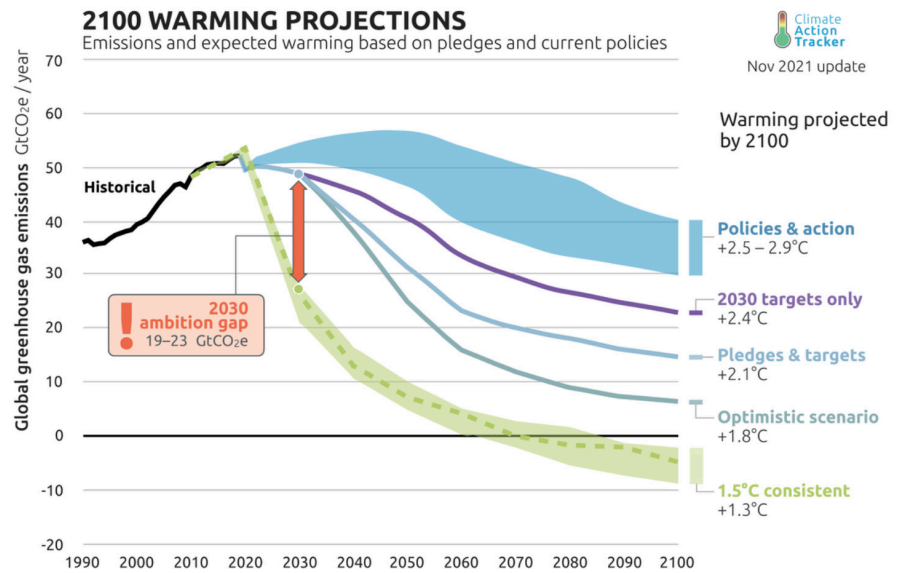
Figure 2
Climate Action Tracker, 2021

Air Pollution & Health

CHAPTER 1-2

The purpose of the conducted survey was to understand the user's concerns and needs caused by air pollution. It is the initial stage of the methodology used in the research. Based on the insights gained from this initial research, in Chapter 2, technological aspects were examined for appropriate interactions.

The discovery phase of the user research had a quantitative approach, surveying people in various age ranges and from various geographical locations.

Major insights gathered from the survey were the physical side effects people were collectively experiencing due to air pollution. The experienced side effects were headaches, dry eyes, sinus problems, sore throat, breathing problems, coughing, irritated skin, dry skin, acne, and worsening skin diseases.
Furthermore, when asked about long-term concerns, the top two were pulmonary diseases and skincare in terms of both medical and cosmetic.

The skin, being the first contact point of air pollution. It is a kind of display in which air pollution is illustrated. Irritated skin, dry skin, acne, and skin diseases are the biological reactions to air pollutants but also an indicator of how it is affecting the body. There are several factors that deal with skin conditions but studies show how different air pollutants contribute to air.

The following research explains the different types of air pollutants and each contributing factor to skin health.

Figure 3
Air pollution & health survey

Air Pollution & Skin

CHAPTER 1-3

Even before the COVID-19 pandemic, it was the norm to wear a face mask to protect oneself against pollution in Asia. The mask is used as a protective shield from toxic particle matters that can penetrate into the body. When it comes to the skin, however, what kind of measures can be taken?

It is first important to examine the exact side-effects from air pollutants. More than a decade ago, dermatologists have examined the effects of air pollutants on the skin. From minute irritations to deadly diseases, the findings were very revealing. Image 4 displays a study where participants are exposed to airborne phthalates, a group of chemicals that are commonly used in hundreds of mass produced products ranging from toys to perfumes. The studies found that participants absorbed the same amount or even in some cases more through the skin in comparison to their lungs (Svoboda, 2018).

With various pollutants that are coexisting in the air, what are the pollutants that are most harmful to our skin? There are about 15 types of air pollutants that have negative impacts on human health and the environment. Among the many, 6 are considered the key pollutants to be monitored for healthy and sustainable living. These pollutants are: Particulate Matter (PM), Ozone, Sulfur dioxide, Nitrogen dioxide, Carbon monoxide, and Lead. Additionally to these 6 pollutants, Volatile Organic Compounds (VOCs) are a large group of chemicals with toxic substances. When each or a combination of these pollutants are in contact with skin, there are various side effects that contribute to both dermatological cosmetic and medical conditions.

Having considered the 4 main pollutants and other contributing factors of air pollutants, the following research explains the harmful effects each pollutant has on the skin. They are: solar ultraviolet radiation (UVR), polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), and particulate matter (PM).

Ultraviolet Radiation (UVR)
The solar UVR consists of three spectral areas: UVA (320-400nm), UVB (280-320nm), and UVC (180-280nm). The effects on human skin differ depending on the wavelength. "While UVA has been implicated with skin aging (photoaging), it has been linked, along with UVB, in the development of cutaneous immunosuppression and skin cancers such as malignant melanoma, basal cell carcinoma (BCC), and squamous cell carcinoma (SCC) (photocarcinogenesis)" (Drakaki et al., 2014). More evidence suggests UVA along with environmental pollutants (PAHS) increases visible photodamage in skin (Burke & Wei, 2009). Furthermore, the amount of average annual UV radiation has been correlated with the number of cases of skin cancer (Armstrong & Kricker, 2001).

Polycyclic Aromatic Hydrocarbons (PAHS)
PAHs are among the most widespread organic pollutants. As mentioned previously, PAHs have been linked to skin cancer. (Drakaki et al., 2014) PAHS pollutants can be adsorbed on the surface of PM, making it toxic. Long term-exposed skin to PM-bound PAHs could lead to oxidative stress and skin aging (Drakaki et al., 2014).

CHAPTER 1-4 # Patient Interview

Volatile Organic Compounds (VOCS)

"VOCs, with the presence of sunlight and NOx, cause the formation of photochemical oxidant products -mainly O3- at ground level, also called summer photochemical smog" (Drakaki et al., 2014). Research shows that exposure to VOCs contribute to the development of inflammatory and/or allergic skin reactions such as atopic dermatitis or eczema (Drakaki et al., 2014).

Particulate Matter (PM)

Particulate Matter are particles in the air that are a mix of different sizes and compositions from factories, power plants, automobiles, fires, natural dust, etc. The particles are extremely small, nanosize, and are highly reactive toward biological surfaces and structures and induce oxidative stress in human skin and correlates to skin aging such as wrinkles and pigment spots. (Drakaki et al., 2014).

To have an in-depth understanding of the people's experiences in relation to skin issues caused by external factors, qualitative research in the form of interviews were conducted.

Who	Carlo Roman Picaso
Condition	Atopic dermatitis caused by allergies (food, animals, etc.) and air quality.

A patient interview was conducted to gain insights on personal experiences in regards to air pollution and skin. The aim of the interview was to find pain points, current behavior, and further future needs of the patient. The interview revealed that his skin condition was caused by personal food consumption, ambient air quality, and humidity. His personal actions to prevent skin breakouts were to be moisturized, wear scarfs as protection, and constant showers to alleviate toxins from penetrating his skin. A major pain point for the patient was that it was hard to recognize or determine which environments were bad for him. It was only visible after the breakouts had started, by which point it was too late.

Through the interview, it was clear to see that there is a need for a form of indication of ambient data in common environmental public spaces or private spaces. The patient in this case, already is aware and more sensitive of the environments that he enters. However, for an individual or society that has not suffered from such conditions yet, would not have such awareness.

In order to determine what kind of technology and design approach to take to communicate such ambient data, technology and social psychology is examined in the following chapter.

Chapter 2. Theoretical Framework

Image 3
Study participants of aiborne phthalates (Svoboda, 2018)

Image 4
Dermititis patient interview, Carlo Picaso

CHAPTER 2-1 Technology, Society & Ecology

This research deals with technology as a means to gather ambient data information. Technology is evolving rapidly and influencing society simultaneously. By examining the relationship among technology, society, and ecology, the aim is to examine what kind of interfaces or experiences would be fit for the research goals and purposes. This is the Technology Pillar in the previously presented Methodological Design Model.
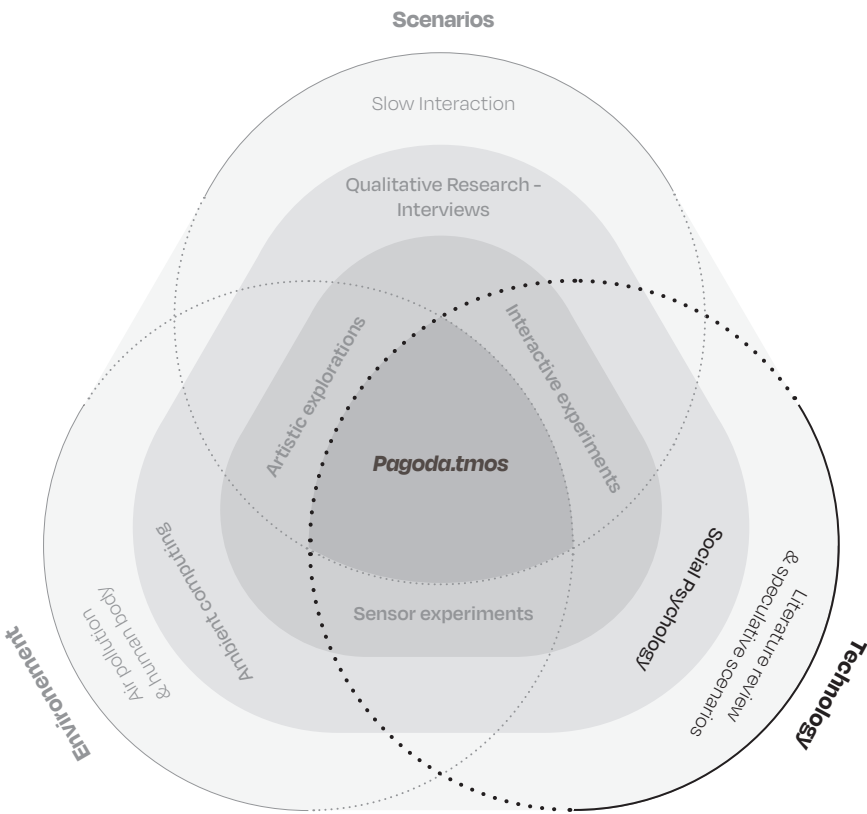
Figure 1
Research Methodology Model

Smart technology is defining the economy and social stratification. Artificial intelligence, machine learning, robotics, and other smart innovations are feeding into what is shaping our world today, including social and economic development. John Markoff's 'Machines of Loving Grace' deep dives into the relationship between humans and machines/technology. Markoff explains intelligence augmentation as work/technology that expands human capabilities. Markoff points out that technological augmentation has questionable tendencies, "with machines that will simultaneously augment and displace humans" (Markoff, 2015). Various films and literature deal with this double edged reality.

'Unauthorized Bread' is one of four tales in Cory Doctorow's 'Radicalized'. Salima, a refugee, is confronted with the technology of the modern world. The home tangled with IoT devices will not function unless the product is confronted with other inputs that are permitted. The smart toaster continues to deny Salima's unauthorized bread until Salima hacks the system. The story portrays the toxic economic and technological stratification, the reality of modern day society. Salima is a refugee who is placed in the lower class in social stratification. She is one without power or authority, one that is even denied by technological advances (Doctorow, 2019). When technology was created to augment the lives of humans, in this scenario, technology starts to have prerequisites for users. It is a world where technology is the judge for the users. Human existence is to please technology and not the other way around. How does this look when we apply the same scenario between technology and our ecosystem?

There have been countless speculations on how the technology fueled world would look like. A 1989 Korean animation called 'Year 2020 Space Wonder Kiddy' portrays how 2020 would look like. The premise of the animation starts with the demise of the Earth caused by technology, overpopulation, depletion of natural resources, and air pollution. As an attempt to seek an alternate habitation, Wonder Kidi explores space. Ironically, the goal of space exploration is to find a new habitat to then incorporate the same technology that was the source of destruction (Kim, 1989).

Technology and ecology have been two entities that have been linked throughout history and will continue to affect future societies. Starting from the First Industrial Revolution, new power sources have been utilized to make production and everyday life more efficient and productive. With this technological advancement also comes inevitable consequences on Earth, climate, and ecosystem. In Bridle's 'New Dark Age: Technology and the End of the Future', weather forecasting is an example of this double-edged sword. He states that "computation is both a victim and a contributor to climate change (Bridle, 2018). With the technology we use today for computational forecasting in weather, we are contributing to electronic consumption and thus 2% of total global emissions. Although computational technology brings information to our fingertips, we are once again contributing to the negative changes in our environment. As technology continues to advance, is it only contributing to the ecological demise in a strained future? And how will the intertwined relationship between technology and nature shape the future ecosystem?

Various studies and literature deal with the topic of how technology is affecting our ecosystem. Kaczynski's 'Industrial Society and Its Future' illustrates plausible scenarios in the next decades to come (Kaczynski, 2018). He states that remnants of wild nature that are remaining will be preserved for science and the true wild nature will be nonexistent. Both Bridle and Kaczynski's texts portray a dark future of scarce nature. In the past decade, Artificial Intelligence has been developed to foresee and prevent such dark futures. SilvaTerra's Basemap is an example of this technology (Basemap, 2022). By utilizing Microsoft's AI technology, data on forests is gathered to help forest conservation by providing detailed maps to identify risks. IBM's Green Horizons is another initiative to tackle air pollution ((Air Pollution in China and IBM Green Initiatives, 2016). Internet of Things, Big Data processing, and cognitive computing are used to analyze environmental data to create weather and pollution forecasts. With this technology, future smart cities can utilize this data for a healthier environment. Machine Learning is another powerful tool that has been developed to tackle climate change. "Tackling Climate Change with Machine Learning" is a paper that evaluates how machine learning can reduce greenhouse gas emissions. Sectors that are analyzed in this paper for utilizing Machine Learning include electricity, transportation, city/urban planning, industrial production, farms, and forests. The study also includes climate prediction where climate risks are calculated (Rolnick et al., 2019).

There are, however, climate prediction problems dealing with climate models. Kochanski states "no matter how many weather

stations we construct,... the Earth will generate at most one year of new climate data per year" (Rolnick et al., 2019). This circle backs to Bridle's point on the "crisis of knowledge and misunderstanding", "what we perceive as weather in the moment shadows the globe as climate: tiny moments of turbulent activity through which we can barely grasp as unseen, unknowable totality" (Bridle, 2018). The unpredictability in nature and climate will always exceed data and there are too many unknowns for a complete and accurate analysis. In a world where technological development and advancements are in high demand, it is obscure to fully define the solution to the complex relationship between technology and ecology. This relationship continues to evolve and is inevitably implemented in future forms of life.

Technology has been used to prevent damages done to our ecosystem. Big data is analyzed by utilizing various technological advancements to further develop our living environments more sustainably. However, it is unclear if these advancements are truly helping our ecosystem. It is important to be aware if we are in Salima's situation and question if our existence is for technology and not the other way around. Pivoting from technology as the authority over users or society, I suggest focusing on the initial purpose of technology; intelligence augmentation that is focused on the user's needs and societal purpose. What kind of approach can we take to achieve this?

User experience is a field that focuses on identifying problems and needs of users to consequently create solutions that will enhance

experiences. Rather than focusing on economic and business implications, I would like to explore technology and experiences in an emotional and experiential manner on an individual and societal level that provides qualitative depth for awareness and behavior change in regards to air pollution and climate change.

Image 5
Year 2020 Space Wonder Kiddy, Animation, 1989

Image 6
The Social Dilemma, Documentary, 2020

CHAPTER 2-2 Social Psychology

To further develop the emotional and logical aspects in awareness and behavior change, theories in social psychology are examined as air pollution and technology are both individual and societal topics. Social psychology indicates how one's individual thoughts and behaviors are influenced by the presence of others. Through social psychology, perception and behavior change can be further understood.

In the case of air pollution, there is a growing importance to be carbon neutral in order to reduce global greenhouse gas emissions, as seen in Chapter 1. With current policies established in the Paris climate agreement, countries and companies must contribute to achieve the aims of the agreement. However, with such warming projects seen in Figure 1, there is still a big need to inform and improve individual and social mindset on the current situation.

In order to achieve such goals and improve social perception and behavior, salience, Gibson's theory of perception and Dissonance theory are examined.

Salience

Salience refers to the quality of having prominence or being noticeable. In neuroscience, salience bias (perceptual salience) has proven to influence feedback-related neural activity arising from choice. (Lou et al., 2015) In the field of UX, it has been used to guide and influence one's decision making within digital interfaces. (Using Salience to Guide User Decision-Making, 2012) An example of this would be motivating one to donate. By highlighting critical information such as "what they can donate, who it can help and, specifically, how it will help", the users are able to gain meaning into the act of donation.

Self-efficacy refers to a person's beliefs and confidence in their abilities, behavior, and performance. In order to have a larger societal impact on personal health, air pollution and ultimately climate change, both saliency and self-efficacy are important factors to consider.

In terms of salience and self-efficacy in climate change, studies found that "certain images are related to respondents' feeling that climate change is important (salience), and that other images are associated with respondents' perceptions that they can do something about climate change (self-efficacy)". (Lou et al., 2015) In terms of salience, images showed the negative impacts of climate change, while images influencing self-efficacy depicted relatable forms of reducing climate change. The study also suggests "using

images that run against common public perceptions of climate change, journalists can challenge these mainstreet perceptions". By offering new perspectives, viewers can reflect upon the imagery.

For this research project, I propose to introduce salience in the form of a physical structure that is placed in our everyday environment to showcase the prominent state of the proposed design within the prominent state of the current climate crisis. The materiality, form, and interaction of the design will also aim to encourage self-efficacy. This would be achieved by presenting ambient data in the form of unexpected or uncanny experiences. These experiences will be further explored through UX Methodologies and Design Explorations in the following chapters.

Chapter 3.
Context Inquiry

CHAPTER 2-2-2   ## Dissonance Theory

One of the aims of this project is to increase awareness of climate change to motivate people to reflect and increase awareness. Although most people are aware that individual and societal actions contribute either positively or negatively to climate change, it is difficult to put it into action. This misalignment between one's belief and behavior is defined as Dissonance Theory. In order to align these two factors, experiments have been conducted to reduce dissonance based on Festinger's proposals. Major dissonance reduction strategies included attitude change, self-affirmation, and changing behavior. (McGrath, 2017) Studies showed that "once an individual reaffirms her or his sense of self, the importance of a discrepant act is weakened, and it no longer arouses dissonance." (McGrath, 2017) Utilizing interaction design, my goal would be to provide an experience that can be a prompt for attitude change. This will be achieved by presenting unexpected modalities in data computing. Furthermore, the structure and materiality of the design aims to provide an introspective perspective that leads to self-affirmation and behavior change. In the following chapters expand on the type of modalities and experiences of the developed designs.

CHAPTER 3-1

Design Experience

User experience deals with end-to-end interaction of a design or service. It deals with creating meaningful experiences that are functional, problem-solving, and usable among many. To determine the overall design experience, in addition to the social psychology theories examined in Chapter 2, UX methodologies are examined to understand the mindset and needs of users and viewers of this research project. In the case of this project, modalities are used as a sensory experience. Furthermore, in order to understand and examine the pain points of air pollution on skin and health, scenarios are explored based on real life patients.
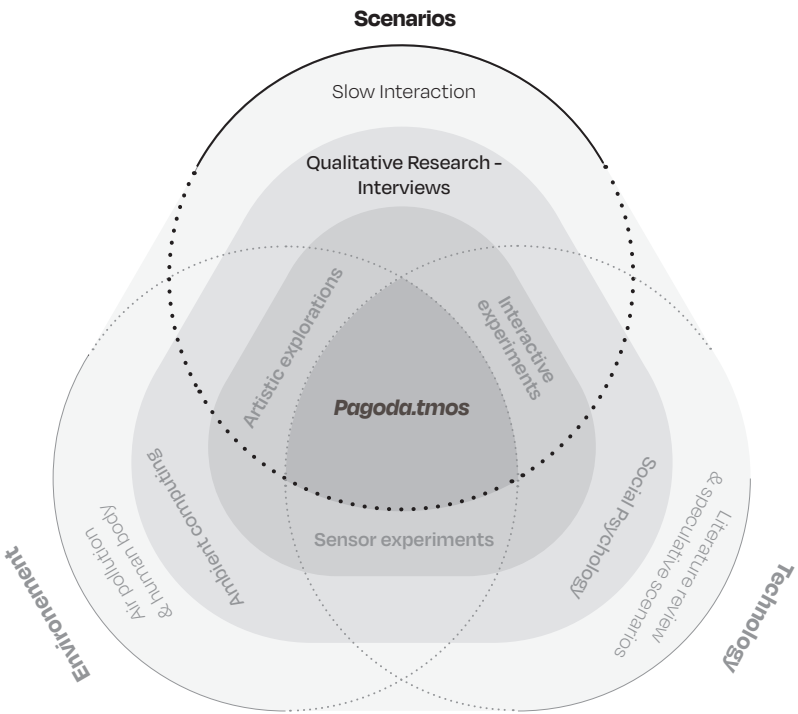
Figure 1
Research Methodology
Model

CHAPTER 3-2 # Modalities

In the field of human-computer interaction (HCI), a modality refers to a sensory input and output between a computer and a user. (Karray et al., 2008) In a computer to human interaction, computers can use various technologies and methods to communicate information to users. In the field of psychology, specifically in perception and cognitive understanding, modalities include visual, auditory, tactile/kinesthetic, smell, and taste (Anderson, 2004). The most common modalities in the form of unimodal, independent single channels, interactions are visual, auditory and kinesthetic.

Visual-based modalities refer to the visual outputs from a computer, such as graphics, color, data, etc. Examples of this on a universal level are stop sign colors and their significance in the driver's action. In terms of data and information, this refers to diagrams, tables, graphics, etc. Audio-based modalities refer to sound based outputs such as a ring from a cell phone, and error sound, etc. Kinesthetic modalities refers to movements of the body.

In the context of this project, as described in Chapter 2, the overall interaction and design forms are abstract as an introspective method. Therefore, in terms of modality and output of ambient data, unimodal interaction will be used per design to have a clearer delivery in information. To define the type of modalities and interaction design to use in the prototypes, case study projects are examined that provide unique sensory experiences.

CHAPTER 3-3 # Sensory Experiences

When speaking about sensory experiences in this research, it refers to the experiences that the design proves to the viewer in terms of modalities such as visual, auditory, and kinesthetic. All design experiences use modalities in some form to engage the viewers. Architect Kengo Kuma's Breath/ng air purifying sculpture is an example of how materiality and visuals provide an immersive experience that allows viewers to have an introspective view on air pollution. (Kengo Kuma's 'breath/Ng' Sculpture Absorbs 90,000 Cars Worth of Pollution, 2018) In addition to the functional and emotional value, the sculpture is an example of providing salience in the topic of air pollution.

Another example of salience and self-efficacy in design is the Utah Monolith. The triangular metal pillar was discovered in 2016 with no indication of its purpose or makers. (Artist or Aliens?, 2020) With this abstract nature of the pillar, viewers were more intrigued and began to question its origin, connecting it to undiscovered concepts such as aliens. This uncanny nature of the pillar focuses on the visual form and materiality of the design.

The Dangling String by Natalie Jeremijenko is an example of how kinesthetic interaction is used as a modality. A motor is connected to the cable and generates movement by the input of local area network data. Kinetic and auditory modalities are stimulated, providing a new representation of information that is widely represented in a screen display (Vallgårda, 2009).

The case studies above are representations of how different modalities in experiences can provide logical and emotional value. Additionally, salience in the topic and purpose is provided by the uncanniness of design form, structure, and materiality. To define what type of modality, experience, and design are needed for the project, slow interaction is examined.

Image 8
Utah, Monolith

Image 7
Breath/ng, Kengo Kuma

Image 9
The Dangling String,
Natalie Jeremijenko

CHAPTER 3-4

Slow Interaction

For changes that are difficult to sustain, motivation can be low and must require a slower change that influences one's long-term views. Slow change is introduced as a method of "interaction computing technologies created with the purpose of changing people's attitudes or behaviors without using coercion or deception" (Fogg, 2002).

In the case of heightened perception of invisible threats, I propose the AMBIENT Cycle (Figure 3) that illustrates the experience between one's inner mind and the surrounding ambient elements that ultimately creates the method of slow interaction.

In the case of perception, Freud believed behavior derived from three levels of perception: preconscious, conscious, and unconscious. The conscious mind contains all awareness of thoughts, memories, and feelings. The unconscious mind contains thoughts, memories, and feelings that are outside of our conscious awareness. Freud believed the unconscious continues to influence our behaviors. Therefore, the conscious and unconscious are two major factors when analyzing and influencing one's slow interaction experience.

Interaction design in terms of interface, physical product, or space, there are two major influences – the physicality of the product and the emotional influence it has on the user. Emotional influence in this case refers to the user experience that evokes positive emotions. Positive experiences provide curiosity and motivation; two

factors that therefore influence perception.

The physicality of the design needs 4 major factors to communicate with the user. The first is design and its emotional influence on the user. The second is the context in which the design is placed that heightens the understanding of the design. The third is data and information in which the design and interaction provides the user. The fourth is the feedback. Feedback refers to a signal or experience that triggers the user's senses for cognitive understanding of the data. Examples of this could be sound, color, design form, etc.

CHAPTER 3-5

Scenario Explorations

From the initial survey conducted (Figure 3), I identified 3 individuals that were experiencing major skin health issues derived from air pollution. By conducting interviews and analyzing their behavior, my goal was to see the role user experiences and technology have with these individual users.

To first understand each individual's situation, I identified the pain points they experienced on a daily basis. The three main categories of issues derived from air pollution are:

1. Attributing to new skin conditions / diseases such as skin cancer
2. Worsening pre-existing skin conditions such as atopic dermatitis
3. Adult acne, sunspots and other cosmetic issues

To understand each user's lifestyle and issues, a segmentation matrix of lifestyle positioning (Figure 5) is used. The following are three scenarios and their respective skin problems:

1. Scenario 1: Gas & Dermatitis
2. Scenario 2: UV & Skin Cancer
3. Scenario 3: PM & Acne

The x-axis illustrates the negative effects of air pollution from cosmetic issues to clinical. The y-axis illustrates the user's lifestyle from indoor to outdoor.
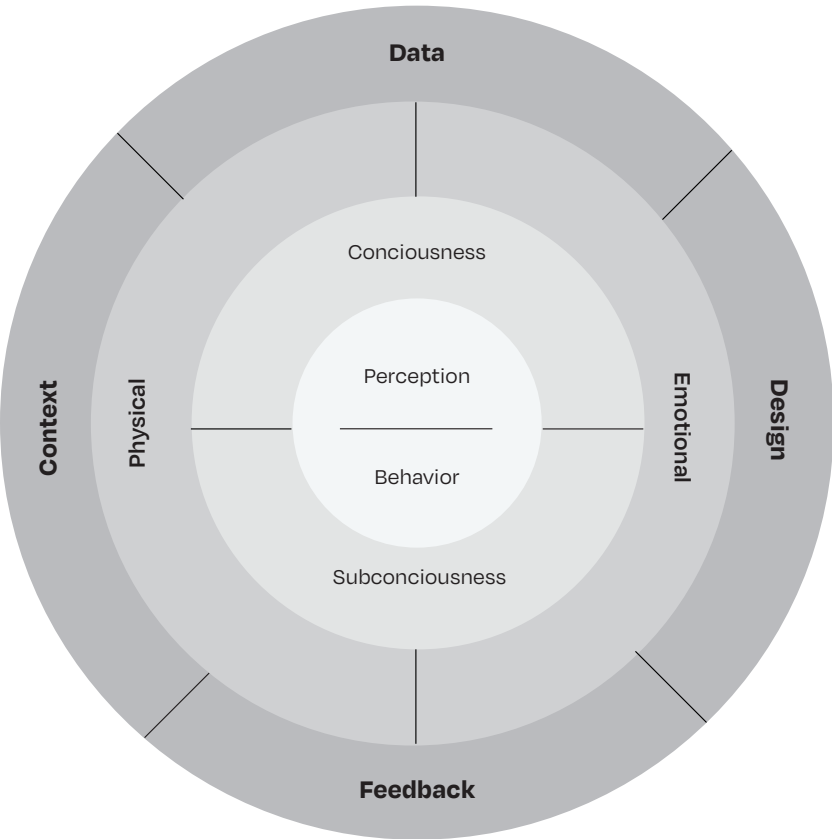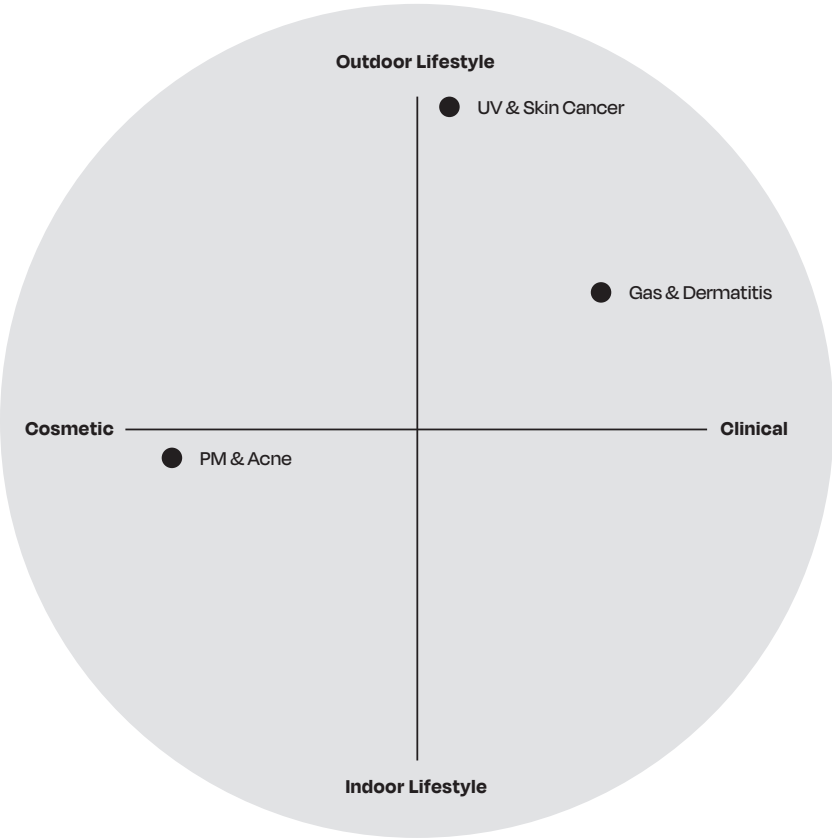

Figure 4
AMBIENT Cycle: Prototype Design Framework

Figure 5
Lifestyle positioning

Scenario 1 : Gas & Dermatitis

Name	Yerin Song, 26 years old
Place of Residence	Seoul, South Korea
Skin Condition	Atopic Dermatitis since age 22.
Cause	Atopic dermatitis caused by Sick House Syndrome (SBS)
Medical Treatment	Tablets and cream taken when conditioners are severe and for when she experiences extreme itching. Moisturizer for when skin is dry.
Job/Occupation	Indoors mostly during the day at work or in university. Spends 2 hours commuting. She sometimes goes to industrial areas for work.
Weekday Lifestyle	Indoors mostly during the day at work or in university. Spends 2 hours commuting. She sometimes goes to industrial areas for work.
Weekend Lifestyle	Meeting friends or family usually within the Seoul city.
Concerns	She cannot tell which environments are not good for her skin. Also, when she goes to the industrial areas for work, it is an obvious cause of her outbreaks and feels that it is an unhealthy place for her skin health.

Based on the interview, a user journey is constructed (Figure 5) to identify pain points and needs. As Yerin mentioned, the biggest problem for her is when she must go to the industrial areas for work. The chemicals in the air are toxic to her skin, becoming one of the causes of breakouts for atopic dermatitis. If she is aware of the toxicity levels in her environment, she will be able to change her location or take on other actions that will try to counteract the effects of the pollutants.

Findings & Opportunities

To design the appropriate pain points that she experiences throughout an average day. With her skin condition being a major issue in her life, she is aware that certain areas and places might have high tVOC levels but would like to know specifically when and the intensity levels. With this qualitative case study research, the aim and goal is to make an impact on an individual level with a societal experience.

Image 10
Demititis condition,
Yerin Song

Figure 6
Journey mapping,
Yerin Song

Time	Activities	Environment	Experience	Painpoints	Needs
07:20 (Morning) — Wake up	Wake up	Home	●		
08:00 (Morning) — Commute to work	Commute to work	Public transportation		Air pollution in the city and public areas that can cause outbreaks	Pollution levels of current location within the city
09:00 (Morning) — Work	Work	Work building		Doesn't know what kind of chemicals are released and can cause outbreaks	Chemical levels of current location
12:00 (Afternoon)	Work building	Work building			Chemical levels of current location
13:30 (Afternoon)	Work building	Work building		Doesn't know what kind of chemicals are released and can cause outbreaks	
16:30 (Evening)	Work	Work		Doesn't know what kind of chemicals are released and can cause outbreaks	Chemical levels of current location
18:30 (Evening)	Commute to home	Work		Air pollution in the city and public areas that can cause outbreaks	Pollution levels of current location within the city
19:30 (Evening)	Personal time	Home or outdoors	●		

CHAPTER 3-5-1

Scenario 2 : UV & Skin Cancer

Name	Andreas Holz, 67 years old
Place of Residence	Freiburg, Germany
Skin Condition	Actinic keratosis on forehead
Cause	Too much sun exposure
Medical Treatment	Treatment cream for spots
Job/Occupation	Oboe Musician in Freiburg Orchestra
Weekday Lifestyle	Indoors for work but spends the rest of his time outdoors
Weekend Lifestyle	Outdoors cycling in the Black Forest near home or other mountains
Concerns	Spends most of his passtime outdoors mostly by cycling. He loves being outdoors but must be careful about sun exposure due to his skin condition. He must apply sunscreen often as a preventative measure.

Most of Andreas' passtime consists of outdoor activities, especially cycling in the mountains. He was instructed by his doctor to reapply sunscreen every 2 hours. He was informed that more than 20 minutes of direct sunlight makes his skin vulnerable to UV rays. While biking he has his helmet on but it does not protect his skin fully. Although his wife is concerned with his skin condition, Andreas feels that occasional sunscreen application is enough.

To increase his awareness during his time outdoors, it is important to provide real-time information in a simple yet effective manner.

Findings & Opportunities

Figure 6 displays Andreas' motivation for behavior change as well as his ability. Due to his past skin condition history, he is aware that he needs to take action but still lacks motivation to be as meticulous as he should be. His personal preference with technology is simplicity. He prefers an analogous approach rather than complex user experiences.

Consequently, the design must be simple with clear communication that signals high UV ray levels. Using his outdoor lifestyle and exposure to skin, this could also be a relatable pain point on an individual and societal level.
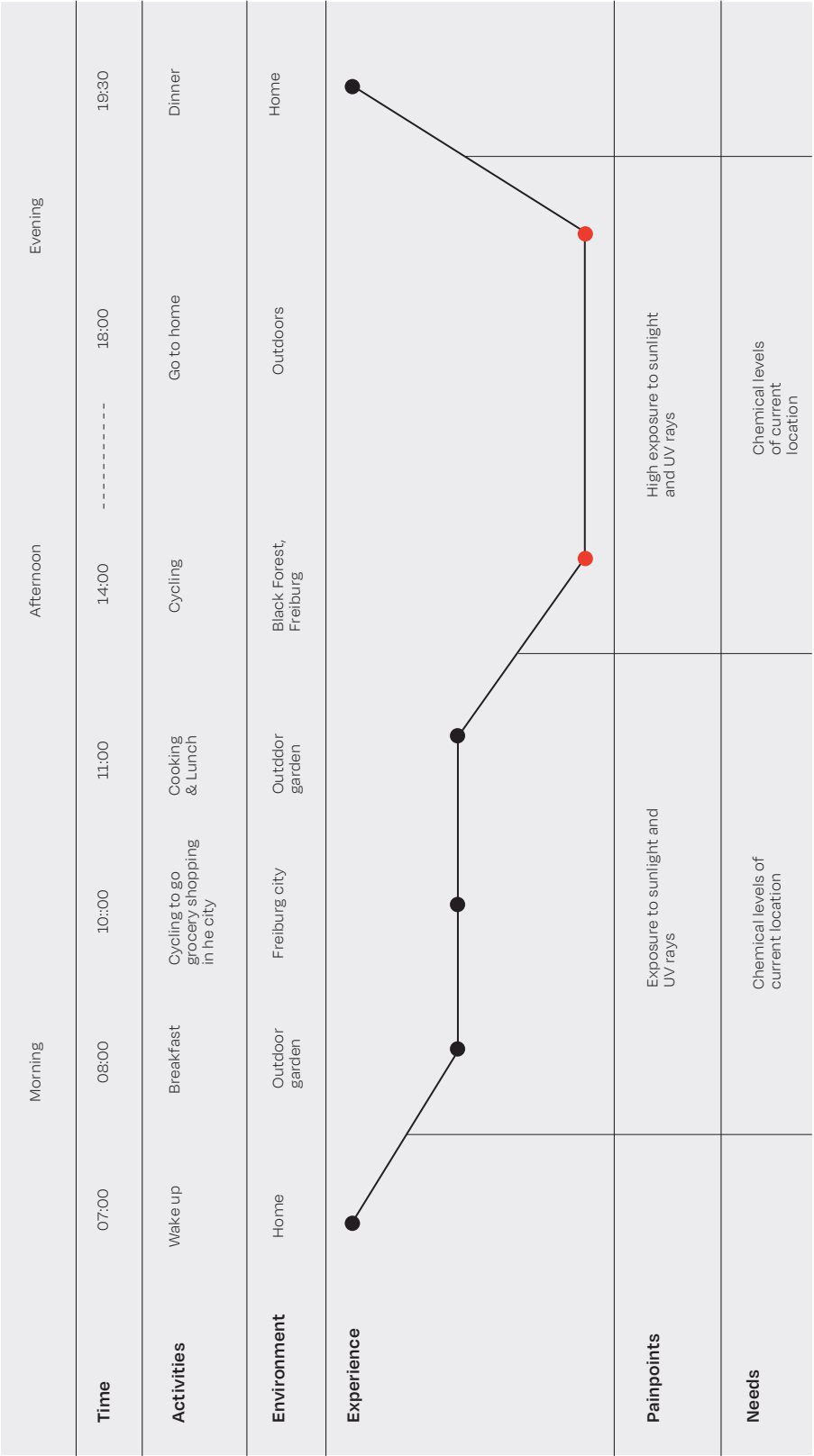
Image 11
Actinic keratosis,
Andreas Holz

Figure 7
Journey mapping,
Andreas Holz

	Morning				Afternoon		Evening	
Time	07:00	08:00	10:00	11:00	14:00	18:00	- - - - - - - - -	19:30
Activities	Wake up	Breakfast	Cycling to go grocery shopping in the city	Cooking & Lunch	Cycling	Go to home		Dinner
Environment	Home	Outdoor garden	Freiburg city	Outdoor garden	Black Forest, Freiburg	Outdoors		Home
Experience								
Painpoints		Exposure to sunlight and UV rays				High exposure to sunlight and UV rays		
Needs		Chemical levels of current location				Chemical levels of current location		

Scenario 3 : PM & Acne

Name	Hyojae Lee, 23 years old
Place of Residence	London, England
Skin Condition	Adult acne
Cause	Skin sensitivity to ambient environment, stress, and menstrual cycle.
Medical Treatment	Acne treatment (laser and chemical) to reduce skin inflammation and frequency of breakouts.
Job/Occupation	Student
Weekday Lifestyle	Spends time mostly at university. She is mostly commuting from and to the university in public transportation in a city environment.
Weekend Lifetstyle	Resting at home or ,eeting friends usually in London.
Concerns	With the changing environmental factors and pollution, she feels like it adds to her adult acne. However, it is hard to tell exactly when or where the causes are happening.

In a city environment, there are various factors such as air pollution, car emissions, construction, etc. that can contribute to high Particulate Matter levels. Although Hyojae is very concerned about her skin health, she must live in the city environment without knowing when and where there might be high PM levels that affect her skin.

Findings & Opportunities

Fig 10 displays Hyojae's daily journey. As a representation of most student life, she is spending a large amount of time in the city. With this scenario and case study, it also provides personal context in a larger societal experience.

Image 12
Acne,
Hyojae Lee

	Morning			Afternoon		Evening	
Time	08:00	09:00	10:00	12:00	13:00	16:00	17:00
Activities	Wake up	Commute to university	Class	Lunch (university)	Class	Tube & bus	Dinner/personal time at home
Environment	Home	Tube & bus	University	University campus / city	University	Tube & bus	Home or outdoors
Experience							
Painpoints	Air pollution in the city and public areas that can cause acne			Air pollution in the city and public areas that can cause acne		Air pollution in the city and public areas that can cause acne	
Needs	Pollution levels of current location within the city			Pollution levels of current location within the city		Pollution levels of current location within the city	

Figure 8
Journey mapping,
Hyojae Lee

Chapter 4. Design Explorations / Experimentations

CHAPTER 4-1

Sensor Technology Experimentation 1 - General Exploration

To gather real-time environmental data, my first experiment was to see the correlation between real-time data and cognitive behavior. For this experiment I recorded my senses of the air quality in a diary format.

Using arduino and environmental sensors, real-time data was collected. I used the CCS811 Air Quality sensor to measure CO2 and tVOCs. Furthermore, I chose 3 locations - office environment (ZHdK university atelier), ZVV train, and home environment (studio apartment) to compare experiences based on the environment.
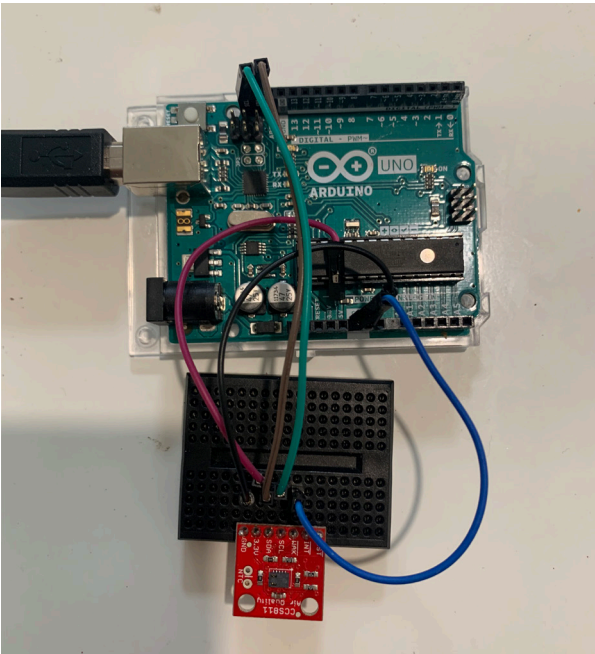
Image 13
CCS811 Air quality sensor experimentation

Location 1 : Office Environment

Location	Office environment (ZHdK Atelier)
Date	August 21, 2020
Time	14:00 – 16:00
Ambient	Open window
	4-5 people in the same environment

Test Result and Analysis

During the two hours, there were no visible changes that led me to believe that the air quality was bad. With the window open nearby, there were inputs of fresh air coming from the outdoors. When examining the data, there are spikes in CO_2. These correlated with the time where there were more people near the test subject. However, the perception in air quality was the same even though data showed a drastic increase in CO_2.
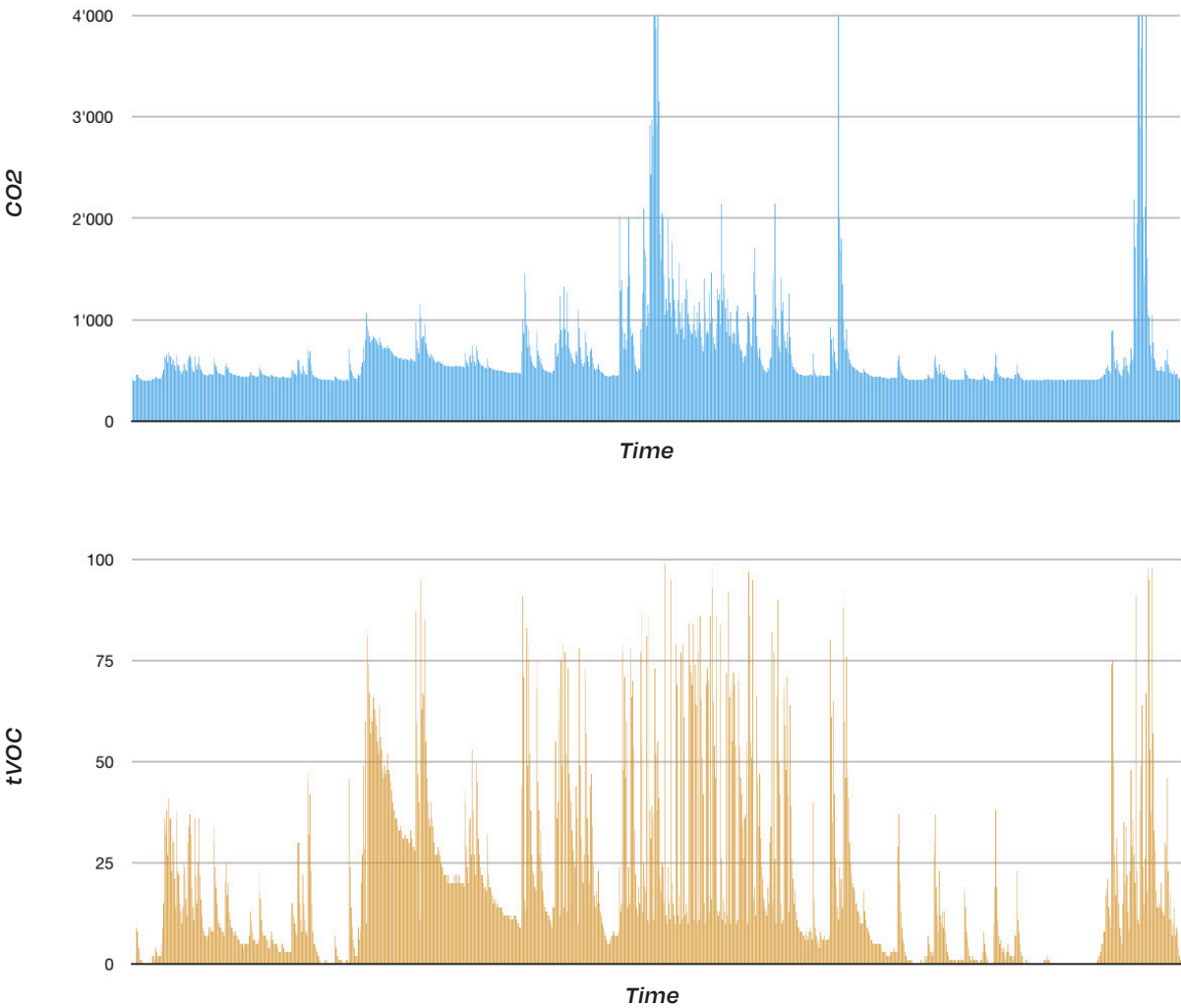
Figure 9
CO_2 measurements by
time in office environment

Location 2 : ZVV Train

Location	ZVV Train
Date	August 26, 2020
Time	18:50 - 19:50
Ambient	Enclosed area
	8 people in the same environment

Test Result and Analysis

The overall air quality perceived through cognition was bad air quality. The environment itself was enclosed with several people. Human sensor used for better cognition of air quality was smell. By smelling food (or the process of making food) as well as gas from the train itself, it was a hint to the quality of air. When examining the data however, the cognitive perception and data do not have exact correlation. The data showed overall bad air quality with spikes that were constant.
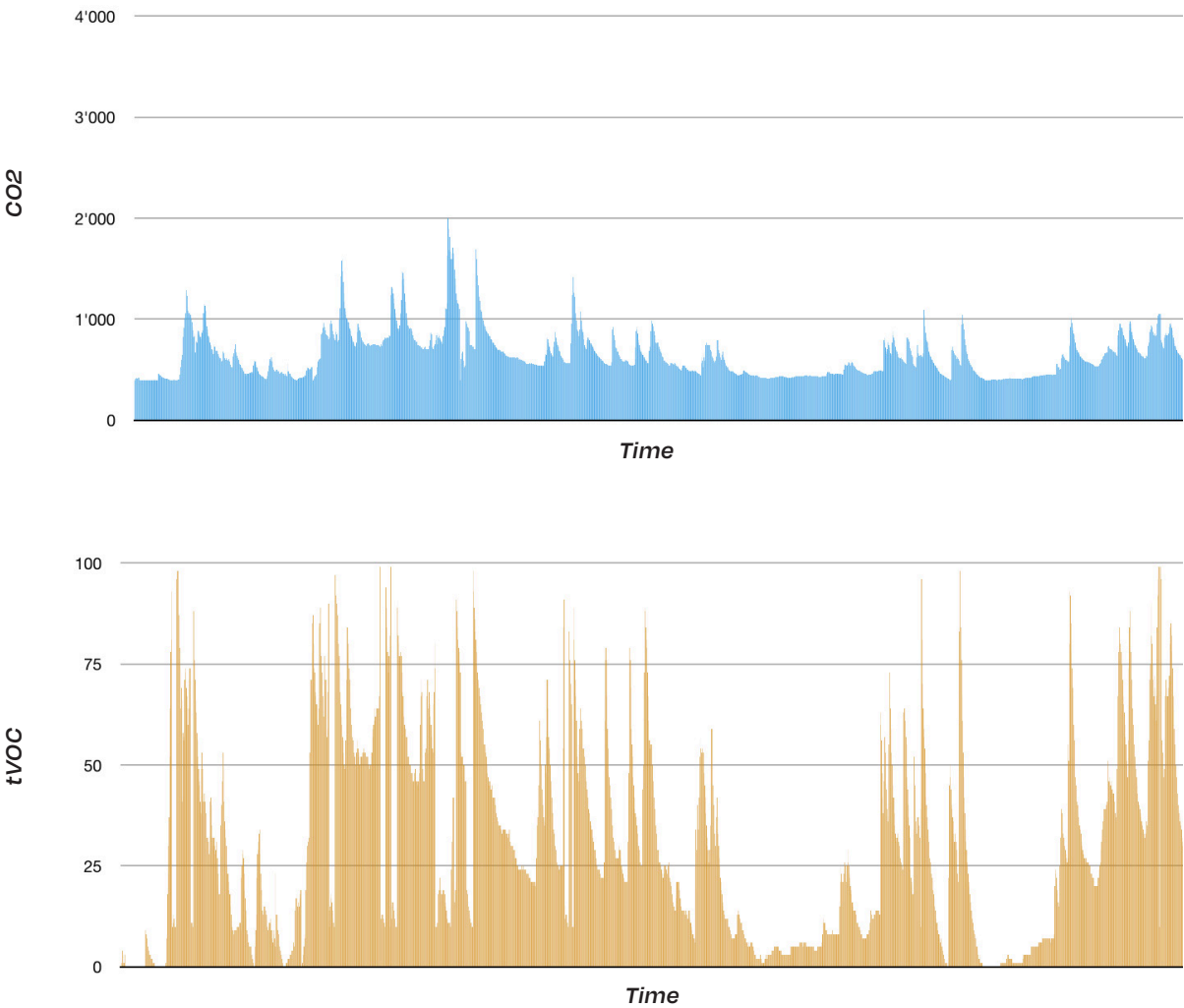
Figure 10
CO2 measurements by time in ZVV train

Location 3 : Home Environment

Location	Home environment (studio apartment)
Date	August 26, 2020
Time	19:15 - 20:15
Ambient	Closed window while cooking 26 square meter living space

Test Result and Analysis

The experiment was conducted purposely in a cooking environment, where more gasses and CO_2 are generated. The window was closed to heighten cognitive perception also. While cooking, the overall perception of the air quality was bad. Smell was overwhelming which made it hard for the test subject to focus specifically on air quality. Furthermore, there was an evident increase in air temperature within the environment as well as the test subject's body temperature which was also a disturbing factor. The data from the sensor showed that there were high spikes in certain times that correlated with cooking. For the test user, however, it was difficult to differentiate when these times were because of the lingering senses of smell and temperature.
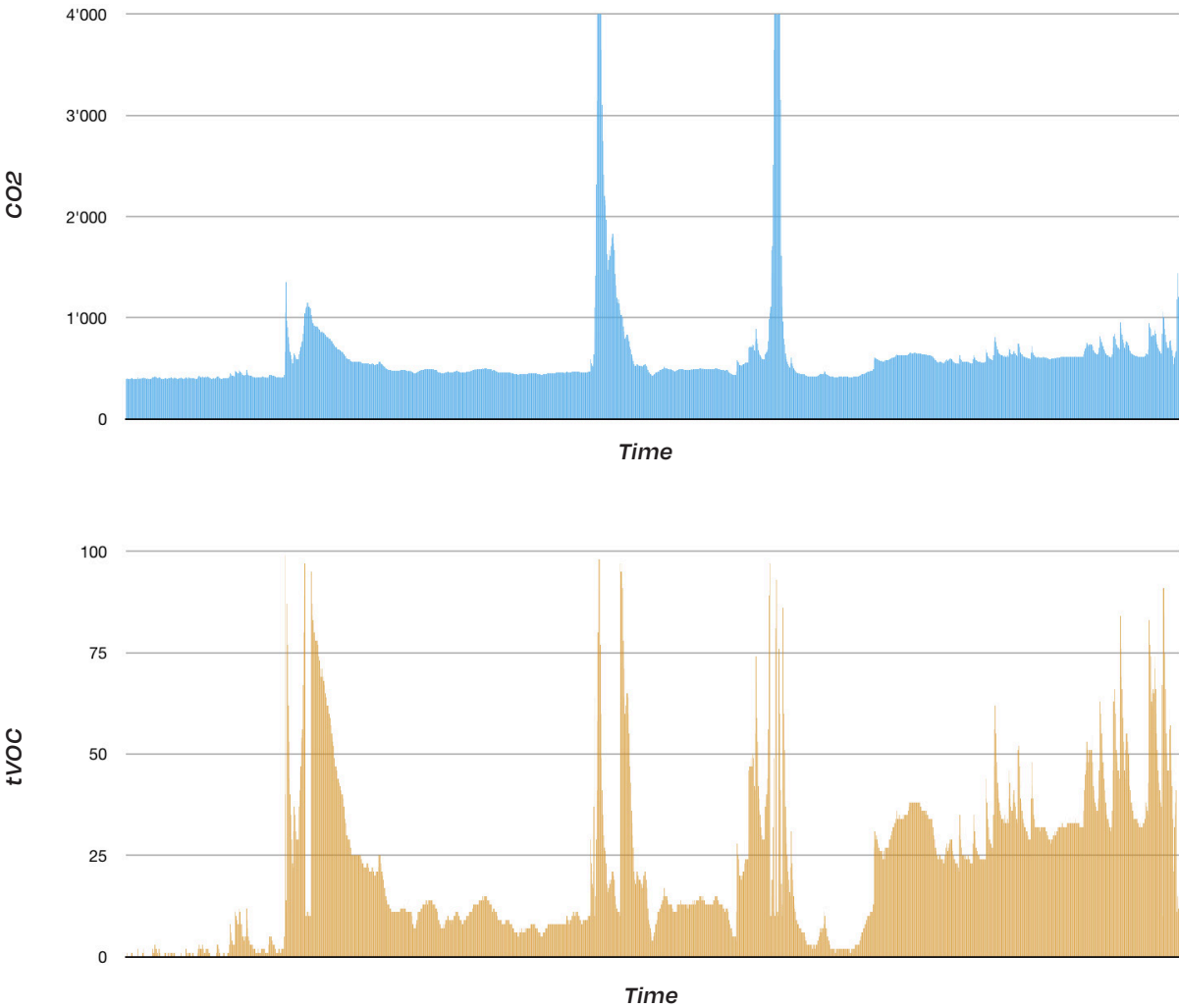
Figure 11
CO2 measurements by
time in home environment

CHAPTER 4-2

Sensor Technology Experimentation 2 - Scenario 1

Findings & Opportunities

Experimentation 1 showed that cognitive perception lacked detailed data on the exact time and amount of pollutants in the environment. The general perception was close to the overall air quality (very bad, bad, good, very good). However, human cognition lacked detailed air quality perception based on exact times.

The location of the tests were done in generally good air quality environments based in Zurich, Switzerland. There would also be different experiences and findings when air quality is generally bad or when there are extreme variations in air quality within the same location.

To have a better and precise understanding of the environmental input data, the next experimentations focus on the output form for the data. Common outputs are user interfaces that display numbers and values. However, to have a more intuitive and emotional approach, I have explored haptic and color outputs.

As a development from Experimentation 1, I began to examine which air pollutant to sense that is correlated to the user. In the case of User 1: Atopic Sensitivity, the pollutant that has an effect on the skin is harmful gas. As a result, the BME 680 sensor is used for data sensing. The BME 680 senses temperature, humidity, pressure and gas. For the purpose of this experiment, gas is the only factor that is sensed.

In terms of the output, I explored a haptic approach for the user to understand the level of toxicity levels in the air. Haptic perception is based on human touch receptors such as skin, muscle, and joints. Touch sensations are mediated by receptors that respond to pressure, vibration, and heat flow (temperature). This sensation within the skin is referred to as cutaneous sensing, while beneath the skin in muscles, tendons, and joints are kinesthetic sensing. In terms of cutaneous sensing, I used the vibrating motor as it has a subtle yet effective personal sensation on the skin.

The vibrating motor is reactive to the data received by the sensor. As gas levels increase, the vibrating rate and intensity increases.

With the arduino model, I visited various locations in Zurich to test how the data from the sensor correlates with the haptic vibrating motor. Furthermore, it was important to see how it connects with the perception of air quality (gas). The following two locations were examined for testing and analysis:

Location 1 : Home Environment

Location   Home environment (studio apartment)
Date   January 14, 2020
Time   12:00 - 13:00
Ambient   Closed window while cooking 26 square
                 meter living space

Test Result and Analysis

The arduino module was connected to the computer to check data numbers. The test was purposely done in a cooking environment with smoke so that gas levels would increase. The vibrating motor was taped on my forearm so that I could compare the data with the vibration sensation on the skin.
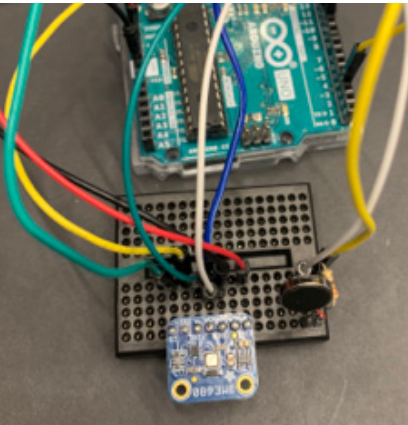
Findings & Opportunities

Experimentation 2 was a developed experiment from Experiment 1. Experiment 1's finding showed that there needed to be a clear output/experience for the user to clearly understand the sensor data. As a result, Experiment 2 used a vibrating motor to trigger the cutaneous sensor on the human surface skin. As a result, it was clear that the more toxic gasses were sensed, the higher the vibration levels were.

During the experimentation, the hardware aspect was a pain point. The computer and arduino had to be connected to check sensory data. Connected to the arduino was also the vibration motor that had to be taped onto one's skin. Making the hardware more compact and wearable would be a solution to explore and develop on.

User 1's most sensitive area of the skin are her forearms, specifically the cubital fossa, where there is direct skin surface contact between the forearm and the biceps. It is also an area that is often exposed to the air. The next opportunity would be developing wearable forms that protect the area as well as provide haptic sensory data.

CHAPTER 4-3

# Sensor Technology Experimentation 3 - Scenario 3

Color is a common form of displaying information to users. This is due to the psychology of perception with color.

Similar to the traffic light, air purifiers share the same color coding to portray the status for particle pollution, specifically particle matter (PM). According to the Air Quality Index (AQI) determined by the United States Environmental Protection Agency (EPA), there are 5 levels of air quality that are identified with color. The following chart is the AQI basics for particle pollution (EPA, US Environmental Protection Agency, 2014).

For Scenario 3, particulate matter is one of the factors that can contribute to acne. To detect particulate matter, the HM3301 sensor was used to detect PM 2.5, fine particles that are two and one half micrometers or less in width. Following the AQI, the input of PM2.5 levels correlated with the output of colors.

| Daily AQI Color	Levels of Concern	Values of Index	Description of Air Quality
Green	Good	0 to 50	Air quality is satisfactory, and air pollution poses little or no risk.
Yellow	Moderate	51 to 100	Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.
Orange	Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is less likely to be affected.
Red	Unhealthy	151 to 200	Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.
Purple	Very Unhealthy	201 to 300	Health alert: The risk of health effects is increased for everyone.
Maroon	Hazardous	301 and higher	Health warning of emergency conditions: everyone is more likely to be affected.

Table 2
Air Quality Index, US EPA
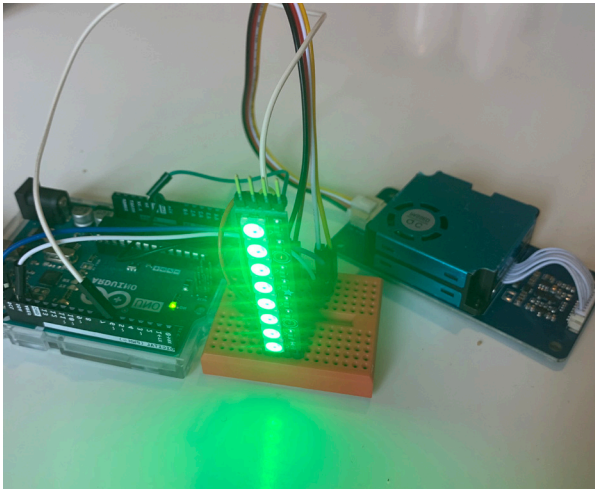
Good
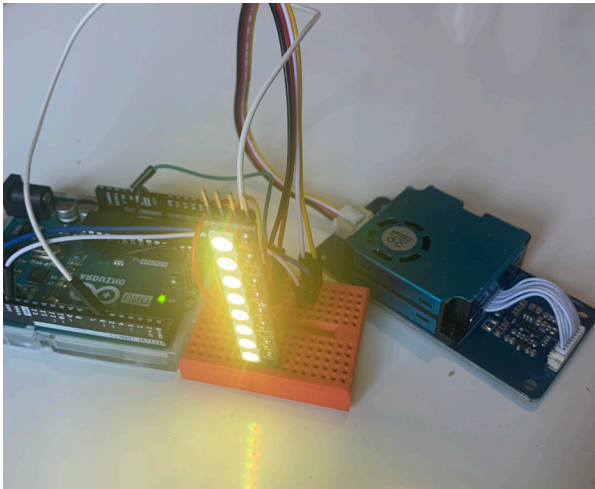
Normal
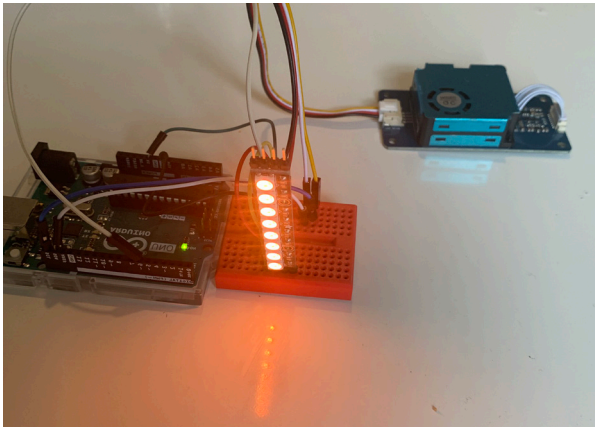
Bad
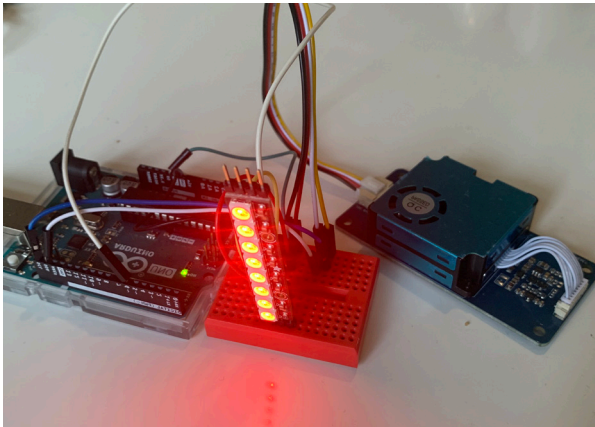
Very Bad

Image 16
HM3301 sensor as input and color LED lights as output

CHAPTER 4-4

Material Exploration 1 - General Exploration

Findings & Opportunities

Color is a powerful tool to portray a message. There are various established implications and perceptions based on color. An example of this is the traffic light. Similarly, particle matter already has an established Air Quality Index based on levels and colors.

Although color is an effective method to display status, it still lacks prompt for users that are not highly motivated, as is the case for User 03. There are opportunities to explore further prompts to create behavior change. This can be explored by triggering other human sensors such as visual and smell. In the case of visuals, form of shape is explored. This is further explained in Chapter 5.

Knowing the exterior environment that causes issues with skin is what was explored in the previous experimentations. The purpose of material exploration 01 is to try and understand the status of one's current skin to have a holistic view on the exterior factors as well as the internal status of the human body. Two test subjects used a pH strip each to try and check the status of their body's pH level. The pH strip was on the test subjects' skin for three hours while outdoors. It was then compared with the external look of their skin to see if there were any visible correlations.

Image 17 shows pH strips with a color scale indicator of test results. Two tests were conducted to test skin pH levels.
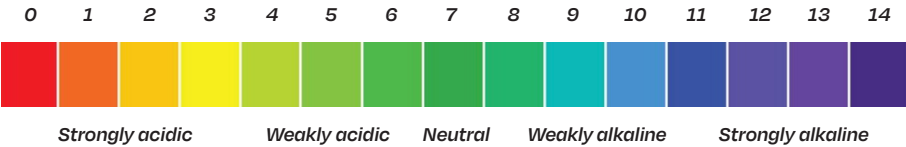
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |

Strongly acidic   *Weakly acidic*   *Neutral*   *Weakly alkaline*   *Strongly alkaline*
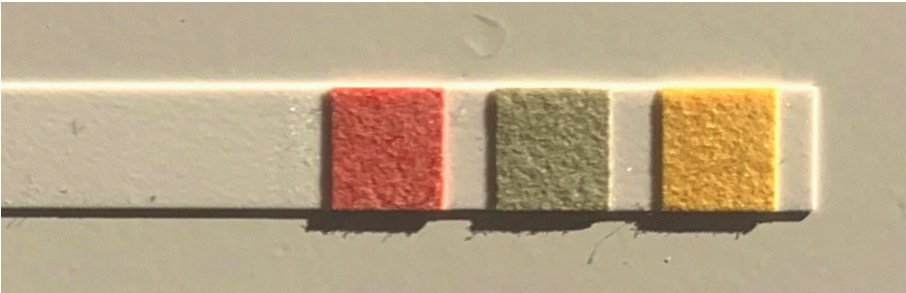
Image 17
Untested pH strip

Material Test 1

Name Jooin Shin
Date September 1, 2020
Time 15:30 - 18:30
Location Walking and taking public transportation in Zurich

Test Result and Analysis

Test showed pH level was 4.5. This level indicates that the test subject's skin is mildly acidic. The optimal value for face and body should be between 4.7 and 5.75. Acidic skin increases the change of skin having inflammatory conditions such as acne. Although the pH strip showed that I had to neutralize my skin, the surface appearance was normal. Therefore, the urgency and motivation lacked to take action to neutralize the pH level.
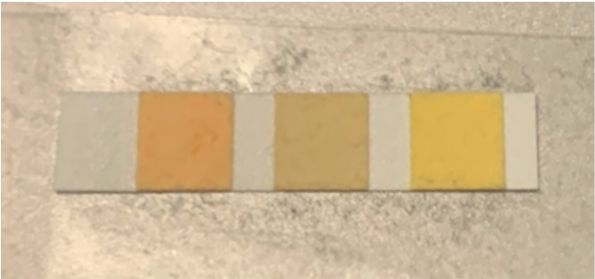
Image 18
pH strip test 1 result

Material Test 2

Name Johannes Kastner
Date September 1, 2020
Time 15:30 - 18:30
Location Riding motorcycle on highway

Test Result and Analysis

Test showed pH level was 6.5, which is neutral. External appearance of the test subject's skin also showed no visible problems. Furthermore, the test subject has no prior problems with skin troubles and maintains a healthy skin condition.

Image 19
pH strip test 2 result

Material Exploration 2 – Scenario 2

CHAPTER 4-5
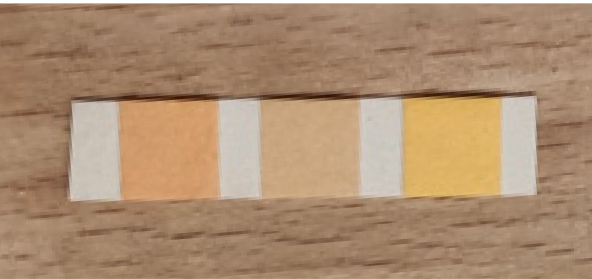
Findings & Opportunities

Material exploration 1 showed that it is difficult to examine the body's condition based on 1-time use pH strips. Without extreme level drops, it is also difficult to examine the color changes on the pH strips. Furthermore, there are various contributing factors derived from internal causes that cause skin problems. This could be food, menstrual cycle, water balance, etc. Therefore, for the purpose of this research I found that focusing on only external factors is appropriate.

In future studies, there are great opportunities if it is possible to measure all contributing factors that range from internal body influences to external environmental factors.

In the case of User 02, the ability and usability with technology is low or novice. To take a more analogue approach, rather than using a sensor and displaying the output in a technological manner, materials explorations were made. Photochromic film or sheet is a material that is sensitive to UV and changes color based on UV levels. To test the effects of the photochromic sheet, a simple weave was made and exposed to the sun (Image 20). The effects were immediate, changing color to a darker red as it was more and more exposed to UV rays. When sunscreen was applied to the sheet, the areas that had sunscreen showed that the color remained white as it was protected from UV rays. The material test showed that it was highly effective.

As a material for prototyping wearables, photochromic yarn was the secondary test for the material exploration. Similar to the sheet, the yarn was also very effective, having immediate changes based on UV rays (Image 21).

No UV Ray exposure
0 seconds

Medium exposure
5 seconds

High exposure
10 seconds

Low UV Ray exposure with suncreen
2 seconds

High exposure with suncreen
10 seconds

Image 20
Photochromic paper test

No UV Ray exposure
0 seconds

Medium exposure
3 seconds

High exposure
5 seconds

High exposure
10 seconds

Image 21
Photochromic yarn test

CHAPTER 4-6

Artistic Exploration 1 - Scenario 3

Previously mentioned in Chapter 3, it is important for User 3 to have effective prompts (other than color) that motivates behavior change. Triggering an emotional response is one method in approaching this issue. As an artistic exploration, I created a video that uses ceramics as a metaphor for skin. The materiality of skin and clay has been linked even in the Bible - "Then the Lord God formed the man of dust from the ground and breathed into his nostrils the breath of life, and the man became a living creature." With this metaphor, the goal of this artistic exploration was to take an emotional approach as well as create an effective connection between air and skin.

Both are strong yet delicate that come in various forms, textures, and color. Both are also affected by the air and atmosphere. Both feel heat, dryness, and humidity. When there is extreme pressure and stress, there is an imbalance and can cause damage.

Through this artistic exploration, the connection between air and skin was more evident to viewers. Further exploration of the materiality of ceramics and other materials is an opportunity to engage users to the purpose of the research and design.
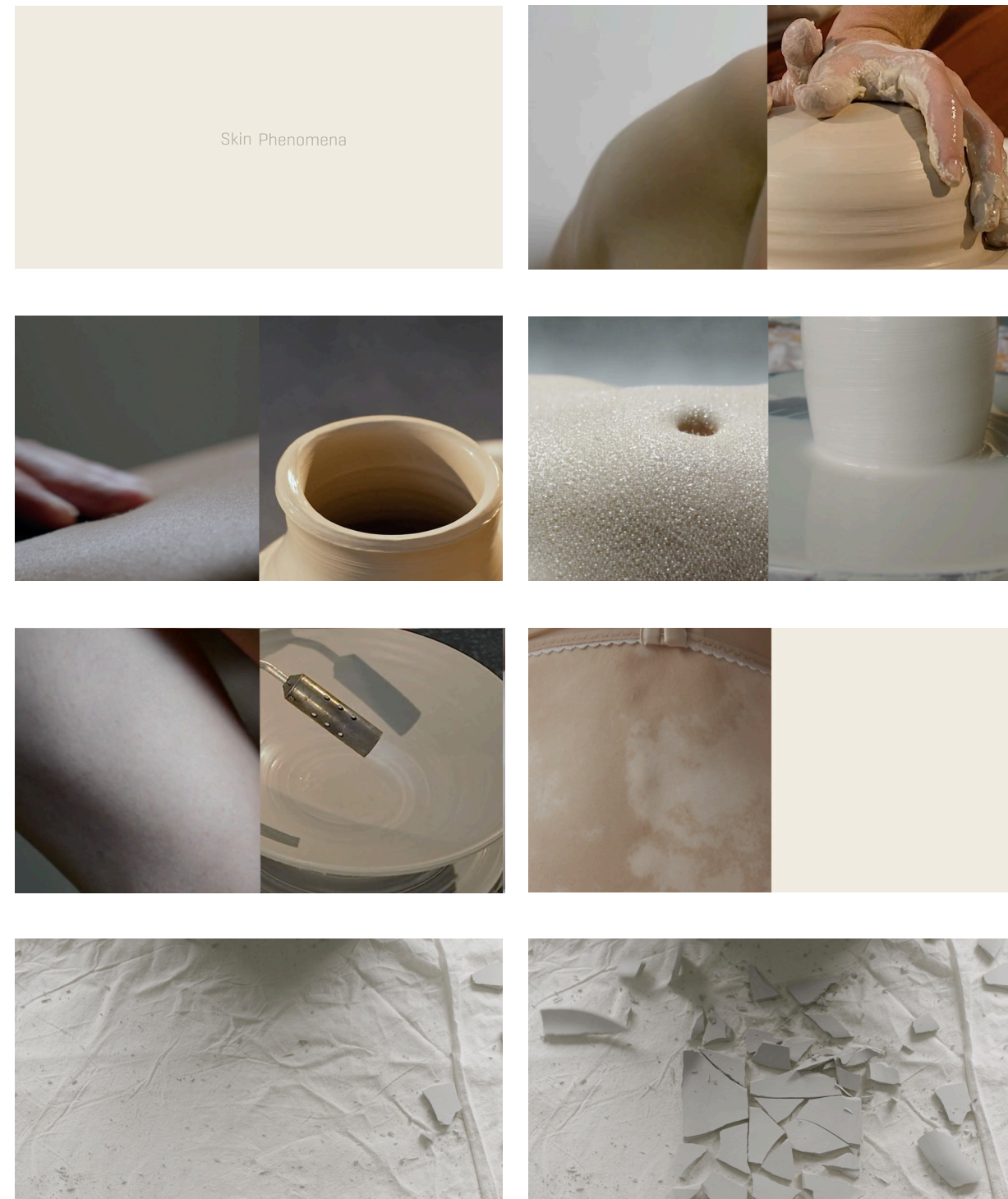
Skin Phenomena

Image 22
'Skin Phenomena' video
exploration

CHAPTER 4-7

Artistic Exploration 2 - Scenario 3

A public viewing was conducted in the form of an exhibition to evaluate people's perception and reception of the topic and prototype.

As my research topic deals with the invisible, the main issue was how to portray my findings to the public. Which artistic approach can I take to make the invisible and technology have an empathetic emotional connection to the public? The research project deals with health issues that are sensitive as well as extremely important to the ones that are affected. As a result, it is also important to portray this to the public.

During Artistic Exploration 2, I found that having a metaphorical material and object was an effective way to connect technology to the public. Lights, sensors, wires, and arduino are all objects that are high in functionality but low in empathy. As a mediator and representation of the topic study, I created a ceramic piece that represents the skin. The glaze on the ceramic form shows different textures of the skin, possibly affected by air pollutants. Within the form technology resides to measure the threats that could enter the skin.
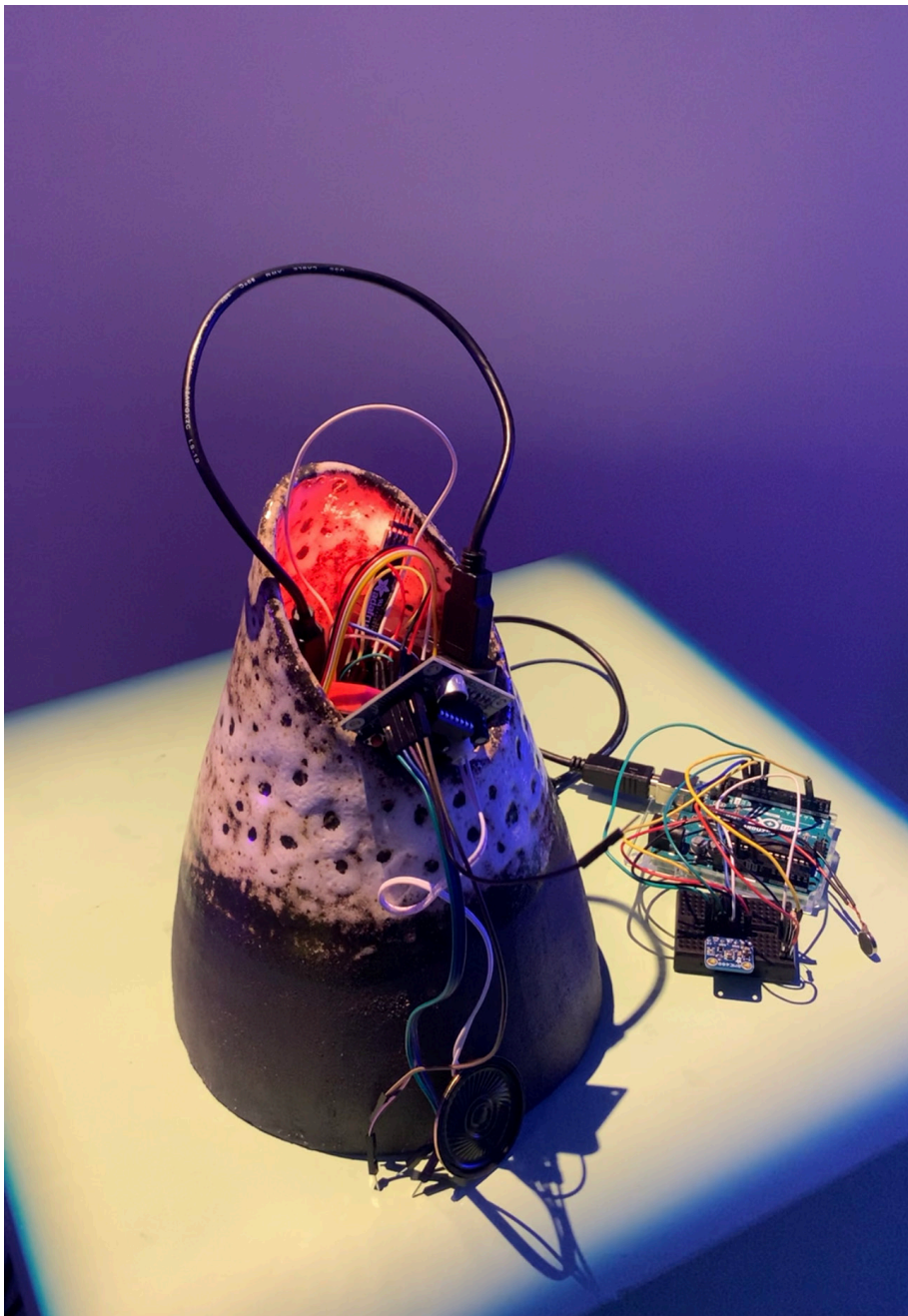
Image 23
Ceramic body
installation

Image 24
Ceramic body
installation

Chapter 5.
Design
Prototypes &
Explorations

Findings & Opportunities

Through the artistic and conceptual manifestation of ceramics, I found that most of the viewers connected with the artistic approach. The metaphor of skin as an interface was more visible and relatable to the viewers.

Other important artistic/design factors included the texture and finishings of the ceramic pieces. To make the topic of skin more apparent, it would be more apparent to reflect it into the ceramic textures.

Further factors of exploration were movement of the ceramic forms. The prototype form presented was in a static form but saw that having movement shifts based on sensory data could be an interesting and more perceivable approach.

CHAPTER 5-1

Design Concept & Framework

Through the UX methodology of user scenarios, major pain points and needs were identified. These users are essentially a representation of a group of people experiencing similar pain points in relation to air pollution and atopic dermatitis.

For the prototypes to have a personal and societal experience, the explored form is in sculptural pieces that can be placed based in public spaces for ambient data computing and individual and societal experiences..

Based on the suggested AMBIENT Cycle in Chapter 3, the four factors (Data, Feedback, Context, Design) are considered for each Scenario.

Figure 3
AMBIENT Cycle: Prototype
Design Framework

CHAPTER 5-2
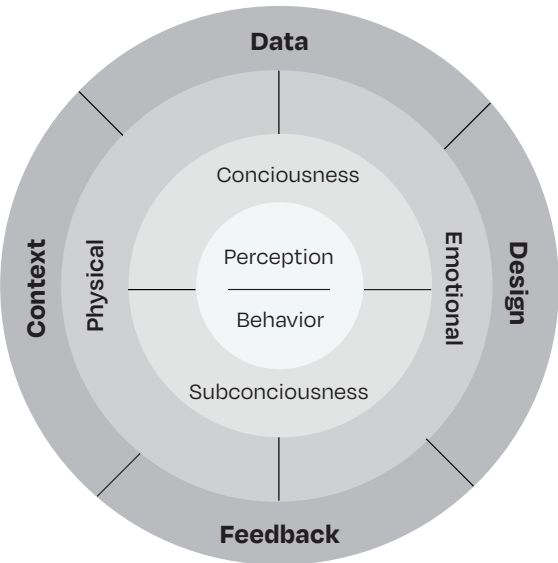
Gas & Dermatitis Prototype

Through the UX methodology of user scenarios, major pain points and needs were identified. These users are essentially a representation of a group of people experiencing similar pain points in relation to air pollution and atopic dermatitis.

For the prototypes to have a personal and societal experience, the explored form is in a large sculptural piece that can be placed based on data collection and user lifestyles.

Based on the suggested AMBIENT Cycle, the following four factors (Data, Feedback, Context, Design) are considered:

Data

In the case of 'Gas & Dermatitis', the data collected are tVOCs (Gas), as it was the major contributor for the user scenario.

Feedback

In the case of feedback, vibrating motors are utilized for an experience that is personal and based on one's skin. As an interactive sculpture, sounds generated by touching ceramics and the vibrating motor provide a more immersive experience on an ambient level.

Context

Inspired by the user scenario, the context and location of the interactive ceramic will be located in an office space. Although one perceives a building space to be safe, uncommon syndromes such as Sick House Syndrome can occur. Therefore, by providing such

context, people will be more aware of their "safe" surroundings and environment.

Design

During the 20th century, the U.S. Rust Belt was a region dominated by manufacturing. With booming industrialization and high amounts of coal burning, high levels of air pollution affected cities, health, as well as animals. To detect carbon particles during this time, scientists collected black carbon data that were trapped in the feathers and wings of songbirds (U.S. Air Pollution Was Once So Bad, Birds Turned Black, n.d.). As seen in Image 25, there is a clear color difference based on air pollution levels.

Taking inspiration from this study, colored feather modules will be the interactive elements for the vibrating feedback. Viewers will be able to touch dark colored "feathers" to experience motor feedback based on ambient data levels.

The 'Gas & Dermatitis' Prototype focuses on the visual representation of feathers as a signal for interaction with the prototype and viewer/user. This small scaled version tests the effects of the vibrating motor on the ceramics as well as the perception from viewers and users.

Findings

The vibrating motors with the materiality of ceramics create a unique sound that brings attention to the prototype. The color differences are also good indicators for viewers to see which areas to touch for interaction.

However, it was evident that it was still difficult for some viewers to connect the case study of skin with the prototype. Therefore, the materiality and finishings of the ceramics need to reflect the condition of the atopic dermatitis condition. Furthermore, for the experience to be more ambient, the scale of the prototype needs to be increased. In order to achieve this, a modular form is most practical while using ceramics. Furthermore, a clearer output of sound as an indicator is needed to provide clearer information on data levels.

Vibrating units in red

Sensor

Ceramic body

Image 25
Feather color change in songbirds due to air pollution
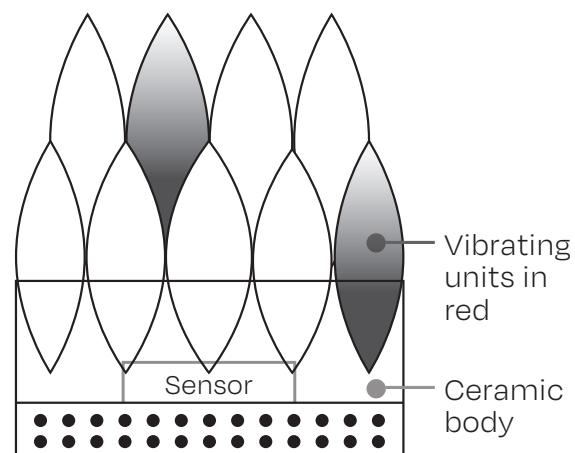
Image 26
'Gas & Dermatitis' ceramic prototype

CHAPTER 5-3

UV & Skin Cancer Prototype

In the case of the ' UV & Skin Cancer', the same UX methodology approach was taken to find pain points and analyze which data and design would be experienced.

The prototype forms are also designed in a sculptural piece that can be placed based on data collection and user lifestyles.

Based on the suggested AMBIENT Cycle, the following four factors (Data, Feedback, Context, Design) are considered:

Data

The cause for the user's skin cancer is UV rays, and therefore the data collected would be UV levels.

Feedback

The user was mostly exposed to sunlight when he was doing outdoor activities and not actively thinking about UV exposures. Therefore, color will be the main feedback as it is a clear and fast indication for users in an active and outdoor environment.

Context

Inspired by the scenario, the context and location of the interactive ceramic will be located in an outdoor nature setting. He was mostly cycling in a forest area and having the sculpture in such a setting will be visual indicators of their surroundings.

Design

Similar to humans, amphibians are threatened by the increase in air pollutants. In particular, frogs have cutaneous respiration, which means they breathe through skin (Frog Respiration). Therefore, as inspiration, the poison dart frog's skin pattern is the motif for the ceramic.

When there are low UV levels, the photochromic thread is white. When there are high levels of UV, the thread reacts and the saturation level turns more and more red.

In the scenario, there was a need to be able to have a helpful signal for the user to be more aware of his environment. His unawareness was the main pain point of his health status in relation to his skin cancer diagnosis.

Using this scenario as inspiration, the prototype is a sculptural form that integrates into the natural environment. When there are no UV rays, the ceramic remains its natural beige color. When it is exposed to high UV rays, the circular patterns on the surface change color and turn red.

Findings

The change in color intensity is intriguing to viewers. However, there is a need for the colors to be more prominent. Furthermore, the scale and size of the sculpture is not as prominent as expected to have a visual and experiential impact. Therefore a larger scale with stronger changes in color would alleviate these pain points.
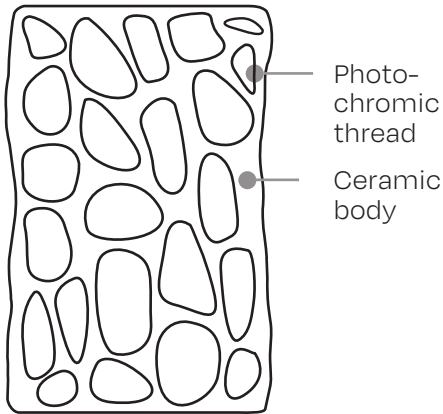

Photo-chromic thread

Ceramic body

Image 27
Poison dart frog skin pattern

Image 28
'UV & Skin Cancer' ceramic prototype

CHAPTER 5-4

PM & Acne Prototype

Based on the suggested AMBIENT Cycle, the following four factors (Data, Feedback, Context, Design) are considered for the Scenario of PM & Acne.

Data

In the case of adult acne, bad PM levels are a contributing factor to one's skin health. Therefore, the data collected is Particulate Matter (PM).

Feedback

The feedback of the data is reflected in the form of the ceramics. A kinetic interface will allow the sculpture to be more interactive and reflective of the environment.

Context

As an interactive sculpture for a personal and societal experience, the ceramic will be placed in a cityscape.

Design

As a signal of danger, the kinetic change is inspired by sea urchins. When there is a high level of PM, the spikes on the ceramic are a signal of danger. When the PM levels are low, the spikes are inside to signal that there is no danger in the environment.

Findings

The modular form of the structure is interesting, given that it has the opportunity to become a larger sculptural piece. It is a good indication and starting point for how the overall structure could be for the design artefacts. In terms of materiality, various finishings and glaze tests are needed to embody the topic of skin into the design.

Image 29
Pacific purple sea urchin
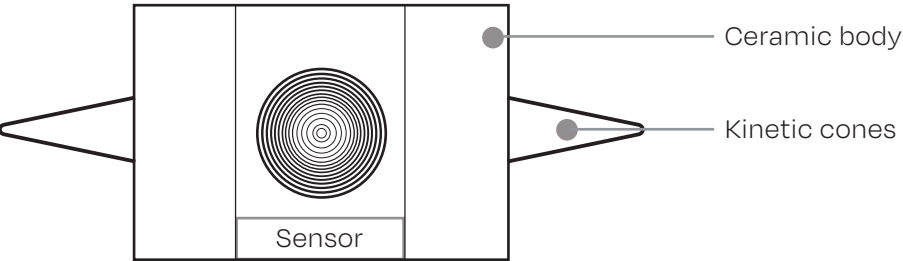
Ceramic body

Kinetic cones

Sensor

Figure 3
AMBIENT Cycle: Prototype Design Framework

CHAPTER 5-5

Design VR Exploration

As seen in the proposed AMBIENT Cycle, the prototypes are influenced by Context, Data, Feedback, and Design. To experience the 4 major factors, a VR model was created for a real-life environmental experience. The designs of the potential artefacts were also explored virtually to experience the designs on a larger scale.

For each prototype, the proposed context was created. 'Gas & Dermatitis' Prototype is in a building interior setting, where subtle gas toxins from buildings may not be so evident, as seen in the case of Scenario 1 and her experience with Sick House Syndrome. 'UV & Skin Cancer' Prototype is in a forest area, where one might suspect nor be aware of exposed sunlight during physical activities. 'PM & Acne' Prototype is in an outdoor cityscape, where general air pollution quality of particulate matter can be detected.

After building a preliminary model of the environment, a VR test was conducted to examine the virtual model and interaction with the ambient and ceramic figures. As a result, it was clear to see there was a need for larger scale sculptures that influenced viewers' perception and interest.

The VR exploration was a useful medium to visualize the final artefacts. Although the digital versions of the sculptures were interesting to experience, it was clear that a natural approach, rather than a digital approach of visualizations, were more appropriate to the nature of the project concept.
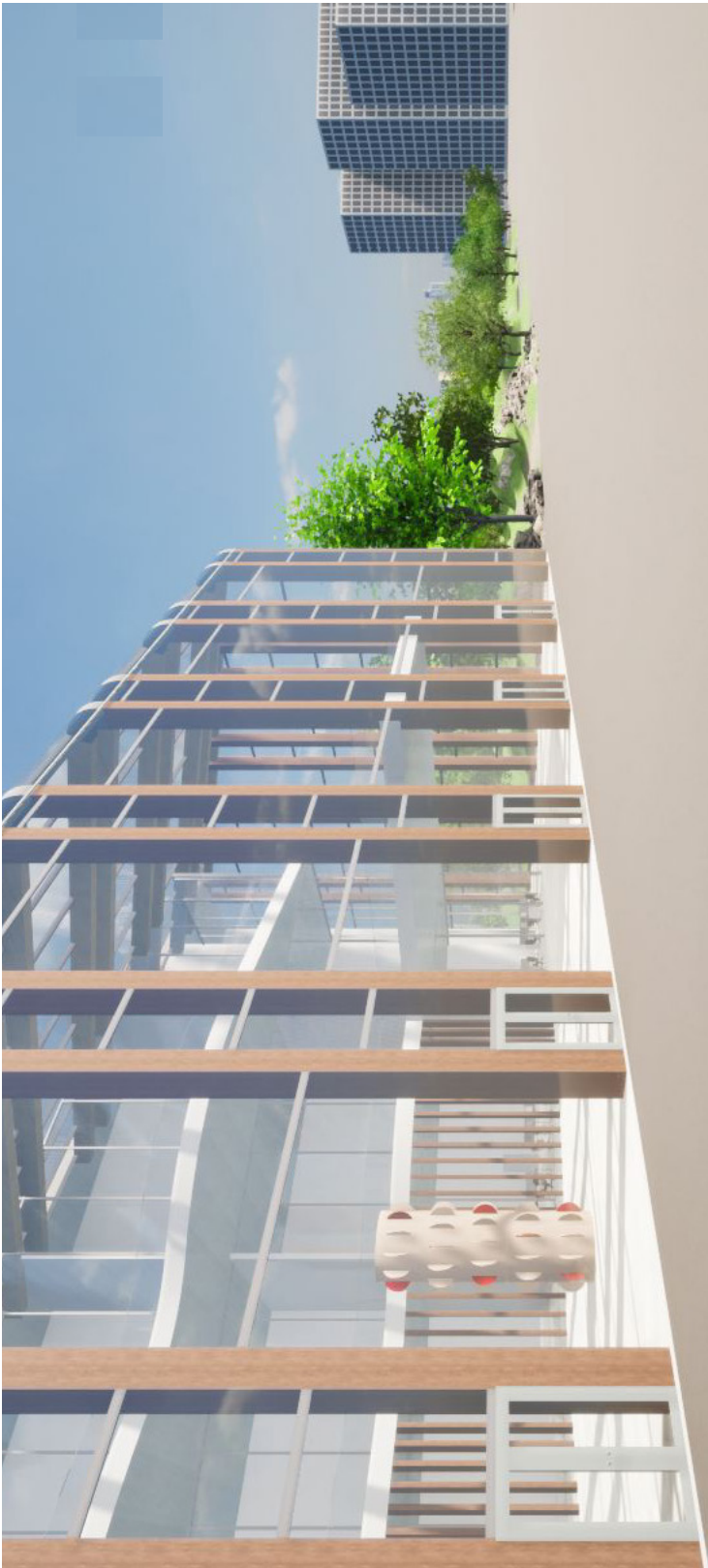
Image 31
VR scene

Image 32
VR test

Chapter 6.
Pagoda.tmos
Artefacts &
Ethnographic
Research
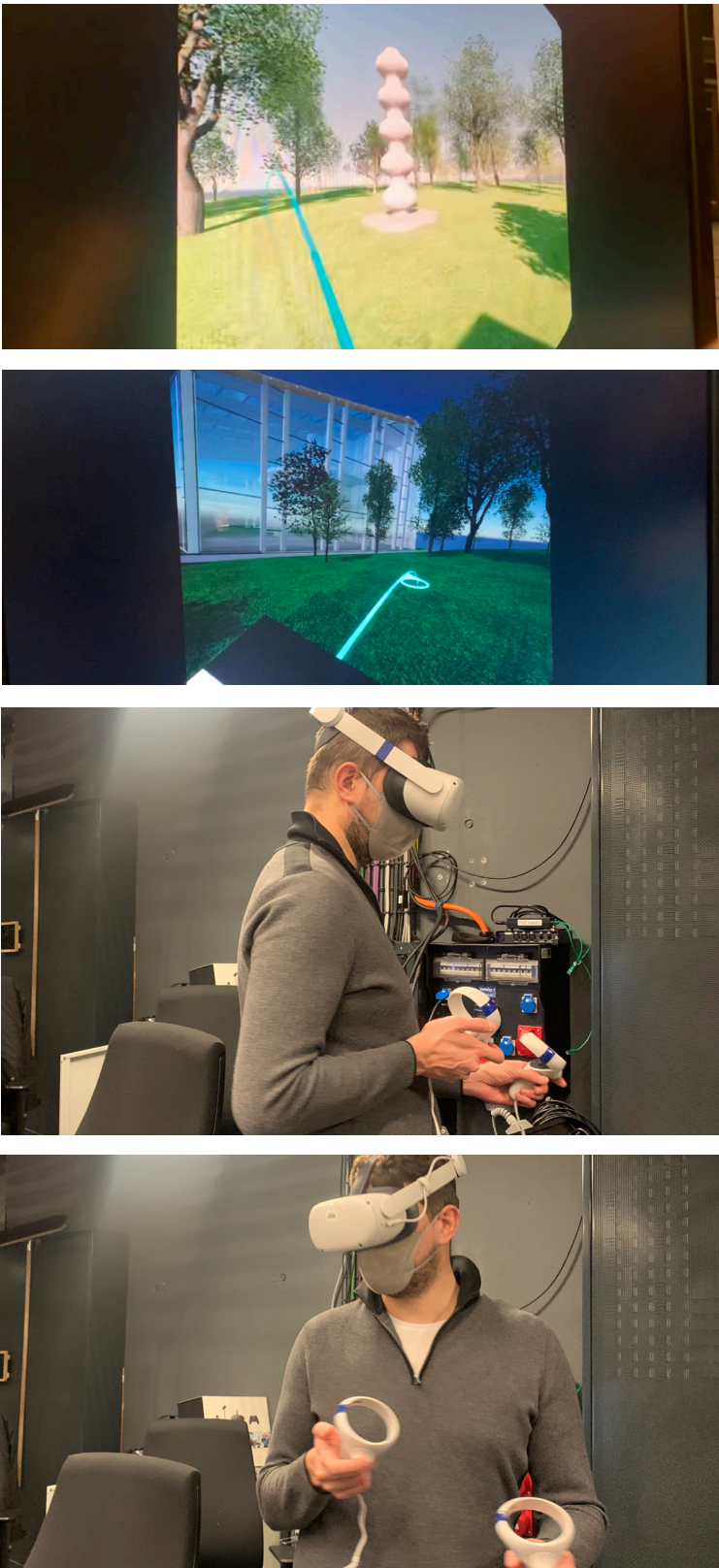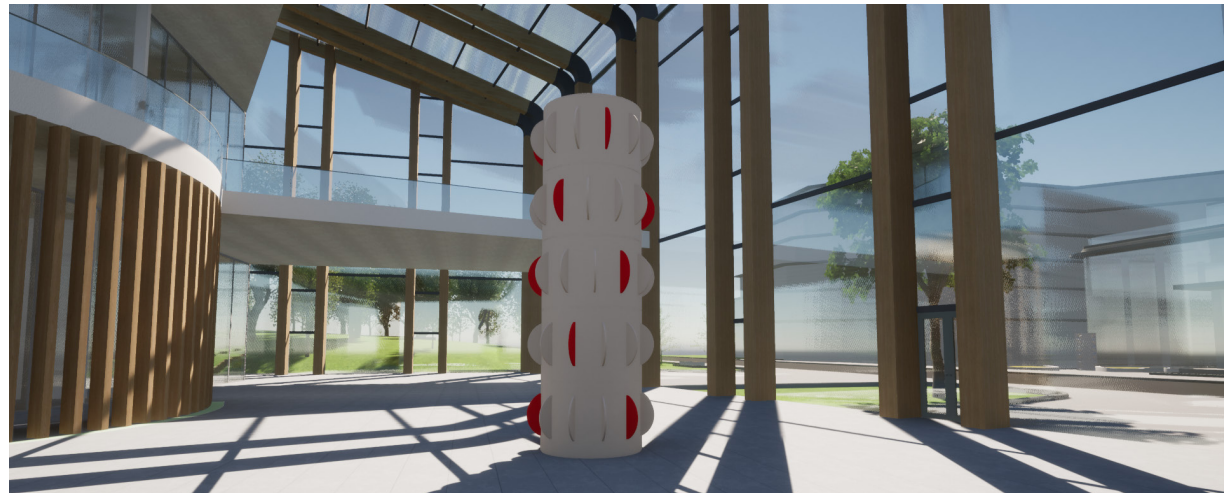
Image 33
Artefact exploration in VR

CHAPTER 6-1

Pagoda.tmos Final Concept & Design Process

In various cultures and groups around the world, there are objects that represent or connect one to a spiritual level.
An example of this is a Totem pole, which is made by native people and represents cultural and family heritage.

In Buddhism, pagodas are towers found in Buddhist temples. They are a representation of Buddah himself, and a place for enlightenment. (Cheon, 2011.) Inspired by the form and meaning of these towers, the artefacts created also embody the spiritual and enlightening nature of pagodas. When considering nature and the atmosphere an invisible spiritual being, the *Pagoda.tmos* are a place of enlightenment for individuals and society to connect to the higher power of nature. The *Pagoda.tmos* are in nature, also a place that is meant to be a place of various experiences such as a place of contemplation, reflection, awareness, knowledge, connection, gathering, etc. among many as seen in Figure 20.

In terms of materiality and visual aesthetics of the design, ceramics is the main material that will be used. It is the connection and embodiment of the topic of skin and nature. The natural textures of the clay will be presented with accents of vermillion (orange red) as a symbol of danger.
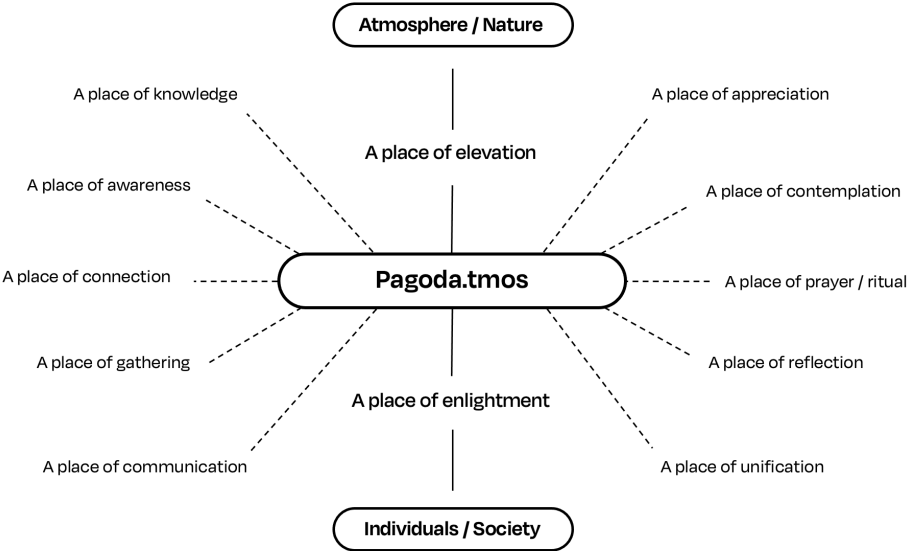
Figure 12
Pagoda.tmos Concept

Image 34
Buddhist Pagoda in South Korea

Pagoda GS
Final Artefact

CHAPTER 6-2

The form and design of the *Pagoda GS* is inspired by windchimes. Windchimes are by function a reaction to the velocity of wind. In a spiritual sense, they are also used to keep away evil spirits. For *Pagoda GS*, the sound will be generated by tVOC data instead of wind. Based on the data parameters, there will be appropriate sound outputs determined by intensity. *Pagoda GS* is placed in an indoor area without the influence of natural wind. Instead, sound is mechanically produced and invites visitors to contextualize their environment.

The design process consists of 5 major processes. The first is the physical design development of the form and design of the physical ceramics. The second is the mechanical and software design of the ambient data input and ceramic output. The third is the fabrication of the ceramics into a developed design. The fourth is the final mechanic and software development based on data parameters and their appropriate outputs. The fifth is creating the interactive interface for the installation for viewers to experience *Pagoda GS*.

Image 35
*Jooin Shin, Pagoda GS,
2022*

Image 36
Pagoda GS, 2022

Design Development

Based on the basic prototyping in Chapter 5, the final design was developed to focus more on sound generation. The design development process is as follows.

Physical Design - Ceramics & Form

Initial renderings of the design structure were made in the form of tiered towers, as inspired by pagodas. In order to focus on the concept of sound generation, the form and concept was developed to a windchime. Each design takes into consideration how each data values based on parameters would be represented and experienced.

Mechanical & Software Design - Data & Output

To further investigate the mechanics of sound generation through motors, basic low fidelity prototypes were made to validate the concept in a practical manner. Two different motors were tested to validate the torque in order for the mechanics to produce enough force and have enough durability. After testing, the servo motor had the appropriate torque and power to produce movement in order to generate sound.
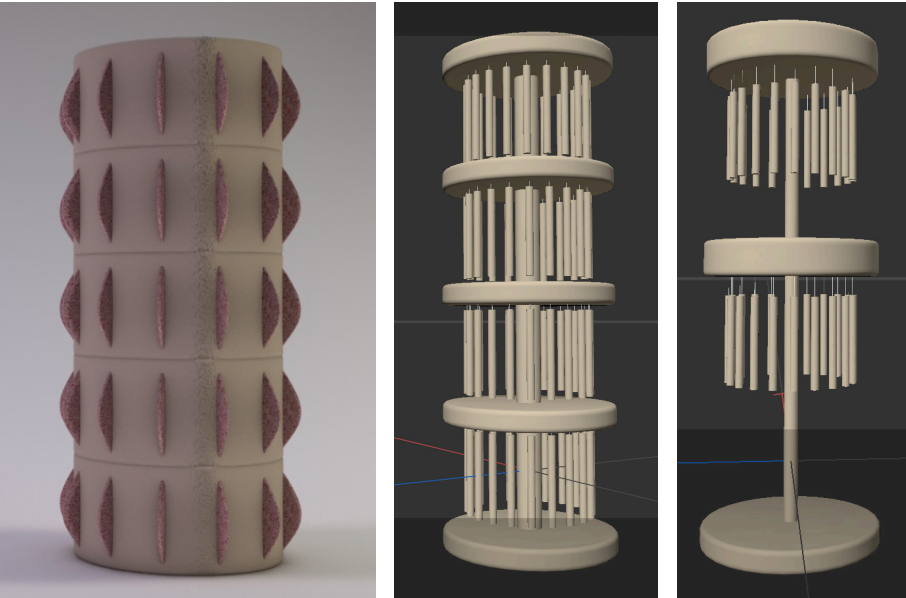
Image 37
Initial renderings for
Pagoda GS
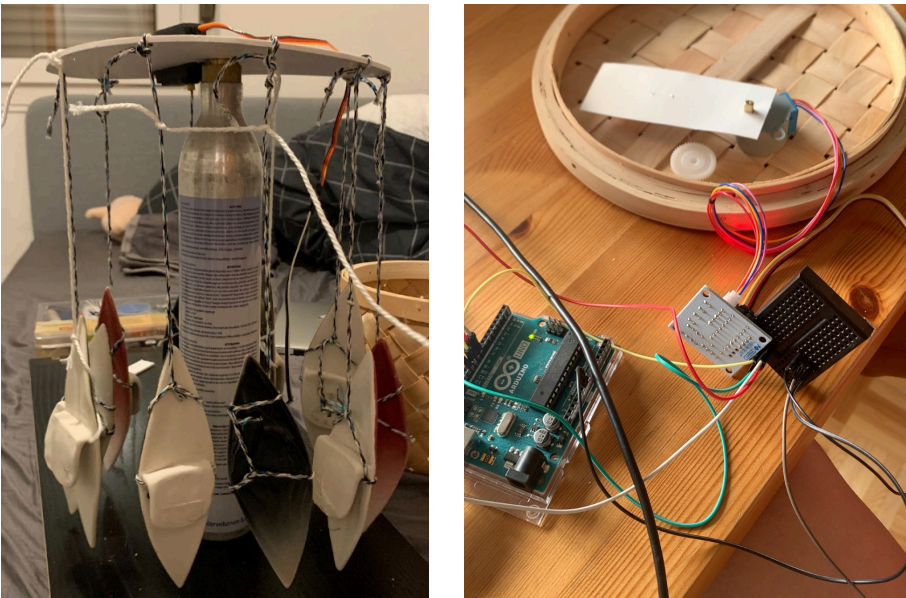
Image 38
Low fidelity prototyping
for Pagoda GS mechanics

Physical Design Fabrication

The two to ceramic tops are made with clay slabs with thick glaze that shows a sense of movement and change in a material that is not malleable once fired. It is a representation and symbol of the ever-changing state of the climate as well as the potential change of the self and society.

Image 39
Pagoda GS design process of ceramic tops

To connect the ceramic tops as well as extend the circuit to the bottom, a wooden pole is used. There is a groove on the pole where the wires go down all the way down to the bottom wooden slab in a seamless manner. As a base of the two top tiers, a thick wooden slab is carved. On the bottom of the slab, the battery is stored and powers the arduino and motors hidden within the two ceramic tops.

Image 40
Pagoda GS stand

Mechanic & Software Development

The auditory feedback is created by generating movement through a mechanical structure. Servo motors move the mechanical gears, which makes the aluminum chimes collide and generate sound. The intensity of gear rotation determines the intensity of sound. This is a direct indication and representation of gas levels. The higher the gas levels, the higher the rotation of the gears. The following Table 3 is a description of the output based on the gas level inputs. The top and bottom of the windchime are connected through electric wiring and controlled with the Arduino.
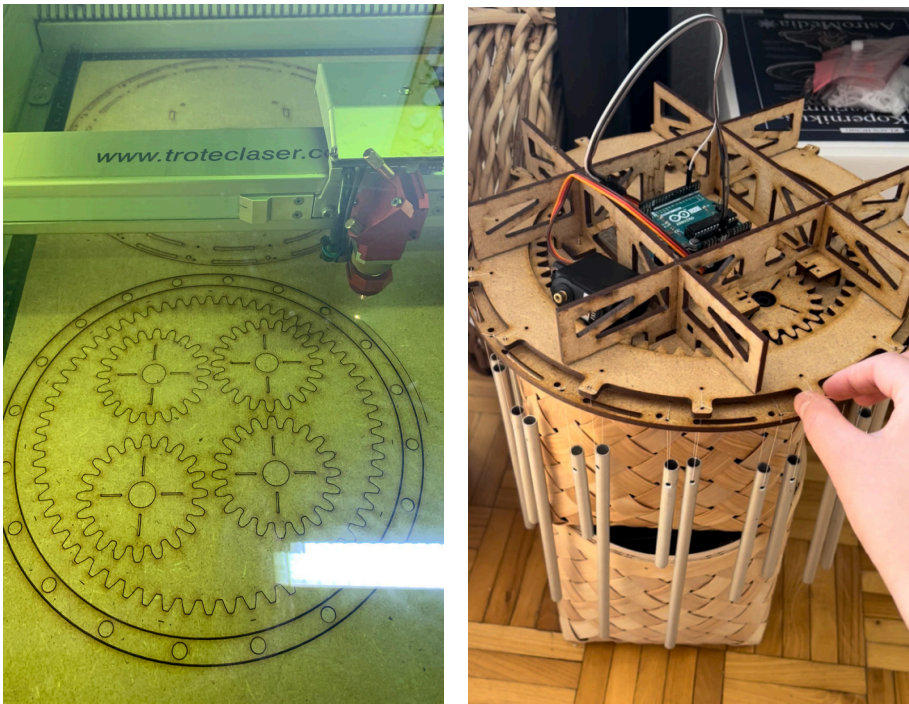
Image 41
Pagoda GS mechanics
design process

Image 42
Pagoda GS assembled
mechanics

The following table shows the output parameters in motion based on gas levels detected through the BME 680 sensor.

Sensor: BME 680	Sensor data (Gas levels)	Motion Description
Good	170 KOhms	Top module rotates slightly Bottom module no movement
Moderate	21 - 169 KOhms	Top module rotates slightly Bottom module rotates slightly
High	11 - 20 KOhms	Top module rotates at high level Bottom module rotates slightly
Very high	0 - 10 KOhms	Top module rotates at high level Bottom module rotates at high level

Table 3
Pagoda GS data input & output parameters
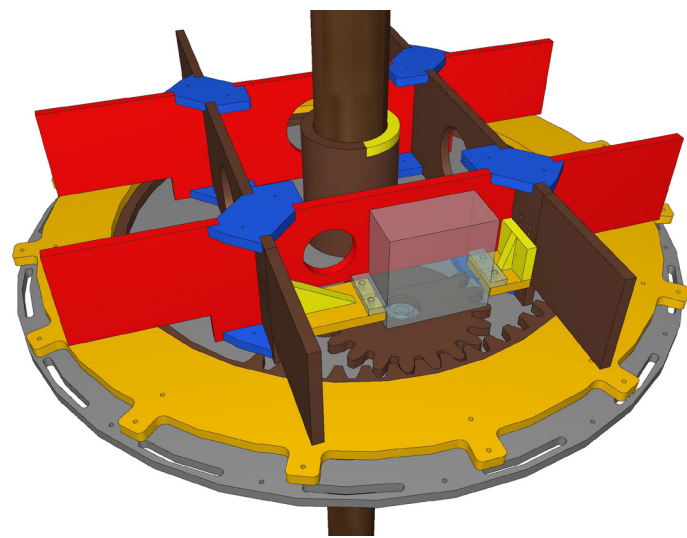
Image 43
Pagoda GS final mechanics

To connect the software and hardware devices, the Arduino Uno is used as the platform. The following figure is the circuit schematic that is used to connect the two servo motors, BME 680 sensor, and power source.

Figure 13
Pagoda GS circuit schematic

CHAPTER 6-3
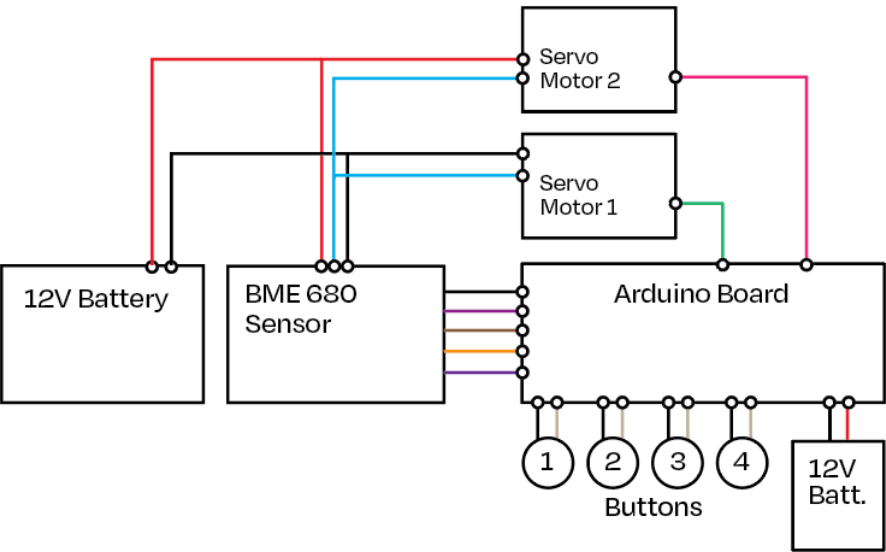
Pagoda UV
Final Artefact

Installation Design

In addition to the interaction with the ambient data and the Pagoda GS, an interactive interface is made for viewers. The viewers are able to interact with the Pagoda by blowing their breath into the sensor. Based on the CO2 levels detected by the viewers, Pagoda GS will react accordingly. Furthermore, to easily experience all parameters of data levels, buttons are created. By pressing on each button, a simulation of TVOC parameters are generated and the results are seen on the Pagoda GS.

The form of the *Pagoda UV* is developed from the initial prototype of UV & Skin Cancer. The structure of the sculptures are tiered, which is influenced by the concept of Pagodas. The pattern and form of the design is also inspired by nature, resembling mushrooms or poison dart frogs, as explored in the previous prototype.

The design process consists of 5 major processes. The first is the physical design development of the form and design of the physical ceramics. The second is developming the bio-reactive photochromic material that reacts to the UV exposure. The third is the fabrication of the ceramics into a developed design. The fourth is constructing the ceramic bodies with the photochromic material to be reactive to UV expsoure. The fifth is creating the interactive interface with an indoor UV lamp for the installation for viewers to experience *Pagoda UV*.

Image 44
Pagoda GS Installation
Interface

Image 45
Jooin Shin, Pagoda UV,
2022

Image 46
Jooin Shin, Pagoda UV,
2022

Design Development

Based on the basic prototyping in Chapter 5, the final design was developed to have a more tiered shape with more prominent indicators of color change. The design development process is as follows.

Physical Design - Ceramics & Form

The prototype created previously had a design form that was more vase-like. To make the physical design more pagoda-like, an oval shaped design was created. Furthermore, more surface area for photochromic bio-reactive areas are designed for clear outputs.

Bio-Reactive Design - Data & Output

UV levels as feedback is shown through the color change of photochromic pigment. The applied pigment has a stronger color than the paper or yarn materials explored previously in Chapter 4. The orange red color of the pigment is activated based on the ambient level of UV. To test the powder, various mix of glue and resin a

Image 47
Initial renderings for
Pagoda UV

Image 48
Photochromic powder

Physical Design Fabrication

The ceramic body forms are hand-built to have a unique and organic nature to the design. Circular shapes are carved into the bodies before bisque firing. After bisque firing and final glazing, the photochromic pigments mixed with resin are applied in the holes. A total of 6 bodies are stacked to make one unified structure that is 1 meter tall.

Bio-Reactive Design Development

Image 50 shows the changes from indoors, where there is none or very low UV exposure, to outdoors, where there is high UV levels on a sunny day.

Image 49
Pagoda UV ceramic body design process

Image 50
Photochromic color change

CHAPTER 6-4

Pagoda PM
Final Artefact

Installation Design

The installation is shown indoors and therefore UV must be replicated through lightbulbs. With the UVB (280-315 nm) light bulb, the color change can be simulated indoors. To encourage the visitors to simulate the UVB light on to the interactive sculpture, a mini interface is created, similar to *Pagoda GS*. On this interface, the lightbulb is placed with instructions on how the visitors can experience the *Pagoda UV*.

The form of the *Pagoda PM* mostly resembles the form of a traditional pagoda seen in Buddhist temples. Similar to the *Pagoda UV*, it has 6 tiers that are stacked together. Each tier has 4 open holes, where cones move in and out of the body structure. The form is developed from the artistic exploration explained in Chapter 5.

The design process consists of 5 major processes. The first is the physical design development of the form and design of the physical ceramics. The second is the mechanical and software design of the ambient data input and ceramic output. The third is the fabrication of the ceramics into a developed design. The fourth is the final mechanic and software development based on data parameters and their appropriate outputs. The fifth is creating the interactive interface for the installation for viewers to experience *Pagoda PM*.

Image 51
Pagoda UV Installation Interface
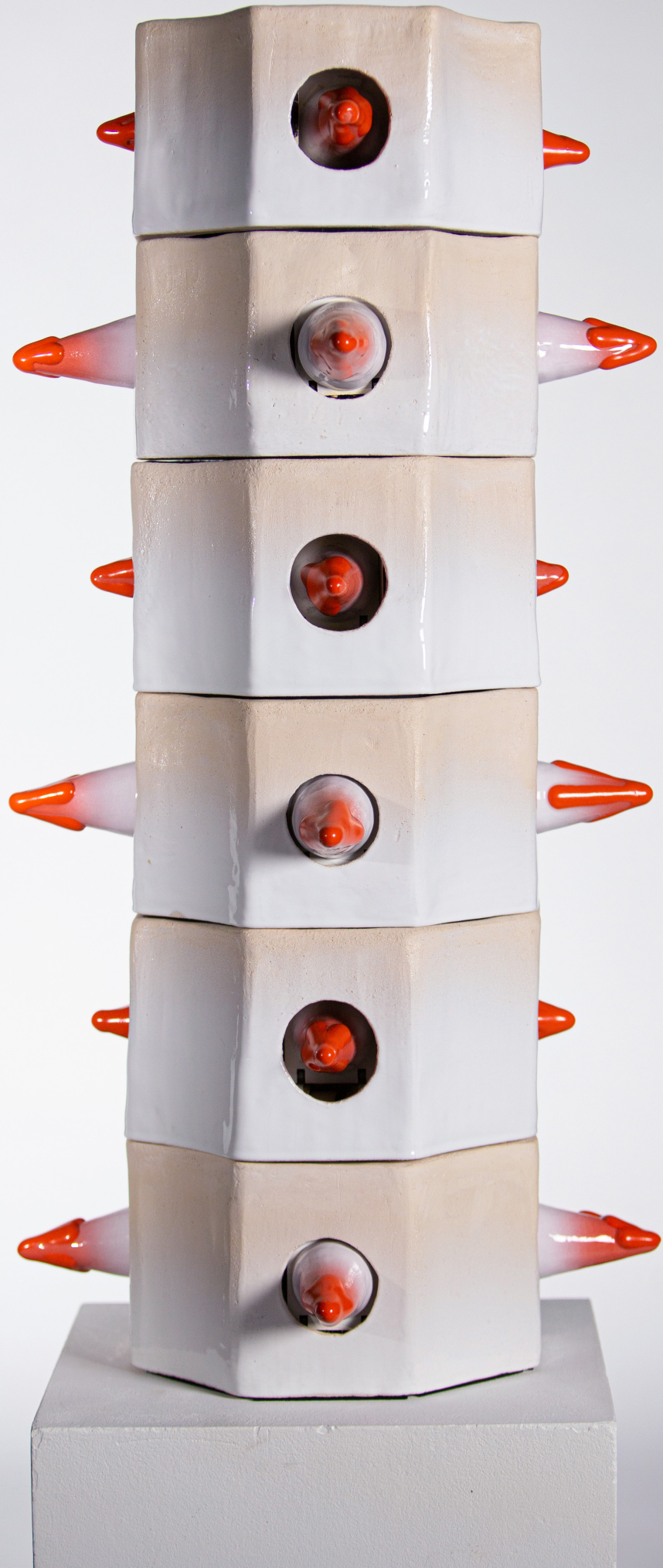
Image 52
Jooin Shin, Pagoda PM,
2022

Image 53
Jooin Shin, Pagoda PM,
2022
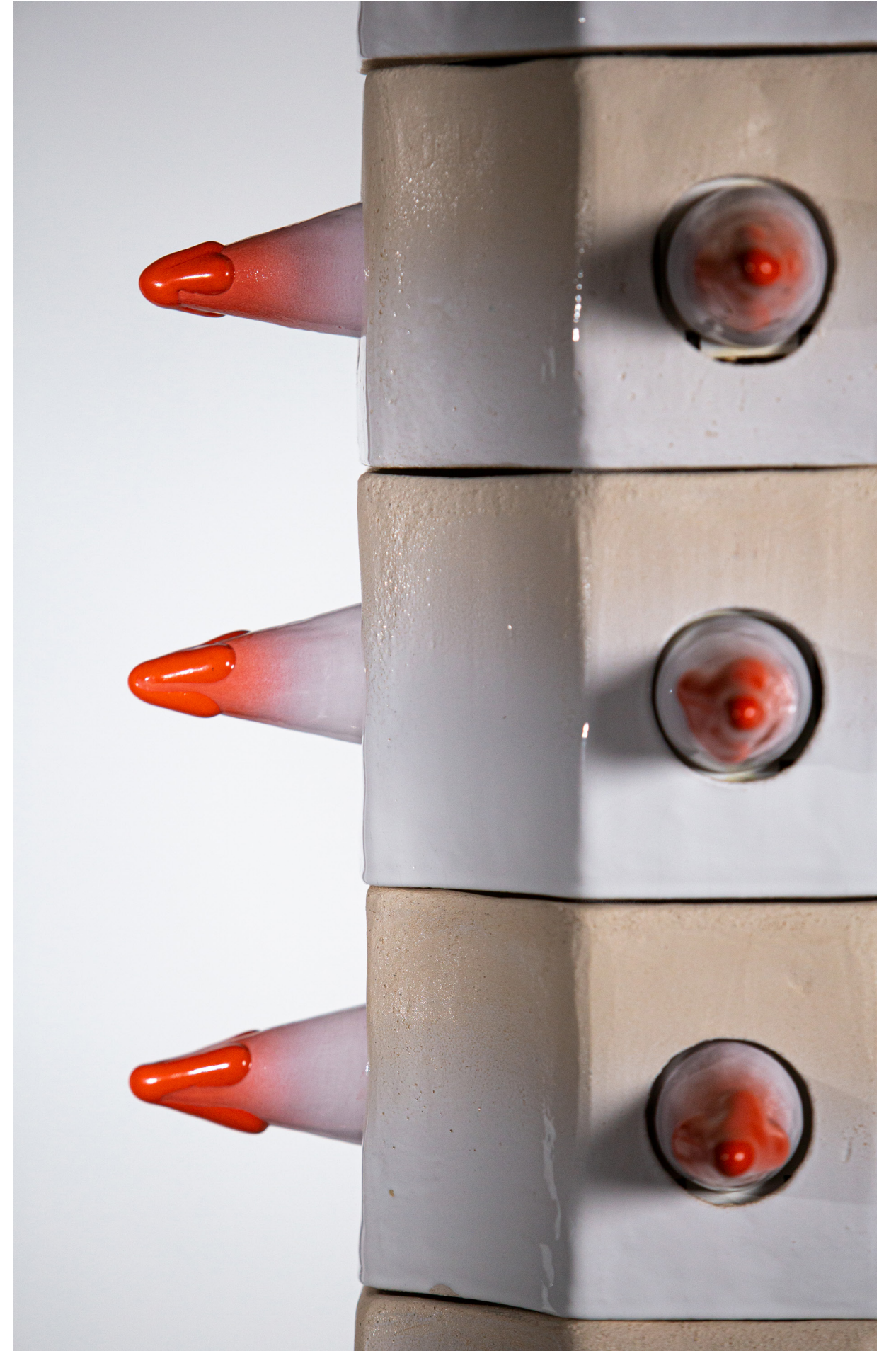
Design Development

To define the form and material finishes, 3D variations were explored. To test final finishes on the ceramics, various glaze tests were made as seen in Image 57. The final color of vermillion is used to signal danger.

Physical Design - Ceramics & Form

Initial renderings of the design structure were made in the form of tiered towers, as inspired by pagodas. In order to focus on the concept of sound generation, the form and concept was developed to a windchime. Each design takes into consideration how each data values based on parameters would be represented and experienced.

Mechanical & Software Design - Data & Output

One of the biggest challenges of *Pagoda PM* was to create a mechanical structure that would pull and push the cones in and out while still being small enough to fit into the ceramic bodies. Various low fidelity prototypes were created to test the possibilities of moving the cones from 4 sides while enduring the weight of the cones. Furthermore, similar to the *Pagoda GS*, the *Pagoda PM* needed motor torque testing. After several tests, the stepper motor showed enough power to push and pull the 4 ceramic cones.
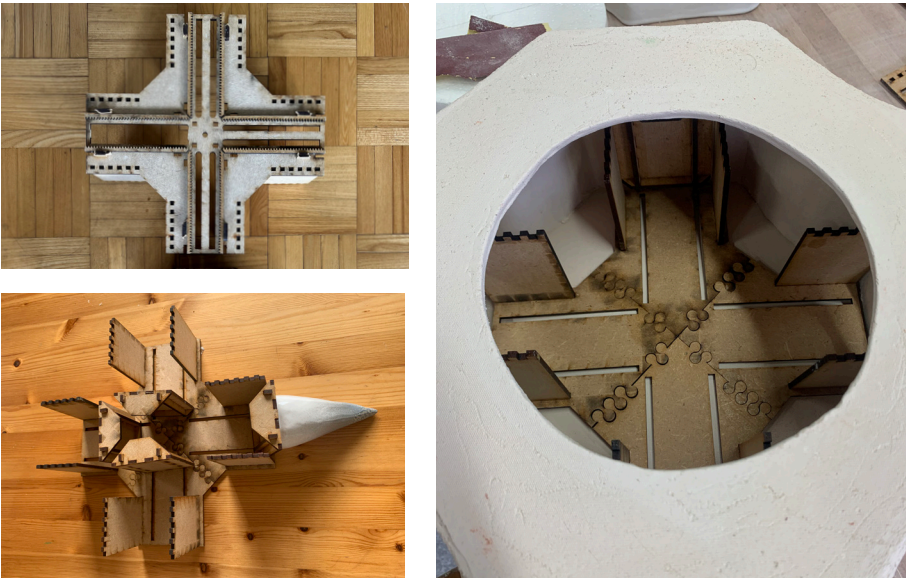
Physical Design Fabrication

The ceramic bodies are created with ceramic slabs with a basic mold-like structure as a guide. The sides are carved out for the cones to move in and out. The top and bottom are also carved out for wiring to connect the mechanical structures.

Due to the size limitations of the ceramic bodies, the size of the cones needed to be precise. Therefore, a mold was made to create 4 cones per tier, 24 cones in total. A total of 6 tiers were created for *Pagoda PM*.

Image 56
*Pagoda PM ceramic
body design process*

Image 57
*Pagoda UV ceramic
cones design process*

Mechanic & Software Development

The feedback of the PM levels are illustrated through the kinetic movements of the cones inside the ceramic bodies. The mechanical structure is made by laser cutting components and assembling them together within the ceramic bodies. The mechanics are hidden within the ceramic bodies and all 6 bodies are connected through electric wiring and controlled with the Arduino.

In terms of feedback parameters, the design has specifically defined motion outputs based on PM levels. Low PM levels output a slower and passive movement, while high PM levels show a high speed movement that represents danger. The specific parameters with the Grover laser 2.5 sensor (HM 3301) are described in Table 4.

The mechanical and software development was done the same way as the *Pagoda GS*. An arduino board was used as the software and hardware device. Due to the high number of motors and circuits, an Arduino Mega was used as the running device. Figure 14 shows the circuit schematic that is used to connect the six stepper motors, Grover laser 2.5 sensor (HM 3301), and power source. In addition, a start and stop switch was installed per tier to control the movements of the cones within the ceramic bodies.

Sensor: Grove laser 2.5 (HM 3301)	Sensor data (PM levels)	Motion Description
Good	170 KOhms	Random movements by cones from all 6 modules limited to about 5cm of cone length.
Moderate	21 - 169 KOhms	4 cones on each module come out from bottom module to top and go back in from top to bottom. Action is repeated.
Unhealthy	11 - 20 KOhms	Every other cone move out 100% then goes in while every other cones that were inside move out 100%. This action is repeated.
Very unhealthy	0 - 10 KOhms	All cones from all modules come out 100% at once and then go in at once. This action is repeated.

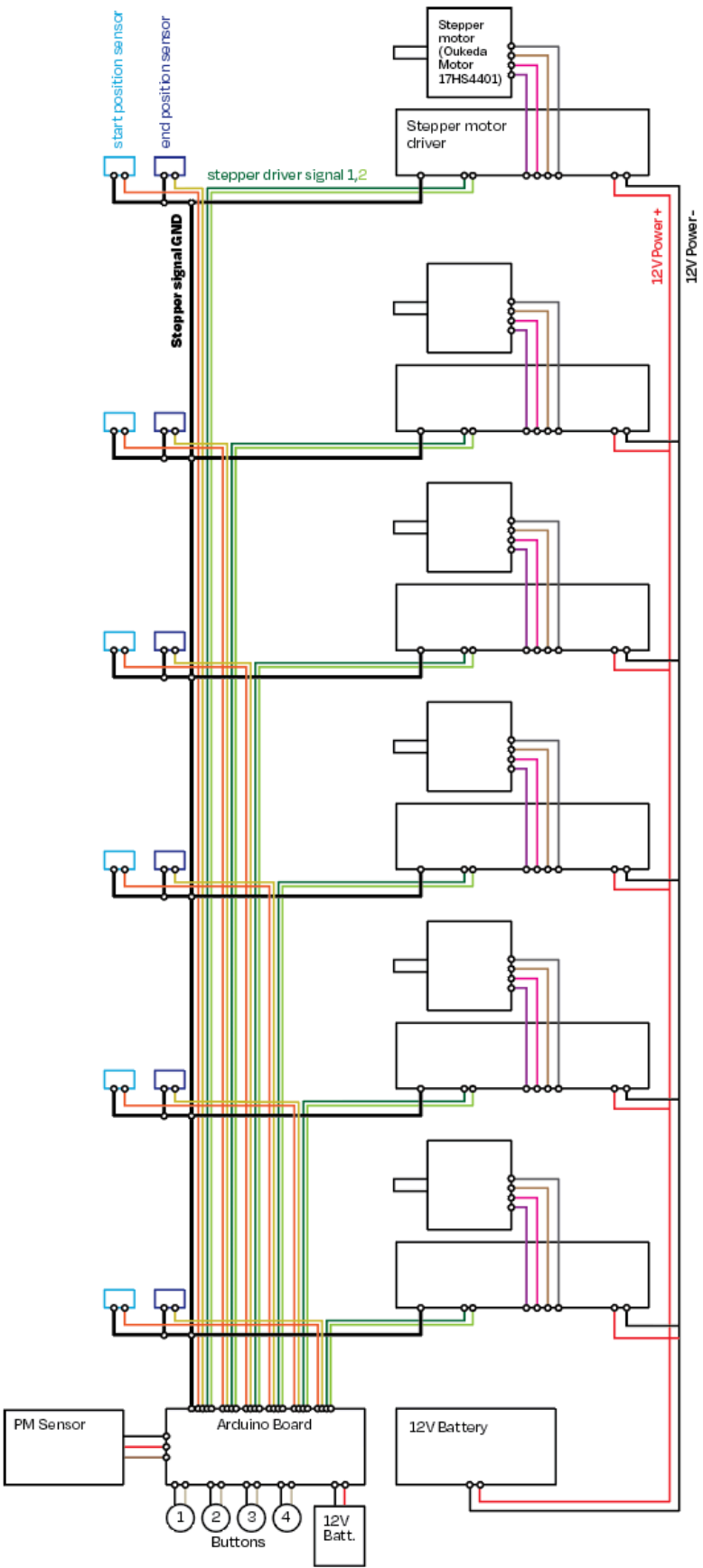**Table 4**
Pagoda PM data input & output parameters
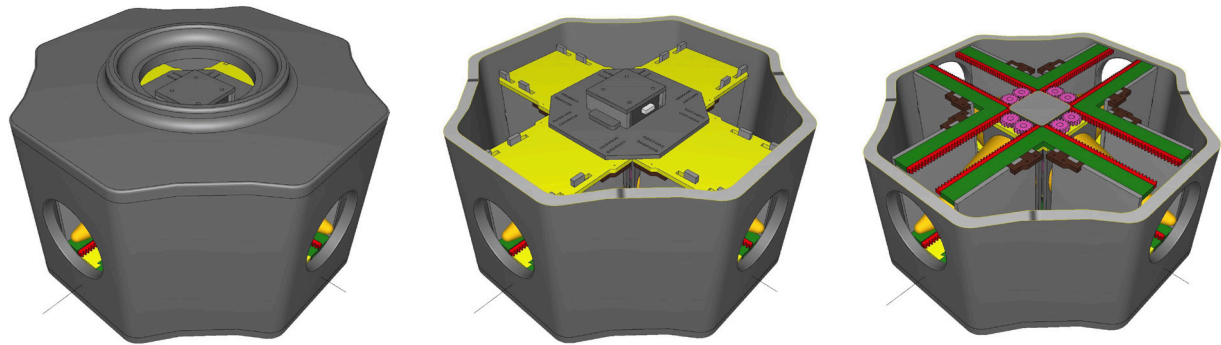
Image 58
Pagoda PM mechanics

Image 59
Pagoda PM mechanics design process

Figure 14
Pagoda PM circuit schematic

CHAPTER 6-5

Pagoda.tmos
Video Ethnography

Installation Design

The installation design for *Pagoda PM* is in alignment with the purpose and functions of the installation for Pagoda GS. The sensor box is installed with the Grove laser 2.5 (HM 3301) laser. The visitors are instructed to rub their hands with dust on top of the box with holes, where the laser lies underneath. When the sensor detects the dust, there will be a kinetic output from the ceramics. To experience all four parameters, buttons are also installed for the visitors to push as an additional option.

As a validation and feedback on the *Pagoda.tmos* series, *Pagoda UV* was placed in the public space of the rooftop of ZHdK to conduct video ethnography. After observing the experiences from the viewers, interviews were conducted on viewers to get a better understanding of their experiences and take-aways. To discover specific feedback and information on the viewer's experiences, the following questions were asked.

Image 60
Pagoda PM Installation Interface

Image 61
Pagoda.tmos video ethnography

Aim	Question
Understanding the viewer's perception of the unseen air quality.	How would you describe today's weather or ambient environment?
Understanding the viewer's current mindset on the climate crisis.	What do you think about climate change and air pollution?
Understanding the viewer's current mindset on climate change and their health.	Do you feel threatened by air pollution and its effects on your body?
Understanding the viewer's current behavior and motivation.	What do you do about GS/UV/PM?
Understanding the viewer's experience with *Pagoda.tmos*.	Can you describe your experience with the *Pagoda.tmos*?
Understanding the potentially changed point of view with *Pagoda.tmos*.	How does this experience allow you to see data and climate change in a different way?
Understanding the potentially changed point of view with *Pagoda.tmos*.	Does this affect or influence your relationship to the environment/air?
Understanding the potentially changed point of view with *Pagoda.tmos*.	How would you like to take action going forward?

Table 5
Ethnography research interview questions

The research was conducted through observation and interviews to identify people's reaction and take-aways from the designs. To have a more organic interaction and exchange, the interviews were voice recorded. The findings of the video ethnography and interviews are as follows.

An intriguing experience

"It's such a cool sculpture to see, you're super curious about how does the elementary react." (Hanh-dung Nguyen)

My first impression was the texture. I was so intrigued, I was wondering how is it done and what does it represent? What is that? (Silvia Monti)

The unexpected elements of materiality and data created a sense of curiosity and interest in the design and the function of the pagodas. The experience is a good entry point to catch one's interest to further examine the concept, data, and information that the pagodas wish to communicate to individuals.

An connecting experience

"It's a different way because it's combined with art, so it's not just, data or a text message or video. And I like arts too, so I think it's a kinda closer way to approach to it." (Jessia Curschellas)

An emotional connection is achieved through interaction design. A shift in perspective is achieved by approaching data and information in a new modality or experience. Through creative experiences, new audiences who are not initially interested in interaction design, technology, air pollution, and climate change can connect to these wider topics.

" I look at it in terms of how it impacts living being. Because the statue looks kind of like a mushroom but also looks like a coral. They look like living beings that are all impacted. It feels like it's showing in a more material way, like concrete changes. While the dashboard, for me, it's something digital, something. They could be those numbers. You could show me another scale and I would not actually know. I'm not seeing it, I'm not feeling it. And plus, it's like a little robotic stuff. It feels like I have no connection action towards that. While the object feels like skin texture itself, like something that's a bit more alive." (Silvia Monti)

The materiality, form, and interaction of the sculptures also represents the natural and organic forms of life that makes the crisis of air pollution more tangible and real. The natural interfaces connect the reality of air pollution and it's effects on living entities in an emotional manner.

A revealing experience

"I would say the sculpture showed me that UV is really strong, even though it was cloudy where we stood. And the thing is, I know that UV is really dangerous, but seeing it on the sculpture was also an eye opening experience. So maybe I will think about how strong the sun is." (Erika Jorquera)

The connection between the unseen dangers and its effects are represented and communicated. The contrast between one's perception and reality is clearly visible, which allows the viewer to be more aware and attentive of reality. By experiencing this discrepancy, the viewer is able to have a sense of revelation and a new perception.

The viewer is able to understand that there are dangers that are not always visible, and that it is important to be aware of one's surroundings. The viewer is also able to understand the effects of these unseen dangers, and how they can impact one's life.

Image 62
Pagoda.tmos video ethnography

Chapter 7. Conclusion

CHAPTER 7-1

Contribution to the Field of Interaction Design

Pagoda.tmos is a project that aims to bring emotional experiences that connect invisible data and phenomena to individuals and society. The interaction between data and design along with the interaction between design and individuals/society provide a new perspective and approach to interaction design. It becomes a medium where personal and social psychology is explored to contribute to societal issues such as air pollution and climate change. In terms of data visualization, interaction design is a crucial part of this project. Invisible data is not only visualized, but experienced by exploring various modalities in the form of natural interfaces. With these explorations in interaction design, new perspectives on technology, environment, society, and design are explored.
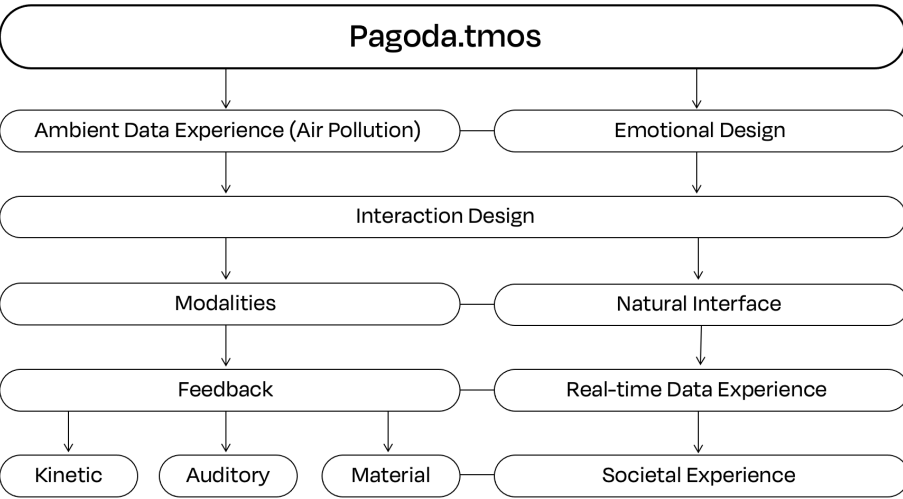
Figure 15
Pagoda.tmos & Interaction design

Ceramics & Interaction Design

User experience and interaction design is usually associated with interaction in digital interfaces and spaces. This research takes the base of technology and uses the materiality of ceramics to approach physical interaction in a new direction. With ceramics and interaction, the static nature of the material is transformed to a unique and uncanny experience. The mixture of high technology and natural craft materials is an unusual pairing that not only intrigues the viewers, but also breathes life to new experiences that are both familiar and new. The ethnographic research showed that the ceramic interfaces are effective for creating new forms of interaction. The interactive experiences engage the public to the larger topic of air pollution and climate change.

Based on *Pagoda.tmos*, I developed a set of design principles for creating interactive experiences with ceramics. These principles can be used by designers to create new and innovative ways of interacting with the material.

1. Use the materiality of the ceramic to create an experience that is both familiar and new.

2. Use technology in disguise to create an experience that is both uncanny and intriguing.

3. Use interactive inputs and outputs to communicate the message of the project.

Objects of Connectivity

The ambient setting of the *Pagoda.tmos* are public spaces to grab people's attention and make them think about the air they're breathing and the implications of climate change. The pagodas become a sort of tangible connection between people and their thoughts, the pagodas and their purposes, and the larger meanings of climate change and air pollution. They also provide a connection between viewers, as they share in the experience of the pagodas. The pagodas thus provide a means for people to connect with each other and with the larger issues at hand. In doing so, they create a space for dialogue and contemplation. The pagodas are also a way to bring people back to nature. In a fast-paced city, it can be easy to forget the importance of the natural world. The pagodas provide a way to connect with the natural world, and to appreciate the air we breathe.

CHAPTER 7-2

Future Outlooks & Opportunities

Air Pollution & Data Experience

Pagoda.tmos explores unexpected modalities to experience data of air pollution. Experiencing data through bio-reactive materials, kinetic motion, and sound generation intrigues and challenges viewers in terms of perception and awareness. The bio-reactive materials used in the installation change color in response to the level of UV, providing a visual representation of the data. The kinetic elements of the installation create a sense of movement and change of PM, while the sound generation adds another layer of information in gas for the viewer to process. The installation is a multi-sensory experience that engages the body and mind to dually perceive data in a more tangible way.

Design & Awareness

Air pollution is an invisible threat that is threatening both human health and the Earth. Although it is common knowledge, it is difficult to see the changing air quality, especially when the problem is an invisible one. By making the problem more visible through interactive sculptures in a tangible and perceivable manner, the concept of air pollution becomes more real. Furthermore, adding salience to the invisibility increases awareness and encourages people to change their behavior for positive impact.

This research has shown the potential of interaction design in various ways. The following fields are opportunities to research further to develop and contribute to the field of interaction.

New Interfaces

The first is exploring materiality as a new unconventional interface for data and information. By utilizing ceramics as a major design element, it was a seamless connection to the topic of skin, air pollution, and nature. Skin can be seen as a natural human interface to our health and the nature of ceramic clearly represents this concept. In terms of climate change, ceramics embodies a more organic and natural entity that distances itself from technology while still embodying information detected through technological advances. To further develop a sense of unexpected interfaces, future opportunities lie in exploring natural materials as mode of interfaces. These could be in the forms of natural interfaces of various materials such as textiles and leather. Even future opportunities can be in biochemical materials that involve further scientific investigation, research, and collaboration in the field of science and technology.

The second opportunity in interfaces is about exploring the potential of data visualization as an artistic form. As one can see from *Pagoda. tmos*, data visualization can become a form of art. When designing a data visualization piece, designers have the opportunity to consider various artistic elements such as aesthetics, materials, and technology. This can be a powerful tool to communicate a message and

engage the audience in a more creative and meaningful way.

The third opportunity is to further explore the potential of data visualization in public spaces. Data visualization can be used as a tool to engage the public in a more interactive and meaningful way. By doing so, it can create a more interactive and educational experience for the public.

Modalities as experiences

In this research, unimodal experiences were developed to have clear communication about one specific ambient data to the viewers. These types of unexpected modalities in data visualization contributed to unique experiences that drew attention to the topic and issues of air pollution and climate change. By developing more uncanny or unexpected experiences, the aim would be to draw more attention to unseen topics at hand to further encourage mindset and behavior change. Other modalities to explore can be experiencing the taste and smell of air pollution and climate change. Furthermore, auditory and kinesthetic modalities that are explored in this research can also be developed further to have a more immersive experience. These experiences can also be explored in other environmental contexts.

Societal behavior change

The aim and goal of the research was to encourage individuals and society to have new perspectives on air pollution, skin, technology, and climate change. By adding salience and unexpected design experiences to these topics, there were reactions and change in perceptions around one's ambient environment and what data means to the viewers.

To further investigate societal mindset and change, there are opportunities to develop this project for a wider range of viewers. It would be an opportunity to present *Pagoda.tmos* in bigger societal platforms around various cities. By gathering ethnographic research in different cities and countries with varying air quality levels, it would be interesting to compare research data from cities with high pollution levels to low pollution levels. By doing so, the aim would be to compare behavior and mindset change through the *Pagoda.tmos* experiences in varying cultures and society with different levels of air pollution levels.

Therefore, the following are further research questions for possible opportunities. *How do different cultures and communities respond to air pollution? How can we encourage individuals to have a new perspective around air pollution? How can personal or community data be utilized for sensorial experiences regarding the invisible?*

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Appendices

Patient Interview - Carlo Roman Picaso

Jooin Shin

Carlo Picaso

Can you share your name and your age?

Yes, I can. Yeah. I am a Carlo Roman Picasso and I am 35 years old.

So to my understanding you have a skin condition and can you explain what it is and since when you've had it.

So, exactly the name is I have a skin condition and the name is I don't know in English but the name is a topic atopic dermatitis. And I have had this since my childhood.

Do you know what caused it in the beginning?

Itchy skin so the skins were itchy and sometimes getting red and just like fire or the skin starts with become very dry.

Do you know why you had this?

It could probably be genetics but it's also not exactly sure. The mostly sense since I visit many doctors skin doctors they said it's just climate, the climate because my body is a tropical body and the temperature and conditions in in Europe is much more different compared like in the Philippines is much more dry. And my skin always has to stay moist.

So is it the air and the climate that's only affecting your skin or are there other reasons?

I also feel it when the air pollution is strong. Somehow I feel it on my skin and it started also itchy Yeah, I cannot prove this. There's a feeling which makes me not comfortable.

Can you describe the feeling?

It feels like heavy, sticky. Somehow I cannot breathe somehow my skin cannot breathe. I feel it. And I get somehow sweaty. So the only thing what I would like to do is just taking shower.
It helps a lot. Because if I don't take shower, I feel my my skin starts somewhat itchy again. So and if I take shower it somehow it feels Yeah. Just like you mean it's just it's moisture. Yeah, it's clean of course. Yeah. And and the moisture.

Do you have some places that you went to when you experienced this specifically?

Yes. Especially in the Philippines. That's it de Manila. Yeah, I feel it very. It was very intensive and also in South Korea and Seoul. I didn't realize it until somebody told me that the Seoul has very strong air pollution that's why it always makes me feel sweaty and then a friend of mine told me yep, take a shower and and see how the water looks like and it was coloured brown.

So before you go to like some places you want to prevent your your skin irritation so are there like some things that you do to prevent this

Yes, so one thing is just going to hit area like Philippines actually not many countryside I remember when I was now always when I was visiting Philippines and when I got the countryside I feel immediately I feel much much better I felt even heavier even no problem with the heavy heat it's more the opposite I feel much more comfortable my skin is even much more smooth and and shiny.

So if you go to the city like do you know that you cannot prevent skin irritation you know that it will happen so you just go anyway?

I go anyway but I using long hours many times and also scarf to protect my skin. That's why you see me often with a scarf.

You use that even for summer? Even in summer do you wear long sleeves?

Yeah because the one one thing is if I using good it makes more heat and that's why I have no problem in the summer using a hood because I feel really comfortable so many people asking me why it's summer why you're using hoods. And but yeah,

Okay, have you seen anything like in your do you use anything in your daily life to help you with this like in terms of technology

Example okay, like if technology is a steam machine. I prefer to use steaming machines to have moisture the air I feel special in the wintertime I feel it's very very dry not only I don't not only I feel it by my my nose also skin

So it's what your environmental status is like to check how the temperature is like.

I have had a temperature and humidity checker. I have test to check it and when there's when it's very low then I start to using the steaming machine.

Do you have any technology to see where the air pollution is coming from? What kind do you think would be helpful? Do you think if you see it you will avoid going to this place or do something to help your skin?

Do you mean like something like a watch a timer with additional information? It would be nice something which is not so as I say, it should be an it should be a technology which is integrated in the place or in the city that give any motion or some kind of information could be an abstract or some I don't know, some specific information, but I think something like a digital clock with the information feels more negative? Because mostly of the clock, the digital clock I'm not sure using white light or I remember red LEDs. It's even with the colour feels more negative, if I also see the air pollution number, but of course, I mean somehow more organic.

Scenario Interview - Yerin Song

Jooin Shin

Yerin Song

Can you explain your skin condition?

I have the skin condition called atopic dermatitis.

Did you remember when you started to have this condition?

I started having it a few years ago. It started when our company moved to the new building. I started to get itches and went to the doctor. The doctor told me it is sick house syndrome. It happens when a building or house is constructed with cheap materials and the toxins are released through the walls. I think I was exposed at work and started to develop this condition.

Do you know what causes your breakouts?

It's not so clear but bad air and air pollution makes it bad. I feel like bad air pollution is clogging my pores, especially in a city environment.

Did the condition come as a surprise for you?

Yes, it just came out of nowhere and I was surprised because I didn't even know about sick house syndrome.

Do you go to some areas in the city that you feel are especially bad for your skin?

I have to go to the industrial area for work since I need to make electronic samples for work. In these places we spray a lot of paint and when I go there my skin feels ill.

Can you feel when you would have a breakout?

No, it's difficult to know since I am in the area and I can't see if there is so much bad air that is bad for my skin or can trigger a break out.

Do you have medication that you can take for your condition?

No, there is no certain medication I can take. I go to the doctors for check ups but I have to take care of my skin myself.

What do you do to take care of your skin?

1. Before I sleep I always take a shower because if I don't my skin get's very dry and the dermatitis gets worse.
2. I sleep with very think moisturizing lotion.
3. I don't eat food that makes my body heat up like spicy things or alcohol. I don't go in hot bodies of water, swimming pools, or even the sea. I don't work out intensely because my body will overheat and it's bad for the dermatitis.

And can you describe your average day and how long you spend in the industrial area?

Well, I go to work at around 9am and I can go to the industrial area any time of day, depending on the work. I can spend from 2 hours to 6 hours there. And then I commute home. Sometimes I stay in the office all day and sometimes I go to the industrial area all day also.

Is in these industrial areas that you feel most threatened by the toxic air?

Yes, already I can smell the paint spray and my skin feels very irritated when I am there for too long. I feel there are high levels there.

Do you think it would help if there were any indicators of these toxic levels?

Yes! It would be very helpful to see when it is too much then I can take a break before my skin gets too irritated. It would help a lot and I would feel better also.

Scenario Interview - Hyeon-sook Noh, wife of Andreas Holz

Jooin Shin

Hyeon-sook Noh

Could you tell me about your husband's condition?

He showed possible signs of skin cancer on his forehead because of too much sun exposure.

I'm sorry to hear that. What kind of treatment did he have to get?

The doctor prescribed a cream that he had to put on. After a while his skin started to get red and swell up. And after that his skin went back to normal. It actually looked completely new, like baby skin.

He doesn't have this condition anymore?

No, he doesn't but the doctor told him to be very careful of sun exposure.

Does he do a good job of taking care of his skin?

No, he goes cycling in the Black Forest very often and even though he knows he needs to take care he is not so careful.

What precautions should he take?

He is always supposed to put on sunscreen and also wear a hat but he doesn't have this habit and doesn't want to do it sometimes. He will do it maybe once.

How do you encourage him to be more careful?

I usually just tell him often but it becomes nagging and he doesn't listen.

In which areas do you think he should be careful about his skin?

He goes cycling a lot and when he's out in nature there is a lot of sun and he doesn't realize. I think this was the cause of the problems and he should be especially careful. In the city and in everyday life also he should make an effort.

How often does he go cycling?

During the weekends he goes on a regular basis. He also goes during the weekday more often now because he is close to retirement. He is also working in the garden on his wood projects and this is also something he should be careful about.

When does he know or does he know when to put on sunscreen or go indoors?

The doctor told him to always wear a hat and apply sunscreen every 2 hours but he is only doing it once sometimes when I remind him or tell him to do it.

Scenario Interview - Hyojae Lee

Jooin Shin

Hyojae Lee

Can you describe your skin routine for me?

I have very sensitive skin so I am very careful to what I put on my skin and products that I use. I always wash my face day and night but even I have problems with acne.

What do you think are the causes for this trouble?

I think mostly hormones, stress, pollution, what I eat.. It's hard to tell because it's different every time and hard to know what is the exact reason. Like, when I have my period I get more on my chin area too.

In terms of air pollution, how do you think this contributes to acne?

I was living in Seoul, South Korea before and the air pollution is very bad there. Lots of cars, fine dust, things like that and I can feel it on my skin. Feels like my pores are clogged and makes my acne worse.

How do you feel the air pollution in London?

I feel air pollution in London too. There are many cars, the tube has bad air quality.

What precautions do you take?

I use a lot of skin care products. I always wash my face. I used to go to the dermatologist in Korea but I don't go in London. But it's hard to take care of my skin because there are many things that makes my skin bad, like my period.

What do you usually do to see things that could affect your acne?

I check when I will get my period and then I know the acne will get worse. I also used to check the air quality or PM levels on my phone. As you know, we worked in the home appliance department together so I would check the PM levels so see if the day had bad dust.

Ethnographic Interview - David Jorquera

Jooin Shin

David Jorquera

How would you describe today's weather and your ambient environment?

Well, it's very bright, sunny and windy. And I think because it's windy, you wouldn't think that it's hot enough or that the sun is too strong. And we are here in Zurich, like in the middle of Zurich on the rooftop of ZHdK yeah and it's noisy I don't know what do you mean with the environment?

Just your surroundings? Like your the area?

Yeah, we are in pretty green part of Zurich. It's the rooftop of ZHdK. And yeah, it's very green with a lot of trees and plants

What do you think about climate change in air pollution in your life?

I think it's a pretty big deal. And we should all be aware of climate change. And I think especially here in Switzerland, you can notice it big time. Because you can see like the glaciers melting away. And also you can feel like the weather changing. Like Springs always a little bit stranger. We have a lot of hot days also in winter and a lot of rainy days in summer. And I think it's changing a lot in the last few years

Do you do you feel threatened by air pollution and its effects on your body?

Yeah. I don't really think a lot about it. But I know that's a problem, especially when you live in a city. And yeah, I think it's a big a bigger problem than we think.

Yeah what do you do about UV?

I always try to say try to avoid the sun or like staying too long in the sun. And I also use a lot of sunscreen especially when I'm in the mountains hiking because the sun factor is really high in the mountains and yeah, I'll always use like sunglasses and hat to protect me except of now

Can you describe your experience with the pagoda?

I think it's really interesting that it changes its colour with the sun and it looks really artsy and beautiful. I think it's nice to have like something like that. Or look at it. Yeah, have it around in the environment. And yeah, I think it could really help to make people aware of looking at the sun and like protecting you from the sun don't know a lot about it. So

How does this experience allow you to see data and climate change in a different way?

That's a really hard question. What to seek data?

Yeah. So like the it shows like, kind of ambient data, right? Like the red the colour changes, like, showing the data of like high UV exposure. So how does this like the pagoda allow you to see data and climate change in a different way?

Like, how it makes you to visualise that or think about that more. Like when you see the sculptures?

How would you like to take action going forward?

I don't know. I mean, how does it? What does it have to do with climate change?

Okay. I think it makes me like instantly aware of the sun and that it's really strong. And you also can see, like, on the colour that if it's really red, that the sun is very bright. And yeah, it helps me to remind that we should protect protect ourselves and also reminds me of the climate change that we should do something about it. See

I think I could do action with also making other people aware of climate change. That's, I could do that with art or with videos or short, short films. Yeah, and also like to tell people about it or explain it to people or friends that don't know a lot about it. So vert spreads around. Okay,

Ethnographic Interview - Erika Jorquera

Jooin Shin

Erika Jorquera

How would you describe today's weather or your ambient environment?

It's very sunny, but also very windy. So it's cold, but nice.

What do you think about climate change and air pollution?

I think climate change is a threat. It's really a problem. Nowadays and air pollution, I would say, especially living in a city, it's a problem.

Do you feel threatened by air pollution and its effects on your body?

I would say sometimes I feel like the air is not fresh and then I feel maybe threatened, but it's not like a real it's threat. I would say it's just a feeling like, oh, I don't like this air.

What do you do about UV?

I put on sunscreen on my skin and I use sunglasses and yeah, I would say since I got really, uh, sunburnt a few years ago, like really bad, I try to like still use, um, long clothes, even though the sun is out.

Can you describe your experience with the pagoda?

It was very interesting to see the circles, um, interact with the UV. So it was nice seeing them red instead of white and also in the environment here, outside, it looked really nice.

How does this experience allow you to see data about climate change in a different way?

I would say it's maybe a new experience to see it on a sculpture. I think I only saw data about climate change, maybe on screens interfaces, but not on an actual sculpture. So it's a new experience.

How would you like to take action going forward?

I would say the sculpture showed me that UV is really strong, even though it was cloudy where we stood. And the thing is, I know that UV is really dangerous, but seeing it on the sculpture was also an eye opening experience. So maybe I will think about how strong the sun is.

Ethnographic Interview - Jessica Curschellas

Jooin Shin

Jessica Curschellas

How would you describe today's weather or your ambient environment?

So the weather today, I really like it. Like today when the sun shining and it's kind of fresh air, but Yeah. And here on the top of the roof with all the plants and like this it's very nice in middle of a city, But, uh, if you, yeah, you think of it when you're in the Alps or it's like a different air. It's much fresher there, so, Yeah. But it's kind of nice, um, to be here.

What do you think about climate change and air pollution?

It's a very important theme and um, I think every person should, should have an impact or should know that we have an impact and you can do little things to help. And yeah, me, I also, I'm not kind of doing everything or a lot, but I know little stuff can help also. And I just, yeah. Do little things.

Do you feel threatened by air pollution and its effects on your body?

Sometimes it's, yeah, it's difficult when I see, it's stupid, but when I see, videos or images, how it could impact, my skin or everything then yes, of course. Um, but sometimes I forget about it.

What do you do about UV?

Sunscreen and also just wear a hat and, I don't like to have burnt skin.

Do you avoid the sun?

No, I love the sun. I love staying in the sun and also, staying a long time in the sun, but I really, um, avoid sun burnt skin.

Can you describe your experience with the pagoda?

I've never heard about it before, like material with you. We only, uh, on clothes or like this, so I think it's a very, uh, interesting thing that it can change the color. And also I like the, the structure. Um, and yeah, it's nice that I could touch it.

How does this experience allow you to see data and climate change in a different way?

Mm it's a different way because it's combined with art, so it's not just, data or a text message or video. And I like arts too, so I think it's a kinda closer way to approach to it.

How would you like to take action going forward?

Um, that's a difficult question because I think everybody wants that it has to go forward much faster. Um, and yeah, it's difficult because everybody should do something, but the mindset should change a little bit and also the people who have an impact or can change. I don't know how to say it, but, um, it should go a lot faster.

Does this help change or influence your mindset on the environment and air?

Yes, it does. Um, I think especially on the air because the air is, um, something I can see and now I can see a change of the air, because of the change of the color.

Ethnographic Interview - Hanh-Dung Nguyen

Jooin Shin

How would you describe today's weather and your environment like your air?

What do you think about climate change and air pollution?

Do you feel threatened by air pollution and, and its effects on your body?

What do you do about UV?

Can you describe your experience with the pagoda?

How does this experience allow you to see data and climate change in a different way? Like data about your, your surrounding ambient?

Does this affect your influence? Oh, does this affect? No. Oh, does this affect or influence your relationship to the environment and air?

How would you like to take action going forward?

Hanh-Dung Nguyen

It feels like it's normal. Like, um, it's a bit cold and windy, but it should be that way. I think it's the beginning of spring And the air. I don't sense anything in particular.

I don't sense it directly, I would say, but it's something that I would for sure, like to avoid, like I try to act on, in a smaller scale about it.

Um, yeah, sometimes I wonder if my skin reacts to it, But other than that, I've never really thought about it.

Usually I'm quite careful about it. Sunscreen and long sleeve.

It's such a cool sculpture to see, you're super curious about how does the elementary react.

Like it's much less abstract than just data than just raw numbers. And like here I can directly see result in such a poetic way. I really like it.

Yeah, I think about it. For example, here, you see trees around and you would never really ask yourself that, but actually it's something we should really think about. It's because we are still in the city and really touched by that.

I can only do stuff on the small scale. For example, take public transport instead of your own car or small steps like that. I think also in your diet maybe and in what you buy.

Ethnographic Interview - Silvia Monti

Jooin Shin

How would you describe today's weather or ambient environment?

What do you think about climate change and air pollution?

Do you feel threatened by air pollution and its effects on your body?

What do you do about UV?

What do you do about gas?

Silvia Monti

I would say days today's. Further, it's quite hot, full of pollen and dust in the air. Sometimes when you walk outside, you start to sniff or like a scratch. It's very full of dust. Also in the balcony you would see all the yellow dust of the pollen piling up. It's quite impressive how much things are in the air.

I feel climate change is so big it's difficult to even imagine realistically what will happen in the next year. Air pollution also been invisible. You don't have an impression of how much it impacts us. You can smell sometimes smoke, but it's ever every time it's all around us. Sorry, it's a bit wide.

I do. I think mostly. For example, cigarette smoke. That is where I noticed often. I love sitting outside in bar and restaurants and all the time I start to smell a bit of smoking. I get extremely paranoid because I know so much about the bad effect of cigarettes and smoking that the moment I smell the order of cigarette. I'm like, oh no, it's entrance already on my lungs. I'm already aging terribly. I'm already getting cancer and stuff like that. That is a smile that I recognize. I don't know about all the types of smells that I don't know what to pay attention to. Maybe smog you can recognize. But sometimes we have perfumes or incense in shops, condos. I guess everything that has a perfume is dangerous, but I don't know exactly which one is bad and which one is good.

Mostly sunscreen. I tried to pay attention about sunscreen and not go out when it's too hot and to wear even when it's maybe hot. Pay attention to wear something to cover skin on possible.

Like the smoke? On the spot. Very silly. I literally hold my breath. If I cannot move. I try to check where the wind comes from and try to change my place in a way that the smoke of the cigarette doesn't come towards me. But the first one is really holding the breath. It's so natural. Instinctual like, no, I should have to prevent this guest, this smoke to come to even enter. I have the impression at the moment this pollution enters in my body, it's already attacking.

It has nothing to do. But yeah, it's a very instinctual response.

What do you do about particulate matter, like dust?

I am kind of a clean freak. I did dust home very often, especially for pollen. But yeah, I don't have humidifiers or other ways to check out the pollution, the dust, specifically in my house.

Can you describe your experience with the Pagoda UV?

My first impression was the texture. I was so intrigued, I was wondering how is it done and what does it represent? What is that? This impact between the smooth surfaces. It looks like stone. So I had the impression that it looked like some type of coral that is melting. And then it was interesting to know that the color changes. So the statue feels like reactive is like another being, like me on the spot that is reacting to the environment. I find that it's more interesting than just an interface, like on the phone. I have at home a similar thing to check on the air pollution, at home, on the particles, but I have a different relationship towards that. I don't have to pay attention to the statute to look at it and interpret that. The other one just gives me the data, but it feels more attached. I have to remember to look at the data. When I look at the statue, I almost am more aware of the impact of the UV on the statue because I see the material changes. I don't know if it makes sense. I'm aware of the impact instead of being aware that it is that has has numbers. Because the numbers I can't quantify.

How does this experience allow you to see data and climate change in a different way?

I look at it in terms of how it impacts living being. Because the statue looks kind of like a mushroom but also looks like a coral. They look like living beings that are all impacted. It feels like it's showing in a more material way, like concrete changes. While the dashboard, for me, it's something digital, something. They could be those numbers. You could show me another scale and I would not actually know. I'm not seeing it, I'm not feeling it. And plus, it's like a little robotic stuff. It feels like I have no connection action towards that. While the object feels like skin texture itself, like something that's a bit more alive.

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