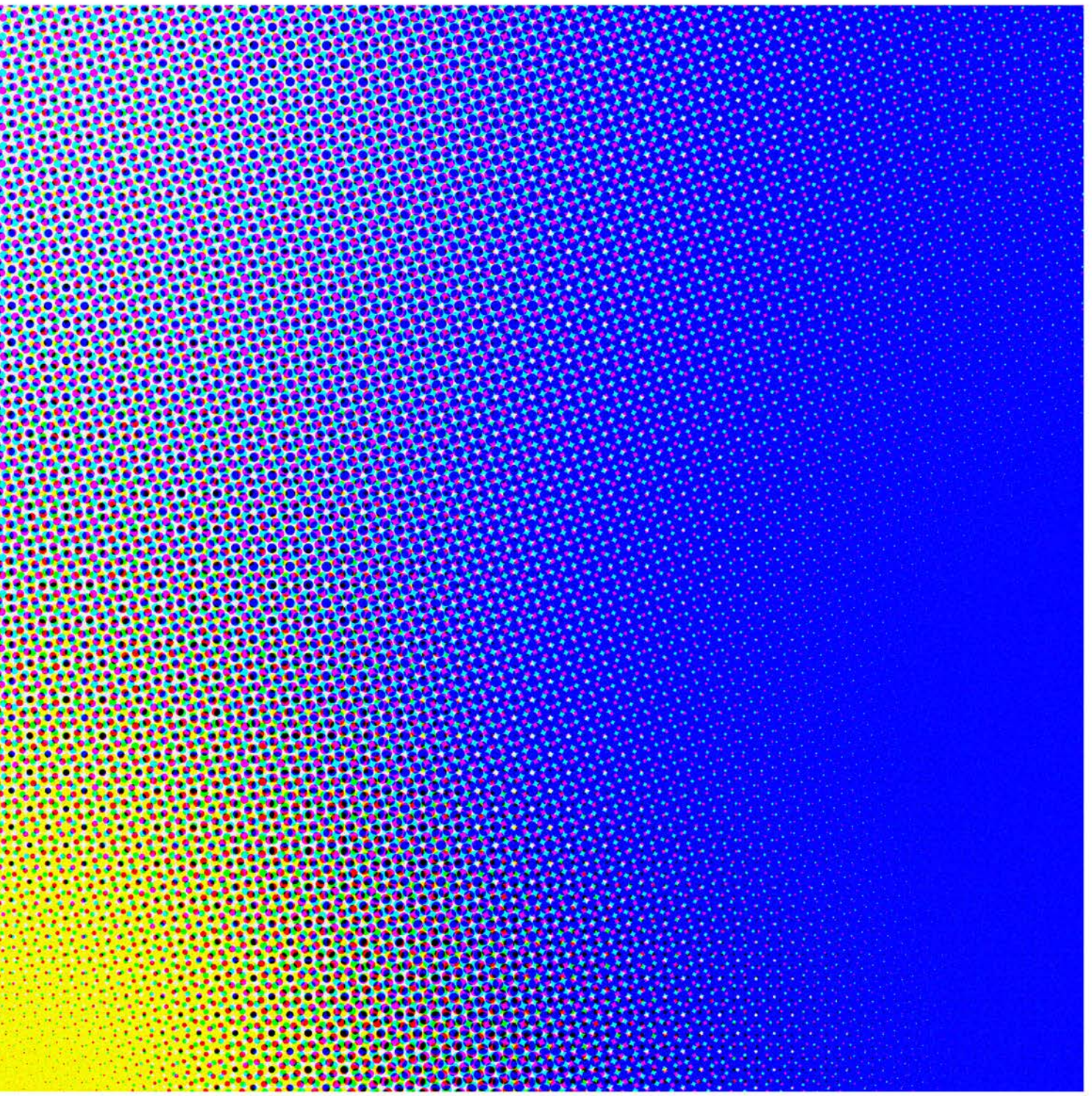

Internodes

Berkeley MDes

FA22

Master of Design (MDes)
University of California, Berkeley

Jacobs Hall
2530 Ridge Rd
Berkeley, CA 94709
+1 .510.664.7574

37.8760° N, 122.2588° W

mdes@berkeley.edu
design.berkeley.edu

MDes Leadership

Eric Paulos • Director
Kyle Steinfeld • Associate Director
Gwynne Keathley • Executive Director

Faculty and Instructors of Core MDes Courses • Fall 2022 Cohort

Yoon Bahk
Danika Cooper
Björn Hartmann
Brian Hinch
Eric Paulos
Kyle Steinfeld
Randy Swearer
Floor van de Velde
Kuan-Ju Wu

Special Thanks

Stephanie Bianco
Amy Dinh
Joey Gottbrath
Aleta Martinez
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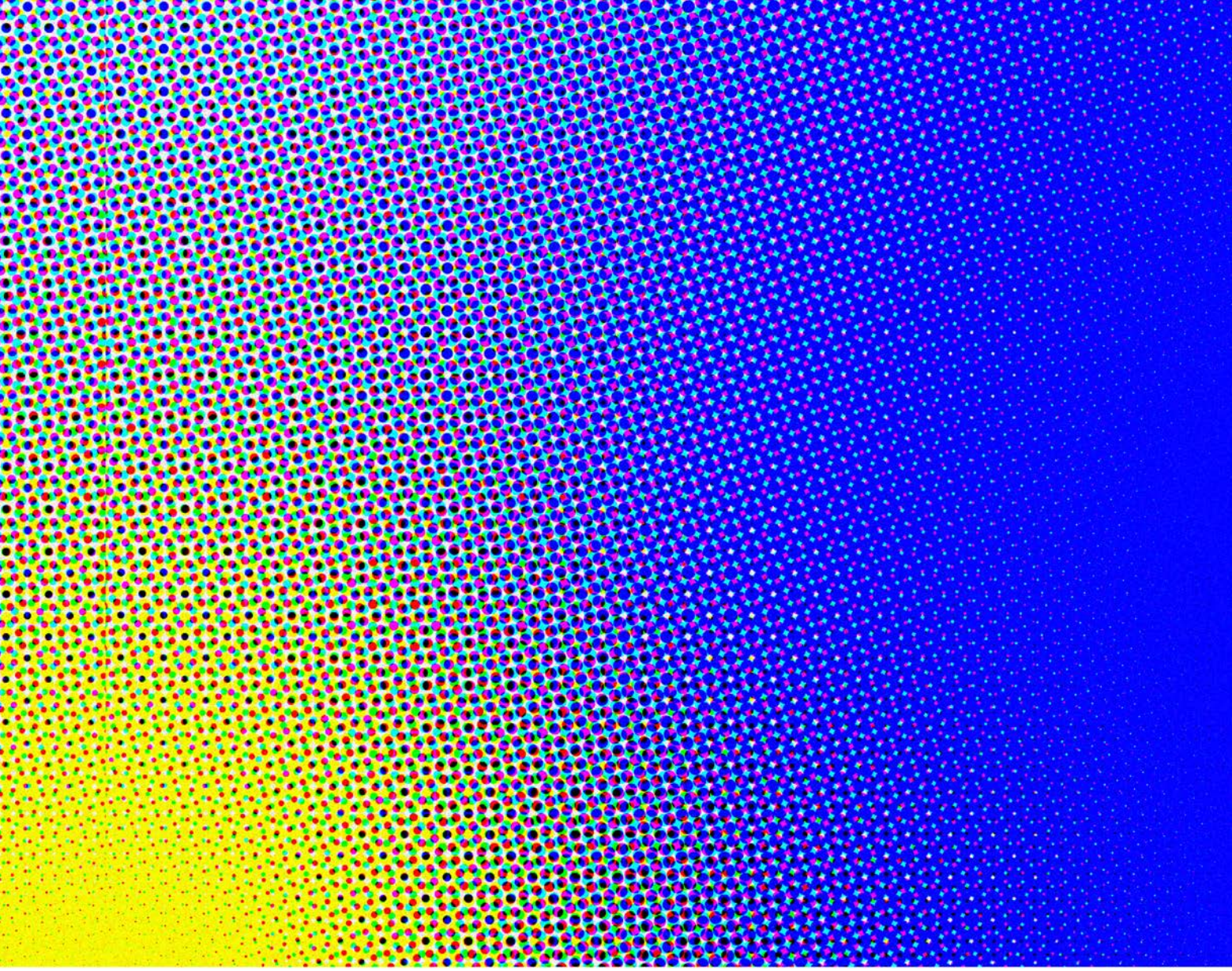


Internodes

Berkeley MDes

FALL 2022 • THESIS EXHIBITION

ABOUT
BERKELEY MDES

The University of California, Berkeley Master of Design (MDes) degree program is a three-semester, professional graduate degree in design that integrates human-centered design with engeering excellence across a range of technologies to prepare students to excel in creative practices to **design tomorrows thoughtful technologies, today**. Jointly offered by the College of Engineering and the College of Environmental Design, the program's interdisciplinary curriculum connects technical rigor, design theory, and social practice to prepare students for a broad range of creative and technical roles.

Housed within the Jacobs Institute for Design Innovation, the Berkeley MDes provides a dynamic, hands-on curriculum that uniquely equips students to develop a critical human-centered design perspective along with deep fluency across a range of existing and emerging technologies.

Studio-based coursework integrates programming, human-centered design process, and a wide materiality exploration from electronics and mechatronics to soft and organic living materials. Provocative project briefs encourage students to use a range of design processes to identify new problem spaces and develop novel technologies through co-creative processes, iteration, and physical prototyping. A set of debate-focused seminars help shape students' critical lens on design through analysis and discussion of the ethical, ecological, and societal implications of practice within an evolving environmental and socio-technological landscape. Students further their expertise through technical electives and offerings in social practice or entrepreneurship relevant to their interests and career goals. Their studies culminate in a semester-long Design Studio where they work individually or in teams, leveraging their distinct perspectives, design sophistication, and technical skills, toward **designing emerging technologies that benefit people, society, and planet**.

ABOUT
THIS BOOK

In the final studio course of the MDes program, students encounter, deconstruct, detangle, and develop novel designs using emerging technologies to impact humans, culture, ethics, the environment, and/or society at large. Collectively, students engage deeply with themes within small clusters of students who have shared visions. Individually, students engage in semester-long iterative development of a focused, design exploration with intellectual depth, technical rigor, ethical and social justice lens, and visual polish. Through a series of progressive milestones of thinking, making, and critiques with domain experts, studio work evolves and culminates in a final written **MDes Thesis and Studio Exhibition**.

This book highlights the full body of thesis work across the graduating Fall 2022 MDes cohort. The book is organized by thematic clusters. Students work on self-selected and directed projects. Projects are placed into clusters to form cohesive collections of similarly scoped projects. These are not team-based works but rather themes of studio work.

You will find an overview of each cluster in terms of its domain, precedence, and design opportunities followed by a series of individual projects within that cluster. Projects were developed individually or in small teams and explicitly engage with **technology as a creative material** in their final designs. This book serves to introduce and highlight the breadth of the Final Thesis Studio Exhibition work and inspire you to explore each project more deeply through its written MDes Thesis.

During the Fall 2022 semester, the MDes Thesis Studio was led by Eric Paulos, Danika Cooper, and Yoon Bahk.

We invite you to open your mind and be inspired by the broad, creative work of the Fall 2022 MDes students!

Congratulations to all our MDes Fall 22 graduates!

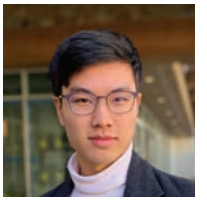
Eric Paulos
Director, Master of Design (MDes)
Professor, EECS • BCNM
University of California, Berkeley

Kyle Steinfeld
Associate Director, Master of Design (MDes)
Associate Professor, Architecuture
University of California, Berkeley

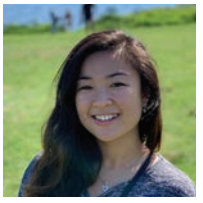
Fall 2022 Berkeley MDes Graduates


Akash Mahajan


Benal Johnson


Bennett Ngan


Can Ge


Carolyn Nguyen


Celia Diaz


Chialing Chen


Debbie Yuen


Denise Heredia

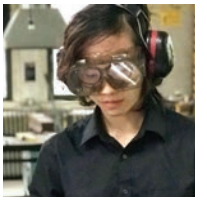

Dongho Koo

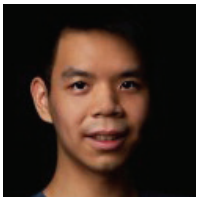

Eleanor Mayes


Emily Joens


Felicia Renelus


Hannah Bartolomea


Haoyang Chen (Thomas)

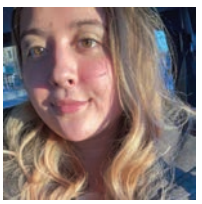

Billy Kwok


Jacob Kritzinger


Jaesuk Huh


Jennifer Wong


Jessica (Jess) Kim

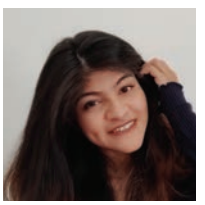

Kaila Lee Negrón


Lucila A Duloup (Lula)


Maya Chen


Ming Gong (Aria)


Qianyi Chen (Daisy)

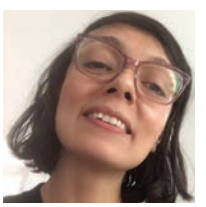

Ramyani Roy


Roland Saekow


Salih Berk Dincer (Berk)


Sara Friend


Sora Kang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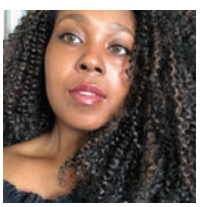
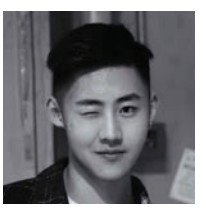

Taylor Speed


Yiyao Yang (Amanda)

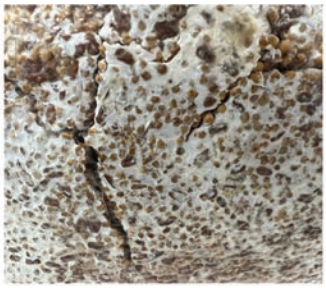

Yuting Wang (Kathy)


Zhipeng Pan (Rustin)

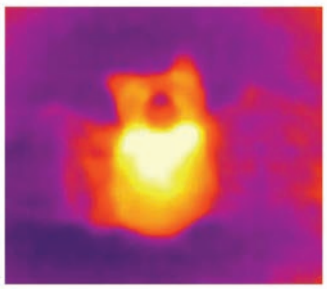

Zoe Ingram

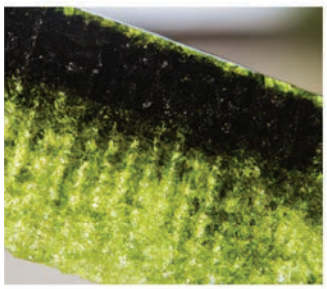
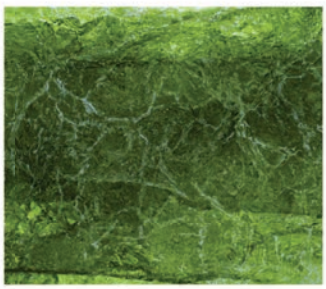
CONTENTS

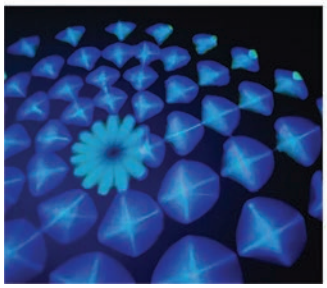
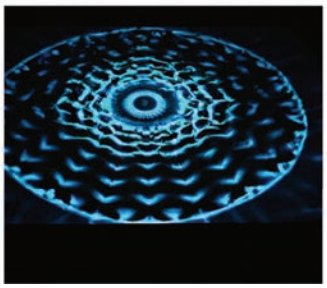
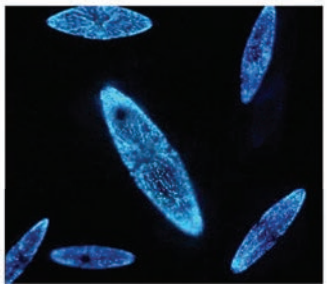
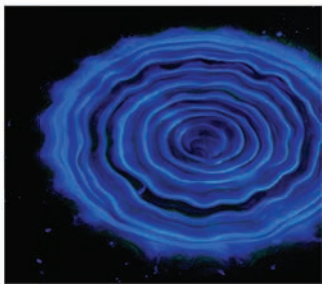
ACTIVE MATTER



Active Matter focuses on examining biomaterials as agents of social change. We explore the physical essence of these materials to drive our research, considering how living matter can be pushed toward new experiences and modes of intervention. This cluster's key underpinning is to question our relationship to nature and the materials it encompasses. Active Matter is prompted by a culture of extractivism, driven to overcome an existing tension between human impact and sustainability. Aether is a sound installation that situates bioluminescent plankton as a co-author and design material through kinship and experimentation. FungalForm is an ecologically beneficial evaporative cooler that grows the user mushrooms. The mushroom-growing MycoCore is a parametrically optimized form inoculated with mycelium which is used for bioremediation after disposal. Bio+ endeavors to examine cross-species interactions in the human living space. This project proposes a symbiotic way of living through the exploration and design of microalgae. Bat Babble is a thermal monitoring device that detects changes in bat roosting positions within dry caves as a proxy of their health. It serves as an early warning system for future pandemics.

Active Matter touches on both the practical and speculative use of engaging with organic materials for more sustainable futures, and is therefore grounded by recent works in the field of biomaterials; the bio-materials industry has grown exponentially over the last decade. These new materials have become viable alternatives to numerous products whose production relies on non-renewable and natural resources, which cause extensive damage to our environment. We now have high-performance bioplastics, leather alternatives, packaging materials, and architectural construction materials.

Of the current high performing biomaterials, mycelium has fast become the primary choice for producing a substitute for many of these synthetic alternatives. It has already been adopted by companies such as Ikea, Adidas, Lululemon, Mercedes Benz and Hermès (Mylo™ Unleather, 2022) (MycoWorks, 2021). In 1997, tests with mycelium as a potential bioremediation agent of oil spills were conducted by mycologist Paul Stamets and researchers from the Pacific Northwest National Laboratory. Mycelium was able to decompose 97% of pollutive polycyclic aromatic hydrocarbons (PAHs). (Trimarco, 2010) In 2007 Paul Stamets implemented

this research when a Cosco Busan oil tanker ruptured and spilled 53,000 US gallons (201000 L) of petroleum fuel oil into San Francisco Bay. (Office of Response and Restoration - NOAA , 2022) After 16 weeks of mycoremediation, the Total Aromatic Hydrocarbons levels in the contaminated test soils were reduced from 10,000 ppm to 200 ppm. This contamination value was low enough for the soil to be used for landscaping alongside highways. (Stamets, 2010) (Washington State Department of Transportation, 1999).

In light of the COVID-19 pandemic, we are faced with yet another consequence of global health in need of remediation. The importance of monitoring bats as an indicator species because of their insect-rich diet and low reproductive rate has been argued by biologists (G. Jones et al., 2009). As human populations expand into habitats overlapping with bats, the impact of humans on bats and vice versa increases. Monitoring programs such as the United Kingdom's iBats project highlights the ecological contribution of bats as seed dispersers and pollinators, stressing the need for conservation before larger irreversible ecological changes take hold (K. E. Jones et al., 2013).

The emergence of Severe Acute Respiratory Syndrome and other novel coronaviruses such as SARS-CoV-2 (COVID-19), the immune system of bats has been of key interest. Bats act as a natural reservoir for many diseases that can spread from animal to people, more than many other animal species making them of key research interest (Irving et al., 2021). The COVID-19 pandemic has shown the importance of an interconnected one world, one health reality with the finding that bats are a probable reservoir for the disease (Zhou et al. 2020). The health of animals and their environments is connected with the health of humans, and we must act now to be better prepared.

New frameworks for biological human-computer interaction have been proposed to examine how humans interact with nonhuman organisms. In the paper Speculating on Biodesign in the Future Home, the authors discuss the state of the art of interactive biodesign systems in human living space (Gough et al., 2021). Human-Biology Interaction (HBI) is an emerging field that studies the relationship between human beings and living matter. In recent years, the development in technology, bioengineering, and design enables the birth of Micro-HBI – a sub-field of HBI that focuses on living cells and molecules (Lee & Riedel-Kruse, 2022).

Designers, biologists, and artists have long asked the question: How might we utilize microorganisms for novel and sustainable material development? Much of this work blurs the lines between imposition and thoughtful utility, while some highlight the importance of forming favorable relationships to that which we make-with. Microorganisms like microalgae have been widely studied given these research questions. French artist Lia Giraud leverages microalgae's light sensitivity to present organic images with this biomaterial. Her projects challenge the constraints of still image presentation and explore the possibility of dynamic visualization (Giraud, 2014). Microalgae photosynthesis also inspires designers to dive into the aspect of sustainability. "The Coral" by Hyunseok An creates a wall-mounted microalgae bioreactor to grow microalgae in living spaces (An, 2019). French scientist Pierre Calleja has invented microalgae lamps that can light up on their own and absorb a ton of carbon from the air each year (Calleja, 2012).

Despite the prior research and projects on microalgae, the interaction between humans and microalgae hasn't been thoroughly studied. It is still a novel field with gaps to be filled. Similarly, Hybrid Living Materials (Neri Oxman & The Mediated Matter Group, 2017) is a study that introduces synthetically engineered E.coli that produces responsive color. E.coli bacteria is suspended in a hydrogel solution, and then sprayed on a 3D printed translucent mask. When the surface of this mask comes into contact with human breath, it then changes color. The final expression on each mask is a visually beautiful display produced by the bacteria and guided by the designer; this work exemplifies the potential bacterial colonies possess as co-authors in the design process. By designing with life, Oxman and the mediated Matter Group realize a toolkit that combines programmable matter and programmable life. While the final artifact reflects genetically modified bacteria, it is a demonstration of favorable making-with which relies on the intelligent capability of the bacteria to actuate.

AETHER

Kaila Lee Negron

A sound installation that situates bioluminescent plankton as a co-author and design material through kinship and experimentation.

1

“We are inextricably bound by our intellectual reasoning to realize the potential of the materials around us.” – René Descartes

1 *Pyrocystis fusiformis in interactive cubes. (TU Delft 2020)*

As just .0001% of the earth’s biomass, we have left an inordinate 8.3 million tons of plastic in the oceans (World Ocean Institute, 2021). This is just a glimpse at our impact on earth; in this decade alone, while we’ve made some strides in meeting our net zero goals, we have left an unsustainable carbon footprint that will take years to remediate. Much of this is the result of apathy towards our home planet and its nonhuman inhabitants. As our world inches closer to the consequences of our complacency, humans are met with the responsibility of **reconstructing** their relationship to the natural world. What might this look like? While many designers have focused on developing practical solutions to mitigate the climate crisis, this study focuses on **renegotiating** existing tension between human and nonhuman, living organisms by evaluating their potential as intelligent material. Given its complex intracellular machinery, *Aether* will focus on pyrocystis fusiformis, a self-actuating, living material.

P. fusiformis is a bioluminescent dinoflagellate that produces light through transient receptor potential channels, sophisticated cellular machinery that responds to external force by converting energy from its pH reactions into flashes of light in just .15 milliseconds (Latz 2018). This same cellular machinery is comparable to the human nerve cell which provides us with the capacity to sense external stimuli through touch or taste. Pyrocystis fusiformis requires consistent care in order to culture, and produces ephemeral flashes of light that may be unsuitable as a long term alternative light solution. In spite of its temporary nature, its initial flashes are an exciting natural phenomena that have been underexplored due to the difficulty of culturing this organism. Capable of absorbing large quantities of carbon, this unsuspecting

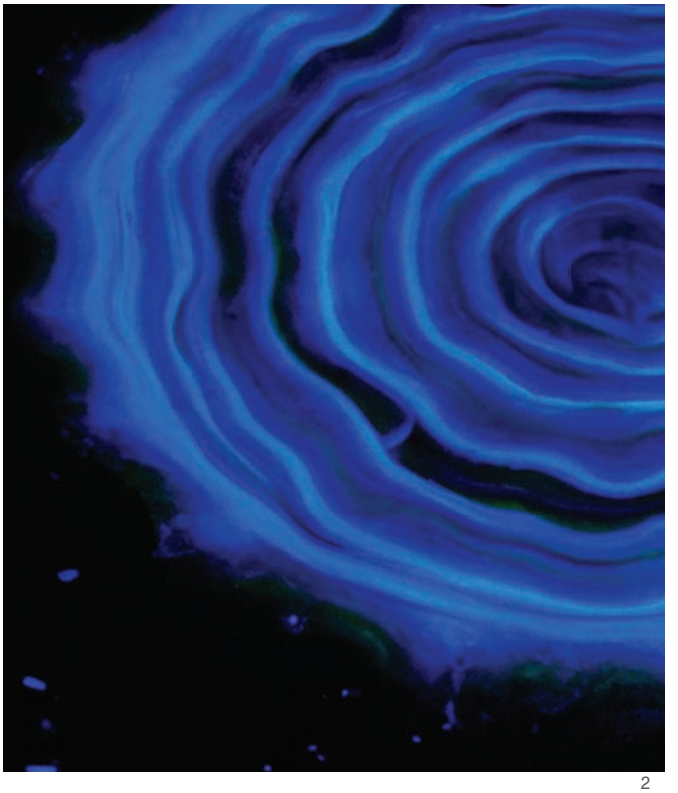
microorganism presents a unique opportunity of engagement as design material. How might we forge connection with this organism in light of our mutual ability to respond to external stimuli?

Aether, an experimental design project, focuses on expanding the performance of pyrocystis fusiformis as a design material through kinship and experimentation. In this study, I culture bioluminescent phytoplankton over a period of 8 weeks. By experimenting with various actuators such as magnetic stirrers, vibration, and cymatic rigs, I evaluate this organism's luminance and light consistency. These metrics of visual potential inspired an exploration of sound and the physical deformations it imposes on water, resulting in the interactive artifacts: *Aurora* and *Echo*.

Aurora is a soundscape co-authored by pyrocystis fusiformis and I, where I approach the organism as a material that self-actuates to produce vivid cymatic visualizations. Echo is a sound installation which demonstrates the organisms' complex, visual response to pure tones. Each of these artifacts demonstrate the results of my approach to p. fusiformis not simply as a material to be utilized, but as intelligent matter with agency in these collaborative works. By nurturing this organism and realizing the difficulty of caring for it appropriately, my experience serves as a case study of kinship in itself. In this study, I conduct ethnographic field research to assess user attitudes and potential acceptance toward my proposed artifacts. This field research alongside a phase of material exploration informed the final design of an interactive exhibition where I utilize tools including TouchDesigner, Arduino, Adobe Premiere, Lightroom, and Ableton Live.

The final artifacts in this installation exist as a spatial soundscape that fill the exhibiton space with a sound composition produced by measuring the conductivity of pyrocystis fusiformis. Using sine waves and whale calls, this composition creates a sense of poetic catharsis that has occurred through establishing kinship between myself and p. fusiformis. When the organism is stimulated by its own sound composition, it realizes new cymatic visualizations of various patterns based on the formation of the water when agitated. To achieve this effect, I built a cymatic rig which consists of a 6.5" woofer, amp, and circular plate. The sound composition is then played through speakers while pyrocystis fusiformis is suspended in the circular plate; when the organism perceives the external force via the sound vibration, it creates patterns that are organized while biologically chaotic seeming to take a life of their own. The input is the result of a co-authorship between myself and p. fusiformis, while its visual expression exemplifies the organism's quality as a design material and autonomous agent.

By capturing the essence of this ephemeral, intelligent media, Aether challenges existing paradigms of making-kin and making-with, which often relies on the modification of materials to secure outcomes. Aether, a materials-driven design project, arrives at its final expression by proposing a new form of craft which shies away from precision and instead observes chaotic compositions. In doing so, the aforementioned artifacts posit a new cultural pattern for making-with unicellular, intelligent technology. This material expression is the result of an interplay between human, machine, and pyrocystis fusiforms.



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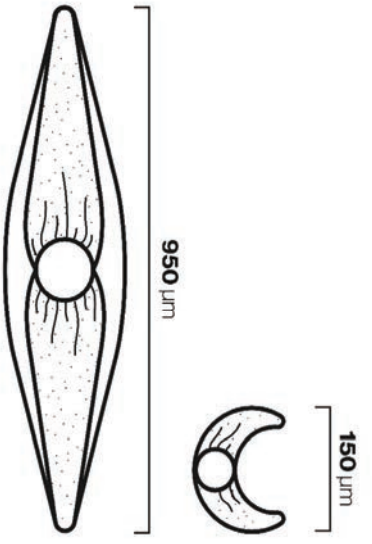
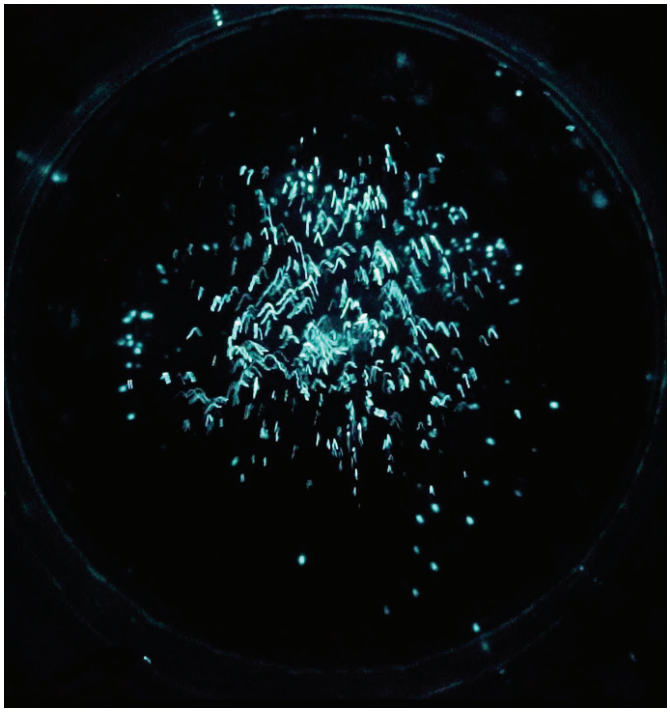


3

2 *Vivid cymatic paintings express indigo (Generated by Kaila Lee using DALLE-2, 2022).*

3 *Overview of cell structure and size between pyrocystis fusiformis and pyrocystis lunula (sal et al., 2013)*



4

5

In many ways, this study is motivated by my five-year old self who adamantly sought to be a marine biologist; a five-year old Kaila that can not imagine the potential for children in the future who cannot go for nature walks or visit the zoo to experience the joy of what is so beautiful about our home planet. I've always been connected to the water, and began swimming in the ocean at age two. From this young age, I became deeply familiar with how witnessing the ocean as an observer that is less than one percent of the earth's biomass can be exciting, humbling, and terrifying all at once. My thesis navigates this feeling and the responsibility it imbues by reimagining new relationships to living, nonhuman organisms around us as co-authors with agency and material ownership. I find my point of intervention at dissecting our co-existence with the matter around us in order to reconstruct how we understand nonhuman cognition and its value.

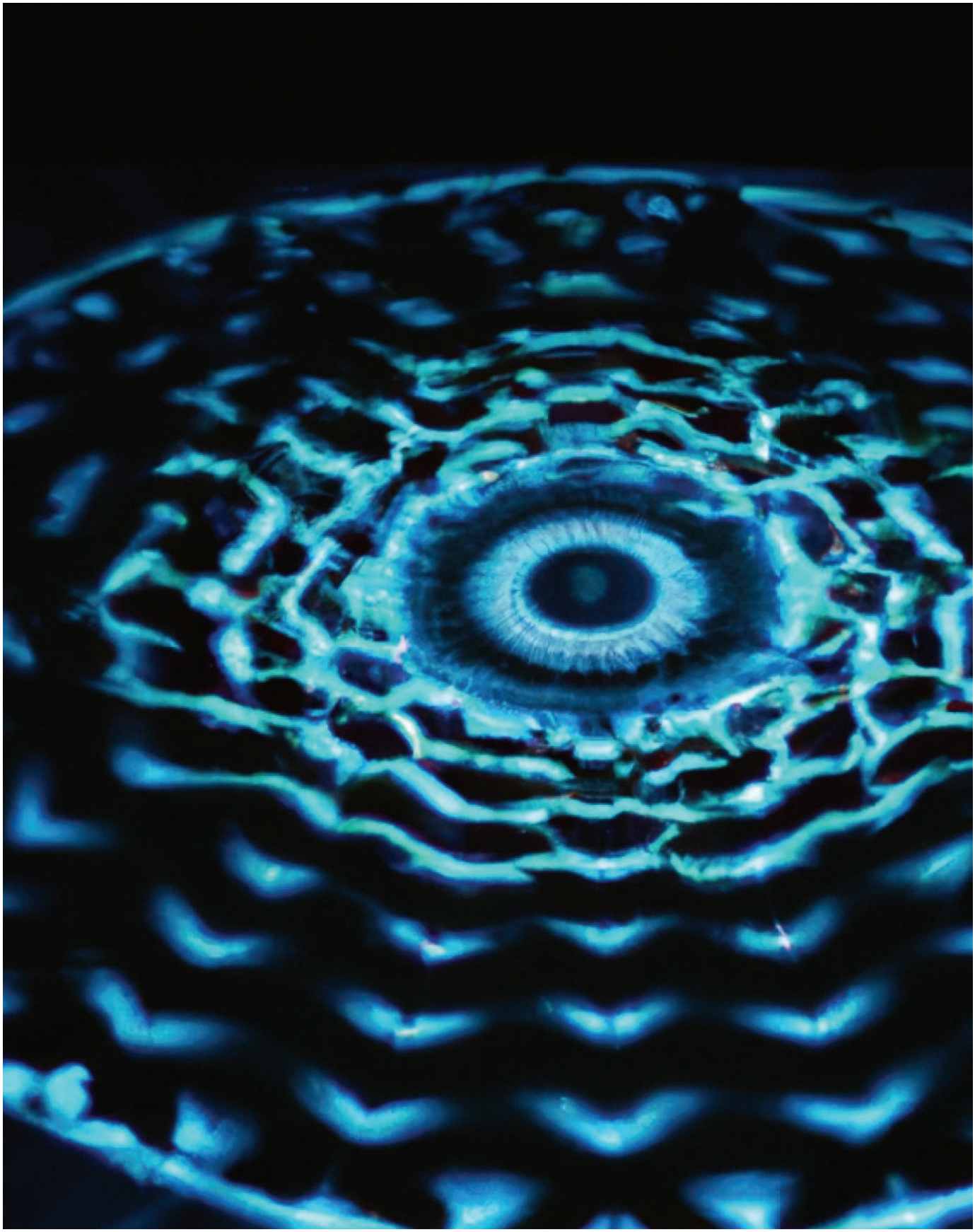
Thinkers like Neri Oxman and Donna Haraway have intimately inspired my research in their ability to nurture existing conditions and imagine wild, beautiful futures. This study is motivated by recent work which explores living organisms' potential to author sustainable materials and solutions to the ongoing climate crisis, requiring both new forms of kinship and material design. Aether aims to join discourse which decenters human-centered design, where the earth and its nonhuman inhabitants are brought into the foreground.

In light of the broad and wicked nature of the climate crisis, this project is not a practical product solution. It instead offers a more pensive take by considering the questions: What is your relationship to living matter? How might we co-author new material compositions where p. fusiformis retain agency? Aether is a discursive probe that necessitates a perspective shift to nurture life whose intelligence varies from our own.

4 *Pyrocystis fusiformis on a cymatic rig, 32 Hz (Jack Smith, 2016)*

5 *100ml of pyrocystis fusiformis culture in Erlenmeyer flasks (Van Dortmont, 2020)*

6 *Cymatic visualizations produced by bioluminescent phytoplankton (Generated by Kaila Lee using DALLE-2, 2022)*

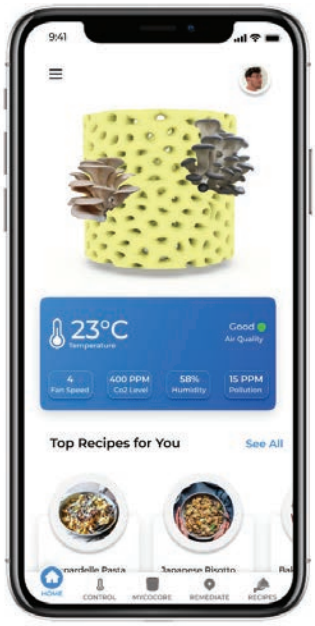


FungalForm

Jacob Kritzinger

Product design for a mycoremediated future.

1



2

FungalForm is an evaporative tower cooler incorporating a replaceable mycelium core, or MycoCore, designed to grow the user mushrooms. FungalForm has the ability to both actively and passively cool the environment around it. Furthermore, through intelligent control software, FungalForm can self-modulate its active evaporative cooling stage to provide the MycoCore with the optimal environmental conditions for mycelial and mushroom growth.

Mycelium has been proven to be highly efficient at biodegrading petroleum hydrocarbons and a number of plastics. It also acts as a hyper-effective bioabsorption agent, absorbing a considerable variety of toxins, such as heavy metals and toxic inorganic and organic chemical compounds. These attributes make mycelium an excellent candidate for aiding in the bioremediation of the world's freshwater sources.

The lack of mycoremediation adoption is due to the short time frame the United States federal regulations allow for the total removal of targeted contaminants during environmental remediation activities. (Alexander, 2019) Current mycoremediation solutions do not work quickly enough to be deemed effective by regulatory bodies. An obvious answer to this seems to be the use of an increased quantity of mycelium in the mycoremediation process. However, there is a permanent shortage of mycelium, especially when it is most needed. "...there is more oil spilled than there is currently mycelium available.". (Stamets, 2010) Refusal to adopt mycoremediation due to its lengthier remediation process is puzzling as the most common alternative methods are burning contaminants or relocation and mass storage of contaminates.

Numerous mycoremediation products have been developed over the last three decades, but none have found a successful product-market fit. Products such as MycoMat or MycoRemedy were touted as ready-to-implement bioremediation units but were never adopted in any formal

1 *Italian Oyster Mushrooms (Pleurotus pulmonarius) growing on a 3D printed MycoCore. The MycoCore is printed from Alage based PLA.*

2 *Home page of the FungalForm mobile app. The FungalForm app controls the device, orders new MycoCores, displays mycoremediation data and shares daily mushroom recipe recommendations.*

remediation strategies. One type of product which has shown more potential is mycoremediation media, such as that sold by RAPID, a South African hydrocarbon and chemical spill response company. Mycoremediation media is essentially standard bulk inoculated substrates. The major limitation with products of this nature is the stock available, as these companies are not set up for mass mycelial cultivation.

A solution to the mycelium shortage lies in the introduction of mycelium into everyday households. Instead of trying to convince regulatory bodies to invest in the development of mycoremediation products, we create consumer market demand for a product which incorporates mycelium. A product for households including a replaceable mycelium component that, when discarded, could act as a mycoremediation agent.

This thesis aims to design an evaporative cooler which houses a mycelium-inoculated grow core, with the intention of making mushroom cultivation as commonplace as the growth of indoor plants. The grow core will consist of a replaceable 3D printed form, optimised for mycelial and mushroom growth, filled with specifically formulated substrates pre-inoculated with mycelium. In addition, the thesis will include the development of a circular product ecosystem which includes biomaterial harvesting for the fabrication of manufacturing materials, mycelium cultivation processes and a mycelium product subscription network where expended mycelial cores are exchanged bimonthly.

Although the ecosystem in which this product will exist will be extensively investigated and delineated, this thesis will be limited to producing a proof-of-concept product. Therefore, the greater scope and effectiveness of FungalForm's mycoremediation potential will not be tested in situ. Instead, the project will be set in a speculative narrative where the potential impact of FungalForm will be defined. Through this integration of mycology into everyday life, we can start to heal our polluted water sources while being prepared for future contamination events.

Future work would include active integration of the mycelial cores into polluted environments, predominantly those which are a potential source of potable water, such as rivers located within urban communities.

Decades of continued scientific research has demonstrated the extensive ability of mycelium to act as an agent in bioremediation. Mycelium's ability to degrade pollutants lies in the enzymes it naturally produces to process materials into a food source. Over 120 novel mycelial enzymes have been discovered, each offering specialised degradation abilities. (Stamets, 2010) The number of studies and experiments dealing with mycelium and mushrooms has rapidly accelerated in the last decade. However, even with all the new research that has been performed, we still only know an infinitesimal portion of the possible benefits and opportunities the kingdom of fungi holds. (Briggs, 2018) There is a great need for mycelium to play a more significant role in our lives. However, currently, it is of the utmost importance to discover an effective and federally adoptable method to utilise the remediative powers that mycelium has to offer.

3

4.1

4.2

3 *Inoculating sterilised organic rye grain with a liquid Pink Oyster (Pleurotus djamor) mycelial culture.*

4.1 + 4.2 *Italian Oyster Mycelium growing on bulk substrate contaminated with heavily dyed 2-stroke motor oil.*

5

6

Designing for living materials like mycelium requires an entirely different design methodology from traditional product design. One must account for many variables that must be precisely controlled to achieve healthy mycelial growth. Instead of design for manufacturability, one could say it requires design for habitability.

Figure 8 illustrates the main stages which make up FungalForm. The first stage is the systems terracotta water reservoir and principal mode selection switch. Stage two houses FungalForm's replaceable MycoCore and active evaporative cooling system. Stage three of FungalForm comprises multiple terracotta chambers that act as the main passive evaporative cooling module. The base of stage three also houses the Raspberry Pi and power-switching components controlling FungalForm.

FungalForm is predominately controlled through a mobile app but has two power control switches integrated directly into the device. The entire surface of FungalForm's first stage controls the active evaporative cooler through capacitive touch. Due to the moisture permeating through the terracotta of the entire first stage, it was possible to integrate a Raspberry Pi and capacitive sense Hat to control the unit through any surface interaction. There is also an LED ring momentary switch located at the unit's base, primarily a safety component. Its purpose is to switch power from the mains outlet.

As designers, we should be held accountable for the impact of our designs, not only on the users but also on our world's natural environments. We must consider both the effects of creation and the implications of disposal. Through designing FungalForm and performing the research to write this thesis, it has become clear to me that we must design products with a more personal relationship with nature. We can create a beautiful dialogue between artefact and life by utilising more natural materials and actual living matter in our products.

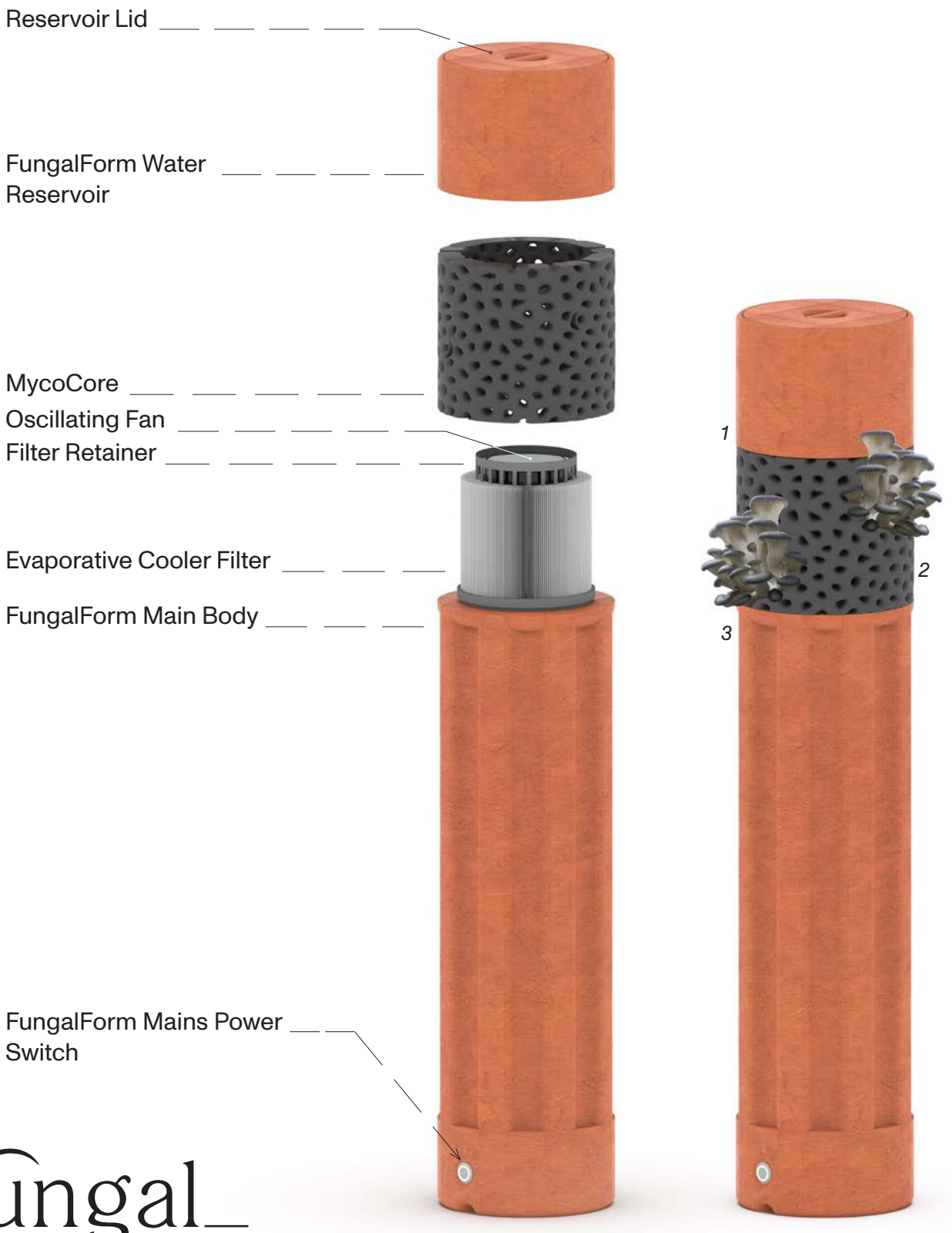
7

5 *Filling a MycoCore with Italian Oyster Mushrooms (Pleurotus pulmonarius) inoculated bulk substrate.*

6 *Product packaging for the replaceable MycoCores, including installation instructions.*

7 *Pink Oyster (Pleurotus djamor) mushrooms growing on a MycoCore.*

8 *An exploded diagram of the FungalForm evaporative cooler and MycoCore.*


Reservoir Lid
FungalForm Water Reservoir
MycoCore
Oscillating Fan
Filter Retainer
Evaporative Cooler Filter
FungalForm Main Body
FungalForm Mains Power Switch
1
2
3

Fungal_ —Form

Bio+

Amanda Yang

Proposing a symbiotic way of living

1

Bio+ proposes a symbiotic way of living through the design and experimentation of microalgae. Microalgae is an essential part of the natural ecosystem, and it is also seen as one of the most valuable future energy sources. This biomaterial can not only fix greenhouse gas emissions through photosynthesis but also serve as renewable biofuel. To picture a sustainable future, this project aims to invite microalgae to human living space by integrating this living matter with everyday objects. Within the scope of this thesis, desk was chosen as an everyday object to support the cross-species interaction. The interaction design mainly leverages microalgae's light sensitivity, which is the ability to form image patterns based on projected lighting. People can interact with the microalgae by directly drawing or writing on the desk surface. In addition to the home setting, the desk can also be placed in classrooms to educate children on the concept of symbiosis.

1 *Symbiotic desk in living space. Desk model made by Amanda Yang, background image from Freepik.com*

This project adopted an experiment based design process. Multiple experimental trials were conducted to study the habits and characteristics of microalgae. It was found that microalgae are highly sensitive to brightness and temperature change. In addition, any vibration and motion in the microalgae culture body can also cause significant change in the pattern they form. User studies were conducted to bring in the perspective of human users. Participants shared their daily interactions with desks and discussed their understanding of symbiosis. The experiments and interviews both yielded valuable insights which were fed continuously into the iterative design process. The final outcome of this project is a symbiotic desk that supports three cross-species interactions – Fax, Doodle, and Calendar. Apart from proposing human-microalgae symbiosis, the interaction design also discusses the value of natural time in this digital era.

Humans keep iterating the ways we interact with the world. People have started implementing tools with natural materials since the Early Stone Age. As the tools we use change from stones to mobile phones, our relationship with nature hasn't shifted much. Societies are built within nature while secluded from nature. In order to hold a sustainable future, we should pay more attention to the environment and other living species on the planet. How can we design our space in a way that embraces nature? Where do biomaterials fit in this digital society? Bio+ endeavors to examine cross-species interactions in the human living space. This project experiments Human-Biology Interaction (HBI) design through the exploration of the biomaterial, microalgae. The value of this living matter is pushed to its entirety in the form of digital symbiosis. In the emerging field of HBI, scientists and designers have studied methods and frameworks to utilize biomaterials in interaction design. Micro-HBI is a sub-field of HBI that targets on a microscale, diving into micro living cells and molecules. Previous works on microalgae mainly focus on their photosynthesis process. Microalgae have been used in energy sources, lighting, and art exhibitions, but little work has been done on microalgae-based interaction design. Bio+ introduces this biomaterial to human living space as a novel integration of design, science, and technology.

Previous work has targeted microalgae as a renewable energy source. The designs focusing on this biomaterial mainly center around the installation of microalgae bioreactors. Designers and scientists have explored various ways to integrate this biomaterial into our society and living space. Although numerous research and projects have been conducted, the application of microalgae is still an emerging field with gaps to be filled. Little previous work targets the interaction between human beings and microalgae. Most of the existing design projects build installations or decorative bioreactors that passively sit in people's living spaces. Bio+ aims to design a symbiotic environment in which human residents and microorganisms can actively engage. Leveraging the light-sensitivity of microalgae, Bio+ will touch on the potential of human-microalgae interaction in everyday life in the form of mutualistic symbiosis.

The main artifact will be presented in the form of a symbiotic desk which provides a biological intelligence interface for cross-species interaction. The desk supports three interactive features – Fax, Doodle, and Calendar. Users may interact with the microalgae by directly drawing on the desk. The input from human users would be captured by camera and recognized by computer vision algorithms. The microalgae in the desk will then form visual output feedback through calibrated photosynthesis. The desk itself is also a bioreactor to sustain microalgae reproduction. The design of the desk and its interactions also prompt people to think about the value of natural time in this digital era. Efficiency, a glorified term in modern society, is deliberately played down in this symbiotic design.

The nature of living materials fosters an experiment-based design process. Microalgae have to be grown with care in a specific environment. It comes with great difficulty to predict the growth and behaviors of this active microorganism. Bio+ is carried out based on experimental results and insights, which also significantly influence the ideation and design stage of the project. Compared with the typical interaction design process,

2

3

2 *Previous microalgae bioreactor design from the Bit.Bio.Bot exhibition by EcoLogicStudio*

3 *Microalgae pattern developed from image projection over 4 days*
Photos taken by Amanda Yang

4

5

working with living organisms requires extensive scientific research and time-sensitive prototyping.

In this project, electronics and algorithms are used to bridge the interactions between human users and microalgae. The input generated by humans is detected, converted, and presented by electronic processors. Here Bio+ proposes a model of modern symbiosis, in which technology serves to support double-sided cross-species translation. Essentially, technologies are used to translate human intelligence into the 'language' that microalgae speak. The translation should also be able to proceed in the reverse direction, which means microorganism behaviors can be converted into human language as well. Bio+ applies this model to a simple everyday object. It is believed that the model is also replicable on a greater scale, and symbiotic design has great potential in the fields of architecture, industrial design, and city planning.

Within the period of three months, Bio+ mainly focuses on experimentation, research, and interaction design. Other aspects of the symbiotic scenario, including microalgae recycling and renewable energy collection, have not yet been thoroughly explored. For next steps, Bio+ aims to explore symbiotic objects as sources of renewable green energy. Ideally, electrical energy can be extracted from bioreactors during photosynthesis, and replaced microalgae culture can be collected by oil refineries for biofuel production. As energy shortage becomes an urgent issue in this century, Bio+ pictures a biological crowdsourcing approach to gather sustainable green resources. In the future, more research and experiments will be conducted to verify the practicality of this future envision.

4 *Microalgae patterns formed when Petri dishes were placed outside on patio for 3 days*
Photos taken by Amanda Yang

5 *Symbiotic desk in classroom setting (classroom background from Demco Interiors)*

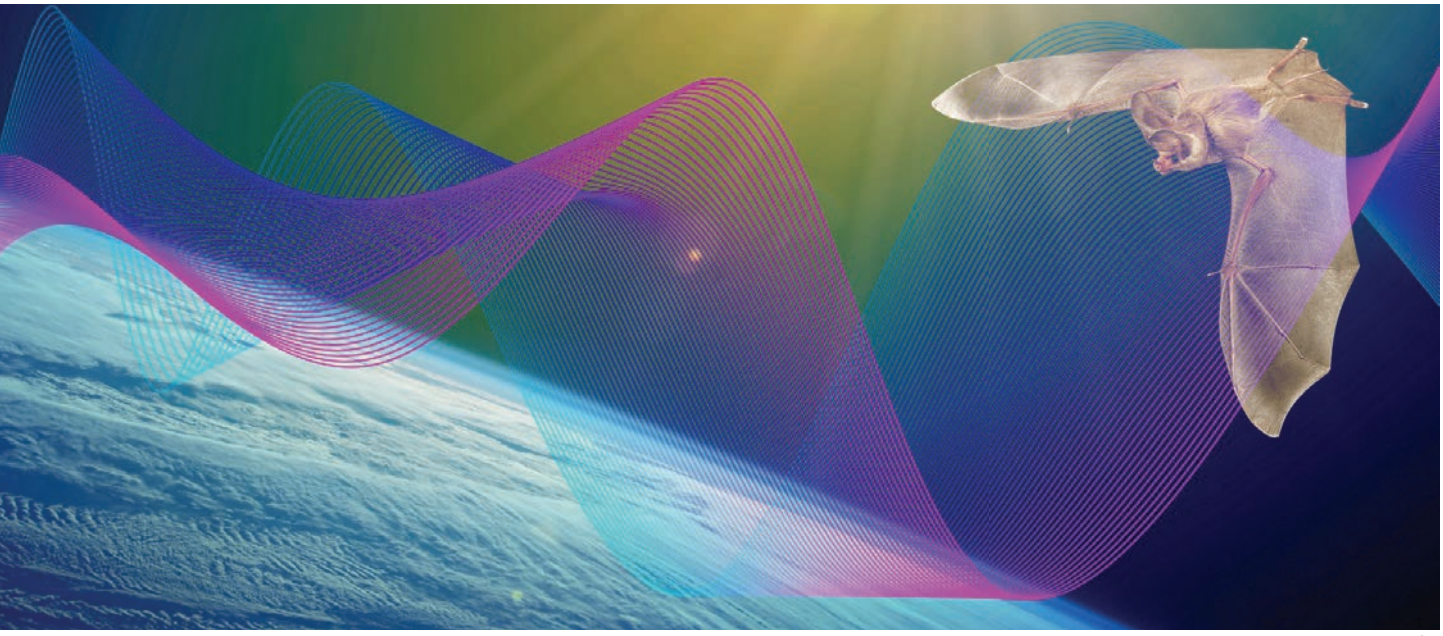
6 *Symbiotic desk with interactive features: fax, doodle, calendar*


HI. HOW ARE YOU
Miss You
KATE
SAVE
field trip!

Bat Babble

Roland Saekow

Listening to bats to prevent the next epidemic



1

Public health systems rely on data to save lives. The natural world that surrounds us is constantly sending us signals. But we are not listening. Today, much of the work in the field of public health is consumed by reactionary measures. Once a disease has jumped from animal to humans and begun to spread, the effort shifts to curbing the spread. The moment for prevention at the source has passed, and mitigating the spread becomes the focus.

But what if we could get ahead of the next pandemic? The answer may lie in our ability to listen to some of the smallest creatures that soar off into the sky each night– bats. Over millions of years, bats have evolved a unique immune system that allows them to co-exist with many viruses. Bats therefore act as natural reservoirs, including many coronaviruses. Monitoring the health of bats can serve as an early warning system for the next pandemic.

1 *Listening to biological signals like bats can help prevent the next epidemic. Bat photo by Michael Durham/Minden Pictures, Bat Conservation International. Earth photo by NASA.*

Problem Statement

Monitoring bats at scale is a time consuming and manual process. Today, specially trained teams of field researchers hike and climb to cave entrances where they deploy nets to catch bats as they exit. Once captured, the bats are subjected to a barrage of procedures including drawing samples of blood. USAID's Emerging Pandemic Threats (EPT) program and the North American Bat Monitoring Program (NABat) have organized much of the work to date.

Automation is the natural response to this problem. If the health of bat populations around the world could be routinely monitored, then researchers could gain valuable insights to save lives in a preventive framework. Such systems could provide data streams from otherwise inaccessible and remote caves.

Methods

The method of finding this answer may lie in monitoring the social behaviors and movements of roosting bats within caves. Bats are highly social creatures, and studies have shown that much like public health measures implemented in human populations for social distancing, sick bats will distance themselves from the colony by roosting away from other bats in times of illness. Sick bats will also perform a type of self-imposed lockdown by staying within their caves, preventing the spread of disease to other nearby bat colonies.

A range of sensors is evaluated for their suitability to monitor roosting bat movements including acoustic, infrared night vision, light detection and ranging and thermal imaging. Selection criteria will be based on accuracy, endurance time and deployment costs. The outcome of this work is the design of a low cost panoramic thermal imaging system which can be affixed to cave walls to monitor changes in bat social behaviors and movements as a proxy of their health. By unlocking data from bats, public health officials can be better equipped to make life saving decisions.

Limits

Working with bats and navigation of caves requires safety training and obtaining multi-dose pre-exposure vaccines for diseases such as rabies. Bat guano (fecal droppings),which lines the floor of caves with active bat populations, is classified as biological hazardous waste. In lieu of working directly with active colonies of bats in caves, a bat conservancy, show cave and conferences involving both caves and bats were attended and consulted. Testing of the prototype thermal imaging system was performed with faux bat replicas with internal heaters to simulate their body temperatures at exterior natural rock walls.

Significance

Development of a global monitoring network for bat health has the potential to equip public health teams with data to act proactively for future emerging threats. Field scientists would only need to visit caves that are detecting anomalous data. The platform could be further augmented to monitor additional animal species. Bats exist throughout the world on all continents except Antarctica. Listening to bats can change the course of human population outcomes nearby and abroad.

Future Work

Many projects and efforts exist to monitor bats. The described prototype is only one piece of the puzzle. Future work may involve the synthesis and analysis of trends from a variety of sources including sensors placed within and outside of caves. Since bats can fly long distances each night, and some species migrate long distances, how might the data sources across entire regions be pieced together to tell the broader story of bat health globally? Future research should continuously evaluate the appropriateness of new sensor technologies, especially ones suitable for the biological needs of different bat species that exist throughout the world.

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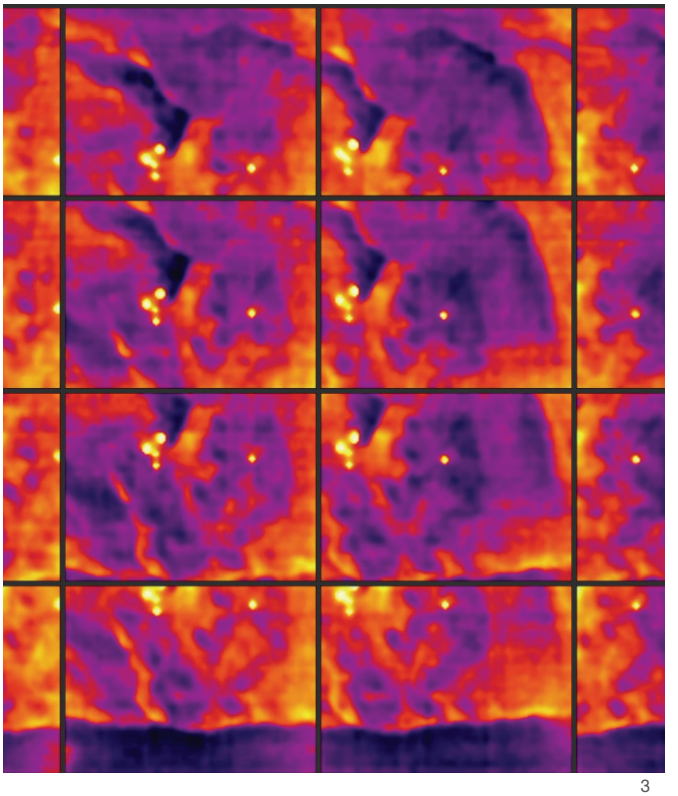

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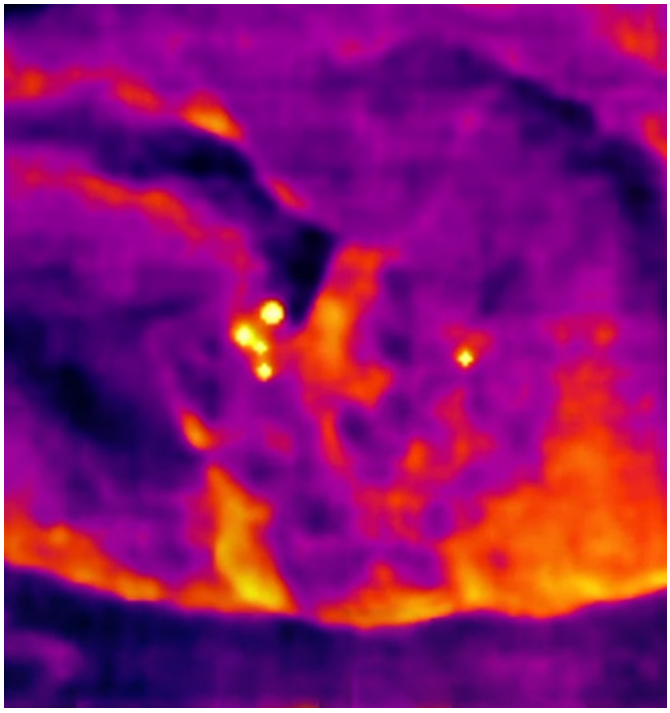
2 *Creating panoramic thermal images with an infrared detector and motorized tripod mount*

3 *A series of photos are extracted from rotating video footage and are stitched together*



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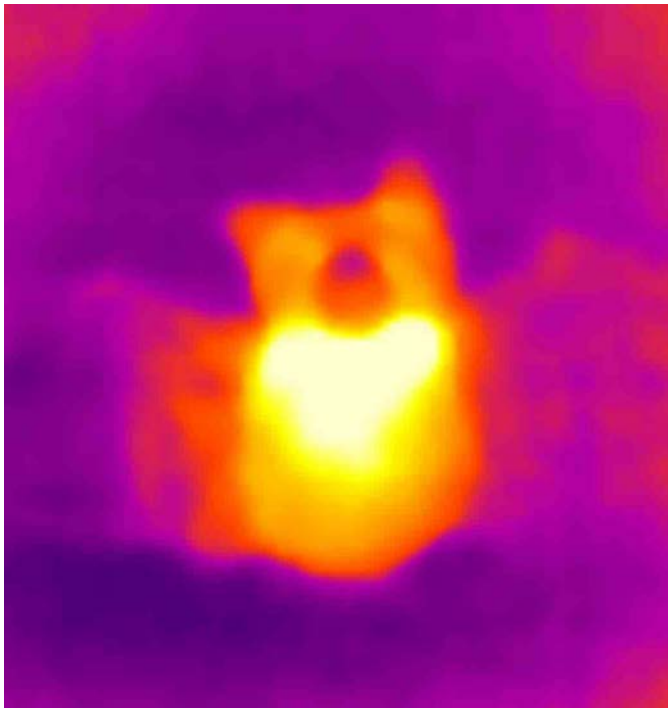

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Enclosed in a smooth plastic half dome to prevent any bats from latching on, the field monitoring unit of Bat Babble contains a two axis rotary mechanism. This mechanism rotates the narrow field of view of a consumer grade thermal imaging unit in a 180 to 270 degree coverage zone. The thermal imaging sensor used is a Seek Thermal Compact XR unit costing $150 with a pixel resolution of 206 × 156. The field of view is narrow at 20 degrees, making it a candidate for panoramic stitching to create a wide capture of the cave interior and bat locations.

The rotary movement also captures portions of the cave floor including guano deposit locations. The presence or absence of guano deposits under isolating bats can be used to correlate bat roosting positions. Temperature of the bats and their guano can also be logged for future and historical comparisons. The thermal imaging sensor is moved in a grid like pattern with the resulting images stitched together to form a panorama. Panoramas are then compared against one another to map the change in bat positions. If a threshold of bats roosting in pattern meeting the threshold where social distancing is detected, then the communication module can be activated.

Power and communication is supplied via an umbilical cord to the cave entrance where a weatherproof storage box contains the power and radio communication packages. This minimizes the need for deep servicing of the unit by externalizing power and data logger access at the foot of the cave.

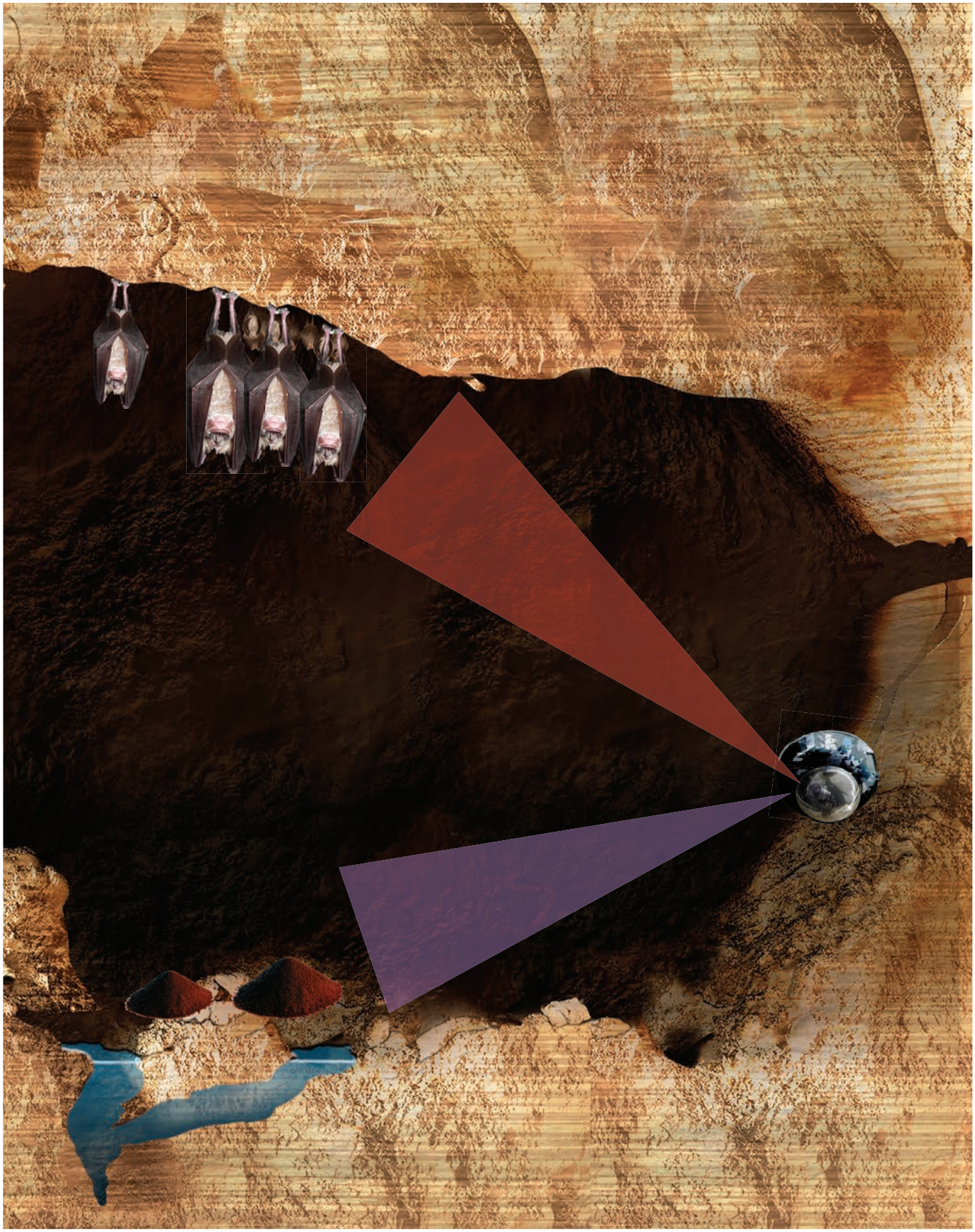
Development of a bat health monitoring network can equip public health teams with data to act proactively for future emerging threats. Field scientists need only to visit caves that are detecting anomalous data. The platform could be further augmented to monitor additional animal species.

Listening to bats can change the course of human population outcomes locally and abroad.

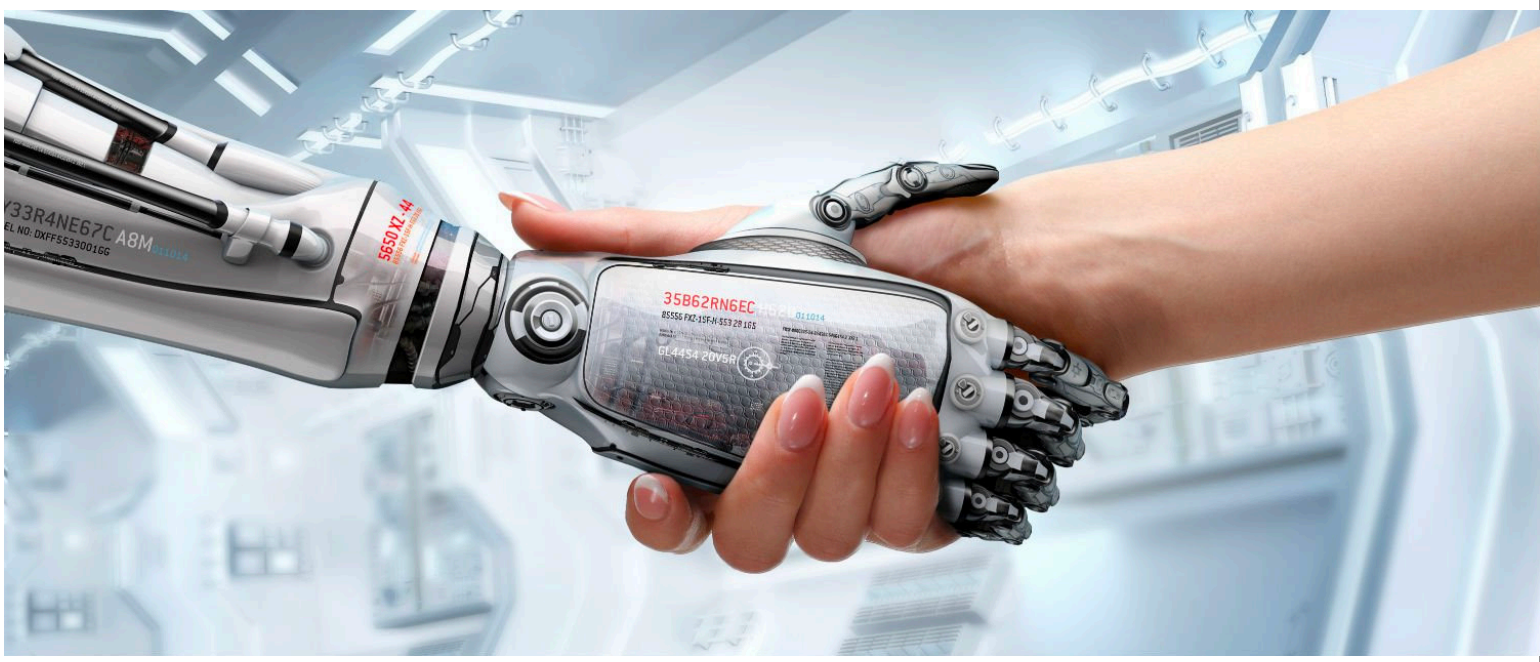
4 *Completed thermal panorama showing glowing locations of simulated bats along rock wall*

5 *Thermal image close up of simulated bat with internal heating element used for calibration and testing*

6 *Panoramic thermal imaging camera for bat cave monitoring. Cave background by Nicolle R. Fuller / Science photo library. Bat photo by Marie Jullion. Heap guano photo by Simon A. Eugster. Crystalline texture by Armin Kübelbeck*



THE BEST ASSISTANT/FRIEND FOR YOU!



The purpose of this cluster, the best assistant or friend for you, is to analyze user characteristics using technologies such as artificial intelligence or machine learning and to provide desired functions by personalizing them accordingly.

We thought about how to deliver the fruits of this emerging technology to a variety of users without focusing on the technology itself. Projects within this culter focus on a number of topics, such as:

- Exercise that helps people live a healthy life
- Creativity that can help with artistic activity that inspires culture
- Removing barriers to conversation for people who have discomfort due to disability
- Giving users the choice of content they want

Our cluster has conducted research that can solve various people's daily problems and make their lives richer.

Will AI (Artificial Intelligence) become a good friend to humans? AI, which was designed to enrich the lives of mankind, has recently been embroiled in various controversies, such as bias and side effects of algorithms. It's not just AI. The Fourth Industrial Revolution technologies such as big data, IoT, robots, and life sciences can become a double-edged sword depending on how they are used in the future.

For example, the number of stores that have installed unmanned kiosks has surged especially since the COVID-19 pandemic. Not only fast food restaurants and restaurants, but also cafes, convenience stores, theaters, and large marts are introducing it one after another. However, complex operation methods, screen configurations, and unfamiliar digital terms are not easy challenges for the elderly and the disabled, as well as for the middle-aged with relatively high

digital adaptability. It is pointed out that technology that helps humans is rather alienating them.

Obviously, on the other hand, the development of AI and machine learning has helped human life a lot. The translator has almost eliminated the language barrier between people, and now everyone owns an AI assistant like Siri. In this digital age where new technologies are emerging every day, the question is:

“How will we use these new technologies?”

Even though a lot of new brilliant technology continues to be invented and developed, the important thing is the direction of use, and our cluster believes that it is the designer’s role to lead it in the right direction. Will technology be for the Tech? or will Tech be for people?

The formal definition of artificial intelligence is “the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings.” Artificial intelligence is a powerful tool in enhancing software experiences to better meet users’ needs. Machine learning is a branch within artificial intelligence that “focuses on the use of data and algorithms to imitate the way that humans learn, gradually improving its accuracy” (IBM).

This cluster focus on utilizing AI to facilitate and assist people’s diverse activities and fully enjoy their life and art activity. In this cluster, we will be exploring how tools integrated with AI/ML algorithms can create tools that facilitate inner creativity and social interaction. Our focus will be on how people communicate and grow conversations while ensuring our tools are accessible and easy to use for our target audience.

Within this cluster we explore the following:

Sora Kang introduces a new concept called ‘Theatrical Language Processing’ (TLP), and an AI-driven creativity support tool called ‘Scribble.ai’ for actors as an application of TLP.

Scribble.ai is developed in order to augment actors' creativity and spark spontaneity and it generates improv-purposed scripts for dialogues and monologues, based on TLP.

Debbie is interested in using machine learning to tailor user experiences to each individual's needs. In addition, to use tools such as TensorFlow to take inputs and train that data to support to user in navigating software experiences.

Dongho wants to help people for those who want to learn how to exercise on their own by providing the result of detailed analysis with AI and matching the video of professional athletes who are most similar to the user.

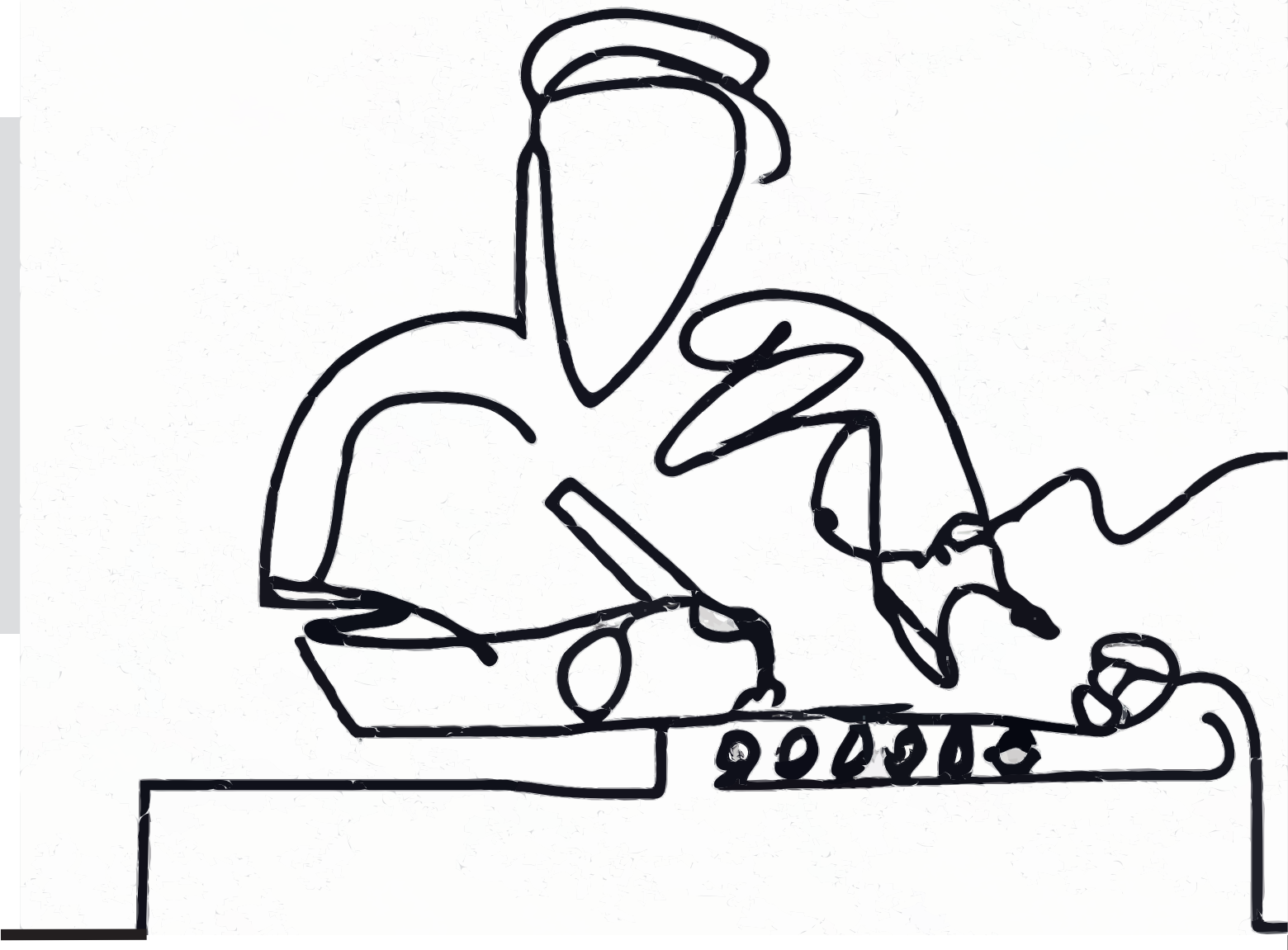
Zhipeng is interested in how feeds algorithm shape our perception about the world, he wants to propose and provide a plug-in for Chrome-based browsers that provide users countermeasures against the social media, resulting users with a broader perspective and breaking the phenomenon of information cocoons and echo chambers.

The focus of our cluster is to learn together and support each other in executing machine learning algorithms. In addition, our goal is to make our project accessible for everyone regardless of their financial situation, their disability or difficulty,

SCRIBBLE.AI:

Sora Kang

Theatrical Language Processing and an Application in an Improvisational Theater Script Generation Tool using GPT-3
#Creativity Support Tool for Actors



"All the world's a stage, and all the men and women are merely players." Jaques said, in As You Like It (Shakespeare and Dusinberre 2015, Act II Scene VII Line 139). Today, computers make digital worlds – stages – providing a space in which people can perform their own scenes.

Experiences shape us. New stimuli and unfamiliar situations have a considerable impact on our creativity and psyche. Actors train using improvisation exercises to expose themselves to novel stimuli. Improvisation exercises and training involve entering a creative state of mind, allowing actors to "live truthfully under imaginary circumstances". In this project, we introduce a new concept 'Theatrical Language Processing',(TPL) and an AI-driven creativity support tool called 'Scribble.ai' for actors as an application of TLP. Scribble.ai is developed in order to augment actors' creativity and spark spontaneity, which will ultimately help them to come alive on stage. This tool generates improv-purposed scripts for dialogues and monologues, based on TLP. With this tool, actors can practice with custom scripts written by AI and practice improvisation in an interactive manner.

Acting is the process of new character creation and development. In other words, it is the study by which an actor creates a character based on the script and transforms themselves into that person (Green 2018). The bigger theme, theater is about interaction among humans, which includes questions and conflicts, collapse, dreams and steps to those dreams, victory, tension, and then the resolution to that tension. On the other hand, Human-Computer Interaction (HCI) is the study of how humans (man) interact with computers (machines), and it is like a theater in the sense that it creates digital stages that have a special relationship to reality (Laurel 2014). Accordingly, since both theater and HCI studies have their goals to understand the way how human beings interact with each other and behave, we believed that there is a clear advantage in combining these two areas. Furthermore, we have found that theater studies have already begun to appear in interaction design. As an example, 'scenarios' are widely accepted as a tool to research the profound user experiences within the design requirements and specifications (Macaulay et al. 2006). We expect that this study can further emphasize the importance of research on human-computer interaction combined with film and theater studies.

This project mainly focuses on improvisation acting, one of the main subfields of theater. Improvisation is one of the most essential skills for actors, as it is very common for an actor to be asked to perform improvisational work. The author also did a lot of improvisation throughout her acting career: from auditions to practice, and even on stage or at a filming site, and has found that improvisation acting is valuable since improvisation forms the 'reality' on stage or filming site. This prevents the 'Mannerism' stage wherein actors that become too accustomed to their lines no longer perform normal mannerisms since they already know what is going to be said (e.g. not pausing before responding to another actor's line). More specifically, once actors get used to the lines and script after a lot of practice, they tend to act as planned. As a conversation is ultimately a 'reaction', actors should listen to what other actors are saying, and they think and respond to them. However, once actors memorize all the lines and get familiar with them too much, it is indeed easy to 'speak' rather than 'tell'. It is 'not real doing', hence, this bores the audience. Actors want to prevent the 'Mannerism' stage as well as live in the moment on stage and in front of the camera. This became the primary driver of improvisation theater.

Two main points of improvisation are unpredictability and interactivity. In other words, improvisational activities shouldn't be pre-planned or easy to predict so actors can stay alive and truly interact with each other from moment to moment. Moving on to the technical developmental approach of this tool, a GPT-3 model which is a Recurrent Neural Network(RNN) model has been used for this project to deal with the two main points 'unpredictability' and 'interactivity'. Since RNN is designed to mimic the human way of processing sequences as a type of Neural Network where the output from the previous step is fed as input to the current step, it has the ability to make real-time conversation according to the user's input (Sherstinsky 2020). Additionally, as an artificial intelligence-driven tool, it also has the potential to write more unique and distinct scripts for actors who are already familiar enough with human-created scripts.

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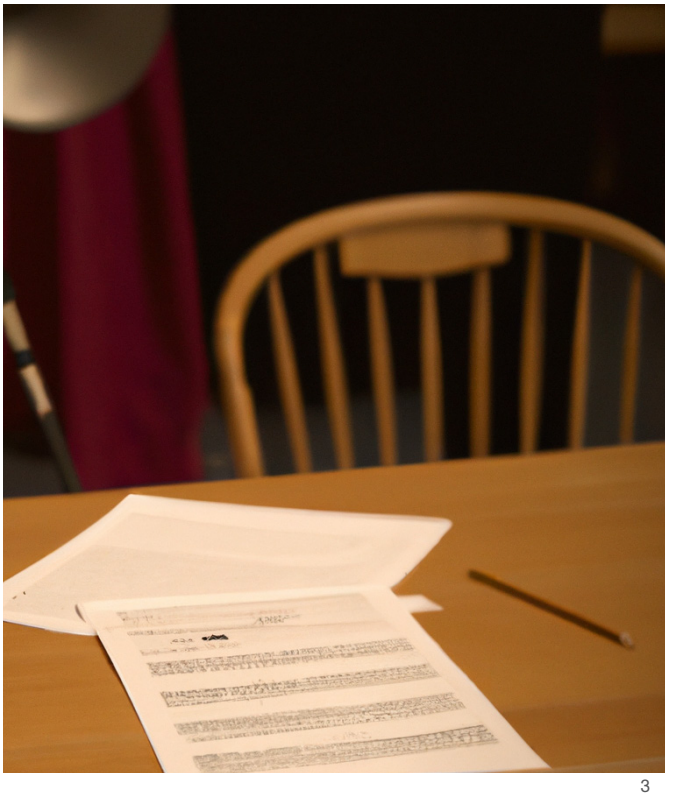


3

2 *Improvisational theatre rehearsal (fictional image)*

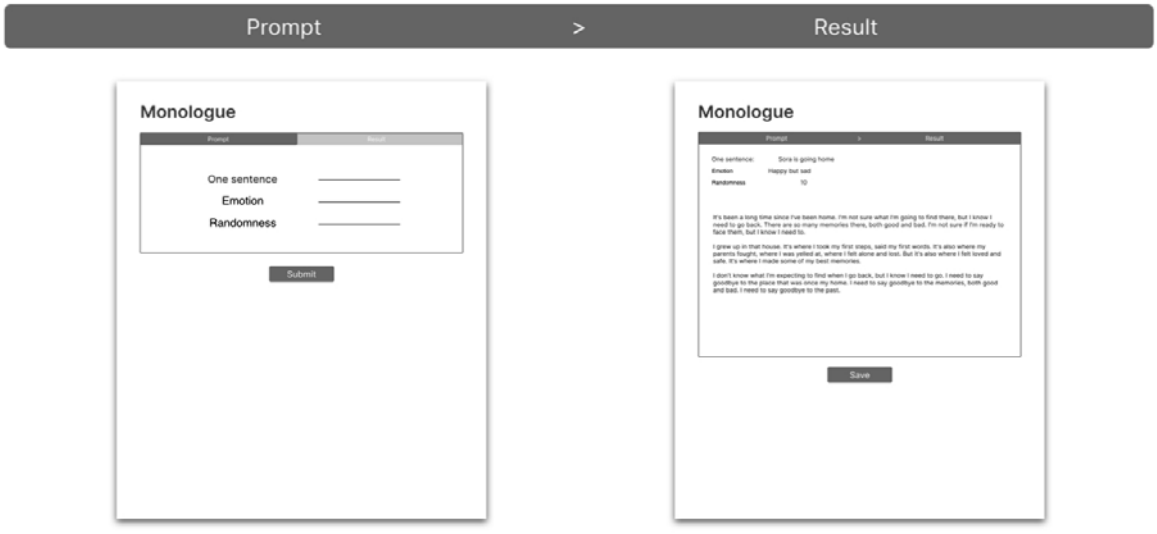
3 *Improv-purposed script (fictional image)*

Interactive Dialogue Generation

To break down each stage, there are three required inputs in the 'Idea Input' stage - keywords, genre, and randomness. Based on the three inputs, AI will generate a script with a short summary and dialogue, and show the output as a result on the interface. In the next stage 'Conversation', users can input a new line or new prompt in case they want to further develop the story with AI. For example, users can simply type in the textbox "Sora: I want to go home", or "The girl named 'Jessica' comes and try to talk to the people", and the tool will generate the next part of the conversation or story based on the new input. It allows users to interact with the tool on a real-time basis in the form of conversation. In the last stage 'Scriptzing', the user can finalize their scripts and reformat them into a screenplay format. Since the target users are actors, this function puts the story in a format that the users will be familiar with, displaying the contextual information provided by the screenplay format. This tool also provides an export functionality where the user inputs and all the generated texts – the summary of the story and the finalized scripts – are written into a .txt file.

Monologue Generation

This tool also provides a monologue writing function based on three user inputs - one sentence, emotion, and randomness level. It calls the 'mono_writing' function in the backend on the three inputs and prints the output of 'mono_writing'.



To lay out the interaction system, the goal for each user (human) and AI in the tool must be clearly defined. Users wish to get a new well-written script for improv practice in a fast and convenient way. On the other hand, the AI is tasked to understand the user's language and process it to generate a unique script based on their input. Additionally, it is important to establish what the human's capabilities and limitations are. Our limitations, from the perspective of HCI, are the following – individual differences, perceptive capability, human error, special needs, and variable states (Webb 2022).

Since we each have our own language and unique needs, a critical decision was to select inputs that allow for broad usage but also ask the users to provide information that can be readily understood by the AI. Hence, we used what we believe is the smallest number of inputs needed so that each function can be utilized most effectively, and work best alongside the other functions, while still providing enough breadth for the user to customize parts of the scripts to their liking. Lastly, throughout the project, we examined how actors interact with the AI, how they utilize the tool in their improv activities, how they feel about using AI-generated scripts, and how AI understands human language.

Richard Feynman and Stephen Hawking are two of the world's most brilliant minds.

But when they're not working on their latest theories, they're bickering like an old married couple.

Hawking: I'm telling you, Feynman, there's a black hole at the center of the universe!

Feynman: Oh, please. Everyone knows that there's no such thing as a black hole.

Hawking: Fine. Prove it.

Feynman: I will! Just give me a few minutes...

Feynman: All right, I'm ready.

Hawking: What took you so long?

Feynman: I had to run some calculations. And, actually, you're wrong. There is a black hole at the center of the universe.

Hawking: I knew it! I told you so!

Feynman: But it's not what you think. It's not some giant monster that's going to suck everything in. It's just a tiny little thing.

Hawking: That's not what the experts say!

Feynman: Well, the experts are wrong. I've done the math, and I know what I'm talking about.

Hawking: Fine. Prove it.

@Scribble.ai-generated scripts

Feynman: All right. Let me show you my equations. See, here's where you're going wrong. You're assuming that mass is constant, but it's not. As things get closer to the black hole, they start to move faster, and their mass increases. So your equations are all off.

Hawking: Hmm. I see what you're saying. But that doesn't change the fact that there's still a black hole at the center of the universe.

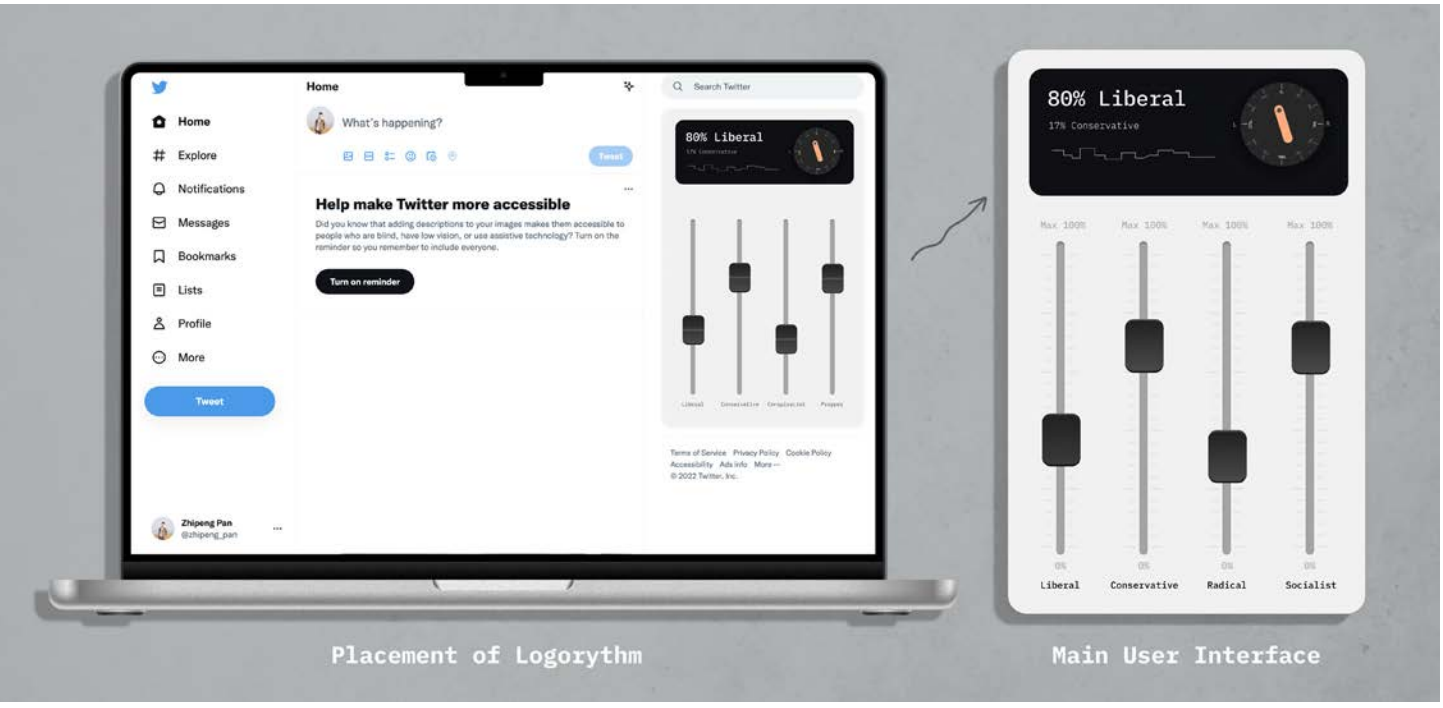
Feynman: Actually, it does. If you take into account the changing mass, then the black hole disappears.

Hawking: What? That can't be right

Logorythm

Zhipeng Pan

A Social Media Feeds Control System



1

Algorithms are a double-edged sword: they make it easier to stay informed about new content of interest to us, but they also shape how we see the world. The algorithm behind Twitter's daily feeds that tailor what we see each day to our tastes only compounds the negative effects of this phenomenon, such as political manipulation, technological addiction, echo chambers, and fake news, leading to mental constraints, ideological polarization, and limited horizons. News feeds algorithms have progressed from simply enclosing users in filter bubbles to presenting an entirely different reality for some (Cinelli et al., 2021).

The media informs us about happenings that occur outside of our immediate surroundings, and editors select the feed we see daily (Cinelli et al., 2021). This project investigates how to implement countermeasures as a tool or system against the current feed recommendation mechanism to provide social media users with a broader perspective and break the phenomenon of information cocoons and echo chambers.

The project proposed and provided a plug-in for Chrome-based browsers that provide user countermeasures in three ways:

1. Using anti-algorithms to combat existing feed algorithms. 2. Controlling feeds parameters and content recommendation mechanisms via engaging interaction. 3. Utilizing data visualization to display and educate users to view the world beyond traditional patterns.

Based on these three main functionalities, this project aims to create an interactive system with an alternative lens for navigating social media content. Users can access a vast world of information by having the ability to adjust Twitter feed's content, refresh feed recommendations, and view data visualizations of browsing history analysis.

1 *Image of the placement of Logorythm software and introduction of key user interface*

The final design produces a variety of prototypes, including workable prototypes, product design, user interface design, and 3D printing. Prior to 3D printing, the shape and attributes of the Logorythm are determined and specified using innovative methods. In the initial phase of project development, the functional prototype will rely on Chrome extension plug-in. In the next phase of the project (not for this thesis period) , a physical controller will be implemented based on an industrial controller.

The software interface will be placed on the right corner of the screen to achieve better readability. Users can open or close the interface by opening or closing the chrome extensInteraction: The user can interact with the program on the left side of the screen by dragging the slider ion icon. The fundamental interface comprises two components: the political detector and the feeds parameter controller. The political detector will reveal the political status and composition of the current feeds. The feeds parameter controller will allow the user to set the political ingredient's percentage level.

Three primary features of Logotythm

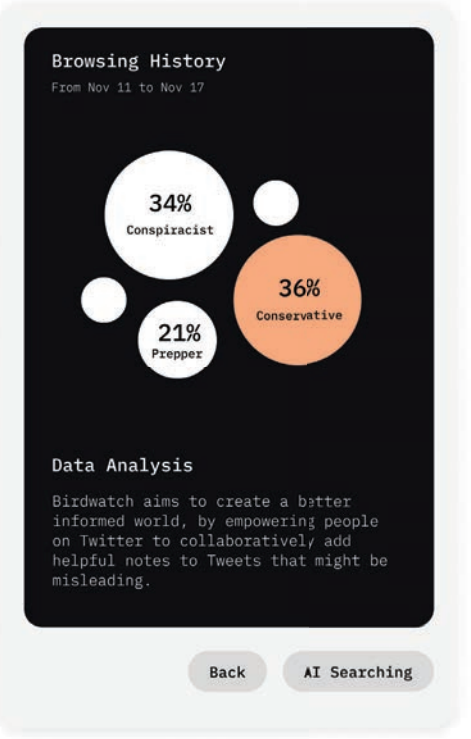
First feature is feed content modification and control. There are a lot of hidden political standings in the current Twitter feeds. By providing a variety of political standing parameter modifications, the system can call and extract feeds from the Twitter database, giving user-defined feeds in order to fulfill the goal of providing more different perspectives of feeds.

The second feature feeds browsing history analysis. The system will detect and analyze the user's browsing history of feeds over a specified time period and record the analysis results. The result will show in a data visualization format that shows the browsing history over a certain period, as well as the political types of feeds

Technology structure: It provides users with more intuitive display results by utilizing browser history extraction and analysis techniques. This method can extract Chrome browser access records from the Twitter database, filter and display the records based on periods, and by analyzing historical records, it is possible to associate search terms with search engines or display them based on periods. (Xue, n.d.)

On top of this, data visualization of historical records, in order to provide more playability and educational value, achieves its objective of encouraging. The data visualization of the user's surfing history will be developed into two parts: a network map of opinions and a more comprehensive data analysis. Regarding the network map of views, users can utilize the center as an axis to travel around and explore the nodes related to the center, thereby expanding their perspective of the world. Thus, according to the project's objectives. In addition, more granular data analysis includes the precise moment of seeing each point of view, comparative data, etc., which can assist and educate users on how to check their feeds, surfing records and interaction patterns in a more comprehensive manner.

The third feature is the Feeds refresher. Twitter's feeds are reset with a single click. By pressing the "Refresh" button, the current



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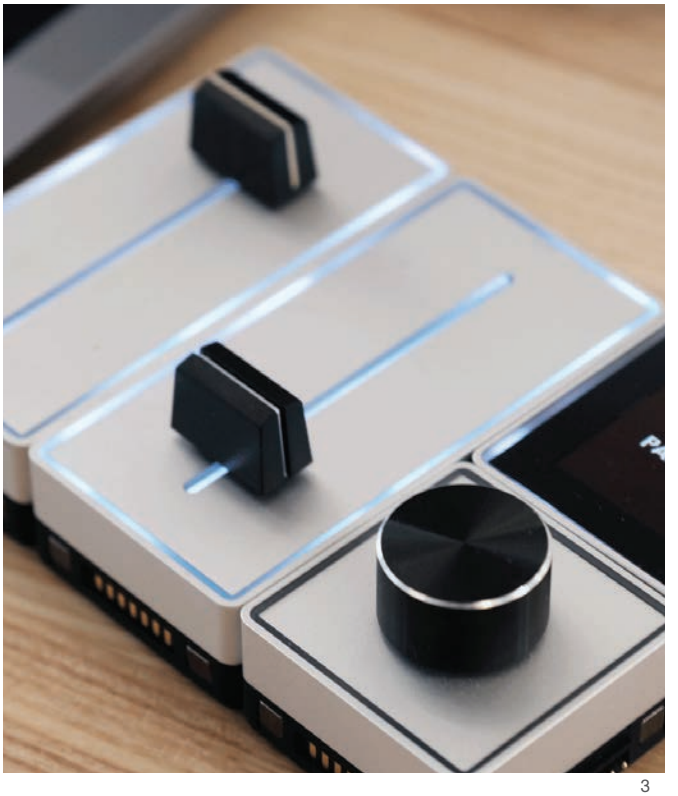

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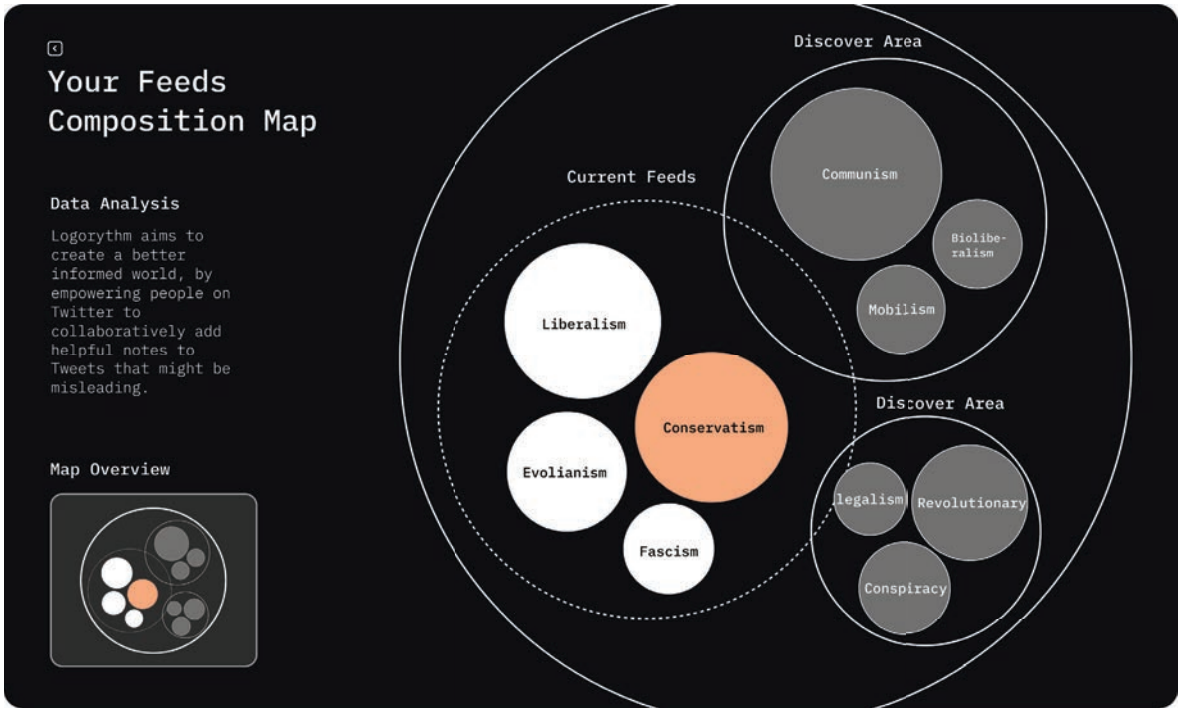
2 *Data visualizaiton of browsing data history*

3 *Hardware, based on palette expert kit*



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4 *Data visualization of political standing map based on existing browsing history*

5 *The hardware setup of Logorythm.*

user's Twitter recommendation can be quickly reset so that they can perceive multiple perspectives.

The technical working logic: when the program starts, it crawls 100 Twitter feeds from others feeds based on the system database to form a list; then it detects whether the "refresh" button is pressed, and if the button is pressed, a random array with 100 elements is generated; this array contains 100 unique values from 0 to 20, such as: [2,3,1,4,6,8,5,19,15...], and these values are used as the serial a number of the new push content, according to the system. The 20 tweets are rearranged by these serial numbers.

This project studies opportunities to integrate countermeasures as a tool or system against the present feed suggestion mechanism in order to provide users of social media with a broader viewpoint and break the phenomena of information cocoons and echo chambers. The project proposes a plug-in for Chrome-based browsers that provides user countermeasures in three ways: 1) employing algorithms to counteract existing push algorithms; 2) changing the parameters of feeds and content recommendation mechanisms through interactive means. 3) presenting and educating viewers to view the world outside typical patterns through data visualization.

I improved my C4D skills while working on the investigation and design phases of this project by creating 3D-printed models. I improved my 3D modeling and rendering abilities as I worked on the physical model, which helped me gain a deeper understanding of industrial design. When interaction design and data visualization are combined, the playability of the data visualization is improved, and the product as a whole is improved.

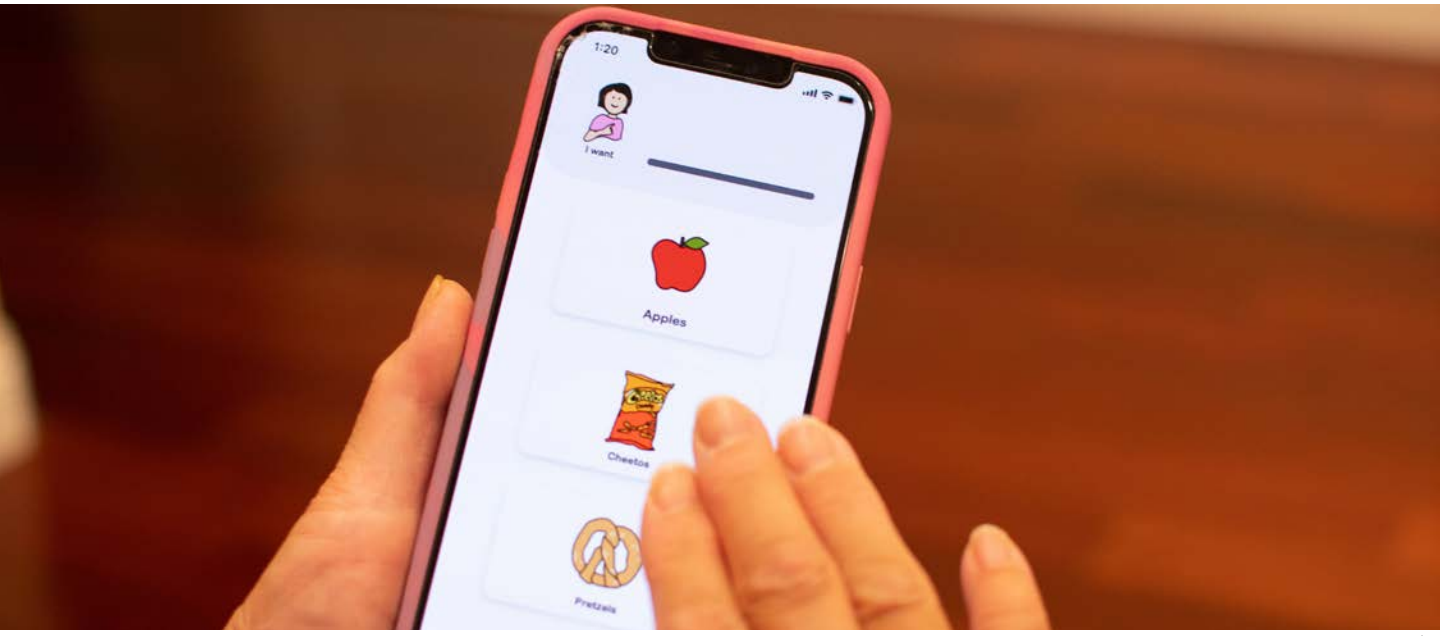
The intention of the Logorythm project is to provide a critical and speculative challenge to the existing state of the social media world. My goal is to encourage users to think critically about their social media experience. Additionally, the very presence of the initiative itself presents a challenge to the existing social media environment. Logorythm's potential has not yet been fully investigated.

5

Project Euphemia

Debbie Yuen

Reimagining the future of communication technologies



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1 *First iteration of Euphemia mobile application*

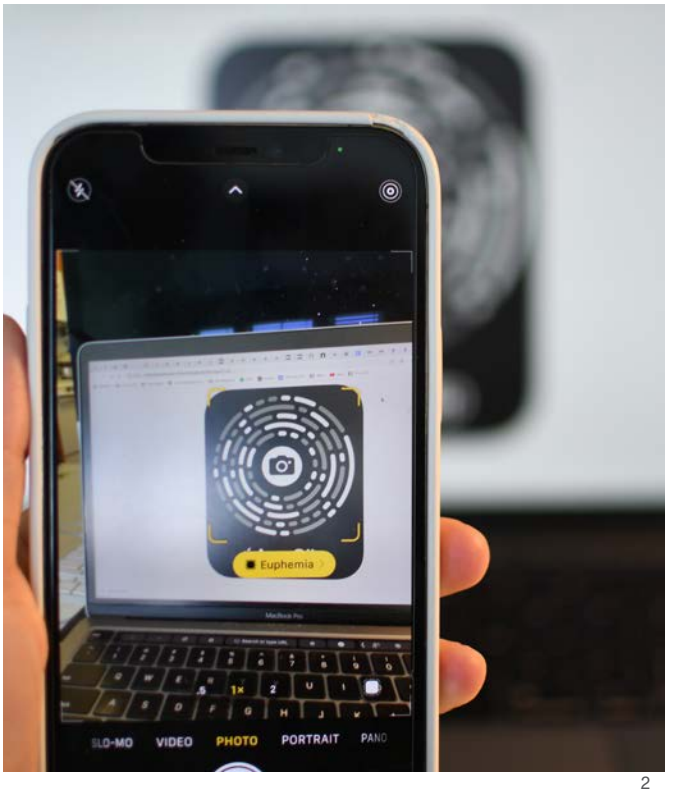
In the twenty-first century United States (US), technologies including smartphones, tablets, and computers are commonly used to build connections. However, many of these opportunities to connect with the outside world with such technologies aren't always accessible to non- or minimally speaking (Mv) individuals. In this paper, I focus on adopting augmentative and alternative communication (AAC) devices that support the picture exchange communication system (PECS) for Mv individuals.

In traditional AAC devices, Mv individuals share their physical devices with trained communication partners (Tps). Recent industry advances in AAC are minimal and focus on teaching Mv children spoken language. For Mv adults, significant barriers exist when adopting AAC devices because they do not effectively bridge the gap between Mv individuals and relationships outside of Tps. According to Chris Norrie and Elizabeth Hannah's research paper, despite technological advancements, communicating with AAC devices are often passive events and cumbersome to operate. Conversations with nonpersonal relationships remain a challenge because traditional AAC devices are designed as medical devices as part of speech therapy for a subset of people with disabilities learning how to speak and their respective care teams.

The objective of this study is threefold. First, participants are enrolled in evaluating Proloquo2Go. Their reflections highlight user experience (UX) and user interface (UI) improvements to Prologuo2Go and other traditional AAC technologies. Second, I develop Euphemia, a beta iOS application. Euphemia connects various ways of communicating without speech including hand gestures, vocalizations, and generated images with both physical PECS icon books and AAC devices. This application challenges augmented reality (AR) and machine

learning (ML) integrations in AAC devices. Lastly, I utilize a mixed-method approach with User Experience Questionnaire (UEQ) and Usability Testing. Data gathered through interviews conducted during and after usability testing determines how intrusive or unintrusive modern technological tools can be integrated and adapted into users' lives. Future studies will focus on implementing user feedback for the second iteration of Euphemia.

There is an urgent need to continuously innovate AAC devices to (1) give Mv individuals the opportunity to voice, exchange, and listen to each other's opinions, and (2) challenge what inclusive and meaningful conversation looks like between users and non-users of AAC devices. This study pushes to empower nonverbal communication and represents a contribution to the advancement of accessible technologies.



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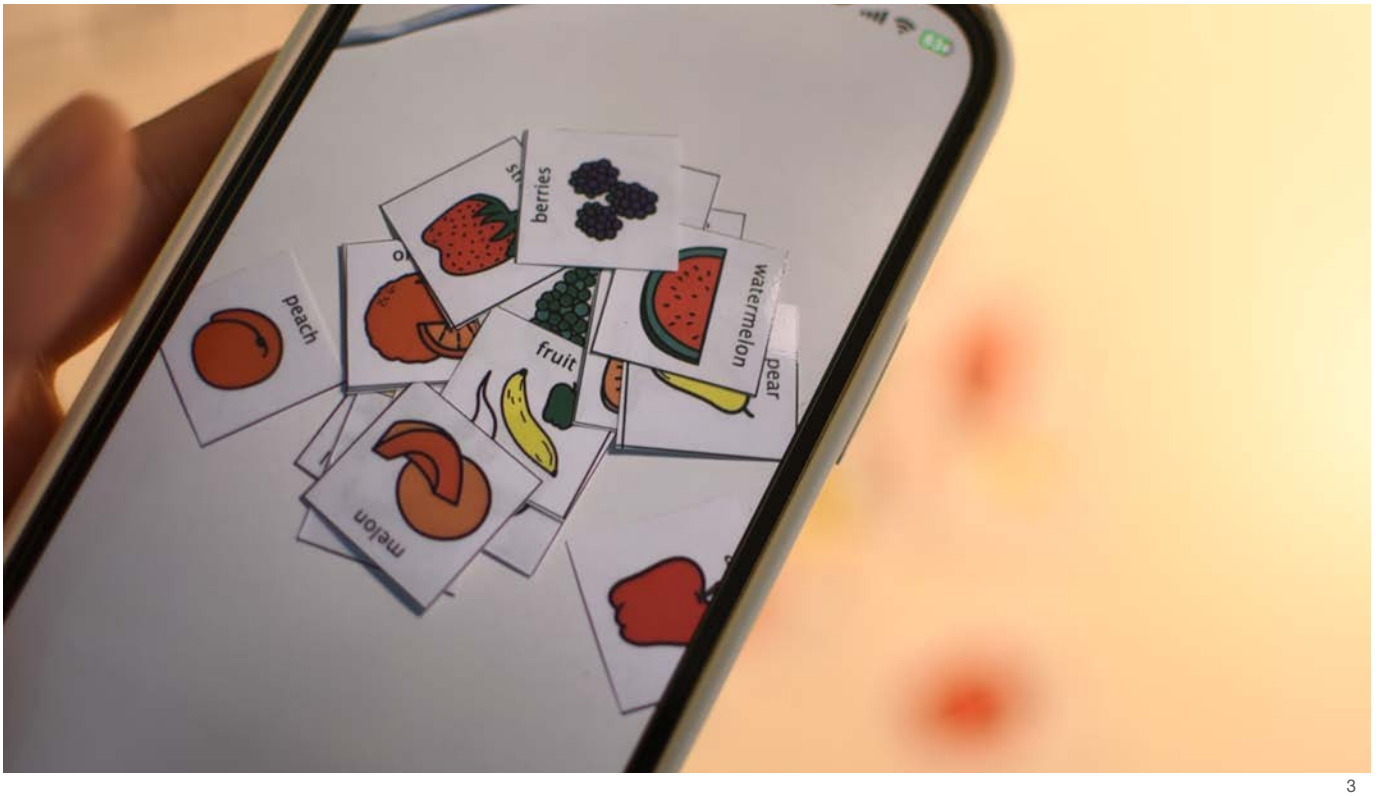


3

2 *Euphemia's interaction with App Clips*

3 *Euphemia's AR experience with physical PECS icons*

4

4 *Picture Exchange Communication System (PECS) book with icons and cards*

5 *A user communication with an AAC mobile application, Proloquo2Go*

Euphemia is a prototype of a communication application designed for iPhones with iOS 16.0 and above. Its objective is to bridge verbal and nonverbal communication between Mv users and nonusers of AAC mobile applications. It explores how the iPhone as a whole can be used to capture nonverbal communication and challenges the efficiency of traditional AAC approaches. It serves to encourage digital and physical spaces that are receptive to nonverbal exchanges. This is especially essential because current AAC applications can improve its influence on nonpersonal relationships. This is important because the fundamentals of communication - listening and speaking help facilitates inclusive communities and empathy towards people with various language needs.

It is highly relevant to study the experience of nonverbal communication in virtual and physical spaces. The opportunity to be heard and to hear are prerequisites for a sense of connection and belonging with others. Through my research, I open up the conversation of what it looks like to include someone who doesn't know how to speak a spoken language. I investigate how communication is represented on iPhones and demonstrate that it is important to provide Mv individuals with the right AAC tools but also just as important to invite verbal, non-users of AAC devices to learn how to meaningfully converse with Mv individuals. How can AAC users initiate deep conversations with their own vocabulary words? What does it like to design AACs that accommodate various users including nonverbal and verbal individuals? In future extensive research endeavors, I hope that AACs can capture the essence of nonverbal communication to contribute to a society where all voices are heard and listened to.


Play UNO Play UNO
Reinforcement
Play UNO
Danc
Legos
back to home page
Chips
CHIPS
Apples
Connect Four
Barney
Pretzel

Self Exercise Assistance

Dongho Koo

Help people who know how to play swing-based sports but want to improve their athletic ability to learn and correct themselves to make the right swing.

1

Self exercise assistance aims to help people who know how to play swing based sports but want to improve their athletic performance by personalized swing analysis and comparing to professional's video with marking of difference swing trajectories to make it easily understandable.

This feature is provided as a software prototype, when the user takes a video of their swing with a smartphone and selects a video file, the software detects and analyzes the exercise pose and informs which part of the body is incorrect when swinging. In addition, not only the movement of the main body parts, but also the movement trajectory of the exercise equipment, racquet or clubs, and the path information of the ball are compared and provided to inform the user whether the ball is generally moving in the right direction.

To help people's easy-to-understand, the analysis result is played along with the video of the professional player in which the user can easily understand it by comparing, and it indicates which body part's swing is different from the professional player's swing. This swing coaching service that people can use immediately when they want, without paying extra, and can easily understand themselves, can make a meaningful contribution to one's athletic life.

1 *Image for three swing based sports players.*
(Left) Aaron Judge, by Noah K. Murray/USA Today Sports, via Reuters
(Center) Sloane Stephnes, by Clive Brunskill/Getty Images
(Right) Tiger Woods, by Rob Carr/ Getty Images

Exercise is a physical activity that helps people to live a healthy life by making their body stronger and relieved from mental illness. However, it is very difficult for many people to consistently exercise for various reasons such as time constraints. Experts claim that the biggest factors contributing to hinder consistent exercising is lack of pleasure, creating competence, and motivating social interactions.

Therefore, this study started with the assumption that if there was a way to satisfy all these motivational factors, pleasure, competence, and social interaction, people could continue to exercise. According to one study, the top ten sports with the largest fan base in the world and those commonly participated in are played with a ball and with others. It is the result that people enjoy watching and actually doing sports that form a team with others or compete against each other rather than ones that are exercised alone. In other words, it seems that social interaction is a motivating factor and occurs while exercising with other people, so enjoyment naturally occurs, then people prefer these exercises.

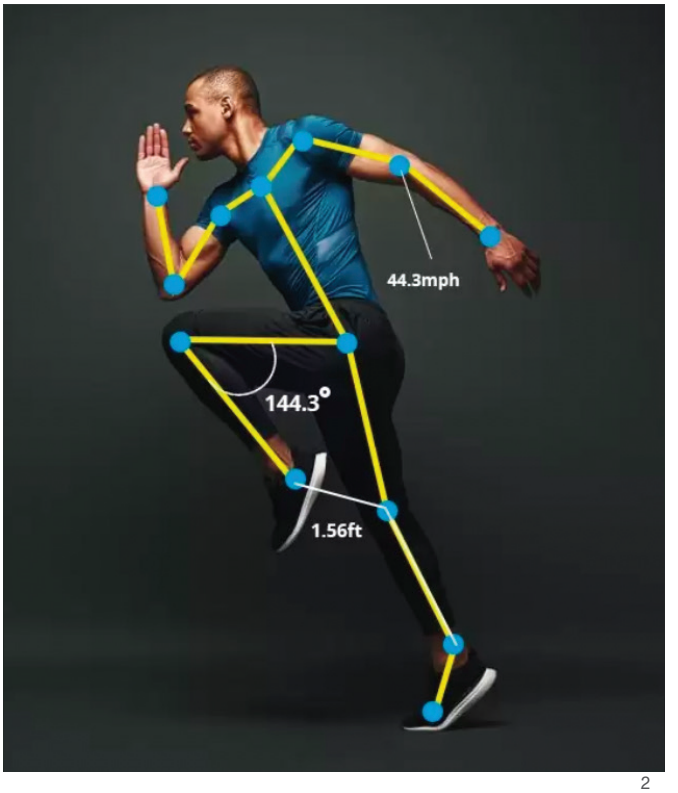
Competence, the other motivating factor, is generally attained as athletic ability improves. Interestingly, the mechanism for the basic movement in seven of the top ten sports was the swing. Therefore, teaching a coaching method to improve one's swing, a basic movement of people's most preferred exercises in order to achieve competence, the last motivating factor, could enable more people to practice consistently.

There are already many ways to learn to swing. However, all of which have disadvantages such as additional cost, time and place restrictions, and difficulty understanding guidance to be improved. In most cases, when people first start exercising, they intend to start by taking a lesson from individual or group coaching by meeting to receive training. However, private coaches, in particular, are relatively expensive and difficult to afford for many reasons, including the need to coordinate meeting and training times. There are on sale practicing assistant products that collect and analyze exercise information by attaching accessories in the form of sensors embedded in sensors to exercise equipment. But these require additional cost to buy devices, and the analyzed result seems too hard to understand for general users.

Therefore, I thought that providing a swing coaching service that people can use immediately when they want, without paying extra, and can easily understand themselves, can make a meaningful contribution to one's athletic life. To prove this concept, I created a software prototype allowing people to receive swing coaching using only smartphones which are used as essentials in people's daily life by using rapidly developed image processing and machine learning technology.

In this software prototype, when the user takes a video of their swing with a smartphone and selects a video file, the software detects and analyzes the exercise pose and informs which part of the body is incorrect when swinging. By analyzing the entire swing video of the user, it does not analyze only a specific static posture, but continuously tracks the main key points of the body to guide the movement of the trajectory during the swing.

At this time, the analysis result is played along with the video of the professional player in which the user can easily understand



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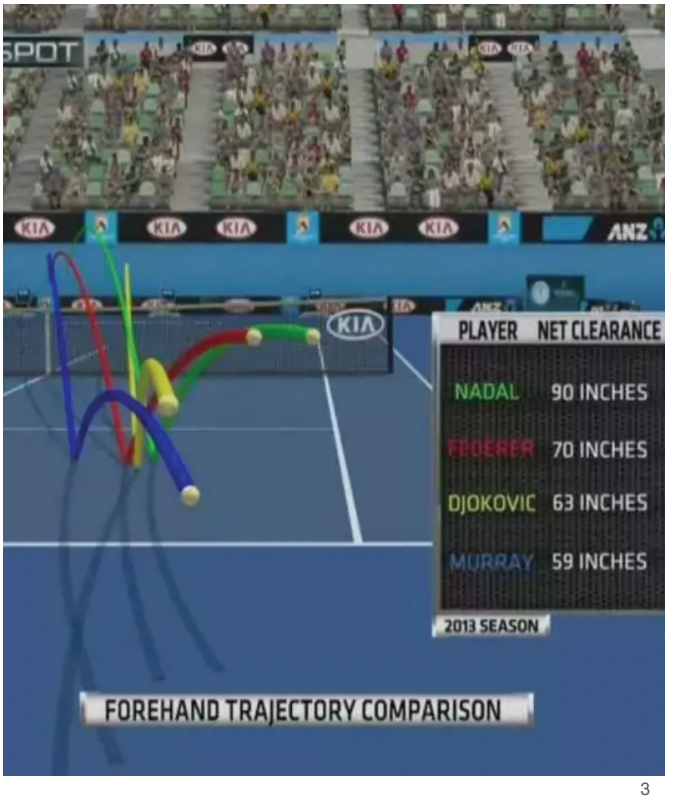

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2 *Pose angle tech from Wicked Tech, India*

3 *Tennis ball trajectory tracking system from TopTennis*

4

it by comparing, and it indicates which body part's swing is different from the professional player's swing. In addition, not only the movement of the main body parts, but also the movement trajectory of the exercise equipment, bats or clubs, and the path information of the ball are compared and provided to inform the user whether the ball is generally moving in the right direction.

These analysis results are generally well-displayed, but when the user and the professional player have different physical characteristics, such as (height, arm, and leg length differences), the swing similarity gap widens. In addition, differences according to the characteristics of each sport such as movement of the body during a swing for each sport or swing deformation in accordance with a moving ball should also be considered.

To solve these limitations in the future, I plan to increase the accuracy of the analysis result by considering the characteristics of each sport, securing the pool of professional players with various physical characteristics, and matching the videos of the professional players most similar to the characteristics extracted from the user's swing image. Therefore, I would like to extend this swing guide to be applied to all available sports in which the swing is mainly used.

4 *Dustin Johnson, by J.D. Cuban on Gold Digest*

5 *Comparision trajectory information for both user and pro videos*

6 *Envisionment of final outcome*

5

6

BEYOND THE INTERFACE

Beyond the Interface focuses on shaping tangible technological interactions that are responsive, unobtrusive, and facilitate mindful connections with ourselves and the world around us. Rather than bending our lives towards technology, we envision a world in which technology is humanized and functioning in stride with us. We believe in the ethos that Mark Weiser set forth - that technology should "help us focus on the things that were really important to us...rather than panicking us" (Weiser, The Computer for the 21st Century). By crafting objects that encourage us to focus on what is most important, we aim to promote personal well-being and promote presence in everyday life. Rather than collapsing our relationships with technology to the interface, we envision a more holistic approach, in which we consider technological objects as emotive, as agents of change, and in dialogue with the world and people around them.

We emphasize the importance of tangibility given that physicality is core to our human experience. From birth, the importance of touch and tangibility helps our cognitive development and our sensitivity to the world. Infants are held skin-to-skin and provided with a multitude of toys of different varieties across color, texture, and weight - all of this is critical to child development. Digital media is invisible and ambiguous, as it requires translation into UI and interfaces for sensemaking. Tangible experiences, in comparison, require less mental cognition to interpret due to the affordances built into physical forms; a handle reads as something to grasp, a chair as something to sit in. With this in mind, our work examines ways in which we can place the value of tactility, emotion, and personal connection at the forefront of technological design.

Early work in our domain dates back to Weiser and Xerox Parc's work in the field of ubiquitous computing, which motivates the existence of technology as both ever-present and invisible. In other words, technology that is seamlessly integrated into our lives and everyday environments.

Weiser defines a new mode of technology interaction as "ubiquitous computing" (UbiComp), where technology is not locked behind an interface, but embedded in the fabric of our everyday lives and is both ever-present and invisible (Weiser, 1999). He further expands on this work in The Coming Age of Calm Technology, proposing that ubiquitous computing should be calm, claiming "both the center and the periphery of our attention, and in fact [move' back and forth between the two" (Weiser, 1997). We are interested in the line of following work that pushes human-computer interactions beyond a traditional graphical user interface, and considers the cognitive effects of these alternative forms of technological presence.

Under the lens of cognition and perception, our cluster's design approaches are also influenced by Lars Hallnas and Johan Redstrom's slow technology philosophy. Hallnas and Redstrom, in their 2001 work, urge designers to build technologies and their interactions in a way that is more conscious and context-aware - revealing parts of themselves in a way that causes us to consider our relationships and interactions with them (Hallnäs et. al., 2001). The goal is not necessarily to slow down our devices, but to craft touchpoints and material aesthetics that give us a feeling of having more time and of being present in a space of interaction. Following the slow technology ethos, our work aims to inspire presence, mindfulness, and intentional engagement. In contrast to ubiquitous technologies which focus on efficient informational output, we prioritize building meaningful interactions that go beyond the transactional.

The medium of our work is tactile - as such we also draw inspiration from Hiroshi Ishii and his students' work in the realm of Tangible User Interfaces (TUIs). TUIs enable the navigation of digital information or experiences via physical interactions or objects. Such interfaces allow for direct translation from the digital to the physical or vice versa, often posing an alternative to traditional digital navigation methods. TUIs aim to leverage the natural way that humans interact with the world in the design of intuitive interfaces - with a greater goal of achieving "a heightened legibility and seamlessness of interaction between people and information" (Ishii, 2008). Our cluster's work is also in dialogue with the fields of Natural User Interfaces, which considers a wider range of gestural or voice inputs for technological devices, in contrast to preset, menu-based touch or click mechanisms. We aim to integrate the affordances and

flexibilities of TUI/NUI interactions, but also propose we design devices from an emotion-driven perspective. If technological devices are to be well-integrated in our lives, we should consider crafting them as more humanized, personable, and motivating their positive presence in our lives.

Our works comment on the value of imbuing emotion into design - looking both at ways in which we can craft technologies with human feeling in mind and even take inspiration from human expression in interface design. We are, first, inspired by Jonathan Chapman's work in emotionally durable design - which studies the ways in which we can create less consumptive and longer-term relationships with designed products. These methods include imbuing personal values, stories, and modes of positive attachment in a product. The designed interactions in this cluster's work focus on narrative building, positive attachment, and perceived value when interacting with a technological device. More than building positive, long-term associations with a product, we are interested in ways in which these technologies can cultivate emotional fulfillment within us. For instance, how can our personal devices help to create a sense of wellness or companionship in our lives? How might they bring our attention to the world or ourselves rather than being a distraction? Our works explore the space of human perception and emotional response through novel actuation methods, narrative and personality design in technological devices, as well as building collaborative experiences. Two of our projects explore the design of personalities into tangible interaction devices. Work in the realm of expressive robotic devices, for instance, reveals that people generally form stronger attachments and higher levels of trust with the objects and devices that exhibit personalities (Forlizzi, 2007) (Whittaker et al., 2021). One project approaches this from a dynamic form and smart materials perspective, while the other considers imbuing humanlike agency in objects through expressive outputs.

Though our approaches range from a materials to expressive interaction focus, Beyond the Interface explores a common emphasis on mindful, holistic, and tactile emerging technology design. The following section details our work in this domain.

Poetic Technologies

Benal Johnson

Exploring expressive and embodied interactions with technology

1

Consumer technology is trending towards a future where interactions are increasingly becoming abstracted from the physical world. They remain digital or ephemeral; gestural, graphical, virtual, and augmented interfaces are receiving heavy investment, while embodied interactions are ignored. This design mindset does not consider the richness of a tangible interaction, nor its increased usability. Additionally, human emotion is not considered in the design of most consumer technology, especially for the home environment; they are designed to be unobtrusive and in the background of the everyday. Poetic Technologies explores a new way of interacting with technology where interfaces and interactions are embodied and expressive. This project explores these aspects through a case study of a family of three expressive smart home devices.

1 *Render of the family of objects by Benal Johnson. November 2022.*

The majority of consumer technology devices available on the market are designed with a technology-first mindset. For example, current home smart devices, such as Google Nest Hub and Amazon Alexa, utilize a combination of Graphical User Interfaces (GUIs) and Natural User Interfaces (NUIs) as their methods of interaction due to their novelty and not necessarily their usability. GUIs refer to screen-based interfaces while NUIs in the consumer product context typically refer to the use of multi-touch interaction, voice UI (VUI), and gesture based controls. NUIs and GUIs make assumptions about what is “natural” to users, claiming that these new methodologies and technologies are easy to adopt and learn when in actuality they introduce new complexities (Norman 6). Gesture-based controls are neither easy to learn nor natural, discarding any notion of cultural context in their interactions (Norman). Additionally, VUIs require a high cognitive load to interact with, especially with complex tasks (Miller). With regard to home smart devices, there is a distinct momentum away from tangible methods of interaction or physical interfaces on these devices, partly due to the claim that physical interfaces cannot

handle the complexity of tasks that Internet-of-Things (IoT) devices are capable of (Scutt). Yet, work done by Donahue, Frens, Vianello, and Zuckerman show not only the ability of tangible user interfaces to adapt to the complexities of IoT commands, but also the preference and ease of use of physical interfaces over NUIs and GUIs (Donahue; Frens; Vianello; Zuckerman).

Beyond the issues of a technology-first approach, existing home IoT make compromises in several other areas of their design. One such area is its overall complexity; combining multiple tasks in a single device has consequences around its usability and ability to contextualize tasks. Placing a wide variety of context-agnostic actions into one device is most certainly an attempt to create a one-size-fits-all smart home product that captures the majority of the consumer market. This is an odd choice in light of the benefits of context-aware computing in anticipating user needs; if anything, creating a set of devices that are contextually relevant could improve usability with smart home devices (Laput). Another design consideration that is emphasized with IoT devices is its unobtrusive and simple branding (Woo). They are meant to be tools that live in the background of your daily life, put out of sight until needed. When we invite technology into a space as intimate as the home, why are they marked as just a tool and not a companion? There is potential to imbue these devices with a rich sense of expression and personality to build our relationships with these devices. Research done by Whittaker et. al. shows that imbuing robotic or smart devices with expression and personality promotes user acceptance and trust, yet this insight is not integrated on a consumer scale (Whittaker et. al.). Existing studies around personality in smart home devices focus on combining existing IoT devices with personality, rather than a full redesign of its physical appearance or movements (Menneken et. al.).

There are several contemporary works from individuals, organizations, and researchers that touch on new modalities for interaction with technology, specifically investigating designing for expression, tangibility, and contextuality. Google's "Little Signals" experimental project (Fig 2) examines a new pattern of communicating information using the principles of ambient and calm computing, imbuing a set of six unique IoT devices with subtle and physical notifications (Little Signals). Although these devices are physical, they do not incorporate any personality traits into each device; they are meant to be unobtrusive and in the background of the daily lives of users (Google). A similar experimental project that focuses primarily on the use case of checking the weather comes from Uniform Group's Weather Systems (Fig 2)(Uniform Group). A set of three devices communicate different information about the weather through physical actuation, whether it be mimicking the sound of rain, the strength of a breeze, or the physical temperature (Uniform Group). These devices express and visualize data using physical displays, yet are still in the same realm of "calm and unobtrusive" devices like that of Google's Little Signals (Uniform Group, Little Signals). Both of these projects do not incorporate expression and emotionality into their designs and emphasize technology as an unobtrusive tool.

The variety of design decisions around interfaces, contextuality, and emotion in current smart home technology leaves a case for exploring how they could be designed differently. This thesis examines a new paradigm of interacting with technology in

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2 *Little Signals. https://littlesignals.withgoogle.com/. Accessed 17 Nov. 2022.*

3 *Weather Systems: The Weather before It Happens. Directed by Uniform Group, 2014. Vimeo, https://vimeo.com/110909173.*

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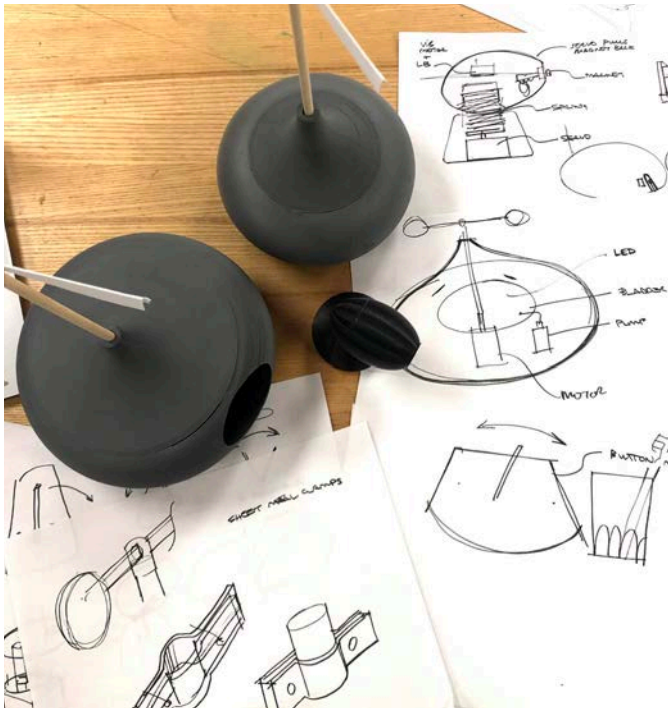

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which devices are designed contextually, expressively, and with tangible and embodied methods of control. These themes are explored in a case study in which three smart home devices are redesigned to express their personalities through form language, physical actuation, and embodied methods of control. Each device lives in a distinct context in the home - the bedroom, living room, and bathroom - and has a practical function that matches with each context.

To execute this case study, a four phase approach was used. First, contextual inquiries were conducted with participants to uncover the routines in their daily lives to determine appropriate contexts in which to design an expressive IoT intervention. Second, low fidelity prototypes and interaction models were made in response to the needs uncovered in the preliminary interviews, ensuring they fit into appropriate contexts in the home. Third, a framework was created to match IoT devices with distinct personalities and practical actions within their given context in a person's routine. Finally, high-fidelity prototypes were fabricated using a variety of tools and filmed in a narrative format that brings both their interaction and sentimentality to life. With regard to the limits of this work, the short time frame to execute this is the biggest limiting factor. To balance the tradeoff of time and final quality of work, secondary research will not occur after the high fidelity prototypes are created in order to dedicate the most time for design and fabrication. In addition, there will be a limited set of expressions per device due to the scope and time to execute. The impact of this work will ideally challenge existing paradigms around what it means to interact with technology and to think about new possibilities of interactions beyond what is considered the norm.

4 *Early interaction prototype by Benal Johnson. November 2022.*

5 *Image of the prototyping process of the family of objects by Benal Johnson. November 2022.*

6 *A render of Tobi, one of the three devices in the family. Rendered by Benal Johnson. November 2022.*

6

Tuning In

Denise Heredia

Exploring tangible everyday sound exploration

Prototype exploring sound replay through conductive cord wrapping.

Everyday, personal, and home technologies are growing in their ubiquity. Currently, these devices are designed to seamlessly integrate and assist with functional tasks in our lives. Reflective and mindful interactions with these technologies are often an afterthought due to an emphasis on efficient, personalized content delivery. More than this, their tangible interfaces are often nondescript and function as shells for sophisticated digital functionalities. Tuning In explores an alternative narrative for everyday technologies - one which encourages presence with our lived everyday experience, through curation and exploratory replay of sounds.

This project draws inspiration from a range of design efforts, which prioritize mindful or cognitively nourishing interactions rather than the most efficient or functional ones. Since the advent of personal and widespread computing, human-computer interaction researchers have been drawn to study our perception and lived experience with technologies.

As such, there have been experiments and philosophies, ranging from Hallnas and Redstrom to Weiser, that push towards more naturalistic, human-tailored, and emotionally mindful interaction designs. This project is inspired by works in this realm that enable exploratory engagement with the functionalities of a device, empower people to curate their own paths and interaction methods, as well as inspire a sense of presence or co-creation during interaction.

In addition to these design philosophies, Tuning In is inspired by more contemporary works in slow technology, such as that of the Everyday Design Studio at Simon Fraser University. Devices such as the Olo Radio, Olly and Chronosope explore tangible ways of interacting with

personal data (music, photos) and making our digital footprint more visible to us, as well as a potential tool for reflection.

Today - as technological applications become more personalized, context-aware, and “always on” - it is our duty as designers to craft the mechanisms by which these tools can become a means of cultivating within rather than distracting from our lives. Often, this work involves questioning existing modes of technological usage in order to generate new perspectives and practices. The field of interaction design provides a stage in which we can directly intervene in our relationships with technology and shape new ones. This can include switching out mediums of communication between humans and devices, introducing ambiguity in usage, generating questions about a set system, or exposing a clear flaw in an existing interaction environment.

This thesis takes this inquiry based approach in proposing a materials-forward, exploratory, and tangible mode of interaction with the sounds around us. By crafting an environment for everyday sound interaction, I question the comparative value of efficient content-delivery based devices versus more ambiguous tangible interaction environments that require a nontrivial amount of human input and exploration to “work.” The goal is to celebrate the latter of these two, and inspire other design technologists to consider a similar approach in developing new experiences.

In addition to considering behavioral interventions, designers today have the ability to push past the visual and screen-based interfaces that are often taken as a given in the development of new technologies. Especially as we have the ability to create more immersive experiences, there is a need to explore the mechanisms by which we can celebrate and bring in more of our senses. One realm with high potential for exploration is that of audio coupled with tactility. In thinking about the exploration of digital sound, we often think about traditional sound controllers or synthesis tools that consist of knobs, sliders, and buttons. However, the physical rigidity of these devices can often silo our perceptions of sound as a signal and interaction with digital sounds as a complex, mathematical process. Inherently, sound is fleeting, flowing, and ephemeral. How can form and dynamic interactions with materials enhance these innate characteristics of sound? From a human experience perspective, sound requires us to be acutely present in order to experience the full range of its textures. This project explores the celebration of these innate sound characteristics as well as the effects that close listening can have on us.

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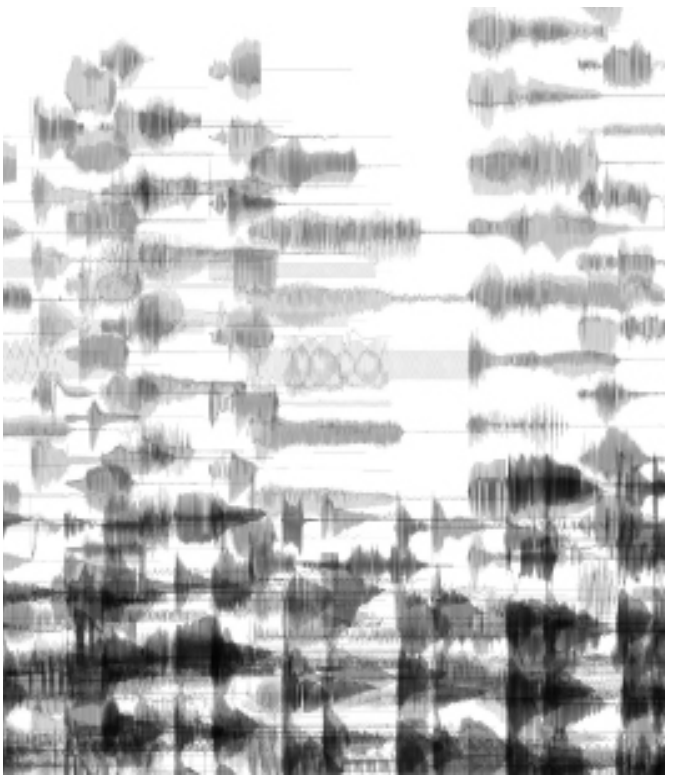

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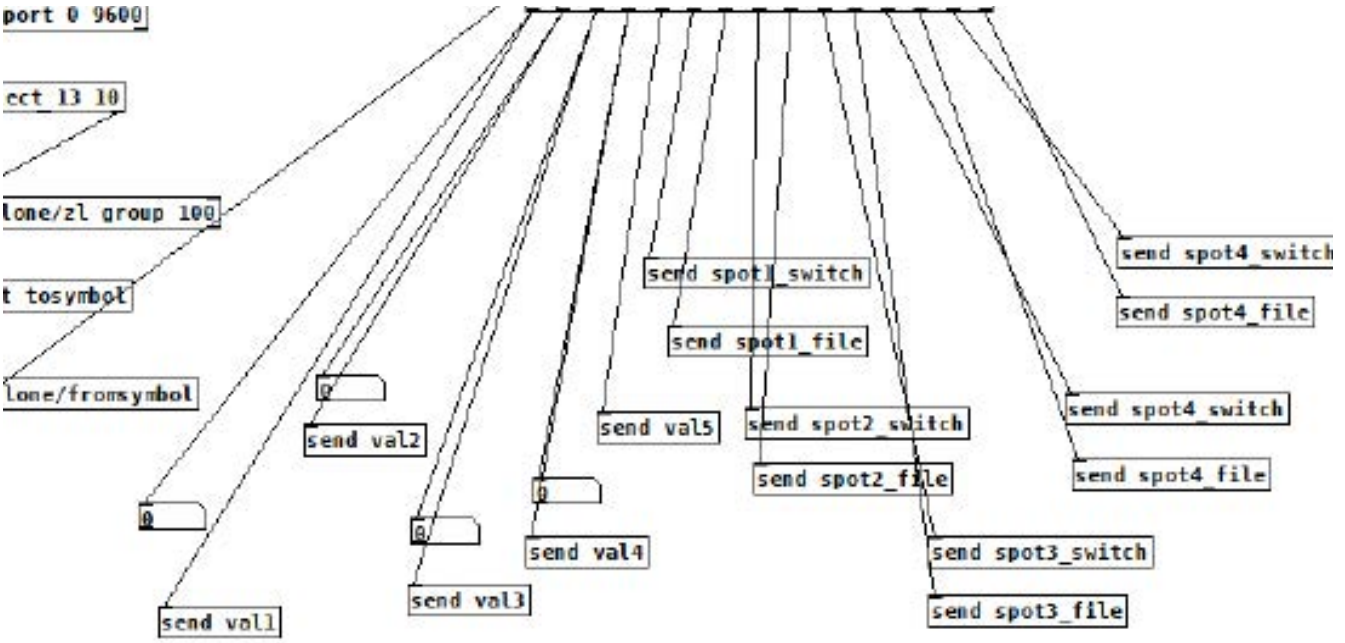
2 *Olo radio - a device to explore music history metadata. Designed by WIll Odom and Tjis Duel.*

3 *Clips from Bicycle Built for Two Thousand - a 2,088 voice, computer synthesized piece of collaborative sound art.*



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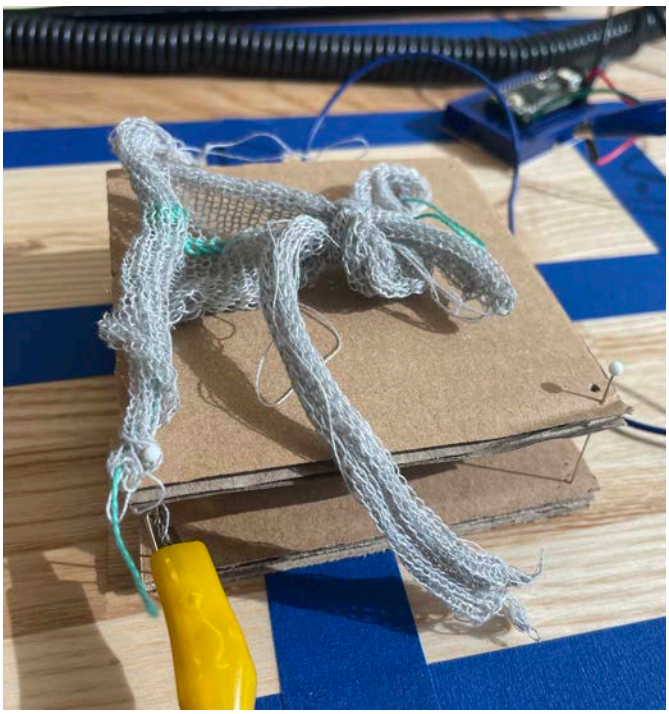
4 *An in-progress signal mapping tree.*

To set the stage for this project, I gathered a range of contextual perspectives on personal technologies and existing listening devices such as smart speakers. In tandem, I ran a study on personal sound capture with 12 participants and ~50 snippets of everyday sounds in order to probe our current perceptions of personal sound collection.

Through this study, I gathered current perceptions around audio capture and sound-driven memories. Captured sounds were analyzed and clustered, revealing what sonic content participants deemed worthy of recording, and informed what types of replay interactions heighten the re-experiencing of a recorded sound. For instance, do sounds have a range of textures, actors, or temporal characteristics? What tangible manipulations in the interaction environment best map to these qualities? What is the essence of a set of sounds curated by a person at a given time or in a given context, and what physical interaction mechanisms can bring these to the forefront? With this context, the listening device's playback interactions, physicality, and exploratory identity were designed.

The designed artifact of this project is a tangible interface that enables collaborative and exploratory replay of personally curated sounds from everyday experiences. The sounds presented in this work were collected with a set of friend and acquaintance collaborators - ranging from audio memories to daily environments or curious sound encounters. Through physical manipulations of knit conductive cords and movement of physical sound objects, listeners can unravel textures of audio clips and collaboratively produce soundscapes in real time. Rather than traditional knobs and sliders, the playback controls are left slightly ambiguous - allowing listeners to navigate the tangible environment and create their own understanding of the soundscape. Through this interaction, Tuning In aims to promote the value of tactility, sound, and open-endedness in technological design.

From a sound perspective, the design demonstrates the dynamic affordances of conductive textile inputs for replay and motivates a materials-forward approach to slow, exploratory audio interfaces. In addition to this, the project presents a platform for collaborative synthesis of sounds - both by opening up curation to participants' daily experiences as well as by inviting open-ended manipulation of sound textures during replay. The curation and navigation through replay of these sounds can serve as a way to celebrate experiences within a community space over a period of time, for instance. The greater goal of this work is to encourage emerging technology designers to prioritize the value of design for reflection, human engagement, and emotional durability in their work. From a material perspective, it demonstrates the potential of sound and tactility to push such efforts forward.



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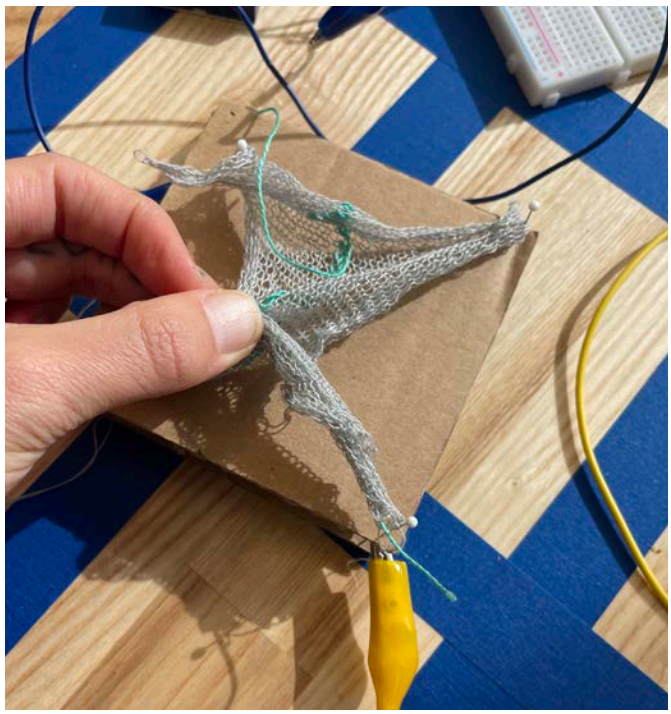

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5 & 6 *Conductive thread swatch interfaces.*

Pebbles

Salih Berk Dincer
Tania “Tee” O’Neill

A set of interactive companions you want to meet

1

Objects have a personality that can affect how we perceive and interact with them (Norman, 2004). These objects that we touch and see are constrained in their form and shape by the limitations of their static material. What if an object could break free of its static, external form and take different shapes in response to stimuli?

Pebbles is a set of tangible interfaces with their own unique behaviors and functionalities. They are designed to interact with their environment, user, and each other. Pebbles’ functions, shape, and interfaces disrupt the negative emotional state of its user through the creation of a playful environment; it also creates an emotional outlet.

Pebbles explores what interaction would be with an object that has morphic capabilities. Also, Pebbles is the first project that attains the requirements of a newly described domain - named as Expressive Natural Tangible User Interfaces (ENTUIs) - by using the vocabulary defined and tested the hypotheses (creating expressive technologies through the natural interactions) made in the domain.

1 *Prototypes (Second Iteration) of Pebbles by Salih Berk Dincer & Tania “Tee” O’Neill. November 2022.*

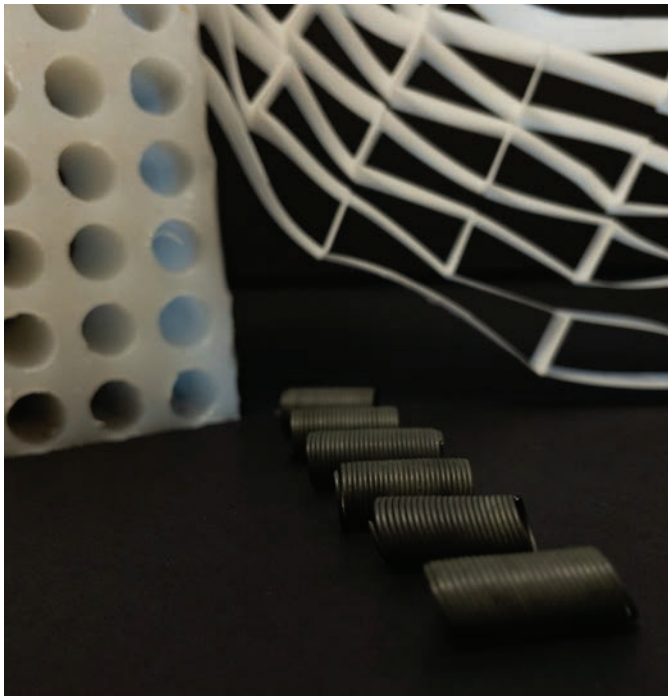
Our goal with Pebbles is to provide the user with a set of "companions" to minimize unsettled feelings. Our strategy is to create an emotional attachment to Pebbles by providing stimuli through interaction to evoke positive emotions through behavior and trigger actions through suggestions.

The methods chosen are physical contact and haptic feedback, which have also proven to be effective in reducing perceptions of loneliness by providing an emotional outlet and stimulating the brain (Zhong et. al, 2002). Each Pebble's dimensions and overall shape will invite the user to hold the object. The surface was made of silicone and soft to the touch with texture to stimulate and promote touch (Smith et al. 2020). The study of shapes points to the fact that rounded shapes are perceived as friendly by their user (Strohmeier, 2016). In addition, rounded forms conform to the contour of our hands. We hope to enhance the tactile experience through the addition of texture. Texture provides stimuli to the tactile senses (find studies that connect with the tactile sensors and emotions). Each of them in the set has eyes, an element of our choice that anthropomorphizes Pebbles (Rogers et. al, 2011). Eyes were chosen for a specific reason. It is a human characteristic that draws the user to the object because, as research shows, people have the inclination to "accept and enjoy objects with human-like qualities" (Rogers et. al, 2011). Even though anthropomorphism has been proven as one of the effective methods for dealing with loneliness, a few products already exist in the market; however, they do not benefit from the materiality, and the interaction with the products is not intuitive.

Pebbles defines a new domain called Expressive Natural Tangible User Interfaces (ENTUIs) because of its connection to materiality and form. In this sense, Pebbles' focus on decreasing loneliness increases the range of applied techniques and tools because of the role that expressiveness and emotional design play in the interaction between methods and tangibility. Within initial prototyping, anthropomorphism was the primary influence- all interactions and forms were intentionally designed for increased emotional attachment from the users. For testing, two mockups were built: Chillpill and Fanfan [image 4 and 5]. Each mockup has components of anthromorphism through how they look and how internal technology communicates. Both modules are laser cut and equipped with the electronics needed to make them interactive.

The next iteration has a soft "skin" that allows for form change and also includes directional microphones and an OLED screen. The prototype gave direction in understanding how form and material could be interactive with its interaction while also structuring further interaction.

Pebbles are companions designed to assist and create a playful environment for their users. They invite their users to play; while maintaining prolonged attention, subtly coaching/teaching users emotional coping mechanisms through activity engagement. For the final design of Pebbles, the unique personality given to each module serves to establish a stronger emotional attachment between the user and the "Pebble" (technology). In that sense, Pebbles is unique - its function mimics successful coping methods while also providing a sense of play. In addition, they interact with each other -providing a sense of community- and



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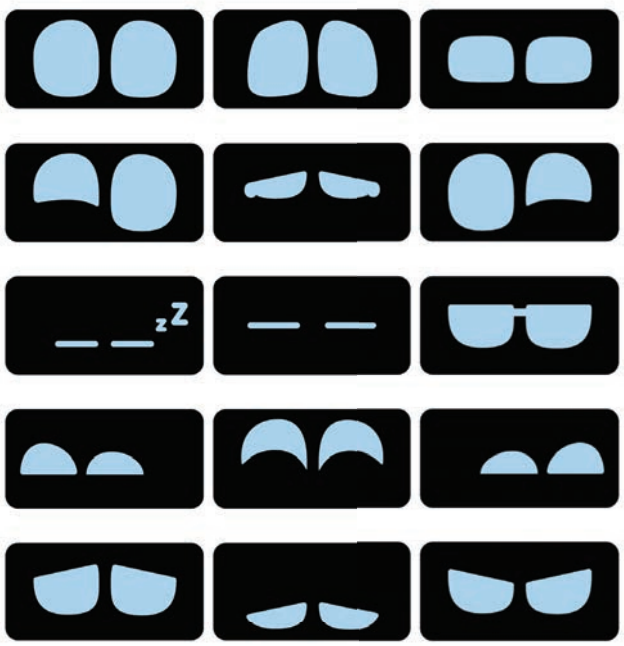

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2 *Material and Structure Exploration for shape-changing skin, Auxetics, and Nitinol by Salih Berk Dincer & Tania "Tee" O'Neill.*

3 *Eye expressions designed for Pebbles by Salih Berk Dincer & Tania "Tee" O'Neill. November 2022.*

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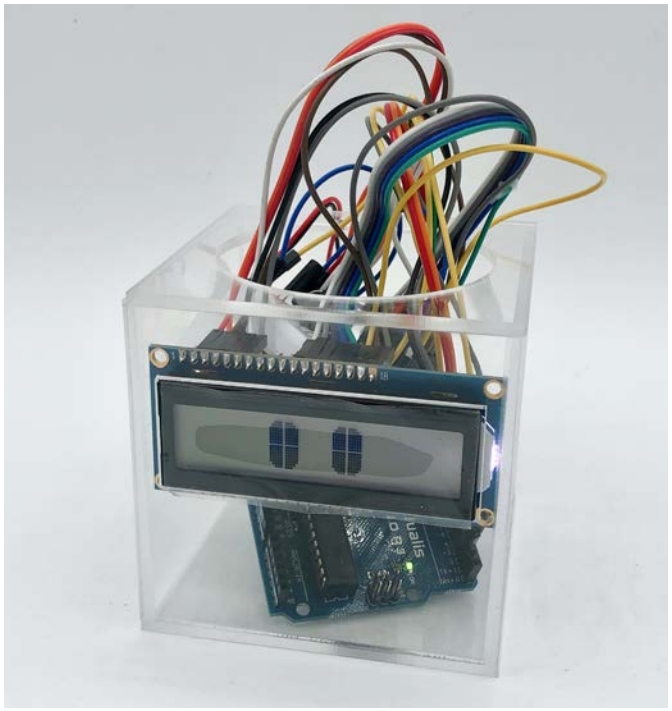

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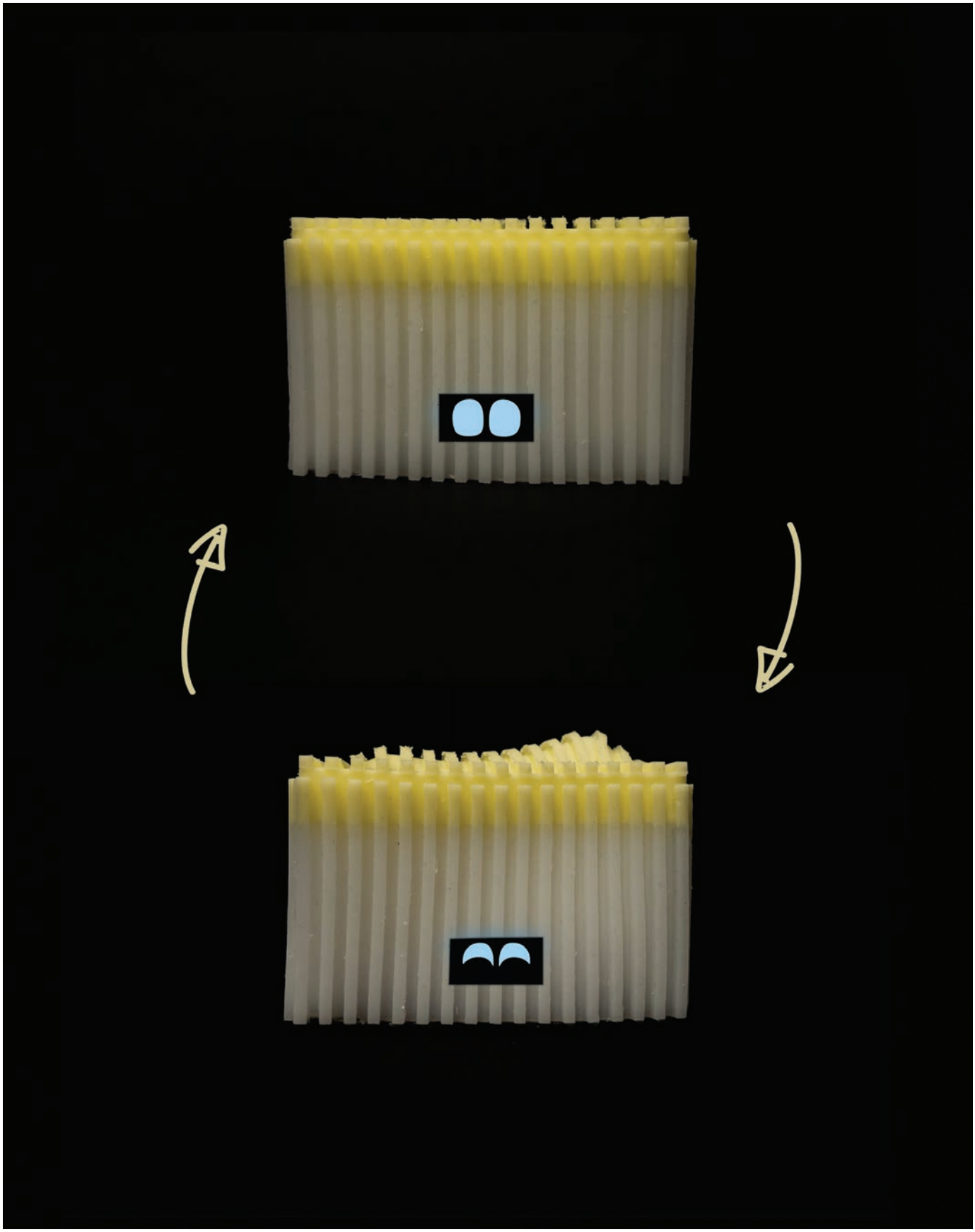
communicate with their user through Universal Languages (such as facial expressions and imitation of physical gestures). Universal Languages used in Pebble's communication design are based on popular cultural elements from movies and shows (inspired by Minions, Eve, and Wall-e) to target and specify its user populations. The changes in the form are designed in a way that the emotional state or the reaction of a Pebble is emphasized.

4 *Prototype (First Iteration) named as Fanfan by Salih Berk Dincer & Tania "Tee" O'Neill. October 2022.*

5 *Prototype (First Iteration) named as Chillpill by Salih Berk Dincer & Tania "Tee" O'Neill. October 2022.*

6 *Pebbles with Silicone Skin by Salih Berk Dincer & Tania "Tee" O'Neill. November 2022.*



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BLURRING BOUNDRIES

Illustration made by Julia Kuo. https://www.juliakuo.com/

Mixed reality technology has blurred the boundaries between the virtual and physical worlds and enabled new possibilities for connecting people together. BBCR explores the connection between human beings in different contexts, such as at work, in classrooms, and in personal spaces.

TeachXR is a tool designed by Hannah and Lula, which empowers high school science teachers to customize and implement XR as a storytelling medium in their classrooms. A possible output of TeachXR was created as an AR experience designed by a local teacher to demonstrate invisible concepts while explaining enthalpy.

In the context of workspaces, Daisy and Billy's project Limino explores interactions for the adaptive blending of physical and virtual environments in Head-Mounted Displays. Specifically, they investigated the benefits and trade-offs of configurable, body-tracked, and context-aware passthrough.

Can's project APEX explores the opportunities of building an augmented public engagement experience that is empowered by AR technology to bridge local communities and experts in the architectural and urban design industry.

Yilin's project could also be applied in some areas like collaboration. The wrist is a traditional place to wear a watch, meaning it could reasonably fit into everyday life and social contexts. EMG data, which uses sensors to translate electrical motor nerve signals that travel through the wrist to the hand into digital commands that you can use to control the functions of a device, can understand finger motion of just a millimeter. What Yilin wanna explore is how to make AR as a light and daily tool to use so that it could be more accessible and see what's the potential in some scenarios.

Lastly, Bennett's project Mixing Signals integrates embodied and distributed cognition into a MR notification system for seamless immersion and manipulation between the physical

and digital world. This multi-modal approach to notifications explores functional tech while preserving the intimacy associated with personal and intimate spaces.

Prior Art

XR in education

Chemistry is made up of microscopic processes that are invisible to the human eye (Gabel, 1999; Johnstone, 1993). Academic instruction and educational technology has improved over the last millennium, enabling teachers to illustrate complex topics. Still, modern 2D instruction is insufficient for teaching microscopic chemistry concepts (e.g., Ben-Zvi et al.; Griffiths & Preston, 1992) because they exist are 3D structures (Barak & Hussein-Farraj, 2009; Wu et al., 2001). Emerging XR technologies afford teachers with 3D demonstrations. Teachers' interest in these technologies has increased (Grunwalk Associates LLC et al., 2011) as studies have repeatedly reported positive outcomes (Lamb et al., 2018; Johnston et al., 2018).

Many teachers do not have time to learn new technology (Hasse, 2017) and receive few guidelines on coupling technology with content (ibid). Improvements to student learning is inconsequential if teachers cannot opperate the technology. There needs to be a tool to support teachers with using XR technologies.

Adaptive and Context-aware Blending

Various interaction methods have been presented to support object selection and manipulation in MR. Interaction tools, such as blended agents (Schmidt et al.) and virtual lenses (Looser et al.), were demonstrated in previous literature. However, neither of them addressed the use case of blending adjustment. Other work has proposed the use of a two-state focus mode toggle for filtering out real-world events (Fender and Holz), but the continuous blending adjustment remained unexplored. Although a recent paper has examined different ways to interact with a passthrough sphere (Wang et al.), they were specifically designed for the sphere, and the paper did not explore a wider range of blending targets. In summary, interaction for blending adjustment remained an area that invites more investigation.

A step beyond dynamic manual adjustment is context awareness. The domains of context-aware computing and MR were seldom discussed together until the past few years. One of the studies demonstrated that automatic adaptation of MR interface elements based on task and environment enables more timely and precise information delivery to the users

(Lindlbauer et al.). It further indicated that MR interfaces are inherently context-sensitive because they are unconstrained and often embedded into user environments. Followup literature proposed an adaptive MR interface featuring dynamic layout adjustment (Cheng et al.). However, these works mostly concerned the adaption and adjustment of 2D interfaces in MR. A recent publication proposed making MR interface reactive to contextual events in the real and virtual worlds (Wang et al.), but did not apply it to blending adjustment. For blending specifically, a recent study explored transforming real-world distractive events into coherent and complementary content in the virtual world (Tao and Lopes), while another proposed proximity-based switching among three blending modes (Seo et al.). However, we are not aware of work that applies activity and environmental awareness to passthrough-based blending.

Mixed Reality Notifications

As a response to the growing complexity of daily tasks and habits, notification tools have become a vital component of everyday life. XR's ability to merge physical and digital boundaries together creates potential for immersive notifications that are contextually aware as well as cognitively engaging for the user. Multi-modal notification styles in VR such as haptics, sound, and visuals have been explored for their interruptibility and effectiveness, but lack insight into how spatial awareness could be employed in MR as a means to tether physical embodiment into an otherwise digital experience (Ghos et al.). Previous studies on physical-digital notetaking tools outline how the flexibility of analog input forms could be combined with digital functionality to bring the best of both worlds together, but were conceptually developed before MR was introduced as a technology (Yeh et al.).

Physical self tracking and writing as embodied cognition have been studied to possess qualitative benefits of deeper engagement and enriched experiences, as well as quantitative benefits of memory retention stemming from a strengthened mind-body connection (Abtahi et al.). They also bring the benefit of immediate customization - bullet journals and notetaking are inherently flexible and easily adaptable to the needs of the user (Ayobi et al.). Altogether, these concepts have not been explored as a cohesive concept in mixed reality, with physical manipulation as an input and multisensory experience as a notification output.

TeachXR

Lucila Duloup & Hannah Bartolomea

A desktop tool that enables high school chemistry teachers to implement and customize XR activities as a medium for classroom storytelling.

1

Background

Many students struggle to learn microscopic 3D notions of chemistry that are not visible to the human eye (e.g., Ben-Zvi et al., n.d., Griffiths & Preston, 1992) when they are taught using traditional 2D methods of instruction. Emerging virtual and augmented reality technologies have been shown to improve student learning of 3D science topics by allowing students to learn about these concepts in 3D space (Johnston et al., 2018; Lamb et al., 2018). Yet, many teachers struggle because they do not have time to become sufficiently familiar new technologies (Hasse, 2017) and receive few guidelines on how the technology should be coupled with the subject matter (Hasse, 2017). The improvements of these technologies are inconsequential if teachers cannot use them.

1 *Render of the two artifacts designed in this thesis project. Desktop tool called TeachXR and an AR experience for chemistry class.*

Methods

This project speculates that if there were a tool to support teachers with implementing XR technologies in their classrooms, then teachers could explain microscopic science concepts in a way that is easy for students to understand. That hypothesis is tested through a case study of Aaron Glimme, a chemistry teacher at Berkeley High School. This case study builds the foundation for future work to understand how a a tool that provides guidelines for implementing and customizing XR experiences can enable teachers to enhance storytelling of complex chemistry topics by using XR technology in their classrooms. The case study includes interviews with Aaron, observations of his classroom, and designing iterative storyboards, wireframes, mock-ups, and prototypes, all led by observations and direct feedback from Aaron.

Due to the restricted timeline of this project, intensive and repetitive research is limited to Aaron, which narrows the reliability of design solutions. To minimize this limitation, brief interviews are conducted with other science teachers throughout the study to confirm that design decisions are representative of the greater population of high school science teachers. This research is not meant to propose a solution to be immediately implemented at a large scale. The purpose of this work is to identify an essential and overlooked audience in today's educational technology—teachers. TeachXR lays the foundation for future work to bridge the gap between teachers and XR technologies so they can provide students with information in a more digestible way.

The final design has two primary artifacts TeachXR, a desktop app aimed to empower high school teachers to create and share XR activities for their classrooms, and an AR activity designed for Aaron's class as an example of a possible outcome from TeachXR.

TeachXR Desktop App

The TeachXR app aims to lower technological barriers for high school teachers and allow them to use, create, and share XR experiences. The app has two main flows, the explore mode and the creator mode.

In the explore mode, teachers can search the community catalog to find XR experiences in a gallery format. Filters allow teachers to find the most relevant experience, such as grade, topic, subtopic, the technology used (VR and AR), curricula compliance, and type of activity.

When the teacher selects an activity, a four-step process start—Description, General Settings, XR activity, and Instructions. The four steps are intentionally organized to replicate the interface of presentation softwares that teachers are typically familiar with, such as Powerpoint and Keynote.

In the creator mode, teachers who prefer customization can easily edit XR experiences using the creator mode. This mode has three steps, General Settings, Create, and Review. The design layout is consistent with the explore mode and keeps it as simple as possible to lower technological barriers for high school teachers.

One of the biggest challenges was simplifying and standardizing what options a teacher needs to create an XR experience that is useful to explain chemistry topics. Through interviews, it was discovered that a critical part of explaining chemsitry concepts, is showing the relationship between the macroscopic, molecular, and atomic scales. Therefore, the creator mode allows teachers to design for three views macroscopic, molecular, and atomic editable scenes.

The macroscopic view is the first step to creating the XR experience. This view illustrates things that are visible to the naked eye, scuh as water in a conical flask. The teacher selects an element or molecule they want to illustrate, which is placed in a conical flask by default. The container can be changed to match their presentation needs. Teachers can also add an optional title or descriptive text. All changes are visible in real-time and automically formatted in the center.

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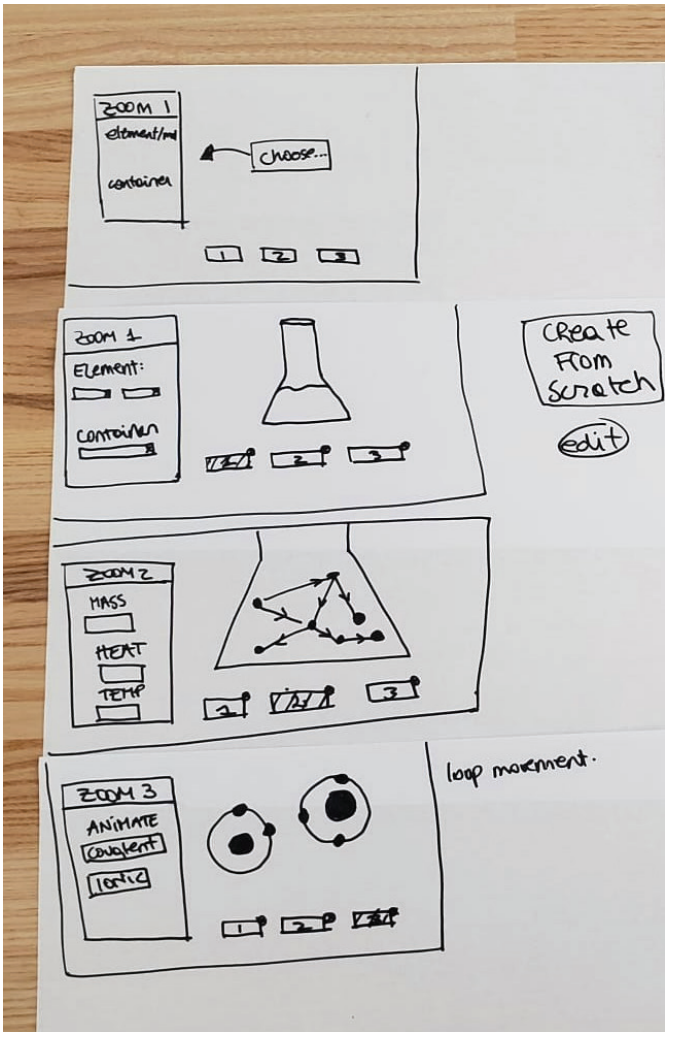

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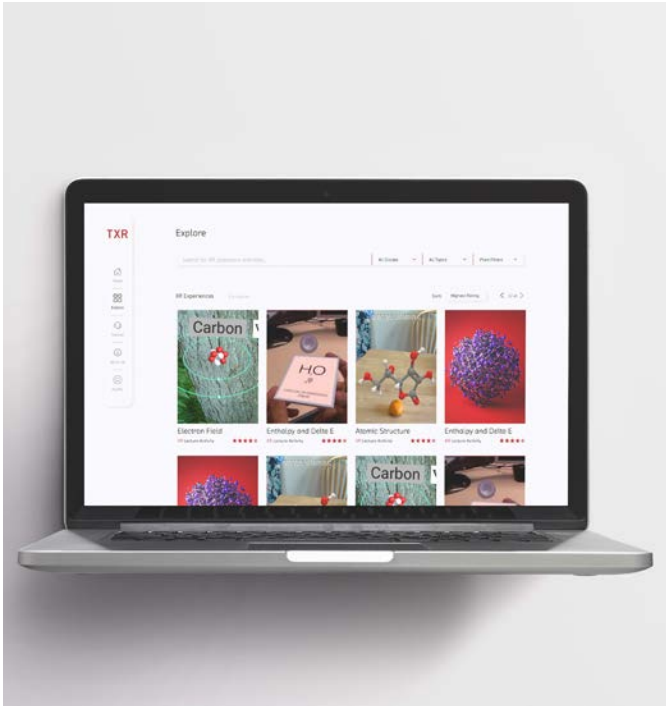
2 *Observation in Aaron Glimme AP class at Berkeley High School.*

3 *Ideation process Creator Mode for TeachXR*



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The molecular view shows the interaction of particles, which can be controlled by formulas. Teachers can chose from a list of formulas, depening on the concept being illustrated, and adjust formula values to show how molecules are impacted.

The atomic view is automatically created based on the element or molecule and variables selected. Science teachers may only use the molecular view to show particle motion, or only the atomic view to show molecular bonding. Each view can be turned on or off at any time.

AR Experience (Ouput of TeachXR)

The AR experience was designed in associate with Aaron as a possible outcome of the TeachXR tool. The experience is built for Aaron's enthalpy lesson—it visualizes how H2O molecules change from physical states. Molecules are color-coded to be consistent with science diagrams and illustrations.

The experience was built for Android in Unity with the AR Core template. An AR image tracker Manager component tracks three image that when activated, show three different prefabs representing the three different states of H20.

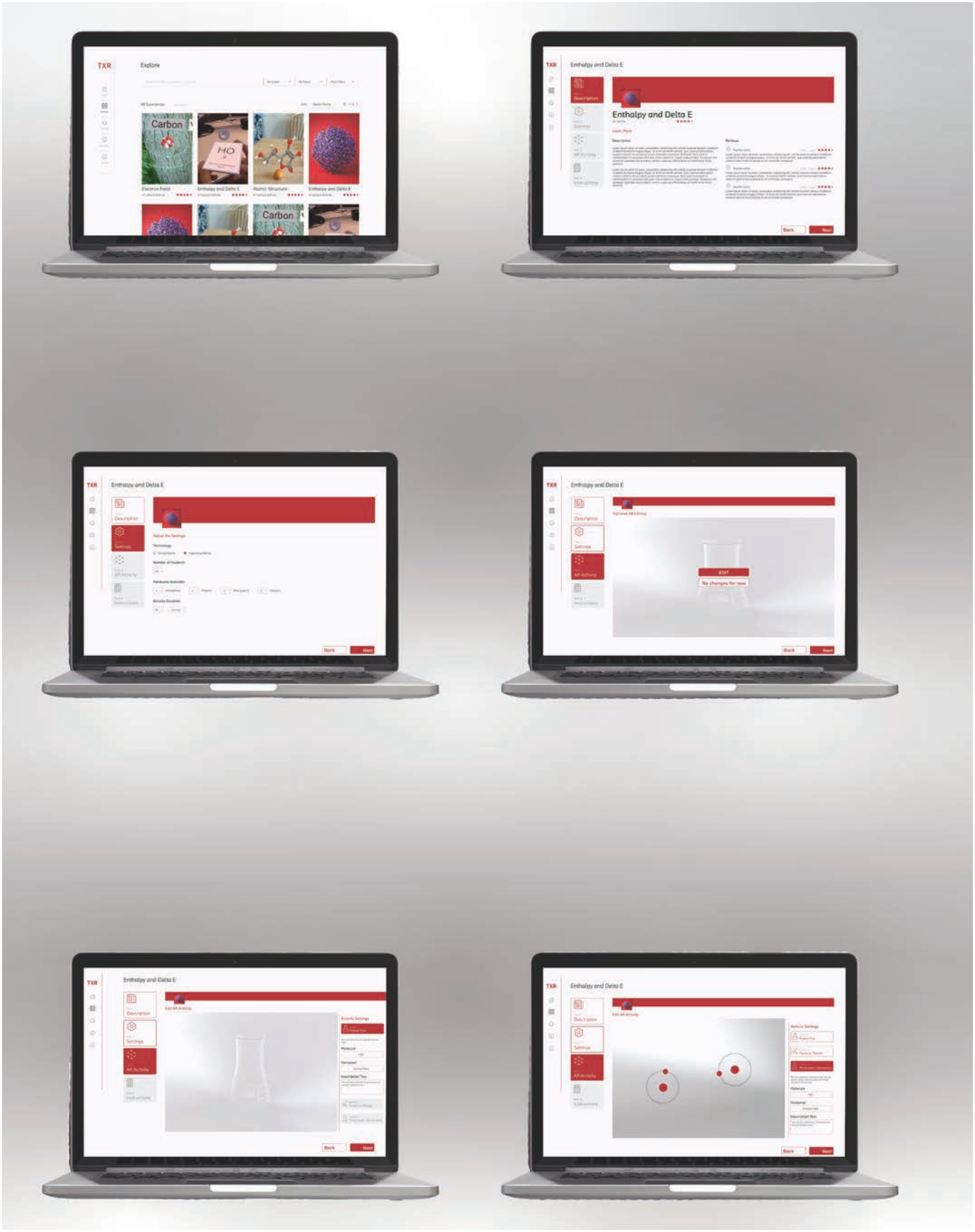
Looking Ahead

TeachAR creates a future where XR technologies are accessible and exciting for teachers. In this future, students' academic experiences are only limited to the imagination—no experience is too dangerous, expensive, invisible, or even impossible for a teacher to cultivate.

4 *TeachXR explore screen*

5 *AR experience - Solid state H20*

6 *TeachXR Screens*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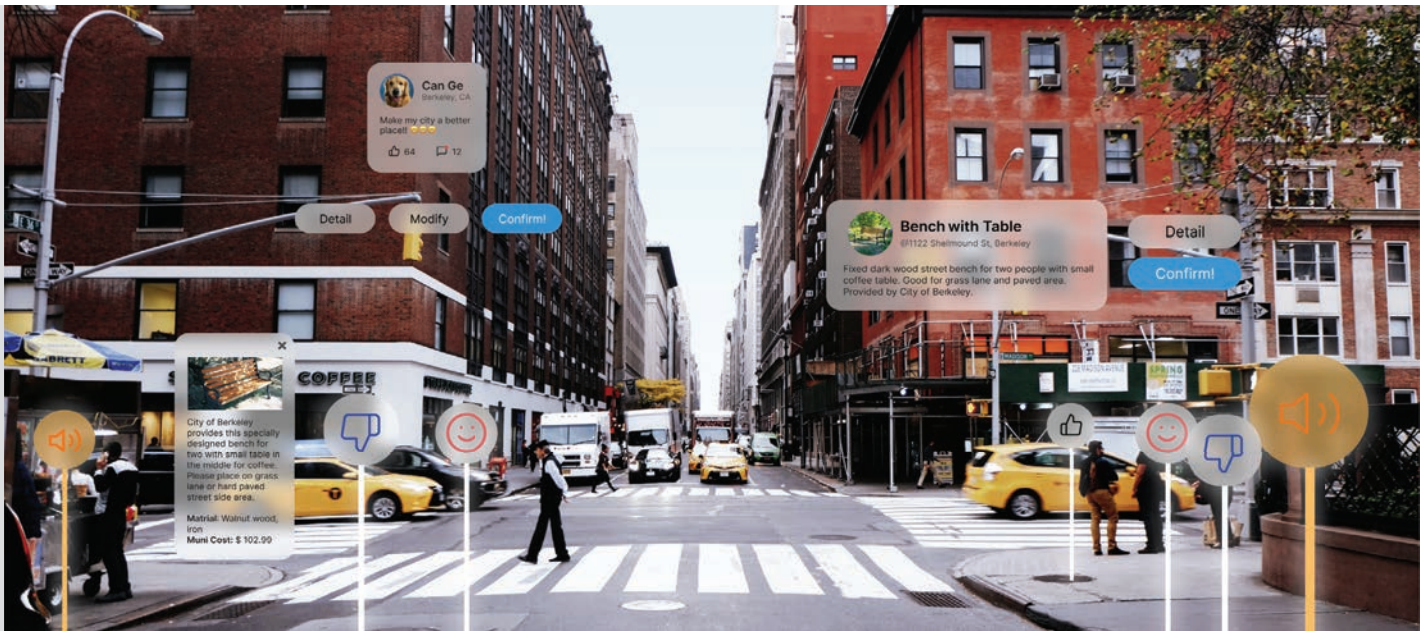
APEX

Can Ge

Augmented Public Engagement Experience: an augmented reality system to bridge local communities and urban development experts



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For decades, Augmented Reality(AR) researchers have been exploring its potential applications in reducing learning barriers in highly professional domains. As AR technology advances, we can almost see how its applications seamlessly bridge the exclusive professional domains and normal people. Current AR applications can provide a highly inclusive way to engage with virtual objects or interact with other users. They are blurring the boundaries of virtual and physical worlds by creating collaborative content in digital environments that can be overlaid in the real environment.

1 *An AR system to bridge local communities and urban development experts*

Meanwhile, city government and urban designers are facing challenges from the gap between highly professional design content and the public's limited domain knowledge. The design concept can easily clash with the user's actual needs when designing urban spaces. So in the architectural design and urban planning area, public participation and community engagement is essential in project development. However, the current public participation models still need to communicate with the public through traditional technical drawings and in-person group discussions, which will likely cause misunderstanding and exclusion.

Seeing these trends of XR and the problems in the public participation domain, I am proposing a design project that connects the tool of augmented reality and the problem space of public participation in urban development. The project explores the opportunities of building an augmented public engagement experience (APEX) that is empowered by AR technology to bridge local communities and experts in the architectural and urban design industry.

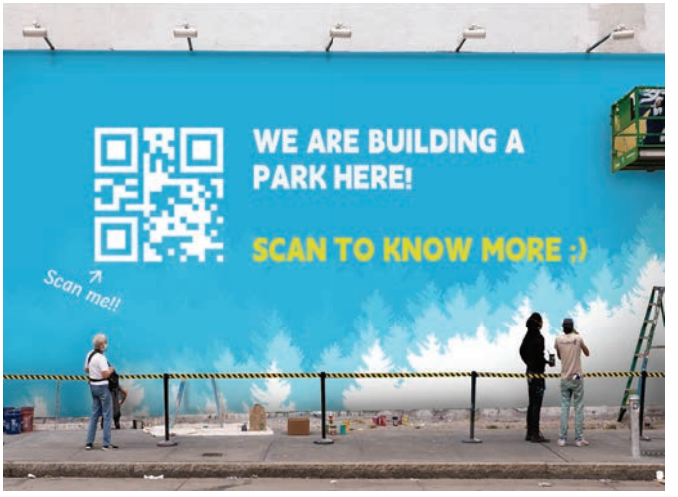
With this project, I want to address AR's significance and unlock how people understand their city and neighborhood environment. Instead of letting citizens go to a session they have no time for, how can it go to them? AR technology offers the opportunity to bridge the divide

between residents and their cities, making change appear before their eyes and allowing entire neighborhoods to weigh in on how their future community will look, feel and operate.

Initially, I conducted thorough research on the current landscape of public engagement to understand the limitation and pain points of traditional participation models. Secondly, the project focused on innovative solutions that solve the problems in these scenarios by connecting digital and physical realities. Eventually, high-fidelity prototypes are created. The outcome will be a series of working AR prototypes, a video of the design process, and a well-documented research report. As a designer, I understand that AR can benefit from multiple potential use cases in urban development, and the design could be different in different cities. However, due to the limitation of this thesis project, the final presentation and showcase will focus on the urban park design in Berkeley, California, as a case study.

With this project, I want to address AR's significance and unlock how people understand their city and neighborhood environment. Instead of letting citizens go to a session they have no time for, how can it go to them? AR technology offers the opportunity to bridge the divide between residents and their cities, making change appear before their eyes and allowing entire neighborhoods to weigh in on how their future community will look, feel and operate.

From another perspective, this project can also give designers a hint about how XR can make the city more inclusive. When designers discuss accessibility and inclusive design, the primary focus is always on underprivileged groups with physical or mental disabilities. Compared with highly professional domain experts, the public is also underprivileged regarding domain knowledge in this area. If we expand the concept a little, all the individuals with less knowledge or experience in communication are underrepresented, and AR technology has the potential to mitigate this problem. This thesis tries to reframe the concept of inclusive design so that understanding complex concepts in the professional domain is also attainable for the public and makes the experience more accessible. This design's application of AR is limited in the urban development field as a case study. However, this exploration may set the foundation for future inclusive AR experience design studies in other industries.



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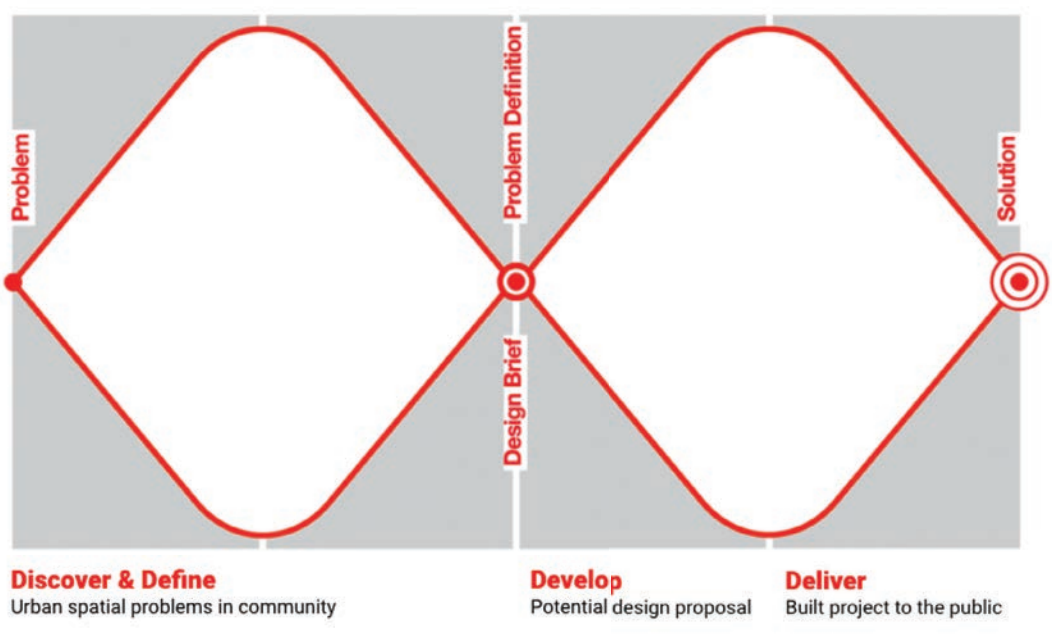
2 *An example of AR marker in the community to trigger the APEX experience*

3 *An APEX screenshot of proposing a bench in the park*



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APEX consists of three primary features: propose, comment, and discover. In the 'propose' feature, users can add a preferred design at a location in their community. Initially, the user opens this AR experience, and the app will guide the user to choose a location by a target indicator. After choosing the location, a virtual design project will appear and project on the actual environment in the user's device. Then, the resident can switch between different proposals from the experts, see design detail, and modify the size or layout. By pressing the confirm button, the user can leave this proposal in this specific GPS location for other residents or urban experts to review.

In the 'comment' feature, citizens can review the design offered by peer users or urban design experts and leave comments or 'like' them. Through this mode, users see all the proposals in this community and communicate their opinions with others. For example, a resident may open this AR experience and see a bike track in a proposed community garden. The resident can either tap the like button to show support for this design or leave a comment on how this track is too focused on pro mountain bike players and lacks leisure trails for beginners.

In the discover feature, residents can see the community's real-time map with the location of all the proposals and comments. Except for the proposals from the 'propose' feature and design from professional urban designers, it also illustrates all the ongoing construction sites in the neighborhood. The user can follow the map to the site and leverage AR to see the built space virtually. This mode aims to provide more transparency between the city and the public and help citizens to understand their surrounding urban environment. For example, Berkeley residents may find the construction site near their homes annoying and curious about what is happening in their community. They can easily open the map and see all the ongoing projects near them, then go to the construction site finding that a community activity center will be built in six months. Moreover, they can even see the exterior of this community center, experience the space in the AR world, and learn detailed information about it.

4 *Double Diamond Design Method for urban development project*

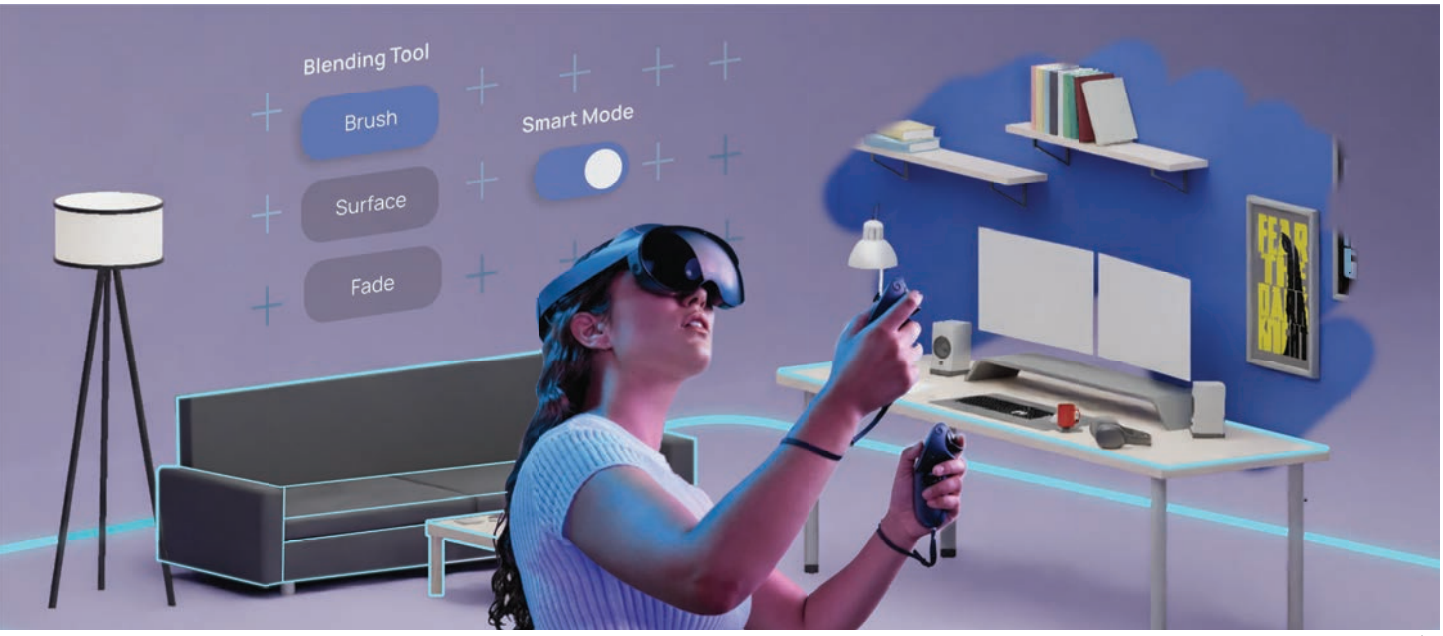
5 *A simplified design process diagram for this thesis project*

6 *After choosing the location, a virtual design project will appear and project on the actual environment in the user's device. Then, the resident can switch between different proposals from the experts, see design detail, and modify the size or layout.*

Limino

Daisy Chen
Billy Kwok

Exploring Interactions for Adaptive Blending of Physical and Virtual Environments in Mixed Reality



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With the recent advancement in Mixed Reality (MR) hardware and software, a seamless experience that blends the physical and virtual worlds is finally becoming a reality. One of the defining features of the next-generation MR experiences is the ability to see through the headset via real-time camera footage, commonly referred to as passthrough. While passthrough has been explored in a limited number of academic research and commercial products, the implementations are relatively experimental and primitive. Inspired by recent literature on passthrough, such as RealityLens and LIVE, as well as the notion of adaptive Mixed Reality advocated by David Lindlbauer, we think blending interactions and context-aware blending are two areas that deserve more attention and investigation, as they are both examples of the building blocks needed for smarter and personalized MR experiences.

1 *A concept render illustrating some of the interactions in edit mode and context-aware mode of our prototype (part of the image contains content from Meta Quest Pro promotion materials)*

The outcome of this project is an interactive MR application prototype that allows users to create, alter, and remove passthrough based on their situational needs via manual and automated interactions. These two types of interactions correspond to two design explorations contributing to the aforementioned research areas of blending interactions and context-aware blending. Through these explorations, we investigated the benefits and trade-offs of configurable, body-tracked, and context-aware passthrough. We hope our work will provide insights into the design considerations of more productive, customizable, and safer MR experiences in the future.

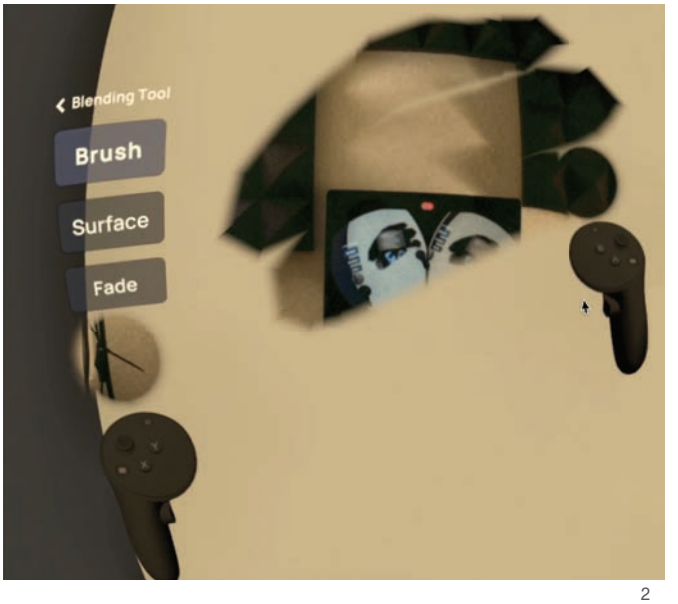
The software was implemented in Unity using the Meta Presence Platform SDK and Oculus XR Plugin with OpenXR backend. We have chosen Meta Quest 2 and Quest Pro as our testing devices due to their availability and community support, but the experience can be ported to any 6DOF MR headsets that support passthrough, spatial anchors, and controller tracking.

The core of the application is an interactive MR workspace loosely resembling the room where the users are physically situated. In addition to completely virtual content, users can map out real-world objects upfront, such as desks, couches, walls, doors, and windows. These mappings will be used to generate their digital twins. Users can also control the desired amount of virtuality and physicality by adjusting the blending of the physical and virtual environments dynamically through a set of manual and automated interactions. We devised two design explorations to analyze the use cases and trade-offs of these interactions.

In the first design exploration, we implemented and tested three types of manual interactions that alter the passthrough appearance of the physical space around work desks, namely fading, piercing, and casting. With fading, users adjust the opacity of virtual content to reveal the background passthrough behind it. The two interactions we implemented in this category are global fading and object fading. With piercing, users can create, update and remove passthrough cutouts through their controllers and a popup interface. We implemented passthrough brush and passthrough surface as the two examples in this category. With casting, users can cast a passthrough shadow onto the environment as if they are using a searchlight attached to different body parts, specifically, head and hand tracking in our prototype. In the testing and evaluation phase of the first exploration, participants were asked to complete a selection of tasks on a virtual computer screen in MR, including typing and reading, while sitting around a work desk. They could customize their MR workspace using any blending interactions in the three categories. We evaluated the trade-offs of each interaction type based on the user feedback and our observations.

In terms of technical implementation, the software architecture and mechanism that enable the above interactions consist of three parts. The virtual world consists of both virtual objects and digital twins. Virtual objects, such as decorative plants and soothing scenery, are used to support the experience aesthetically. The digital twins, such as desks, couches, walls, doors, and windows, support the visual consistency across realities, as well as the fading interaction at the object level. These digital twins are generated based on the bounding boxes of real-world objects tracked by the Presence Platform SDK. The passthrough content is rendered on a passthrough material through an HLSL shader that exposes the camera feed and creates soft edges along the passthrough boundaries. The passthrough imagery is combined into the virtual environment through the composition of different rendering layers sorted by their rendering priority in the depth buffer. The position and opacity of the content in each layer contribute to the overall blending of the scene as illustrated in Figure 5 on the next page.

The second exploration applied context awareness to the blending interactions in three use cases - item searching, break time, and bystander interruption. In item searching, when users stretch their arms to reach their coffee mug, a passthrough headlight is automatically switched on to help them locate the object. In the break-time use case, a brief fade-out of the virtual content reminds the users to take a break at the end of their MR meeting indicated in their calendar feed. In bystander interruption, a bounding box, rendered in passthrough, reveals the real-world position of any person who enters the room. In the testing and evaluation phase, each participant was put in



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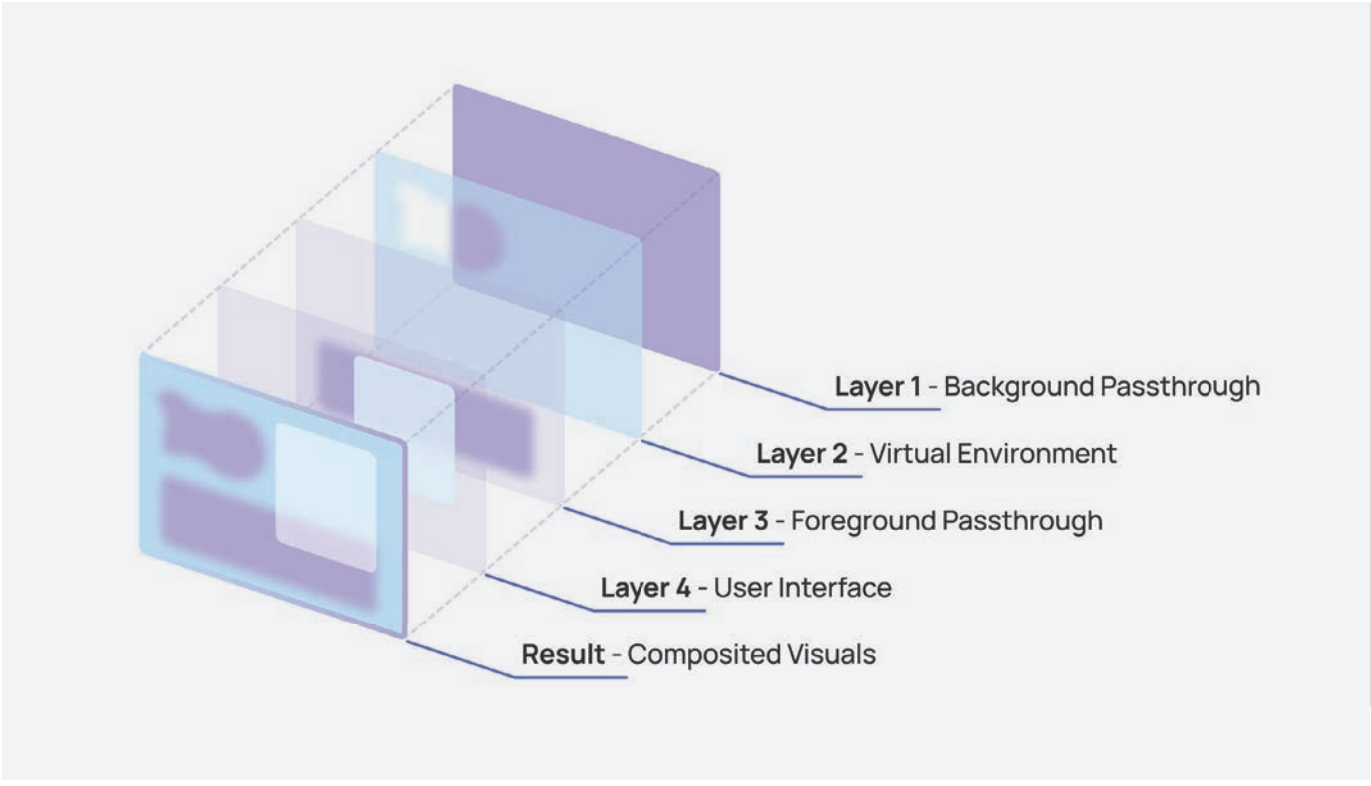
2 *A live demo of the passthrough brush interactions*

3 *An illustration of the fading interactions*

4 *An illustration of the casting interactions*



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the three scenarios. Similarly, we evaluated the feasibility and limitations of context-aware blending based on user feedback and our observations.

The context-aware system transforms events into blending changes. For activity awareness, motion-based events are detected using the built-in sensors. For example, the application detects standing by monitoring the vertical position of the headset relative to the floor, and arm movement by measuring the distance between the headset and the hands. While time-based event detection can be implemented via third-party calendar integration, we utilized a time-out mechanism in our prototype, allowing us to focus on the interactions. For environmental awareness, our prototype relies on an external camera for visual input due to the restricted access to passthrough data. The camera stream is fed into a pose estimation Tensorflow model to predict the presence and movement of bystanders in the environment. The derived data is pushed to the MR application via a local WebSocket server and triggers the corresponding blending changes.

We observed a number of patterns and user behaviors from the testing of our prototype, for instance, the dependence of immersion preference on cognitive load and the challenges of false positives and negatives in context detection. We hope the design vocabularies and interactions we proposed in this project inspire more studies on customizable and context-aware blending. This work also opens up future venues for studying mixed-initiative interactions across the reality-virtuality continuum, for example, by combining manual configuration and context awareness. Last but not least, we hope this work can provoke the design of future workplaces that seamlessly integrate virtual environments into the physical world.

5 *Rendering architecture*

6 *An illustration of the item searching use case*

7 *An illustration of the bystander interruption use case*

6

7

Mixing Signals

Bennett Ngan

A Mixed Reality notification system driven by embodied cognition

1

As a response to the growing complexity of daily tasks and habits, scheduling tools and notification systems have become a vital component of everyday life. Digital calendars and productivity apps excel in accuracy and efficiency, driven by smart enhancements like cross-platform synchronization and user-specific tailoring. However, traditional tools like pen and paper are still useful - the act of manipulating physical objects strengthens the cognitive connection between thought and action, elevating the quality of the experience. This is exemplified by users that prefer documenting information by hand, claiming that they enjoy the feeling or tangibility that manual tools provide. Both types of tools possess qualities unique to their respective mediums, altogether representing a fuller picture of how human thought and consciousness can manifest itself in both digital and physical worlds.

1 *Render of the Mixed Signals physical devices. These objects interact with and are controlled by a HoloLens 2 AR headset (not pictured)*

Mixing Signals is an immersive reality project that explores the combination of digital and physical tools together for immersive notifications that are contextually aware and cognitively engaging for the user. This multi-modal approach to notifications explores functional tech while preserving the intimacy associated with personal and intimate spaces. The new notification system is composed of two inputs and two outputs: the Signalbook (pen & paper input), Quickcube (haptic input), Signaler (multi-sensory output), and HoloLens 2 AR headset (holographic output).

Design Framework

Contextual inquiry and user research helped lead design direction through the formation of three key concepts: cognitive translation, dynamic notifications, and embedded automation. Cognitive translation refers to the ability of a tool to translate thoughts into an externalized format that can be accessed later on. Interesting applications of this concept can be found in

human habit - in college, a roommate would throw a book in front of the bedroom door before going to sleep in order to create a visual disruption in his morning routine; this helped remind him of an important task the next day. Dynamic notifications in the form of multi-sensory outputs provide contextual relevancy, since the urgency of reminders is often varied and is not typically reflected in phone reminders. Lastly, embedded automation combines the benefits of both digital and physical tools by merging digital functionality with the tangible experiential quality of physical objects.

Creating Notifications

Mixing Signals implements these concepts through layered interactions during notification input and output. Signalbook, a customized notebook to write down tasks and ideas, serves as the primary input medium. Written information is recorded with the HoloLens with the help of AI-driven Optical Character Recognition (OCR), logging it in a digital format and automatically setting notifications. It also allows the user to assign priority levels and precise time reminders, creating high-resolution notifications that capture objective (ex. doing laundry) and subjective (ex. making vacation plans) ideas. This input method is intended for premeditated notifications, where the user plans out their day ahead of time in a manual, reflective format. In contrast, the Quickcube allows the user to capture low-resolution notifications in transient moments where expediency and convenience are paramount. Curling the cube into a fist activates all six switches and creates a highly urgent notification, pressing three sides corresponds to a medium notification, and two creates a low urgency notification. Whether rushing to another appointment, halfway asleep, or engaged in conversation, the Quickcube creates notifications when writing in the Signalbook is inconvenient or unnecessary. This interaction is dependent on externalized memory, where the physical act of creating the notification enables the user to recall the idea that they had earlier (with the aid of contextual clues like location and time recorded).

Experiencing Notifications

As output devices, the HoloLens and Signaler transmit signals to the user with visual layering and sensory output. The Signaler sends sensory notifications that corresponds to its urgency - smell as low, visual light as medium, and sound as high. When received, the user can interact with the holographic UI to gain further contextual information about the notification, or change settings for it. This notification hierarchy is useful in scenarios where variability in disruption is desired: a user might only want to be notified of the weather forecast in a subtle, unobtrusive manner, but would want to be jolted from focus if a family emergency is occurring. Together, the output devices generate notifications that are contextually relevant and adaptable to the needs of the user.

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2 *Photos taken during contextual inquiry and user interviews*

3 *Breakdown graph of notification hierarchy based on time and urgency of notification*

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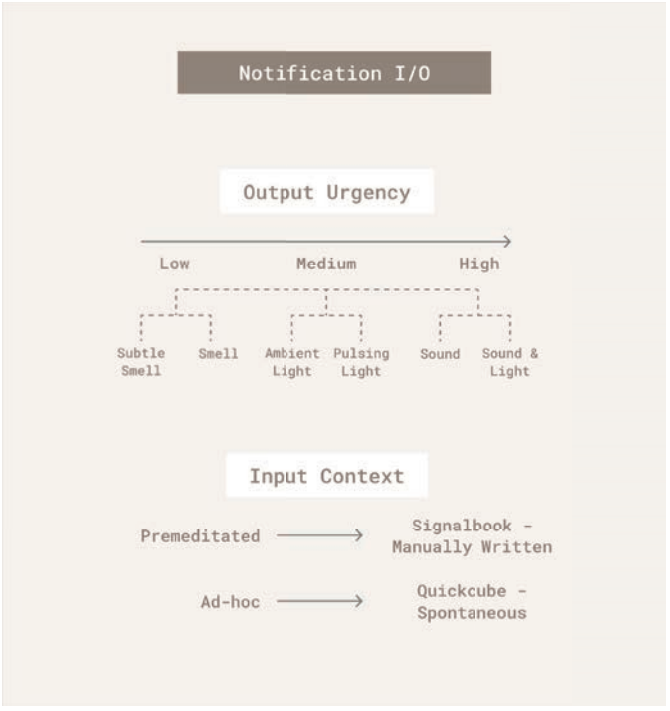

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notifications that are contextually relevant and adaptable to the needs of the user.

Industrial Design

The physical form and feel of each device suggests its intended use in various environments - the Signalbook is nestled into a tray by default, but can be removed to be carried around as a portable notebook. This creates the notion that the Signalbook has a dedicated space where the user writes tasks in a predictable routine, but also has the flexibility to be edited throughout the day. The handle and lamp-like feel of the Signaler communicates semi-portability, suggesting that the device can be periodically tethered to certain environments that the user spends time in. Lastly, the pocketable size of the Quickcube allows it to be brought everywhere, inferring spontaneous and instinctive use from its convenient design.

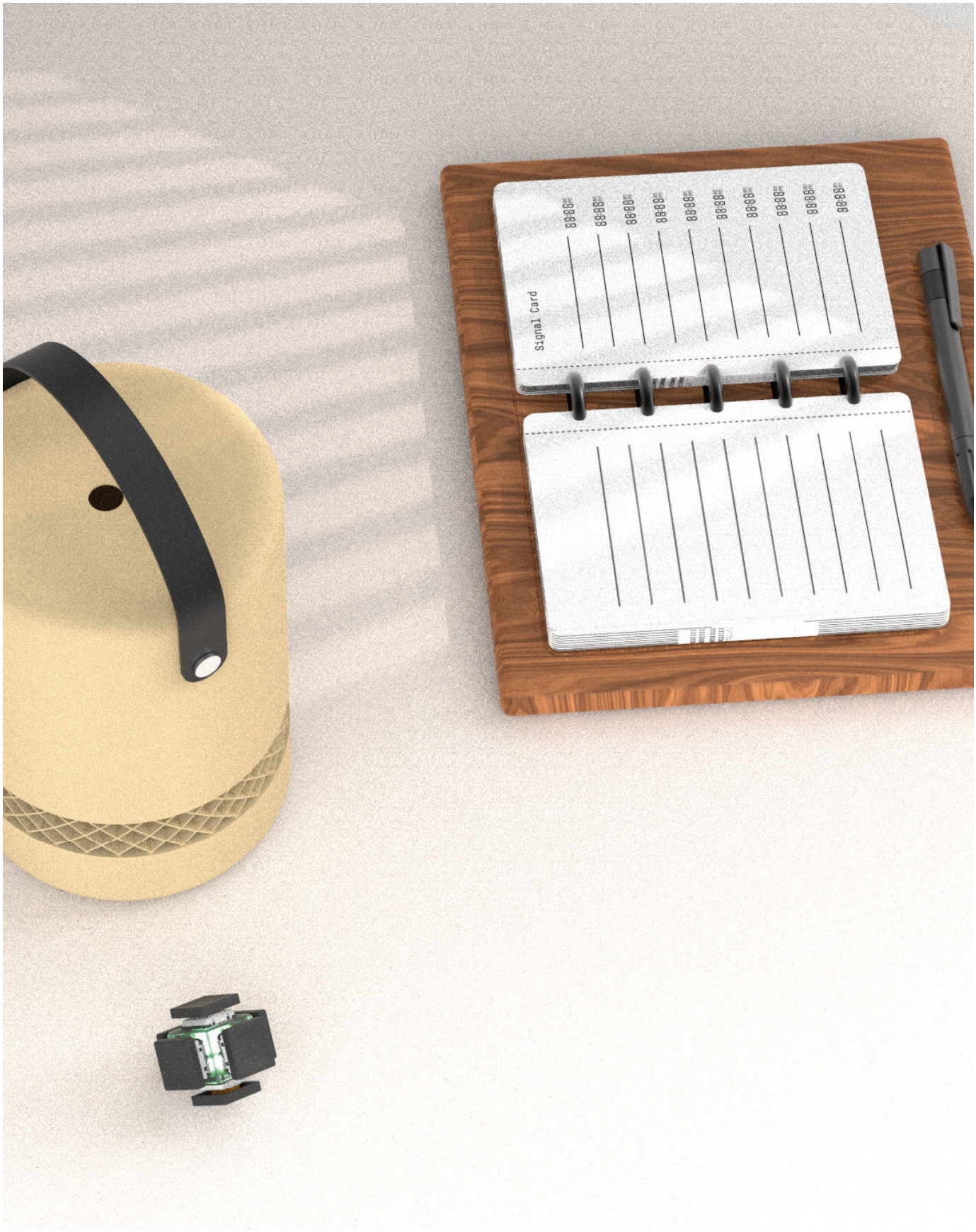
Throughout the experience, an underlying theme is that the intimacy of the physical world is preserved for the user even as digital aspects are incorporated into it. When notified, users are not immediately faced with distracting visuals, but are allowed to selectively choose information to be seen. The technology itself does not completely detract the user from the physical world, but instead serves as an augmentation that encourages their engagement with the world in an organic and intuitive manner.

On a larger scale, this project explores the practical integration of embodied and distributed cognition into everyday life. Everyone has their own “quirks” of how they externalize information, whether by placing physical objects on their desk to remind them to do something the next day, or by placing post-it notes in odd places for quick and adaptable documentation. In contrast with the monotonous nature of typical phone notifications and disruptive alarms, Mixing Signals focuses on creating nuanced interactions that reflect and cater to these habits.

4 *Early prototypes of interactable 3D virtual objects with HoloLens 2 & Vuforia*

5 *Input/Output breakdown of notifications*

6 *Top view render of the physical Mixed Signals devices*



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DEMOCRATIZING MENTAL HEALTH

With increased national rates of anxiety and depression from the 2020 COVID-19 pandemic, self-guided mental wellness tools/apps have become increasingly popular. In a research study on Headspace, a meditation apps, users reduced stress by 14% in as little as 10 days (Economides et al. pg.1). Self-guided cognitive behavioral therapy apps, which consist of digital journaling and data visualizations of mental health progress, have been effective at improving symptoms of mild to moderate depression as well as negative thoughts (Kilo Health, 2022).

Though today's breadth self-guided mental health tools like these have demonstrated efficacy without the presence of a mental health professional, they fail to accommodate the needs of people from various circumstances, backgrounds, and needs. Some people struggle to visualize or articulate how their feelings, have unique cultural stressors that aren't focused on, or struggle to understand their mental health progress without external visualizations outside their imagination.

Our cluster explores how we might better democratize mental health tools for all by serving these types of people so that nobody gets left behind. We aim to do this by challenging self-guided mental health tools like to be interactive, visual, engaging, culturally responsive, and data-driven through the application of mobile, VR, AI, and data visualization technologies.

LITERATURE REVIEW

Visualizing Our Minds

Self reflective practices such as journaling have proven benefits for dealing with symptoms of many mental health issues such as anxiety and depression. However, they often lack a way to measure progress over time, a way to truly give thoughts and feelings concrete form, and a way to stay motivated. One way to overcome some of these issues is through visual representations of your mental state. These types of visualizations provide a way for people to process what is going on internally in a new way, to externalize and give form to the abstract concept of their mind. However, most visualizations that currently exist are static

and generalize the experiences of everyone going through a particular mental illness and are specific to diagnoses rather than individual experiences of mental wellbeing.

The rise of text to image AI as well as the capabilities of natural language processing gives us the tools to tackle some of these challenges. NLP is able to extract data from journal entries and AI tools like Dall-e and Stable Diffusion enable the generation of art from text based data. We aim to use these tools to help people empathize more with themselves and their minds.

Cultural Complexities In AI + Mobile

"Self-therapy" apps often provide CBT (Cognitive-Behavioral Therapy) knowledge and techniques on various topics, such as how to manage workplace stress or burnout. Dating back to the 1950s, CBT is a psychotherapeutic treatment that involves reframing one's cognitive thinking, such as countering negative self-talk with more positive thoughts. When delivered through mobile and AI technologies, such as app Bloom, it's been proven to be effective at helping people overcome mild to moderate symptoms of depression at a faster rate than therapy.

However, data points required to match people to culturally responsive mental health content aren't collected. Cultural complexities aren't a part of AI personalization models in self-guided mental wellness apps. In a competitor analysis of self-guided mental wellness apps that Jennifer conducted across Mind Doc, Headspace, and Bloom, there were very few to zero questions asked about a user's cultural attributes like racial background outside of age and gender. The mental health topics were more general — universal across ethnicity, sexual orientation, etc. If these attributes are collected, we can leverage them along with existing technologies in neural networks, such as in the case of Netflix. They can match users to content based on similar cultural attributes and behaviors.

Desirable States

Neurofeedback therapy was pioneered in the 1960s by two researchers: Dr. Joseph Kamiya at the University of Chicago and Dr. Barry Sterman at UCLA. This style of therapy monitors the brain for brainwave activity and almost immediately gives an iterative and continuous loop of information supported by a recommendation or an action. Clinical neurofeedback therapy, which is carried out by trained healthcare workers in hospitals and clinics, finds its applications in treating Attention-Deficit Hyperactivity Disorder (ADHD) and seizure

conditions. The symptoms of various neurological and mental health conditions are relieved by regulating brain activity through this process.

However, the current neurofeedback practice relies heavily on using it only as a tool for treatment by professionals for a disorder or a situation-based therapy. Neurofeedback thus remains highly inaccessible to the larger public and its applications as a routinely accessible tool at home for general usage is still under exploration. There exists a wide gap between neurofeedback and selfcare. Thus the project - Desirable States explores the possibility for utilizing this technology to empower individuals to use it in a non-clinical setting. Taking inspiration from some of the work at MIT Media Lab's Fluid Interfaces Group like the project Deep Reality, it tries to map human stimuli and mental states generated in a conventional everyday environment to create mental fitness interactions.

Emotionally Safe Spaces

Mindfulness is the act of being intentionally present in order to process inner thoughts and feelings, which aids in regulating emotions. Many individuals find the traditional method of staying still in silence difficult and prefer more engaging methods like hiking, playing video games, exercising, or reaching out to friends and family (cite).

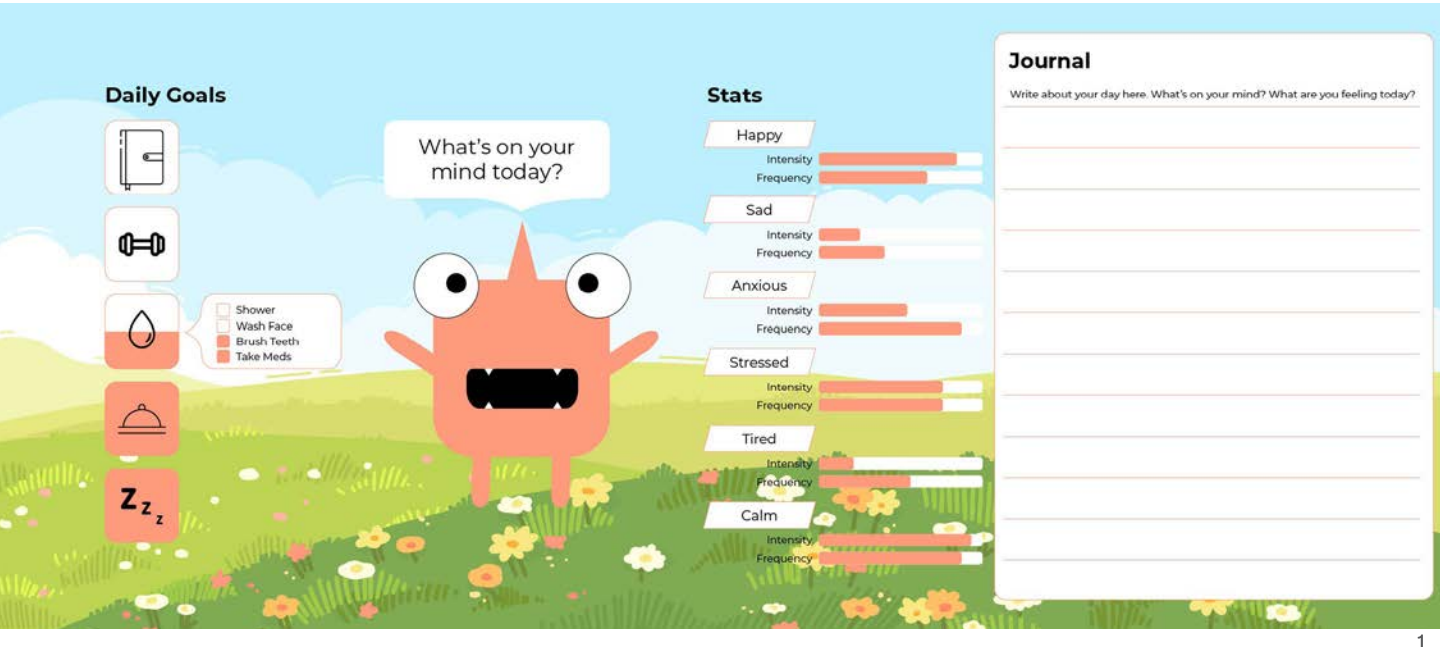
Mental health applications like Calm or Headspace provide varied content so that mindfulness is easier to practice for a wider range of users. These platforms are more effective than traditional methods because they get users into flow, a state where the brain can relax and focus on an activity with low effort (Wilkinson and Chilton). They follow the BJ Fogg's Behavior Model to design the experience based on the user's trigger to use the product, their motivation to start a target task, and their ability to complete the task. Alrobai Amen's research on persuasive technologies discovered that flow can cause digital addiction. Making the user's activity transparent can allow them to make informed decisions.

However, these online mental health interventions are not able to sustain users because they lack visual cues. Virtual reality (VR) technology became popular when psychologists like Barbara Rothbaum, Walter Greenlead, Hunter Hoffman, and Albert Rizzo successfully treated patients suffering from anxiety, phobias, trauma, and bipolar disorder because of the realistic virtual environments. VR environments can create emotionally aesthetic experiences in which the objects evoke the user's emotions.

Visualizing Our Minds

Sara Friend

Externalizing and giving form to inner thoughts and feelings through the analysis and visualization of self reflective writing



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Abstract

Our minds are intangible, abstract, nebulous things. We cannot see them, we cannot touch them, and we often struggle to understand them. The mind is so different from the body. We often think about our bodies as vessels that carry us through life, that do work, and that keep us running. We understand that we need to fuel, clean, and take care of our bodies in order for them to continue to function and for us to survive. But our minds are different. Feelings are not concrete. Thoughts have no physical form. How can you care for something you cannot see or touch?

This project aims to help people approach their mental health from a new angle, to inspire a more instinctual desire to practice mental hygiene, and to create a more positive relationship between themselves and their minds.

This is done by utilizing the current self reflective practice of journaling as the groundwork from which to extract data and create visual representations of a person's thoughts and feelings. Through data collection and natural language processing, journal entries become monsters, forms that are alive, empathetic, and in need of support. These dynamic beings help to illustrate progress and motivate care throughout one's mental health journey.

Extended Description

People have tried to visualize mental health and wellbeing in the past through illustrations, data visualizations, and exercises in imagination. But these methods tend to have been too generalized, too focused on diagnoses rather than individual and complex experiences of

1 *Mockup of a screen of the app where you can see your generated monster, its "stats", the progress towards your daily goals, and a place to write a new journal entry.*

background image: Freepik.com

mental wellbeing, and too static without an exploration in how our minds change over time. There needs to be a better means of giving our minds form in a way that is informative, individualized, and ever changing. We all need the chance to connect with our minds in a way we never have before and to gain the tools to motivate ourselves to take care of our minds as we do our bodies.

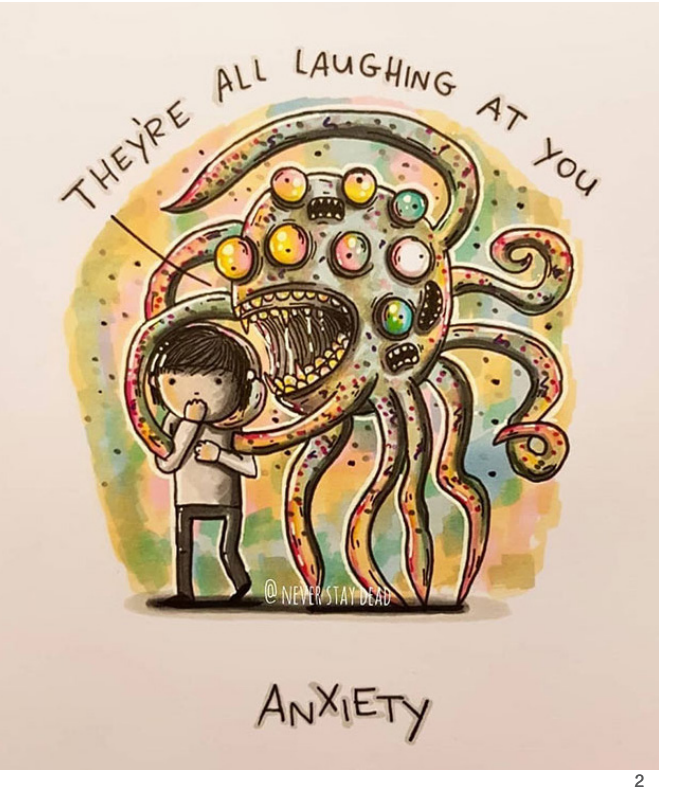
The goal of this project is to change the way people think about and conceptualize their minds and encourage a deeper empathy with their mental wellbeing. It aims to connect people with themselves in the way they are able to connect with others.

Access to mental healthcare is crucial to the wellbeing of every person. Unfortunately however, many people are unable to get the care that they need. According to the National Alliance on Mental Illness and the American Psychiatric Association, there are a lot of reasons for this, including stigma, cost, availability, and medical bias. The confusing and difficult process of trying to find care coupled with exorbitant costs associated with many providers, means that a lot of people are simply unable to get professional help. Because of these difficulties, it is extremely important that there are options for people to take their mental health into their own hands. This project is not meant to serve as a replacement to therapy or other professional services. It is simply meant to give people a resource to help better their mental wellbeing in just one small way with low to no barriers to access.

Among these barriers to care is stigma. In addition to stigma being perpetuated by the public and the healthcare system, self-stigma is a huge problem as well. This type of stigma is a form of negativity and shame that one might feel towards themselves about their mental health struggles. This perception of self is a big part of what this project aims to reframe. Instead of seeing your mental health concerns as a negative reflection on yourself and a sign that you do not deserve care and support, this project tries to reconceptualize the essence of your mind so that you can see your mental wellbeing as something separate from your self worth. The goal is to show you how your mind is just as deserving of care as any other person's and that empathy, understanding, and empowerment can be powerful tools to dismantle the internalized negativity surrounding your mental health.

The domain that this thesis inhabits is an intersection between reflective writing, artificial intelligence, data visualization, and art in the context of mental health and wellbeing.

Many past projects have been an inspiration to this one in the various areas of the domain. I was very influenced by the work of information designers Giorgia Lupi and Stefanie Posavec and their project Dear Data, as well as journalist and interface/visualization designer Anna Wiederkehr's project Fine. These are both amazing examples of self tracking personal data as well as unique exercises in visualizing and understanding small aspects of daily life. My direction was also propelled by the works of Phil Wall and Toby Allen with each of their independent series of illustrations of mental illnesses in the forms of monsters. This, coupled with research done on the concept of the "Anxiety Monster" used in some therapy practices, led me down the path of using monsters for my own visualizations.



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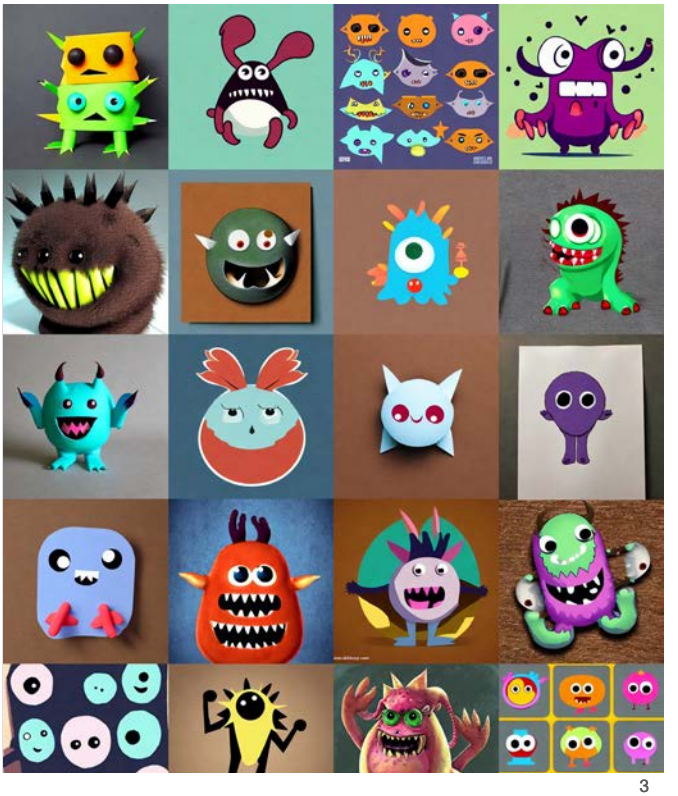
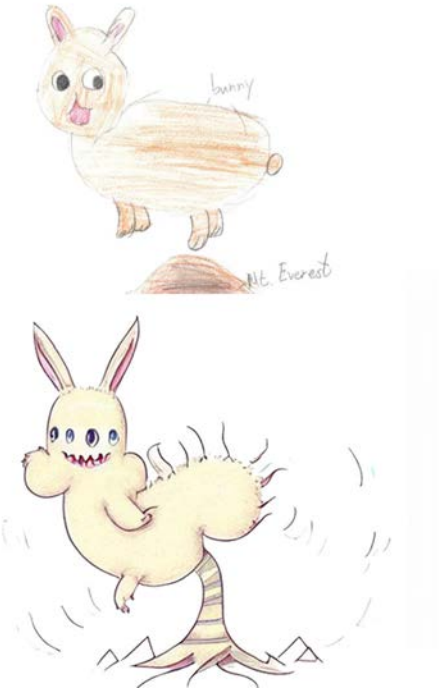


3

2 *Anxiety as a monster by Phil Wall a.k.a. Never Stay Dead image source: https://www.instagram.com/p/BqgViC3HY17/*

3 *AI generated monsters using various prompts containing keywords such as "illustration," "cute," "monster," and "emotion."*



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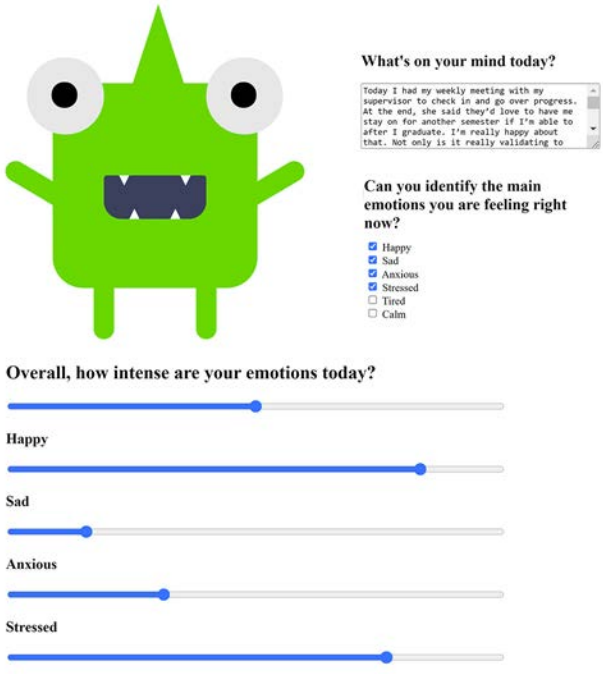

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The monster representing a person's mind is the metaphor at the center of this project. This metaphor is what allows people to translate their feelings of empathy and care for another being to themselves. It allows them to see their minds in a new form that can make the invisible visible.

Much of this project was spent on research, ideation, and discussion before moving into technical development. Research was conducted to figure out how people currently conceptualize their minds, how people can track their thoughts and emotions in a way that promotes self reflection, and what products and services already exist in this space. Findings from this research led to the conclusion that journaling was the best method to use for the user input, monsters would be used as the imagery of the visualization, and AI would be used to process the journal entries and generate the visuals.

After fleshing out the metaphor and visual form of the monsters, the technology needed to be developed to create those monsters. The first step of that was creating a place for people to journal and record their thoughts and feelings. Then, a program had to be developed to analyze those journal entries to extract data from it. It was decided that natural language processing would be used here to pull out important meaning and themes from the freeform writing. Finally, a way to take that data and generate the monsters that represent it was created. This allowed the user to see the data that had been extracted from their journal entries in visual form.

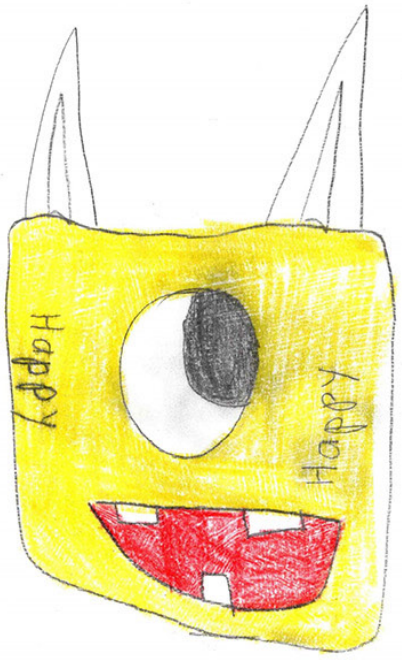
The completion of this thesis will not only bring a new resource to help people increase their mental wellbeing, but it will also open up a broader conversation about how we view and think about mental health. This project will hopefully encourage people to not only empathize more with themselves and their minds, but also with other people who may be struggling in ways that are invisible to them.

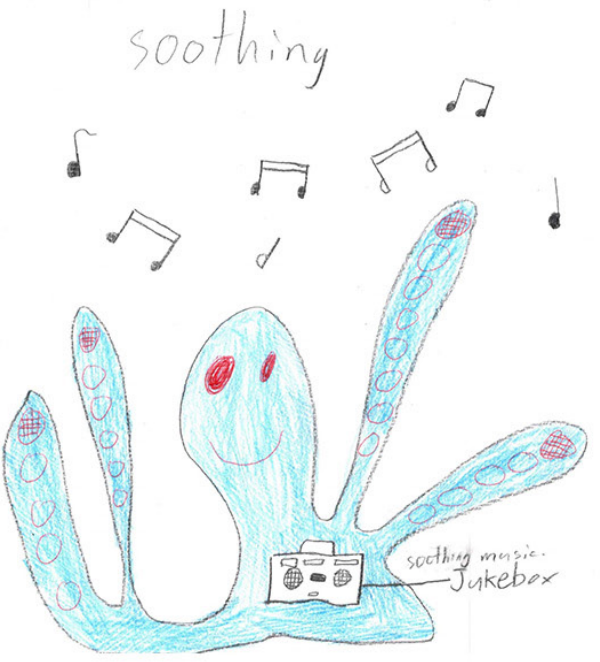
4 *Using the Artbreeder collage feature, a drawing of a kid's mind and a description of the drawer's thoughts and feelings is turned into an AI generated monster.*

Prompt used:
"Illustrated Monster.
I feel super excited about tests. I like to get a 100 on my test. I want to hop up and down like a bunny! I hop over Mount Everest!"

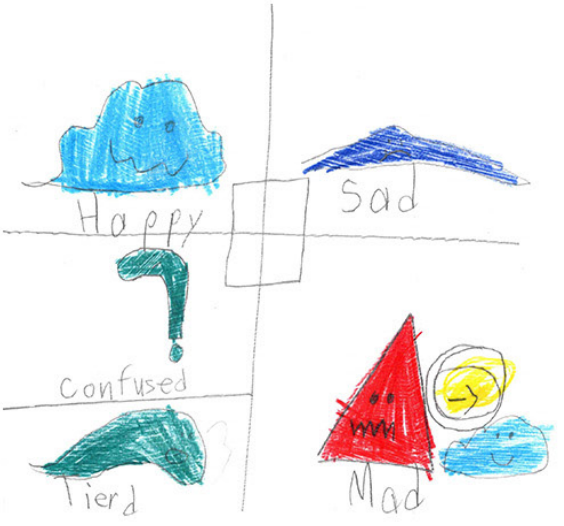
5 *Prototyping the basic monster generation and manipulation based on user input into the journal entries*

6 *Selection of drawings of creatures that represent thoughts and feelings by 3rd grade students*


Happy
Happy


soothing
soothing music.
Jukebox


scared


Happy
Sad
Confused
Tierd
Mad


Anxious
It's
feeling
Anxious

Addressing Cultural Complexities in Mental Health Through AI + Mobile Tech

Jennifer Wong

Providing insights into sources of stress relating to one's intersectionality so that they can feel relief through shared experiences and a greater sense of control over their narratives

1

1 *Taylor Chang, an Asian American woman experiencing day-to-day stress, wants to learn how to manage her stress*

According to Kilo Health, "self-therapy" mobile apps have proven to be effective at helping a generalized population of people treat mild to moderate symptoms of depression without seeing a therapist. However, these apps aren't as helpful for minorities like Asian Americans due to the lack of representation of cultural stressors like the 339% increase in Asian hate crimes reported by NBC News.

Given the limited pool of diverse therapists, affordability barriers, inconveniences of seeking support, and more critically the lack of cultural responsiveness in mental health, I explore how to personalize support for Asian Americans (ages 18-31). I've designed and visualized an AI/machine learning personalization model that predicts mental wellness advice, based on trends identified by therapists/researchers, that are most relevant to various Asian Americans communities after capturing cultural attributes and other data points through a mobile app. This is supported by insights from 12 user interviews, 2 informational interviews with a software engineer and licensed clinical psychologist, and 13 usability tests.

Test outcomes demonstrate that culturally responsive support can be more impactful, motivating, and personalized when distributed through AI/mobile technologies, even if it's based only on having self-critical behavior and an Asian cultural background.

I hypothesize my proposed personalization model can increase levels of personalization and motivation of mental wellness support and self-efficacy. I've created mockups, prototypes, and data visualizations to communicate a proposed personalization model that's reflected in a mobile experience.

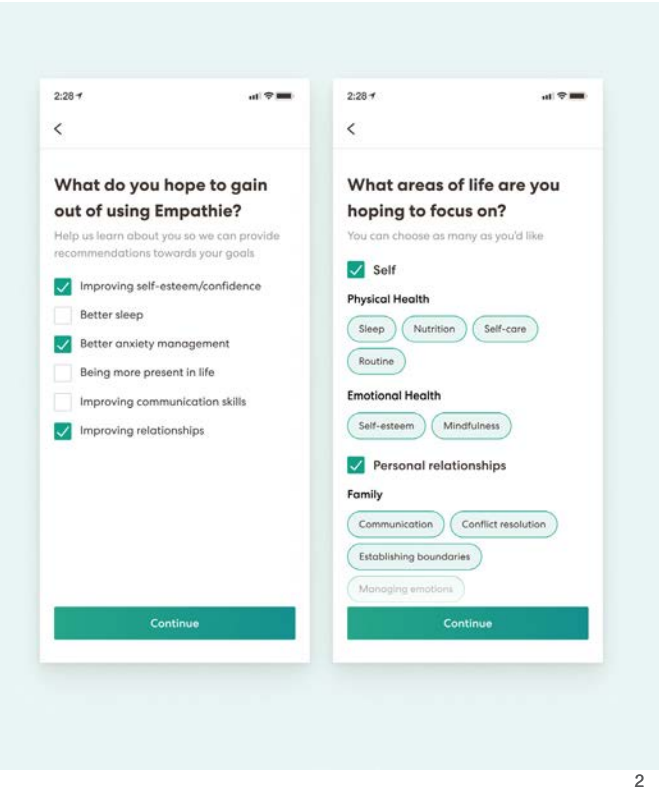
For the scope of this thesis, I'm focusing on Asian Americans (ages of 23-31) due to our shared ethnic identity. This group is small enough to identify niche trends yet broad enough to demonstrate that the personalization model would need to adapt to various sub-communities's needs. I'm leveraging an existing mobile app, personalization model, and mental health advice through Empathie, a self-guided mobile app for early and culturally responsive mental health intervention that I co-founded. It contains a set of mental health videos and activities developed by and displays Asian American licensed therapists.

I, plus the Empathie team, interviewed 8 individuals to identify gaps in personalized support and their impact on self-efficacy. After identifying prevalent attributes, we ran a survey to identify which were most. Collaborating with a licensed clinical psychologist, software engineer, and AI/Data expert, I explored various types of data collection methods and personalization models through informational interviewing/brainstorm sessions, sketching, wireframing, and prototyping. Across 13 participants and 2 rounds of usability testing that evaluated personalization questionnaires and personalized mental health videos, we compared perceived levels of personalization, motivation, and self-efficacy between the proposed personalized experience (Empathie) and Bloom (industry competitor).

Overall, research outcomes demonstrate that culturally-responsive support can be more impactful and personalized through AI/mobile technologies, even if it's based on only 2 data points — having self-critical behavior and an Asian cultural background. Paticipants watched a culturally-responsive video on stress (Empathie's), which explains how the Model Minority Myth affects how Asian Americans feel pressured to uphold unrealistic societal expectations of them being "perfect" and not seek help, had a 6% higher rating of perceived levels of personalization, 9% higher in levels of motivation to improve their mental health, and 23% higher rating for usefulness. 89% of participants also perceived it as more personalized and motivating than the generalized one on stress (Bloom's).

Based on user research interviews and usability studies, Asian Americans aren't aware of how their intersectionality impacts them. Even if they could Google a niche topic, they likely wouldn't be conscious of what to search for without knowing keywords in the first place. Empathie's culturally responsive video was considered an "eye-opener," according to a test participant, and well-received because it made their implicit experiences explicit — building self-awareness that they would have struggled to gain on their own.

However, self-efficacy ratings scored lower due to participants stating that the generalized video felt more action-oriented with its frameworks and tips. A participant included that Bloom's video provided more general information on stress management than the model minority myth video, although it does not explain the reasons behind the stress as well." This comment demonstrates an opportunity to combine the general frameworks in combination with cultural reasons behind one's stress. This can be incorporated in future mental health content by Empathie but is out of scope for this thesis.



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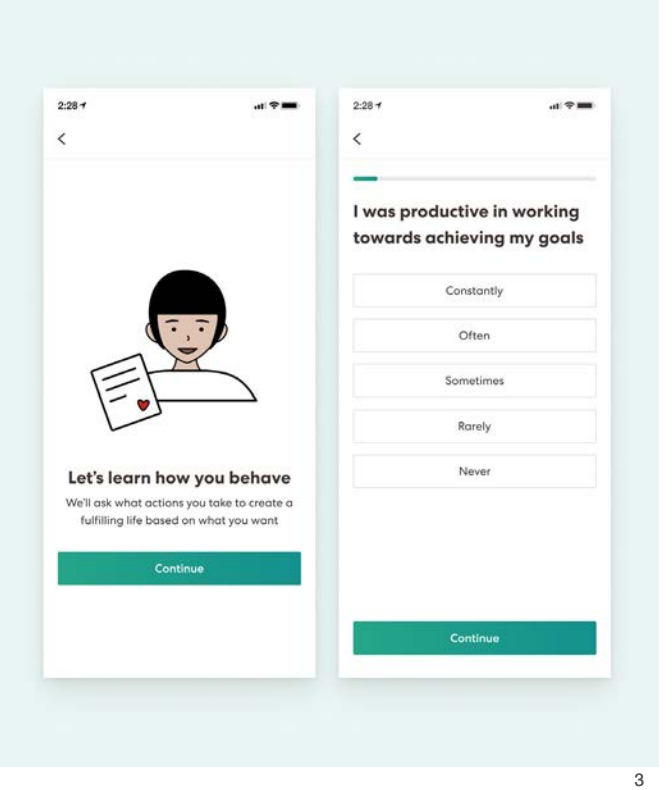

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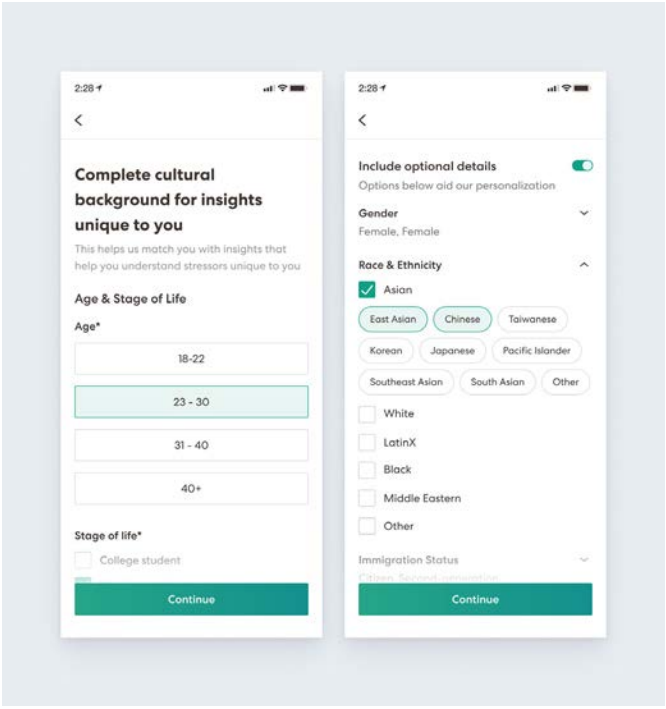
2 *Taylor downloads and signs up for Empathie — providing input on her goals and mental health topic preferences*

3 *Taylor completes cognitive, behavioral, and mindfulness assessments*



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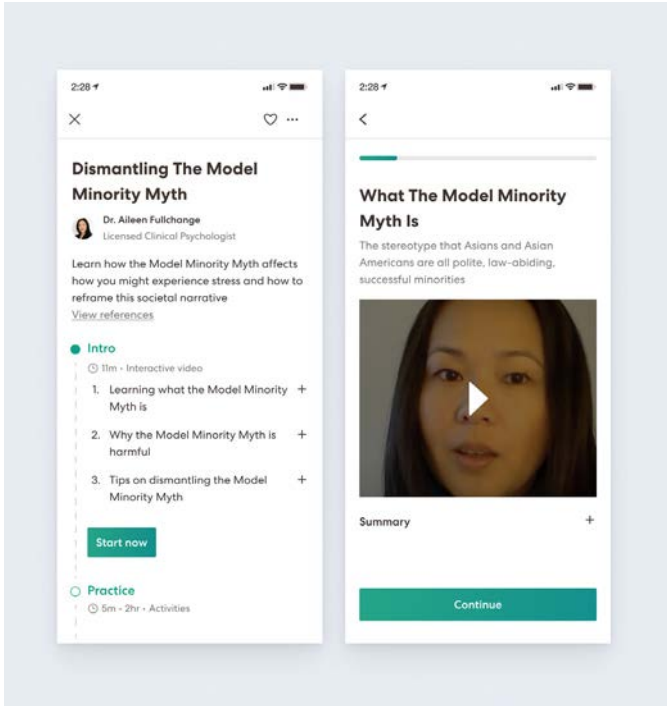

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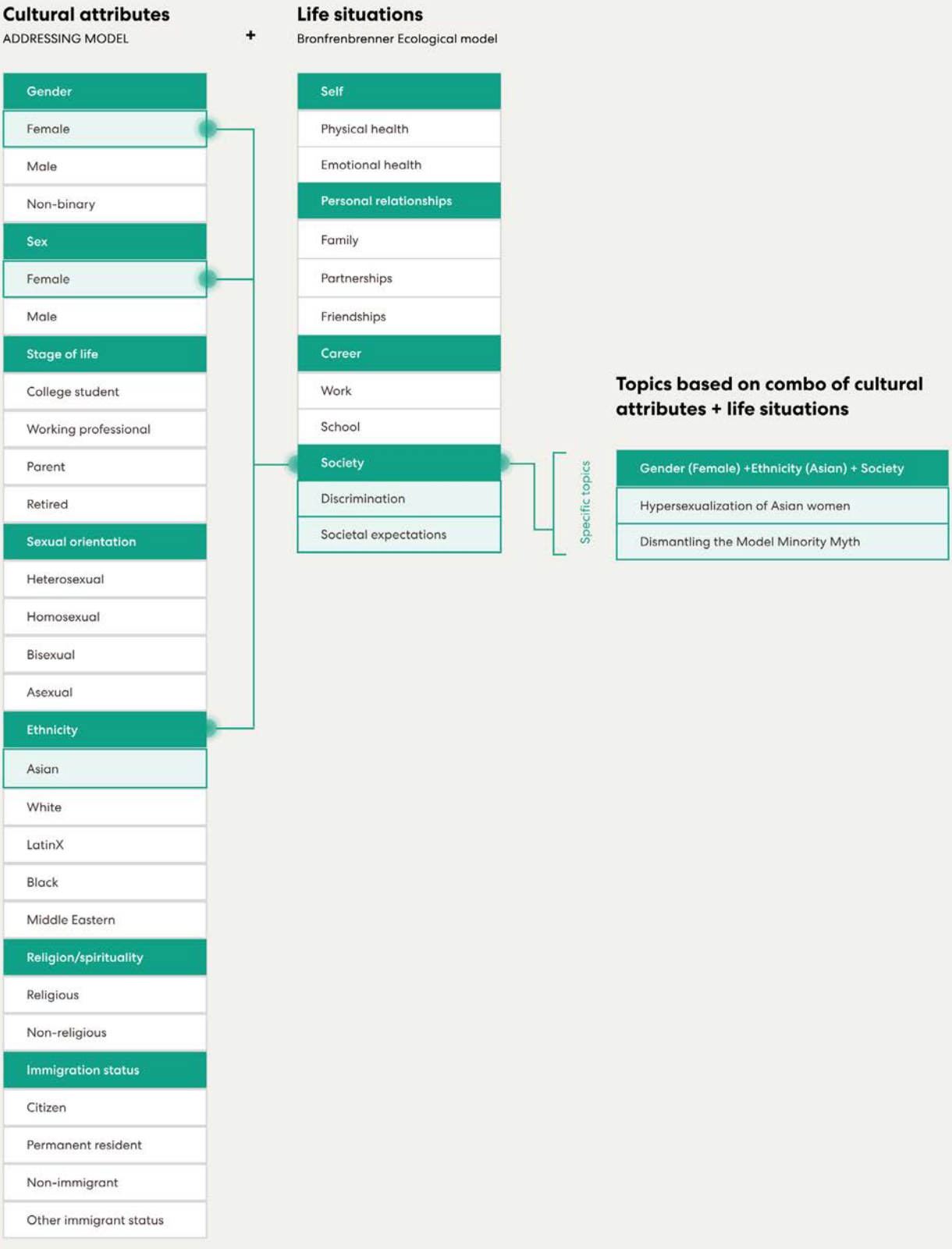
Through examining the plausible impact of providing culturally-responsive mental health support, through the form of CBT-inspired videos and activities, distributed by AI and mobile technologies, I have learned that there is immense value even in providing support that is based off of a broad combination of trends with Asian American communities. Imagine how much more helpful our support could be if we address even more attributes of intersectionality. Research demonstrates that even by considering just two attributes, one about struggling with self-esteem and the other about being Asian in a personalized mental wellness app, Asian Americans strongly preferred culturally responsive topics on stress over generic ones. Secondly, the motivation to work on reducing their stress and levels of perceived personalization were higher than the generic one. This correlation demonstrates that the level of personalization, influenced by consuming cultural responsiveness mental health content, is correlated with the level of motivation.

My argument is not to demonstrate that AI is capable of, should, or could replace therapy. My research demonstrates that AI can automate broad parts of what minority therapists struggle to do at scale, which is to provide relief and knowledge on Asian American trends within various audiences they support and are knowledgeable of. The visualization of the culture-based personalization model can aid therapist content creators in identifying attributes and communities to serve and also correspond with their specialities. I challenge the mental health industry to address cultural complexities in their AI personalization — to not avoid doing so out of concern that it wouldn't be useful or have a high return on investment. By providing more relatable support, mental health companies could increase revenue from increased utilization rates across Asian Americans and other communities.

4 *To receive personalized and culturally responsive mental health topics and activities, Taylor enters her cultural attributes*

5 *Taylor gains insight and knowledge on how to manage her stress related to societal expectations of Asian Americans*

6 *Data visualization of culture-focused personalization model for Taylor, Asian woman*


Cultural attributes
ADDRESSING MODEL
+
Life situations
Bronfrenbrenner Ecological model
Gender
Female
Male
Non-binary
Sex
Female
Male
Stage of life
College student
Working professional
Parent
Retired
Sexual orientation
Heterosexual
Homosexual
Bisexual
Asexual
Ethnicity
Asian
White
LatinX
Black
Middle Eastern
Religion/spirituality
Religious
Non-religious
Immigration status
Citizen
Permanent resident
Non-immigrant
Other immigrant status
Self
Physical health
Emotional health
Personal relationships
Family
Partnerships
Friendships
Career
Work
School
Society
Discrimination
Societal expectations
Specific topics
Topics based on combo of cultural attributes + life situations
Gender (Female) +Ethnicity (Asian) + Society
Hypersexualization of Asian women
Dismantling the Model Minority Myth

Desirable States

Akash Mahajan

Powering mental fitness through Brain Computer Interfaces and Augmented Reality

1

Even though mental health and physical health are closely interlinked and are equal components of the overall health, currently there exists a fundamental gap in how we perceive both of these domains. Physical health is seen with an extremely proactive lens of physical fitness, where we track various parameters like calories intake, steps, endurance, strength, balance, etc. but in a stark contrast, we are very reactive when we talk about mental health. It only becomes part of our conversation when someone is diagnosed with a condition.

Our current perception of mental health undermines the numerous factors and habits in our daily life that influences our mental wellbeing, over time which either amplify or evolve into a diagnosed illness. The problem I thus wish to address through this work is - How do we build personalized experiences for individuals to track and act on mental fitness metrics and help them get into a desirable mental state?

Overall, the work I've showcased is an exploration of how the amalgamation of three independent fields - mental health, brain computer interface and mixed reality could help individuals to get into a desirable mental state. It is also part of the larger narrative of breaking down the walls between mental and physical fitness. While I try to build the analogy between the physical and mental metrics, I realize the inherent subjectiveness and fluidity of this domain, where we are still trying to formally define mental fitness and also acknowledging that the desirable states of an individual change with time, context and environment. But by creating this personalized mental fitness experience, I inspire individuals to get into specific mental states as part of a daily routine instead of remediating brain functions in response to a diagnosed disorder.

1 *Image source - Brain Computer Interface Enables People with Disabilities to Drive Autonomously'. Audi.Com*

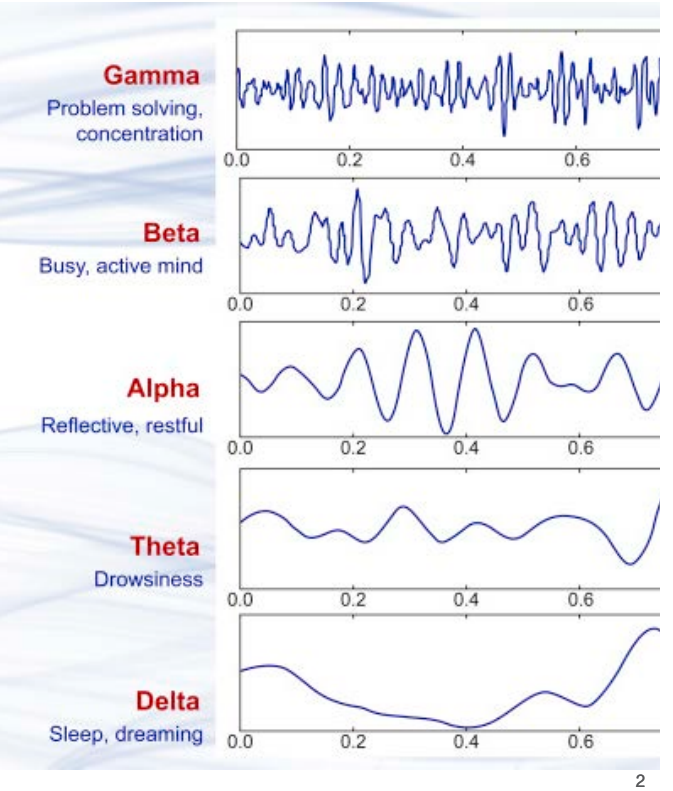
The intersection of mental health and emerging technologies brings with it a possibility to develop new perspectives on how each of us could realize and interact with our mental health states. My fascination with brain and brain-computer interface arises because of its the ability to transcend conventional motor outputs, thus taking a step towards inclusivity while exploring future interactions as shown in Figure 1. It also provides an opportunity to perceive and regulate information that cannot be expressed through other human senses. Augmented Reality is a more immersive media that has already proven its effectiveness in enhanced visualization and treating illnesses like PTSD. Combining them together by monitoring brainwave activity and almost immediately providing a feedback supported by mixed reality, could make mental health data more relatable, allow us to empathise with our own brain and provide a one-stop solution for education, training, diagnosis, and therapy. It is a step towards bridging the gap between clinicaly conducted neurofeedback and self-care.

In this project, I lay down the digital and physical infrastructure for prototyping an individual's end-to-end experience for a mental fitness routine. This implementation could then be seen as proof-of-concept for the broader hypothesis that replicates such an experience for every desirable mental state.

Considering mental health and fitness is a really broad area that ecompasses various emotional states associated with different kinds of external simuli, I selected a state that could could be directly seen in analogous to physical fitness - Flow state. Being increasingly used by athletes, musicians etc. as part of Optimal Performance Training, a person in this mental state has the perfect combination of calmness, focus, and awareness. Often referred to as being 'in the zone'. Achieving this mental state means a higher motivation to complete a task, increased mental endurance and reduced distraction thus resulting in a better overall performance.

I utilize a Muse electroencephalography (EEG) device as shown in Figure 3 that detects electrical activity and brainwaves by inserting electrodes in contact with the scalp. It is a brain sensing headband with seven sensors out of which 5 are in contact with the forehead and the other two are rubber ear sensors. The portability of modern EEG headsets make them ideal for a consumer product that could be used at home. Advanced signal processing techniques have enabled deeper analysis and classification of the brainwaves extracted through EEG into various spectrums based on frequency bands (Figure 2) - alpha: 8-13Hz, beta: 13- 30Hz, delta: 0.5-4Hz, gamma: >30Hz and theta: 4-8Hz. All of them have a correlation with certain human behaviors. Alpha brainwaves were identified as the target data for tracking the flow state because of its direct association with relaxation and attention. The alpha waves were therefore deployed as the human trigger to control and interact with the augmented reality experience.

To design the visual exercise, I layed down a 3 point criteria or checklist for it to be considered capable of generating a flow state in a person - The task should be moderately challenging, rewarding and should require an investment of time and energy.



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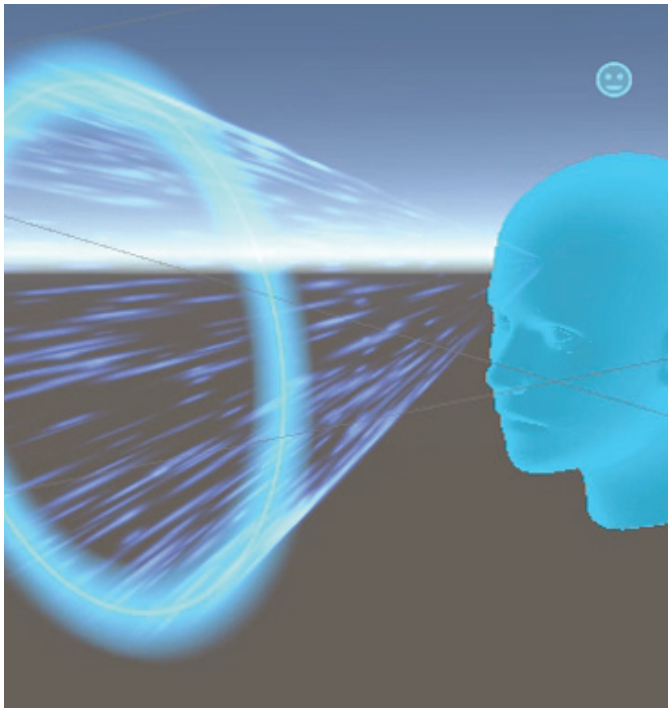
2 *Brain wave samples with dominant frequencies belonging to beta, alpha, theta, and delta bands and gamma waves*

3 *Image from one of the tests on Muse headset conducted by me*

4



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Psychedelic visualizations have been associated with increased neural activity and therefore I explored visualization exercises that can be used to induce certain triggers in the brain. I focused on utilizing symbols and shapes that can be smoothly communicated in a guided mental imagery setting across different user groups. The final interactive augmented reality experience was designed by taking inspiration from a mental visualization routine - Exercising the Third Eye. The experience consists of a series of circumscribing shapes - a circle, followed by a square, a triangle, and finally a circle again as shown in Figure 4. A four step routine where the individual is prompted to imagine these shapes in series.

The final BCI-AR integration requires the users to wear an eeg headset. It might be before an exam, before a football match, a band performance or for a daily exercise routine. They are guided to close their eyes, focus and imagine a circlular ring on their forehead. As the users follow the instructions, the heighted focus and calmness is reflectd throught the increased alpha wave frequency. Crossing the callibrated point of threshold is identified as the point of entry into flow state which when reached generates the augmented reality circular ring through face tracking (Fig 5). The same is repeated for all the subsequent shapes and it is continuously noted that how quickly does the participant is able to complete the exercise.

The prototype assists the users to get into a flow state but also helps them achieve it faster than before, thus empowering them to build healthy mental fitness habits at home for sustainable effects and prevention from future illnesses. Moreover, it reimagines how we interact with ourselves, our data and the external environment, opening up multiple possibilities of eeg and AR device integration to build more immersive and effective experiences for mental healthcare applications

4 *From 'Visualiztion Exercise For Opening the Third Eye' by Alexadre Porto*

5 *Image of a circular AR ring simulated on a 3d rendered human face*

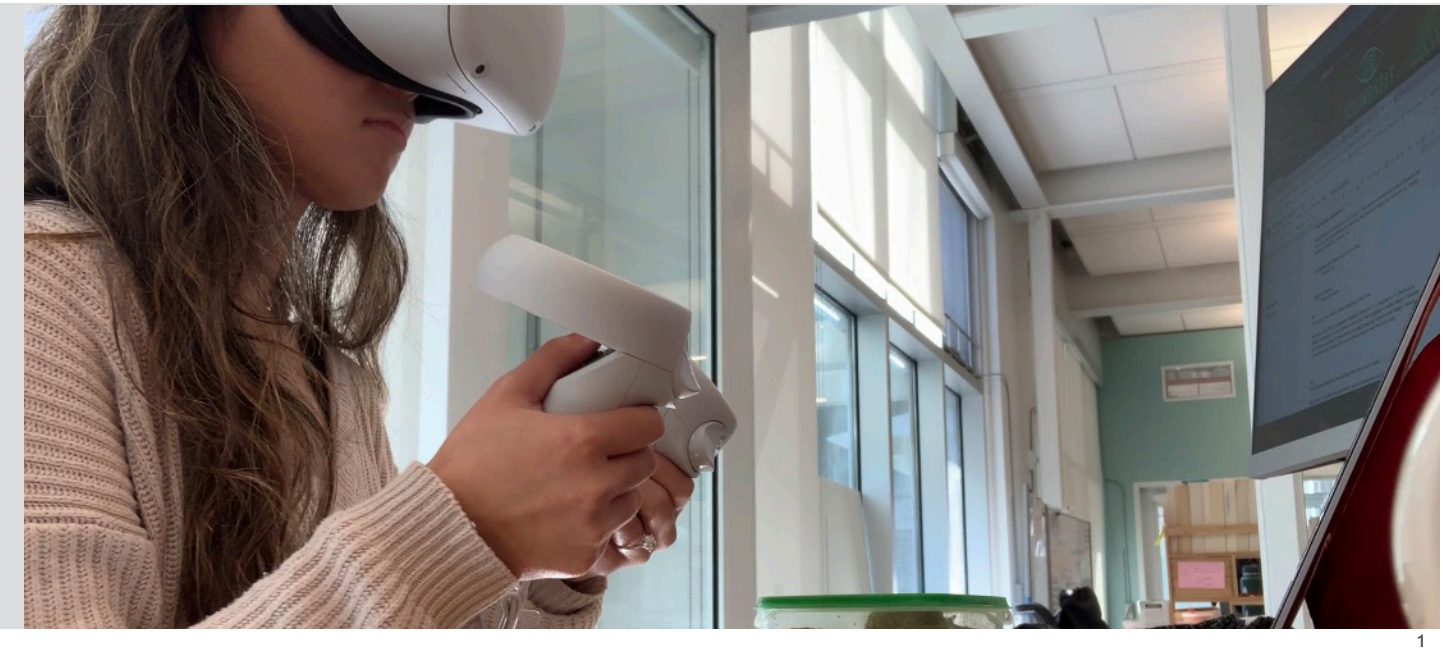
6 *Image from 'How to Own Your Mind' by Napolean Hill*

6

Emotional Safe Spaces

Carolyn Nguyen
Chia Ling Chen

Accessible spaces to practice emotional regulation in a safe and private manner



1

College students struggle to prioritize and maintain their mental health while adjusting to a new lifestyle with limited time, money, and personal space. During times of high stress, self-care activities like exercise, sleep, breaks, and counseling are cut out to spend more time on assignments and job hunting. Left untreated, students feel hopeless and consider substance abuse, dropping out, or committing suicide.

Relaxation methods in VR have been proven effective in reducing subjectively reported stress (Kim et al.). However, effectiveness and practicality are two separate issues, which may be why VR-based relaxation has not been widely adopted. Mental health applications offer quick and affordable guidance, the disciplinary aspect of mental health practices remains boring and difficult to sustain long-term. These apps offer primarily audio-based guidance and gamification methods to increase engagement, but lack senses of smell, touch, and sight to engage the user's body into a relaxed state. Students prefer new content in the form of video games, social media, and film as methods of passive relaxation.

So far, Virtual Reality (VR) technology has effectively treated mental disorders in clinical studies. This success opens new investigations that aim to reduce stress in individuals with hectic lifestyles. However, the virtual environments in these studies remain the same for all participants and have yet to incorporate individual preferences as part of the experience. In an increasingly fast-paced and distracting society, Mindscape aims to evoke reflection and relaxation through emotionally aesthetic experiences based on users' preferences.

1 *Image of VR experience in relaxation methods taken November 2022 from Berkeley California by Carolyn Nguyen after hours of observing the users .*

We interviewed and tested 12 students individually over 5 rounds of VR experiences. The tests took place in an open classroom for independent studies, while the student wore an Oculus Quest 2 headset display monitor (HDM) within the classroom to emulate typical environments of students.

In the first round, participants shared their methods of coping with stress and level of experience with VR technology. After the interview, participants chose a VR meditation application from the Oculus Quest Store and provided feedback after completing one activity. We found out that engagement and motivation of revisiting VR meditation applications are low.

We extended a qualitative interview with each student and found out that there is lack of personalization and the feeling of "being there" is hard sue to the public space setting. Therefore, to increase the level of engagement we added olfactory and temperature control in the entire VR experience. On the other hand, to promote motivation we incorporate a tracking dashboard that presents the progress and effort that has been put in.

To narrow down on the relaxation methods, we picked three therapeutic activities from cognitive behavioral therapy (CBT) methods used for coping with stress and anxiety: (1) guided meditations, (2) breathing exercises, and (3) body scans. Methodologies within persuasive design systems and behavior design from "Fogg's Behavior Model" guided the user flows and interactions. We evaluated the experience's effectiveness based on participants' self-reported questionnaires related to presence, mood, aesthetic emotions, and product recommendations.

We ideated and prototyped experiences with two core elements in Unity. The first is to incorporate de-stressing activities, 360 videos, audio, 3D interactions, and UI with visual, audio, olfactory, and temperature elements as options to increase presence of the environment. Second, participants filled a post-survey and provided their mood after the activity. We are interested in finding elements that contribute to each participant's emotionally aesthetic experiences within their constraints of time and space.

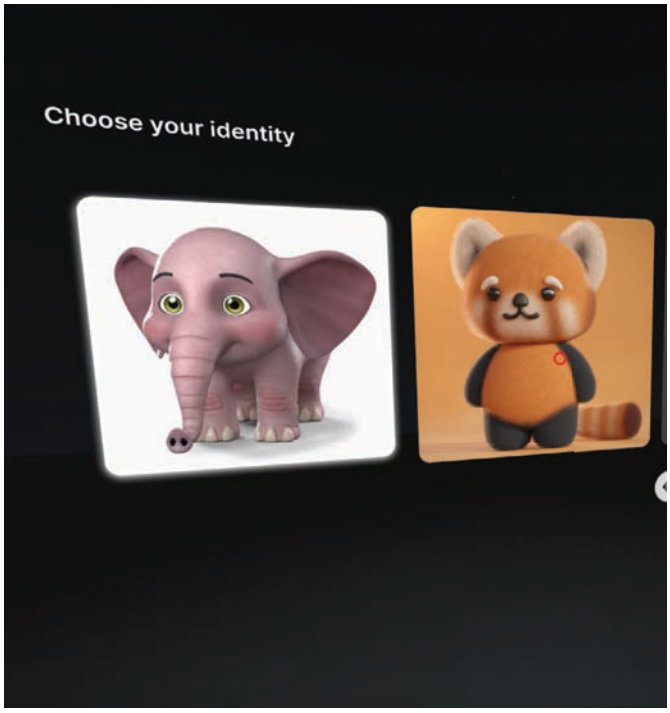
In this project, we aim to test out the threshold of personalization that affects engagement and motivation to revisit VR-based relaxation methods. During the dry run, we saw a lot of reflections on the audio and visual alignment in guided meditation; therefore, in our next iteration we are planning to reuse some of the clips, but add audio that aligns with the visuals.

2

3

2 *A photo of VR relaxation methods testing*

3 *The user flow of the entire VR experience*



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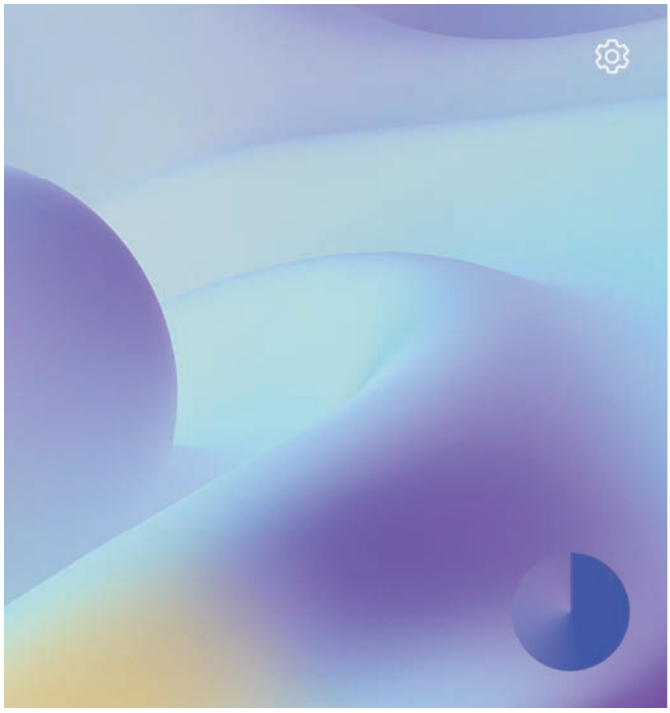


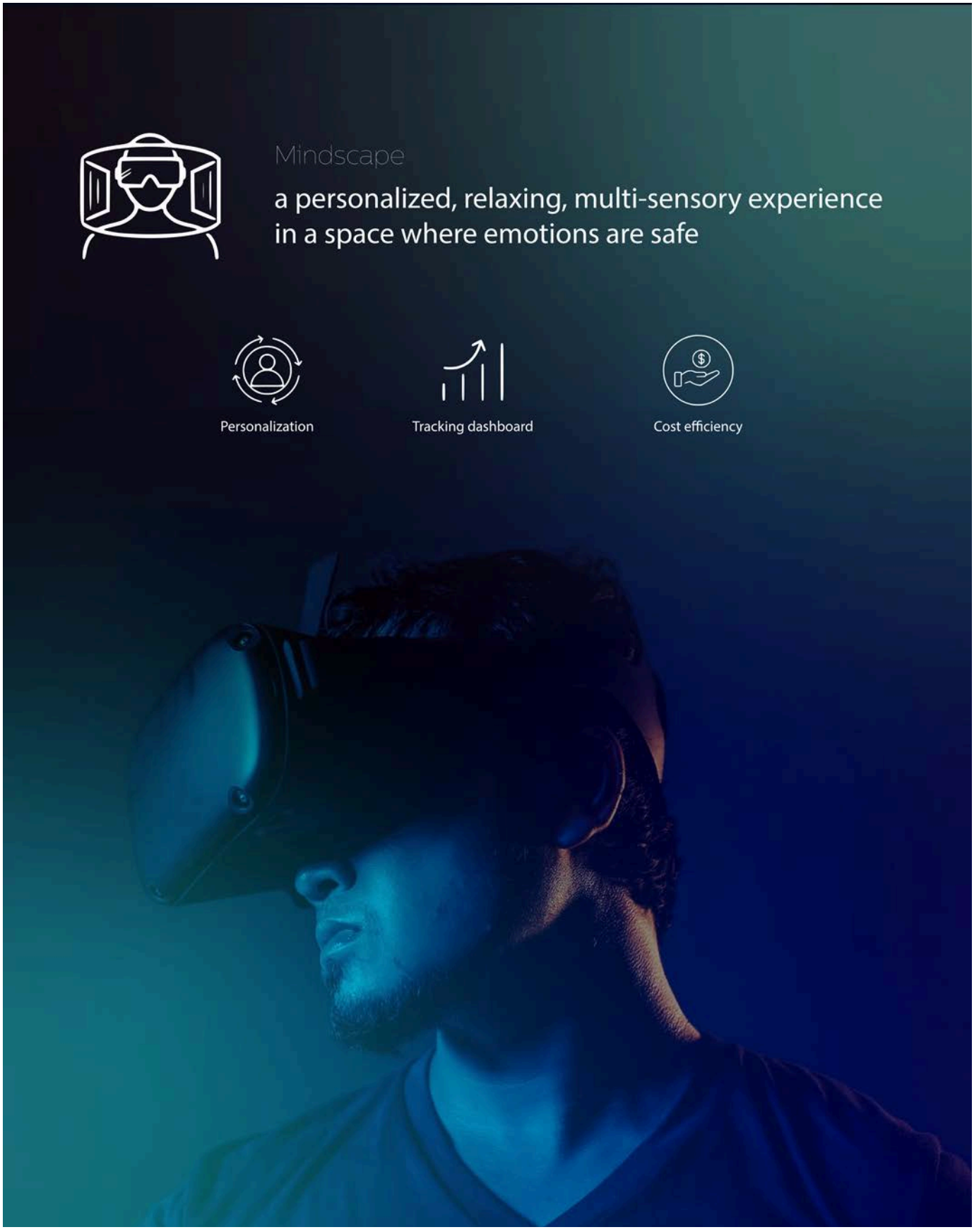
5

The next step for this project should be to enlarge our testing group of college students with high-fidelity design and integrated technology on a VR headset. Progress tracking can be a metric for assessing one's well-being, which everyone can benefit from in their day-to-day practice. The crux of this research is finding ways to increase motivation and engagement, and we've discovered that by utilizing tools like virtual reality, we can immerse individuals in distinctive and individualized stress-regulating experiences in a quick setup. In a culture that is overburdened and moving quickly, we believe that the usage of virtual reality will boost student engagement and motivation to develop a habit of preserving their mental health. As this research progresses, it is becoming clear that there are several prospects for VR utilization in the healthcare industry.

4 *A low fidelity wireframe in Figma*

5 *A user interface prototype in Figma*

6 *A poster of our concept*


Mindscape
a personalized, relaxing, multi-sensory experience
in a space where emotions are safe
Personalization
Tracking dashboard
Cost efficiency

DYNAMIC METHODS OF INTERACTION

Today's user has grown to expect customizable options across a wide range of products and services. They not only expect customization, but become frustrated when not included. Lack of customizability results in poorer user experiences, barriers of inaccessibility, and a lack of engagement from participants. Technology has made recent advances that make this dearth of customization inexcusable; it is straightforward to provide users with a variety of at least surface level aesthetic options. By embracing a variety of options for customization, design embraces a diversity of perspective to engage with; accessibility is borne of the creation of customizable systems, products, and services; bespoke design begets equity. By creating an unlimited array of options for users, one framework can serve many. By shifting ownership of the solution to the user, we make design free and democratic. A dynamic method of interaction that transfers ownership to the user is inevitable for modern design. Our platforms may span a wide range of topics such as low-code XR development, highly personalized ride sharing, human food interaction and experience, and tactile data analysis, but they are united under the common goal of creating customizable, democratized design.

By allowing for a personalized touch, modular and customizable design approaches have already been successful across industry. For example, personalization of shoes is a service provided by Nike By You, which allows the customer to choose which area of the shoe to change the color and fabric to their desired look.("Nike by You Custom Shoes." Nike.com, 2022) However, this is an inherently limited interpretation; users can only make decorative aesthetic changes. They aren't included in the design process of the base model. If we look to alternative methodologies, such as the Right-to-Repair movement ("What You Should Know About Right to Repair" Klosowski, 2021) we see a different relationship between creators and users. Confidence and democracy are emphasized as they pertain to ownership. This creates a framework that supports a shift in the power dynamics between designers and users, providing more freedom to individuals.

Eleanor Mayes explores the flexibility of data depiction and accessibility. Customization is particularly important when allowing users to have creative control over data visualization and other subjects with many variables and options. VizTouch software can generate the

designs of tactile graphs, which are then 3D printed. (Brown and Hurst TEI 2012) The software allows the user to select Braille or alpha-numeric labels, and the software will eventually allow users to curate data themselves. As Marriott et al. state in their 2021 ACM Interactions call-to-action regarding accessible data visualization: "...enabling the customization of standard features such as the timing for interactions, speed of movement, and distance traveled will improve accessibility." Specifically this refers to customization of technology for those with motor disabilities. It is especially important to have dynamic means of interaction, particularly regarding customization of prototypes or the options to convey information. (Jansen et al. CHI 2015 Crossings.) As evidenced in a 2017 paper on Interactive 3D printed models (ASSETS '17 Shi et al.) providing the opportunity for users to select how to interact with new technology increases engagement. Participants wanted to "... switch among different modes using a switch or a button... the embedded audio content of an I3M could be customized to meet varied needs from different users."

Thomas Chen focuses on personalizing future ride-hailing experiences. Although transportation services through ride-hailing and sharing have been developed to enhance the user experience by companies such as Uber or Lyft, most work in this area focuses on affordability and on-demand time efficiency of the service cycle, not enough attention has been given to the riding experiences inside the vehicles. According to Alejandro Tirachini's paper "Ride-hailing, travel behavior and sustainable mobility: an international review," the author wrote, "There is great diversity among the most important reasons to use ride-hailing. First, trip cost, travel time, ease of payment, no need to drive after drinking alcohol, and waiting time are highly valued in most of the studies reviewed." (Tirachini 7). According to Umar Zakir Abdul Hamid and Fadi Al-Turjman's book "Towards Connected and Autonomous Vehicle Highways", chapter "Introductory Chapter: A Brief Overview of Autonomous, Connected, Electric and Shared (ACES) Vehicles as the Future of Mobility," the authors referred and described four elements of future mobility which are "Autonomous Driving; Connected Vehicles; Electric Vehicles and Shared Mobility" (Hamid and Al-Turjman 4) Inspired and prepared by the ACES elements, his thesis project focuses on designing future riding experience of shared vehicles by proposing an autonomous, modular ride-hailing vehicle that can be customized according to passengers' comfort and preference, to add a personal connection to their journey for single passenger/party per time.

Kathy Wang is pushing the AR/VR interfaces from the Graphical UI (GUI) into the real-world. Flat screens have replaced a variety of specialized physical artifacts that existed for a long period of time. These artifacts provide different functions including measuring the passage

of time, predicting the movement of planets, drawing geometric shapes, and computing. (Drawing Instruments 1580-1980, 1988) Now that we have removed the concept of a physical screen as an interface, we should rethink what kind of devices are compatible with AR/VR headsets. What becomes our next interface? Tangible devices could be the answer. With the combination of AR/VR, tangible interaction and IoT technologies, we can attach digital interfaces or information to the physical artifacts and augment our physical surroundings. MIT Media Lab pointed out that the locus of computation is now shifting from the desktop in two major directions: i) onto our skins/bodies, and ii) into the physical environments we inhabit. (Tangible bits, ACM SIGCHI, 1997) The shift is now happening at a rapid pace. Wearables technologies such as Apple Watches are popular among the consumers, and the physical environments or objects are embedded with microcontrollers and given the ability of computing. We will be seeing a lot of push backs from the GUIs into the real-world.

Taylor Speed explores the history of Multisensory Human-Food Interaction. Human-Computer Interaction (HCI) is field of research that emerged within the early 1980's. The major differentiator for this domain was the fusion of cognitive science and human factors engineering applied to computer science. Prior to this, computers were traditionally reserved for industry professionals and the occasional hobbyist. This mode of usage became more accessible to the general public via personal computing during the late 1970's. Since then, HCI has developed into a rapidly grown field, attracting diverse concepts and practices. New explorations gave rise to the emerging technology that has become a ubiquitous asset to the modern experience. Similar to personal computing, the capabilities of multisensory technology have inspired practitioners (neuroscientists, gastronomers) in adjacent fields to investigate its potential applications. Thus, evolving into Multisensory Human-Food Interaction (MHFI). In short, MFHI addresses our interactions with food. This particular field draws on diverse methods and approaches to support and enrich food practices. Through the integration of fields such as, HCI, psychology, gastronomy, and sensory marketing, practitioners are actively capitalizing on the interaction between humans, food, and emerging technology. Despite still being in its infancy, there has been steadily growing interest in the development of technology that poke and prod on multisensory influences on flavor perception to enhance human–food interaction.

Skrōl

Eleanor Mayes

1

Skrōl is a handheld tool that aims to address data accessibility through dynamic interaction. Moving in the same fashion as a computer mouse, it consists of a robust system of multi-sensory options that allow for evolving analysis of information in real-time. Currently, data visualization is largely inaccessible to the Blind, low-vision, and other disabled communities. This project utilizes a unique combination of existing sensory interfaces (actuators, outputs, etc.) for multi-modal communication of datasets without the need for visuals or sight.

1 *The first iteration of the housing for Skrōl. Designed in Fusion 360 and printed on an Ultimaker S3 using black PLA.*

This project employs affordable and readily fabricated materials and open-source software. As such, Skrōl aims to act as a stepping stone to encourage disabled makers to engage with and command analytic or computer modeled technologies. Users can customize and select from tactile information, haptic feedback, audio output, and other means to convey and analyze datasets of their choice. Dynamic graphic representations of data yield analytic insights; even more so when representational conventions are manipulated. It is for this reason that real-time interaction with customizable displays is so empowering to users. As an accessible, affordable, portable, and easily understandable interface, Skrōl can empower Blind and low-vision, as well as disabled (and non-disabled) users to interact fully with data representation and analysis.

Skrōl is a lightweight handheld device, akin to a computer mouse, used to analyze datasets. It consists of an oblong plastic housing atop a polyurethane wheel. This wheel allows Skrōl to glide along any relatively smooth surface. The housing contains a vibration motor that buzzes at specific distance intervals representing the tick marks of the x-axis. When it reaches the endpoint of the axis, it continuously vibrates to let the user know. The housing also contains a piezo buzzer, speaker, and speech-to-text board. It has several buttons for input, which allows the user to switch channels, and provide other functionalities for the user to

customize. The y output servo motor takes advantage of coarse mechanoreceptors along the underside of the finger, specifically Ruffini corpuscles which can detect motion, stretching of skin, and finger position. *(APA Dictionary of Psychology)*

The body of Skrōl is tilted forward so that the arc that the servo dial sweeps contacts a larger area of palmar skin than it would if the housing was perpendicular to the surface. This tilting also helps the hand assume a natural position when resting on the device. The housing itself has an ergonomic topography; the middle finger is guided into position over the y data dial as it is located within the trough of the housing surface. This serves two purposes; firstly it guides the user's fingers into place, and secondly it protects the dial from being chipped off by any accidental bumps or blows. The dial itself has a notable horizontal width in order to distribute any force across the surface of the finger, instead of being point-like so that it is not painful or protruding into the user's hand. The buttons on the far side of the housing are at staggered heights so that they line up with the relative position of each finger. Each of these buttons is a latching (maintained) pushbutton, because unlike momentary push-buttons and other switches, latching push-buttons can tactilely indicate the current mode each setting is in. These settings can also be queried through voice commands, which respond to users' questions about the current position and state. The polyurethane wheel is connected to two radial ball bearings, which in turn are permanently attached to a thickened aluminum shaft. A specially designed component connected to the wheel spins within the shaft and couples directly to the rotary encoder. As mentioned above, Skrōl has symmetrically designed housing to accommodate both left- and right-handed usage. The corresponding functions associated with the terminal buttons on the end can be switched. The whole unit is powered using a rechargeable lithium ion battery.

The hardware: The device uses a TinyS3 microcontroller to communicate between the input and outputs of the device. Alternative microcontroller options to investigate included the arduino uno, arduino nano, Teensy 2.0, and others. These were rejected for reasons including size, storage capability, lack of wireless communication with the computer, etc. The microcontroller is connected to the rotary mouse encoder which in turn is connected to the wheel that travels along the surface. The microcontroller is also connected to the output actuators; this includes the servo motor, the vibration motor, and the speaker. An EMIC 2 text-to-speech module is also connected to the microcontroller.

The code: The code is written in C++ for compatibility with the Arduino IDE for easy and rapid prototyping. It makes use of an encoder library (in the public domain) as well as a servo library. The code for the vibration motor and piezo buzzer includes adjustable values for vibration frequency, duration, and repetition with each tick mark passed. For example, if the tick mark interval is set to five, every time the encoder passes a value that is a multiple of five, the device will vibrate. The code makes use of a nested loop for the data set that is input. It pairs a single index value with an x-value and its corresponding y value, but places them in two separate arrays. This links the encoder input (x-value) to the servo motor output (y-value.) Currently Skrōl maps functions, not all relations. In other words, each x-value only corresponds to a single y-value. This is not to say that users

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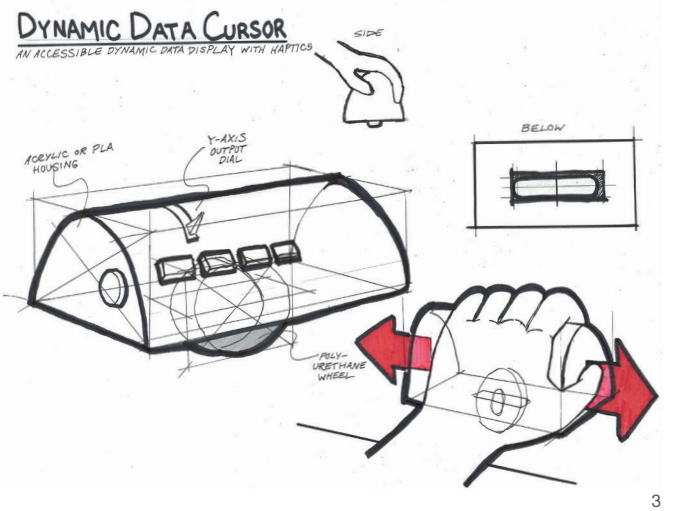

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2 *Collection of computer mice, courtesy of Chris Myers, used for inspiration for the housing design.*

3 *An early illustration of the mechanisms and interaction with Skrōl, as it slides back and forth along a surface.*

skrol_code §

```
#include <Encoder.h>
#include<Servo.h>
Servo servo;
//int x[10] = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10};//xdata
//int y[10] = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10};//ydata
int x;
int y = sin(x);
int ymin = 1;//here put the max y
int ymax = 10;//here put the min y
const int output = A0;//this is output, buzzer or motor, const int is read only
const int domainlow = -50;//this is the low endpoint
const int domainhigh = 50;//this is the high endpoint
const int intervals = 5;//this is the scaling of the tick marks on the x axis
const int buzzfreq = 500;//this is the frequence of the piezo buzzer
const int viblevel = 200;//this is the vibration motor speed, from 0 to 255 (analog)
int xval;

Encoder myEnc(2, 3);
//   use pins that have interrupt capability, avoid using pins with LEDs attached
void setup() {
  //pinMode (output,OUTPUT);
  Serial.begin(9600);
  servo.attach(9);
  Serial.println("Basic Encoder Test:");
}
long oldPosition  = -999;
void loop() {
  long newPosition = myEnc.read();
  if (newPosition != oldPosition) {
    oldPosition = newPosition;
    Serial.println(newPosition);
for (int i=0; i<10; i++) {
   if (newPosition == x[i]) {
    y[i] = map(y[i], ymin, ymax, 0, 180);
     servo.write(y[i]); //break; //this exits the loop
     }
}}
 //vibration motor
    if ((newPosition % intervals)!= 0){analogWrite(output,0);}
    if (newPosition >= domainhigh || newPosition<= domainlow){analogWrite(output,vibl
```

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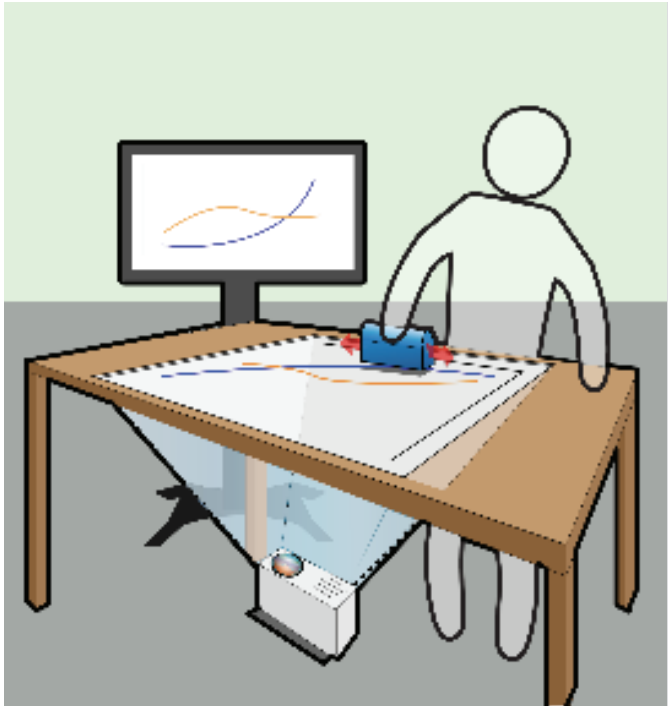

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cannot switch between y-values from multiple data series while at the same x-value; this is made possible with the buttons on the housing. Additionally, as discussed below, future iterations of Skrōl may be modular; in doing so it would allow for single data sets with x-values corresponding to multiple y-values. For now, the code has been left in its raw form so that it can easily be read using screen reader technology. Future iterations may include a user interface to provide a no-code environment and increase accessibility.

4 *Draft of the C++ code written in the Arduino IDE with the nested loop of x and y variables with the same indexing.*

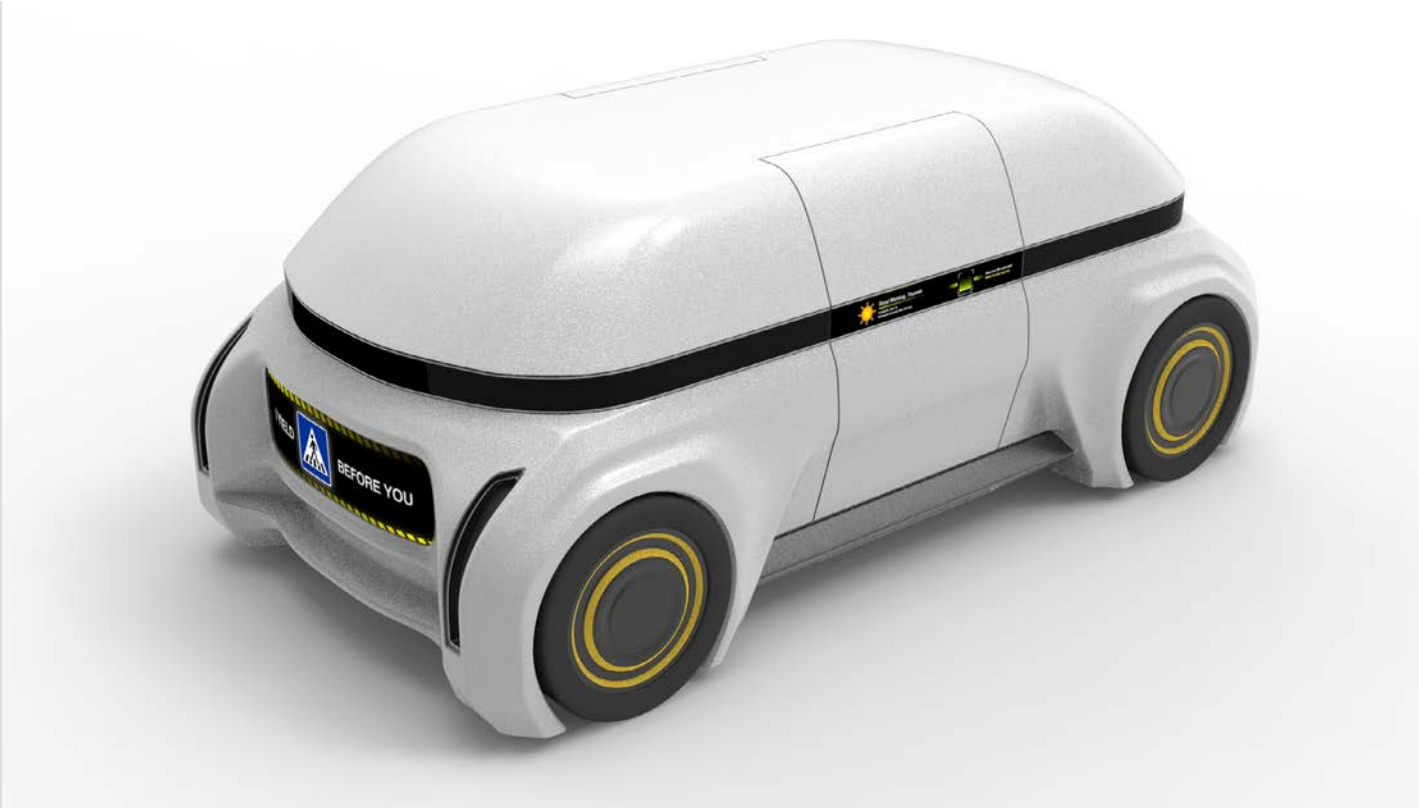
5 *Proposed layout for demonstration of Skrōl capabilities and user interaction.*

6 *A later rendition of the housing design for Skrōl, featuring a more ergonomic arrangement.*

Modular Shared Vehicle

Haoyang (Thomas) Chen

Future ride-hailing with personalized riding experience to make the journey is as enjoyable as the destination.



1

Current shared vehicles provided by ride-hailing services impact passengers' lifestyles due to meaningless use of commute time and loss of personal connection to each ride. Suppose passengers can personalize interior configuration for a temporary time during their rides. In that case, the journey could be as enjoyable as the destination due to meaningful use of time, even if they do not own the vehicle. The thesis project responds to the problem of a lack of personalized riding experience in shared vehicles under current ride-hailing services by proposing an autonomous, modular shared vehicle design that users can customize the interior of the car to support any productive, leisure, or other technical needs during their commute. This shared vehicle is only shared because riders do not have ownership of it, and serves as a ride-hailing vehicle. The vehicle only provides service to one passenger party at a time. It is currently not designed for passengers to ride with unfamiliar riders because that demolishes the purpose of personalizing the ride experience.

1 *Modular shared vehicle, image by Thomas Chen*

There are three sections of the design embodiments:1) A modular interior with different modules that are function-themed (daily tasks, hobby, workout, etc.), 2) An exterior design that house the interior with the same design language, 3) A mobile device application that demonstrates how passengers can customize, summon the vehicle and control the interior components inside the vehicle. The design language among these three sections should look unified by following the same color theme, form hierarchy, and soft, user-friendly curvatures. In the following paragraphs, details of the three sections of the design and the user flow will be explained.

To begin with the modular interior, three parts are modular in the interior section. The section A module, section B module, and the backrests. All modular parts can be individually placed

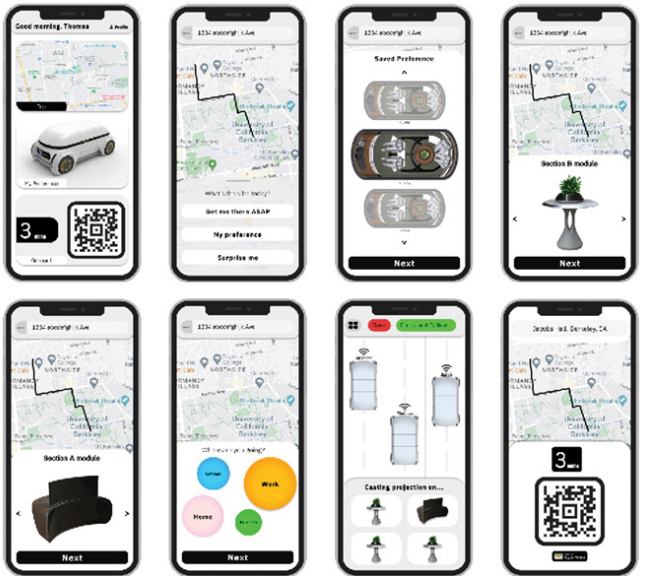
or combined in a function-themed configuration. The section A module will always be placed at the vehicle's front end. It is interchangeable with any other section A module by horizontally sliding on and off against the rails on the side of the interior wall. These modules are multifunctional since they are larger and can provide housing for more components. However, they will take relatively longer to replace compared with the section B module due to their size. Thus, if users need to customize the section A module before their ride, they might have to book the vehicle a time before their trip to allow the right section A module to be installed before use.

In contrast, the section B module is a "quick switch" module that is interchangeable by going vertically up and down between different parts. It only provides a single function depending on the specific model, is smaller in size, and users do not need to leave as much time before their trip for the module to be installed. The backrests are also detachable depending on the number of passengers. Passengers need to enter how many are traveling when ordering the pickup, and the backrests will be added accordingly. This design feature aims to use the interior space most efficiently and provide passengers maximum space.

Apart from the modular components of the interior, there are universal parts that will stay in the vehicle unchanged. The belt screen surrounding the entire interior will always stay on top of the side panels to show passengers different information or commands, such as weather, contact, and module functions. All the lighting will stay fixed inside the vehicle, and passengers can also adjust the brightness and color of the light on the belt panel. Unlike the detachable backrest, the central bottom part of the chair will remain on the rail at the bottom of the chassis.

2

The modular shared vehicle is designed to be remotely customized and summoned by the mobile app before users' departure. When users open up the app, they will first see an opening page representing the service they will get for a few seconds. Then they will come to the home page where they can choose any of the three options: 1), Selecting their destination, which will lead them to the next pages where users will enter or select saved/past destination, confirm the modules depending on how fast they want the vehicle or their needs. Then a vehicle will come and pick them up. 2), Configure their setup for the vehicle interior for later use. Even if the users do not need a ride, they can still play with all the available modules and choose which one to add to the interior. After they are satisfied with their choices, the entire interior setup can be individually saved as a preference that is ready to use when ordering a ride later. For example, if a user wants to work out on his way home after work, he can add a fitness-themed combination of module-A and B and save it as a workout preference. Whenever he needs to work out on his way home, he can easily select the workout preference, and the vehicle will come with modules from his saved preferences. 3) Presenting onboarding QR code to the vehicle when it arrives. When a vehicle comes to pick users up from the road or an assembly unit, they will receive a countdown of when the vehicle will arrive at their current location and a QR code to onboard. They need to point the QR code to the vehicle to register and then be permitted into the vehicle so that it can pick up the right passengers and the service will not be misused.



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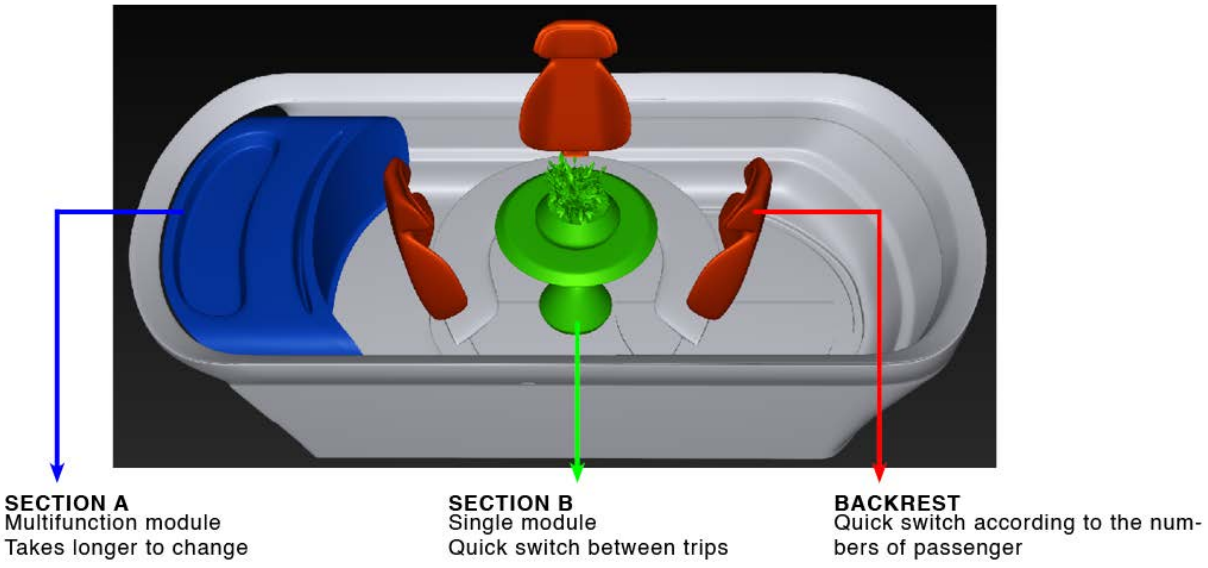
2 *Function-themed interior configurations, image by Thomas Chen*

3 *Mobile device app for users to customize and summon the vehicle, map from Google Map, image by Thomas Chen*



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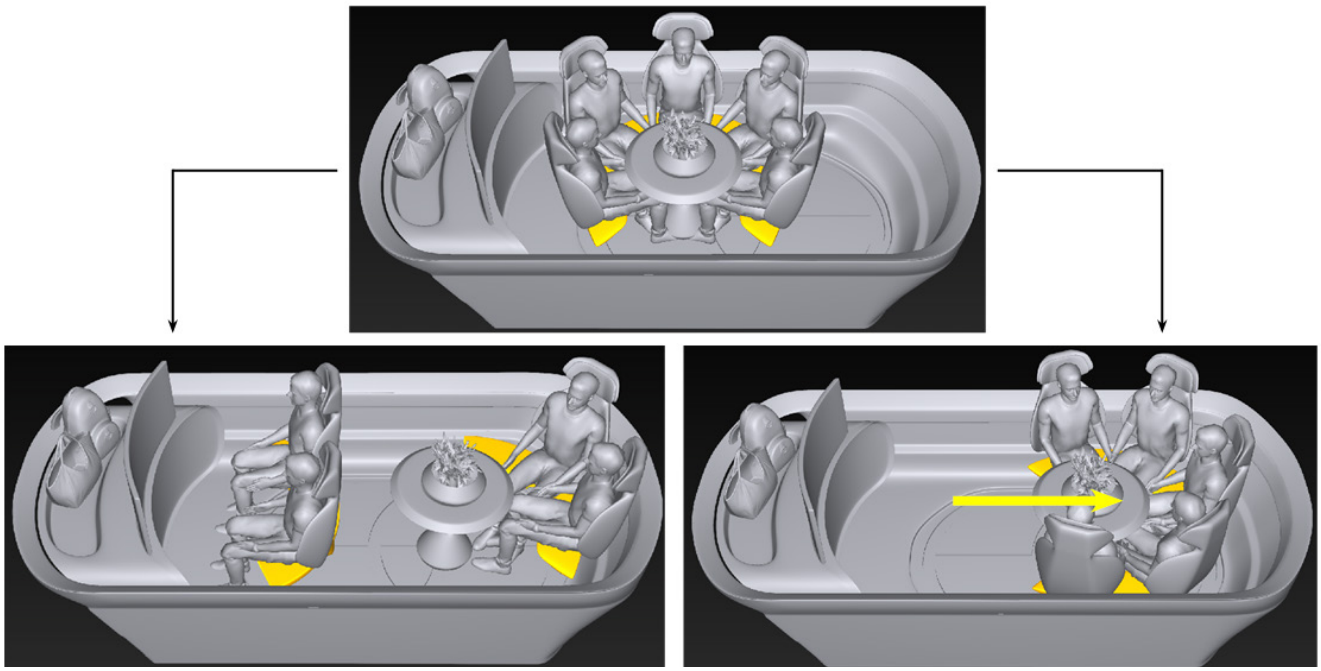

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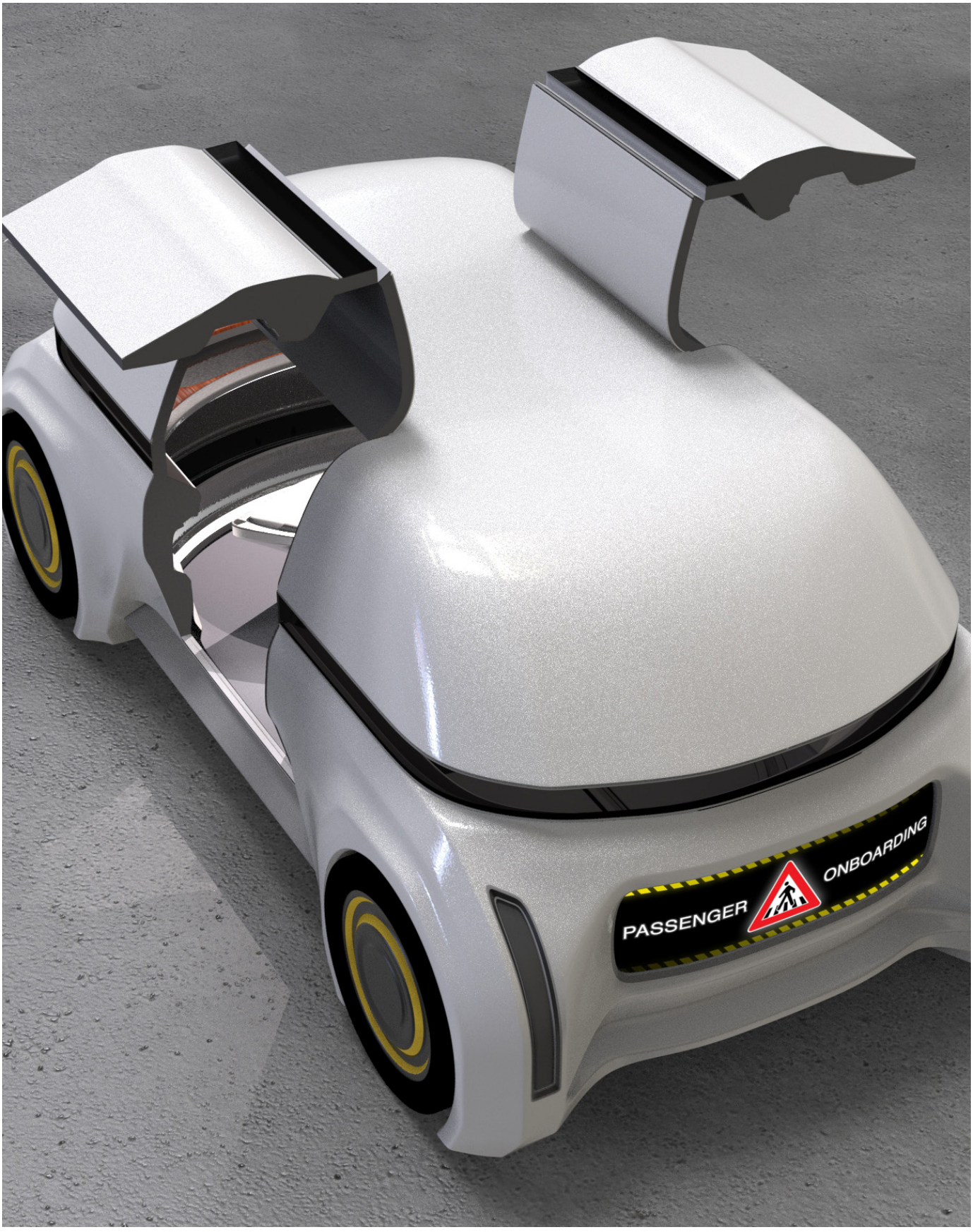
4 *Customizable interior parts, image by Thomas Chen*

5 *Modular seats for space use efficiency, image by Thomas Chen*

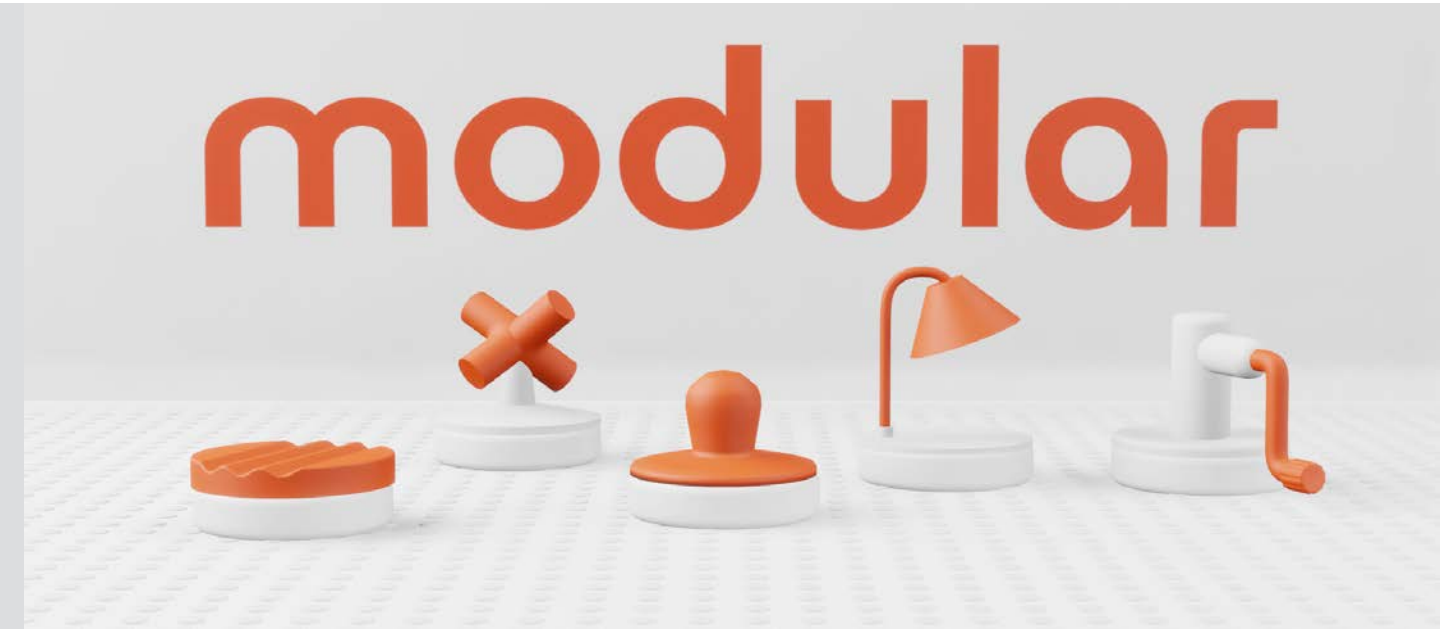
6 *Vehicle entrance/exit, image by Thomas Chen*


PASSENGER
ONBOARDING

Modular Senses

Kathy Yuting Wang

Bridging the authoring between sensing hardware and AR/VR applications



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Modular Senses is an innovative sensing solution made for spatial computing technologies such as AR/VR. The goal is to bridge the authoring between hardware and AR/VR applications by eliminating the unnecessary steps and simplifying the process of implementing sensors. Modular Senses is helping to transfer the ownership of design and development from AR/VR experts to people from various industries.

1 *The rendering of Modular Senses. Designed in Rhino3D and Rendered in Blender.*

Currently, AR/VR devices have very limited sensing abilities. Head-mounted Display headsets are generally equipped with a camera, microphone, and controller, so that the headset can see, listen, and track movements. Other than that, to enable other input devices, users would have to add other third-party sensors. While current computers have USB ports that can connect to various Arduino sensors, AR/VR is not as easily accessible. There are too many obstacles for implementing third-party hardware for cross-platform AR/VR applications. There is a range of headsets and phone-based AR/VR devices that each require various tools and frameworks such as Unity, Unreal Engine, ARkit, ARCore, etc. This is a lot to learn in terms of the spatial computing component. Then there is also a physical computing component where users need to learn electrical engineering, soldering, prototyping. Lastly, the user has to build a communication pathway between the physical computing device and the spatial computing device, which is also hard because there are different ways for users to connect their microcontrollers to the headset. Some users would use a headset to stream visuals from a game engine like Unity, and let Unity read the data that is sent from the microcontroller's serial port. Other users may find a way to build the connection wirelessly with the headset via bluetooth. It requires the user to fully understand the medium they are using in order to find the

most efficient and suitable methods. For example, it may be easy for users to connect Vuforia and microbit via bluetooth on an iOS device, but it would be impossible to do that on the Oculus Quest 2. We have to note that not all of the headset grants user access to their bluetooth function. For example, Oculus Quest 2 does not allow unauthorized third-party devices to connect with the VR headset via bluetooth. This process of learning the limitations of each hardware and applying different approaches is both time-consuming and requires a lot of learning. The challenge for adding sensing abilities to AR/VR applications is the steep learning curve, which limits more creative people from entering the field. It is an urgent task to reduce technical barriers and enhance efficiency.

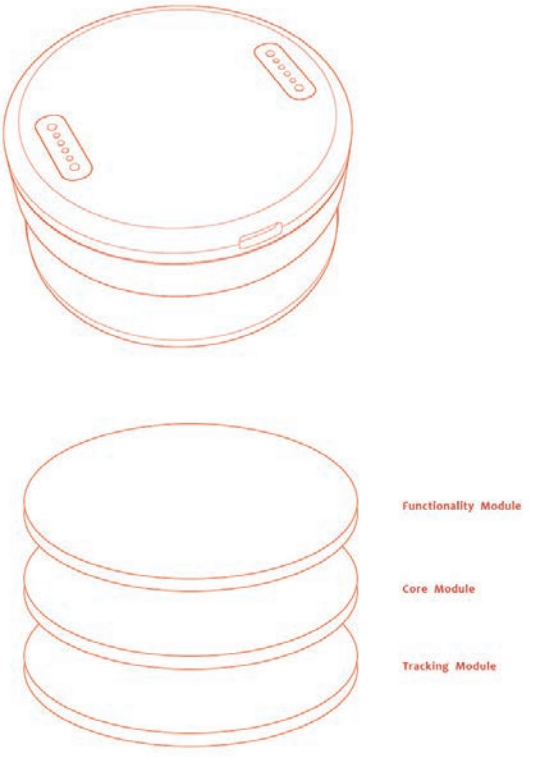
Overall, Modular Senses aim to simplify the following processes:

(a) Hardware engineering and prototyping
(b) Authoring between hardware and existing AR/VR platforms
(c) Coding for AR/VR applications with unique sensing abilities

In order to simplify the hardware engineering and prototyping process, I need to redesign the sensors. Instead of having the user solder wires, the modular device is equipped with magnetic connectors that have four contact pins. With this design, we can easily attach one module onto another. Users can add a functionality module to the core module if they want to include a new sensing ability. The process is as easy as stacking a burger. As shown in figure 2, a full set of Modular sensors usually contains three components, a Core Module, a Functionality Module (Input/Output) and a Tracking Module. The Core Module contains an ESP32 board and a lithium-polymer (LiPo) battery, which provides computing and power.

The Functionality Modules contain a variety of sensors. They can be categorized as input or output sensors. For example, input sensors are sound sensor, temperature sensor, light sensor, color sensor, rotary sensor, touch sensor, etc. Output sensors include LED, scent, motor or other actuators. In figure 3, there are two demonstrations. The one on the left is a project that is implementing a temperature sensor as the functionality module. The AR flower blooms when the physical environment reaches 61 °F . The example on the right is a demo of using a sound sensor as the input module. If you blow on the virtual flower, the sensor will detect the sound and then the virtual flower will bend down slightly, depending on how hard you blow. These are just two simple use cases of the functionality module. There are more possibilities for us to explore with different input and output modules.

The Tracking Module provides a way of recognizing the physical location of the device. And there are various options for users to choose. The most common one is the Quest 2 Tracking Module that's compatible with their controllers. It works like a mounting accessory, which allows users to attach sensors onto their existing controllers. Other advanced Tracking Modules are either using RFID (Radio-frequency identification) or Ultra-wideband (UWB) tracking. The RFID Tracking Module uses electromagnetic fields to automatically identify and track tags attached to objects or physical surroundings. The first step is to put a tag next to your window, and input the tag's physical location in Unity.



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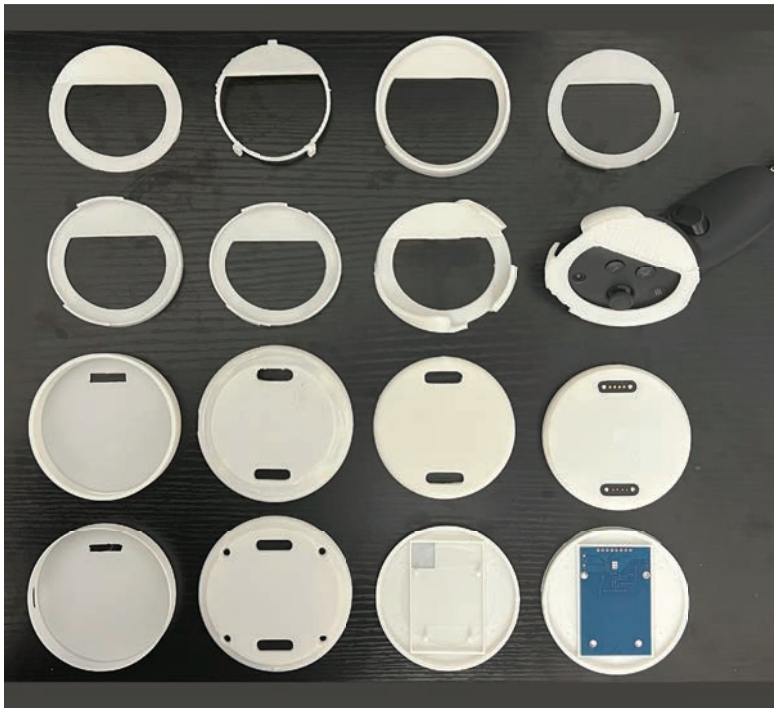
2 *Diagrams of the Modular Senses Hardware. Designed in Adobe Illustrator.*

3 *Two demonstrations of implementing modular senses into AR projects. Designed and Rendered in Blender.*



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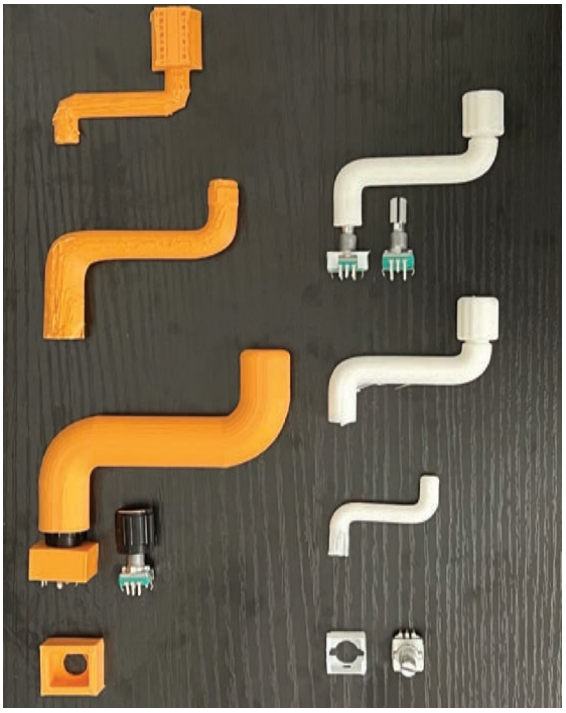

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Then, the tracking module that's placed on the tag will identify the tag and receive the location data from Unity. You can consider the tag as a portal or an tracking anchor that connects the virtual world and the real-world. The third Tracking Module is using the UWB technology, which is a short-range, wireless communication protocol that operates through radio waves. UWB Module has pros and cons. The advantage is it can sense extremely precise movement in real-time and send the location data to the AR/VR devices wirelessly. However, there is a limitation as well. It requires at least three of them as the base station that helps accurately track the module.

Currently, Modular Senses provides a plugin for Unity. The ESP32 within the Core Module can communicate with Unity wirelessly. Once the Functionality or Tracking Module is attached to the core module, Unity will be able to fetch data from them. There will be a library or basic functions I preset for each functionality module. Users can modify the parameters by playing with the Graphical User Interface I designed in Unity. At this stage, we are able to develop responsive AR/VR contents or applications with Modular Senses and Unity. Users can deploy their application to iOS, Android, Quest, etc. from the Unity Engine. In the future, this tool can be deployed as a WebVR or WebAR tool that supports multi-users collaboration and runs on the cloud.

4 *Industrial Design of the Tracking Module for the Oculus Quest Pro Controller.Industrial Design of the Core Module. Final result of the Fabrication. Designed in Rhino3D and printed with PLA.*

5 *The process of designing the Rotary Input Module. Reducing the size and enhancing the comfortability. Designed in Rhino3D and printed with PLA.*

6 *Modular Senses Starter Kit. Designed in Rhino3D and rendered in Blender.*


Core Module
Tracking Module
Functionality Module
Functionality Module
Sensing solution made for AR/VR
modular

Sensory Seasoning

Taylor Speed

Exploring the subtle players of persuasion

1

Staring into a crowd of 300 straight-laced listeners, Korean Industrial Designer, Jinsop Lee, astonished the onlookers with a single question; “Why is sex so damn good?” The answer to this rather intimate question is the same reason why riding a motorcycle thrills us or why clubbing can be so intoxicating. Humans are vulnerable to the stimulating affect of such activities due to evolutionary biology; The five senses. Crossmodal in nature, the classic sensory modalities of touch, vision, hearing, sight, and sound have shaped our perception of the world around us. Recognizing the impact of heightened stimulation, is it any wonder why food has such a grasp on the human experience? Arguably, the perception of flavor is undeniably one of the most multisensory experiences of our existence! Alternatively, one can refute that it is the non-edible factors of dining that truly enhances the richness of dining. Inspired by the phenomenon of synesthesia, Sensory Seasoning investigates this discourse.

1 *Cover Photo/Credits. Sophi Miyoko Gullbrants, Ritual Awakening; 2021*

While sight, touch, taste, sound, and smell play a fundamental role, there are subtle players that mold the experience beyond our consciousness. From the tableware to the atmosphere, these external elements flirt with our psychological perception of flavor. This four piece collection attempts to stretch synergy between food and the humans senses.

Sensory seasoning is a somatic interpretation of a budding new field called Multisensory Human-Food Interaction. Lengthy in name yet concise in concept, MHFI concerns itself with idea that eating is an interplay of all senses. Recognizing that all of our senses are interconnected, the end result is one of layered enrichment.

Sonic Touch

verb: to come into contact with the nature of sound

A stimulating eating experience is about the tactile interaction with food and drinks. Touch is a direct tool for knowledge acquisition. What we feel in our mouths is equally as important as what we feel in our hands. The weight, natural temperature, shape, and color of a bowl directly influences how people perceive the taste of food. Additionally, the sound emitted from the surrounding environment (ie. utensil to surface, background music, vocal echoes, food preparation, etc.) provide further information for our perception. Sonic Touch is focused on this crossmodal experience; particularly concerning the harmony between tactility and sound. Inspired by the natural ridges, creases, and folds of human skin, the visual surface invites a mixture of curiosity and aversion. Added layers of bluish, beige, and pink hues provide further information of the anthropoid anatomy. Round in nature, humble in size, the viewer is incentivized to hold the 5.5 inch long, 3.2 inch high body. Through closer inspection, sounds of mastication can be heard via an embedded mini-Bluetooth-speaker hidden inside the under belly.

Echoic Fumes

noun: sensory memory retained from gas, smoke, or vapor

Inspired by the harmony between olfaction and recollection, Echoic Fumes attempts to trigger a stream of memories through scented vapor. The idea being that the presence of scent will transport the viewer to places beyond the present. Thus enhancing the experience. The emphasis is on the aromatic vapor and the tangible body is simply a subset of the affect created. Echoic Fumes is made of three parts. Beginning with the head, we have a 2 inch enclosed stem-like neck that expands into a half circle. There are six 5mm holes traveling along the base to allow an exit for the fumes. From there, we reach the second half of the body. Made of cast cement, the bottom half closes the other half of the circular form with a flat bottom for stability. With no holes, this half conceals the source of the fumes. Gently pulling on the neck, the upper half of the body is lifted to reveal the miniature, battery-operated smoke machine.

Cemented Rye

noun/past tense: a cereal plant fastened with cement

In 2012, Professor Charles Spence of the University of Oxford, released a study detailing the significance of tableware on our perception of flavor. He concluded that these non-consumable elements all have the capacity to illicit significant effects in our behavior towards the food and drink we are consuming. Surely there is much to be said about why a utensil's weight dictates the dish's worth. This imposed value system extends beyond tableware. Cemented Rye explores the edible value system humans applied in order to separate the wealthy by disenfranchising the poor.

Aside from its nutritional value, bread has also been the source of great class division. Wheat bread was reserved for those of wealth and status. While Rye was left for the poor due to it's longer shelf life

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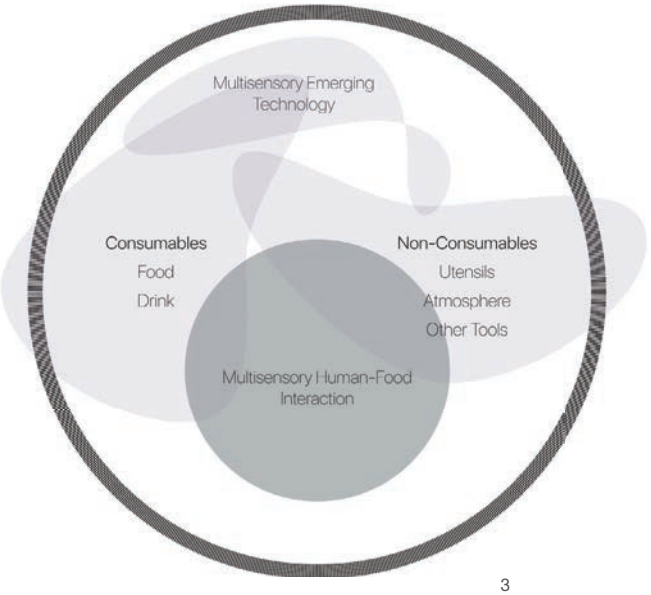

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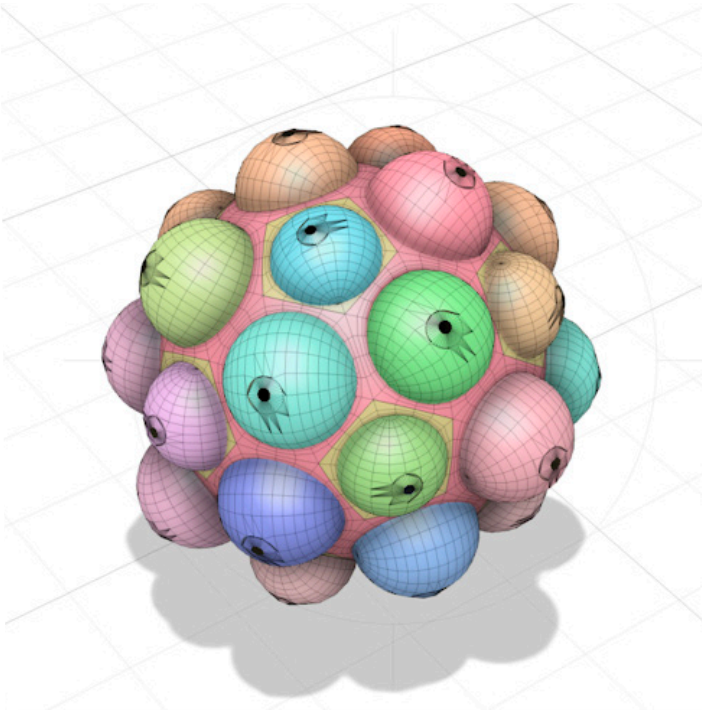
2 *A detailed image of the tactile surface of Sonic Touch. Emulating the warmth of skin and the function of a bowl.*

3 *A graph of the domain in which Sensory Seasoning resides.*



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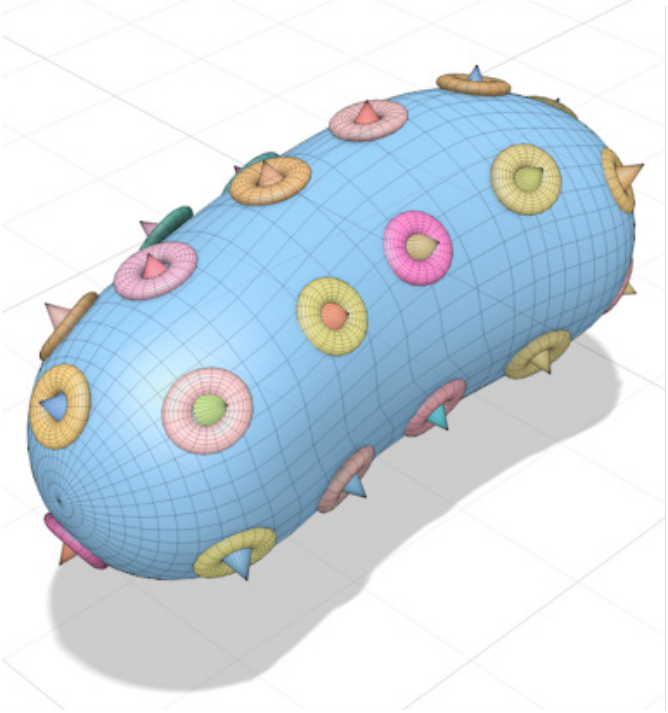

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and accessibility. Combining the human psychology with perceived value, Cemented Rye attempts to manipulate the mind into placing value onto the historically devalued; Rye Bread. To the naked eye, the surface is that of glazed marble. However, the piece is made entirely of a mixture of sand, cement, and water. Adding to the illusion of prestige, it is as weighty to the touch as it appears to the pocket. Not to be fooled into consumption, the objective is to illicit a conversation about classism and the perception of value.

/'BlooBerē/

noun: a blackened dwarf shrub of the perennial flowering plants

Round shapes are subconsciously paired with sweetness. As they resemble the roundess in fruits. When evaluating freshness, nasal receptors are the primary tool. Followed by sight. /'BlooBerē/ is a playful look at how we mentally conceptualize conflicting realities. The name is pronounced just as one may imagine; blueberry. The viewer's brain associates a mental image of this fruit from prior memory. This memory conflicts the visual information before them. Because the form resembles a strawberry coupled with embedded seeds. Yet, the color is a deep navy blue with a stem made of black, human hair. The visual information is foreign to the familiar mental image. A question to the viewer is if /'BlooBerē/ is in fact a blueberry or a strawberry? Is it still natural or now artificial? Today, we have allowed for our food to be engineered beyond it's original state. /'BlooBerē/ is a reflection of what we have accepted as normal.

4 *A 3-Dimensional iteration of /'BlooBerē/ inspired by organisms found in the human body.*

5 *A 3-Dimensional iteration of /'BlooBerē/ inspired by traditional foods that have been altered beyond recognition.*

6 *Each image of Echo is unique in a [illegible] caption!*

6

INTERNAL WORLDS

Internal Worlds is rooted in metaphors of collision and hybridization – our theses use extensive worldbuilding to bring to life personal stories of intercultural contact, fluid identities and social unrest. Through the development of interpersonal and inter technological dialogues, we seek to ask two questions: 1) where does design informed by personal narrative fit into a landscape of emerging materials and technologies; and 2) how can these different materials and technologies be used to foster human connection around those personal narratives?

In the ensuing thesis projects, *Internal Worlds* asks viewers to reflect on how internal experiences ("worlds") can be translated into and expressed in emerging conversations around technology application. By interacting with each project, audiences experience small, representative portions of the human lifespan – beginning with language (*Blend: In Dialogue With Linguistic Fluidity*) and ending with death (*Beauty In Mortality*).

Internal Worlds was collectively inspired by the integration of concepts within material and technological execution. Our cluster looks to design and create new visual languages and methodologies that uplift our selected research areas. By magnifying social nuance and realities, our cluster looks to question existing social paradigms and create new conversations.

Prior Art

Designers and creators such as Behnaz Farahi exemplify our cluster's themes – her project *Returning the Gaze* (2022) discusses the subversion of gendered power dynamics in specificity to the objectification of feminization. In the center of the installation a female model wears a suit reminiscent of an astronaut. On her head is a headpiece with two cameras, and she is flanked by four large screens which depict her eyes; in this way, viewers "meet" the redirected gaze of the model. The interactive twist creates atypical power dynamics, amplifying the experiential impact of the overall concept. This collaboration between

technology and viewers to fully realize a concept are aspects that Internal Worlds sought to integrate in their own projects.

Internal Worlds is informed by and draws from positioning of inquiry through intentional spatial interaction. As a collective, our thesis draws on utilizing similar formats of interaction design- addressing the grander question that is raised in interaction design. How do we create spatial and material interactions that address and create introspection in viewers in a meaningful way?

In a similar vein, projects such as the Australian Pavilion's *Repair* in the 2018 Venice Biennale were a source of inspiration. This installation was a collaboration between Baracco+Wright Architects and Linda Tigg – it is a "living" space that contains more than 60 species of grassland plants from South East Australia. The intent of *Repair* is to challenge and question the relationship between architecture and the natural world. It also draws on the history of colonialism in Australia and its consequences on the plant life of the land. By creating an "inside/outside" transplanted environment, this installation asks viewers to reformat and re-en envision societal relationships between nature and spatial inhabitants.

Methodology and Approach

Internal Worlds was guided by research and design frameworks spanning many fields. A few stand out in particular:

Gabriella Coleman, a professor of Anthropology at Harvard University, writes about and researches digital politics, digital culture society and the ethics of hacking. Books she's written include: *Coding Freedom: The Ethics and Aesthetics of Hacking,* which was published in 2013; and *Hacker, Hoaxer, Whistleblower, Spy: The Many Faces of Anonymous,* published in 2014. Colman's strong belief of using ethnograghy as a method of accessibility inspired our cluster's research methods and process.

Discursive design ideology, as Bruce and Stephanie Tharp review in their 2019 book *Discursive Design: Critical, Speculative, and Alternative Things*, is a form of design inquiry rooted in reflection - something that the *Internal Worlds* cluster as a whole strives for. In asking practitioners and audiences alike to take on an "anthropological gaze", discursive design projects inherently look beyond utilitarian features (as driven by the market) and instead towards more speculative, provocative, and communicative means of transformation.

Overall Internal Worlds looked to a variety of sources to inspire our collective thesis. As our cluster's topics have a wide range of research and methodologies we wanted our projects to be an amalgamation of knowledge derived from process driven procedures. Our work holds collective themes of cultural and social hybridity, narratives, and cycles.

1 *Farahi, B. (2022). Returning The Gaze. https://behnazfarahi.com/returning-the-gaze/*

2

Blend: In Dialogue With Linguistic Fluidity

Maya Chen

A Celebration of Heteroglossia

1

Blend: In Dialogue With Linguistic Fluidity addresses the seismic effects of migration on one's grasp of diasporic belonging and multilingual identity. It is not only deeply connected to my own encounters with geographical and cultural disruption, but it's also intertwined with the lived experiences of generations of uprooted people; the multitudes of those who cannot call a single place a home, or have to wrestle with contrasting linguistic urges that twist their tongues. *Blend* draws from heteroglossia, a sociolinguistics term (coined by literary theorist Mikhail Bakhtin in his seminal work, *The Dialogic Imagination: Four Essays* [1981]) that describes the existence of simultaneously diverse contextual forces impacting language use. As a result, *Blend* conjures up speculation, and most importantly celebration, of the contact-driven alchemy that has shaped the language that inhabits us today.

1 *Light hitting the trees in the Nancy Pelosi AIDS Memorial Grove, San Francisco Golden Gate Park. Image by Maya Chen, November 2022.*

The central artifact of *Blend* is *The Forest of Utterances*, an interactive audiovisual installation that stands as a metaphor of the close relationship between migration, language and cultural contact, and the hybridity of speech and self that subsequently emerges. A space symbolic of travel and movement – a forest – is the site of speculative, unfamiliar blends of languages, set into action by traversing down new and old paths. In portraying language as a geographic landscape rather than just a tool devised by humans to communicate, *The Forest of Utterances* materializes intercultural contact zones as points of linguistic recombination for fragmented identities. The intended effect on the audience – whether they have known this feeling of fragmentation or not – is for them to start mining their own unconscious patterns of language usage, from the mundane to the extraordinary, in the real-life contact zones they inhabit.

As a design thesis, *Blend* ventures down a framework of inquiry that comes from a hybrid of self-reflexive and archival research. I draw much of my methodology and approach from the

Emerging literature around the fields of discursive design and autoethnographic design. In *Discursive Design* (2019), Bruce and Stephanie Tharp present an ideology that is deeply investigative, anthropological, and critical. I orient myself within this as a design practitioner that aims to communicate an underlying message about society and culture through a built artifact. My visualization of the contact zone, going by this framework, embodies the underlying sociocultural forces (such as migration) that give it life. Onlookers are tasked with interpreting the repercussions of migration on language structure, and leave with a visceral understanding of the hybrid identities within the intercultural contact zone.

It has been brought up that my thesis is hard to place within the arena of design topics that the MDes stands for, and I agree. *Blend*, along with my other cluster members' theses, sees an opportunity to exist in the liminal space between *doing* and *being*; it argues for designed experiences around subjective, discursive *being* to be treated with the same scrutiny as objective, product-oriented *doing*. In short, *Blend* is crafted with the intention to give breath to othered, suppressed voices, and in doing so, takes on a novel design vernacular of its own.

The initial motivations for this project were stirred by my personal struggles with reconciling two cultural identities with myself, American and Chinese, while simultaneously feeling isolated from both. I write about this simultaneity in my thesis as a "lump in my throat"; something hard, tight, and obstructive that cuts into my everyday conversations and mangles my speech - a product of frequent moving around in my childhood and teen years. In researching this lived experience from a linguistic point of view, I soon found literature in sociolinguistics that echoed my use of vocabulary such as *simultaneity*, *hybridity*, and *internal chaos*.

There exist intangible spheres of multilinguistic encounters called *contact zones*. These invisible locuses of language and cultural mixing (and subsequent confusion) have been identified by sociolinguists as the driving forces behind why we use language in unique ways. I applied my skills in design to materialize this. Through the splicing, shuffling, and recombination of spoken utterances in different languages, I render an acoustic version of codeswitching. Through the construction of a space that resembles the peace and hush of a forest, I simulate the drastic effects that movement and migration may have on one's internal language frameworks.

The Forest of Utterances thus is a physical installation that brings a forest ecosystem to the sterile, concrete interiors of Jacobs Hall. Viewers wear Bluetooth headphones and move around a grassy patch of ground, unaware that they are being tracked by a camera. Their movements change what they hear; one minute they are listening to a story spoken in English, and the next it morphs into an amalgamation of English-Mandarin.

Sitting in the far corner of the space is a handmade screen, upon which visuals of the participants' movements (and their subsequent effects on the utterances they are hearing) are projected.

As a means of personal confrontation with a culturally hybrid way of speaking and thinking, this thesis also hopes to inspire others to reflect on this notion as well.

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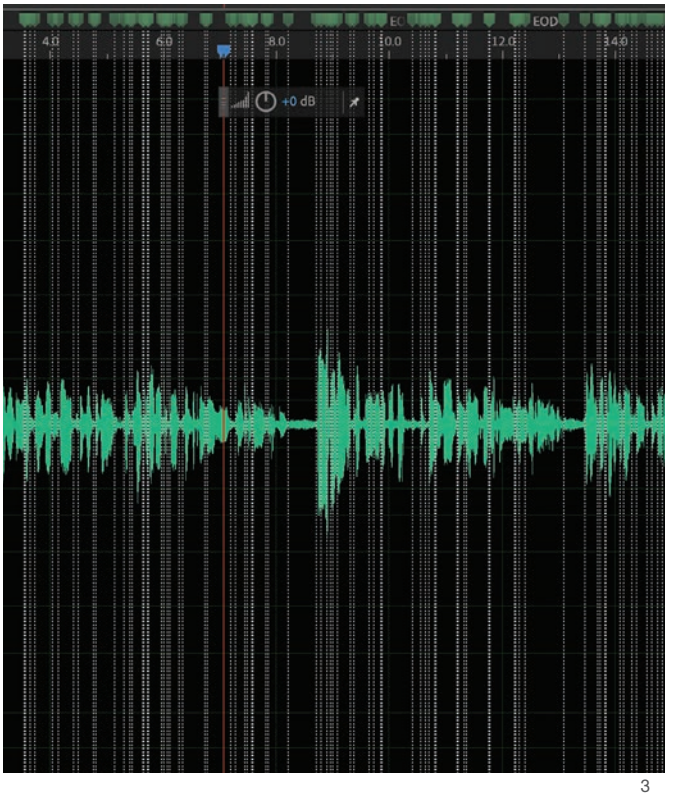

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2 *A moving background - snapshots from Aizuwakamatzu, Shanghai, and Berkeley.*

3 *Splicing sentences in Audition.*

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4 *A source of inspiration for the installation - the Australian Pavilion at the 2018 Venice Biennale.*

5 *Felicia bathed in nature in front of the shoji screen. Image by Maya Chen, November 2022.*

6 *Testing out forest projections on the shoji screen. Visuals from Porter Robinson's music video, Mirror (2020).*

7 *Light hitting the trees in the Nancy Pelosi AIDS Memorial Grove, San Francisco Golden Gate Park. Image by Maya Chen, November 2022.*

Language is a living thing. It's an entity that goes through a cycle of birth, reproduction, travel, and death; it is conquered and is the conqueror, and a mirror to humanity's idiosyncrasies. Through us, language flows, and through language, we form connections. So, as we reach the end, think of this: what makes your language use unique?

7

Latino VR Museum Park

Ming Gong

Reimagining narratives on the US-Mexico border and immigration through VR experience

1

1 *MaestraPeace in Mission District*

"Latino VR Museum Park" aims at communicating the historical and cultural aspects of Latino culture to people in San Francisco in an interactive way. Through learning about the history of familiar cultural contents and interacting with them, users can gain a better understanding of how the immigration culture contributes to forming the society they live in.

The reason why I develop this project is that the border wall and immigration issue not only affects people's lives in the border city, but also throughout the United States. Specifically, people born in California, the state with the highest concentration of Latino communities in the US, are used to the Latino cultures around them. Instead of being forced to study the history and language without understanding why they are doing it, people are more willing to know about the context and history of the places they live in. For instance, what is the history of the Latino community in California? Why are there so many of them?

This research aims to create an interactive virtual experience that enables residents of California to interact with frequently encountered Latino scenarios in their daily lives so that people can understand how Latino culture contributes to the city's diversity and explore the real causes and stories of immigration. For instance, by entering a taco restaurant, the audience can discover more about Latino food customs and culture, including the normal diet, the history of ingredients, and the significance of food to Latino communities. I hypothesize that this immersive experience might inspire empathy for immigrants and make people aware of the significance of respecting all cultures.

The design framework begins with gathering cultural information through learning about Latino history, cultural artifacts, and cultural values. Generally, I applied two approaches to collect the information I needed: historical research and interviews. In "Latinos in La Misión: A Story

of Resistance and Community", the author describes how the Latino community in Mission District successfully protested against urban reconstruction in the 1970s to preserve their neighborhoods (Miño-Bucheli, 2022). In this period, immigrants are united together to protect their cultures and numerous progressive organizations, artists, activists, and public murals all began to emerge. Due to this knowledge, Latino artworks were showcased in the virtual museum during the design implementation stage, providing visitors with an appealing method to learn about this resilient immigration story. Then, I was able to convert the cultural contents into virtual environments by following the MDA framework, which demonstrates three principles for an engaging experience: Mechanics, Dynamics, and Aesthetics.

By following this framework, I first set up the unchangeable mechanics, including environmental settings and objects in the virtual world. When building the settings, instead of directly simulating and reconstructing the realistic buildings and scenes, I developed these spaces to be more interactively artistic with the method of abstraction. For instance, La Taqueria is one of the most famous Taco restaurants in San Francisco with arches as its entrance. When reconstructing this building, I followed the arch design language and applied it to serve more functions such as windows, decorations, and furniture. I also applied brighter colors to the buildings and added effects such as lighting, touchable screens on the facade to make the visual aspect more engaging. Then, I was able to create dynamic scenes in which users can receive different feedback based on their own choices and behaviors. For example, a public square allows users to give full play to their creation by decorating a Christmas tree together with elements gathered from the learning experience.

The objective of this experience allows users to: (1) learn about the historical development of Mission District. (2) discover the cultural meanings of Latino contents appearing in daily lives. (3) understand how Latinos contributed to the multicultural characteristic of San Francisco. Before starting the experience, users appear at the entry of the museum park, being informed of the key locations to visit by having a dialogue with the character or looking at the bulletin board. After entering the museum park, users can witness a Latino-style block with restaurants, commodity stores, and residents appearing along the street. Each of the buildings serves as a medium to introduce one aspect of the Latino culture. For instance, by entering a taco restaurant and interacting with the settings there, users can discover more about Latino food customs and culture, including the normal diet, the history of ingredients, and the significance of food to Latino communities. By visiting an immigrant's house, users can have dialogues with characters, interact with artifacts in the house, so as to understand the living habits of Latino people and hear their immigration stories. A personalized experience can also be gained through picking up and wearing costumes in a commodity store, or entering the Mission Park to collaborate with local residents to set up for a neighborhood event.

The application of realizing interactions in the virtual world is developed with the combination of Unity and HMD (Oculus Quest). There are several methods of interaction applied in this project with different purposes to form a comprehensive

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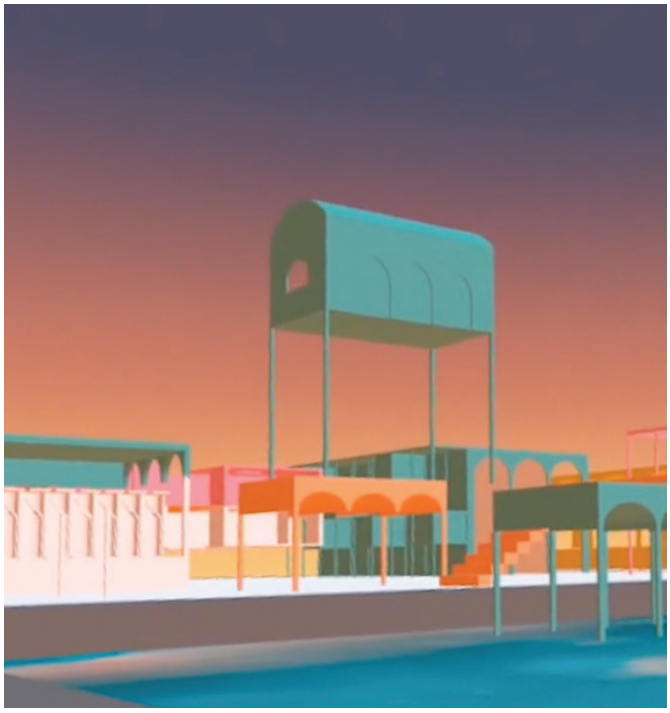
2 *Mission Makeover in Mission District*

3 *Mission Dolores*



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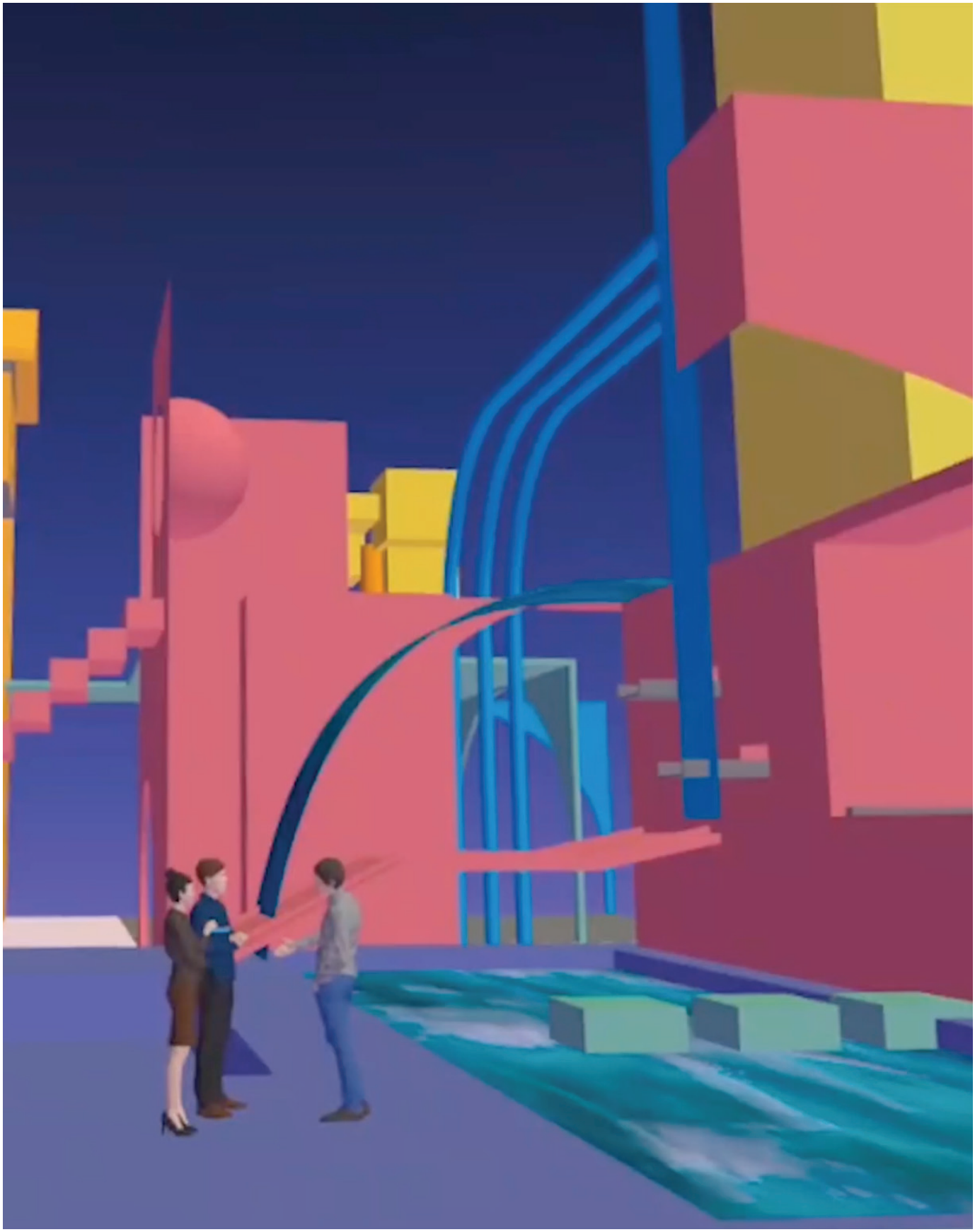
experience: (1) Geographical movement. Considering there are multiple places that users can explore, I applied the teleportation technique throughout the space. In front of each building, there is a luminating circular spot on the ground. By clicking on it, users can be transported directly to that spot, and enter the building. Meanwhile, users can also choose to physically move around the space by operating their controllers. (2) Interaction with objects. The interactive objects in the scene are available to be touched and picked up by users for learning and entertaining objectives. To better help users figure out which object is interactive, a hover effect is created. Specifically, when users are hovering on a grabbable object, the controller will shake slightly (haptic feedback). By pressing the trigger, the object will just appear in users' hands. Another scenario containing interaction with objects is that users can move and change objects in a personalized way, such as decorating a public space with Latino residents. In this case, I built several trigger detection areas where users can attach the selected items to. For instance, users can grab the Christmas decorations from commodity stores and bring them to decorate the Christmas tree on the street.

This research paper investigates the application of virtual reality (VR) in promoting people's awareness of the influence of immigration on their daily lives and developing engaging ways for understanding Latino culture. The virtual museum provides people living in San Francisco access to discover the Latino culture around them, which contributes to cross-cultural collaboration and empathy. At this stage, the project will be presented in an exhibition format that allows the audience to use the VR headset to immerse themselves in the virtual world. In the future, there is the possibility to enrich the contents displayed in the virtual museum, invite more potential users to play in real time, and even introduce it for educational purposes.

4 *Retail store in Latino VR Museum Park*

5 *Church in Latino VR Museum Park*

6 *Recreational public space in Latino VR Museum Park*



6

Celebration of Digital Aura

Celia Diaz

Exploring human vulnerability to digital assets by understanding how technology affects our cultures.

1

1 *Image of a pinata downloaded on 16 of November 2022 from Unsplash by Santiago Filio Published on December 19, 2018*

Our objects hold this inner closeness to us, but it is not just our physical closeness that we are attached to; it is our embodiment of them. Our values and attachments to our inanimate objects have furthered beyond our physical proximity and evolved to our digital extent. Our connection to our things has moved beyond what we can feel and touch to what we can see and hear. Cultural significance enhances our value of these objects because it helps us build a self-identity by using them. The problem is that we have become vulnerable to inanimate objects beyond our physical environments and into the digital world because we have built a close inner identity to our digital assets. Those digital assets represent our self-identities in artificial realities that are not the real world, but the significance extends to our real-world selves. Currently, scholars still treat the mind as being separate from the body. Thinking of the second self, as Sherry Tickle puts it, "The Second Self remains a primer in the psychology of people's relationships with computers. Computational objects, poised between the animate and inanimate world, are experienced as both part of the self and the external world." (Sherry Turkle, 2005). Our objects represent our identities through an extension of ourselves. Anthropologists have collected and analyzed these object assemblages to understand cultures and peoples for centuries.

People like Amber Case have recently introduced the term cyborg anthropology' after Donna Haraway stated, "we are all cyborgs now" (Donna Haraway, 1985). This field focuses on the symbiotic interactions between humans and machines. Also, it looks into how our values and culture are changing the shape of these interactions by being mediated by high technology (Amber Case, TED Talk, 2011). However, those objects were physical assemblages demonstrating physical modifications of tools used to extend the physical self. However, what happens when our digitized selves lead our identities? The framework I will follow for this

project is ethnographic research and a speculative artifact. The goal is to provoke audiences to realize that what they see is not exactly what they get; it only holds value in a digitized world. What identities will we hold with our digital assets? This project's foreseen limits in accessibility are because of the visual components this artifact entails. However, by using other methods of multisensory design it will expand to reach more audiences. The project is significant work because we are heading to a world of more everyday use of digital assets. By informing audiences about how these digital assets are valued, we can prepare them to be focused on something other than artificial technology and experience the beauty of real-world environments. Moving forward, we must become more comfortable coexisting with our digital selves in our everyday real-world experiences. The project's hope for the future is to use technology to create a more meaningful world and be less distracted by shiny outcomes. This project can trailblaze the opportunity to open the possibility where humans and their digital assets can co-create coexisting environments. It will address new possibilities for understanding how fundamental artifacts are to human cognition and perception (Carl Knappett, 2005). This dynamic approach will allow new thinking about the past and future material culture.

My motivation for this project is that I am using this project as a way of bridging my two fields of Anthropology and Design. These fields have a unique way of meshing that I want to make visible through my writing and artifact installation. The term I follow to link these two disciplines is called 'Cyborg Anthropology. We are thinking about how technology impacts our culture. With technological advances, we need to refocus our visions of what it means to have technological advances in our lives and how they influence us. Sherry Turkle talks about how 'addictive' technology can be because it only allows humans to be who they choose to be outside real-world constraints. I am excited to move this project forward because of new digital assets that instill value into our society. Technology is guiding an artificial world as in the 'metaverse,' Our environments are being designed digitally and leaving out the actual physical environment. We need to refocus our perceptions to see the beauty beyond artificial reality as a layer of filtration and an integration of our lives. We need to expand our social beings and be comfortable with the world outside the digital world like we once did. By guiding audiences through a provocative physical object, the hope will be to have them be surprised and even disturbed to see some digital assets they interact with daily being brought into the real world.

Through the method of 'making' as Tim Ingold describes, "The task of the maker is to bring the pieces together into a sympathetic engagement with one another so that they can begin- as I would say- to correspond." (Tim Ingold, 2013). I am using my hands as a process with making allows me to connect with the material. The primary material is paper, but newspaper and tissue paper contain different properties in this case. During the process, there were times of frustration because things wouldn't stick together or the tissue paper would rip. But this slow process of time teaches me as a designer that process takes a slowness and an interconnectedness with our mind, body, and hands.

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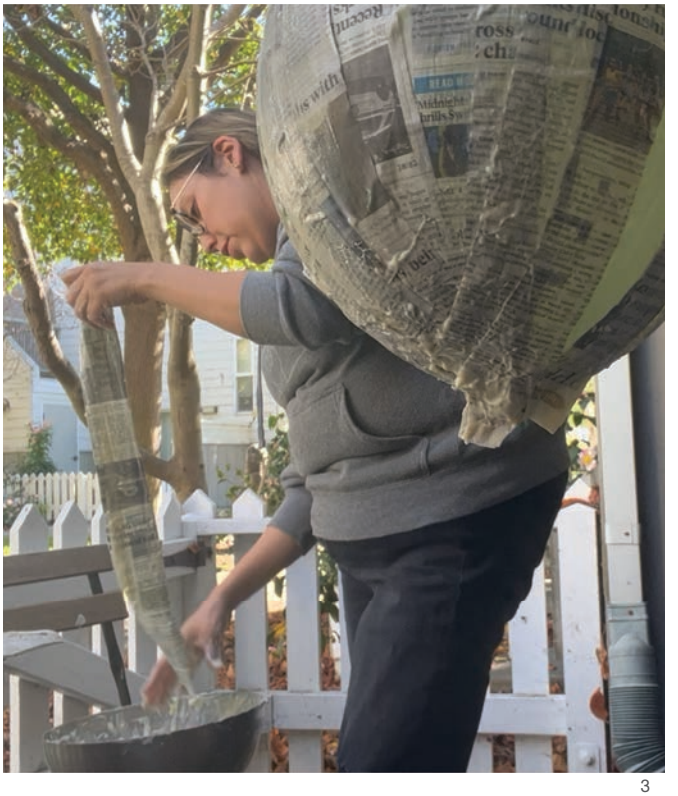

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2 *Image of Birthday party taken on March 2002 by Jesenia Diaz.*

3 *Image of paper mache process taken on November 3, 2022 by Celia Diaz.*

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I call my artifact, Celebration of the Digital Aura. It is an archaic artifact presented as a high technological piece. This piece was inspired by my talk with author Amber Case. She advised me to think of an archaic artifact that has existed in prehistoric times (a Piñata) and call it high tech by adding technological aspects onto it. This artifact is meant to provoke audiences with confusion and disturbance. Could you imagine 30 years from now breaking open a Piñata in order to receive your digital assets? This piece forces audiences to think about interacting with digital assets that have a valuable meaning to them in real world life

The Piñata itself is made through the process that most people are familiar with called, paper mâché. The process consists of inflating a latex balloon and wrapping it submerged in Elmers glue newspaper and applying it to the balloon itself to create a hardened outer round form. During my three iterations, I finally discovered the best mixture to build a strong form. This mixture was flour, elmers glue and warm water; which created a sticky paste. This paste needed to have the right consistency in order for the newspaper to stick and harden. After about three days, the newspaper was hard enough on the outside for me to be able to release the air from the balloon on the inside.

The interaction of video, light and sound will be the focal point for this artifcat. The artifact will stand alone in air to be clearly visible by the audience. It is currently hung from a 59 by 47 inch clothes rack to allow freestanding mobility. The artifact is meant to live in any given free space environment. Usually, piñatas arehung from a rope that is connected to a tree. The rope allows both constraints and mobility to be able to bring the piñata side to side and up and down. The piñatas still performance is the main aspect of this piece. It needs to stand alone and be self explanatory to the audience.The constraints in this artifact lie upon its weight due to its ability to be able to hang free standing.

4 *Image of attaching cones to the base taken on November 5, 2022 by Celia Diaz.*

5 *Image of tissue paper decoration process of the cones taken on November 6, 2022 by Celia Diaz.*

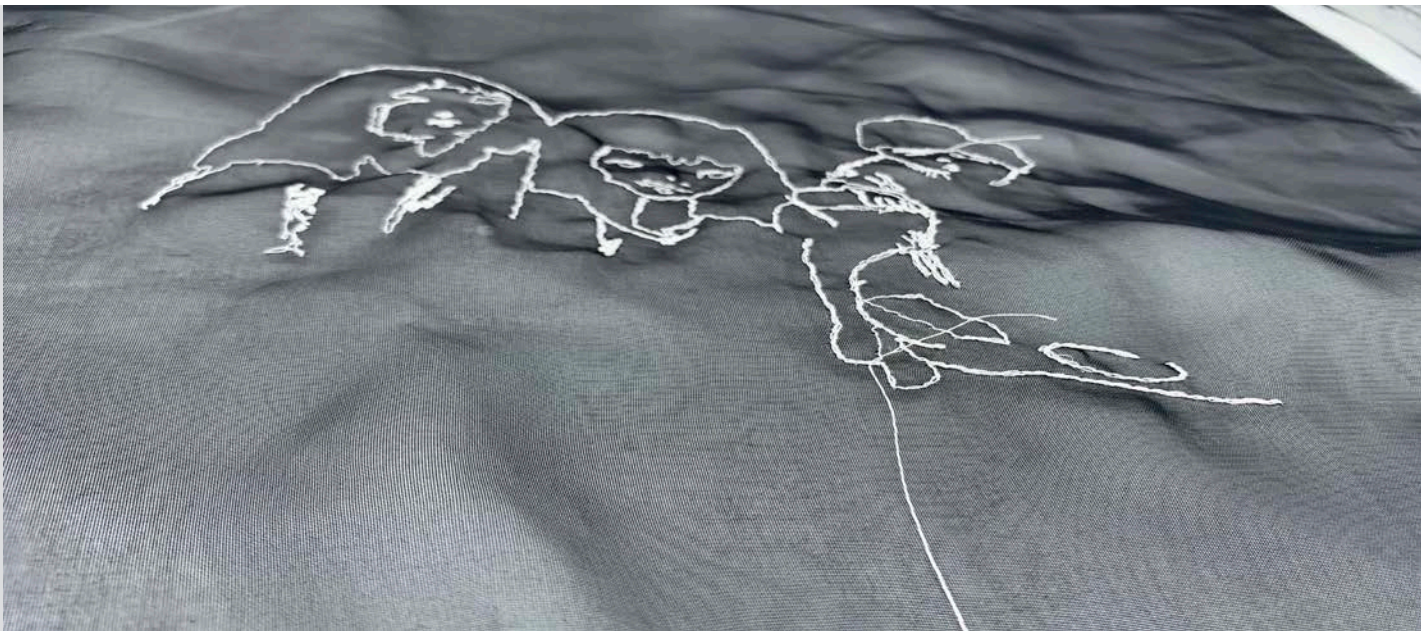
6 *Image of final artifact taken on November 16, 2022 by Celia Diaz.*

6

To Indulge a Child

Jessica Kazuko Kim

Amaeru (甘える)



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To Indulge a Child is a direct translation from the Japanese word “Amaeru”(甘える). Based on the societal significance of the mother-child relationship in Japanese society, it is held that “giri” (cultural societal obligation) is built on the foundation of pure love- the “spoiling” of a child. A child is fawned over for five years, to build a base of parental and familial love at the core of their character. In alignment with this philosophy To Indulge a Child seeks to layer technical and conceptual nuance on the foundation of cultural familial love. Therefore this thesis project exists on multiple points. One to technologically merge “traditional” and “contemporary” technologies. Two to reframe Japanese-American cultural dissonance within the context of the social phenomena of named familial generations. Finally this thesis also tracks interpersonal cultural identity as a retrospective from an internal and external perspective.

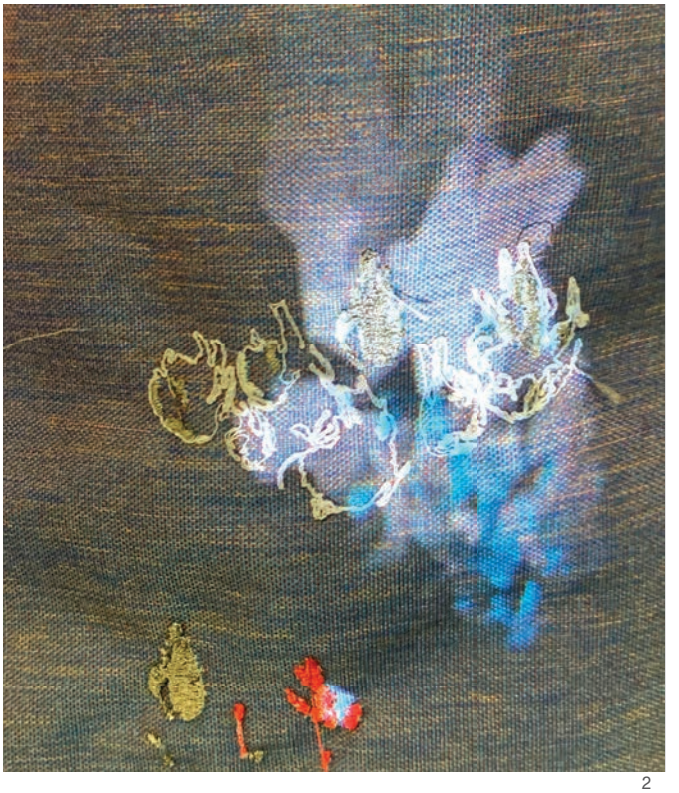
1 *Cut off of embroidered figures on sheer cloth*

Technically To Indulge a Child questions the role of tangibility in AR/X. These technologies are effective in creating immersive environments that play with the user’s perception of space. However it hinges on the use of a single “tool” as a method of navigation, to “control” material augmentation. How could tangible inputs to a virtual environment create increased accessibility to immersive experiences? Furthermore, how can cultural narratives be the central focus rather than the novelty of a virtual world? The following work explores how interfacing augmented environments with textiles uplifts cultural narratives. Based on Japanese-American (JA or “Nikkei”) multigenerational research, “To Indulge a Child” creates an ambient atmosphere that layers interactions. My thesis functions at the intersection of smart textiles in HCI and

AR, expressing itself in the artistic rendition of the Japanese folklore Kitsune no Yomeiri. In examining the communal phenomena of named generations and thus named cultural nuances, this project maps and uplifts invisible intrapersonal and interpersonal connections to identity through culture. To Indulge a Child centers itself on how the current Nikkei community places themselves within personal and communal cultural identity. Through juxtaposing the experience of Nikkei cultural dissonance with the disorientation between immersive and tangible experiences, does To Indulge a Child present a unique technical and conceptual exploration

This work engages with the symbolic significance of textiles (as a "past technology") with AR ("emerging technology") to potentially format new visual material languages. Drawing upon cultural and personal symbolism within textiles and how this field expresses such symbols (such as through the use of color, composition, and material), " relies on the textile development process as well as the visual components displayed in the projection mapped AR visualization. Through a reinterpretation of textiles inspired by and built from Nikkei intergenerational cultural phenomena, "To Indulge a Child" brings forth invisible narratives while also making new ones. By making fabrics that engage with tangible interactions that catalyze AR the following work reinterprets and brings forth abstracted familiar visualizations of JA culture and legacy. In experiencing such technological collaboration, viewers outside of this cultural community can potentially re-envision new ways of storytelling and holding space for conversations around identity and culture. This thesis re-conceptualizes and redefines what a textile is, redefining the function and application a "textile" is. "To Indulge a Child" seeks to create new narratives through new interactions between material and AR projection mapping.

This thesis focuses on the cultural realities of the initial three generations of the Japanese-American(JA) community post immigration. These tapestry lamps are a spatial experience- each panel, each fabric has a different connotation depending on the context of other embroidered imagery and interaction with the projected world. As each familial generation experienced varied degrees and types of cultural nuances the color and materiality are different according to each lamp. Within the Issei (first-generation) and Nissei (second generation) there are secret panels which are only revealed through the activation of the smart textile. Each smart textile top panel hosts an embroidered version of the Japanese character for number three. According to each lamp and the correlated generation, different parts of the characters are "colored" in- to indicate the type of cultural nuance displayed. Viewers must then piece together the cultural knowledge exhibited by interacting with the smart textile on the top of the lamp, and its subsequent visual



2

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2 *Image of a projected wisteria render on an embroidery of a drawing of fire. Early sampling of project.*

3 *Mockup of projected image on cloth*

4

5

effect on the overall visual experience. Therefore each experience is its own unique experience- dictated by interaction and context.

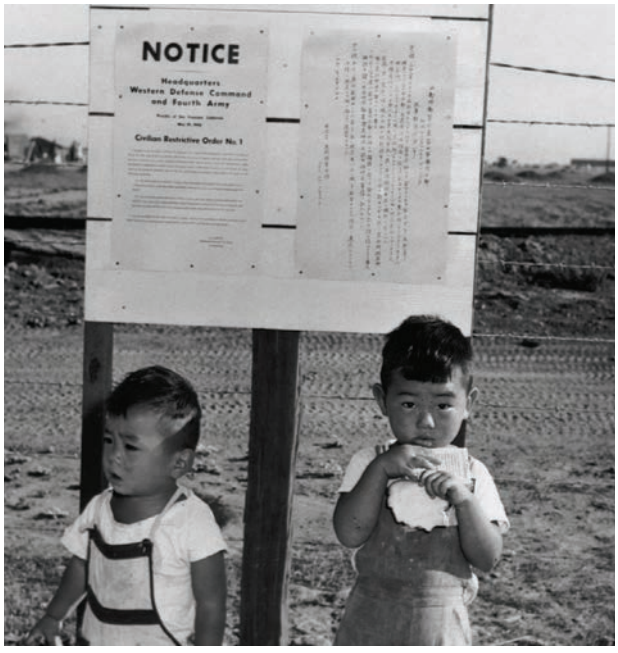
Therefore when connecting Nikkei cultural dissonance to AR activated textiles it is imperative to understand the lack of technological cultural expression within this community. Factors that contribute to this are technological fluency, communal trauma, and cultural communication barriers. "To Indulge a Child" acts as a medium that allows for post-historical trauma healing and reparations in the JA community but also allows viewers outside of the JA community to compose new storytelling methods. Through witnessing and allowing interpersonal experiences to be witnessed can greater nuance in cultural identity conversations be achieved.

Overall To Indulge a Child inquires about how imitation of this time-space evokes nostalgia and connection. By exploring textile's capacity as a touch interface, To Indulge a Child raises questions about object materiality in parallel with AR. Are we truly augmenting reality? Or are our materials informing the visualization of perceptions around augmentation? On a cultural narrative level - how do we indulge our cultural communal communication through materiality and AR?

4 *Visual hypothesis of layered photograph of Manzanar Block 12 internment garden and print of "Kitsune no Yomeiri" myth*
"Kitsune No Yomeiri – the Fox Wedding."
Hyakumonogatari Kaidankai, 5 June 2014, https://hyakumonogatari.com/2013/07/19/kitsune-no-yomeiri-the-fox-wedding/.

5 *"2014 / Manzanar's Japanese Garden Restoration Project Recognized Nationally." Japanese Art Culture in LA, http://www.culturalnews.com/?p=12322.*

6 *"'Kitsune No Yomeiri' (1860) by Utagawa Yoshitora: Pinterest, 13 Aug. 2019, https://www.pinterest.com/pin/574701602449343629/.*



Children in front of sign at internment camp
"George Takei: We Japanese Americans Must Not Forget Our Wartime Internment." The Guardian, Guardian News and Media, 27 Apr. 2012, https://www.theguardian.com/commentisfree/2012/apr/27/we-japanese-americans-wartime-internment.

6

My Pleasure

Emily Joens

Daringly designing a new category of pleasure.

1

My Pleasure is a new type of toy. A toy that focuses on self-exploration *without* the orgasm. A toy that is non-penetrative in nature and is not solely focused on clitoral stimulation. Rather, it concentrates on the parts of the vagina that are 'unseen' and 'untouched' by traditional sex toys.

The aim of this project was to create a romantic, feminine design which is inspired by the calming effects that nature has on the human nervous system. The shape of this design is inspired by the flowers of the Orchidaceae family. This genus was chosen specifically for its resemblance of a vagina.

By utilizing a shape, symbolic of the feminine, the artefact aims to create mental and physical space for exploration of (her) pleasure without the subconscious cognition of a (male) counterpart. By creating a design which is inspired by and 'mirrors' the vagina, it aims to create a subconscious recognition of self - of her own genitalia - allowing her to fully step into her own pleasure.

Explorative in nature, this artefact is geared at creating a conversation. A conversation about pleasure, and what it really means to the you, the viewer. What are your perceived values of pleasure, and where were they derived from? Do you feel that you are worthy of this pleasure? Or do you (subconsciously) shy away from it?

It is these last two questions which are of grave importance, because sexuality starts in the mind. It is our mind — and not our genitalia — that is our largest sexual organ. So what happens when the largest sexual organ does not believe that pleasure is an abundant experience?

1 *Material Exploration (Silicone, Faux Gold Powder)*

It was with this perspective that gold, as a material, was integrated into the project. Gold, which symbolizes excess was integrated to subconsciously impact the viewer into thinking that pleasure is an abundant feeling. A feeling that we all deserve.

The act of sex is innately human, whilst creating objects of pleasure is deeply ingrained into our genetics. Sex toys are a ubiquitious part of both ancient and current cultures, and date back to 28,000 years ago. Many ancient cultures created objects of pleasure, and even worshiped deities with overly large genitalia.

Yet in today's society, sex toys have become a deeply taboo domain. A topic so stigmatised it makes people feel uncomfortable. This thesis aims to investigate why masturbation and its associated artefacts make so many of us, deeply uncomfortable and how this stigma can be ameliorated through design.

When analyzing the history of female sex toys (an opaque topic with few sources) it becomes apparent that shape, function and material(s) used are still in their infancy. The user journey associated with these toys are commonly associated with an incorrect understanding of the female anatomy and the female orgasm. Sex toys have been largely limited to phallic-shaped products, focusing on orgasm as opposed to creating a conscious ritual.

Currently, an anti-movement of sex toy brands, focusing on minimalist design, colour, gender-fluidity and clitoral stimulation are flourishing in the sex toy domain. However, the discussion and education surrounding self-exploration is missing. It is this intersection— of newly designed sex toys, self-exploration, conscious-raising masturbation and ritual building habits that this project focuses on.

The intent of this artefact is to help the user explore her body. Explore her pleasure. To understand the physiological responses to different stimulations of the vagina.

My Pleasure focuses on the entire journey up until orgasm, whilst traditional sex toys focus on getting the user to orgasm as quickly as possible. However, it is important to note, that traditional sex toys and My Pleasure are not competing products, but rather two products which work symbiotically. The primer focusing creating a ritual act of exploration, self-care, and (re) connection of mind-and-body whilst the latter on the hedonistic aspect of masturbation and pleasure.

As Todd Baratz, a licensed psychotherapist who specializes in sex therapist, said: 'Stop defining your sexuality by centering penetration. If your not trying to get pregnant it actually doesn't matter what type of sex your're having. Instead of specific sexual acts, think about eroticism, kink, comfort and creativity.'

Although he refers to sex with a partner, the same sentiment is transferrable to the art of masturbation. It is this explorative mindset that users' should have after using this artefact. A mindset that helps them learn; to learn what they like, and what they do not like.

2

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2 *Material Exploration (Silicone, Faux Gold Flakes)*

3 *Material Exploration (Silicone, 24k Gold)*

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I hope, through this artefact, that users will be able to concretely answer ‘what is pleasurable for me?’

Through the focus on ‘connection’ of self and the ‘connection’ of mind and body, this design aims to waken and strengthen the relationship that the user has to themselves.

My Pleasure was inspired by orchids, a powerful symbol for femininity, fertility, and sexuality. A recent study published in the Journal of Environmental Psychology, showed that when humans viewed images of flowers, it reduced “negative emotion, blood pressure and cortisol release”, and had a regenerative effect on the human mind. Connecting the act of pleasure with symbolism of nature aims to create a calming, unwinding effect which reduces internal stress.

Each pedal is made of silicone and has an individually integrated motor. Fine metal mesh allows the user to adapt, mould, and alter each petal to an ideal position of pleasure.

This artefact was designed to enable high levels of individualisation and customisation, taking into account that each individual has a unique configuration and personal equation for pleasure.

The use and exploration of gold as a mateiral is another important feature of this artefact. It aims to create a design imbued with images of opulence, richness and the sensuality of ancient cultures.

Subconsciously, its use aims to suggest that pleasure is abundant and plentiful. Research has shown that to the human eye, gold is perceived as water, explaining its allure on humans. Its water-like optics makes gold a material that humans’ unconsciously believe they need to survive.

4 *Image prototyping of an exhibition space for the final presentation. Created by Emily Joens using MidJourney, an AI image generator. Created by Emily Joens.*

5 *Image prototyping of an exhibition space for the final presentation. Created by Emily Joens using MidJourney, an AI image generator. Created by Emily Joens.*

6 *Image prototyping of an exhibition space for the final presentation. Created by Emily Joens using MidJourney, an AI image generator. Created by Emily Joens.*

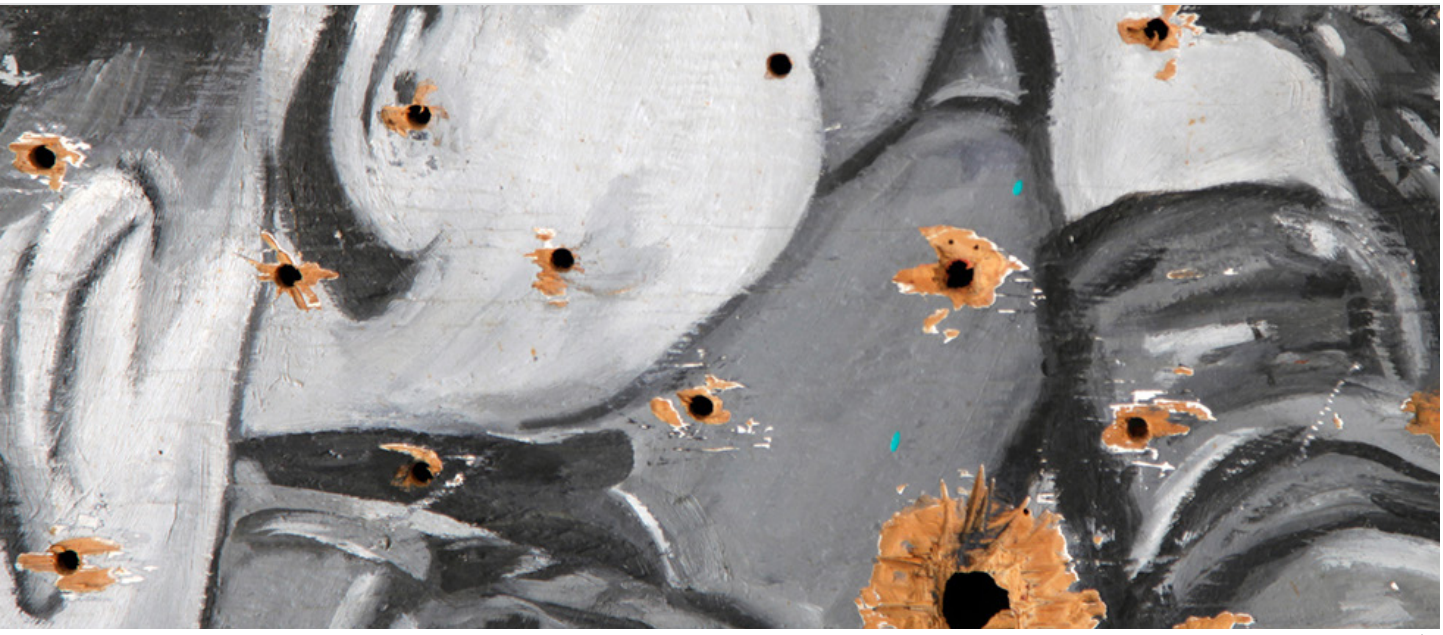
By making use of this psychological effect, My Pleasure aims to destigmatize self-exploration and self-pleasure, highlighting that it is an essential, and normal human need. A need we require to survive.

6

Guns?

Jaesuk Huh

Exploring the gun violence in U.S. and creating emotional connections to the issue.



1

The rate of gun violence has been increasing over the past years. Guns have killed as many as 39,000 people and caused about 85,000 injuries each year ("Fast Facts: Firearm Violence Prevention"). It would be safe to say that the gun violence issue in the U.S. is a very serious problem that is very hard to resolve.

One way of tackling the issue as a designer is to create a space where people can pay honors to the people who have lost their lives to gun violence. In 2021, using 40,000 silk flowers, Giffords created a gun violence memorial in front of the National Mall in Washington DC to pay tribute to the victims of gun violence. The number of flowers represents the people who have died from gun violence each year ("A Place to Remember & Reflect"). The bold installation has created a unique visualization that has impacted the audience and brought attention to the issue.

The limitation of this type of physical gun violence memorial is accessibility and immersiveness. The installation itself is massive and has to be set in a wide range. The installation is hard to move and it is not easily accessible to people far away. Also, though the installation might be unique, the objects in the gun violence memorial are not interactive.

The purpose of my project is to create a gun violence memorial inside the Virtual Reality (VR) world. The memorial would bring attention to the audience and evoke conversations around the problem. The features of the VR environment would allow the viewers to have easier and quicker access to the gun violence memorial. What is more, the audience would be able to interact with objects within the memorial, thus creating more empathy toward the victims.

1 *"BE SURE OF YOUR TARGET AND WHAT'S BEYOND IT" by Sherman Finch*

I come from a country where gun violence is rarely talked about, but the topic was always in my head and felt frustrated when I saw news related to gun violence. I thought, personally for me, it would be interesting to work on something very unfamiliar and I could provide something creative and fresh. I was not aware of the gun violence topic before, but I found out that the matter is very serious here in the U.S. I researched gun violence in the U.S., and the reasons were very complicated and extensive, but one fact was that the number of gun violence victims keeps going up every year. Gun violence is a very complex issue, involving the politics, rights, and interests of different groups of people. It is not an easy problem to work on considering all the groups involved. But one thing is certain. Gun violence results in tragic consequences, and we need to make a constant effort to try to resolve the issue. There are growing voices of concern and more gun regulation laws are passed every year, but the statistics do not seem to reflect that. I would not be able to provide a definite solution to the issue, but I thought there might be some opportunity as a designer to tackle the issue from a different angle. I am not a lawmaker or a politician who can change gun regulations and pass bills to fund gun violence research. However, I am willing to bring people's attention to the matter as much as possible, spark conversations, and influence other people to engage in the issue. I believe that as more people come together and gather power to tackle the problem, we can have a positive influence on gun violence matter.

My approach to the gun violence issue is to create a VR memorial installation that brings attention to the viewers. There are several advantages of adapting the Virtual Reality world over the real-world space. The unique platform allows the user to become more immersive in the environment, thus creating more empathy and connection towards the objects (Slater and Usoh 92). The visuals and audio generated by the VR headset emulate the real world and that mimic reality making viewers feel more present in the space. Thus, an immersive space can be created using VR technology, evoking emotions and developing a sense of awareness without designing a physical installation in the real world where size limitations and financial constraints exist. Another unique characteristic of VR is scale and accessibility. Assuming that the users have HMDs, anyone around the world can access the same VR installation at any time simultaneously. This means that people do not have to travel or physically visit the created installation. VR opens up more opportunities for people to participate and create social awareness of gun violence.

The final design is a VR environment of a peaceful forest filled with grass, trees, and flowers. There is a river running through the forest and the only thing that the viewer can hear is the wind and birds chirping. The day is at night when there are only stars shining in the sky. Next to the river, there is a massive grass ground and the viewers can see colorful flowers on the ground.

As mentioned above, the general setting of the environment is a forest. Users can walk around the forest but the main area is the middle part, which is a massive grass ground. Colorful flowers are blooming in the main area, and these flowers each represent the victims taken away by gun violence. The main area is surrounded by tall trees, giving the main area a sense of holiness and concentration. Next to the main area, there is a wide, long river running down, which gives the place more liveliness.

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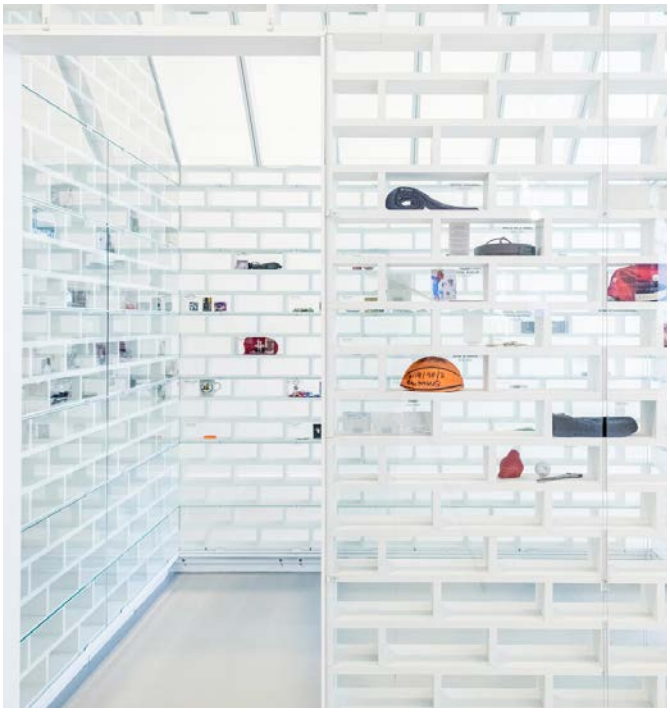
2 *Photography by Jay Rembert*

3 *Illustration by Laura Porter*



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The forest setting gives the overall feeling of tranquility and peacefulness. I wanted to represent a space where victims are now resting in peace and many people are remembering them.

The main objects are the flowers. Flowers might be a too common object that is related to death and paying respect, but I believe that is the strength because the object is very intuitive and easily relatable to the topic. Also, the beauty of the object adds to the environment, paying tribute and providing a visually aesthetic scene to the lost ones. The flowers are interactive. It cannot be moved or deleted, but the viewers can select a flower with the VR controller and view the contained information. When a flower is selected, a pop-up panel is shown and information such as the initials and age of the victim, and the place and date of the incident is shown on the panel. The information lets the viewers better relate to the victims, creating empathy towards them, and paying honors with sincerity.

Gun violence cannot be easily solved without the power of mass people. I was personally shocked by how many people die and get injured every year by guns in the U.S. However, by taking small steps such as visualizing awareness and seriousness of gun violence, we can create a bigger step and approach the issue with confidence and positivity.

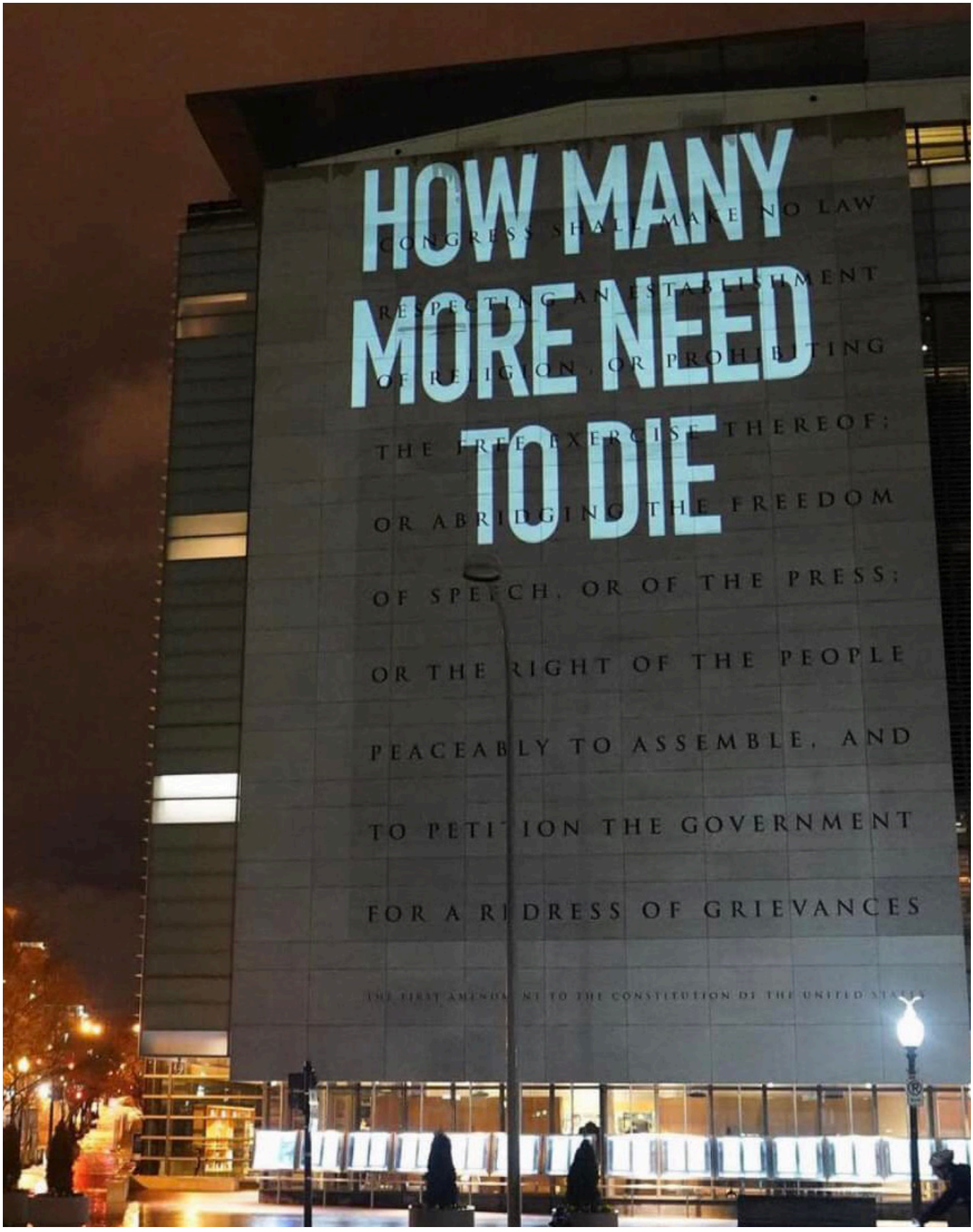
My VR gun violence memorial project aims to pay honor to the victims of gun violence. The VR memorial space would not be enough to cure the pains of the families of the lost ones, but I hope to alleviate their sadness.

Over the course of time, more flowers would be added in my VR environment. However, I wish that the number of flowers added to slow down. I believe as more and more people join the conversation and add forces to change the issue, the gun violence problem can be dealt with activeness and eventually more preventions would be made.

4 *"Gun Violence Memorial Project", National Building Museum*

5 *"Non-Violence" by Carl Fredrik Reuterswärd*

6 *Digital Video Project by Robin Bell*


HOW MANY
MORE NEED
TO DIE
CONGRESS SHALL MAKE NO LAW
RESPECTING AN ESTABLISHMENT
OF RELIGION, OR PROHIBITING
THE FREE EXERCISE THEREOF;
OR ABRIDGING THE FREEDOM
OF SPEECH, OR OF THE PRESS;
OR THE RIGHT OF THE PEOPLE
PEACEABLY TO ASSEMBLE, AND
TO PETITION THE GOVERNMENT
FOR A REDRESS OF GRIEVANCES

6

Beauty in Mortality

Felicia Renelus

1

Death has become at the forefront of the news, social media, and our personal lives. The Covid-19 pandemic has contributed significantly to death anxiety or severe fear of death, but phobias of death have been long-standing in Western culture. As a by-product of this anxiety, the mental health of many individuals has become fragile. Western culture, specifically American culture, shies away from talking about death openly. This fear of discussing death creates taboos around death, even though it is ever-present. If death is not being talked about or acknowledged or the tools to cope with death are not publicly available, then how are people coping? How are people helping address the fears they might have about death?

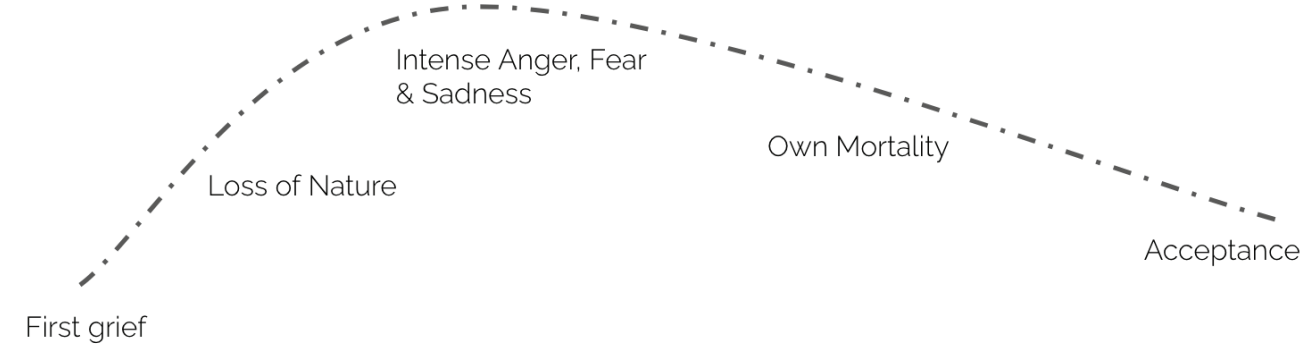
1 *Rendering of the phsyical installation space vis DALL E.*

Death also comes in many forms and is not simply just the loss of life. Death also has effects in other areas of our evolving world like technology. Death comes in the tools that no longer exist as a result of technological advancement and then death continues to leave its mark with the digital presence of those who have passed. We might be able to view the death of tools as just part of a lifecycle of technology, but sometimes it is hard to view our own lives and the lives of others as a part of this greater cycle of life on Earth. Addressing one's own mortality is another important component of accepting death as part of our realities. Death is an inevitable part of life, yet many people fear facing the realities of death and their mortality. Death can be beautiful, despite the sadness it can bring. Many cultures have celebrated the passing of loved ones in meaningful and touching ways to help cope with and mourn the loss of life. Death does not need to remain a taboo subject and should be talked about more openly as so many of us experience the death of family, friends, pets, and the nature around us.

This paper is to dissect why Western culture's sentiment around death exists and connect it to the stories, traditions, and methods people have used to find solace in commemorating the lives of those they had loved most. This is accomplished by conducting interviews with people willing to share their own personal and cultural dealings with death, while also researching various Indigenous beliefs surrounding death as well. The final artifact is an immersive audio experience that allows users to hear the personal and cultural stories of others who have dealt with death and loss. Using 8D audio and recorded narratives, users will experience these stories in a room filled with light and clouds while sitting in a coffin of their own. Although telling stories of death and dying can be triggering and dark, this experience is meant to feel light and airy. Each story is meant to feel like a hug and a reminder we are not alone to help combat these darker feelings around death. Additionally, there are tragic deaths that are hard to ever find comfort in. It is important to acknowledge these deaths, however, it is also important to not provide a solution on how to feel, but provide a space that expresses raw and honest thoughts about tragic deaths so that users can feel seen and understood.

Beauty in Mortality as an installation works to help reframe our perception of our death and move forward to live our best living lives. It provides an accessible means of engaging with death other than conversations and reading by conveying easy-to-follow audio stories, but also as a public installation, gives access to anyone looking to start thinking about what death means. Death does not have an end and will continue to happen, but this installation must live on. As part of the physical installation, Beauty and Mortality exists as a physical and digital book that carries more beautiful stories about death. In its digital anthology version, stories can be collected from users of the experience as part of an optional post-reflection, while also being publicly available for other individuals to add to.

2

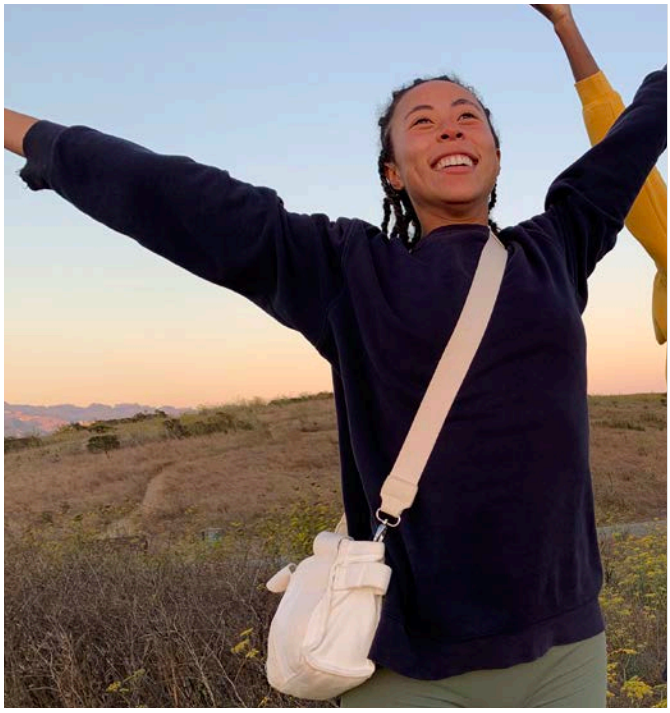


3

2 Duggan's Funeral Service is a family owned funeral home serving San Francisco and its various cultural and religious groups

3 Five selected story themes chosen from the digital anthology to be included in the immersive installation

4

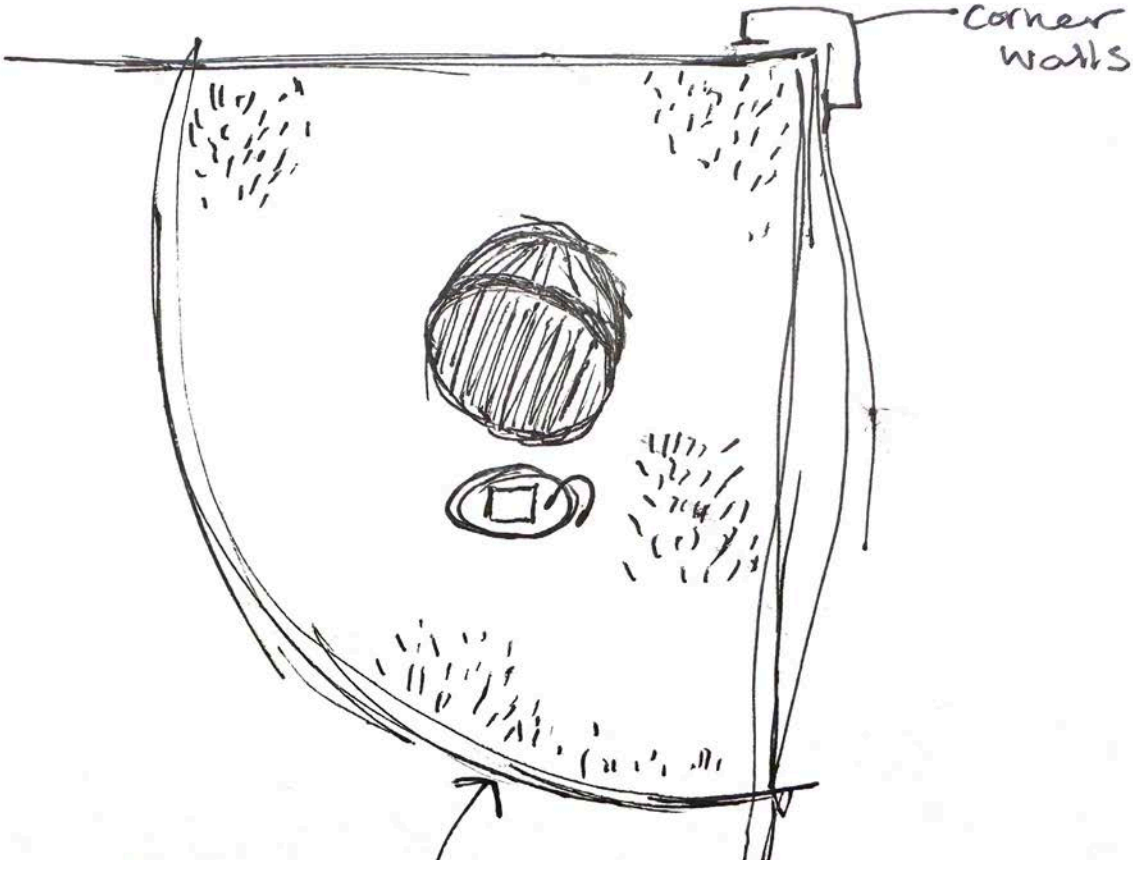


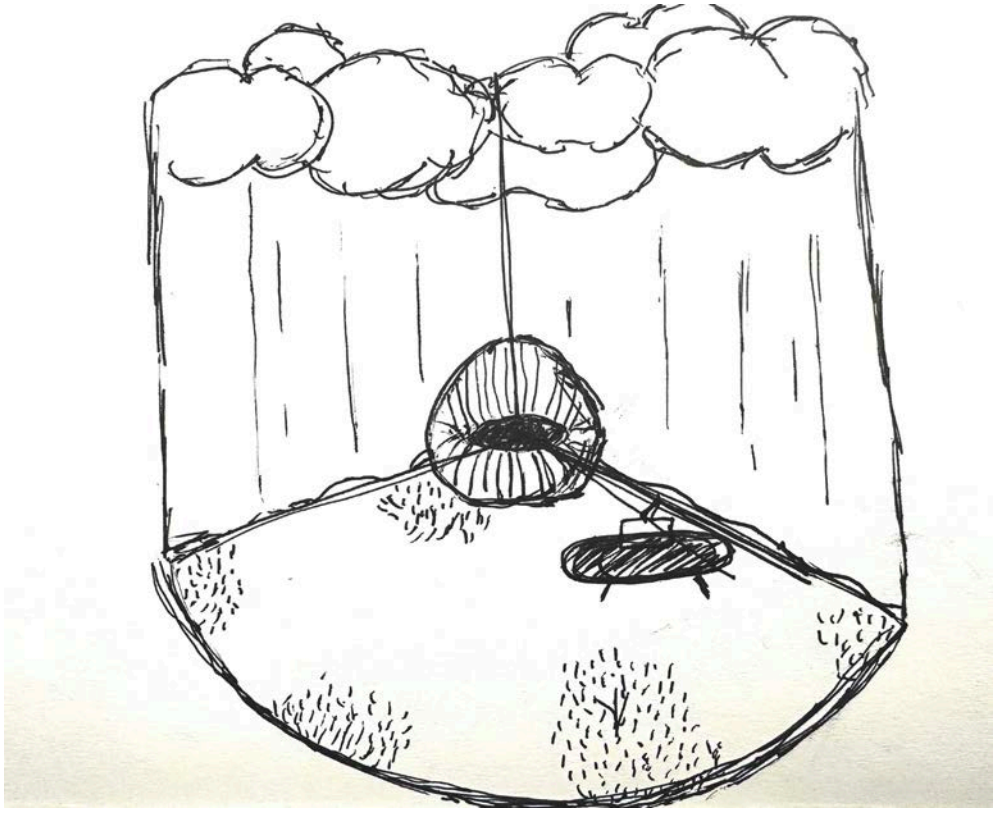
5

4 Dori Torres talks about her experience with funerals while growing up in Puerto Rico.

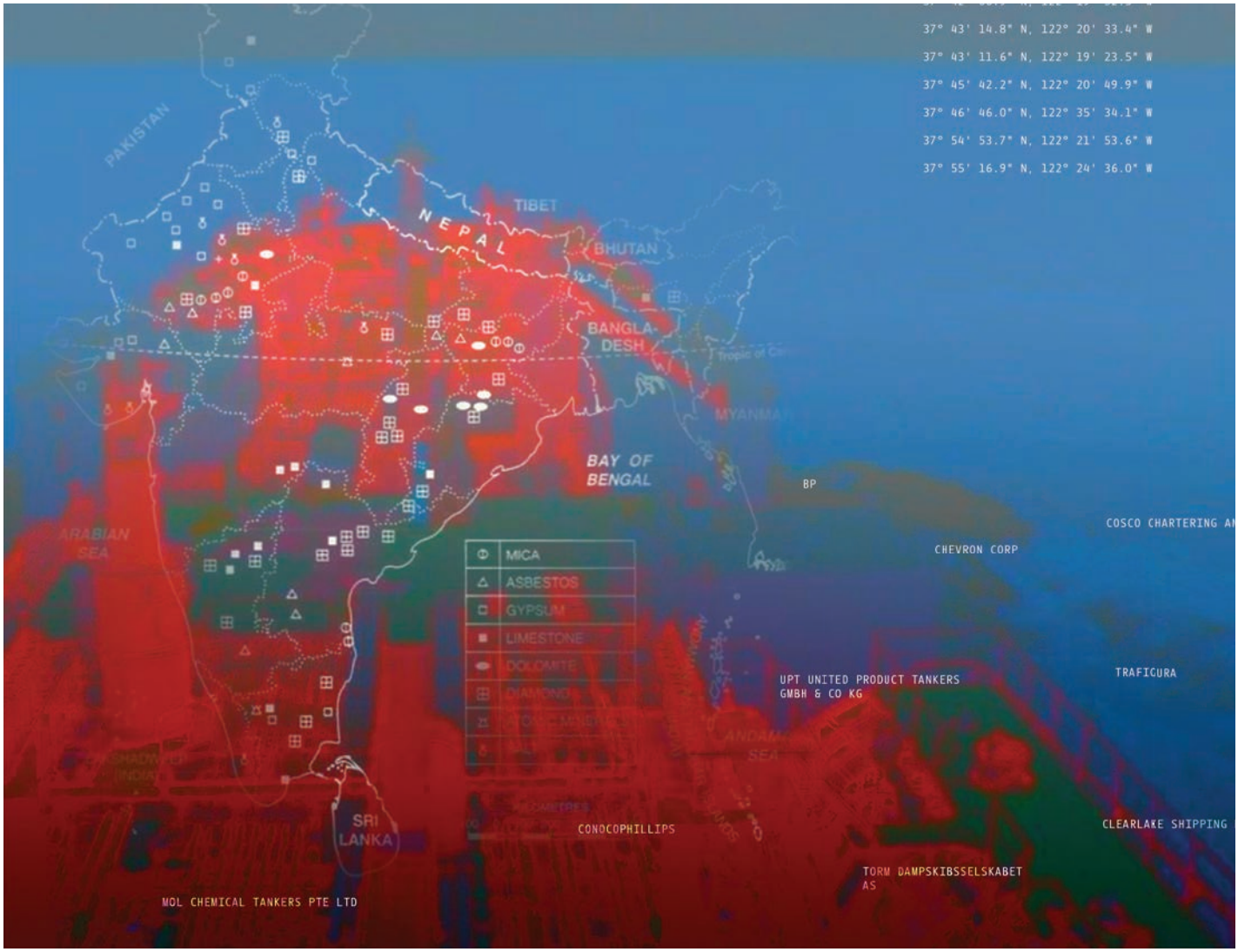
5 Lola Olabode reflects on her near death experience in the water and how that has shaped her new perspective on life.

6 Sketches of my vision for the immersive installation component.


Corner
walls



SPATIALIZING DATA



Our cluster reviewed the work and history of a few domains. The history of data visualization spans centuries and many different mediums, from Paleolithic cave paintings to hand-drawn maps to determine where cholera outbreaks occurred ("John Snow's Data Journalism: The Cholera Map That Changed the World." The Guardian), to the beginnings of computer graphic processors.

Environmental art is defined by the Tate Museum as "art that addresses social and political issues relating to the natural and urban environment"(Tate Foundation. "Environmental Art"). Environmental art often comes in the form of installation, sometimes using natural materials. This domain allows artists to investigate the human relationship to the environment they exist in, tackling issues such as climate change, consumerism, pollution, deforestation, waste, and many more. Environmental art has always played a role in the history of art, but in recent decades, the domain has become much more prominent, due to the visible effects of our changing planet. Both projects in the Spatializing Data cluster were heavily influenced by pioneers of the environmental art movement.

In Olafur Eliasson's 2014 installation Ice Watch, the artist installed twelve blocks of ice, forged from a fjord outside Nuuk, Greenland. The blocks were arranged in a circle to imitate a clock, and sat in a public city square in Copenhagen, coinciding with the publication of the UN IPCC's Fifth Assessment Report on Climate Change. Viewers interacted with the ice blocks for several weeks, as they melted in the city square, changing every day to highlight the pressing problem of global warming. Eliasson repeated the installation two times following Copenhagen, in Paris for the UN Climate Conference COP21, and in two locations in London.

Eve Mosher's 2007 piece HighWaterLine consists of 70 miles of chalk drawn on the streets of New York in areas 10 feet above sea level - areas that are expected to be underwater in the future due to rising sea levels. In areas where chalk couldn't be used, she installed tubes of light sticking out of the ground to visualize the height the water would reach. While Mosher's piece has been extirpated by the elements, the artist continues to conduct workshops around climate change to educate residents of areas that will be affected and engage the community

(Kolbert, Elizabeth. “Crossing the Line.”). Andrea Polli’s 2015 piece Particle Falls is a real-time, reactive, projection visualizing air quality data in public spaces. Using a nephelometer, an instrument for measuring the concentration of suspended particulates, Polli’s piece reflects particular particles detected in the air at a given moment (Polli, Andrea, and ChemHeritage. The Making of Particle Falls.). This shows viewers what is in the air they are breathing and draws attention to the threat of microscopic particles in our air. Polli and Mosher’s pieces are also good examples of both the domains of data visualization and environmental art represented in a single piece.

In Ai Weiwei’s 2014 piece Laundromat, the artist visited and collected mundane elements from the lives of refugees, then transported them across the world, to be displayed in galleries. These exhibits gave physical form and meaning to the challenges and heartbreak of upheaving one’s life, illustrating the plight of refugees. This work informed the cluster’s approach to transforming a space around us and bringing viewers into a different world than their own.

Ikene Iljeoma harnesses the power of our interrelations and interconnection in Peacemaker 2 and Heartfelt, 2021. This work encourages collaboration between audience members to evoke feelings of empathy, connection, and success. Empathy building to educate and therefore empower to advocate seemed to be a common thread in the cluster and Ikene’s work informed the different ways to achieve these emotions.

Guillaume Couche, the lead designer at Wolf in Motion, an agency in London, worked with Queen Mary University to create Atlantis, a virtual reality experience “analyzing swimming data collected on real turtles and a VR application to educate school children in Cape Verde”. (Wolf in Motion, 2021) His work is proof that data represented in a way anyone can interface with makes it possible to form allies with those who might not have a voice.

Neri Oxman’s work with silkworms in the Silk Pavilion inspired the cluster to take a closer look at the most vulnerable communities and discover the importance of those communities, so the work can help amplify their importance, just as Oxman amplified the natural and simple processes of movement and growth that the silkworms are capable of to change the way industry treats them, altering their position in the supply change from material to the maker.

Behnaz Farahi, through her work in Can the Subaltern Speak urged us to play on the strengths of a vulnerable community to discover alternative speculative futures for them as

she speculated the discovery of a new language that allows women to upend power dynamics wielding the very hijab that was mean to oppress them as their weapon.

SEA LANE

Zoë Ingram

A sculpture powered by locational maritime data and research, to illustrate the risk of chemical tanker movements across bodies of water.

1

Sea Lane is a research project and sculptural installation that visualizes local maritime data in a given area. While the transportation of chemicals across bodies of water may not be at the front of everyone's mind, Sea Lane invites viewers to engage with a visual representation of the "risk" of chemical movements at a given moment in their location. To achieve this, the project is made of a location-specific sculpture that houses a data visualization. The project is able to model "risk" based on a few different sources of data such as the sculpture's location and population/ demographics of the area, maritime ship data in the sculpture's port, and derived information about the chemical tankers in the area (ship year, what it's carrying). All these parameters are run through an algorithm that weighs the risk of spills in the area, and presents this information to the viewer. The project intends not to shame the viewer or try to scare them, but to invite them to think about all of our roles and responsibilities as consumers participating in this global activity. Likewise, the project does not seek to end maritime traffic, but to create a lasting impression on viewers about the risks and effects of chemical tankers on our planet, something most people are unaware of.

1 *Composite image of Crane Cove Park, Chemical Tanker Ship, and map of hydrography of San Francisco Bay Area*

Sea Lane is defined by three factors: material, data, and location. All three factors must be present for the piece to work. When looking at the history of ship-building, one could spend years researching all the different materials required to create such a heavy object that can move across waters. Materials like iron and steel are of course necessary for structure, acting as frames, and armor for the vessel. Other materials like aluminum, fiber-reinforced plastic (FRP), and polyethylene are all prevalent in modern tanker ships ("Exploring the Hull Material Used in Modern Boat Design." SHM Blog). Copper is a very alluring material in this context, as it is most commonly found in engine and boiler rooms. Today, copper tubes and piping are used in cooling mechanisms, especially on oil and chemical tankers (0 Centuries of Copper:

Shipbuilding, Copper Development Association Inc). This particular use case interested me.

When thinking about the risks associated with moving chemicals and oil over bodies of water, the precision required to keep the vessel safe relies heavily on the materials chosen. This material decision directly influenced the form of Sea Lane, and I felt the need to include copper in the sculpture.

The data used in the piece had to be hand-scraped from a few sources. Sites like marinetraffic.com provide basic information about ships around the world: position, flag, and ship type. However, accessing data beyond the basics becomes quite costly very quickly, as much of the data is requested and used by large shipping corporations, who can afford to pay thousands of dollars a month for unlimited API requests. Due to the cost, the data collection for Sea Lane became a sort of forensic investigation. I pulled data from many sources and drew connections based on historical information and research. For example, while it is nearly impossible (as an individual) to find out exactly what type of chemical is being carried on a particular vessel, one can look at the location from which the vessel is coming, the year the ship was built, and the classification of the ship to get a rough estimate of what's onboard. Only ships built in more recent years are qualified to transport the more dangerous chemicals like methanol, while older tankers can transport less dangerous solutions like palm oil.

For the location of the installation, I scouted various different sites. I knew the piece needed to be in an environment that was directly related to the work - somewhere near the water, ideally with tankers in view. These requirements slimmed down a list of potential installation sites around the Bay. The final design is a sculptural installation, consisting of three five-foot copper pipes, embedded with LED neopixel lights to reflect three different data points. The piece was installed at Crane Cove Park in San Francisco on December 2, 2022, with the pipes mounted in the sand at the water's edge. Projection mapping is used to display the raw maritime data on the pipes, while the light patterns blinked from inside the pipes. The structure of the sculpture consists of an inner skeleton and an outer shell. The inner skeleton is made from three PVC pipes, each five feet tall. The PVC pipes are one inch in outer diameter, allowing them to sit inside the copper shell. Mounted using glue to the PVC at every five inches are LED neopixel lights, hand soldered to provide a pathway for power, data, and ground lines between each neopixel. These neopixels are connected to power and ground lines using transformers and powered by an Arduino microcontroller. The outer shell of the piece rests on top of the PVC pipe, surrounding the PVC with type L copper. The copper pipe is 2 inches in outer diameter and has hand-drilled holes every five inches, allowing light to pass through from the neopixel embellished PVC. The copper pipes are treated with a patina, created from a solution of vinegar and salt. This patina represents the inherently corrosive nature of toxic chemicals, and the effect they have on materials we consider to be strong, like metal. This approach was tested and studied over a period of several months prior to building Sea Lane, to determine the best method for creating an additive patina.

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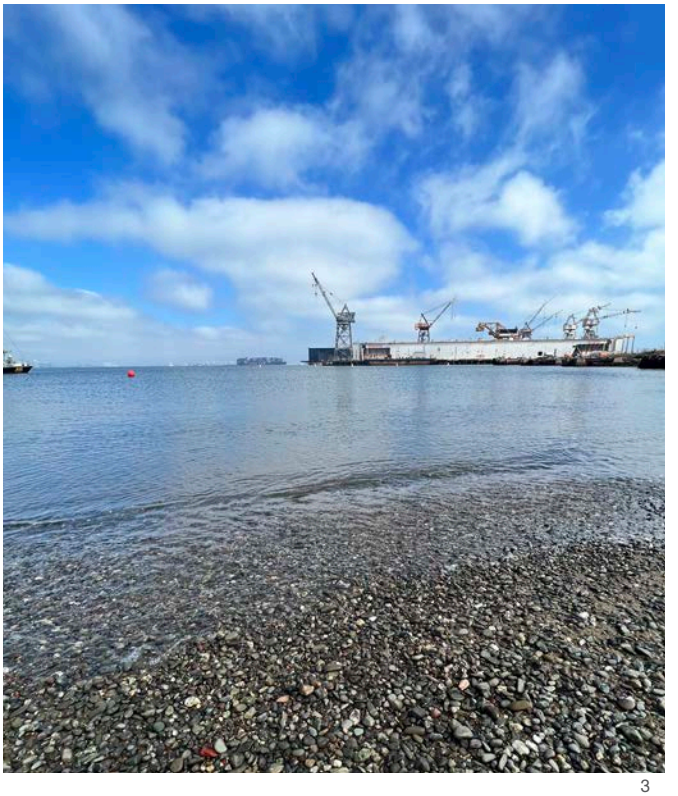

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2 *PVC skeleton with neopixel LEDs*

3 *Crane Cove Park at Potrero Point, San Francisco*

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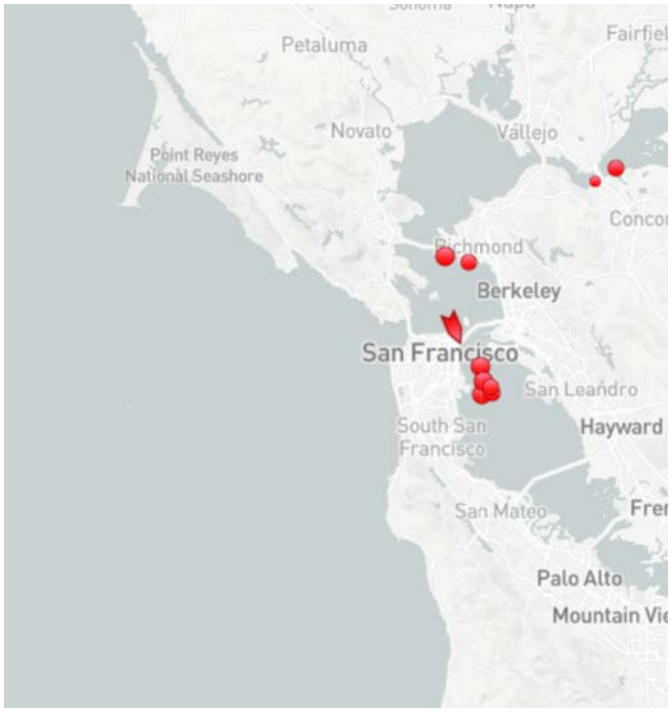

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Through the design and development of Sea Lane, I learned a lot about research, and how to come up with information when information is limited. Because a lot of maritime data is behind a paywall, I had to learn to piece together data from other sources, as well as use historical data to build a context around the project. I feel the most significant outcome of the project is not the installation itself, the code, or the sculpture, but the documentation of the piece and the writing about it. My thoughts on how to say something through my work have been structured. I hope that through my research, my writing, and my work, viewers will think about their mark on this world, and the role they play in its transformation over the next several hundreds of years.

4 *Copper patina tests using different vinegar solutions*

5 *marinetraffic.org map of chemical and oil tankers in the area*

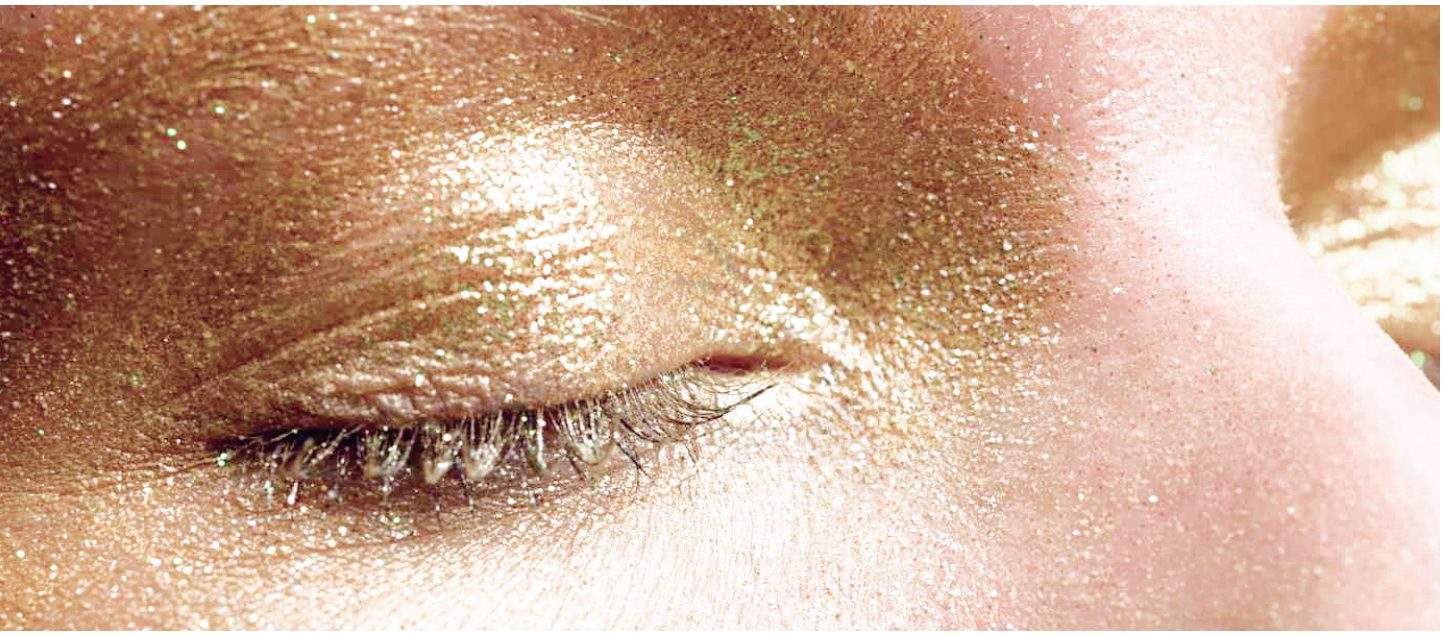
6 *Even more captions are better than just one caption!*

6

Case ID CI77019

Ramyani Roy

A gamified & speculative exploration, rooted in data, of alternative supply chains of mica for the resolution of the issue of children labor in mica mines in India



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Child labour in mines is identified as one of the worst crimes against children by the International Labour organization but 7000 miles away, in the cities of Jharkhand and Bihar, 22,000 children climb down dark open-pit mines to scrape at the earth for fourteen hours everyday to collect 5 to10 kgs of mica. This mica then finds its way into every electronic appliance we use, into most of the paint on the walls and cars around and in most of the makeup products we use. Using any of these products consequently implicates us in the crimes against them. The answer isn't to stop using the mineral all together.

The children (often as young as four years of age) are forced into mining due to an endless cycle of poverty perpetuated by local mobsters and cracks in the legislature. Our key role is to find alternative cleaner mica supply chains so that children are not forced to put their lives in danger everyday.

This body of work focuses on an actionable problem: the disproportionate value accumulation of the mineral in a limited geographical area i.e the disparity in the true value of the mineral as observed at the port of export versus at the mines where the children are, observing this form of wage theft and as the primary cause of the need for child labour in these mining communities.

Through the design of an interactive visual installation, a safe space for speculation, discovery and discourse, I encourage innovators and experts to come together and re-imagine alternative equitable routes for the mica supply chain and in doing so, discover alternative futures for the children.

1 *Caption: Closeup of Mica as used in Makeup*
"Mica Is Commonly Found in Makeup—But What Does it Do?" by Byrdie, November 27, 2022

I grew up in the City of Joy.

Nestled in the east coast of India, bordering Bangladesh, and on the shore of the Bay of Bengal, the city of Calcutta, otherwise called the City of Joy, is steeped in culture & music, perpetually in a trance, as if frozen in its vibrant colonial past . I'd see the port everyday and watch in awe as the ships, with smoke rising high into the skies, sailed beyond the Howrah Bridge and into the Bay. I'd wonder what they carried and where they went. I know now that the wonderment and awe would have served better to be of suspicion.

Many of those ships, I know now, carried mica.

Mined by children living lives that were a stark contrast to the childhood I'd had. While I had fussed about grades and friendships, just a 100 miles away, 8 year olds were climbing down into dark pits at the break of dawn, terrified for their lives as they crouched in tunnels and scraped away at the earth, for fourteen hours a day, just to earn enough to put food on the table for their families.

Their lungs were soaked with mica dust, the cuts on their skin infected from the earth and their little minds burdened with the worry of tunnels tumbling down upon them and the unknown shadows of looming predators when they strayed too far. It took me 25 years to chance upon this secret.

Discovering my geographical entanglement to the issue and how omnipresent the mineral is in every aspect of our lives, I felt the need to find a different inflection point for resolution of the issue.

It's a socio-political, generational and gargantuan problem to solve, one that needs changes in legislature, government policies and social hierarchy, if not an entire economy being upended.

While national and international organizations attempt to help these children, some being the Kailash Satyarthi Children's Foundation, the Responsible Mica Initiative and Terre des Hommes, investigative journalism by Refinery29 from 2019 and Java Discover in 2021 shed light on the fact that despite tremendous efforts by each of these organizations, very little progress has been made to repair key elements that sustain illegal mining practices in this region namely wage theft, domestic terrorism, counterfeit licenses by locals during company surveys.

Rampant in many isolated villages in India and often extremely well concealed by local transgressors, these practices perpetuate illegal practices and slip through the cracks during investigations by external organizations.

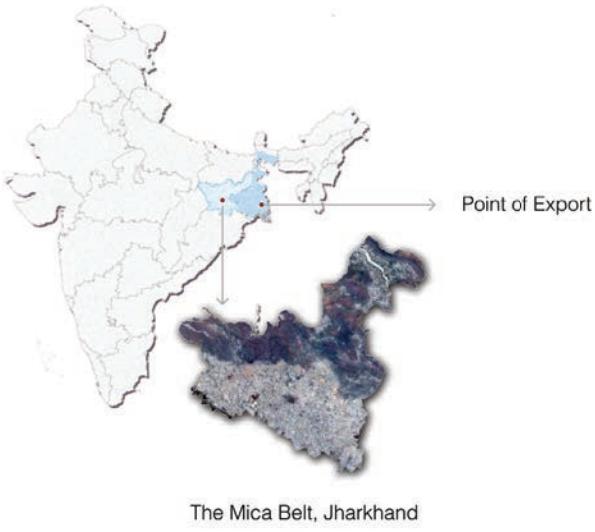
This makes me believe more divergent problem solving is necessary to look at indigenous problems and the political ecology of the land. By drawing connections, mapping the mica trail and piecing together information to trace this rather opaque supply chain , I developed a visualization environment that could become a space discovery of existing constraints and a stage for performative collaborative design and discourse.

2

3

2 *Mica (muscovite) found on the roads in Jharkhand, a city facing the "resource curse" Beautycounter, 2020*

3 *Still from the mines with children "The Makeup Industry's Darkest Secret Is Hiding In Your Makeup Bag" by Refinery 29, 2019*



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Two elements form the exhibit. The present day data of mica use is abstracted into a physical outline of the world atlas with the exact geographic locations across the world that use mica mined from these mines connected to the geographic location of the mica mines with threads. The number of threads from each location denotes the amount of mica each location imports. The purpose of this piece in the exhibit is for the audience to be able to situate themselves in this issue and realize our undeniable connection to the children .

The mica mines and the land they are situated in are exaggerated and highlighted in an elevated table over the country of India and forms the centerpiece of the exhibit where the audience can interface with more information around the culture of this particular ecosystem. A projection onto this terrain urges interaction between the audience and participants with the terrain. Interactions reveal discovery of the geometric increase in the value of the same quantity of mica in a small 100 mile distance between the mines and the ports and the disproportionate value we pay for the mica versus the meager amount miners earn for it.

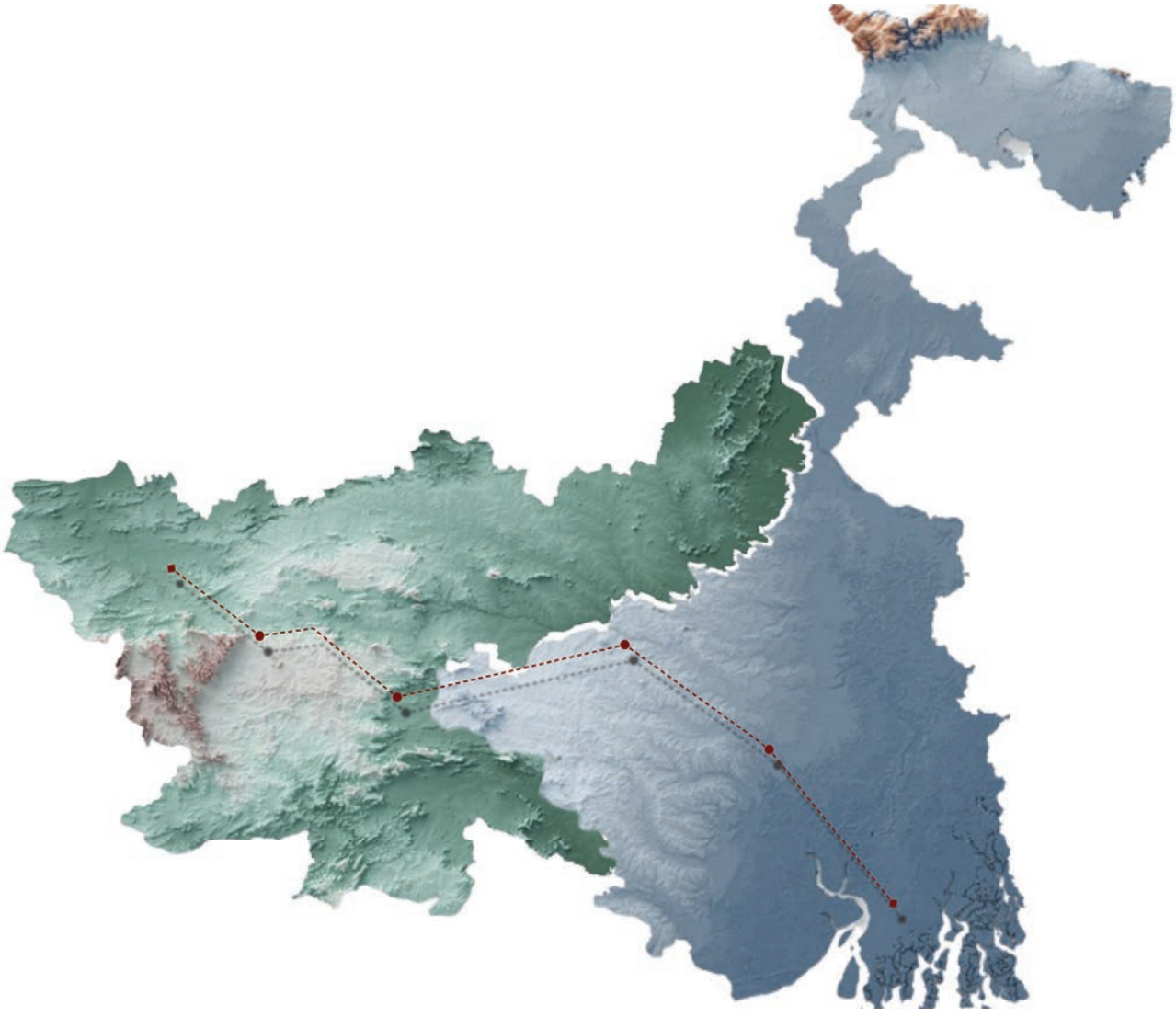
As the participants continue engaging with these discoveries, they are encouraged to redistribute the resources they previously distributed in the mica supply chain to the benefit of the children in the mines. A successful operation/completion on the participant's part reveals alternatives to the current supply chain and reveals incredible opportunities that lie latent in these communities.

These speculative futures one can create and discover during this interaction are strongly founded in possibilities identified through research and in collaboration with the Kailash Satyarthi Children's Foundation and therefore are real possibilities that we as changemakers, innovators and creators can then explore and realize beyond the exhibit.

4 *The two states in the installation artifact to trace the journey of the mica from the mica belt in Jharkhand to the port in Calcutta*

5 *An interactive installation that inspired this work "Salt Worldwide", German Salt Museum in Luneburg , Germany 2010*

6 *Illustration of the geographical terrain of the land of the mines overlaid with the path of mica from the mines to the port (top left to bottom right) that is spatialised in the exhibit.*



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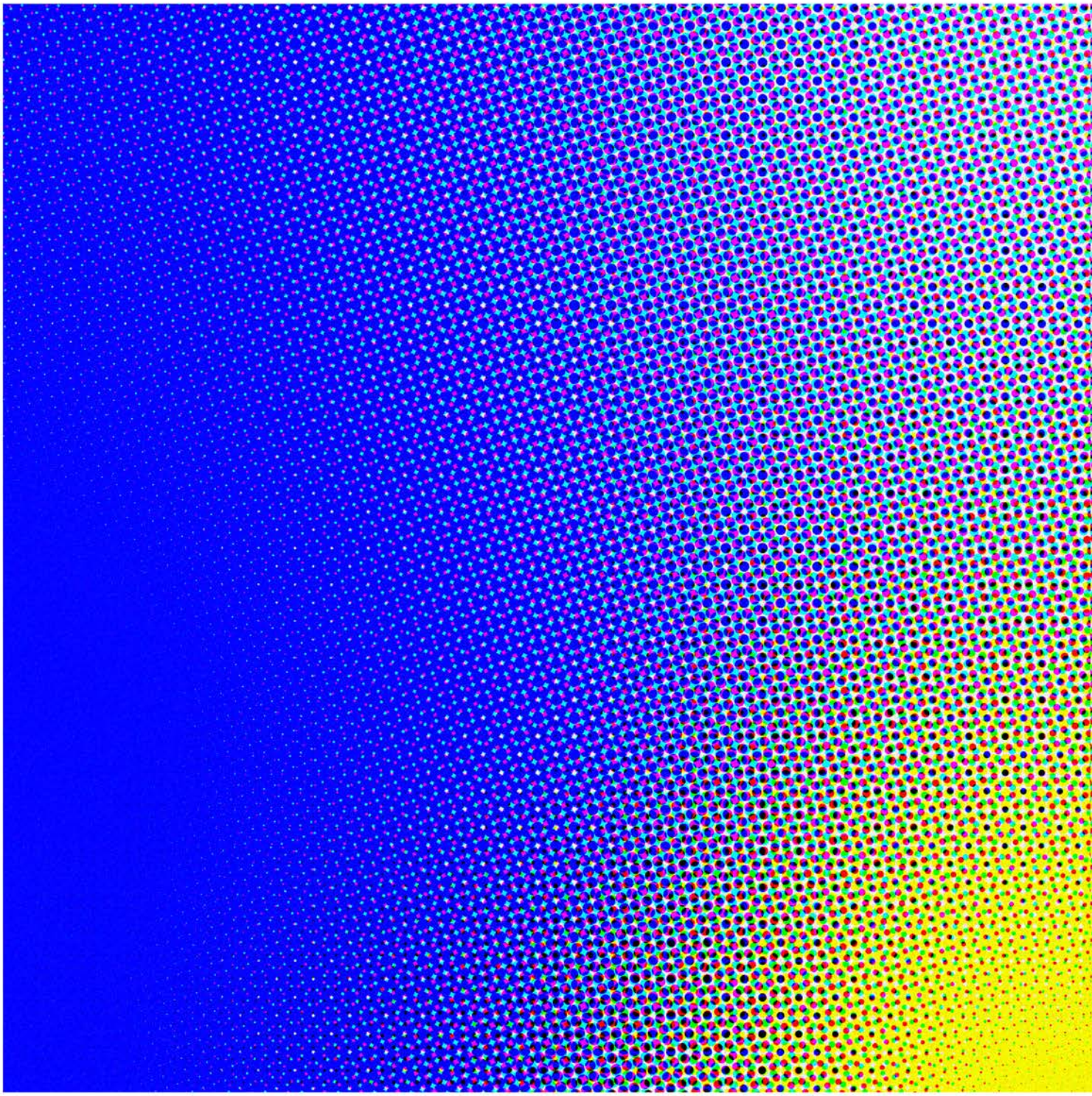

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